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February 09, 2017

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Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

PTO/AIA/424 (09-12)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Jeffrey G. Lawson	Nonprovisional Application Number (if known):	
Title of Invention:	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.

2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.

3. The applicable box is checked below:

I. ☑ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. The executed inventor's oath or declaration is filed with the application. (37 CFR 1.63 and 1.64)

II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Jeffrey Schox/	Date 2013-01-16
Name (Print/Typed) Jeffrey Schox	Practitioner Registration Number 42445

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.*

☐ *Total of _____ forms are submitted.

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The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

DECLARATION AND ASSIGNMENT

This combined Declaration and Assignment is in relation to the patent application entitled SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS attorney docket TWIL-P01-US2 which was filed on 01 October 2012 and given application number 13/632,798.

As the below named inventor, I hereby declare that:

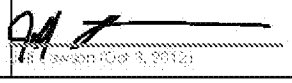
- I have reviewed and understand the contents and the claims of the patent application.
- I acknowledge the duty to disclose all information known to me to be material to the patentability of the claims of the patent application.
- I believe that I am the original inventor, or an original joint inventor, of a claimed invention in the patent application.
- The patent application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than (5) years, or both.

WHEREAS, Twilio, Inc. ("the assignee"), a state of Delaware corporation located at 501 Folsom Street, 3rd Floor, San Francisco, California 94105 is desirous of acquiring an exclusive right to the claimed invention.

For valuable consideration that I acknowledge, I hereby sell and assign to the assignee the full and exclusive right and title to the invention, to all patent applications for the invention in the United States and in all other countries, and to all patents issued on the invention in the United States and in all other countries; and I hereby request the Director of the United States Patent and Trademark Office to issue all patents on the invention to the assignee.

Executed by:

Name	Signature	Date
Jeff Lawson		Oct 3, 2012

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Executed by:

Name	Signature	Date
John Wolthuis		Oct 8, 2012

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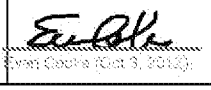
Executed by:

Name	Signature	Date
Evan Cooke	 Evan Cooke (Oct 3, 2012)	Oct 3, 2012

SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of co-pending US Patent Application number 13/632,798, filed 01 October 2012, which is a continuation of US Patent application number 12/417,630, filed 02 April 2009, now issued as US Patent Number 8,306,021, which claims the benefit of US Provisional Application number 61/041,829 filed 02 April 2008; US Provisional Application number 61/055,417 filed on 22 May 2008, US Provisional Application number 61/100,578 filed on 26 September 2008, US Provisional Application number 61/156,746 filed on 02 March 2009, and US Provisional Application number 61/156,751 filed on 02 March 2009, which are all incorporated in their entirety by this reference.

TECHNICAL FIELD

[0002] This invention relates generally to the telephony field, and more specifically to a new and useful system and method for processing telephony sessions in the telephony field.

BACKGROUND

[0003] In the last decade, legislation and the advent of Voice over Internet Protocol (VOIP) have revolutionized the communication industry with new technologies, business models, and service providers. Software and commodity

hardware now provide an alternative to expensive carrier equipment. One can implement extensible call switching and voice application logic in Open source software applications, such as Asterisk and FreeSwitch. These new application stacks, however, usher in new complexities and challenges, requiring new skill sets to deploy, develop, and maintain. Deploying telephony services requires knowledge of voice networking and codecs, hardware or services to bridge servers to the public phone infrastructure, capital investment in hardware, and ongoing collocation of that hardware. These burdens are a mere prerequisite to developing the actual application, which requires developers to train in new languages, tools, and development environments. Even telephony applications that currently try to leverage a model more similar to web-development such as Voice Extensible Markup Language (VoiceXML), require the dedication to learn a new language and understand telephony interaction. Ongoing operation and maintenance of these services requires teams to adopt new analysis tools, performance metrics, and debugging methodologies. Developing even the simplest of voice services (such as a so-called "phone tree") requires significant upfront and ongoing investment in specialized infrastructure, skills, and operations. Thus, there is a need in the telephony field to create a new and useful system and method for processing telephony sessions. This invention provides such a new and useful system and method.

SUMMARY

[0004] The method of the preferred embodiment for processing telephony sessions include the steps of communicating with an application server using an

application layer protocol, processing telephony instructions with a call router, and creating call router resources accessible through an Application Programming Interface (API). The method and system of the preferred embodiments enables web developers to use their existing skills and tools with the esoteric world of telephony, making telephony application development as easy as web programming. The method and system use the familiar web site visitor model to interact with a web developer's application, with each step of the phone call analogous to a traditional page view. Within this model, developers reuse their existing tools and techniques, including familiar concepts such as HTTP redirects, accessing resources through an API, cookies, and mime-type responses to construct complex telephony applications. The method of processing telephony instructions and creating call router resources accessible through an API (a call router API) cooperatively function to enable a stateless and simple telephony language with more call router resources and information provided through the call router (preferably a REST API as is familiar to many web developers). In one embodiment, the telephony instructions set may have fewer than dozen verbs, simplifying the language so that developers can quickly learn and implement telephony applications, while the call router API compliments the simple telephony instructions to enable complex telephony applications.

BRIEF DESCRIPTION OF THE FIGURES

[0005] FIGURE 1 is a flowchart representation of a preferred method of the invention.

[0006] FIGURES 2A, 2B, 3A and 3B are schematic representations of preferred embodiments of the invention.

[0007] FIGURES 4A – 4C are examples of a HTTP GET request, a HTTP POST request, and a HTTP GET request, respectively.

[0008] FIGURES 4D – 4F are examples of a HTTP requests.

[0009] FIGURES 5A and 5B are examples of XML responses.

[0010] FIGURE 6 is an example of a call Router request and response.

[0011] FIGURES 7-15 are schematic representations of various applications that incorporate the principals of the preferred method of the invention.

[0012] FIGURE 16 is a flowchart representation of the sub-steps relating to the digital signature aspect of the preferred method of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The following description of the preferred embodiments of the invention is not intended to limit the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

1. Method for Processing Telephony Sessions

[0014] As shown in FIGURES 1, 2A, 2B, 3A, and 3B, the method 10 of the preferred embodiment for processing telephony sessions include the steps of communicating with an application server using an application layer protocol S110, processing telephony instructions with a call router S120, and creating call router

resources accessible through an Application Programming Interface (API) S130. The preferred method may also include other steps and/or sub-steps, as explained below.

1A. Communicating with an Application Server

[0015] As shown in FIGURE 1, the step of communicating with an application server using an application layer protocol S110 preferably includes the following sub-steps: initiating a telephony session S1, mapping a call to a Universal Resource Identifier (URI) S3, sending a request to a server associated with the URI S5, processing the request corresponding to the state of a telephony session S7, and receiving a response from the server S9. One of the challenges of using the familiar web site visitor model is that a third party web application may expose URIs that contain sensitive data or that suggest actions that could maliciously manipulate the application database. In the preferred embodiment, the call router cryptographically signs outbound requests to customer web applications using an account-specific key. More specifically, the step of communicating with the application server includes the additional steps of digitally signing the request parameters S4 and verifying the digital signature of the request parameters S6. Only the call router and the application server know that key, so any request that includes parameters (URL, POST data, headers, etc) signed with that key can be checked for authenticity before allowing such operations. This method also provides verification of authenticity over insecure links (HTTP) with low CPU overhead.

[0016] Step S1, which recites initiating a telephony session, functions to accept an incoming message. The message is preferably a call from a PSTN-connected (Public Switched Telephone Network) or Internet addressable devices, such as landline phones,

cellular phones, satellite phones, Voice-Over-Internet-Protocol (VOIP) phones, SIP devices, Skype, Gtalk, or any other suitable PSTN-connected or Internet addressable voice device. The message may alternatively be a Short Message Service (SMS) message. A SMS gateway server may alternatively connect to a SMS network through a Short Message Service Center ("SMS-C"), directly to the Signaling System #7 (SS7) telephony network, or by any other suitable SMS gateway provider, and the message is preferably received from the gateway by the call router and translated into a format (such as a URI) that can be sent over the public Internet such as HTTP, based on the recipient address of the SMS, such as a short code, or Direct Inward Dialing (DID), or other suitable unique recipient identifier. The message may alternatively be a multimedia message, a facsimile transmission, an email, or any other suitable messaging medium. The originating phone number of the PSTN device is preferably captured using caller ID, but any other suitable ID may be captured, such as a VOIP provider ID, SMS device number, email address, or a short code. The dialed phone number, the EIN, and/or billing identifier, and/or the date and time of the call are also preferably included in the session information. An authentication ID may additionally or alternatively be included in the session information.

[0017] In one variation, Step S1 also functions to initiate a telephony session (such as a phone call) via an HTTP or other request sent to a call router from an application running on a third-party server. In this variation, the application running on the server preferably specifies an initial URI for the call router to use for telephony session in step S3, as well as the phone number (or other addressable destination) to

dial and the source phone number (caller id). In this variation, the call router API is preferably used by the application server to request an outgoing call from the call router.

[0018] Step S3, which recites mapping the call to a Universal Resource Identifier (URI), functions to enable a telephony session to be converted into a format that may be handled with standard web servers and web applications. The mapping is preferably performed using a call router. The initial URI is preferably pre-specified at the call router by a web application (which may be running on a third party server) or call router account owner. More preferably, the initial URI is assigned to the call via a unique identifier for the call destination, such as a DID (Direct Inbound Dial) phone number, or a VOIP SIP address. The URI may alternatively be specified by a remote server or other suitable device or method. In one variation, the URI may be used to encapsulate state information or a portion of state information from the initiated telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, geographic location of the caller (e.g. country, city, state, and/or zip), and/or the unique call ID. The information included in the URI may be included in the form of a URI template. For example the URI default template could be: http://demo.twilio.com/myapp/{dialed phone number}/{originating phone number} or http://demo.twilio.com/myapp/foo.php?dialed_number={dialed phone number}& originating_number={originating phone number}.

[0019] Step S4 functions to digitally sign the request parameters. As shown in FIGURE 16, Step S4 preferably determines the call router account owner and, more preferably, looks up the account owner's unique ID or secret key and signs a set of

request parameters. Step S4 is preferably accomplished by generating a cryptographic hash of the request parameters, preferably including the URI as well as any request body parameters (in the case of an HTTP POST, for example) with the unique key associated with the call router account owner. The cryptographic hash is preferably generated by appending the hash of the request parameters to the original set of request parameters. The hash is preferably appended to a URL, but if the hash is particularly long (i.e. for a very large number of parameters) the hash may be included in an HTTP header, where there is no limitation on size. In a variation of Step S4, at least one sensitive parameter may be individually encrypted using the account owner's secret key before the hash is processed. In another variation, a cryptographic credential delegation system, such as Oauth (oauth.net), may alternatively be used to electronically sign the request.

[0020] Step S5 functions to send the request to a server. Preferably, the request is sent to a URI and, more preferably, the request is sent to the URI mapped in S3. The request preferably includes a cryptographic hash computed from the set of request parameters (acting as a digital signature), but the request may alternatively include individually encrypted request parameters if the parameters are determined to contain sensitive data. The server is preferably a third party server and, more preferably, the server is running a web application. The request is preferably sent to a server over a network. In one variation, the request is sent to a local server on a local area network. In another variation, the request is sent to a server running locally on the device originating the call. In yet another variation, the request may be sent to multiple servers. The request preferably encapsulates at least a portion of the state information from the

initiated telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, geographic location of the caller (e.g. country, city, and/or state, zip), and/or the unique call ID. The request, more preferably, encapsulates all the state information of the call, but may alternatively include no state information or partial state information. The state information from the initiated telephony session is preferably sent via HTTP POST in the request body, HTTP GET in the request URI, HTTP header parameters to mimic the data flow of a web browser, or by any combination or suitable alternative way. If new state information is generated in the course of the operation of the call router, a request to the application server is preferably made to communicate the new state and to request new telephony instructions. Preferably, new state information is not kept or acted upon internally by the call router, but is passed to the application server for processing. Alternatively, partial state information is preferably stored on the call router until a fully updated state is achieved, and then communicated to the application server. For example, the application server may specify that multiple digits should be pressed on the keypad, not just one, before new call state is derived and communicated to the application server. In one variation, the information from the initiated telephone session may be a web-form submission included in the HTTP POST request. The request may include any state information from the telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, and/or the unique call ID, the current status of the phone call (pending, in-progress, completed, etc.), or the results of a telephony action, including Dual Tone Multi Frequency (DTMF) digit processing, or a

representation of or a link to a sound recording, or the status of the last command, or other call state. Examples of a HTTP GET request, a HTTP POST request, and a HTTP GET request are shown in FIGURES 4A, 4B, and 4C, respectively. Further examples of HTTP communication used for SMS messaging are shown in FIGURES 4D, 4E, and 4F. The HTTP request (or any suitable request communication) to the server preferably observes the principles of a RESTful design. RESTful is understood in this document to describe a Representational State Transfer architecture as is known in the art. The RESTful HTTP requests are preferably stateless, thus each message communicated from the call router to the application server preferably contains all necessary information for operation of the application server and response generation of the application server. The call router and/or the application server preferably do not need to remember or store previous communications to be aware of the state. Documents, media, and application state are preferably viewed as addressable resources, combined with data provide to the resource via request parameter, such as HTTP GET or HTTP POST parameters, or request body contents. Such request data may include an updated representation of the call resource, or other call state data generated as a result of call router operation, such as digits pressed on the keypad or audio recordings generated. State information included with each request may include a unique call identifier, call status data such as whether the call is in—progress or completed, the caller ID of the caller, the phone number called, geographic data about the callers, and/or any suitable data. However, a varying level of a RESTful communication (statelessness) may be used, such as by using cookies, session tracking, or any suitable devices to simulate a normal

website visitor model. Preferably, data sent with each request may fully enable the application server to determine the next state of the call to execute. RESTfulness preferably does not preclude using external datasource, such as a database, to lookup additional data to log call meta data, or determine application logic.

[0021] Step S6 functions to verify the digital signature of the request parameters. As shown in FIGURE 13, after the request is received at the server, the request parameters are preferably checked and/or parsed for a hash. The cryptographic hash is preferably included in the URL of an HTTP request, but may alternatively be included in the HTTP header of the request. If the request does not include a hash, and the web application server has enabled the hash function checking as a security measure, the request is preferably determined to be fraudulent, which would include – for example – malicious requests, mis-routed requests, corrupted requests and any other requests not intended for the application server. If the set of request parameters includes a hash, the hash is preferably extracted from the request, and the secret key of the customer web application (i.e. the same key that is stored on the call router as the customer account secret key) is preferably used to generate a server side cryptographic hash of the parameters received. The server side cryptographic hash is preferably compared to the hash included with the request and if the hashes do not match, the request is preferably determined to be fraudulent. However, if the server side cryptographic hash matches the request hash, the request is preferably determined to be authentic and ready for further processing at the application server. In the variation mentioned above in Step S4, where sensitive parameters may have been encrypted using the secret key, Step S6 preferably

includes decrypting the sensitive parameters. The application server and the third parties operating the application are preferably responsible for completing this verification step, but the verification may alternatively be completed by a single party, such as when a single party operates the application server and the call router. The application server may alternatively be configured to ignore a hash included with the request parameters if request authentication is not important to the application.

[0022] Step S7, which recites processing the request corresponding to the state of a telephony session, functions to perform processing functions on at least a portion of the data included in the request. The processing functions are preferably performed on a third party server. The processing functions may include recording the data included in the request and/or metadata about the call session, routing to another URI, performing a database lookup of at least one portion of the data included in the request, voice recognition processing, or any other suitable processing function. The processing functions may re-use logic and data from other business applications, such as customer databases and/or shopping cart applications, which may be linked using caller-id or caller provided information. State information is preferably communicated with each request from the call router, and application state is preferably not required on the application server. Alternatively, the application server may store state between each request related to the call, by using HTTP cookies, sessions, and/or database records. In some cases, such as the case of a static HTML page running on a server or a stored media file such as an mp3 or wav file stored on a server, Step S7 may be simplified, and a file mapped to disk by the URI may be simply returned.

[0023] Step S9 recites receiving a response from the server. This response is preferably an HTTP response. The response is preferably sent as XML, audio binary, or raw text, but may alternatively be any sort of messaging format, including HTML, delimited text, key/value text or binary encoded format. The HTTP response preferably includes directions to perform telephony actions. The response may alternatively or additionally include a new URI or a new URI template to use with the telephony action in Step S3. An additional example XML response is shown in FIGURES 5A and 5B.

1B. Processing Telephone Instructions

[0024] The step of processing telephone instructions with a call router S120 preferably functions to convert the server response into telephony actions or executable operations during a telephony session. The telephony actions may include, for example, playing a pre-recorded sound file at a server-specified URI (such as a static mp3 file located at http://demo.twilio.com/myapp/1234.mp3), reading text to the caller using text-to-speech technology, calling another number (such as creating a new voice connection through the PSTN, SIP/VoIP, or other IP technology system), collecting digits via DTMF input, recording voice response audio, TTY or other inputs, sending an SMS message, or any suitable combination or sequence of these or other suitable actions. This conversion of the server response is preferably performed at a call router. Preferably, Step S120 includes processing the response mime-types associated with the server response. For example, if the response mime-type is XML, it is considered to be a set of call router instructions. If the response mime-type is MP3, it is considered a sound

file to be played for the caller. If the response type is plain text, it is considered to be text to be read, via Text-To-Speech, to the caller.

[0025] Contents of the server response, such as an XML document, are preferably converted into a telephony action by processing the document sequentially (e.g. line by line). Telephony instructions are preferably contained within the document in the form of a markup language, such as XML as shown in FIGURES 5A and 5B. This sequential approach to processing a document of telephony instructions is enabled when the communication is stateless and all the necessary information is contained within the URI. This stateless communication preferably allows telephony instructions (verbs or commands) to be used as the programming interface for a server application performing telephony services. Algorithmic interpretation (based on the state of the communication) of the telephony verbs or the document is preferably not necessary. The telephony actions are preferably executed in the order of telephony instructions found in the contents of the server response. For example, an XML document may include the necessary verbs to carry out the telephony actions of reading text to a caller, monitoring keys pressed by the caller, and redirecting the caller to a new URI using the pressed keys as part of the data within the new URI. Preferably, the telephony action (such as digits pressed) results in new state information, which may result in a repetition of some steps of the method, preferably beginning at Steps S3. The next URI is preferably provided by the server as part of the processing instructions. In another variation, the last URI is reused if the server fails to specify a next URI. In yet another variation, no repetition occurs if the server fails to specify a next URI, and processing

continues below at the next call router instruction. The behavior may be determined by the nature of the call router instruction; for example, instructions that generate no new state information would not need to have a next URI since they don't trigger communication with a remote server. More preferably, the telephony actions result in the repetition of step S3 with the new URI resulting from Step S11, but may alternatively initiate a repetition of one or more steps (Steps S5, S7, S9, or S11) of the method. Step S3 is preferably repeated using all new phone session state information resulting from execution of a telephony action, such as digits pressed, a recorded audio file, or the success or failure of any telephony action requested. Repetition also includes all state information that remains relevant during the course of the session, such as Caller, Called, unique Call ID, and call status. The state information may also be represented in the form of a URI Template. For example, if the server response specifies that the call router should collect DTMF digits, and specifies that the next URL is the URI Template http://demo.twilio.com/foo.php?digits={Digits}, and the caller presses 1234, the resulting URI is http://demo.twilio.com/foo.php?digits=1234. Similarly, if the server response specifies the URI Template: http://demo.twilio.com/myapp/{Digits}.mp3, the resulting HTTP Request could be to a static mp3 file located at: http://demo.twilio.com/myapp/1234.mp3. Thus, a call may be controlled by one server that issued the telephony instruction and a second server that processes the response, as shown in FIGURES 13 and 14. Such call control hand-offs constitute the transfer of state information between servers in the form of a URI and accompanying request data, such as GET, POST, and/or request body. Preferably, all state communications conform to a

syntax established by the call router to facilitate integration between multiple servers. For example, digits pressed on the keypad are preferably communicated to application servers in an identical fashion, thus minimizing the need for coordination between a multiple application servers with regard to how state is transferred. Alternatively, call router instructions may dictate the method of communicating new state information, such as the names and types of variables to send representing new state.

1C. Creating Resources Accessible by a Call Router API

[0026] The step of creating call router resources accessible through an Application Programming Interface (API) S130 preferably functions to expose information and/or functionality of the call router. The interaction from outside parties is preferably performed via the API (call router API). The Call Router API may additionally cooperate with the use of telephony instructions to function as a storage and retrieval format for data generated or required by the call router's operation. The Call Router API is preferably an application programming interface (API) such as a REST API (Representational State Transfer) as is known in the art, but the Call Router API may alternatively be a SOAP (Simple Object Access Protocol) API or any suitable programmatic communication interface. The Call Router API preferably may be used by an application asynchronously to the execution of a call (such as to later query the call records or retrieve recordings). Alternatively, the Call Router API may be used synchronously during the course of a call (such as to alter the state of the call, hanging up a call, initiating call recording, etc.). The Call Router API preferably stores state

information in a persistent URI for a resource. The persistent URI preferably contains all the necessary state information, and this preferably makes data persistent, queryable, and recoverable. The Call Router API is preferably used for modifying resources to alter state of call router and for interacting with media of the call router. An application server can use the Call Router API to preferably query meta-data of call records, caller identification, call media (such as recordings, text transcripts, etc.), account information, transfer or interact with in-progress communications in the call router, and/or any suitable data generated by or required to operate the call router. The Call Router API preferably involves communication between an application server and a call router, but may alternatively be communication from any suitable device to the call router. The Call Router API preferably resides on the same hardware as the call router, but may alternatively reside on remote hardware or on any suitable hardware environment. The communication is preferably HTTP, but alternatively HTTPS or any suitable communication protocol may be used. The Call Router API may additionally be compatible with any HTTP client. The telephony system of the preferred embodiment preferably implements a Call Router API that includes a Call Router API request format, a Call Router API response format, and a plurality of API Resources representing types of data generated by or used by the Call Router.

[0027] The Call Router API request of the preferred embodiment functions as a communication message sent from an application server to an API resource of the call router. The Call Router API request is preferably sent from an application server to a call router, but may be sent from any suitable device to the call router. The Call Router

API request is preferably similar to a REST API request, but the Call Router API request may alternatively conform to any suitable programming principle, such as SOAP. The Call Router API request preferably uses HTTP to interface with a resource, but HTTPS or any suitable communication protocol may be used. Preferably the HTTP or HTTPS method of GET is used to retrieve a resource or resource information, and the HTTP or HTTPS method of PUT or POST is used to create or update a resource. In some cases, PUT or POST may be used to affect the functionality of the call router by modifying the state of a resource. Alternatively, a method parameter may be included in the URI of the resource to identify a requested action for the resource, or any suitable commands or methods may be used to interface with an API resource. The Call Router API request preferably includes authentication such as basic HTTP or HTTPS authentication, by including message authentication information in the URI, such as a cryptographic hashing of the request content using a shared key, or by any suitable method.

[0028] The Call Router API response of the preferred embodiment functions as a communication sent in response to a method performed on an API resource. The Call Router API response is preferably sent from the call router to an application server, or any suitable device. The Call Router API response is preferably sent in response to a Call Router API request, and the response is preferably sent to the originating device. The Call Router API response is preferably similar to a REST API response, where the response is a representation of the requested resource. The Call Router API response may alternatively conform to any suitable programming principle such as SOAP. The Call Router API response is preferably returned as formatted XML with information

corresponding to the HTTP status code, a message, error codes, and/or any suitable information related to the resource. The Call router API response may alternatively be represented as Comma-separated values list (CSVs), HTML, JSON, or any suitable format. In one variation, the response format is determined by a portion of the requested URI, such as a file extension. In one variation, an API resource may be a binary data resource, and the Call Router API response is preferably formatted in a native binary format (e.g., a wav or mp3 audio file), an XML meta-data description, and or any suitable format.

[0029] The API resource of the preferred embodiment functions as an addressable representation of call router meta-data, internal call router state, or the state of a given resource used by the call router. An API resource is preferably addressed by a persistent URI. Preferably, the API resource responds to at least one HTTP action of POST, PUT, GET, or DELETE. The API resource may alternatively respond to multiple HTTP actions. The API resource may alternatively respond to any suitable method(s) that are preferably included in the Call Router API request. Consistent with the RESTful conventions, a GET request of a resource may return the current state of a resource, while PUT may update the state, PUT or POST may be used to create a new resource, and DELETE may be used to destroy a resource. The call router API may alternatively be used to affect the functionality of an in-progress call in addition to modifying data. The API resources of the preferred embodiment include an account resource, caller ID resource, incoming address resource, call resource, media resource, and/or any suitable resource of the call router. The API resources may alternatively be

any suitable combination of the listed resources or other suitable resources. An API resource is preferably a preconfigured (or "static") resource, such as account information, or a resource actively in use by the call router, such as a phone call. Modifying the state of a resource via the API may additionally affect the operation of the call router in real-time, affect the state or capabilities of the call router in the future, and/or have any suitable effect.

[0030] The account resource of the preferred embodiment functions to allow an application to retrieve and/or modify account information. An account is preferably created by a telephony service provider, such as the operator of the call router. Information such as account name, usage information, contact information, initial URI, setup parameters, or any suitable account information may be retrieved or edited by an application using the account resource.

[0031] The caller ID resource of the preferred embodiment functions to allow an application to retrieve, modify, register new caller ID's (phone numbers), and/or delete caller identification information. The caller identification information is preferably for the phone number associated with out-going calls made by an application and/or user (i.e. where the application appears to be calling from). The numbers for outgoing calls are preferably assigned or verified prior to being used as a caller ID. As an alternative, to prevent fraudulent use of caller ID phone numbers in applications, a verification step may be used by the API before adding a new caller ID resource. A request to add a caller ID may be initiated via a request to the API, wherein a random validation code is generated and returned in the API response. The validation code is preferably provided

to an end user. A phone call is placed to the given phone number (caller ID), requesting that the validation code be entered via keypad digits or spoken. Entry of the validation code verifies possession of the phone number, or the device associated with the phone number, at the time of the request. Use of the caller ID resource may additionally be presented in a user interface, such as a web browser, by displaying the verification code. User interface may be provided by the operator of the call router, or may be provided by any suitable application using the API. Any suitable method may also be used for verification of a caller ID. In another alternative, where multiple parties are involved in a call, the caller ID of one of the existing party members may be assigned for additional outgoing calls during that call session.

[0032] The incoming address resource of the preferred embodiment functions to allow an application to get, modify, or provision new inbound DID phone numbers, SMS short codes, SIP Addresses, etc. for use with applications. PUT or POST may be used to set the initial URI associated with the inbound address. DELETE may be used to release the resource. The incoming address resource may be used for real-time provisioning of phone numbers or other addressable inbound identifiers.

[0033] The call resource of the preferred embodiment functions to allow an application to get or modify the state of a telephony session in the call router. A telephony session or call may be in-progress, completed, failed, not yet initiated, and/or in any suitable call status. A call resource can preferably change the state or connection of an in-progress call. State changes preferably include: hanging up or terminating existing telephony sessions, transferring one or more existing telephony sessions from

one contextual group of sessions to another, merging or splitting an existing group telephony sessions, transferring one or more telephony sessions from one communications medium to another (such as from one URI to a second URI), injecting an event or notification into a existing session or group of sessions, recording or ceasing to record the audio from one or more parties on a call, and/or any suitable call action. Call information or call log data can preferably be retrieved by sending a GET to the call resource or by alternatively sending any suitable method. Outgoing calls may also be initiated by using a POST or any suitable method that preferably indicates that a new call resource is to be created. When using the call resource to initiate a call, information may be provided as required to place a phone call, such as a caller ID to present, a phone number to call, and/or a URI to handle the call, but alternatively any suitable information may be provided. A call instruction XML document may alternatively be provided to the API instead of a URI, which is to be used for call instructions. The Call Router API may additionally respond with the status of a call such as if the call is answered, if a machine answered the phone, busy signal, no answer, call failure, and/or any suitable call status. The response may alternatively indicate that the new call request was accepted, but has not yet been initiated. In the example shown in FIGURE 6, caller information and caller ID are included in a POST request to the call resource. This step would initiate an outgoing call to the phone number designated in the caller information. The Call Router API response includes available state information regarding the call, such as whether the call has commenced yet, the call start time, end time, price, caller info, and the Call Router API response could alternatively include any

suitable information. Additionally, information about the call returned at any point by the API may depend on the status of the call. For example, a call start time would not be given if the call has not yet begun, or the call end time, duration or price would not be given if the call had not yet ended.

[0034] Additionally or alternatively, the call resource of the preferred embodiment may be used to transfer a call to a new URI by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, a call is preferably transferred to the new URI for new call instructions. The API may preferably be used to issue asynchronous changes in call state, unlike the synchronous communication between the call router and application server for synchronous URI requests and responses. The call resource, in this alternative, functions to allow a call to be asynchronously directed to URIs. Examples of various applications of the call resource include initiating a new telephony session, terminating an existing telephony session, call waiting, call holding, call queuing, call parking, private call sessions within a conference, carry on multiple call sessions, and/or any suitable application. Any situation where asynchronous events affect the call status, such as a call agent becoming available, or a person returning to the phone after placing a caller on hold. The currently executing call router instruction may be allowed to complete, or may be immediately terminated, before requesting the provided URI. New call state resulting from the last call instruction executed by the call router, such as digits pressed on the keypad or audio recorded from the caller, may be provided to the new URI in a form POST or GET parameters, or may alternatively be discarded by the call router and not provided. As

shown in FIGURE 15, call waiting may be implemented by an application sending a Call Router API request to the call resource that POSTs a new URI for the call. The caller is then directed to the new URI for instructions. A second Call Router API request is sent to the call resource that POSTs the original URI for the call, and thus brings the caller back to the first call session. The call resource may alternatively be used in any suitable application.

[0035] As an alternative embodiment of the call resource, a calls resource may implement a plurality of individual calls as distinct subresources. For example, a URI ending in "/Calls" may be a list of many calls performed by the account, and a URI ending in "/Calls/12345" may represent one specific call, uniquely identified by the key "12345". The calls resource preferably allows retrieval of many call records and/or creating new calls, while a single-call resource represents a single call. The calls resource preferably accepts a request to create a new call resource, as is common in RESTful architectures, which in the Call Router API, preferably serves to initiate one or more new calls. A calls resource may be used to both list current and previous calls using the GET method, as well as initiate a new outbound call using the POST method. Using RESTful principles such as POST or PUT to alter the state of an individual call resource can preferably change the state of an in-progress call, affecting the realtime activities of the call, such as by hanging up, transferring control to a new URI, joining the call with another call, or any suitable telephony action.

[0036] The media resource of the preferred embodiment functions to allow an application to retrieve and/or access information of media stored, cached, created,

and/or used during a call. In one variation, the media resource is preferably a recording resource to access information and recordings made during a call via recording call instructions, or asynchronously via the Call Router API. In another variation, the media resource may alternatively include call transcripts, text messages, key press logs, faxes, a binary-coded resource, and/or any suitable media. The media resource may alternatively include a URI of the binary-coded file (such as a wav, mp3 audio file or PDF document file). In one variation, the media resources may additionally be integrated with the telephony instructions (or markup language) such that a telephony instruction may instruct the call router to perform an action that creates a media resource. The call router preferably sends a response to the application server with the URI of the created media resource. For example, when the call router is instructed to record a message, the call router preferably sends a response to the application server with a unique URI of the recorded message within the API. The media URI preferably responds to GET requests to return the media in a number of formats, such as binary or XML meta-data representations. The media resource may accept requests to delete a media resource. In one variation, the media resource preferably requires authentication to access the resource. In another variation, the media resource may not require authentication to enable URI embedding in a variety of applications, without exposing authentication credentials. In yet another variation, authentication is preferably performed via cryptographic hashing, such that credentials are not exposed to client applications that consume the media resources. In another variation, the media resource allows the initiation of transcription of audio resources to text using

transcription technology. The audio resource used for transcription is preferably generated during telephony sessions (such as by using the record instruction) and hosted on the Call Router API. The media resource preferably allows retrieving or deletion of audio transcriptions generated from recorded media. The media resource may additionally allow centralized hosting of media files, and the resource URIs are preferably exchanged between the call router and the application server, instead of the large media files themselves. The media resource may alternatively be used for any suitable media.

[0037] Additionally or alternatively, a join resource of the preferred embodiment may be used to join one or calls into a shared session that allows the parties to communicate (i.e., a conference) by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, one or more calls are preferably join together such that they are in a conference. The join resource may alternatively be a subresource or part of the call resource.

[0038] Additionally or alternatively, a split resource of the preferred embodiment may be used to split shared sessions (e.g., a conference) into individual call sessions by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, one or more shared sessions involving two or more calls are preferably split such that one or more calls are split into separate calls or into on or more separate conferences. The split resource may alternatively be a subresource or part of the call resource.

2. System for Handling Telephony Sessions

[0039] As shown in FIGURES 2A, 2B, 3A, and 3B, a system 20 and 30 of the preferred embodiment for handling telephony sessions includes a call router 22, a URI 23 for an application server, a telephony instruction 27, and a call router resource 29. As shown in FIGURES 2A and 2B, a first configuration 20 is initiated by a telephony device (such as a telephone call, fax or SMS message). As shown in FIGURES 3A and 3B, a second configuration 30 is initiated by an application developer side (i.e., server 26 calling out). The telephony system of the preferred embodiment preferably additionally implements a Call Router API 28 that includes a Call Router API request format, a Call Router API response format and a plurality of resources substantially similar to those described above.

[0040] The call router 22 functions to initiate or receive calls from the telephony device and connect to a web-application server. The call router 22 is preferably connected to a PSTN device over the PSTN network, such that it can receive and make calls from PSTN-connected devices 21, such as landlines, cellular phones, satellite phones, or any other suitable PSTN-connected devices, as well as non-PSTN devices, such as Voice-Over-Internet-Protocol (VOIP) phones, SIP devices, Skype, Gtalk, or other Internet addressable voice devices. The call router 22 may alternatively or additionally function as or include a message router for use with SMS messages. The call router 22 can preferably connect to an SMS network, such that it can receive and send messages from SMS network devices 21, cellular phones, computers, smartphones, or any suitable SMS network devices. The call router 22 may also send or receive text

messages, multimedia messages, emails, faxes and other suitable PSTN-compatible communication messages. The call router 22 preferably communicates with the application server 26 using an application layer protocol, more preferably using the HTTP, or secure HTTPS, protocol. The communication between the application server 26 and the call router 22 is preferably stateless and any state information (e.g., call state) or data is preferably located in a URI or the request parameters, such as HTTP headers, GET URI parameters, POST request body parameters, or HTTP cookies. Available state information is preferably transmitted by call router requests to the application server for stateless processing, and the application server preferably stores no state. Alternatively, the application server preferably stores local state information, such as databases or sessions, as is common in web development. The call router 22 preferably stores state information in call router resources 29. The call router resources 29 are preferably accessible by the application server 26 and other devices through the call router API 28. The call router resources 29 are preferably similar to those described above. The call router 22 preferably associates each incoming phone number with a starting URI 23, more preferably the URI 23 is provided by the application server 26, still more preferably the URI 23 is provided by the application developer before a call is received at the call router 22 by associating the initial URI with the incoming call address (such as DID, SIP address, etc.) or by the application upon initiation of an outgoing call. The call router 22 preferably sends call data such as the caller number (obtained via Caller ID), caller geographic data (country, city, and/or state, zip) the number dialed, the time of the call, or any other suitable information or parameter. The

call data is preferably digitally signed with a secret key 25 stored on the call router 22. A cryptographic hash of the information is preferably included along with the information as a digital signature. The call router 22 may also encrypt sensitive information (either before or after the cryptographic hash is computed) using the secret key to allow sensitive information to be sent across the network. The call data is preferably sent as an HTTP POST request to the application server 26. Call data may also be sent in URL (GET) variables, or encapsulated in HTTP headers. An example HTTP request containing the information in the header is shown in FIGURE 4A and 4D. As shown in FIGURE 4B, further inputs (such as voice recording or DTMF button pressing) from the PSTN-device may be subsequently submitted to the application server 26 as HTTP requests (GET or POST). As shown in FIGURE 4C, the inputs from a phone keypad may be included in an HTTP GET request. As shown in FIGURE 4E, the content of an SMS message received by the call router may be sent to the application server 26 as an HTTP request. As shown in FIGURE 4F, the inputs from the text message are included in an HTTP GET request. The request data may alternatively be simultaneously sent in the URI (query string), message body (POST) and message headers, or any combination of the above.

[0041] The application server 26 functions to provide data processing logic for requests received from the call router 22. The application server 26 is preferably connected to the call router 22 via a network 24, more preferably via the Internet. The application server 26 is preferably a third party server operated outside of the system, but the system may alternatively include the application server 26. The URI 23 is

preferably associated with an application server 26 or an application on an application server 26. The application server 26 preferably communicates with the call router 22 using an application layer protocol, more preferably using the HTTP protocol, or more secure HTTPS protocol. The application server 26 preferably receives HTTP requests from and sends HTTP responses to the call router 22. The application server 26 preferably runs on a standard stack of programming languages, hosting providers, operating systems and databases to handle HTTP requests, as if the caller were a website visitor in a web browser. The application server 26 also preferably verifies the digital signatures of the call data received in the requests using the secret key to compute a cryptographic hash from the received information and the hash received. If the computed hash and the received hash do not match, or no hash is received with the request, then the application server 26 preferably determines the request is fraudulent, and the request is preferably discarded. If the computed hash and received hash match, the application server 26 preferably determines that the request is authentic and proceeds further with the processing of the request. The application server may alternatively choose to ignore the hash if security is not important. The application server preferably uses call state data communicated by the call router request to determine the next call router instructions, without requiring call state stored on the application server. The application server may alternatively use call state data sent by the call router, such as the caller ID of the caller or the unique ID of the call, to reference additional or external state data, such as rows in a database or session data stored on the application server. The application server 26 preferably responds to HTTP requests

received from the call router 22 by generating telephony instructions 27 for the call router 22. The application server preferably replies to the call router in XML, however, any suitable machine-readable message format may be used, including HTML, key/value pair text, delimited text or binary encoding. The XML preferably includes the telephony instructions 27 for the call router 22 such as connecting to another number, playing a recorded greeting, reading text, and/or requesting DTMF digit entry from the caller. The telephony instruction 27 may alternatively be related to SMS messaging, Multimedia Messaging Service (MMS) messaging, email, or any suitable messaging task. The telephony instruction 27 may additionally be used to send an outgoing SMS message, arrange a phone call from a specific phone number, arranging for a callback, setting up a conference call (connecting multiple numbers), sending an email, interfacing with a calendar or scheduling system, purchasing goods, or services, or any other suitable instruction. The XML instructions are preferably a set of commands to be executed in order, one at a time (i.e., sequentially). An example XML response is shown in FIGURES 5A and 5B. In single telephony session (e.g. one initiated by a PSTN-device or an SMS device) a response from an application server can initiate an outgoing telephony call and/or a SMS message. That is, a single XML response preferably provides the ability to interact with both the SMS network and the voice telephony network (PSTN, SIP/VoIP, etc) sequentially or simultaneously. In addition, audio or video files sent to the call router 22 can be converted to text by an automatic speech-to-text engine, human or other technique, and sent back in text form as an SMS message or an attachment to an MMS. In one variation, an application running on a server may be a

simple static XML page and static sound files, deployed on basic web servers where no development or scripting environment is available. This variation preferably uses URI Templates (a current IETF proposal for HTML5), which essentially includes URLs with placeholders for variable data, like this: http://www.twilio.com/audio/{Digit}.mp3 where the call router 22 would substitute the digits pressed for the {Digit} placeholder in the URI Template, GET the file at the resulting URI, and play the static sound file in response. This allows an entire application to be authored offline in a What-You-See-Is-What-You-Get (WYSIWYG) html editor. For example, if the server response specifies the URI Template: http://demo.twilio.com/myapp/{Digits}.mp3, and the caller presses digits 1234, the call router 22 would GET the static mp3 file located at: http://demo.twilio.com/myapp/1234.mp3 and play it to the caller. The variables used for substitution in the URI Templates preferably correspond to the names of variables defined for state submission in HTTP GET, POST and/or header requests from the call router. From the previous example, {Digits} would be associated with a parameter named "Digits" that is preferably generated as a result of a "gather" telephony instruction (collection of DTMF digits). In the preferred embodiment for the second configuration, the call is initiated by the application server 26 (through the call router 22), and the second configuration 30 is substantially similar to the first configuration 20, such that the call routing is preferably handled identically to an incoming call, namely via URI requests from call router 22 to the server 26 upon call state changes. The application server preferably additionally is able to make calls to the Call Router API as described above.

3. Example Applications

[0042] Call router applications are preferably web applications, implementing the most common phone system features with full APIs for administration. Each Call Router Application object has a unique URI. A call may be transferred to that object instance by specifying its URI as a call destination. The call router applications preferably include: the AutoAttendant application (in FIGURE 7), the Follow Me application (in FIGURE 8), the Conference application (in FIGURE 9), the AutoConference application (in FIGURES 9-11), the Device application, the Person application, the VoicemailBox application, the Group application, and the Queuing application (in FIGURE 12).

[0043] The AutoAttendant application, as exemplified in FIGURE 7, plays a recorded greeting, and waits for the caller to press one or more digits on the keypad. Based on the input, the AutoAttendant preferably directs the call to another AutoAttendant, one or more of phones of a person, a voicemail box or any other valid calling destination.

[0044] The Follow Me application, as exemplified in FIGURE 8, enables a person to be reached at multiple devices, such as a work number, a cellular phone number, a landline, and/or a VOIP device. The Follow Me Application preferably calls these devices in order or simultaneously in an attempt to reach the person.

[0045] The Stay With Me application enables a person to transfer an in-progress call between multiple phone devices, such as a cellular phone and a home phone. For

example, a user may wish to transfer a call from a more expensive cellular call to a less expensive landline phone, or may wish to transfer a call to a landline phone if a cellular phone battery is running low.

[0046] The Conference application, as exemplified in FIGURE 9, preferably allows three or more callers to participate in a call simultaneously, while providing mechanisms to control who can join and speak during the call. The Conference application may alternatively or additionally incorporate SMS messaging control. The Conference application upon receipt of an SMS message including multiple phone numbers, may initiate a conference call to one or more parties, using the single SMS.

[0047] The AutoConference application preferably allows a conference administrator to initiate a conference call with two or more parties by performing one action, such as selecting a button on a website, selecting a button on a phone device, dialing a phone number, or scheduling the call prior to its initiation. Examples of the AutoConference application implemented using the preferred method of the invention are shown in FIGURE 9 (viewed from the PSTN-device side), FIGURE 10 (viewed from the application server side), and FIGURE 11 (initiated by an application server using the call router API).

[0048] The Device application represents a telephone used within the phone system, and may be a hard phone (hardware) or soft phone (software), a VOIP phone or a traditional PSTN phone. The Device application handles configuration details and device status (Do Not Disturb, Busy, etc.).

[0049] The Person application represents a human-being user of a telephone system. The Person may have one or more extensions, devices, and/or voicemail boxes, and may have a preferred order in which to ring their phones or voicemail. A person may have a username and password with which to login and update these settings.

[0050] The VoicemailBox application preferably plays a greeting, and allows the caller to record a message. Once complete, the recorded message may be stored for later listening, emailed as an audio link or attachment, or both. A list of current messages for a VoicemailBox may be retrieved by dialing in, via API, via RSS feed, and/or any other suitable method or device. In one variation, the audio recording may be automatically transcribed, transforming speech to text. The text is preferably included in the email or text message along with the audio link, attachment, and/or retrievable later by any suitable means of the API.

[0051] The Group application preferably represents a logical grouping of other Call Router Application objects, including other Groups. The Group preferably defines the behavior of calls directed to the group, including queuing, hunting for the first available party, and simultaneously ringing multiple parties.

[0052] The Queuing application preferably, upon receipt of a phone call or an SMS message, enters the message sender to a telephony call queue and the message sender is called back via the PSTN, SIP/VoIP network or other telephony network, as exemplified in FIGURE 12. The call may be placed either at the message' originating number or another pre-specified number, either when a human/operator/service is

available (customer service applications) at a pre-scheduled time, such as a wake-up call, anniversary reminder, birthday reminder.

[0053] The call router applications may additionally or alternatively include:

[0054] a Busy Signal Buster service that, upon receipt of an SMS message or phone call transmitting a number to be called that is currently busy, and calls the SMS message sender back at the message' originating number or another pre-specified number when the number is no longer busy;

[0055] a SMS Reader/TTY application that, upon receipt of an SMS, translates the text into audio, using a text-to-speech engine to a caller or the members of an audio conference (e.g., to tell them you will join the call in a few minutes), or for the hearing impaired to use instead of TTY services;

[0056] a Translation application that, upon receipt of an SMS message containing a phrase in a language, translates the language of the SMS message into another language (either manually by a human or automatically by a program) and sends a response message via SMS or email; and

[0057] a Programming application that, upon receipt of an SMS message containing programming code, could compile the code and execute the code, update a website, update a programming project, return data from a database, return a generated computer graphics object as an MMS message, or any other suitable program compilation or computation.

[0058] The call router applications may additionally or alternatively include a Status/Notification application that allows users to get or send the status of an object,

task, or process by sending an SMS message and receiving a call back via the PSTN, SIP/VoIP network or other telephony network. The service may be used by an operator sending an SMS message with the name of a particular server and then get a call back on her mobile phone and hear the status of that server read aloud. The service may also be used for notification, i.e. to call other parties. For example, a store manager may want to let employees know what time a store is opening the next day. The manager could send an SMS message that would then call each employee and tell him or her over the phone the time when the store was opening the next day, and or what time they needed to arrive at work.

[0059] The call router applications may, however, include any collection and/or permutation or these or other suitable prebuilt telephony functions and features.

[0060] Applications of the preferred method may include simple PBX functionality, such as auto-attendant voice menus, employee extensions, and voicemail features. The application may also include other, unconventional, applications such as an Interactive Hold application, a Conference Calling application, an Independent Music Hold Channel, a Voting/Fundraising application, a Sales Application, a Blog by phone service and a Call Annotation application.

[0061] The Interactive Hold application preferably includes interactive activities, such as a playing a quiz game to be played while on hold (with or without the ability to be played against other callers), listening to news headlines or podcasts of the choice of the listener, and using a phone keypad as a synthesizer to create music in realtime. The Conference Calling application may, as an example, include selecting particular (or

random) users from a phone book and instantly substantiating a conference call to the group, with the ability to save the group for future calling. The Independent Music Hold Channel preferably allows independent artists to upload, classify, and grant permission for their works to be played while a caller is on hold. The Voting/Fundraising application preferably connects willing callers (calling to encourage voting or to raise funds for a cause), to potential voters and/or donors respectively, preferably including an interface for the caller to display information about the voter/donor and to make notes about the voter's response to the call. The Sales Application preferably allows sales organizations to quickly integrate inbound and outbound calls with customer relationship management (CRM) applications, or read order details from a shopping cart application. Finally, the Call Annotation application allows call participants to append meta-data, such as reference URIs used in the phone conversation, to a specific call and a timestamp within the call. Participants on the call with a suitable user agent could view the annotations during the call, and people listening to a later replay of the call audio could also receive such annotations at the same timestamp during the playback. The Call Annotation may be used, for example, to facilitate conference call note taking, employee training, sales team collaboration, and/or customer support collaboration.

[0062] Applications may alternatively include hold or park functionality, where a caller is placed in a waiting state until an external event resumes the call, such as another party becoming available. One variation of this application is the call queue, where callers wait for an available attendant to answer a call. Applications of the

preferred method may alternatively include other conventional or unconventional PBX functionality.

[0063] As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims. It is possible, and indeed hoped, that additional applications will be designed and built upon this technology platform (the preferred method and/or system of the invention) that would not otherwise be possible using conventional telephony platforms.

CLAIMS

We Claim:

1. A method comprising:
    - operating a telephony network and internet connected system cooperatively with a plurality of application programming Interface (API) resources, wherein operating the system comprises:
        - initiating a telephony session,
        - communicating with an application server to receive an application response,
        - converting the application response into executable operations to process the telephony session,
        - creating at least one informational API resource; and
    - exposing the plurality of API resources through a RESTful API that comprises:
        - receiving a RESTful API request that specifies an API resource URI, and
        - responding to the API request according to the request and the specified resource URI.
2. The method of Claim 1, wherein the specified API resource URI is a URI of a functional API resource.
3. The method of Claim 2, wherein responding to the API request, prompts the initiation of the telephony session.

4. The method of Claim 3, wherein initiating a telephony session includes making an outgoing call over the public switched telephony network (PSTN).
5. The method of Claim 3, wherein initiating a telephony session includes sending a Short Message Service (SMS) message.
6. The method of Claim 2, wherein responding to the API request includes interacting with the initiated telephony session.
7. The method of Claim 6, wherein interacting with the initiated telephony session includes terminating the telephony session.
8. The method of Claim 6, wherein interacting with the initiated telephony session includes transferring telephony session control to a second application server.
9. The method of Claim 6, wherein interacting with the initiated telephony session includes holding the telephony session.
10. The method of Claim 6, wherein interacting with the initiated telephony session includes queuing a caller of a telephony session.
11. The method of Claim 6, wherein interacting with the initiated telephony session includes joining at least two callers to the telephony session.
12. The method of Claim 2, wherein responding to the API request includes provisioning a new inbound address, wherein initiating a telephony session occurs for an incoming call to the provisioned inbound address.
13. The method of Claim 2, wherein communicating with an application server to receive an application response includes communicating with a server URI that is associated with a telephony endpoint of a destination of the telephony session; and

responding to the API request includes modifying the server URI associated with the telephony endpoint.

14. The method of Claim 2, further comprising receiving a second RESTful API request that specifies an informational API resource URI, and responding to the second API request according to the second request by delivering queried data of the informational API resource.
15. The method of Claim 1, wherein responding to the API request includes provisioning a new inbound address; and wherein initiating the telephony session occurs for an incoming call to the provisioned inbound address.
16. The method of Claim 1, wherein the specified API resource URI is a URI of an informational API resource; and wherein responding to the API request according to the request and the specified resource URI includes returning data of the informational API resource.
17. The method of Claim 16, wherein the returned data is log of calls.
18. The method of Claim 16, wherein the returned data is a recording resource.
19. The method of Claim 16, wherein the returned data is data on an in-progress telephony session.
20. The method of Claim 1, wherein initiating a telephony session includes communicating a call with the Public Switched Telephony Network (PSTN).
21. The method of Claim 1, wherein initiating a telephony session includes communicating a call with the Session Initiation Protocol (SIP).

22. The method of Claim 1, wherein initiating a telephony session includes communicating a telephony message.

23. The Method of Claim 22, wherein communicating the telephony message includes communicating a Short Message Service (SMS) message.

24. A method comprising:

- operating a telephony network and internet connected system cooperatively with a plurality of application programming Interface (API) resources, wherein operating the system comprises:
    - initiating a telephony session,
    - communicating with an application server to receive an application response,
    - converting the application response into executable operations to process the telephony session,
    - creating at least one informational API resource; and
- exposing the plurality of API resources through a RESTful API that comprises:
    - receiving a plurality of RESTful API requests, each RESTful API request specifying an API resource URI,
    - initiating a telephony session according to a first RESTful API request,
    - communicating a telephony message according to a second RESTful API request,

- provisioning a new inbound telephone according to a third RESTful API request, and
- terminating a telephony session according to a fourth RESTful API request.

25. The method of Claim 24, wherein exposing the plurality of API resources through a RESTful API further comprises: delivering queried data of an informational resource according to a fifth RESTful API request, joining at least two callers according to a sixth RESTful API request, queuing the telephony session according to a seventh RESTful API request, holding the telephony session according to a eighth RESTful API request, and transferring telephony session control to a second application server according to a ninth RESTful API request.

ABSTRACT

In one embodiment, the method of processing telephony sessions includes: communicating with an application server using an application layer protocol; processing telephony instructions with a call router; and creating call router resources accessible through a call router Application Programming Interface (API). In another embodiment, the system for processing telephony sessions includes: a call router, a URI for an application server, a telephony instruction executed by the call router, and a call router API resource.

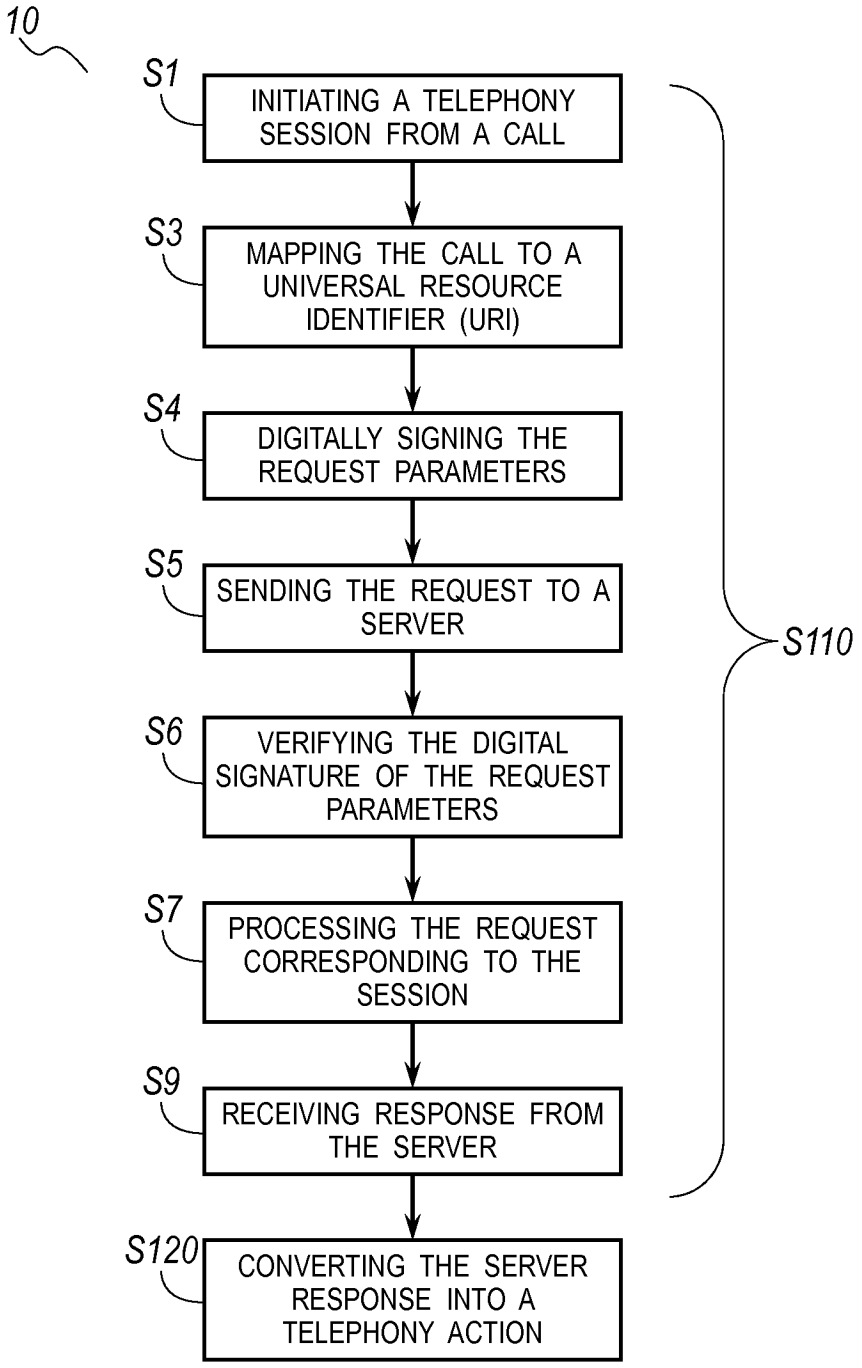

10
S1
INITIATING A TELEPHONY SESSION FROM A CALL
S3
MAPPING THE CALL TO A UNIVERSAL RESOURCE IDENTIFIER (URI)
S4
DIGITALLY SIGNING THE REQUEST PARAMETERS
S5
SENDING THE REQUEST TO A SERVER
S6
VERIFYING THE DIGITAL SIGNATURE OF THE REQUEST PARAMETERS
S7
PROCESSING THE REQUEST CORRESPONDING TO THE SESSION
S9
RECEIVING RESPONSE FROM THE SERVER
S110
S120
CONVERTING THE SERVER RESPONSE INTO A TELEPHONY ACTION

FIG. 1

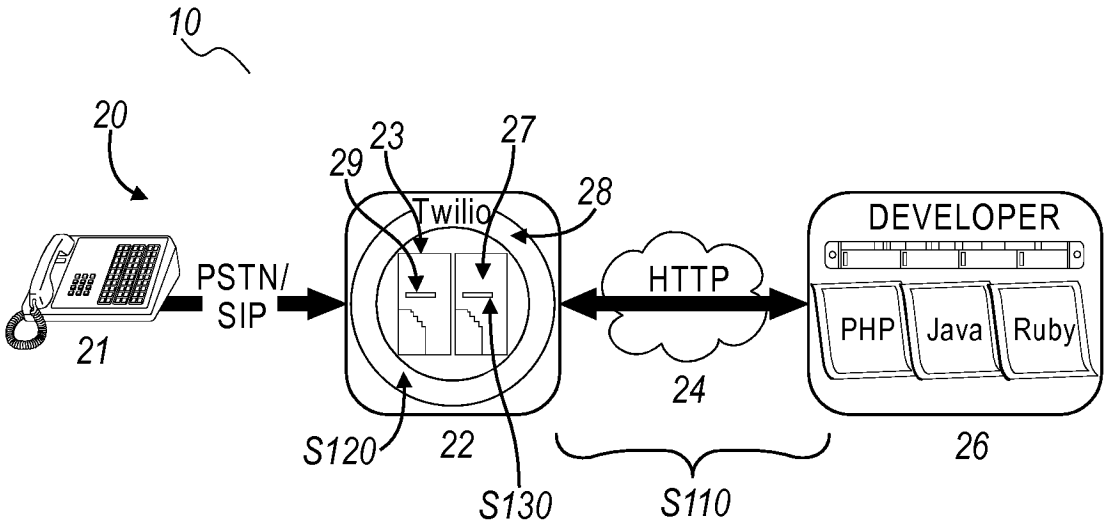
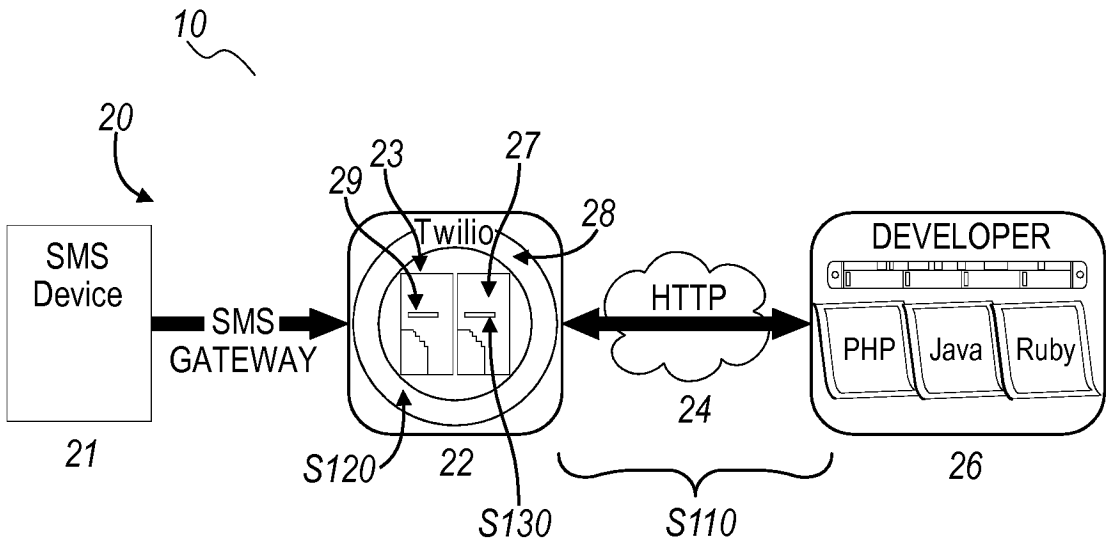

10
20
29
23
27
28
Twilio
DEVELOPER
PSTN/
SIP
HTTP
PHP
Java
Ruby
21
24
S120
22
26
S130
S110

FIG. 2A


10
20
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Twilio
DEVELOPER
SMS
Device
SMS
GATEWAY
HTTP
PHP
Java
Ruby
21
24
S120
22
26
S130
S110

FIG. 2B

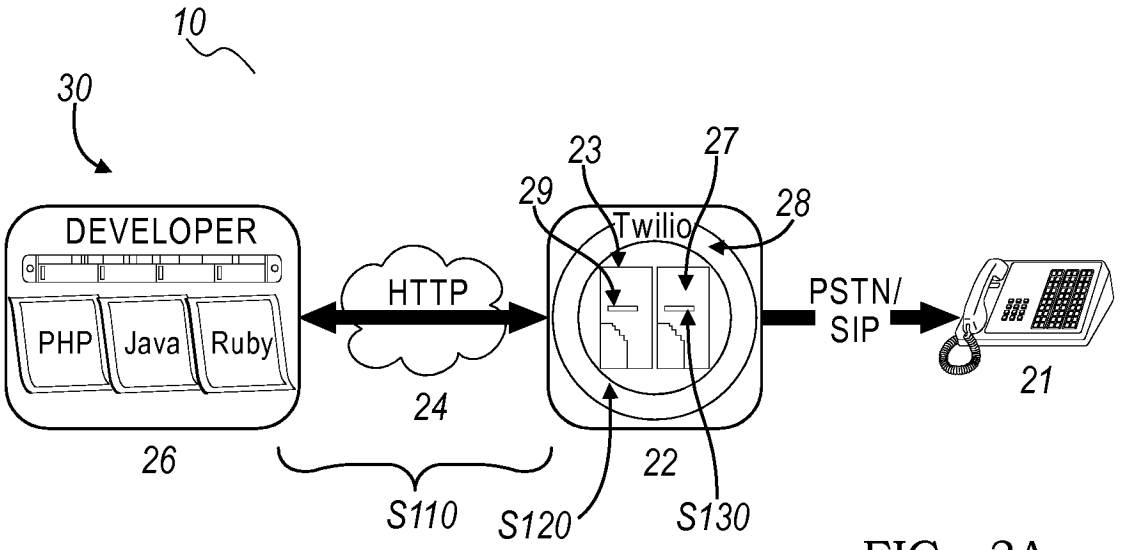
10
30
DEVELOPER
PHP
Java
Ruby
26
HTTP
24
23
27
29
28
Twilio
22
PSTN/
SIP
21
S110
S120
S130

FIG. 3A

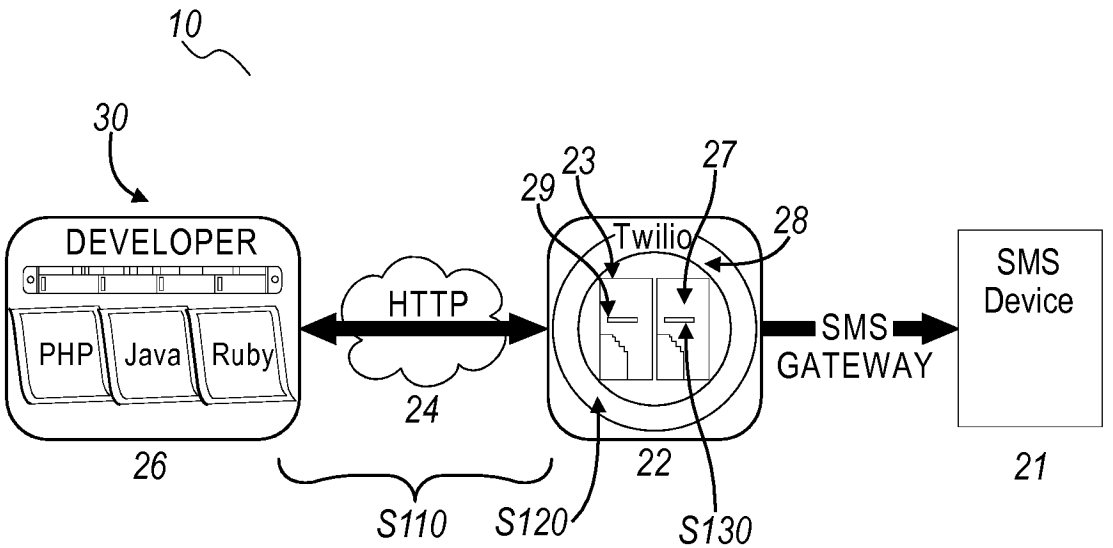
10
30
DEVELOPER
PHP
Java
Ruby
26
HTTP
24
23
27
29
28
Twilio
22
SMS
GATEWAY
SMS
Device
21
S110
S120
S130

FIG. 3B

```
GET /foo.php HTTP/1.1
Host: demo.twilio.com
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIG. 4A

```
POST /foo.php HTTP/1.1
Host: demo.twilio.com
Content-Type: application/x-www-form-urlencoded
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 11

Digits=1234
```

FIG. 4B

```
GET /foo.php?digits=1234 HTTP/1.1
Host: demo.twilio.com
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIG. 4C

```
GET /foo.php  HTTP/1.1
Host:  demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderID=415-555-1212
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length:  0
```

FIG. 4D

```
GET /foo.php  HTTP/1.1
Host:  demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderId=415-555-1212
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length:  21

Message=statusrequest
```

FIG. 4E

```
GET /foo.php?message=statusrequest  HTTP/1.1
Host:  demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderId=415-555-1212
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length:  0
```

FIG. 4F

XML Response

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
        <Collect
                successUrl="http://www.example.com/phonetree.php"
                numDigits="1"
                timeout=20
        >
                <Say voice="female">
For sales press one. For support press two. For the operator, press three.
                </Say>
        </Collect>
</Response>
```

FIG. 5A

XML Response

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
        <sms address=415-555-555
                thanks for the your text, will call at 5 PM.
        </sms>
        <CallAtTime="17:00PST">
                Today
                <Dial>415-555-5309</Dial>

        </CallAtTime>
</Response>
```

FIG. 5B

```
POST /2008-08-01/Accounts/AC309475e5fede1b49e100272a8640f438/Calls  HTTP/1.1
        Caller=4155555309&Called=4155551212&Url=http://www.myapp.com/myhandler.php

<TwilioResponse>
        <Call>
                <Sid>CA42ed11f93dc08b952027ffbc406d0868</Sid>
                <CallSegmentSid/>
                <AccountSid>AC309475e5fede1b49e100272a8640f438</AccountSid>
                <Called>4155551212</Called>
                <Caller>4155555309</Caller>
                <PhoneNumberSid>PN01234567890123456789000<PhoneNumberSid>
                <Status>0</Status>
                <StartTime>Thu, 03 Apr 2008 04:36:33  -0400</StartTime>
                <EndTime/>
                <Price/>
                <Flags>1</Flags>
        </Call>
</TwilioResponse>
```

FIG. 6

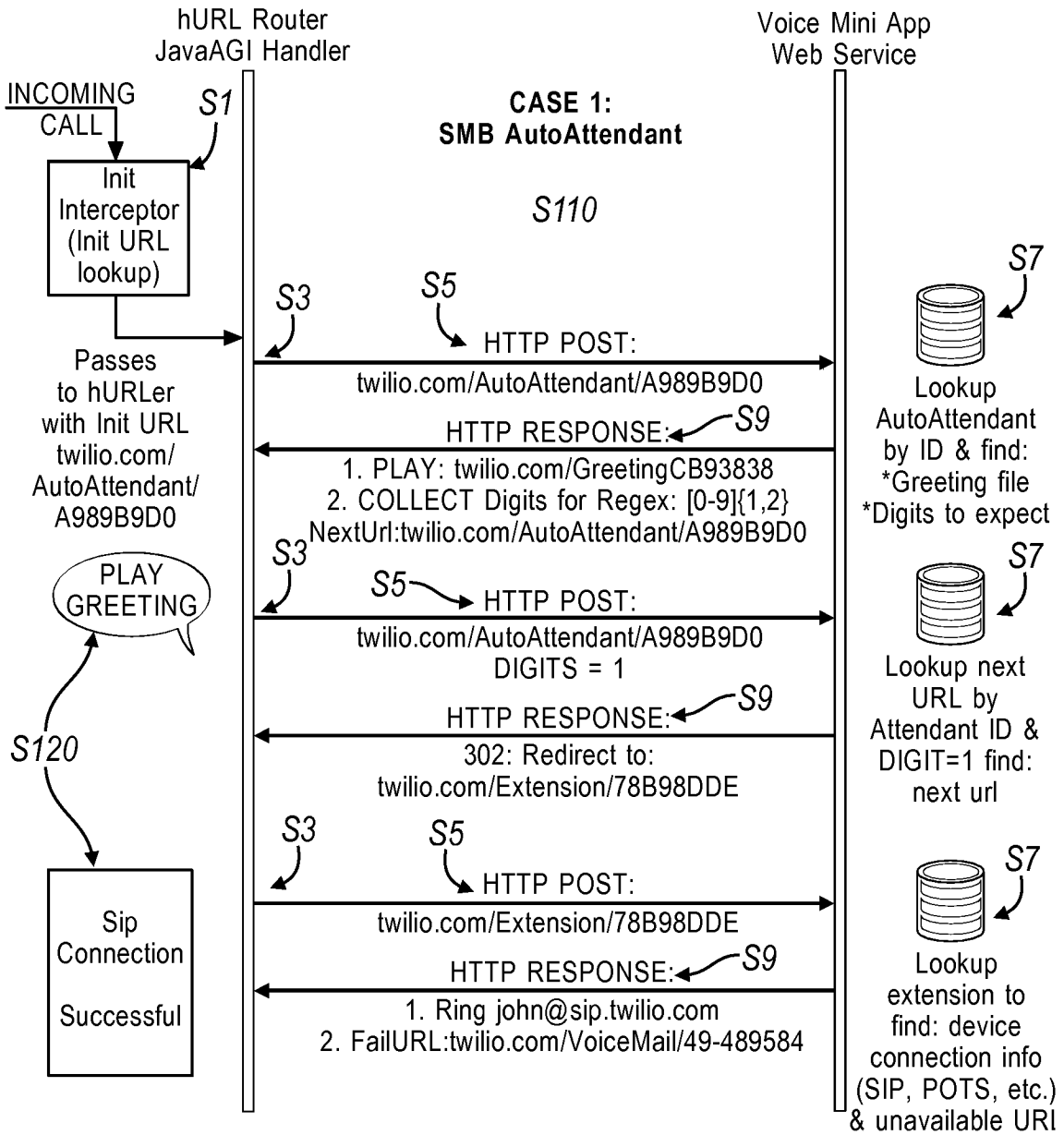
hURL Router
JavaAGI Handler
Voice Mini App
Web Service
INCOMING CALL
S1
Init Interceptor (Init URL lookup)
Passes to hURLer with Init URL twilio.com/ AutoAttendant/ A989B9D0
CASE 1:
SMB AutoAttendant
S110
S3
S5
HTTP POST:
twilio.com/AutoAttendant/A989B9D0
S7
Lookup AutoAttendant by ID & find:
*Greeting file
*Digits to expect
HTTP RESPONSE:
S9
1. PLAY: twilio.com/GreetingCB93838
2. COLLECT Digits for Regex: [0-9]{1,2}
NextUrl:twilio.com/AutoAttendant/A989B9D0
PLAY GREETING
S120
DIGITS = 1
Lookup next URL by Attendant ID & DIGIT=1 find: next url
302: Redirect to:
twilio.com/Extension/78B98DDE
Sip Connection Successful
Lookup extension to find: device connection info (SIP, POTS, etc.) & unavailable URI
1. Ring john@sip.twilio.com
2. FailURL:twilio.com/VoiceMail/49-489584

FIG. 7

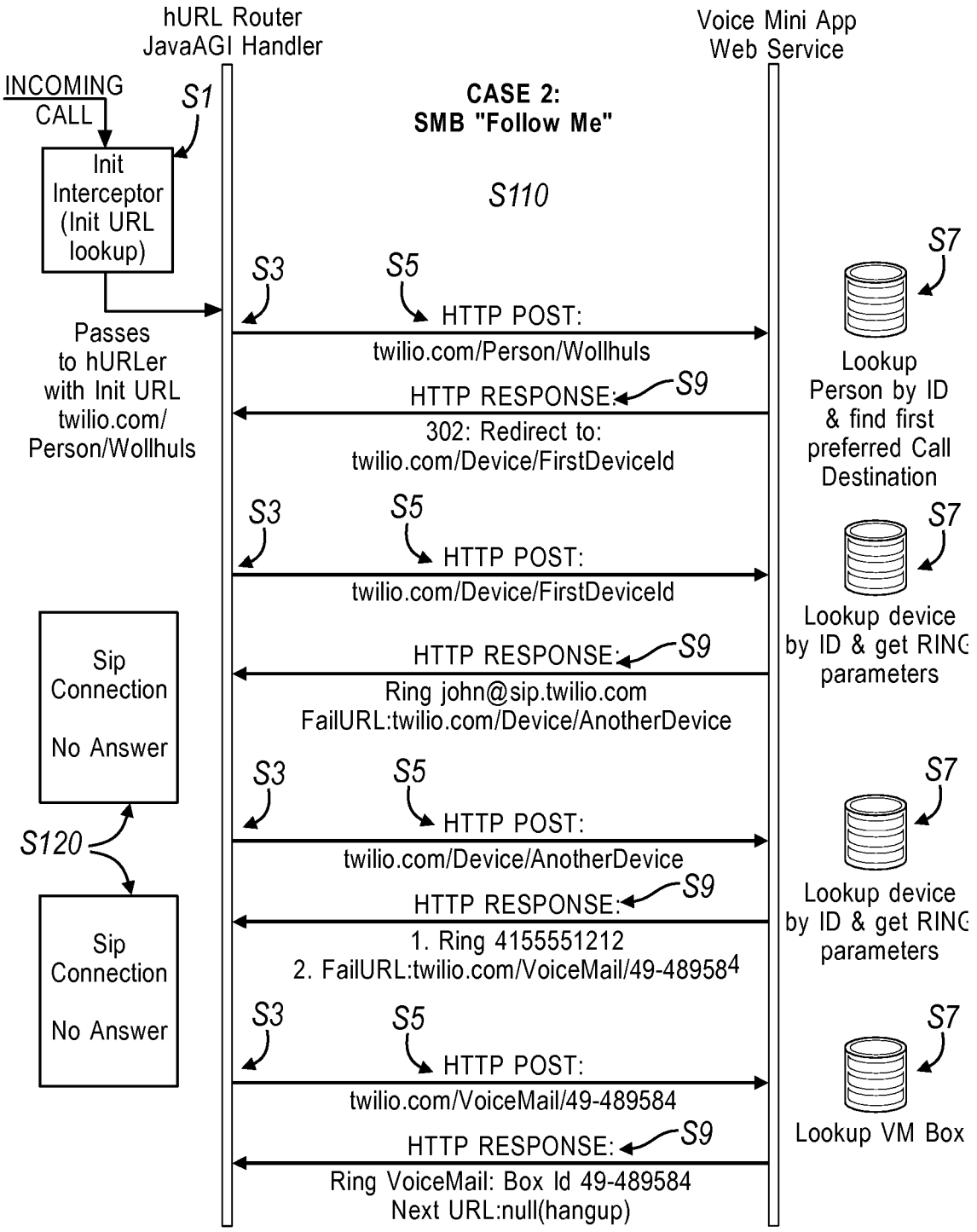
hURL Router
JavaAGI Handler
Voice Mini App
Web Service
INCOMING CALL
S1
Init Interceptor (Init URL lookup)
Passes to hURLer with Init URL twilio.com/ Person/Wollhuls
CASE 2:
SMB "Follow Me"
S110
S3
S5
HTTP POST:
twilio.com/Person/Wollhuls
S7
Lookup Person by ID & find first preferred Call Destination
HTTP RESPONSE:
S9
302: Redirect to:
twilio.com/Device/FirstDeviceId
S3
S5
HTTP POST:
twilio.com/Device/FirstDeviceId
S7
Lookup device by ID & get RING parameters
HTTP RESPONSE:
S9
Ring john@sip.twilio.com
FailURL:twilio.com/Device/AnotherDevice
Sip Connection
No Answer
S120
S3
S5
HTTP POST:
twilio.com/Device/AnotherDevice
S7
Lookup device by ID & get RING parameters
HTTP RESPONSE:
S9
1. Ring 4155551212
2. FailURL:twilio.com/VoiceMail/49-489584
Sip Connection
No Answer
S3
S5
HTTP POST:
twilio.com/VoiceMail/49-489584
S7
Lookup VM Box
HTTP RESPONSE:
S9
Ring VoiceMail: Box Id 49-489584
Next URL:null(hangup)

FIG. 8

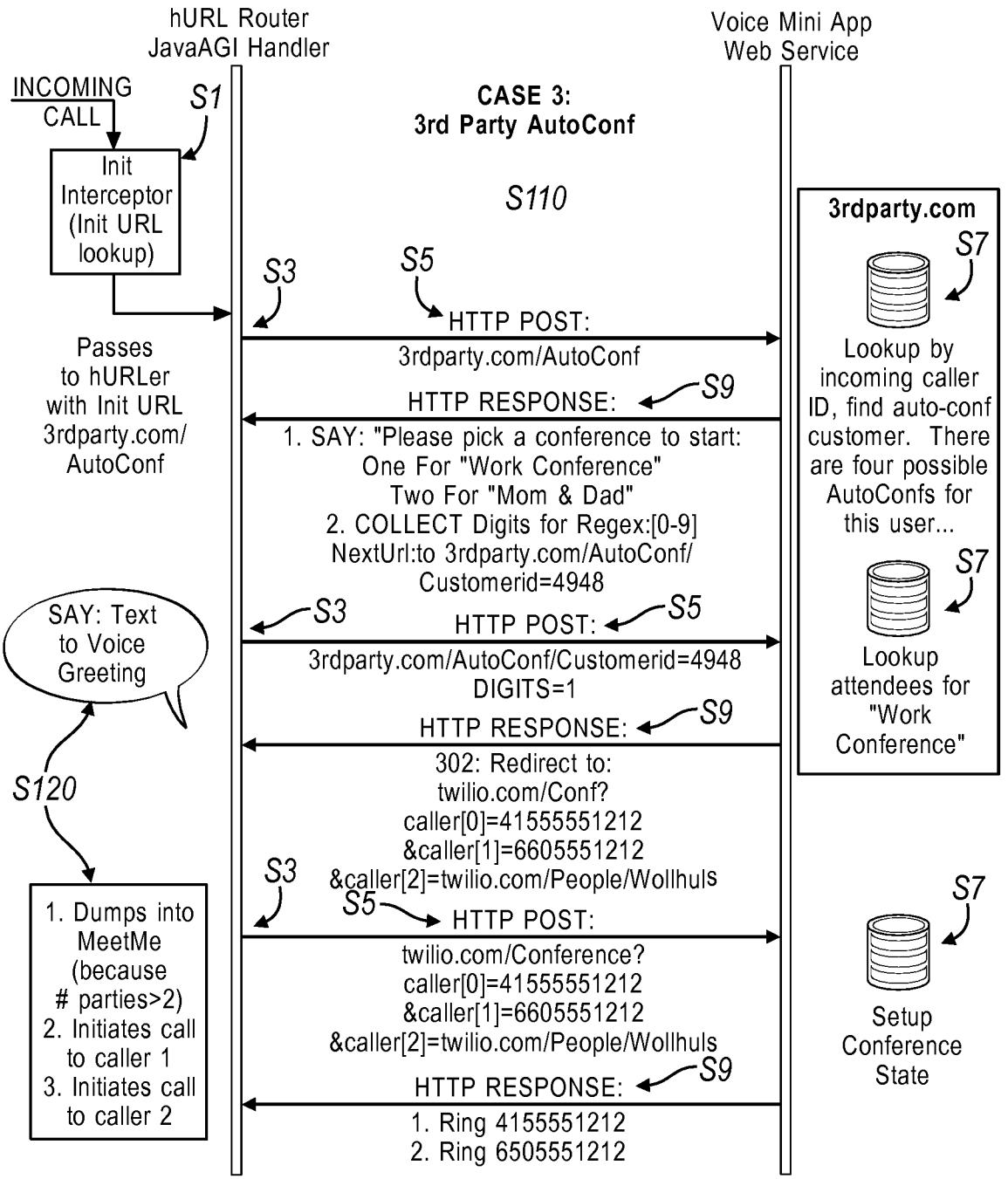
hURL Router
JavaAGI Handler
Voice Mini App
Web Service
INCOMING CALL
S1
Init Interceptor (Init URL lookup)
Passes to hURLer with Init URL 3rdparty.com/ AutoConf
CASE 3:
3rd Party AutoConf
S110
3rdparty.com
S7
Lookup by incoming caller ID, find auto-conf customer. There are four possible AutoConfs for this user...
S7
Lookup attendees for "Work Conference"
S3
S5
HTTP POST:
3rdparty.com/AutoConf
HTTP RESPONSE:
S9
1. SAY: "Please pick a conference to start:
One For "Work Conference"
Two For "Mom & Dad"
2. COLLECT Digits for Regex:[0-9]
NextUrl:to 3rdparty.com/AutoConf/
Customerid=4948
SAY: Text to Voice Greeting
S3
HTTP POST:
S5
3rdparty.com/AutoConf/Customerid=4948
DIGITS=1
HTTP RESPONSE:
S9
302: Redirect to:
twilio.com/Conf?
caller[0]=41555551212
&caller[1]=6605551212
&caller[2]=twilio.com/People/Wollhuls
S120
S3
S5
HTTP POST:
1. Dumps into MeetMe (because # parties>2)
2. Initiates call to caller 1
3. Initiates call to caller 2
twilio.com/Conference?
caller[0]=41555551212
&caller[1]=6605551212
&caller[2]=twilio.com/People/Wollhuls
S7
Setup Conference State
HTTP RESPONSE:
S9
1. Ring 4155551212
2. Ring 6505551212

FIG. 9

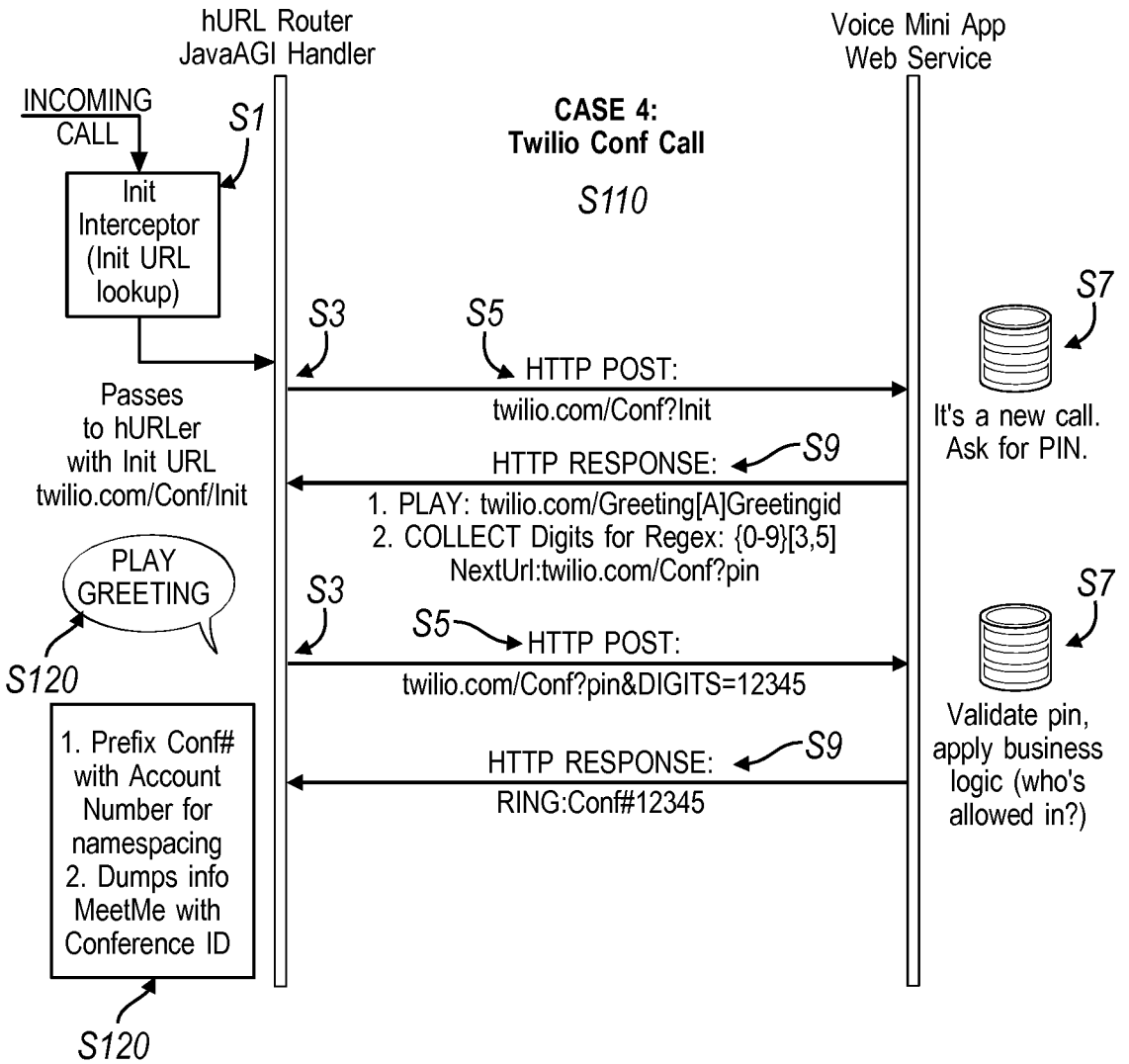
hURL Router
JavaAGI Handler
Voice Mini App
Web Service
INCOMING
CALL
S1
Init
Interceptor
(Init URL
lookup)
CASE 4:
Twilio Conf Call
S110
S3
S5
HTTP POST:
twilio.com/Conf?Init
S7
It's a new call.
Ask for PIN.
Passes
to hURLer
with Init URL
twilio.com/Conf/Init
HTTP RESPONSE:
S9
1. PLAY: twilio.com/Greeting[A]Greetingid
2. COLLECT Digits for Regex: {0-9}[3,5]
NextUrl:twilio.com/Conf?pin
PLAY
GREETING
S120
S3
S5
HTTP POST:
twilio.com/Conf?pin&DIGITS=12345
S7
Validate pin,
apply business
logic (who's
allowed in?)
1. Prefix Conf#
with Account
Number for
namespacing
2. Dumps info
MeetMe with
Conference ID
HTTP RESPONSE:
S9
RING:Conf#12345
S120

FIG. 10

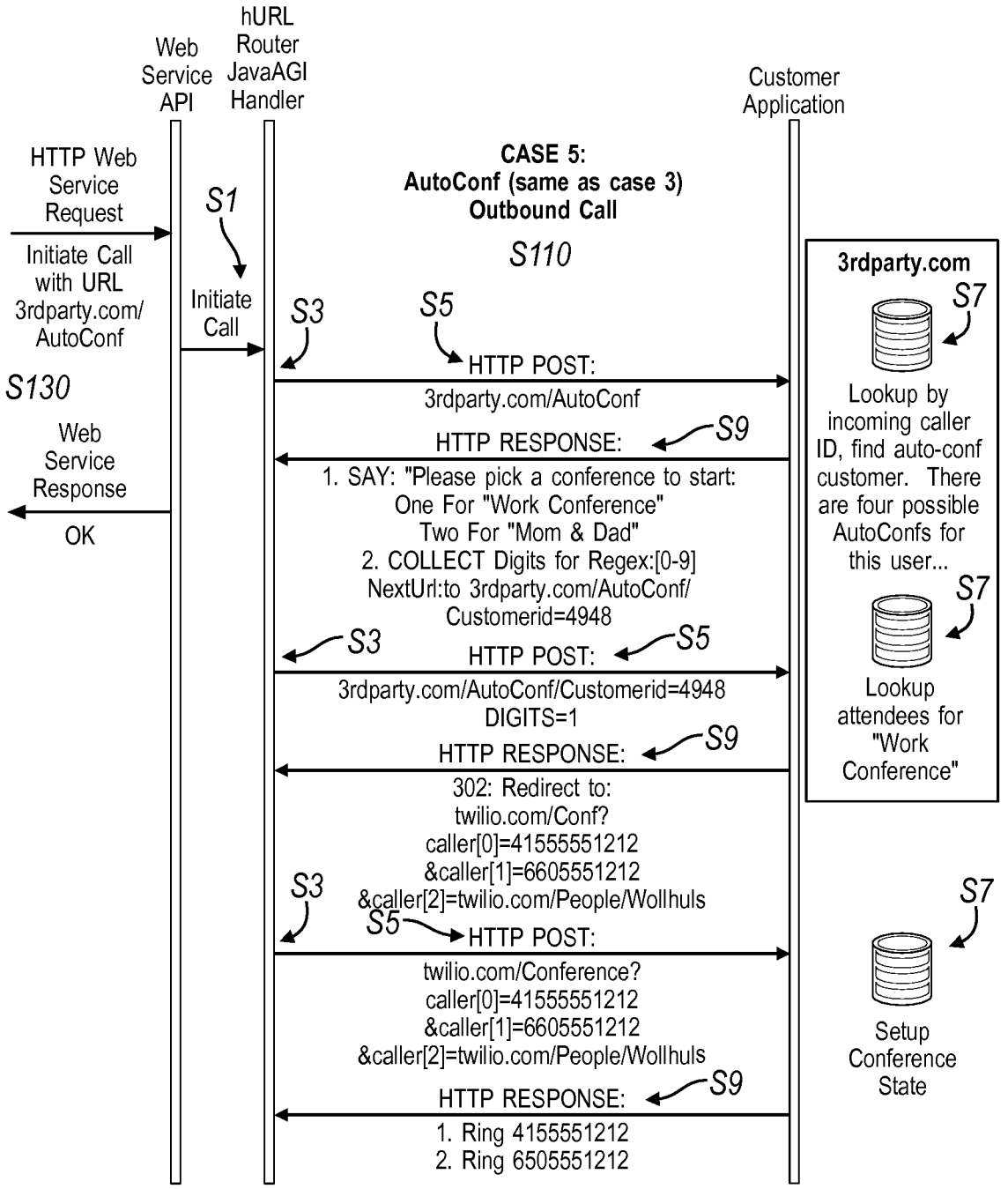
Web Service API
hURL Router JavaAGI Handler
Customer Application
HTTP Web Service Request
Initiate Call with URL 3rdparty.com/ AutoConf
S130
Web Service Response
OK
S1
Initiate Call
CASE 5:
AutoConf (same as case 3)
Outbound Call
S110
S3
S5
HTTP POST:
3rdparty.com/AutoConf
HTTP RESPONSE:
S9
1. SAY: "Please pick a conference to start:
One For "Work Conference"
Two For "Mom & Dad"
2. COLLECT Digits for Regex:[0-9]
NextUrl:to 3rdparty.com/AutoConf/
Customerid=4948
S3
S5
HTTP POST:
3rdparty.com/AutoConf/Customerid=4948
DIGITS=1
HTTP RESPONSE:
S9
302: Redirect to:
twilio.com/Conf?
caller[0]=41555551212
&caller[1]=6605551212
&caller[2]=twilio.com/People/Wollhuls
S3
S5
HTTP POST:
twilio.com/Conference?
caller[0]=41555551212
&caller[1]=6605551212
&caller[2]=twilio.com/People/Wollhuls
HTTP RESPONSE:
S9
1. Ring 4155551212
2. Ring 6505551212
3rdparty.com
S7
Lookup by incoming caller ID, find auto-conf customer. There are four possible AutoConfs for this user...
S7
Lookup attendees for "Work Conference"
S7
Setup Conference State

FIG. 11

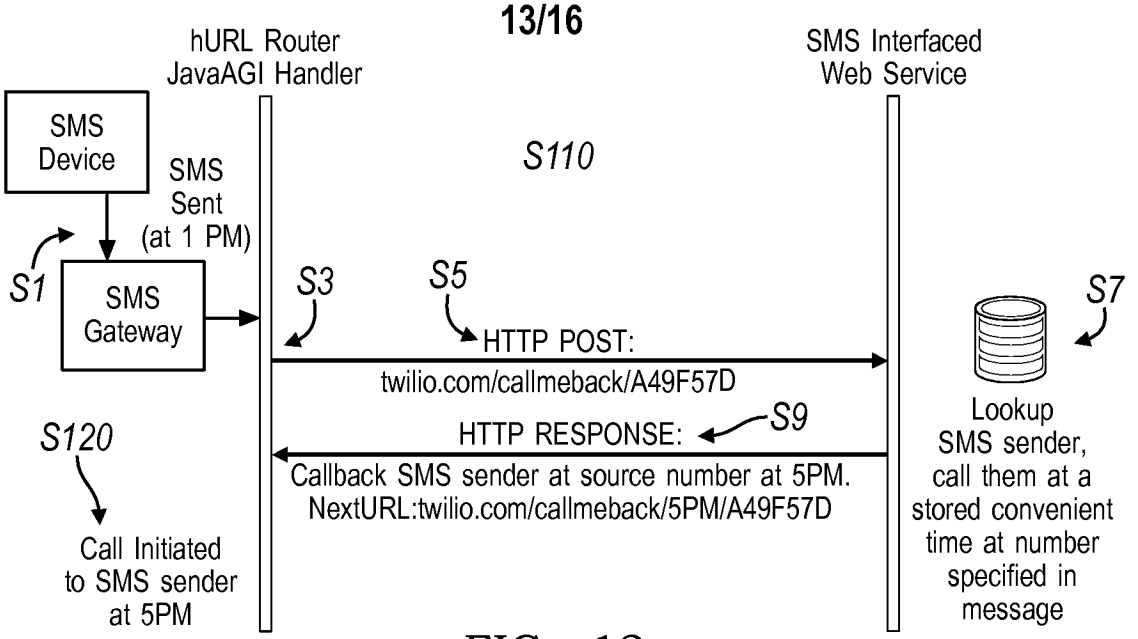
hURL Router
JavaAGI Handler
SMS Interfaced
Web Service
SMS
Device
SMS
Sent
(at 1 PM)
S110
S1
SMS
Gateway
S3
S5
HTTP POST:
twilio.com/callmeback/A49F57D
S7
Lookup
SMS sender,
call them at a
stored convenient
time at number
specified in
message
S9
HTTP RESPONSE:
Callback SMS sender at source number at 5PM.
NextURL:twilio.com/callmeback/5PM/A49F57D
S120
Call Initiated
to SMS sender
at 5PM

FIG. 12

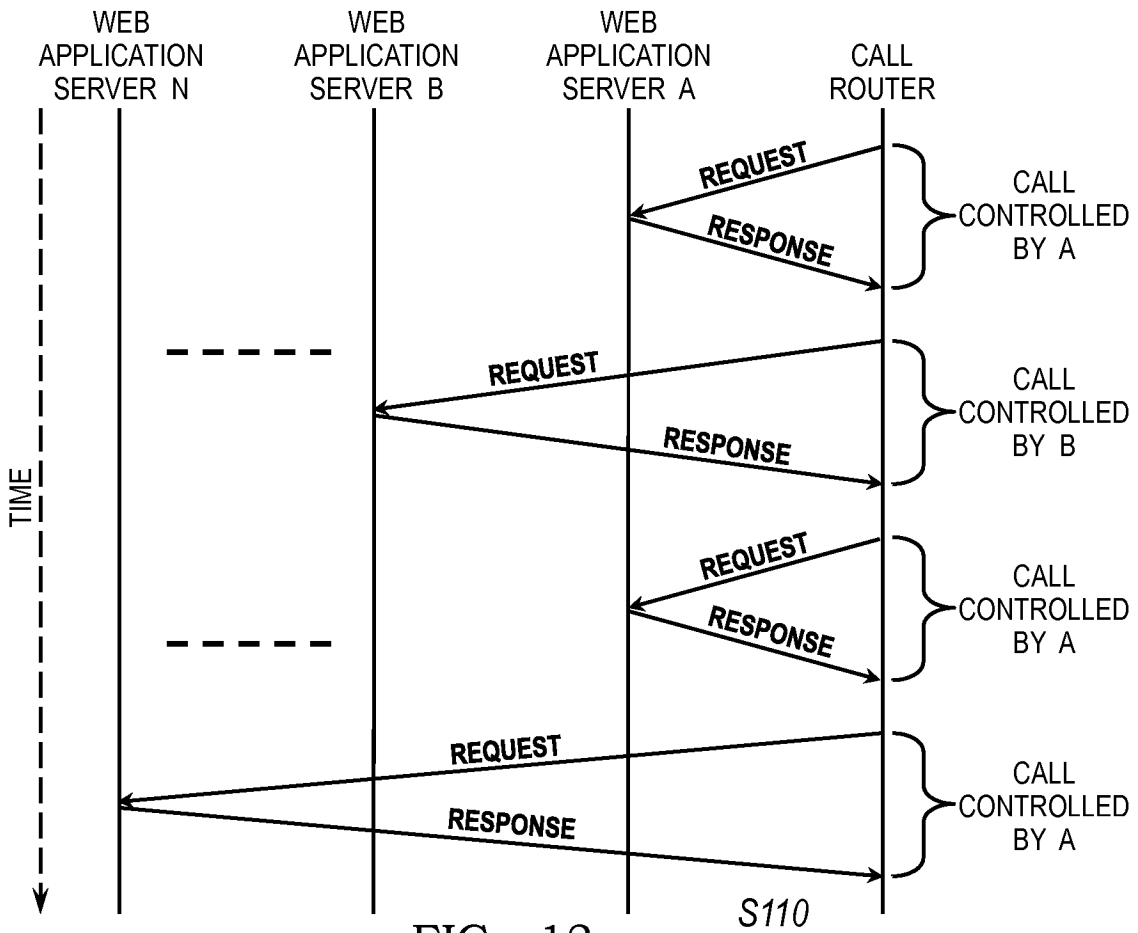
WEB
APPLICATION
SERVER N
WEB
APPLICATION
SERVER B
WEB
APPLICATION
SERVER A
CALL
ROUTER
REQUEST
RESPONSE
CALL
CONTROLLED
BY A
REQUEST
RESPONSE
CALL
CONTROLLED
BY B
REQUEST
RESPONSE
CALL
CONTROLLED
BY A
REQUEST
RESPONSE
CALL
CONTROLLED
BY A
TIME
S110

FIG. 13

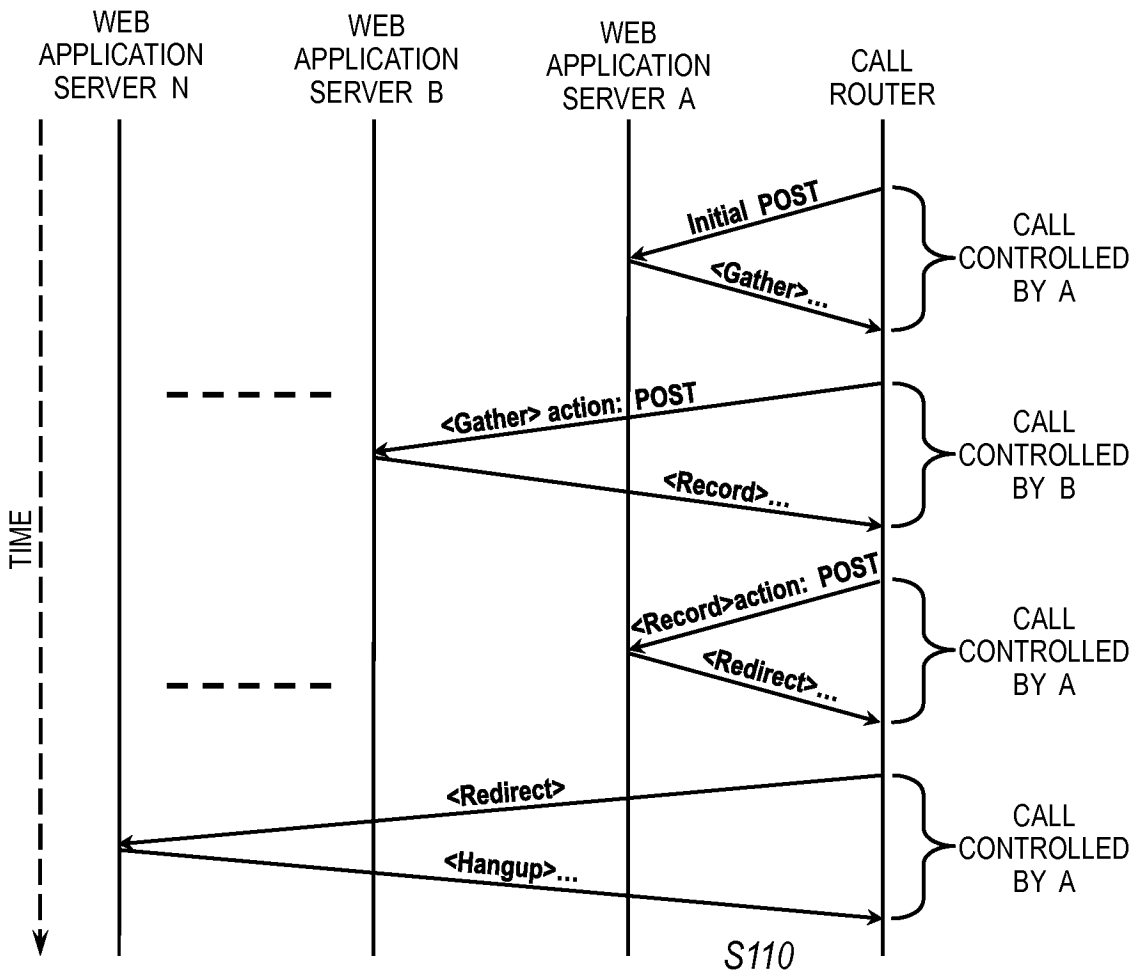
WEB APPLICATION SERVER N
WEB APPLICATION SERVER B
WEB APPLICATION SERVER A
CALL ROUTER
TIME
Initial POST
<Gather>...
CALL CONTROLLED BY A
<Gather> action: POST
<Record>...
CALL CONTROLLED BY B
<Record>action: POST
<Redirect>...
CALL CONTROLLED BY A
<Redirect>
<Hangup>...
CALL CONTROLLED BY A
S110

FIG. 14

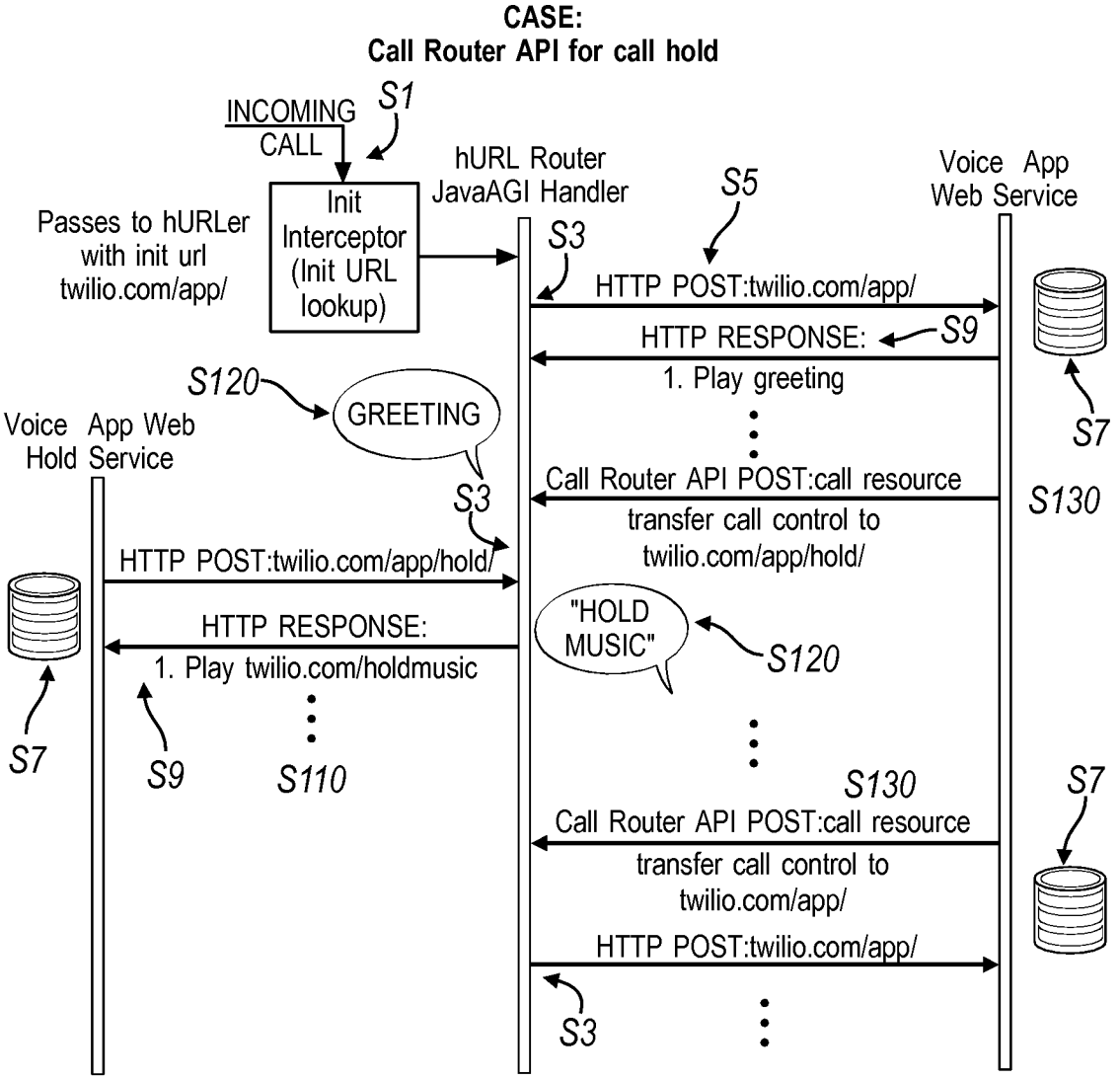
CASE:
Call Router API for call hold
INCOMING CALL
S1
Init Interceptor (Init URL lookup)
Passes to hURLer with init url twilio.com/app/
hURL Router JavaAGI Handler
S3
S5
Voice App Web Service
HTTP POST:twilio.com/app/
HTTP RESPONSE:
S9
1. Play greeting
S7
S120
GREETING
Voice App Web Hold Service
S3
Call Router API POST:call resource
transfer call control to twilio.com/app/hold/
S130
HTTP POST:twilio.com/app/hold/
HTTP RESPONSE:
1. Play twilio.com/holdmusic
"HOLD MUSIC"
S120
S7
S9
S110
S130
Call Router API POST:call resource
transfer call control to twilio.com/app/
HTTP POST:twilio.com/app/
S3

FIG. 15

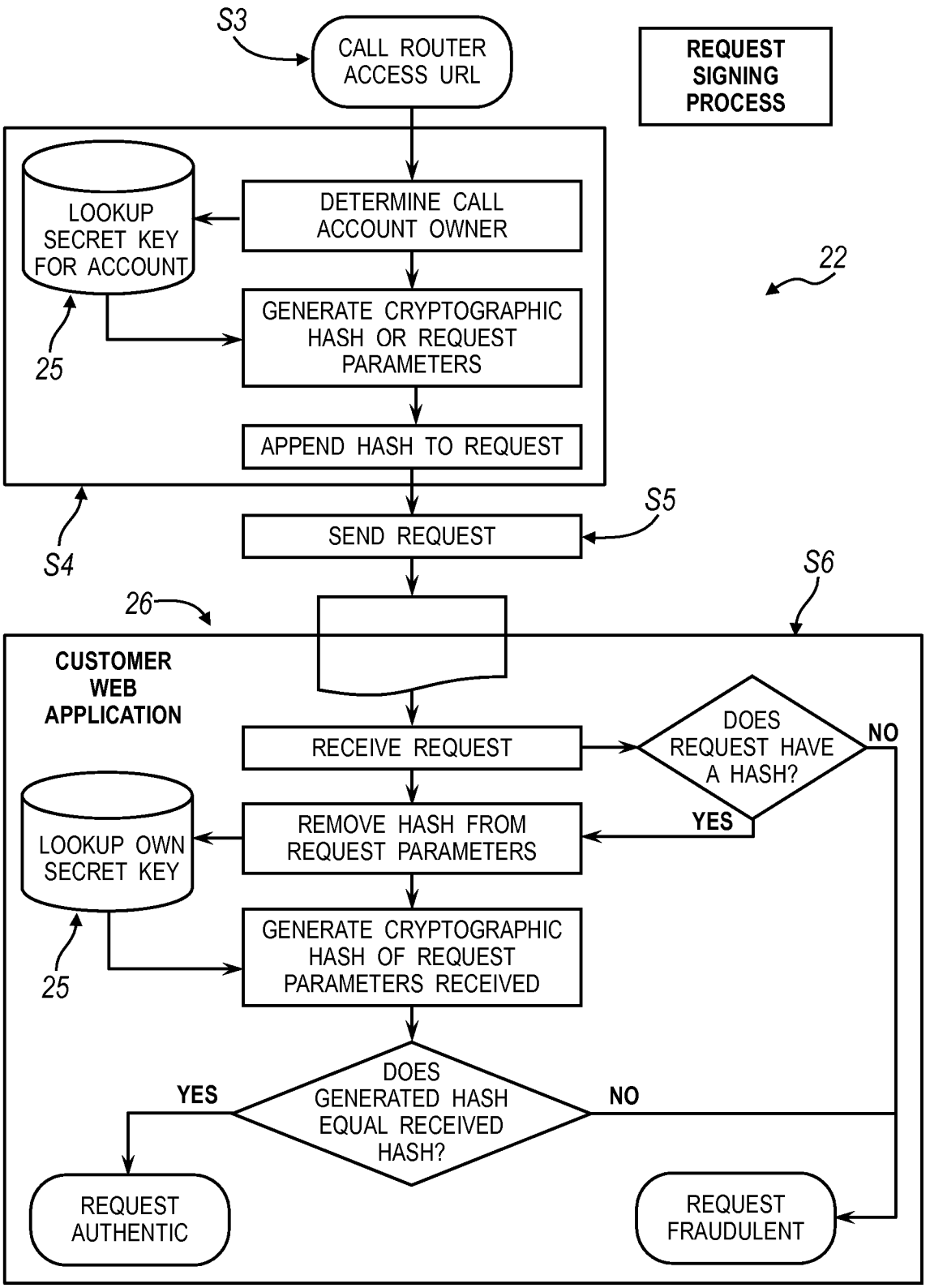
S3
CALL ROUTER ACCESS URL
REQUEST SIGNING PROCESS
LOOKUP SECRET KEY FOR ACCOUNT
DETERMINE CALL ACCOUNT OWNER
22
GENERATE CRYPTOGRAPHIC HASH OR REQUEST PARAMETERS
25
APPEND HASH TO REQUEST
S4
S5
SEND REQUEST
S6
26
CUSTOMER WEB APPLICATION
RECEIVE REQUEST
DOES REQUEST HAVE A HASH?
NO
YES
LOOKUP OWN SECRET KEY
REMOVE HASH FROM REQUEST PARAMETERS
GENERATE CRYPTOGRAPHIC HASH OF REQUEST PARAMETERS RECEIVED
25
DOES GENERATED HASH EQUAL RECEIVED HASH?
YES
NO
REQUEST AUTHENTIC
REQUEST FRAUDULENT

FIG. 16

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS
First Named Inventor/Applicant Name:	Jeffrey G. Lawson
Filer:	Jeffrey Michael Schox/Stephanie Davis
Attorney Docket Number:	TWIL-P01-US4

Filed as Small Entity

Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	98	98
Utility Search Fee	2111	1	310	310
Utility Examination Fee	2311	1	125	125
Request for Prioritized Examination	2817	1	2400	2400
Pages:				
Claims:				
Claims in excess of 20	2202	5	31	155
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Publ. Fee- early, voluntary, or normal	1504	1	300	300
Processing Fee, except for Provis. apps	1808	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3518**

Electronic Acknowledgement Receipt

EFS ID:	14718810
Application Number:	13743078
International Application Number:	
Confirmation Number:	6086
Title of Invention:	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS
First Named Inventor/Applicant Name:	Jeffrey G. Lawson
Customer Number:	49142
Filer:	Jeffrey Michael Schox/Stephanie Davis
Filer Authorized By:	Jeffrey Michael Schox
Attorney Docket Number:	TWIL-P01-US4
Receipt Date:	16-JAN-2013
Filing Date:	
Time Stamp:	17:34:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$3518
RAM confirmation Number	4928
Deposit Account	505858
Authorized User	DAVIS, STEPHANIE

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

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Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	TWIL-P01-US4-ADS.pdf	1433473 9e9c40f7b4f22da2f2fe10984e03be6d5f3dc4b6	no	7
Warnings:					
Information:					
2	TrackOne Request	TWIL-P01-US4-APP-TK1.pdf	183055 5f9bb3f4087926fc62a2d28043cab6586464f60e	no	2
Warnings:					
Information:					
3	Oath or Declaration filed	TWIL-P01-US4-DEC-ASG.pdf	900497 31fe858c8190022f5e25f5991f36747d9883c2b8	no	3
Warnings:					
Information:					
4		TWIL-P01-US4-APP-TXT.pdf	253041 eb8d6b6638ca773c5eda39ee07ed810f2283671d	yes	45

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	39
Claims	40	44
Abstract	45	45

Warnings:					
Information:					
5	Drawings-only black and white line drawings	TWIL-P01-US4-APP-DRW.pdf	903030 0f534b4845f0957963aa457bef3fd61efdc4e32c	no	16
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	41788 1b7e5cc1401258206ddf4e00c0bad50fdde-ce917	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	3714884

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (08-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jeffrey	G.	Lawson	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	San Francisco	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	501 Folsom Street, 3rd Floor		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94105	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	John		Wolthuis	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	San Francisco	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	501 Folsom Street, 3rd Floor		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94105	Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Evan		Cooke	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

PTO/AIA/14 (08-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

City	San Francisco	State/Province	CA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	501 Folsom Street, 3rd Floor		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94105	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	49142		
Email Address	docketing@schox.com	Add Email	Remove Email

Application Information:

Title of the Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS		
Attorney Docket Number	TWIL-P01-US4	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	49142		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13632798	2012-10-01

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13632798	Continuation of	12417630	2009-04-02	8306021	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12417630	non provisional of	61041829	2008-04-02
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12417630	non provisional of	61055417	2008-05-22
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12417630	non provisional of	61100578	2008-09-26
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12417630	non provisional of	61156745	2009-03-02
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12417630	non provisional of	61156751	2009-03-02

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

Remove

Application Number	Country i	Filing Date (YYYY-MM-DD)	Priority Claimed
			◉ Yes ○ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

Name of the Deceased or Legally Incapacitated Inventor :			
If the Applicant is an Organization check here. ☒			
Organization Name	Twilio, Inc.		
Mailing Address Information:			
Address 1	501 Folsom Street, 3rd Floor		
Address 2			
City	San Francisco	**State/Province**	CA
Country [i]	US	Postal Code	94105
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest), as the patent application publication will include the name of the applicant(s).

Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	TWIL-P01-US4
	Application Number	
Title of Invention	SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS	

Mailing Address Information:			
Address 1			
Address 2			
City		State/Province	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications

Signature	/Jeffrey Schox/			Date (YYYY-MM-DD)	2013-01-16
First Name	Jeffrey	Last Name	Schox	Registration Number	42445

Additional Signature may be generated within this form by selecting the Add button. Add

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(51) Int. Cl.: E 04 h, 7/00

BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(52) Deutsche Kl.: 37 f, 7/00

(10) (11) Offenlegungsschrift 1 684 587

(21) Aktenzeichen: P 16 84 587.7 (B 92784)

(22) Anmeldetag: 30. Mai 1967

(43) Offenlegungstag: 18. März 1971

Ausstellungspriorität: —

(30) Unionspriorität

(32) Datum: —

(33) Land: —

(31) Aktenzeichen: —

---

(54) Bezeichnung: Verfahren und Vorrichtung zum Zusammenschließen von Behälterschüssen zu aufrechtstehenden Behältern, insbesondere Getreidesilos, Futtersilos od. dgl.

(61) Zusatz zu: —

(62) Ausscheidung aus: —

(71) Anmelder: Bruchsaler Kessel- und Apparatebau B. Barth KG, 7521 Unteröwisheim

Vertreter: —

(72) Als Erfinder benannt: Barth, Berthold, 7521 Unteröwisheim

---

Benachrichtigung gemäß Art. 7 § 1 Abs. 2 Nr. 1 d. Ges. v. 4. 9. 1967 (BGBl. I S. 960): 26. 9. 1969

DT 1 684 587

Bruchsaler Kessel-und Apparatebau
B. Barth KG.
7521 Unteröwisheim

25.April 1967

1684587

Verfahren und Vorrichtung zum Zusammenschließen von Behälterschüssen zu aufrechtstehenden Behältern, insbesondere Getreidesilos, Futtersilos od.dgl.

Die Erfindung bezieht sich auf ein Verfahren und auf eine dazugehörige Vorrichtung zum Zusammenschließen von Behälterschüssen zu aufrechtstehenden Behältern, insbesondere zu Getreidesilos, Futtersilos od.dgl.

Derartige Hochbehälter erreichen mitunter eine beträchtliche Höhe. Die vorwiegend gleich langen Behälterschüsse solcher Behälter können daher nicht bereits schon in der Werkstatt z.B. durch Verschrauben, Verschweißen, Vernieten od. dgl. zum gebrauchsfertigen Hochbehälter zusammengeschlossen werden, weil der Transport solcher Hochbehälter zu ihrem vorgesehenen Aufstellort infolge der großen Länge mitunter unmöglich oder zumindest schwierig und als sperriges Transportgut bei einem verhältnismäßig kleinen Gewicht auch erheblich teuer sein würde. Die Behälterschüsse werden daher lediglich in der Werkstatt als Halbzylinder vorgebogen. Diese werden am Aufstellort entlang ihren Längsnähten vorwiegend durch Schweißen miteinander verbunden. Die auf diese Weise fertiggestellten Behälterschüsse werden mit Hilfe eines Gerüstes zusammengebaut. Zum Zusammenschließen werden die einzelnen Behälterschüsse von unten nach oben übereinandergesetzt und durch Verschrauben, Verschweißen,

Vernieten od.dgl. miteinander verbunden. Das zum Zusammenbau notwendige Gerüst hat eine Höhe, die praktisch der Höhe des gebrauchsfertigen Hochbehälters entspricht. Es erfordert daher einen großen Konstruktionsaufwand und eine nicht unbeachtliche Zeit für den eigenen Zusammenbau. Außerdem ist das Hochziehen und Aufsetzen der Behälterschüsse sehr umständlich da es zahlreiche Arbeitskräfte notwendig macht, so daß der bisherige Zusammenbau von Hochbehältern z.B. Getreidesilos, Futtersilos od.dgl. infolge seines großen Konstruktionsaufwandes und erheblichen Zeitbedarfes hohe Kosten verursacht.

Es besteht daher die Aufgabe der Erfindung darin, ein Verfahren und eine zur Durchführung des Verfahrens geeignete Vorrichtung zu schaffen, die bei erheblich kleinem Konstruktionsaufwand und kleiner Zeitdauer zum eigenen Zusammenbau mit wenigen Arbeitskräften ein bequemes Zusammenschließen der einzelnen Behälterschüsse zum gebrauchsfertigen aufrechtstehenden Hochbehälter ermöglicht.

Erfindungsgemäß geschieht dieses dadurch, daß die aufrechtgestellten, am Aufstellort zusammengeschweißten Behälterschüsse jedes Behälters in der Reihenfolge von oben nach unten bzw. vom Kopfteil zum Fußteil miteinander zusammengeschlossen werden, wozu zuerst der obere Schuß bzw. der Kopfteil an dem vorgesehenem Standort zusammengeschweißt sowie aufgestellt und um eine Behälterschußlänge hochgezogen sowie alsdann mit dem folgenden, inzwischen darunter

aufgebauten Behälterschuß verbunden wird, welcher darauf in gleicher Weise wie die etwa weiterhin noch folgenden jeweils untersten Behälterschüsse zusammen mit dem vereinigten bzw. darüber aufgesetzten Behälterschuß bzw. den Behälterschüssen wiederum um eine Schußlänge hochgezogen und mit dem jeweils nächstfolgenden, inzwischen darunter fertiggestellten Behälterschuß verbunden werden.

Eine besonders günstige Vorrichtung für die Durchführung dieses Verfahrens zum Zusammenbau eines Hochbehälters ist dadurch gegeben, wenn als Vorrichtung mehrere, mit gegenseitigen Abstand entlang dem äußeren oder inneren Umfang des Behälters verteilte Säulen mit einer die Länge von zwei Behälterschüssen etwas überschreitender Höhe vorgesehen werden, auf denen je ein Tragrohr mittels einer Hubeinrichtung axial verschiebbar gelagert ist, welches etwa die um den Fußteil einer Säule verminderte Länge eines Behälterschusses und am Kopfende ein fest angeordnetes Kupplungsglied zum lösbaren Eingriff in ein am oberen Ende jedes Behälterschusses anbringbares Gegenglied aufweist. Hierbei kann sowohl das feste Kupplungsglied eines Tragrohres als auch jedes zugeordnete abnehmbare Gegenglied am oberen Ende des jeweils unteren, auf einer Grundplatte des Behälters aufstehenden Behälterschusses von je eines Aufhängeöse gebildet werden, die zur gegenseitigen Kupplung miteinander verschraubbar sind. Jedes abnehmbare Gegenglied eines Behälterschusses ist mit einem auf dessen innerer Mantelfläche aufgeklemmten Spannring, z.B. mittels Schrauben, ge-

gebenenfalls durch den Mantel des Behälterschusses hindurch lösbar verbunden. Außer dem die Gegenglieder aufweisenden oberen Spannring des zunächst unteren Behälterschusses ist noch ein zweiter, mit dem Fußende dieses Behälterschusses verklemmbarer Spannring vorgesehen, der auf der Unterseite Zentriernocken mit wenigstens einer in der verlängerten Außenmantelfläche des Spannringes liegenden Stelle aufweist. Jeder Spannring wird von einem kreisringförmig gebogenen, im Querschnitt U-förmigen Profileisen gebildet, dessen glatte flanschfreie Stegfläche nach außen gerichtet ist und etwa einen der Innenmantelfläche der jeweiligen Behälterschüsse entsprechenden Durchmesser aufweist, wobei das Profileisen radial in zwei gleich große, an den Stoßstellen durch Spannschrauben miteinander verbundenen Halbringe unterteilt ist.

Ein nach diesem Verfahren mittels der zugeordneten Vorrichtung durchzuführenden Zusammenbau eines Hochbehälters erfordert praktisch keine Einrüstzeiten. Nach dem Aufbringen der Grundplatte für den Hochbehälter auf das bereits vorbereitete Fundament werden beispielsweise vier Säulen in gleichen gegenseitigen Abständen aufgestellt und die Bodenplatten dieser Säulen mit der Grundplatte z.B. durch Schweißheftung vorübergehend verbunden. Dieses kann ohne einen ins Gewicht fallenden Zeitaufwand mit wenigen Arbeitskräften geschehen. Alsdann kann ohne weitere Verzögerung und ohne besondere Vorsichtnahme mit dem Zusammenschließen der Behälterschüsse begonnen werden. Diese werden in üblicher Weise als

Halbzylinder an den Standort des Hochbehälters angeliefert und nach dem Aufstellen auf der Grundplatte zunächst an den Längsnähten z.B. durch Schweißen miteinander verbunden bevor das Zusammenschließen des alsdann um etwa eine Behälterschußlänge hochgezogenen Behälterschusses mit dem von oben nach unten nächstfolgenden und in gleicher Weise gebildeten Behälterschuß erfolgt. Das Zusammenschließen z.B. durch Zusammenschweißen wird für alle Behälterschüsse immer nur in Abstand einer Behälterschußhöhe bzw. Behälterschußlänge von der Grundplatte und damit in Bodennähe durchgeführt, so daß keine besonderen Sicherungsmaßnahmen gegen Abstürzen, Herunterfallen von Gegenständen z.B. Werkzeugen u.dgl. beachtet werden müssen. Außerdem wird durch die Einsparung von Einrüstzeiten und Gerüstaufwand sowie von Arbeitskräften die Herstellung eines Hochbehälters erheblich verbilligt.

Auf der Zeichnung ist ein Ausführungsbeispiel des Erfindungsgegenstandes dargestellt, das zugleich weitere Merkmale der Erfindung erkennen läßt. Es zeigen:

Fig. 1 eine Ansicht einer Vorrichtung zum Zusammenschließen der im Längsschnitt dargestellten Behälterschüsse eines Hochbehälters, links bei eingebrachten oberen Behälterschuß und rechts bei eingebrachten dritten Behälterschuß von oben,

Fig. 2 die Draufsicht auf die Vorrichtung nach Fig. 1 mit einer nach der Linie II-II im Querschnitt dargestellten Säule.

Jeder Hochbehälter, z.B. Getreidesilo, Futtersilo od.dgl. wird von einer Anzahl Behälterschüssen 1, 2, 3 usw. gebildet, die in der Werkstatt z.B. halbzylinderförmig vorgebogen und erst am Aufstellort entlang ihren Längsnähten bzw. Längskanten miteinander z.B. durch Schweißen, verbunden werden. Das Fertigstellen eines Behälterschusses erfolgt hierbei auf einer Grundplatte 4, die zuvor auf einem vorbereiteten Fundament 5 befestigt worden ist und zugleich als Grundplatte bzw. Boden für den fertigen Hochbehälter dient. Vorwiegend hat die als Boden für den Hochbehälter dienende Grundplatte 4 eine dem Hochbehälter in der Draufsicht entsprechende Umrißform, wobei ihr Außenrand gegebenenfalls unter dem Hochbehälter etwas herausragen kann.

Entlang dem Umfang des zusammenzubauenden Hochbehälters bzw. der Grundplatte 4 werden in etwa gleichen gegenseitigen Abständen z.B. vier Säulen 6 aufgestellt. Jede Säule 6 ist mit einem Ende auf einer Bodenplatte 7 befestigt und zusätzlich auf dieser mittels flügelartiger und etwa radial angeordneter Stege 8 verankert bzw. verschweißt. Um stets einen sicheren und gleichbleibenden Abstand der Säulen 6 zu dem entstehenden Hochbehälter zu gewährleisten, werden die Bodenplatten 7 z.B. durch Heftschweißung, stumpf mit dem Boden des Hochbehälters bzw. mit dessen Grundplatte 4 verbunden.

Die Höhe einer Säule 6 ist etwas größer, z.B. höchstens zweiundeinhalb mal so groß als es der Länge zweier aufein-

ander gestellter Behälterschüsse 1 und 2 bzw. 2 und 3 usw. entspricht. Vorwiegend wird jede Säule von einem Rohr 9 gebildet, auf welchem ein Tragrohr 1o axial verschiebbar gelagert ist. Das auf den Stegen 8 des Säulenfußes aufstehende Tragrohr 1o schließt in der Höhe etwa mit der Höhe eines daneben auf der Grundplatte 4 aufstehenden Behälterschusses 1 bzw.2 bzw.3 usw. ab. Damit das Tragrohr 1o auf dem zugeordneten Säulenrohr 9 mit einem nicht zu großen Spiel gleitet, ist im Bereich des Kopf-und Fußendes innerhalb des Tragrohres je ein Gleitring 11 eingelassen. Außerdem ist im Bereich des Kopfendes und zwar auf der Außenfläche ein etwa radial zur Behälterachse gerichtetes Kupplungsglied 12 , z.B. eine hochkant stehende Lasche starr befestigt, die ein Durchgangsloch aufweist und als Aufhängeöse dienen kann. Im Bereich des Fußendes jedes Tragrohres 1o ist auf dessen Außenfläche eine ebenfalls hochkant stehende und etwa radial zur Behälterlängsachse gerichtete Stützlasche 13 als Führung für einen angekuppelten Behälterschuß befestigt, die mit dem Kupplungsglied 12 etwa fluchtet und eine etwa dem Abstand zwischen dem Tragrohr und dem benachbarten Behälterschuß entsprechende Breite aufweist.

Eine gleich ausgebildete und angeordnete Stützlasche 14 ist zur weiteren Führung im Bereich des Kopfendes jeder Säule 6 befestigt. In vorteilhafter Weise wird diese Stützlasche jedoch etwas kürzer gehalten und am freien Ende mit einer auf dem Außenmantel des Hochbehälters abrollenden Stützrolle 15 versehen. Hierzu wird die Stützrolle jeder Säule 6 zwischen zwei die Stützlasche 14 bildende Konsole 16 gelagert. Die

Mantelfläche jeder Stützrolle kann der Wölbung der Außenmantelfläche 17 des Hochbehälters angepaßt sein.

Auf dem oberen Stirnende jeder Säule 6 ist in einem Lagerbock 18 eine Umlenkrolle 19 gelagert; deren Stirnflächen parallel zu den Flachseiten der Stützlasche 13 und der Konsole 16 verlaufen. Der Durchmesser dieser Umlenkrolle 19 ist größer als der Außendurchmesser des Tragrohres 1o, so daß ein über die Umlenkrolle geführter Seilzug 2o, Kettenzug od.dgl. bei einem zur Längsmittelachse der Säule 6 parallelen Verlauf hemmungsfrei am jeweilszugeordneten Tragrohr 1o vorbeilaufen kann. Das eine Ende dieses Seilzuges 2o ist mittels eines Verbindungsgliedes 21 am Kopfende des Tragrohres und das andere Ende an der Trommel 22 einer als Hubeinrichtung 23 vorgesehenen Seilwinde befestigt. Als Hubeinrichtung 23 kann auch ein Flaschenzug, Schneckenwinde od.dgl. vorgesehen werden. Die Hubeinrichtung ist auf der Bodenplatte 7 bzw. am Säulenfuß befestigt. Beim Drehen an der Handkurbel 24 der Seilwinde in entsprechender Richtung wird der Seilzug 2o auf die selbst sperrend ausgebildete Trommel 22 aufgewickelt und das zugeordnete Tragrohr 1o bis zu einem unterhalb der Stützlasche 14 angeordneten Anschlag 25 hochgezogen. Die Hubhöhe des Tragrohres ist hierbei etwas größer als die Länge eines Behälterschusses 1 bzw. 2 bzw. 3 usw.

Des weiteren ist für das am Kopfende eines Tragrohres 1o fest angebrachte Kupplungsglied 12 am entsprechenden oberen Ende jedes Behälterschusses ein wieder lösbares Gegenglied

26 vorgesehen, die beide miteinander in einem lösbaren Eingriff gebracht werden können. Jedes Gegenglied 26 besteht hierbei im wesentlichen ebenso wie das Kupplungsglied 12 aus einer hochkant stehenden mit einem Durchgangsloch versehenen Lasche, die als Aufhängeöse dient, jedoch einen abgewinkelten gegebenenfalls an die Wölbung der Behälterschüsse angepaßten Schenkel 27 aufweist. Dieser Schenkel 27 hat ebenfalls ein Durchgangsloch, um das Gegenglied 26, z.B. mittels einer Schraube 28, durch den Mantel des jeweils auf dem Behälterboden 4 aufstehenden Behälterschusses hindurch mit einem Spannring 29 verschrauben zu können. Alsdann werden die beiden gleich angeordneten Durchgangslöcher vom Kupplungsglied 12 und Gegenglied 26 miteinander zum Fluchten gebracht und mittels einer durch eine Schraubmutter gesicherten Durchgangsschraube 3o miteinander verbunden. Auf diese Weise wird der jeweils auf dem Behälterboden 4 aufstehende Behälterschuß mit dem Tragrohr 1o der vier Säulen 6 lösbar gekuppelt und kann bis zum Anschlag 25 hochgezogen werden.

Der die Gegenglieder 26 lösbar aufnehmende Spannring 3o wird von einem kreisförmig gebogenen, im Querschnitt vorwiegend U-förmigen Profileisen gebildet, dessen glatte flanschfreie Stegfläche nach außen gerichtet ist. Sie hat einen etwa der Innenmantelfläche der Behälterschüsse entsprechenden Durchmesser, so daß der Spannring praktisch spielfrei am oberen inneren Rand des jeweiligen Schusses anliegt und diesen beim Zusammenbau zugleich versteift sowie in der Kreisform hält. Um den Spannring 3o mit dem oberen Rand des Behälter-

schusses fest verklammen zu können, ist das kreisringförmig gebogene Profileisen radial in zwei Halbringe 31 und 32 unterteilt, welche an den beiden entsprechend verstärkten Stoßstellen 33 durch Spannschrauben 34 wieder miteinander verbunden und dadurch mit dem Behälterschuß unverrückbar verklemmt werden können. Nach Lösen der Gegenglieder 26 und der Spannschrauben 34 kann der Spannring vom betreffenden Behälterschuß wieder abgenommen werden.

Der jeweils auf der Grundplatte 4 bzw. dem Behälterboden aufstehende Behälterschuß 1 bzw. 2 bzw. 3 u.s.w. wird außerdem noch im Bereich seines Fußendes mit einem Spannring 35 verklemmt, der im wesentlichen den gleichen Aufbau wie der obere Spannring 29 aufweist. Auf der Unterseite des unteren Spannringes 35 sind jedoch über den Umfang verteilt Zentriernocken 36 befestigt. Die radial nach außen gerichtete Schmalfläche jedes Zentriernockens 36 ist profiliert und zwar derart, daß im Abstand von der Unterseite des Spannringes nur eine einzige kurze Zentrierstelle 37 vorhanden ist, die in der verlängerten ideellen Außenmantelfläche 38 dieses Spannringes 35 liegt. Zwischen der Unterseite des Spannringes 35 und der Zentrierstelle 37 ist eine nach außen offene Aussparung 39 vorgesehen. Diese ist so groß, daß das Zusammenschweißen der Stoßstelle 4o zweier aufeinander gesetzter Behälterschüsse z.B. 1 und 2 in keiner Weise behindert ist. Von der Zentrierstelle 37 bis zum freien Stirnende ist die nach außen gerichtete Schmalfläche jedes Zentriernockens 36 in Richtung zur Längsmittelachse des zugeordneten Behälterschusses abgeschrägt bzw. nach innen zu stetig verjüngt.

Bei jedem auf dem Behälterboden bzw, auf der Grundplatte 4 aufgestellten Behälterschuß wird der untere Spannring 35 vorübergehend nur leicht am inneren Fußrand dieses Behälterschusses festgeklemmt, wobei die freie Stirnseite der Zentriernocken auf der Grundplatte aufstehen. In dieser Lage hat der untere Spannring 35 nur die Aufgabe zu erfüllen, z.B. die kreisrunde Form des Behälterschusses im Bereich des Fußrandes zu gewährleisten, vgl. hierzu die linke Seite der Fig.1. Ist jedoch dieser Behälterschuß um etwas mehr als eine Behälterschußlänge mittels den Hubeinrichtungen 23 hochgezogen worden, so wird der untere Spannring 35 nach dem Lösen der Spannschrauben 34 so weit nach unten gezogen, bis die Fußkante dieses Behälterschusses in Höhe der Mitten sämtlicher Aussparungen 39 verläuft. In dieser Stellung wird der untere Spannring wieder festgeklemmt. Nachdem der von oben nach unten nächstfolgende Behälterschuß z.B. 3 auf der Grundplatte 4 inzwischen zusammengeschweißt und in Stellung gebracht wurde, werden die bereits miteinander verbundenen Behälterschüsse z.B. 1 und 2 mittels der Hubeinrichtungen an den Säulen 6 wieder herabgelassen, wobei die dabei vorlaufenden Zentriernocken 36 den auf der Grundplatte 4 aufstehenden Behälterschuß 3 genau ausrichten, so daß die Fußkante des oberen Behälterschusses 2 genau auf der Kopfkante des aufstehenden Behälterschusses 3 zu liegen kommt, vgl. hierzu die rechte Seite der Fig.1. In dieser Lage wird der Behälterschuß 3 bequem an den Behälterschuß 2 angeschweißt, wobei infolge der in den Zentriernocken 36 vorgesehene Aussparung 39 die Stoßstelle 4o vollständig freiliegt und bequem auch im Be-

reich der Zentriernocken verschweißt werden kann. Alsdann wird zuerst der untere Spannring 35 aus dem Behälterschuß 2 in den Fußrand des Behälterschusses 3 verlegt und darauf nach dem Lösen und Entfernen der Gegenglieder 26 auch der obere Spannring 29 am inneren Kopfrand des unteren Behälterschusses 3 verklemmt so daß wieder die in der linken Seite der Fig.1 dargestellte Lage der Spannringe entsteht. Nachdem in dieser Lage der obere Spannring 29 festgeklemmt ist und die Gegenglieder 26 unter Durchbohren des Behälterschußmantels befestigt worden sind, werden dann die zusammengeschlossenen Behälterschüsse 1 bis 3 wiederum um etwas mehr als die Behälterschußlänge hochgezogen, worauf in der bereits erläuterten Weise ein weiterer Behälterschuß angeschweißt wird. Die für das Anbringen der Gegenglieder notwendigen Löcher in den Behälterschüssen werden nach der Verlegung der Spannringe wieder zugeschweißt.

Bei sehr hohen Behältern größeren Durchmessers wird die z.B. aus vier Säulen bestehende und im vorstehenden erläuterte Vorrichtung nicht am äußeren sondern entlang dem inneren Umfang des Behälters in gleichmäßigen Abständen verteilt. Dabei werden die Tragrohre der Säulen starr miteinander verbunden. Eine solche Anordnung hat den Vorteil, daß die Vorrichtung ein starres Ganzes bildet, so daß die bereits zusammengeschlossenen Behälterschüsse beim Hochziehen eine stabilere Lage einnehmen.

Das Hochziehen der bereits zusammengeschlossenen Behälterschüsse mittels Flaschenzügen,Schneckenwinden od.dgl. erfordert nur einen verhältnismäßig geringen Kraftaufwand, da derartige Hubeinrichtungen hoch übersetzt sind.Trotzdem kann das Hochziehen noch weiterhin dadurch erleichtert werden, daß anstelle von manuell bedienbaren Flaschenzügen,Schneckenwinden od.dgl. elektromotorisch angetriebene Hubeinrichtungen zur Anwendung kommen.Dadurch wird der Zusammenbau noch wesentlich vereinfacht und insbesändere beschleunigt.Die Verwendung elektromotorisch angetriebener Hubeinrichtungen ist ohne weiteres möglich,da praktisch auf allen Baustellen insbesondere für Hochbehälter bzw.Silos bereits der elektrische Strom vorhanden ist.derartige elektromotorische angetriebene Hubeinrichtungen haben aber noch den weiteren Vorteil,daß das Hochziehen der bereits zusammengeschweißten Behälterschüssen sehr gleichmäßig erfolgt,so daß beim Hochziehen von Hochbehältern großer Höhe von vornherein jedes Schwanken vermieden wird,zumal wenn zusätzlich noch die Tragrohre der vier Säulen starr miteinander verbunden werden.

Patentansprüche.

(1) Verfahren zum Zusammenschließen von Behälterschüssen zu aufrechtstehenden Behältern, insbesondere Getreidesilos, Futtersilos od.dgl., dadurch gekennzeichnet, daß die aufrechtstehenden am Aufstellort zusammengeschweißten Behälterschüsse (1 bzw.2 bzw.3 usw.) jedes Behälters in der Reihenfolge von oben nach unten bzw. vom Kopfteil zum Fußteil miteinander zusammengeschlossen werden, wozu zuerst der obere Behälterschuß (1) bzw. der Kopfteil an den Aufstellort verbracht sowie zusammengeschweißt und um eine Behälterschußlänge hochgezogen sowie alsdann mit dem folgenden, inzwischen darunter aufgebauten Behälterschuß (2) verbunden wird, welcher darauf in gleicher Weise wie die etwa weiterhin noch folgenden Behälterschüsse zusammen mit dem vereinigten bzw. darüber befindlichen Behälterschuß bzw. den Behälterschüssen wiederum um eine Behälterschußlänge hochgezogen und mit dem jeweils nächstfolgenden, inzwischen darunter fertiggestellten Behälterschuß verbunden wird.

2. Vorrichtung zum Durchführen des Verfahrens nach Anspruch 1, dadurch gekennzeichnet, daß als Vorrichtung mehrere, mit gegenseitigem Abstand entlang dem äußeren oder inneren Umfang des Behälters verteilte Säulen (6) mit einer die Länge von zwei Behälterschüssen (z.B.1 und 2) etwas überschreitender Höhe vorgesehen sind, auf denen je ein Tragrohr (10) mittels einer Hubeinrichtung (23) axial verschiebbar gela-

gert ist, welches etwa die um den Fußteil (7, 8) einer Säule verminderte Länge eines Behälterschusses (1 bzw.2 bzw.3 usw.) und am Kopfende ein fest angeordnetes Kupplungsglied (12) zum lösbaren Eingriff in ein am oberen Ende jedes Behälterschusses anbringbares Gegenglied (26) aufweist.

3. Vorrichtung nach Anspruch 2 dadurch gekennzeichnet, daß sowohl das feste.Kupplungsglied (12) eines Tragrohres (1o) als auch jedes zugeordnete abnehmbare Gegenglied (26) am oberen Ende des jeweils unteren auf einer Grundplatte (4) des Behälters aufstehenden Behälterschusses (1) von je einer Aufhängeöse gebildet ist, die beide zur gegenseitigen Kupplung z.B. mittels einer Durchgangsschraube (3o) miteinander verschraubbar sind.

4. Vorrichtung nach den Ansprüchen 2 und 3, dadurch gekennzeichnet, daß jedes abnehmbare Gegenglied (26) eines Behälterschusses (1 und 2) mit einem auf dessen innerer Mantelfläche aufgeklemmten Spannring (29) z.B. mittels einer Schraube (28) gegebenenfalls durch den Mantel hindurch verbunden ist.

5. Vorrichtung nach den Ansprüchen 2 bis 4, dadurch gekennzeichnet, daß außer dem die Gegenglieder (26) aufweisenden oberen Spannring (3o) des zunächst unteren Behälterschusses (1) noch ein zweiter mit dem Fußende dieses Schusses verklemmbaren Spannring (35) vorgesehen ist, der auf der Unterseite Zentriernocken (36) mit wenigstens einer in der verlängerten

Außenmantelfläche (38) des Spannringes liegenden Zentrierstelle (37) aufweist.

6. Vorrichtung nach den Ansprüchen 2 bis 5, dadurch gekennzeichnet, daß jeder Zentriernocken (36) zwischen der Unterseite des zugeordneten Spannringes und der in dessen verlängerten Außenmantelfläche (38) liegenden Zentrierstelle (37) eine die Stoßstelle (40) zweier übereinander gesetzter Behälterschüsse freilegende Aussparung (39) aufweist.

7. Vorrichtung nach den Ansprüchen 5 und 6, dadurch gekennzeichnet, daß die nach außen gerichtete Schmalseite jedes Zentriernockens (36) von der in der verlängerten Außenmantelfläche (38) des zugeordneten Spannringes (35) liegenden Zentrierstelle (37) bis zum freien Stirnende nach innen zu stetig verjüngt ist.

8. Vorrichtung nach den Ansprüchen 2 bis 7, dadurch gekennzeichnet, daß jeder Spannring (29 bzw. 35) von einem kreisringförmig gebogenen, im Querschnitt U-förmigen Profileisen gebildet ist, dessen glatte flauschfreie Stegfläche nach außen gerichtet ist und etwa einen der Innenmantelfläche der jeweiligen Behälterschüsse entsprechenden Durchmesser aufweist und daß das Profileisen radial in zwei, an den Stoßstellen durch Spannschrauben miteinander verbundenen Halbringe (31 und 32) unterteilt ist.

9. Vorrichtung nach den Ansprüchen 2 bis 8 dadurch gekennzeichnet, daß zum Führen der Behälterschüsse (1 bzw.2 bzw.3 usw.) zwischen den Säulen 6 beim Hochziehen am Fußende jedes Tragrohres (1o) und im Bereich des oberen Endes jeder Säule je eine etwa radial abstehende Stützlasche (13 bzw.14) vorgesehen ist.

1o. Vorrichtung nach den Ansprüchen 2 bis 9, dadurch gekennzeichnet, daß an der Stützlasche (14) jeder Säule (6) eine auf der jeweiligen **Mantelfläche der Behälterschüsse** (1, 2, 3, ..) abrollende Stützrolle (15) gelagert ist.

11. Vorrichtung nach den Ansprüchen 2 bis 1o, dadurch gekennzeichnet, daß als Hubeinrichtung (23) für das Tragrohr (1o) einer Säule (6) eine Seilwinde, Kettenwinde od.dgl. vorgesehen ist, deren Seilzug (2o), Kettenzug od.dgl. über eine am Kopfende der zugeordneten Säule gelagerte Umlenkrolle (19) geführt und mit einem Ende oben am Tragrohr und mit dem anderen Ende an der Trommel (22) der Hubeinrichtung befestigt ist.

12. Vorrichtung nach den Ansprüchen 2 bis 11, dadurch gekennzeichnet, daß jede Säule (6) am Fußende eine Bodenplatte (7) aufweist, die beim Zusammenbau eines Behälters mit dessen Grundplatte (4) verbunden ist.

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Fig.1

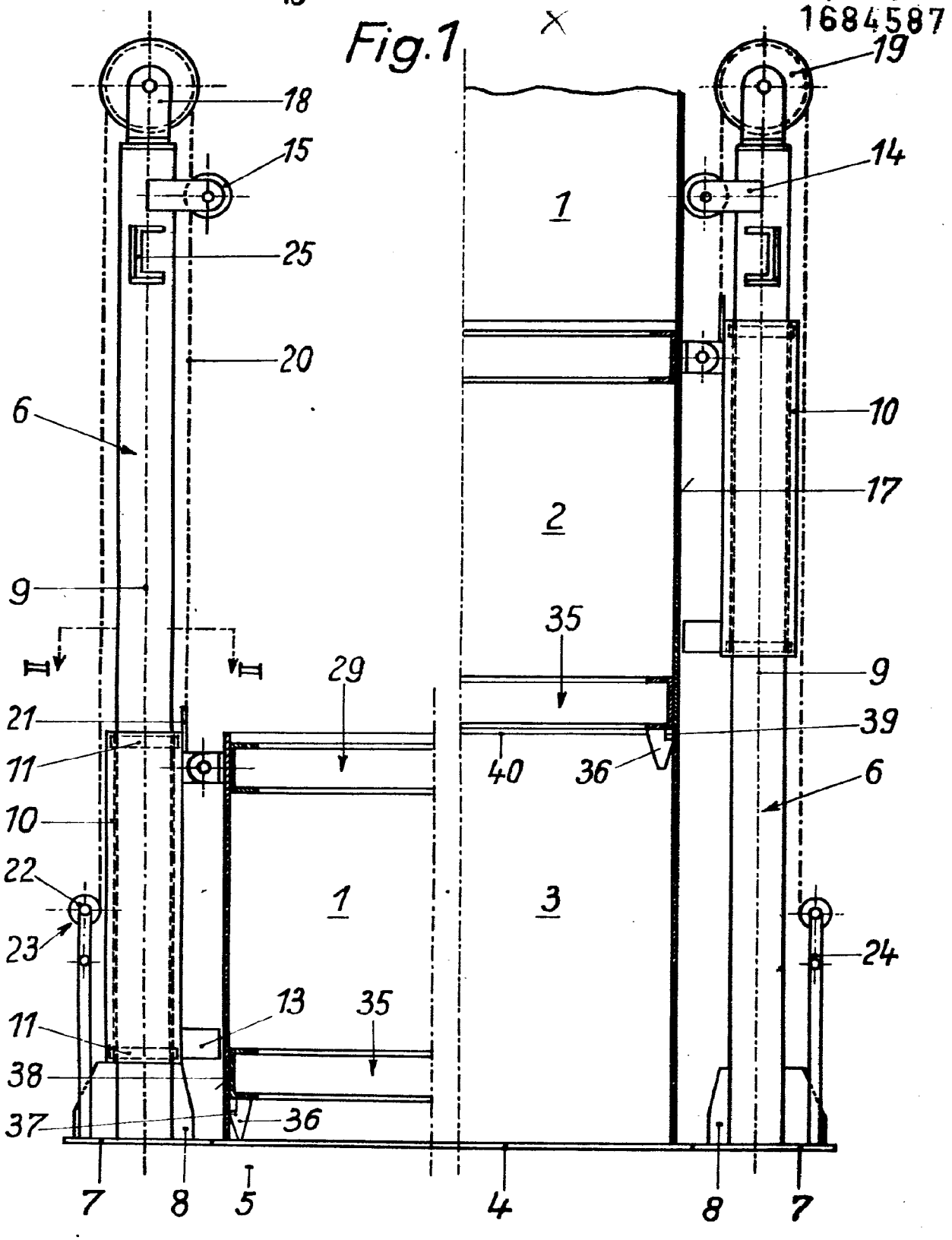

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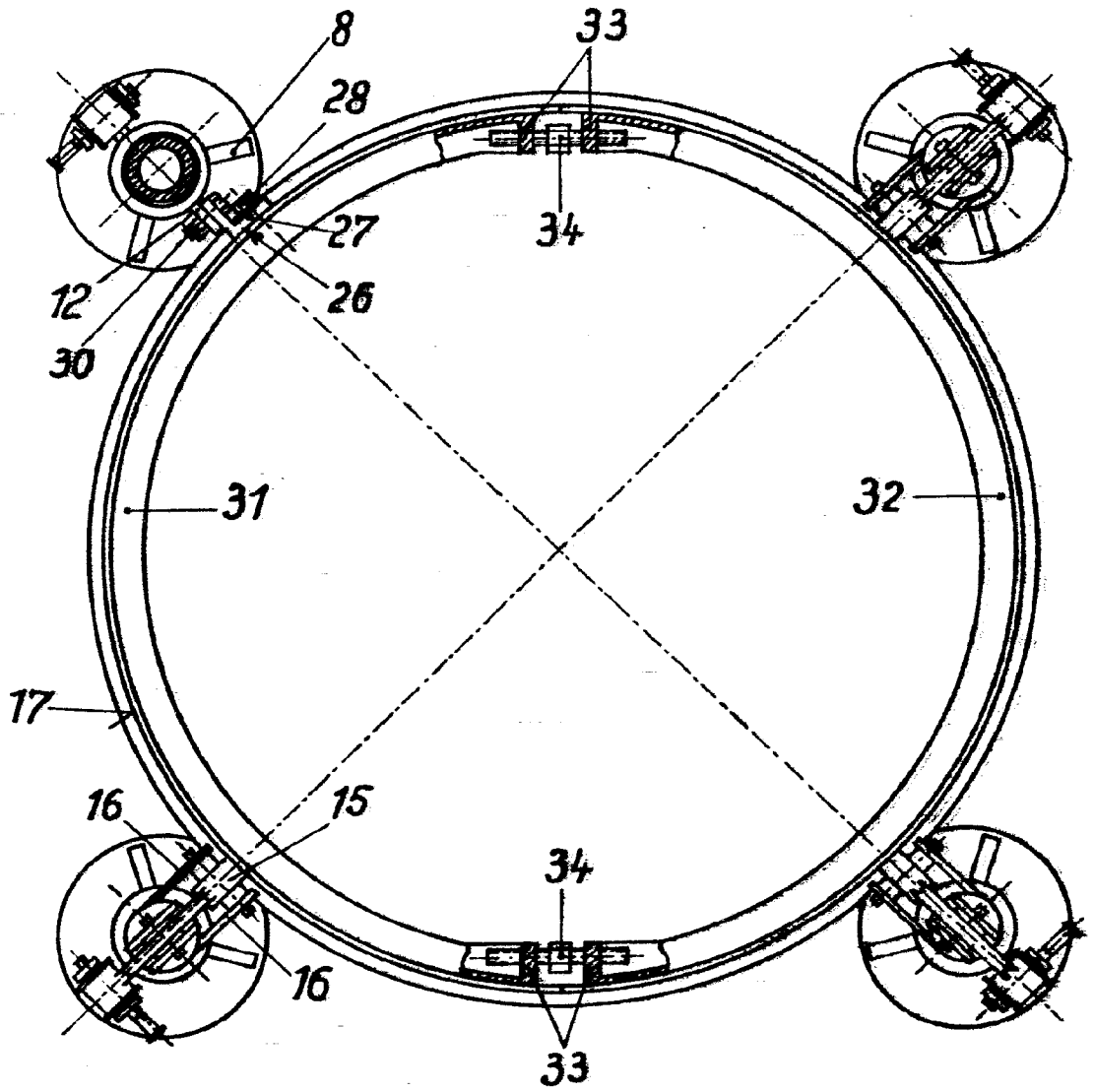
Fig. 2



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(54) Method for constructing a cylindric metal building construction as well as apparatus for carrying out said method.

(57) A method and an apparatus are provided for constructing a cylindric metal building construction, in which the building construction is supported by a number of guidings (5 - 12), such, that always a appropriate support is obtained without the need for additional lifting devices. According to the invention the guidings (5 - 12) are each separately or together movable upwards and downwards.

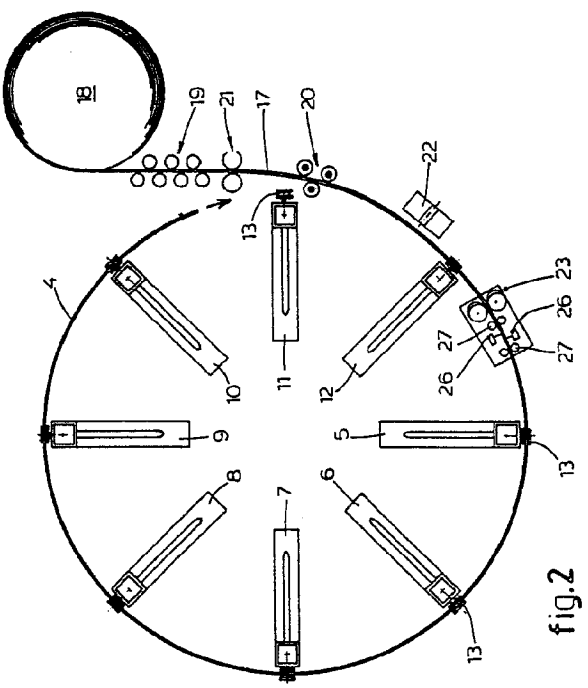

fig.2

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Method for constructing a cylindric metal building construction as well as apparatus for carrying out said method

The invention relates to a method for constructing a cylindric metal building construction by positioning successive rings one on top of the other and interconnecting said rings, said method comprising the steps of:

- in a vertical position supplying the material for constructing the rings, such as metal band or metal plates to be assembled to a metal band, and shaping the material into the desired shape with a shaping device,
- shaping the supplied material into a ring by means of appropriate guidings,
- cutting the metal band or the metal plates assembled to a metal band to a length corresponding to the circumference of the corresponding ring to be shaped,
- connecting the upper edge of the metal band to the lower edge of an already constructed building construction section and interconnecting the beginning and the end of the cut-off metal band section,
- entirely lifting the building construction section constructed like this and supplying further rings underneath until the building construction has reached the desired height, and
- finally placing the building construction onto the ground.

In a known method of this type the supplied metal band is continuously applied to a carrousel comprising a rotating platform of which the rotation velocity corresponds with the supply velocity of the band. When the length of a metal band section is obtained corresponding with the circumference of a ring the metal band is cut loose whereafter winding it onto the carrousel is completed. Next the building construction section that already has been constructed earlier is positioned on top of the ring just constructed and is connected thereto.

This known method has a number of disadvantages. The applied carrousel for winding the supplied metal band for obtaining a ring in principle can be used only for a limited number of diameters of cilindric building constructions to be constructed. If building constructions have to be constructed of which the diameter largely differs from the diameter of the carrousel a completely new carrousel has to be applied. Also the application of thicker materials offers problems in correctly shaping the material. As a further disadvantage of this method it can be mentioned that positioning the already constructed building construction section on top of the upper edge of an already constructed ring calls for a separate lifting device, whereas precise positioning the already constructed building construction section on top of the upper edge of the already constructed ring is very difficult. The reasons for this have to be sought in the low dimensional stability of the already constructed building construction section, the rather high mass thereof and the wind sensibility that can be very important at a building site.

It is an object of the invention to provide a method for constructing a cylindric metal building construction not having the mentioned disadvantages.

Therefore the method according to the invention is characterized in that lifting the building construction already constructed is carried out by synchronously moving the guidings upwards, said guidings comprising supports engaging the lower edge of this building construction section, whereas always that guiding that in the circumferential direction of the building construction section is positioned ahead of the supplied metal band is moved downwards so far shortly before the beginning of the metal band reaches said guiding, that the metal band is moved over said guiding and that the lower edge of the metal band is supported by said guiding.

In constrast with the known method an already constructed building construction section is no longer lifted entirely above a new ring to be constructed, but this already constructed building construction section initially rests totally on the guidings. During the progression of the production of a new ring the support of this already constructed building construction section is progressively taken over by the ring section positioned therebelow, said ring section being supported by the lowered guidings. Like this at each moment a safe and reliable support of the already constructed building construction section is provided wherein too a good positioning of this building construction section relative to the supplied metal band for shaping a new ring is accomplished.

In a preferred embodiment of the method according to the invention after completing the last, lowermost ring and connecting it to the already constructed building construction section, the building construction is lowered by synchronously lowering all guidings and is positioned onto support blocks whereafter the guidings are removed from under the lower edge of the lowermosts ring and wherein the building construction is slightly lifted by means of auxiliary means for removing the support blocks and wherein finally the building construction is lowered onto the ground.

Like this also during the last phase of the construction of the building construction, namely

positioning it onto the ground, no additional hoisting unit or the like is necessary. The guidings that initially are positioned underneath the lower edge of the lowermost ring, can, if the building construction rests on the support blocks, be removed in an easy way, whereafter the building construction is finally positioned onto the ground by means of the auxiliary means.

The invention further relates to an apparatus for carrying out the method according to the invention. This apparatus is characterized in that it comprises a number of lifting units each having a guiding that can be moved upwards and downwards and wherein the lifting units are positioned such that the location of their guidings corresponds with the diameter of the building construction to be constructed. By the presence of a number of lifting units the apparatus according to the invention is very versatile, for the location of the liftings units always can be chosen corresponding with the diameter of the building construction to be constructed. Therefore the same apparatus can be used for constructing building constructions having every desired diameter. Only the number of applied lifting units should vary, wherein by building constructions having a very large diameter a larger number of lifting units should be applied.

In a handy embodiment of the apparatus according to the invention it comprises at least a drive unit for circumferentially moving the already constructed building construction section wherein said drive unit, as seen in the direction of motion, is positioned shortly ahead of the location where the upper edge of the metal band is connected to the lower edge of the already constructed building construction section. Like this a synchronous motion of the building construction section and the metal band is obtained.

Further it is advantageous if the drive unit for circumferentially moving the already constructed building construction section comprises two pairs of drive rolls positioned one on top of the other, wherein the drive rolls of the upper pair of drive rolls engage both sides of the lower edge of the already constructed building construction section whereas the drive rolls of the lower pair of drive rolls engage both sides of the upper edge of the metal band.

If the drive rolls are inclined such, that the rotation axes of drive rolls positioned at one side of the building construction wall diverge into the direction of motion of the building construction, the already constructed building construction section and the metal band are pushed towards each other as can be important for a good positioning of both parts.

Hereafter the invention will be elucidated with reference to the drawing, in which an embodiment of the method and apparatus according to the invention is illustrated.

Fig. 1 shows schematically a side elevational view of an apparatus according to the invention for carrying out the method according to the invention;

Fig. 2 shows the apparatus of fig. 1 in a top plan view at an earlier moment but only showing the latest ring, and

Fig. 3 - 6 show a part of the apparatus during a number of successive steps of the method according to the invention.

The fig. 1 and 2 show an apparatus that can be used for constructing a cylindric metal building construction by positioning successive rings one on top of the other and interconnecting said rings. In fig. 1 it can be seen clearly that already a number of rings 1, 2 and 3 are positioned one on top of the other. Fig. 2 shows the construction of a new ring 4.

If a roof construction has to be positioned on top of the cylindric building construction this roof construction is mounted in a way known perse after the production of a first ring.

As appears from fig. 1 the apparatus comprises a number of lifting units 5 - 12 that are positioned corresponding to the diameter of the building construction to be constructed, or in the present case the diameter of the ring 4 to be constructed. Although in the shown embodiment the number of lifting units amounts eight (see fig. 2), this number of lifting units can be varied dependent on the diameter of the building construction to be constructed. The lifting units 5 - 12 are attached to a foundation constructed earlier, for example of concrete. It is possible too that, if the building construction to be constructed is a tank with a welded bottom, this bottom is firstly constructed whereafter the lifting units are positioned on top thereof. Especially when dealing with heavy and very high constructions it is necessary to support the lifting units for obtaining enough stability, but this is not shown in the fig. 1 and 2. Moreover it is important that the lifting units are leveled.

The lifting units 5 - 12 each comprise a guiding 13 that is connected to a carriage 16 that can be moved upwards and downwards along a guide track 14. This upward and downward motion can be obtained by means of a motor 15 driving a screwed spindle or the like. The upward and downward motion of the guidings 13 too can be obtained by any appropiate means, such as mechanical, electrical or hydraulic or pneumatic solutions.

Further it is possible that the lifting units are activated such, that they all can move upwards and downwards synchronously, and that each lifting unit can be moved downwards independently and advantageously with an increased speed.

During constructing a cylindric metal building

construction a metal band 17 is wound of a coil 18 and is supplied in a vertical position. The metal band 17 firstly is shaped into the desired shape by means of a shaping device for shaping the ring four to be produced. As appears from fig. 2 the shaping device in the present case comprises a stretching unit 19 for stretching the metal band wound of the coil 18 as well as a rolling machine 20 for rolling the metal band to the desired diameter. It is mentioned that by the application of a thicker material it is possible that this does not come from a coil 18 but that it exists of separate metal plates that are interconnected before reaching the rolling machine 20.

During shaping the first ring of a metallic building construction to be constructed all guidings 13 of the lifting units 5 - 12 are in their lowermost position. The end of the metal band 17 that has passed the rolling machine 20 is moved onwards (clockwise as seen in fig. 2) by means of a drive unit 21 and is successively moved over the guidings 13 of the lifting units 5 - 12. For correctly guiding the metal band 17 the guidings each comprise a support wall with flanged edges. It is possible to apply lockings or additional guidings for holding the construction in case of a strong wind or the like.

In another embodiment of the guidings not shown each guiding comprises a number of lower rolls combined with vertical guiding means.

When the metal band 17 is led around the guidings 13 of the liftings units 5 - 12 like this the metal band 17 is, by means of a cutting device 22, cut off to a length that corresponds with the circumference of the ring 4 to be shaped. This cutting device 22 can comprise a cutting torch, a plasma cutting device, a slitting disc, a pair of shears or the like. Finally the beginning and the end of the cut off metal band section are interconnected for producing a complete ring 4.

After the first ring 4 has been formed the guidings 13 of the lifting units 5 - 12 are synchronously moved upwards for which reason the motors 15 are activated. The distance over which the guidings 13 are moved upwards equals the width of the supplied metal band 17. This stroke of the guidings 13 can be preset.

Next via the stretching unit 19, through the drive unit 21 and along the rolling unit 20 the metal band 17 is supplied again. If the forward end of this metal band 17 has reached the vicinity of the lifting unit 12 the guiding 13 of this lifting unit 12 is moved downwards, for example with an increased speed, such that the metal band 17 can pass above said guiding. As a result the upper edge of this metal band 17 contacts the lower edge of the already constructed building construction section, as appears clearly from fig. 1, in which the upper edge of the metal band 17 contacts the lower edge of ring 3. Next the mentioned upper edge can be attached to the mentioned lower edge, whereafter the already constructed building construction section is rotated synchronously with the supplied metal band 17. During said rotation always that guiding 13 that in the circumferential direction of the building construction section is positioned ahead of the supplied metal band 17 is moved downwards so far, shortly before the beginning of the metal band 17 reaches said guiding 13, that the metal band 17 is moved over said guiding 13 and that the lower edge of the metal band 17 is supported by said guiding 13. In fig. 1 the situation is represented in which the guiding 13 of the lifting unit 5 is shortly before moving downwards towards the position of said guiding represented in dotted lines.

Like this the already constructed building construction section is always appropiately supported. After reaching the desired length of the metal band 17 this is cut off again by means of the cutting device 22, whereafter the ends are interconnected and whereafter the previously described steps are repeated until the desired hight of the building construction has been achieved.

For moving the metal band 17 and the already constructed building construction section a further drive unit 23 is applied. This drive unit 23 is, as seen in the direction of motion, positioned shortly ahead of the location where the upper edge of the metal band 17 is attached to the lower edge of the already constructed building construction section. As indicated in fig. 1 the drive unit 23 comprises two pairs of drive rolls 24, 25 positioned one on top of the other. The drive rolls 24 of the upper pair of drive rolls engage both sides of the lower edge of the already constructed building construction section, whereas the drive rolls 25 of the lower pair of drive rolls engage both sides of the upper edge of the metal band 17. Further the drive rolls 24, 25 are inclined such that the rotation axes of the drive rolls positioned at one side of the building construction wall diverge into the direction of motion of the building construction. Consequently the driving force comprises a component forcing the metal band 17 and the already constructed building construction section towards each other.

It is emphasized that it is not necessary to incline the drive rolls 24, 25 as indicated in the figures. Other solutions can be presented for correctly positioning and holding together the metal band 17 and the already constructed building construction section.

In constructing a metal building construction the gauge of the applied material often increases downwards from ring to ring. Therefore it is advantageous if of each pair of drive rolls 24, 25 at

least one roll is settable spring-loaded, so that an automatic setting is possible in reaction to several material gauges. For automatically welding different materials having different gauges a variable circumferential velocity of the building construction is obliged. The driving units 21 and 23 as well as the rolling device applied in this embodiment therefore have to be tuned with respect to their drive velocities.

Further in fig. 2 an automatic welding device 26 is illustrated schematically, said welding device interconnecting the upper edge of the supplied metal band and the lower edge of the already constructed building construction section. Of course every other connecting method can be applied, for example the application of bolts or rivets. However, if materials such as steel, stainless steel, aluminum and the like are used, welding constitutes a very simple but however safe connecting method.

At both sides of the welding device 26 guiding rolls 27 are shown for guiding and leading the metal band 17 as well as the already constructed building construction section at the welding device 26. These guiding rolls too can be settable for an adjustment to several material gauges.

If a thin material is used, it is possible that the welding device comprises a device for single sided welding, in which at the side of the building construction wall facing away from the welding device a cooling unit is applied for cooling this side. This cooling unit can be pushed resiliently against the welding seam for obtaining a smooth wall. Further than a change of the structure of the material and a possible reduction of the resistence against corrosion can be avoided as much as possible. Too the mechanical characteristics of the material, such as the tensile strength and the tensile limit are maintained better.

By a number of materials to be used such a cooling unit is desirable if a double sided welding is applied. These cooling units are not shown in fig. 1 or 2.

Further it is possible that ahead of the welding device 26 an apparatus (not shown) is positioned for treating the edges to be welded, whereas behind the welding device 26 an apparatus for treating the welding seams can be applied.

Instead of the shown automatic welding device 26 it is possible however that the welding process is carried out manually.

As appears clearly from fig. 2 the rolling machine 20 is positioned outside of the circumference of a constructed ring 4. As a result the separate rolling rolls of this rolling machine can be interconnected at their upper and lower sides in a way not shown in detail. As a result this rolling machine 20 too can roll very thick metal band 17 without moving apart the separate rolling rolls of this rolling machine 20.

If a ring is completed it can be rotated along the guidings 13 before lifting the constructed building construction section. By a profile apparatus not shown reinforcement ridges can be pressed into the metal band thus offering the complete building construction a greater stiffness.

After obtaining a building construction section with the desired height, thus a building construction section having enough rings positioned one on top of the other, this building construction has to be placed onto the ground. This can be achieved as represented schematically in the fig. 3 - 6.

Fig. 3 shows that it is not directly possible to place the lower ring 4 onto the ground by means of the guidings 13. Therefore, after the entire complete building construction is sligthly lifted, between the guidings 13 support blocks 28 are positioned (fig. 4), said support blocks 28 having such a height that the guidings 13, after lowering the complete building construction onto the support blocks 28, disengage the lower edge of the lower ring 4 if this lower egde rests on the support blocks 28. Next the guidings 13 are disassembled from the lifting units 5 - 12 and are removed from underneath the lower edge of the lower ring 4.

Fig. 5 shows the next phase, in which the guidings 13 are removed by auxiliary means 29, for example an angle plate with a locking lip. These auxiliary means 29 engage the lower edge of the ring 4 and lift the entire building construction by a synchronous activation of all lifting units 5 - 12. The support blocks 28 are removed, whereafter the auxiliary means 29 are synchronously lowered until one or a number of said auxiliarly means nearly contacts the highest point of the ground, that mostly comprises concrete. After this, divided along the circumference, a number of filling plates are positioned underneath the building construction for filling up the space between the ground and the lower side of the constructed construction, and for leveling and unevennesses of the ground. The auxiliary means 29 now can be lowered synchronously until the entire construction rests on the filling plates (fig. 6), whereafter the auxiliary means 29 and the lifting units 5 - 12 can be disassembled. Next the complete construction can be anchored in the usual way and be sealed.

If the completed building construction has to be mounted onto a prefabricated steel bottom it will be necessary to mount auxiliary means to the inner side and to the lower side of the ring 4 so that by means of specially designed auxiliary means the complete construction can be positioned directly onto the steel bottom.

The invention is not limited to the embodiment described before but can be varied widely within the scope of the invention.

Claims

1. Method for constructing a cylindric metal building construction by positioning successive rings one on top of the other and interconnecting said rings, said method comprising the steps of:
- in a vertical position supplying the material for constructing the rings, such as metal band or metal plates to be assembled to a metal band, and shaping the material into the desired shape with a shaping device,
- shaping the supplied material into a ring by means of appropriate guidings,
- cutting the metal band or the metal plates assembled to a metal band to a length corresponding to the circumference of the corresponding ring to be shaped,
- connecting the upper edge of the metal band to the lower edge of an already constructed building construction section and interconnecting the beginning and the end of the cut-off metal band section,
- entirely lifting the building construction section constructed like this and supplying further rings underneath until the building construction has reached the desired height, and
- finally placing the building construction onto the ground **characterized** in that lifting the building construction already constructed is carried out by synchronously moving the guidings upwards, said guidings comprising supports engaging the lower edge of this building construction section, whereas always that guiding that in the circumferential direction of the building construction section is positioned ahead of the supplied metal band is moved downwards so far shortly before the beginning of the metal band reaches said guiding, that the metal band is moved over said guiding and that the lower edge of the metal band is supported by said guiding.

2. Method according to claim 1, **characterized** in that after completing the last, lowermost ring and connecting it to the already constructed building construction section, the building construction is lowered by synchronously lowering all guidings and is positioned onto support blocks whereafter the guidings are removed from under the lower edge of the lowermosts ring and wherein the building construction is slightly lifted by means of auxiliary means for removing the support blocks and wherein finally the building construction is lowered onto the ground.

3. Apparatus for carrying out the method according to claim 1 or 2, **characterized** in that it comprises a number of lifting units each having a guiding that can be moved upwards and downwards and wherein the lifting units are positioned such that the location of their guidings corresponds with the diameter of the building construction to be constructed.

4. Apparatus according to claim 3, **characterized** in that each guiding is connected to a carriage that can be moved upwards and downwards along a guide track.

5. Apparatus according to claim 4, **characterized** in that each guiding comprises a support roll with flange edges.

6. Apparatus according to claim 5 and 2, **characterized** in that each support roll can be released from its carriage and can be replaced by an auxiliary means that is constructed as an angle plate engaging the lower edge of the building construction.

7. Apparatus according to one of the claims 3 - 6, with a rolling machine as shaping device, **characterized** in that the rolling machine is positioned outside of the circumferential track of the rolled metal band as defined by the guidings.

8. Apparatus according to one of the claims 3 - 7, **characterized** in that it comprises a drive unit for supplying the metal band or the metal plates assembled to a metal band, said drive unit being positioned ahead of the shaping device as seen in the direction of motion of the metal band.

9. Apparatus according to one of the claims 3 - 8, **characterized** in that it comprises at least a drive unit for circumferentially moving the already constructed building construction section wherein said drive unit, as seen in the direction of motion, is positioned shortly ahead of the location where the upper edge of the metal band is connected to the lower edge of the already constructed building construction section.

10. Apparatus according to claim 9, **characterized** in that the drive unit for circumferentially moving the already constructed building construction section comprises two pairs of drive rolls positioned one on top of the other, wherein the drive rolls of the upper pair of drive rolls engage both sides of the lower edge of the already constructed building construction section whereas the drive rolls of the lower pair of drive rolls engage both sides of the upper edge of the metal band.

11. Apparatus according to claim 10 , **characterized** in that at least one roll of each pair of drive rolls is settable spring-loaded.

12. Apparatus according to one of the claims 3 - 11, which is provided with a welding device for interconnecting the metal band and the already constructed building construction section, **charac-**

terized in that near to the welding device at least one pair of guide rolls are provided for guiding the metal band and the building construction section.

13. Apparatus according to claim 12, **characterized** in that the welding device comprises a device for single-sided or double-sided welding wherein at that side of the building construction wall facing away from the welding device a cooling unit is provided for cooling said side of the wall.

14. Apparatus according to one of the claims 3 - 13, **characterized** in that it is provided with pressing rolls for pressing reinforcement ridges into the metal band and/or the building construction section.

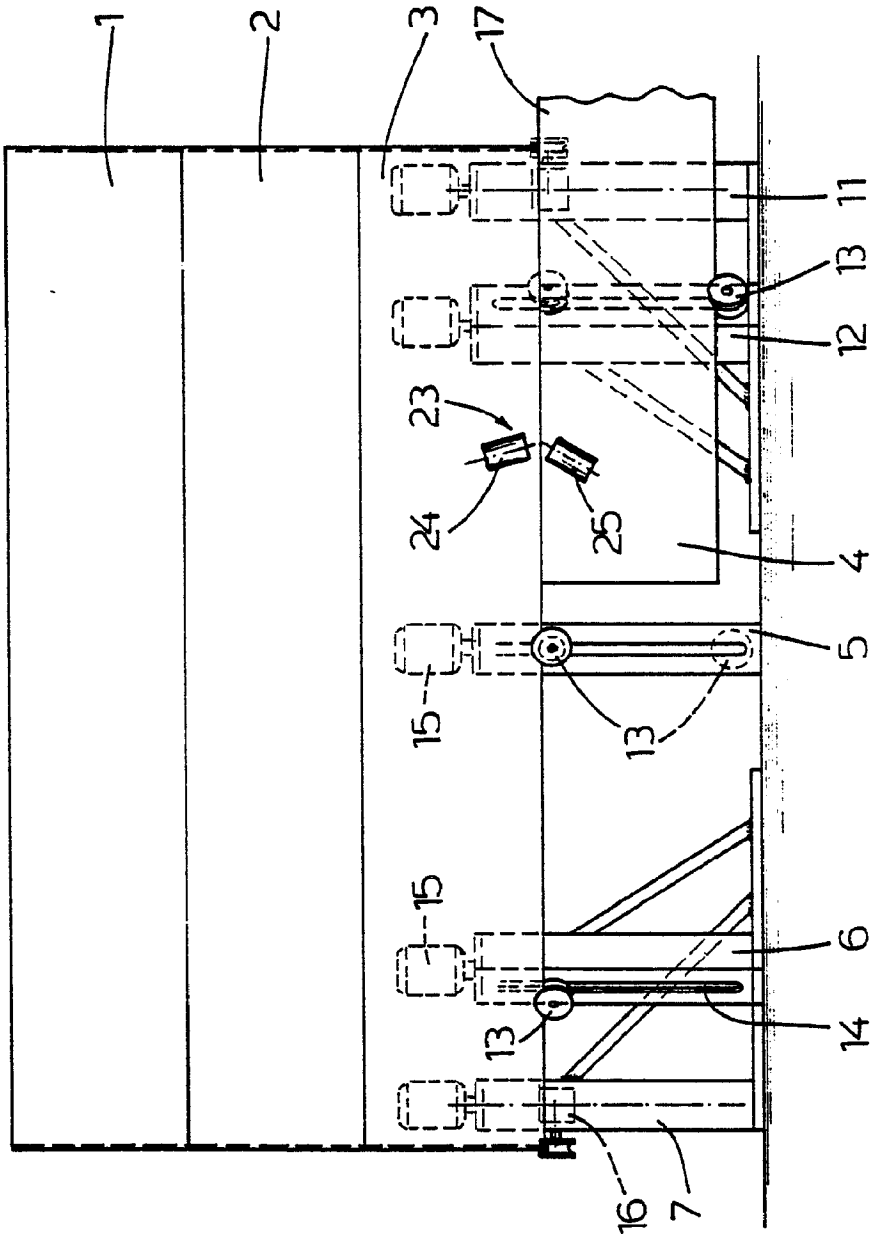

fig.1

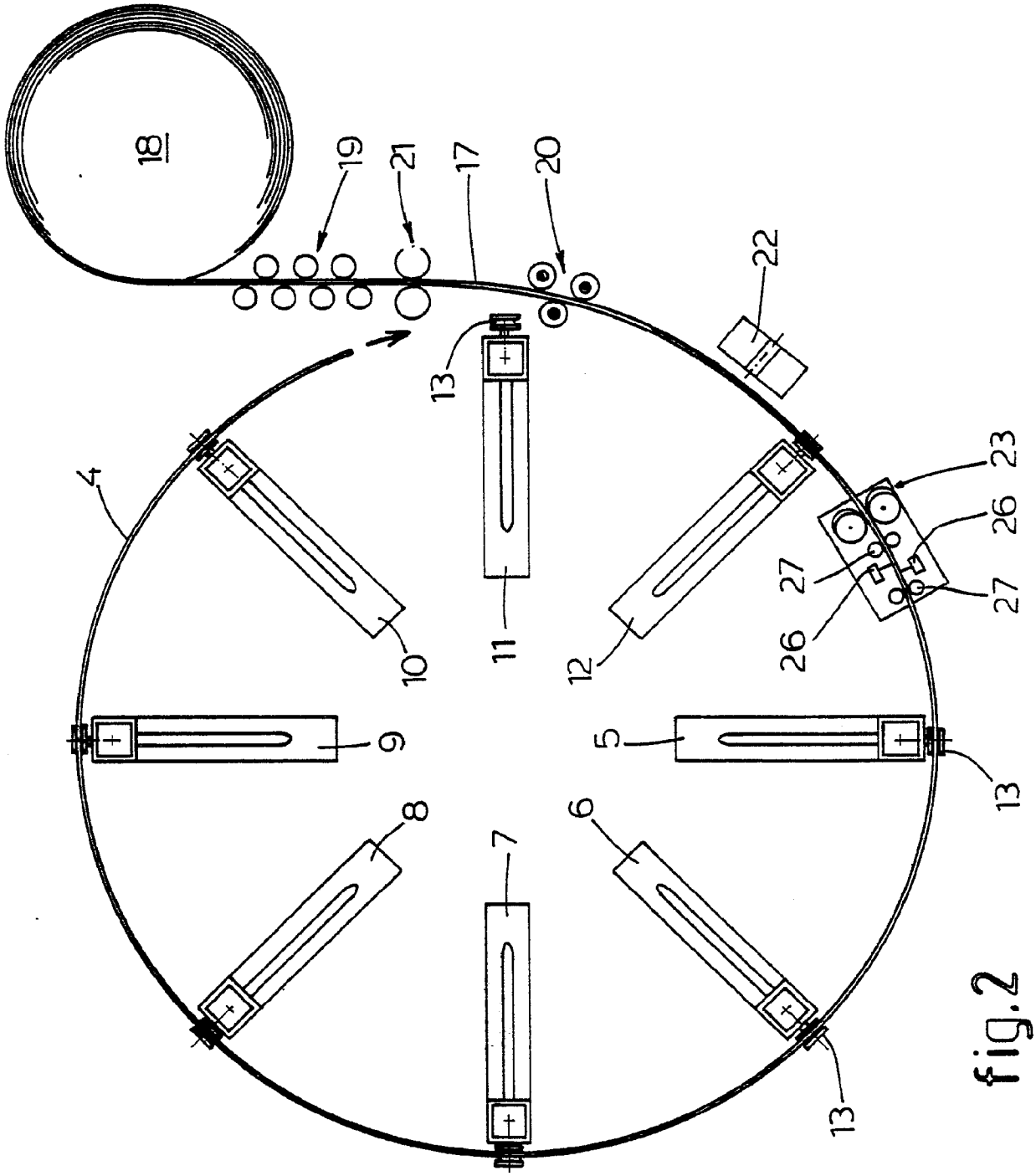

fig.2

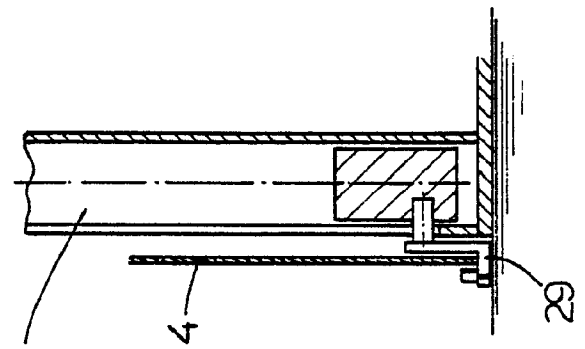

fig.6

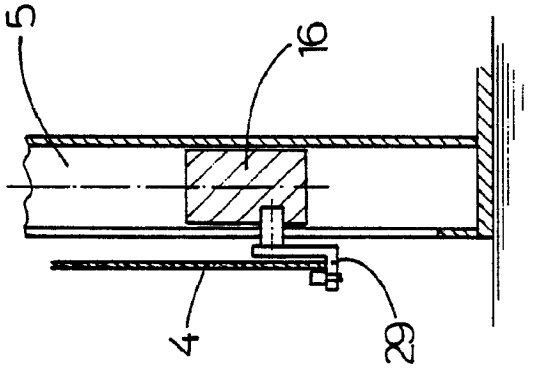

fig.5

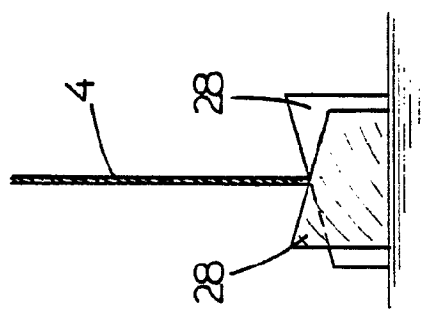

fig.4

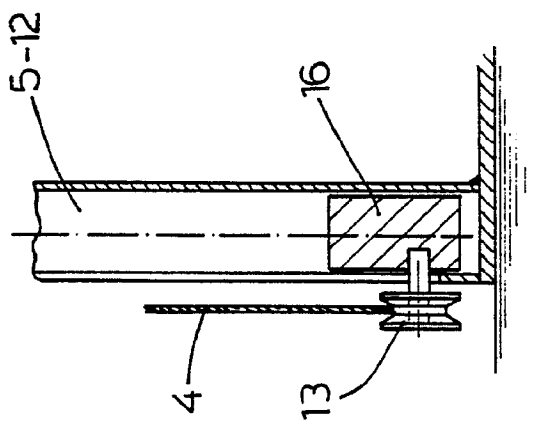

fig.3

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(54) Procédé pour la réalisation d'une enveloppe métallique cylindrique, et installation pour la mise en oeuvre de ce procédé

(57) Ce procédé pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions par soudage de viroles successives, consiste :

- à dérouler en continu une bande métallique (5) que l'on découpe lorsque la longueur souhaitée, correspondant au développement souhaité de la virole ;
- à amener la partie de l'ouvrage déjà réalisée au dessus de cette virole, et à effectuer l'accostage et la soudure horizontale en continu du bord supérieur de cette virole avec le bord inférieur dudit ouvrage au moyen d'une machine à souder, puis à effectuer la soudure verticale de fermeture de ladite virole à l'arrêt ;
- à recevoir chaque bande métallique (5) sur une pluralité de tables de déroulement motorisées (8), destinées à assurer la progression de ladite bande ;
- à solidariser un anneau circonférentiel ou ceinture (55) à la périphérie d'une partie au moins des viroles ainsi réalisées ;
- à réaliser le levage de la partie de l'ouvrage ainsi réalisée au moyen de mats de levage, lesdits mats étant simultanément accrochés au niveau d'un même anneau circonférentiel ou ceinture (55) ;
- à recommencer ces opérations jusqu'à atteindre la hauteur souhaitée de l'enveloppe à réaliser ;
- et, lorsque cette hauteur est atteinte, à soulever l'ensemble au moyen desdits mats de levage, afin de permettre l'évacuation desdites tables de roulement et de la machine à souder, et le dépôt dudit ensemble sur le fond de l'enveloppe, préalablement constitué et mis en place.

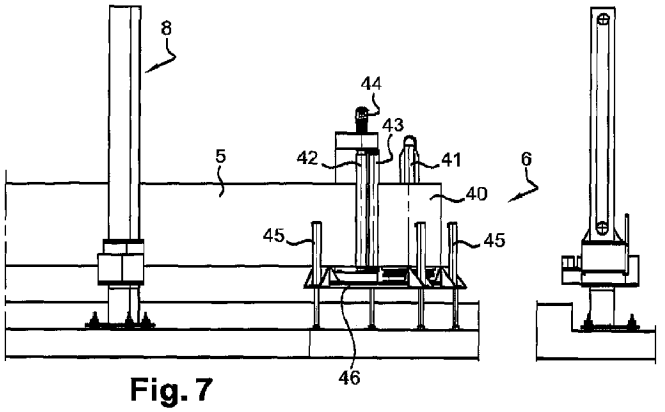

Fig. 7

EP 1 464 418 A1

Description

[0001] L'invention concerne la réalisation d'enveloppe métallique cylindrique de grandes dimensions. Elle concerne plus spécifiquement la fabrication de cuves de telles dimensions, utilisées dans les domaines alimentaires, agrochimiques, chimiques, pétrochimiques ainsi que dans le domaine de l'environnement (traitements d'effluents).

[0002] Les dimensions en question sont typiquement supérieures à dix mètres de haut et quinze mètres de diamètre, donc très supérieures au gabarit routier. Ce faisant, la réalisation de telles cuves doit être effectuée sur site.

[0003] On a décrit, dans le document FR-A-2 551 370 un procédé de réalisation sur site de cuves de grandes dimensions par soudage de viroles successives. Ce procédé consiste essentiellement :

- à dérouler en continu et à vitesse régulière une bande métallique à partir d'une bobine ;
- à déposer simultanément et en continu ladite bande ainsi déroulée sur un manège comportant un plateau tournant, dont la vitesse de rotation correspond à la vitesse d'avancement de la bande, et dont le rayon correspond au rayon de la virole à réaliser ;
- à stopper le déroulement de la bande et à procéder à sa découpe une fois atteinte la longueur correspondant au développement de la virole ;
- à amener l'ouvrage en cours au dessus de cette virole, et à effectuer l'accostage et la soudure horizontale du bord supérieur de cette virole avec le bord inférieur dudit ouvrage, le manège étant en rotation à vitesse contrôlée ;
- à réaliser la soudure verticale de fermeture de ladite virole par arrêt du manège.

[0004] Si ce procédé a permis de grandement simplifier la réalisation de cuves de relativement grandes dimensions sur site, typiquement trois à dix mètres de hauteur et de diamètre, en revanche, il présente rapidement des limites, dès lors que l'on souhaite construire des cuves de plus grandes dimensions. Cette limite est principalement inhérente à la masse que représente l'ouvrage en cours de réalisation, qui peut nécessiter la mise en oeuvre d'engins de levage à très grande capacité, souvent incompatible avec la place disponible sur le site en question.

[0005] L'objet de la présente invention est de proposer une solution à ce problème, de sorte qu'il devient possible de réaliser des cuves, et de manière générale des enceintes métalliques cylindriques de très grande capacité, présentant par exemple une hauteur supérieure à quinze mètres, et un diamètre supérieur à vingt mètres.

[0006] Ce procédé pour la réalisation d'une enveloppe métallique cylindrique de grandes dimensions par soudage de viroles successives, dans lequel :

- on déroule en continu une bande métallique à partir d'une bobine, que l'on découpe lorsque la longueur souhaitée, correspondant au développement souhaité de la virole est atteinte ;
- on amène la partie de l'ouvrage déjà réalisée au dessus de cette virole, et on effectue l'accostage et la soudure horizontale en continu du bord supérieur de cette virole avec le bord inférieur dudit ouvrage, au moyen d'une machine à souder, puis on effectue la soudure verticale de fermeture de ladite virole à l'arrêt ;

consiste :

- à recevoir chaque bande métallique en cours de déroulage sur une pluralité de tables de déroulement motorisées, sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinées à assurer selon un plan déterminé la progression de ladite bande selon un profil cylindrique ;
- à solidariser un anneau circonférentiel, également dénommé ceinture, à la périphérie d'une partie au moins des viroles ainsi réalisées ;
- à réaliser le levage de la partie de l'ouvrage ainsi réalisée au moyen de mats de levage, également sensiblement régulièrement répartis à la périphérie de l'enveloppe métallique à réaliser, lesdits mats étant simultanément accrochés au niveau d'un même anneau circonférentiel ;
- à recommencer ces opérations jusqu'à atteindre la hauteur souhaitée de l'enveloppe à réaliser ;
- et, lorsque cette hauteur est atteinte, à soulever l'ensemble au moyen desdits mats de levage, afin de permettre l'évacuation desdites tables de roulement et de la machine à souder, et le dépôt dudit ensemble sur le fond de l'enveloppe, préalablement constitué et mis en place.

[0007] En d'autres termes, l'invention consiste fondamentalement à ne plus faire appel à un manège rotatif, comme dans le cas du document de l'art antérieur précité, mais à faire appel à une pluralité de tables de déroulement et de mats de levage, permettant de répartir les efforts, et partant, de manutentionner des éléments de masse nettement plus importante.

[0008] Avantageusement, et selon l'invention, les mats de levage sont assemblés au niveau des tables de déroulement. Ces deux organes sont donc en nombre égal.

[0009] Selon une autre caractéristique avantageuse de l'invention, les anneaux circonférentiels de levage ne sont pas solidarisés sur chacune des viroles, mais à intervalles périodiques, fonction notamment de la hauteur possible de levage conférée auxdits mats de levage.

[0010] L'invention concerne également une installation pour la mise en oeuvre de ce procédé. Cette installation comprend :

- un dispositif dérouleur de la bande métallique, stockée sous forme de bobine ;
- un poste de soudage fixe, susceptible de réaliser tant une soudure horizontale qu'une soudure verticale ;
- une pluralité de tables de déroulement, sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinées à assurer selon un plan déterminé la progression de la bande métallique issue du dispositif dérouleur selon un profil cylindrique ;
- une pluralité de mats de levage, sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinés à assurer le levage de la première virole réalisée ou de la partie d'ouvrage déjà réalisée, ainsi que leur redescente au contact de la virole en cours de réalisation ou du fond de ladite enceinte.

[0011] Selon l'invention, les tables de déroulement comprennent :

- un socle, venant se fixer au sol, à la périphérie de la zone destinée à recevoir l'enveloppe cylindrique à réaliser ;
- une structure mobile en translation horizontale sur le socle, et munie :

  - ➢ d'un premier galet, dit galet moteur, motorisé et à axe de révolution vertical,
  - ➢ d'un second galet, dit galet presseur, d'axe de révolution parallèle à celui du premier galet moteur, et monté libre en rotation sur une base elle-même mobile en translation horizontale sous l'action d'un moyen de translation solidaire de la structure mobile, de telle sorte à permettre d'exercer une pression par la génératrice dudit galet, contre le galet moteur, et ainsi à assurer la progression de la bande métallique ;
  - ➢ d'un rouleau à axe de rotation horizontal, positionné entre les deux galets moteur et presseur et affleurant sensiblement au niveau du bord inférieur des génératrices desdits galets, et destiné à recevoir le bord inférieur de la virole en cours de réalisation.

[0012] Selon l'invention, la structure mobile est mobile entre une position opérationnelle, dans laquelle elle reçoit la bande métallique et une position escamotée sous l'action d'un vérin électrique ou pneumatique ou tout autre organe équivalent.

[0013] Avantageusement, le rouleau à axe de rotation horizontal recevant le bord inférieur de la virole en cours de réalisation est constitué d'un matériau à durcissement structurel.

[0014] Selon l'invention, les tables de déroulement se prolongent chacune par un mat de levage. Ainsi, l'ensemble constitué par une table de déroulement et un mât de levage est monobloc.

[0015] La manière dont l'invention peut être réalisée et les avantages qui en découlent, ressortiront mieux de l'exemple de réalisation qui suit, donné à titre indicatif et non limitatif à l'appui des figures annexées.

La figure 1 est une représentation schématique en plan du fond de la cuve à réaliser conformément à l'invention.

La figure 2 est une représentation schématique en section transversale de la figure 1.

La figure 3 est une représentation schématique en plan de l'installation conforme à l'invention.

La figure 4 est une représentation schématique d'une table de déroulement munie de son mat de levage.

La figure 5 est une vue schématique en détail de la table de déroulement proprement dite.

La figure 6 est une représentation schématique de la machine à soudure conforme à l'invention.

La figure 7 est une représentation schématique de la machine à dérouler la bande métallique, conforme à l'invention.

La figure 8 illustre en perspective schématique l'opération de déroulage conformément à l'invention.

La figure 9 illustre l'opération de mise en place du dôme de la cuve sur la première virole réalisée, conformément à l'invention.

La figure 10 illustre le déroulage de la deuxième virole, conformément à l'invention.

La figure 11 illustre le déroulage de la quatrième virole, conformément à l'invention.

La figure 12 illustre en résumé les différentes étapes pour la réalisation d'une cuve constituée de dix viroles.

[0016] La description qui suit concerne la réalisation d'une cuve de grande capacité conformément à l'invention. Cependant, l'invention ne se limite pas à cette seule application, et toute enveloppe ou enceinte cylindrique est également visée par celle-ci.

[0017] La première étape de procédé de réalisation de la cuve conforme à l'invention consiste à réaliser le fond (1) de celle-ci. A cet effet, on réalise un radier (2) en béton, au sein duquel sont positionnés un certain nombre de tiges (4) en forme de queue de carpe, destinées à être noyées dans le béton, et dont l'extrémité supérieure est soudée à une structure métallique servant d'ancrage aux plaques métalliques constitutives du fond proprement dit. Celui-ci est avantageusement incliné, afin de permettre les opérations de vidange de la cuve définitive.

[0018] Dans la figure 2, le fond (1) est incliné de l'un de ses bords périphériques, en direction du bord diamétralement opposé. Cependant, on peut également envisager la réalisation d'un fond, dont le point le plus élevé ou le plus bas est situé en son centre.

[0019] A la périphérie de ce fond circulaire (1), sont ménagées un certain nombre de réservations (3) dans le béton, régulièrement réparties. Ces réservations (3) sont destinées à servir de point d'ancrage et de fixation à autant de tables de déroulement et de mats de levage,

ainsi que cela apparaîtra clairement dans la description qui suit.

[0020] Il peut être observé au sein de la figure 1, que la réservation située le plus en bas de celle-ci n'est pas positionnée avec le même écart angulaire par rapport aux deux réservations qui lui sont immédiatement adjacentes. Cette configuration est dictée par des commodités d'installation du dispositif de déroulement des bandes métalliques, constitutives des viroles entrant dans la constitution de la cuve.

[0021] On a représenté au sein de la figure 3 une vue générale de l'installation de réalisation de la cuve, conformément à l'invention. Au sein de celle-ci, les tables de déroulement associées à leur mat de levage (8) ont été positionnées au niveau des réservations (3) précitées. Corollairement, le dispositif de déroulement (6) des bandes métalliques a également été symbolisé, au voisinage de la table de déroulement la plus basse sur ladite figure. De la même manière, la machine à souder (7) les viroles entre elles a également été représentée. Celle-ci est montée en poste fixe, de sorte que pour assurer la soudure de deux viroles adjacentes entre elles, il importe que lesdites viroles soient animées d'un mouvement de translation circulaire au niveau de ladite machine à souder. Ces opérations de translation vont être décrites en relation avec la description des différents organes permettant d'assurer cette translation.

[0022] Il va être ainsi décrit les tables de déroulement (8) conforme à l'invention, en relation avec les figures 4 et 5. Comme déjà indiqué, ces tables sont fixées à la périphérie du fond de la cuve sur un radier en béton au sein de réservations (3) prévues à cet effet.

[0023] Compte tenu des dimensions importantes des viroles, notamment en diamètre, il importe que toutes les tables de déroulement présentent une surface d'appui de la bande métallique (5) positionnée selon un même niveau. Pour ce faire, elles disposent chacune d'un socle (9) fixable au sein des réservations (3) au moyen d'un pied (10) muni d'organes de réglage en hauteur. Ce réglage de niveau est avantageusement réalisé par télémétrie laser, bien connue pour cette application, de sorte qu'il n'y a pas lieu de la décrire ici plus en détail.

[0024] Le socle (9) reçoit une structure (11) mobile en translation horizontale, entre une position opérationnelle, dans laquelle la table reçoit une virole en cours de réalisation ou déjà réalisée, et faisant alors saillie en direction du centre de la cuve, et une position escamotée dans laquelle ladite structure mobile est en quelque sorte rentrée dans un logement prévu à cet effet au sein de la table, éliminant alors la saillie précitée.

[0025] La transition entre ces deux positions est réalisée au moyen d'un vérin électrique ou pneumatique, dont le cylindre (13) est solidarisé au socle, et dont l'extrémité libre du piston (14) est solidarisée à une paroi de ladite structure mobile ou vice versa.

[0026] Ladite structure mobile comporte un premier galet (15), faisant fonction de galet moteur, et dont l'axe de révolution (21) est vertical.

[0027] Ce galet (15) est motorisé, au moyen d'un ensemble moteur solidarisé à la dite structure mobile, et comprenant un moteur électrique (16), dont l'axe moteur coopère avec un renvoi d'angle (17), actionnant un axe vertical (18). L'extrémité supérieure de cet axe vertical est munie d'un pignon denté, coopérant avec une chaîne (19), coopérant à son tour avec un pignon denté positionné au voisinage de l'extrémité supérieure de l'axe (21) dudit galet moteur (15).

[0028] Corollairement, la structure mobile comporte un second galet (22), dit galet presseur, d'axe de révolution (23) parallèle à celui du premier galet moteur (15). Ce galet presseur (22) est monté libre en rotation sur une base (24), elle-même mobile en translation horizontale sous l'action d'un moyen de translation solidaire de la structure mobile, de telle sorte à permettre d'exercer une pression par la génératrice dudit galet, contre le galet moteur. Typiquement, ce moyen de translation est constitué par un vérin électrique ou pneumatique, dont le cylindre (25) est solidaire de la structure mobile, et dont l'extrémité du piston (26) est solidarisée à ladite base (24).

[0029] Ce faisant, comme les deux galets, respectivement moteur (15) et presseur (22) sont parallèles et présentent la même hauteur et sont situés au même niveau, l'actionnement du vérin (25, 26) entraîne le déplacement de la base (24) sur la droite (sur la figure 5) et corollairement la pression du galet (22) contre le galet (15) par génératrices interposées, permettant de la sorte d'assurer la progression de la bande métallique.

[0030] La structure mobile comporte enfin un rouleau (27) à axe de rotation horizontal, positionné entre les deux galets moteur (15) et presseur (22), et affleurant sensiblement au niveau du bord inférieur des génératrices desdits galets. Ce rouleau (27), monté fou en rotation, est destiné à recevoir le bord inférieur de la virole (5) en cours de réalisation.

[0031] Cet élément plan (27) est typiquement constitué d'un matériau à durcissement structurel, afin d'éviter le poinçonnage susceptible d'être engendré par la bande métallique à son contact.

[0032] Le vérin (13, 14) assurant le déplacement en translation horizontale de la structure mobile (11) est monté et choisi de telle sorte qu'en extension maximum, la génératrice du galet moteur (15) corresponde sensiblement au diamètre souhaité (28) de la virole à réaliser, et donc corollairement de la cuve définitive.

[0033] Selon l'invention, cette table de déroulement (8) se prolonge à sa partie supérieure par un mat de levage, solidarisé au socle (9) de ladite table. Dans l'exemple décrit, ce mat s'élève d'une hauteur voisine de 4,25 mètres. Il est muni d'un crochet ou sabot de préhension (52), susceptible d'être mû en hauteur au moyen d'un vérin électrique ou pneumatique, voire par un autre dispositif assurant la même fonction (non représenté).

[0034] Dans la pratique, le nombre de mats de levage, donc de tables de déroulements est suffisamment im-

portant, pour qu'en cas de défaillance de l'un d'eux, la charge correspondante puisse être répartie sans dommage sur les deux mats qui lui sont immédiatement adjacents.

[0035] On a schématiquement illustré en figure 6 la machine à souder (7) mise en oeuvre au sein de l'installation de l'invention. Celle-ci est montée fixe pendant toute la durée des opérations de montage de la cuve. Elle comprend fondamentalement un socle (30), dont on ajuste le niveau au moyen de vérins (37, 38), prenant respectivement appui sur le fond (1) et sur le radier (2). De ce socle (30) s'étendent deux colonnes verticales (31, 32), sur lesquelles sont montées les têtes de soudage proprement dites (33, 34) de type approprié en fonction de la nature du métal à souder. Ces têtes de soudage sont ajustables en hauteur et en relation l'une par rapport à l'autre au moyen d'organes de translation appropriés (35, 36, 39).

[0036] On a représenté en relation avec la figure 7 la machine de déroulage (6) de l'invention. Celle-ci comporte également un socle ou bâti (46), mis à niveau en fonction du niveau des tables de déroulement au moyen d'une pluralité de vérins (45). Elle comporte en outre un plateau tournant librement en rotation (41), destiné à recevoir une bobine (40) de métal en bande (ou « coil »). En l'espèce, ce métal est constitué d'acier inoxydable. Il pourrait également être constitué d'aluminium. La bande métallique (5) issue de la bobine (40) est ensuite reprise par une paire de rouleaux (42, 43) moteur-presseur, outre un autre rouleau (non représenté) motorisés par un moteur électrique (44), afin d'assurer le déroulement de ladite bande à partir de la bobine selon une vitesse choisie et déterminée.

[0037] La figure 8 illustre ainsi le début du déroulement de la bande métallique (5) au sein de l'installation.

[0038] Il va être maintenant décrit plus en détail, en relation avec les figures 9 à 12, les différents étapes de réalisation de la cuve conformément à l'invention. Dans l'exemple décrit, cette cuve est munie d'un dôme (50). On procède de fait à l'assemblage de celui-ci, secteur par secteur par rapport à une cheminée centrale (51), en assurant le levage et la manutention desdits secteurs au moyen d'une grue (non représentée).

[0039] Lorsque le dôme est réalisé, il est suspendu par les mats de levage (8), dont les crochets ou sabots de levage (52) sont accrochés au moyen d'un lien ou équivalent (54) à des points de levage (53) prévus à cet effet. Le dôme est ainsi élevé d'une hauteur légèrement supérieure à la largeur de la bande métallique (5). Celle-ci peut alors être déroulée de la machine à dérouler (6) au niveau des tables de déroulement, où elle est reprise, le galet presseur (22) de chacune desdites tables venant serrer la bande contre le galet moteur (22). Bien évidemment, la vitesse de rotation des galets moteur est synchronisée avec la vitesse de déroulement de la bande (5) par la machine à dérouler (6) (figure 9 - partie gauche).

[0040] Lorsque le développé de la bande (5) est suffisant pour la réalisation d'une virole continue et complète, la progression de celle-ci est stoppée, puis elle est découpée au moyen d'une torche à plasma ou tronçonnée. Puis le dôme est abaissé au moyen desdits mats de levage, jusqu'à permettre son accostage avec le bord supérieur de la virole ainsi constituée. Les différents points de levage du dôme sont alors ôtés, de sorte que celui-ci ne repose plus que sur le bord supérieur de ladite virole. On procède alors à la soudure en continu dudit bord supérieur de la virole sur le dôme, au moyen de la machine à souder (7), la rotation de l'ensemble virole + dôme étant alors effectuée par la coopération des galets moteur et presseur, pour permettre le passage en continu de la zone à souder à l'aplomb des têtes de soudure de la machine à souder fixe (figure 9 - partie droite). Ensuite, un décapage de la soudure est réalisé manuellement, toujours en assurant la rotation virole + dôme, alors constituant un seul ensemble. Enfin, on assure le laminage du cordon de soudure et son polissage, l'ensemble poursuivant sa rotation.

[0041] Les points de levage sont alors remis en place au niveau du dôme, et l'ensemble alors monobloc dôme + virole est monté d'une hauteur suffisante, pour permettre le déroulement d'une seconde bande métallique, afin de constituer la seconde virole (61) (figure 10 - partie gauche), à l'instar de la réalisation de la première virole (60).

[0042] Lorsque la virole (61) est en place, l'ensemble dôme + première virole (60) est abaissé, afin de réaliser l'accostage du bord inférieur dudit ensemble sur le bord supérieur de ladite seconde virole (62). On ôte les points de levage dudit premier ensemble, et l'on procède, comme pour le premier ensemble à la soudure de celui-ci avec la seconde virole par rotation au niveau de la machine à souder.

[0043] Une fois cette opération terminée, on met en place, notamment par soudure, à la périphérie de la seconde virole, sensiblement à mi-hauteur de celle-ci un anneau circonférentiel ou ceinture (55). Cet anneau a d'abord pour fonction le renfort de la virole en question. Il est également destiné à conférer la stabilité contre le flambement de la cuve définitive. Il garantit en outre la rotondité de celle-ci lors de ses différentes phases de construction. Enfin, il est également destiné à servir d'organe de préhension lors des phases de levage successives. Il permet ainsi de répartir les efforts de charge, et en outre d'éviter les phénomènes de poinçonnage lors du levage.

[0044] Cet anneau est typiquement constitué d'une cornière métallique, ouverte en direction du bas.

[0045] On repositionne alors les moyens de levage des mats sur cet anneau (55), et l'on procède au levage de l'ensemble dôme + virole (60) + virole (61), et l'on recommence ainsi de suite les opérations de déroulement de la bande métallique et de soudage, avec mise en place d'un anneau circonférentiel ou ceinture toutes les deux viroles (voir figure 11).

[0046] On reproduit ainsi l'opération jusqu'à aboutir à

la hauteur souhaitée de la cuve.

[0047] On observe ainsi, que de par la mise en place d'un anneau circonférentiel toutes les deux viroles, la hauteur nécessaire des mats de levage est réduite, diminuant d'autant leur encombrement et les coûts y afférant.

[0048] Lorsque la hauteur souhaitée de la cuve est atteinte, c'est à dire lorsque le nombre de viroles à mettre en place est obtenu, on procède à une nouvelle opération de levage, à l'instar de ce qui a été décrit précédemment, pour permettre d'effectuer le retrait de la machine à souder, et également l'escamotage des tables de déroulement associées aux mâts de levage. Puis, on redépose l'ensemble sur le fond, et enfin on effectue les opérations de soudure du bord inférieure de la virole inférieure sur le bord périphérique du fond déjà mis en place, ainsi que précisé.

[0049] On a représenté en relation avec la figure 12 l'illustration des principales étapes de réalisation de la cuve en question.

[0050] On conçoit tout l'intérêt du procédé et de l'installation conforme à l'invention.

[0051] Tout d'abord, ils permettent la réalisation d'enceintes de grande capacité de manière fiable et en toute sécurité, ce que l'on ne pouvait faire à ce jour.

[0052] Par ailleurs, la mise en oeuvre d'organes assurant la double fonction de levage et de rotation des viroles, permet de réduire la puissance des outils habituellement utilisés pour la réalisation de telles enceintes. Parallèlement, ils permettent de s'affranchir des grues et autres échafaudages, habituellement mis en oeuvre pour la réalisation de telles enceintes. Ils permettent également d'éviter le travail du personnel en hauteur, source de pertes de temps outre d'accidents.

[0053] Enfin, l'invention permet d'optimiser la qualité de finition des soudures, et le maintien de l'aspect de surfaces des bandes métalliques mises en oeuvre, favorisant de fait la conformité de la cuve définitive avec les exigences sanitaires et alimentaires, lorsque celles-ci sont requises.

Revendications

1. Procédé pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions par soudage de viroles successives, dans lequel :

   - on déroule en continu une bande métallique (5) à partir d'une bobine (40), que l'on découpe lorsque la longueur souhaitée, correspondant au développement souhaité de la virole est atteinte ;
   - on amène la partie de l'ouvrage déjà réalisée au dessus de cette virole, et on effectue l'accostage et la soudure horizontale en continu du bord supérieur de cette virole avec le bord inférieur dudit ouvrage au moyen d'une machine à souder, puis on effectue la soudure verticale de fermeture de ladite virole à l'arrêt ;

   ***caractérisé* en ce qu'**il consiste :

   - à recevoir chaque bande métallique (5) en cours de déroulage sur une pluralité de tables de déroulement motorisées (8), sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinées à assurer selon un plan déterminé la progression de ladite bande selon un profil cylindrique ;
   - à solidariser un anneau circonférentiel ou ceinture (55) à la périphérie d'une partie au moins des viroles ainsi réalisées ;
   - à réaliser le levage de la partie de l'ouvrage ainsi réalisée au moyen de mats de levage, également sensiblement régulièrement répartis à la périphérie de l'enveloppe métallique à réaliser, lesdits mats étant simultanément accrochés au niveau d'un même anneau circonférentiel ou ceinture (55);
   - à recommencer ces opérations jusqu'à atteindre la hauteur souhaitée de l'enveloppe à réaliser ;
   - et, lorsque cette hauteur est atteinte, à soulever l'ensemble au moyen desdits mats de levage, afin de permettre l'évacuation desdites tables de roulement et de la machine à souder, et le dépôt dudit ensemble sur le fond de l'enveloppe, préalablement constitué et mis en place.

2. Procédé pour la réalisation d'une enveloppe ou enceinte métallique cylindrique selon la revendication 1, ***caractérisé* en ce que** les mats de levage sont assemblés au niveau des tables de déroulement.

3. Procédé pour la réalisation d'une enveloppe ou enceinte métallique cylindrique selon l'une des revendications 1 et 2, ***caractérisé* en ce que** les anneaux circonférentiels ou ceinture (55) de levage ne sont pas solidarisés sur chacune des viroles, mais à intervalles périodiques, fonction notamment de la hauteur possible de levage conférée auxdits mats de levage.

4. Installation pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions, constituées de l'assemblage successif de viroles, comprenant :

   - un dispositif dérouleur d'une bande métallique (5) stockée sous forme de bobine, destinée à constituer lesdites viroles ;
   - un poste de soudage fixe, susceptible de réaliser tant une soudure horizontale qu'une soudure verticale de ladite bande au niveau des viro-

les déjà réalisées ;

***caractérisée* en ce qu'**elle comprend en outre :

- une pluralité de tables de déroulement (8), sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinées à assurer selon un plan déterminé la progression de la bande métallique issue du dispositif dérouleur selon un profil cylindrique ;
- une pluralité de mats de levage, sensiblement régulièrement réparties à la périphérie de l'enveloppe métallique à réaliser, et destinés à assurer le levage de la première virole réalisée ou de la partie d'ouvrage déjà réalisée, ainsi que leur redescente au contact de la virole en cours de réalisation ou du fond de ladite enceinte.

5. Installation pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions selon la revendication 4, ***caractérisée* en ce que** les tables de déroulement (8) comprennent :

- un socle (9), venant se fixer au sol, à la périphérie de la zone destinée à recevoir l'enveloppe cylindrique à réaliser ;
- une structure (11) mobile en translation horizontale sur le socle, et munie :

  - d'un premier galet (15), dit galet moteur, motorisé et à axe de révolution vertical,
  - d'un second galet (22), dit galet presseur, d'axe de révolution parallèle à celui du premier galet moteur, et monté libre en rotation sur une base (24) elle-même mobile en translation horizontale sous l'action d'un moyen de translation (25) solidaire de la structure mobile, de telle sorte à permettre d'exercer une pression par la génératrice dudit galet, contre le galet moteur (15), et ainsi à assurer la progression de la bande métallique ;
  - d'un rouleau à axe de rotation horizontal (27), positionné entre les deux galets moteur (15) et presseur (22) et affleurant sensiblement au niveau du bord inférieur des génératrices desdits galets, et destiné à recevoir le bord inférieur de la virole en cours de réalisation.

6. Installation pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions selon la revendication 5, ***caractérisée* en ce que** la structure mobile (11) est mobile entre une position opérationnelle, dans laquelle elle reçoit la bande métallique (5) et une position escamotée sous l'action d'un vérin électrique ou pneumatique ou tout autre organe équivalent (13).

7. Installation pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions selon l'une des revendications 5 et 6, ***caractérisée* en ce que** le rouleau à axe de rotation horizontal (27) recevant le bord inférieur de la virole en cours de réalisation est constitué d'un matériau à durcissement structurel.

8. Installation pour la réalisation d'une enveloppe ou enceinte métallique cylindrique de grandes dimensions selon l'une des revendications 4 à 7, ***caractérisée* en ce que** les tables de déroulement sont chacune surmontées par les mâts de levage, de sorte que l'ensemble constitué par une table de déroulement et un mât de levage est monobloc.

Fig. 2

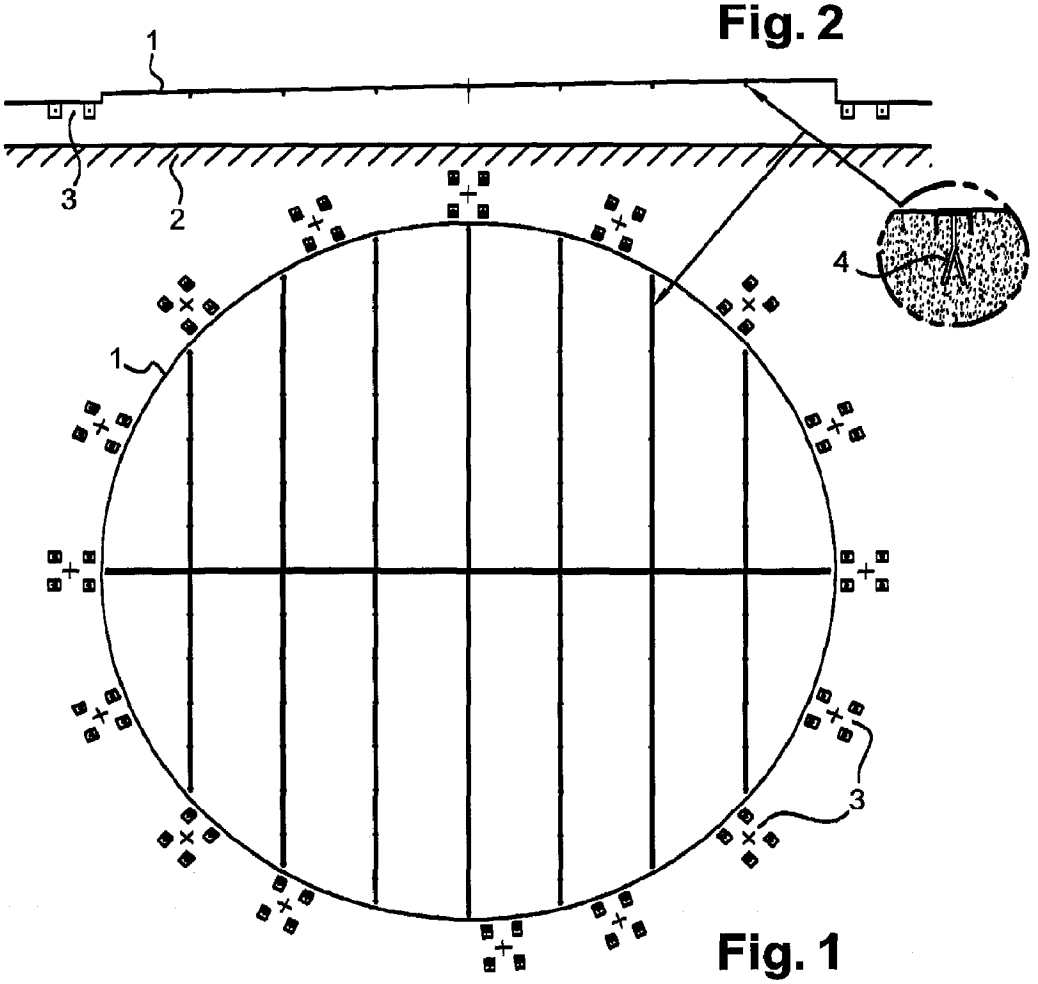

Fig. 1

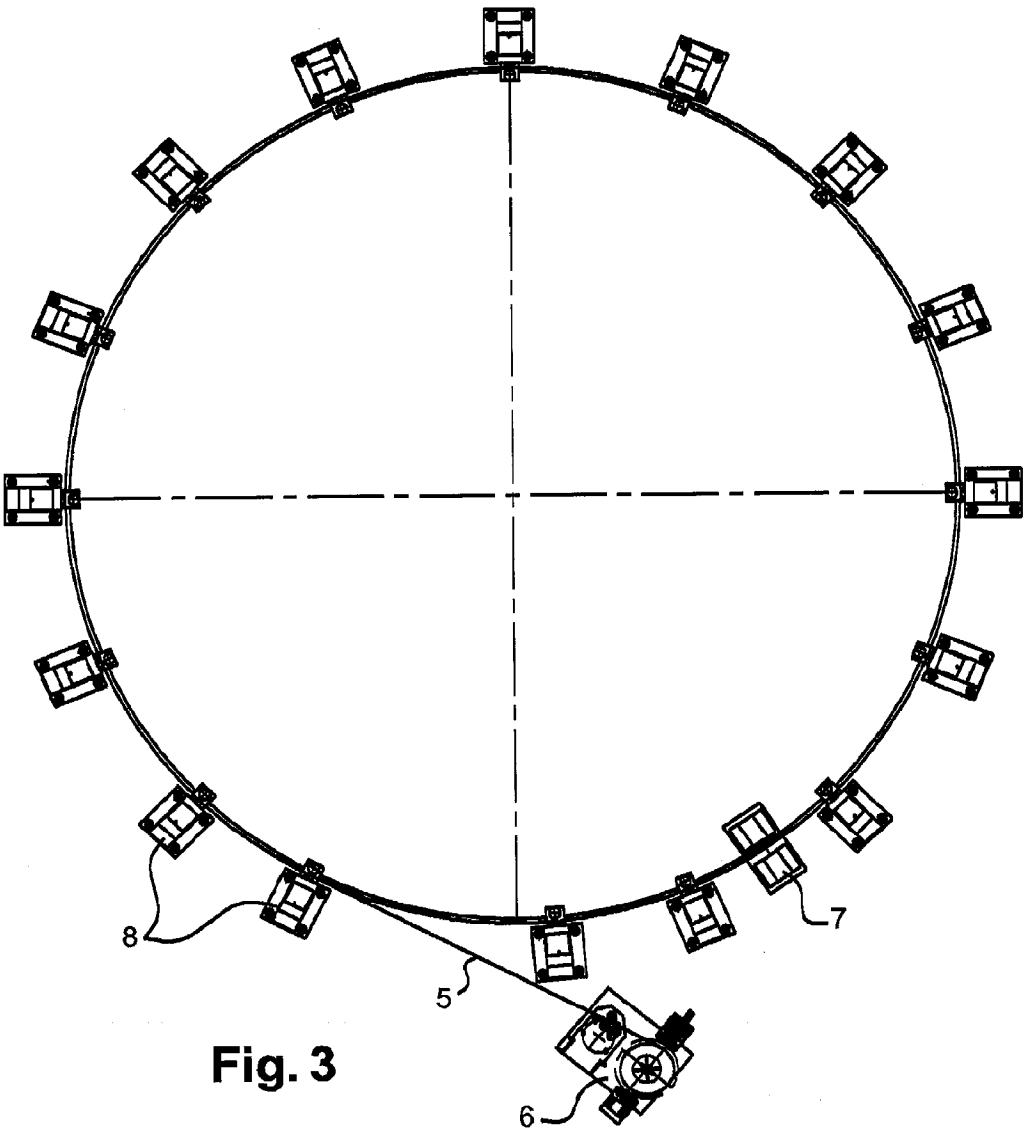

Fig. 3

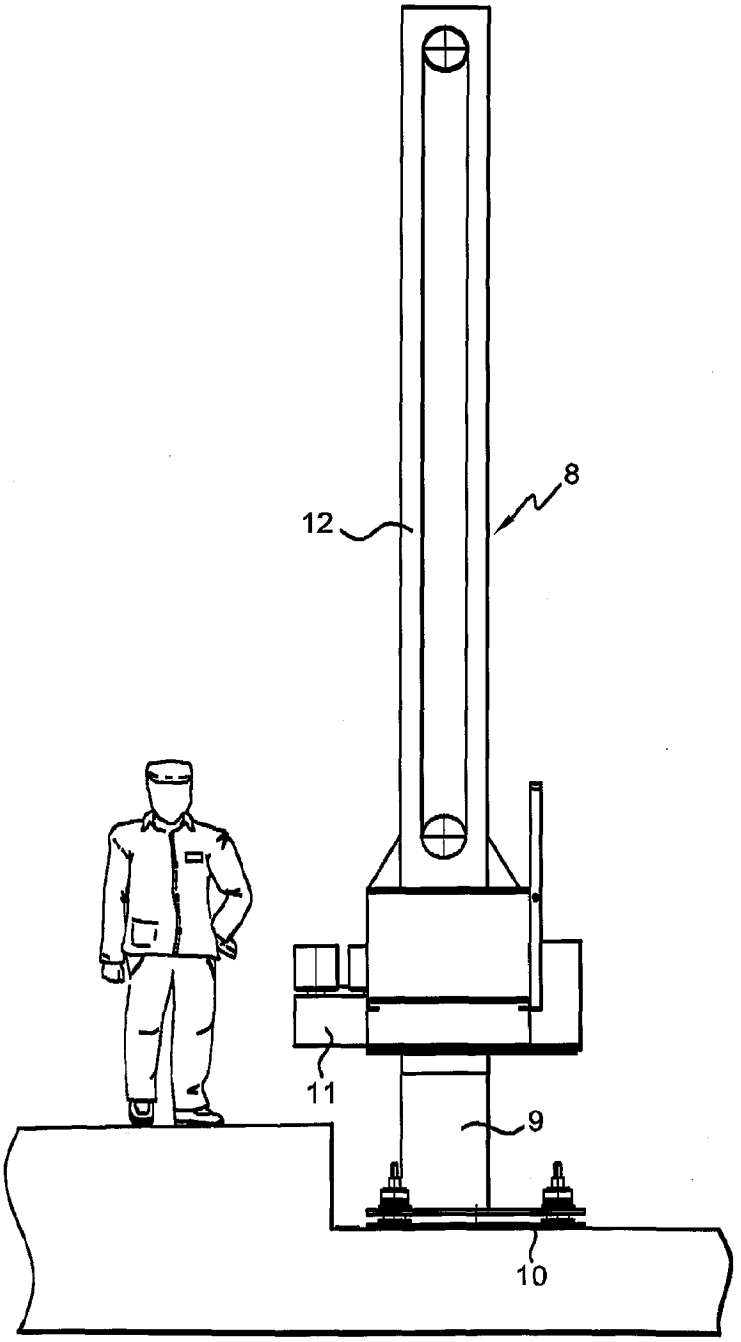

Fig. 4

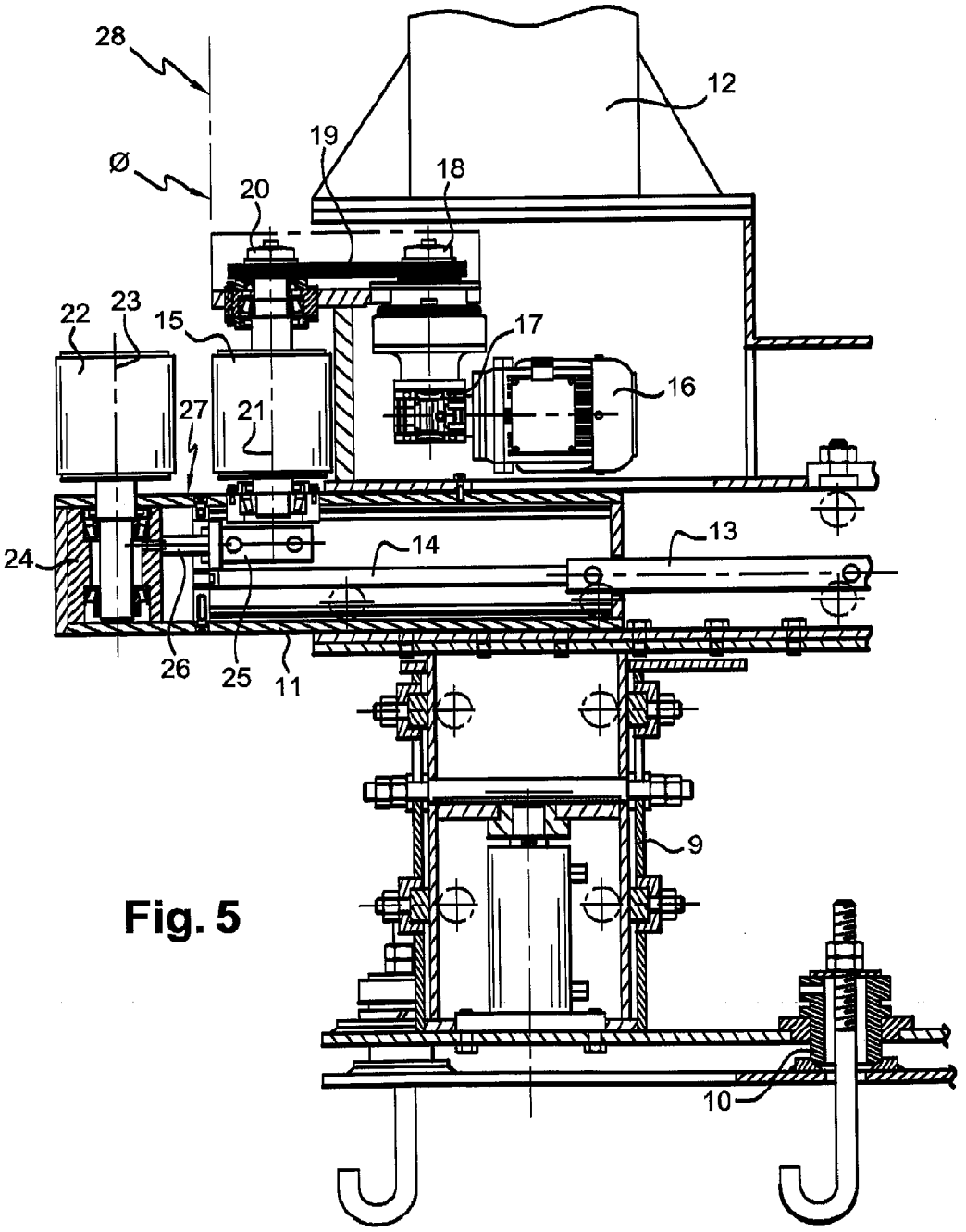

Fig. 5

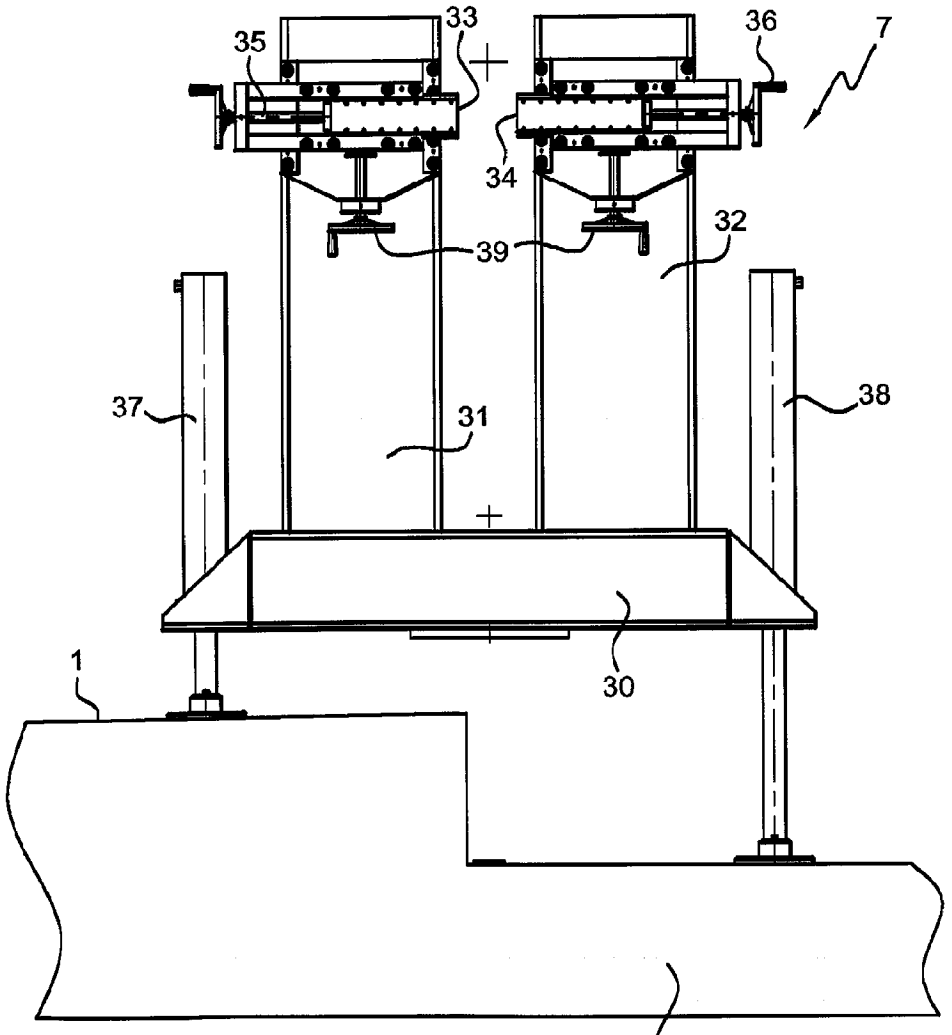

Fig. 6

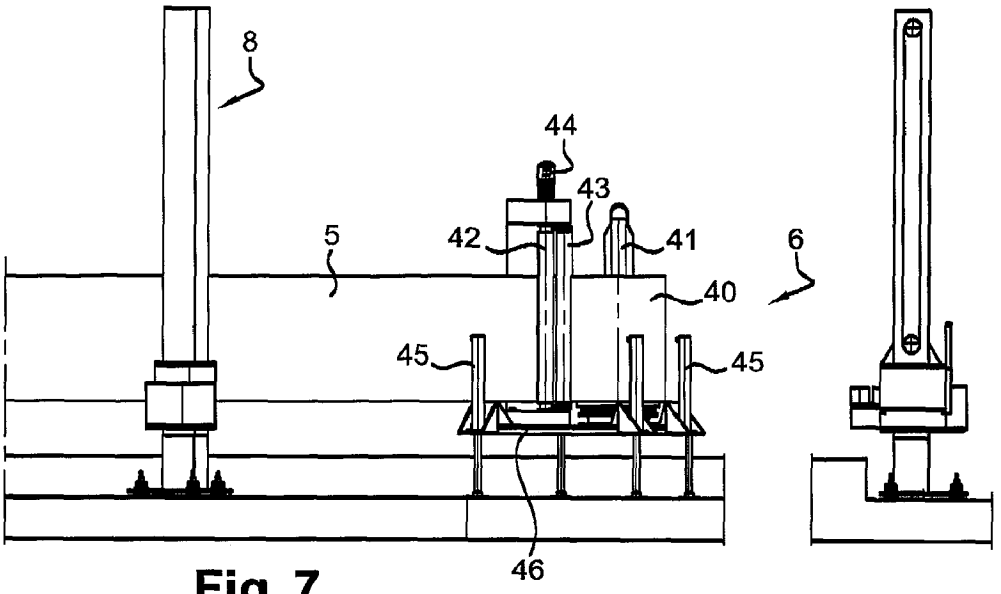

Fig. 7

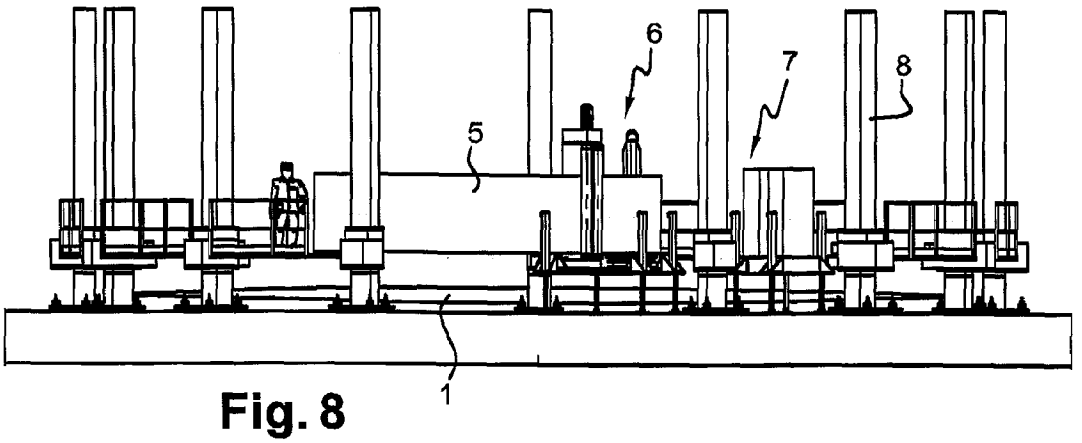

Fig. 8

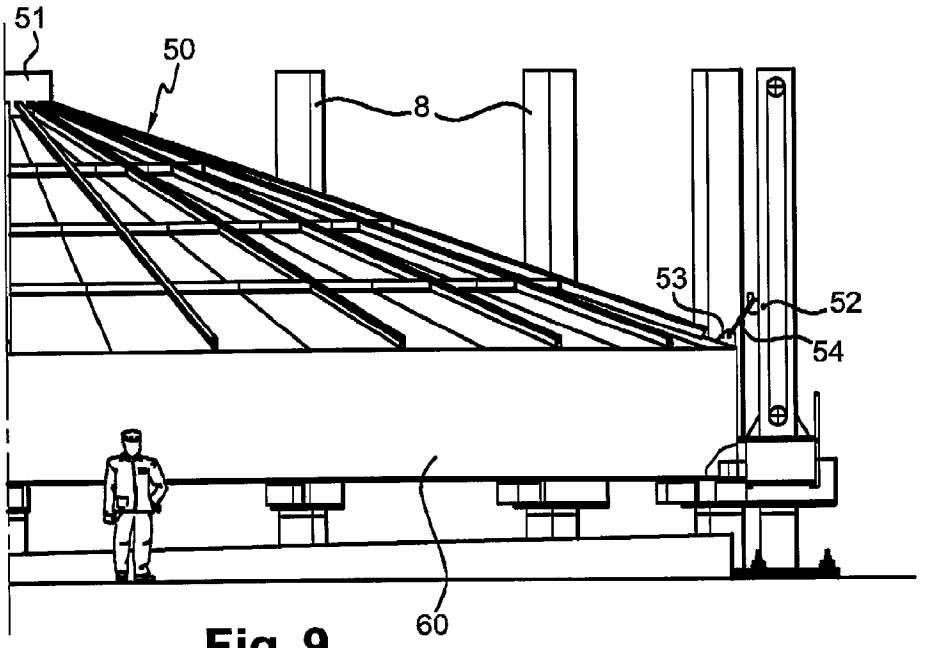

Fig. 9

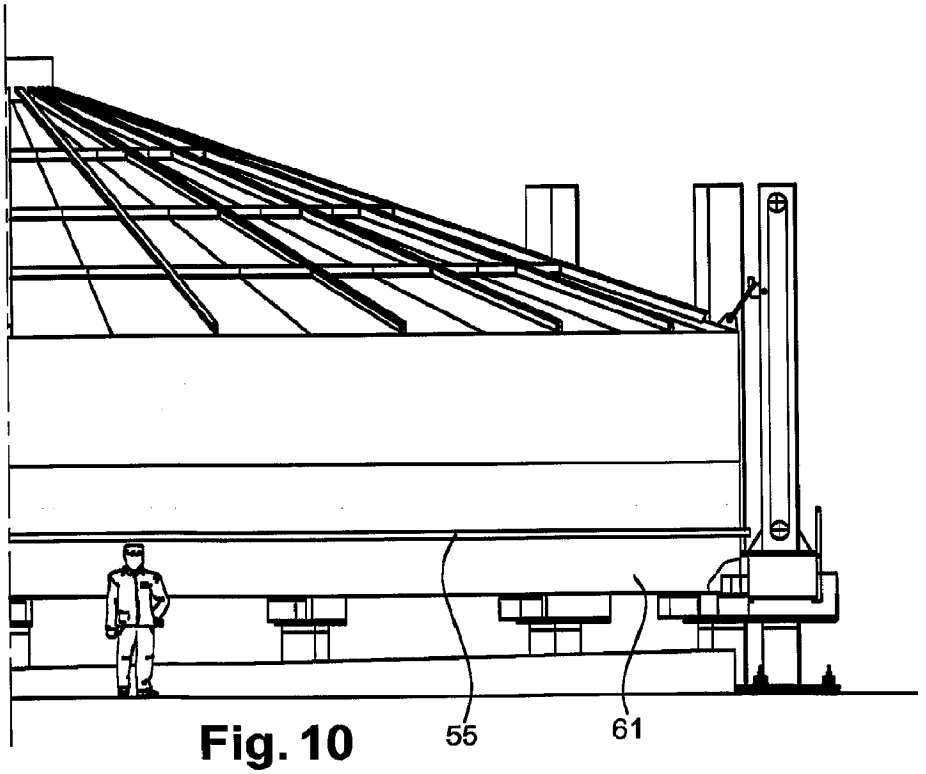

Fig. 10

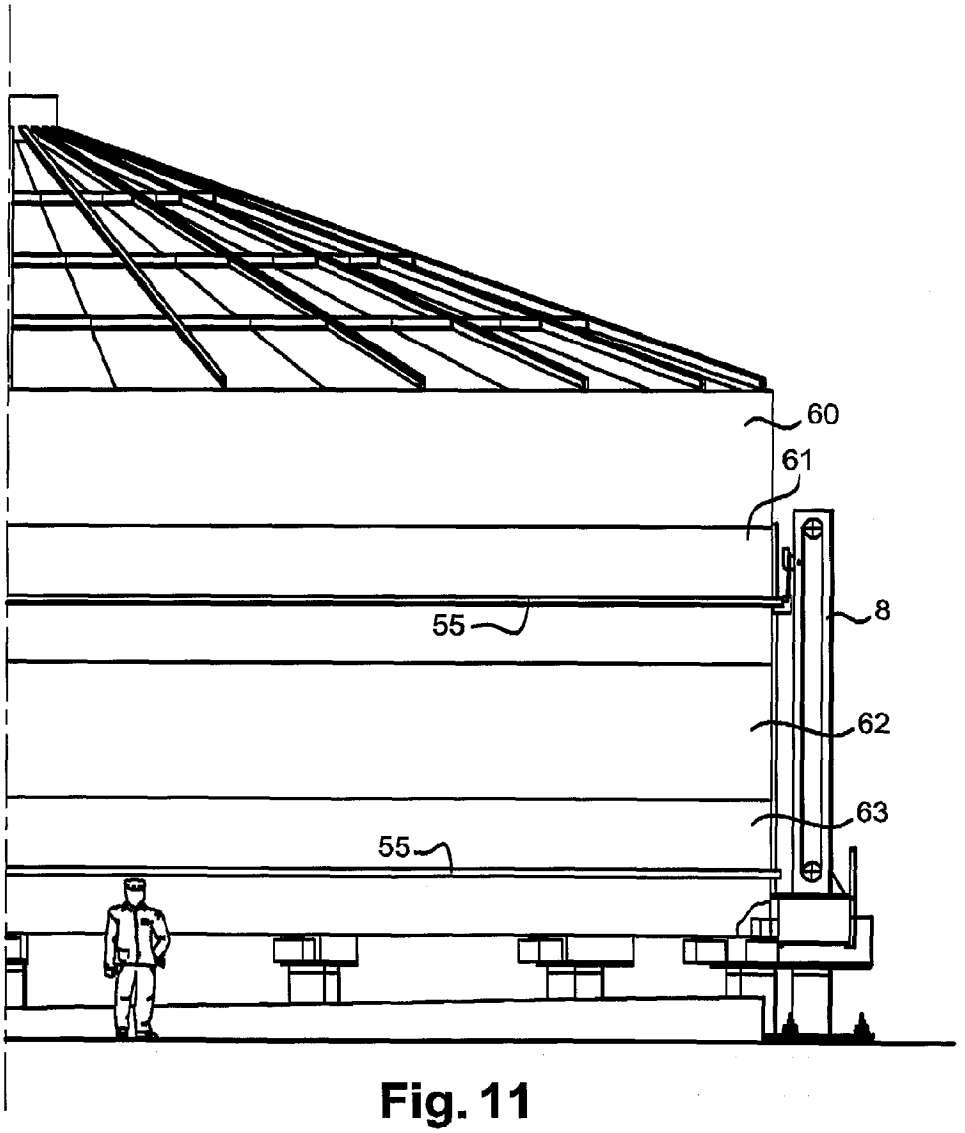

Fig. 11

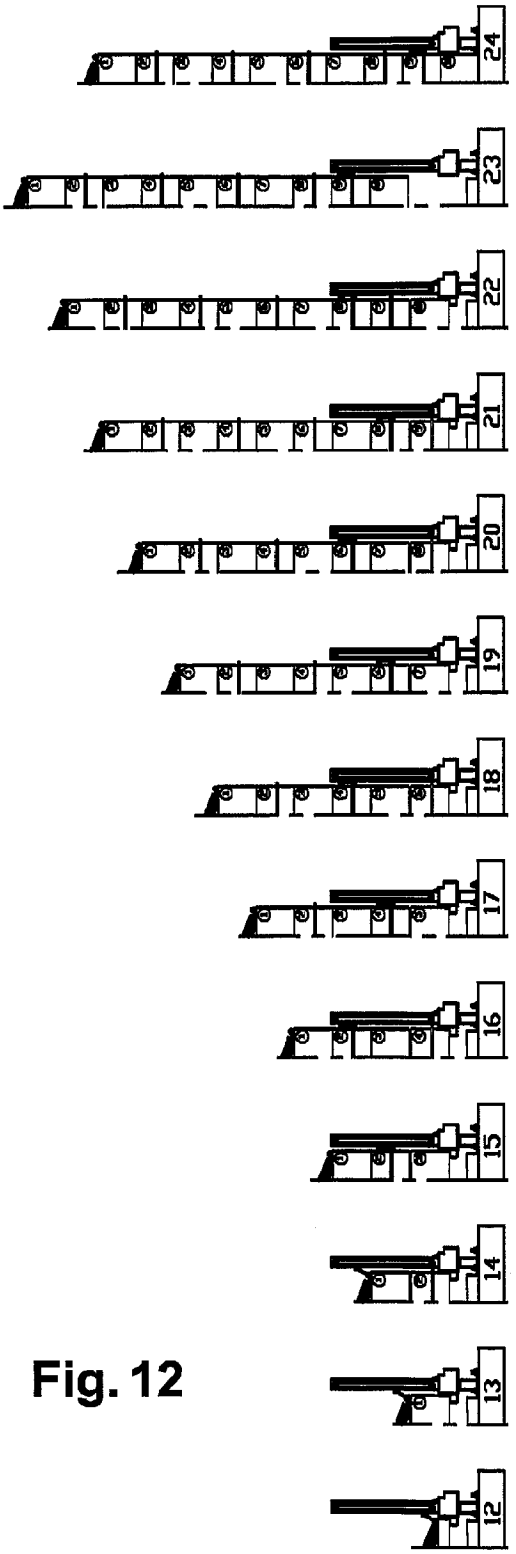

Fig. 12

Office européen des brevets

RAPPORT DE RECHERCHE EUROPEENNE

Numéro de la demande
EP 03 10 0885

DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes	Revendication concernée	CLASSEMENT DE LA DEMANDE (Int.Cl.7)
Y	EP 0 282 126 A (OOSTWOUDER SILO SERVICE) 14 septembre 1988 (1988-09-14)	4	B21D51/18 E04H7/06
A	* le document en entier *	1,2,8	
Y	FR 2 339 720 A (GARCIA GARCIA SALVADOR) 26 août 1977 (1977-08-26)	4	
A	* le document en entier *	1	
A	US 3 380 147 A (MCDONALD ELDON O) 30 avril 1968 (1968-04-30) * le document en entier *	1,5	
A	US 4 121 747 A (MCFATTER MYRON L) 24 octobre 1978 (1978-10-24) * le document en entier *	1,5	
A,D	FR 2 551 370 A (COTEAU CONST SOUDEES) 8 mars 1985 (1985-03-08)		

DOMAINES TECHNIQUES RECHERCHES (Int.Cl.7)

B21D
E04H
E04B

Le présent rapport a été établi pour toutes les revendications

Lieu de la recherche	Date d'achèvement de la recherche	Examinateur
LA HAYE	22 juillet 2003	Ris, M

CATEGORIE DES DOCUMENTS CITES

X : particulièrement pertinent à lui seul
Y : particulièrement pertinent en combinaison avec un autre document de la même catégorie
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O : divulgation non-écrite
P : document intercalaire

T : théorie ou principe à la base de l'invention
E : document de brevet antérieur, mais publié à la date de dépôt ou après cette date
D : cité dans la demande
L : cité pour d'autres raisons

& : membre de la même famille, document correspondant

EPO FORM 1503 03.82 (P04C02)

ANNEXE AU RAPPORT DE RECHERCHE EUROPEENNE RELATIF A LA DEMANDE DE BREVET EUROPEEN NO. EP 03 10 0885

La présente annexe indique les membres de la famille de brevets relatifs aux documents brevets cités dans le rapport de recherche européenne visé ci-dessus.
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22-07-2003

Document brevet cité au rapport de recherche		Date de publication	Membre(s) de la famille de brevet(s)		Date de publication
EP 0282126	A	14-09-1988	NL	8700554 A	03-10-1988
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			US	4618757 A	21-10-1986

EPO FORM P0460

Pour tout renseignement concernant cette annexe : voir Journal Officiel de l'Office européen des brevets, No.12/82

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(74) Agente: **Toro Gordillo, Ignacio**

(54) Título: **Instalación para la construcción y montaje "in situ" de tanques de eje vertical.**

(57) Resumen:
Instalación para la construcción y montaje "in situ" de tanques de eje vertical.
En una mesa volteadora (1) se realiza la soldadura de las chapas (2) que han de constituir cada virola (6) del tanque (8). A la salida de esta mesa se establece una máquina impulsora (4), que arrastra la chapa múltiple (2) hacia lo que ha de ser la base del tanque (8), donde una serie de guías o roldanas (5) establecen para la chapa (2) una trayectoria circunferencial que va a dar lugar a la virola (6), que se cierra mediante una última soldadura vertical. La virola ya conformada se eleva con la colaboración de una alineación perimetral de gatos (7), conjuntamente con la parte del tanque (8) previamente conformada, dejando un espacio inferior para la conformación de una nueva virola sobre la que desciende el resto del tanque (8), para su soldadura perimetral, descendiendo seguidamente los gatos hasta nivel extremo inferior para elevar esta nueva virola con el resto del tanque.

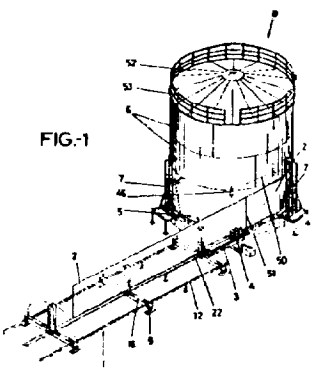


FIG.-1

ES 2 134 107 A1

DESCRIPCION

Instalación para la construcción y montaje "in situ" de tanques de eje vertical.

Objeto de la invención

La presente invención se refiere a una instalación que ha sido especialmente concebida para la construcción y montaje "in situ" de tanques o depósitos metálicos, de eje vertical, obtenidos a partir de chapas planas constitutivas de módulos o virolas, que deben ser soldadas longitudinalmente entre sí, para configurar anillos de diámetro acorde con el del tanque, que posteriormente serán a su vez soldados coaxialmente para la definitiva configuración de dicho tanque.

Antecedentes de la invención

El propio solicitante ideó en su día un procedimiento para la construcción de depósitos metálicos a parte de chapas planas, consistente en proceder inicialmente a la soldadura de las uniones entre las chapas integrantes de cada virola del tanque, en su configuración inicial plana, es decir antes de que hayan tomado su necesaria curvatura, de manera que una vez obtenida una pieza múltiple, de longitud apropiada al diámetro del tanque, se procedía a la curvatura de la misma y finalmente a su soldadura de cierre, elevándose seguidamente la virola obtenida, mediante un sistema de gatos, para establecer debajo de ello una segunda virola, de forma análoga, y así sucesivamente.

Los gatos de sustentación de las virolas, y consecuentemente del tanque en fase de construcción, estaban relacionados entre sí mediante un aro metálico que exigía un perfecto sincronismo en su movimiento, lo que hacía que la maniobra de aproximación de dichos gatos al borde inferior de la virola ya conformada resultase lenta y compleja, ya que tal maniobra debe realizarse de forma manual.

El curvamiento de la chapa resultante tras las uniones entre piezas o módulos se llevaba a cabo con la colaboración de rodanas-guía, situadas sobre una imaginaria circunferencia coincidente con la base del tanque a obtener, pero obviamente entre estas roldanas debe existir un distanciamiento que obliga a que la extremidad anterior y libre de la chapa sea guiada manualmente en el acceso a cada roldana, con la consecuente participación de mano de obra que ello supone.

Las chapas eran alimentadas a través de una mesa volteadora, que facilitaba la soldadura entre ellas por ambas caras, a continuación de la cual se situaba un impulsor, provisto de una pareja de rodillos contrapuestos que, al modo de pinza giratoria, arrastraban la chapa múltiple hacia la zona de curvatura o conformación de las virolas. Esto determinaba un contacto lineal sobre la chapa, a veces insuficiente para conseguir el arrastre de la misma, produciéndose deslizamientos relativos entre los rodillos y la chapa.

Estos rodillos impulsores, determinaban además un punto muerto entre virola y virola, que obligaba a determinados movimientos manuales sobre las chapas, en especial para efectuar el necesario cruce entre las uniones verticales de virolas sucesivas.

El objetivo fundamental de este procedimiento era conseguir evitar las clásicas deformaciones que se producen en las líneas de unión entre las chapas de una virola, cuando la soldadura se efectúa una vez que dichas chapas han sido curvadas, pero sin embargo este objetivo no se conseguía sobre la línea de cierre de cada virola, ya que la soldadura debía efectuarse una vez arqueada la chapa, es decir confeccionada la virola, ni tampoco en las líneas perimetrales de unión entre virolas.

Descripción de la invención

La instalación que la invención propone introduce una serie de perfeccionamientos que resuelven de forma plenamente satisfactoria la problemática anteriormente expuesta, en los diferentes aspectos comentados.

Para ello y de forma más concreta en dicha instalación, partiendo de una estructura base adecuada para la puesta en práctica del procedimiento de construcción de depósitos metálicos a que se ha hecho mención con anterioridad, centra sus características en los siguientes aspectos:

De acuerdo con una características esencial de la invención el citado aro metálico que relaciona todos los gatos con el cuerpo cilíndrico ha sido eliminado, siendo dichos gatos mecánicamente independientes, contando cada uno de ellos con una especie de gancho para su acoplamiento al borde inferior de la virola de manera que la maniobra de aproximación de los gatos a la virola resulta considerablemente más rápida y sencilla, realizándose automática y sincronizadamente el movimiento de los mismos a partir de dicha situación base de aproximación.

De acuerdo con otra de las características de la invención se ha previsto la participación en la instalación de una máquina impulsora de cinco rodillos que mejora el arrastre de las chapas, en ausencia de deslizamientos y sin producir deformaciones en las mismas.

Se ha previsto también la disposición, a la salida de la mesa volteadora, de un bastidor que una dicha mesa con la base de los tanques, bastidor por el que se desplaza la máquina impulsora para tomar la extremidad libre de la virola a introducir en el tanque, desplazarse hasta este último, y posteriormente volver a su posición inicial para que con este recorrido se produzca el necesario cruce entre uniones verticales de virolas, sin necesidad de mover estas últimas, manualmente, sobre los rodillos-guía inferiores en que se apoyan.

De acuerdo con otra de las características de la invención se ha previsto la existencia de mordazas que, actuando sobre los extremos de cada virola determinan un aplanamiento de la misma, que permite que esta soldadura terminal o de cierre se realice también en las mismas condiciones que las restantes soldaduras de la virola, es decir con las secciones a unir perfectamente planas y coplanarias. Paralelamente se ha previsto que el ensamble entre virolas, es decir las uniones circulares entre ellas, se lleven a cabo con la colaboración de grapas, inicialmente sin soldadura y con posibilidad de movimientos longitudinales.

De acuerdo con otra de las características de la invención en el centro de lo que ha de ser la base inferior del tanque se establece un brazo giratorio, dotado en su extremidad libre de medios

de fijación para la extremidad frontal y libre de la virola, que guía convenientemente a esta última para que, sin necesidad de participación manual, acceda directamente a las roldanas de apoyo que establecen la trayectoria circunferencial correspondiente a la definitiva configuración de la virola.

De acuerdo con otra de las características de la invención, se ha previsto que en el sistema de elevación de los gatos, concretamente en el husillo elevador, participen dos tuercas, de manera que mientras una de ellas cumple normalmente el trabajo del gato, la otra actúa como elemento de seguridad que imposibilita cualquier accidente generado por la rotura de la primera.

Se ha previsto también que, cuando por problemas de espacio no es posible la implantación de la mesa volteadora, ésta pueda sustituirse por una desbobinadora.

Asimismo se ha previsto también que cuando el diámetro del tanque es grande se establezca una máquina impulsora intermedia, en el desarrollo del mismo.

Finalmente y de acuerdo con otra de las características de la invención, se ha previsto la posibilidad de que la mesa volteadora se remate en un carril doble, en forma de Y, que permite desviar alternativamente las virolas hacia dos lugares independientes de conformación de sendos tanques, concretamente en el caso de que sea necesario montar más de uno.

Descripción de los dibujos

Para complementar la descripción que se está realizando y con objeto de ayudar a una mejor comprensión de las características del invento, se acompaña a la presente memoria descriptiva, como parte integrante de la misma, un juego de dibujos en donde con carácter ilustrativo y no limitativo, se ha representado lo siguiente:

La figura 1.- Muestra, según una representación esquemática en perspectiva, una instalación para la construcción y montaje "in situ" de tanques de eje vertical, realizada de acuerdo con el objeto de la presente invención.

La figura 2.- Muestra, también según una vista en perspectiva, uno de los apoyos para los volteadores.

La figura 3.- Muestra uno de los niveladores de las traviesas.

La figura 4.- Muestra la traviesa intermedia de la mesa volteadora.

La figura 5.- Muestra una de las traviesas laterales complementarias de la traviesa de la figura anterior.

La figura 6.- Muestra un despiece en perspectiva de una de las volteadoras que participa en la citada mesa.

La figura 7.- Muestra un despiece en perspectiva de la bancada sobre la que se desplaza la impulsora.

La figura 8.- Muestra, también según una vista en perspectiva, uno de los gatos de elevación del tanque.

La figura 9.- Muestra un despiece en perspectiva del mecanismo del gato de la figura anterior.

La figura 10.- Muestra un despiece en perspectiva de una de las roldanas-guía de conformación de las virolas.

La figura 11.- Muestra otra realización de estas roldanas.

La figura 12.- Muestra, finalmente, un despiece del nudo central correspondiente al brazo giratorio de guía para la extremidad frontal de las virolas.

Realización preferente de la invención

A la vista de estas figuras puede observarse cómo en la instalación que se preconiza participa una mesa volteadora (1), donde se va a llevar a cabo la soldadura entre las diferentes chapas (2) constitutivas de cada virola, a continuación de la cual se establece el bastidor (3) sobre el que es desplazable la máquina impulsora (4), que suministra la chapa múltiple constitutiva de cada virola a una alineación circunferencial de guías (5) donde se produce la curvatura de las mismas para la definitiva conformación y cierre de la virola (6), que será posteriormente elevada y sustentada con la colaboración de los gatos (7) que mantienen o sustentan en cada momento la parte ya conformada del depósito o tanque (S), durante todo el proceso de conformación del mismo.

En la mesa volteadora (1) participan una serie de apoyos telescópicos (9), como en el representado en la figura 2, que sustentan a respectivos volteadores (10), como el representado en la figura 6, volteadores (10) relacionados mediante una traviesa intermedia (11), como la representada en la figura 4, y una pareja de traviesas laterales (12) como la representada en la figura 5, contando estas traviesas (11) y (12) con parejas de orejetas (13) sobre las que se montan ejes (14) para libre giro de rodillos (15) para deslizamiento de las chapas (2).

Cada volteadora (10) está estructurada a partir de una bancada (16) provistas de casquillos extremos (17) para su acoplamiento a los apoyos telescópicos como el representado en la figura 2, bancada (16) sobre la que se montan dos brazos basculantes (18), que lo son sobre respectivas ejes (19) y que están asistidos por sendos cilindros hidráulicos (20) establecidos en el interior acanalado de los brazos (18), entre la bancada (16) y un eje o pasador (21) establecido en el correspondiente brazo (18).

Estos dos brazos son susceptibles de bascular independientemente, el uno contra el otro, tal como muestra la figura 1, para abrazar a la chapa (2), y de bascular ambos sobre una de las dos mitades de la mesa, o sobre la otra, para que dicha chapa (2) ofrezca al operario ambas caras, al objeto de que la soldadura de unión entre chapas se realice también por ambas caras, permitiendo además el arrastre de la virola, tanto en la posición vertical representada en la figura 1, en la que el borde inferior de la virola apoya sobre los rodillos (15) de la traviesa intermedia (11), como en posición horizontal en cuyo caso colaboran también los rodillos (15) de la traviesa lateral (12) correspondiente.

A la salida de la mesa volteadora y como anteriormente se ha dicho, se sitúa la bancada (3) para la impulsora (4), la cual aparece representada en detalle en la figura 7, bancada (3) que se prolonga en dos traviesas (22-22'), una de unión a la mesa volteadora y otra contrapuesta, que de forma similar a la traviesa intermedia (11) de la mesa volteadora, incorporan parejas de orejetas (23) soporte para el eje (24) de respectivos rodillos (25) de guiado para la virola.

En la zona de definitiva configuración de las virolas (6), y consecuentemente de conformación del tanque (8), se establece una alineación circunferencial de gatos (7), como el representado en detalle en la figura 8, a base de una guía vertical (26), convenientemente solidarizada a una estructura soporte (27) que asienta sobre el suelo a través de patas telescópicas (28), guía (26) en cuyo seno se establece un husillo (29), accionado por un moto-reductor (30-31), husillo (29) en el que juegan dos tuercas, una tuerca operativa (32) y una tuerca de seguridad (33), estando asociado a la tuerca operativa (32) un cuerpo (34) provisto de un eje transversal que relaciona dicha tuerca con una pareja de soportes laterales (35), alojadas también en el seno de la guía (36), desplazables en el seno de esta última con la colaboración de ruedas (37) determinantes de un perfecto guiado, en ausencia de rozamiento, estableciéndose entre los dos soportes (35) un pasador (38) a través del que se une a la tuerca operativa (32) un gancho (39) provisto superiormente de un casquillo (40) que establece una unión articulada sobre el soporte (10) que permite la basculación del gancho (39) para su desacoplamiento del borde inferior de las virolas (6).

La alineación de chapas (2), constitutiva de cada virola, accede al trazado circunferencial enmarcado por los gatos (7) con la colaboración de las roldanas (5) como la que aparece representada en detalle en la figura 11, provistas de una carcasa base (41) con un asiento superior (42) para un eje (43) de la roldana propiamente dicha (44), en cuyo canal (45) es guiado el borde inferior de las chapas (2), estando la citada carcasa (41) destinada a fijarse inferiormente, en la realización de esta figura 11, o bien lateralmente en la representación de la figura 10.

En el centro de esta línea circunferencial determinante de cada virola (6), se establece un nudo (46), representado en detalle en la figura 12, en el que participa también una base fija (47) sobre la que está montado con libertad de giro, por ejemplo a través de un cojinete, un eje (48) rematado superiormente en una orejeta perforada (49) para acoplamiento de un brazo (50), representado esquemáticamente en trazo discontinuo en la figura 1, que configura un radio de guiado para la extremidad frontal de la chapa múltiple (2) constitutiva de cada virola.

De acuerdo con esta estructuración y tras el soldado de las chapas (2) a través de las líneas verticales (51), por ambas caras, sobre la mesa volteadora (1), las chapas (2) constitutivas de cada virola son guiadas por las roldanas (44) para adoptar la definitiva configuración cilíndrica de dichas virolas, procediéndose al cierre de cada una de ellas mediante otra soldadura vertical en la que participan mordazas, no representadas en las figuras, que aplanan los extremos de la virola durante la fase de soldadura determinando unas condiciones para dicha soldadura final, similares a las de las soldaduras anteriores en la unión entre placas (2).

Una vez que la virola (6) está terminada, sobre la misma se monta el techo o base superior (52) del tanque, y en su caso la barandilla de protección (53) o cualquier otro accesorio necesario, procediéndose seguidamente a la elevación de dicha virola con la colaboración de los gatos (7) que tras enganchar sus ganchos (39) en el borde inferior de la virola, mediante una maniobra manual de aproximación, se elevan simultánea y sincronizadamente mediante el adecuado comando de sus motores (3). La elevación de esta virola será suficiente como para dejar espacio libre bajo la misma para la conformación de una segunda virola (6), en la que se repite el proceso descrito, tras lo cual sobre el borde superior de la segunda virola se establecen grapas de apoyo para la primera que permiten, tras el adecuado descenso de esta última, independizar los ganchos (39) de los gatos (7), pasando a ser la virola inferior la que sustenta a la virola o virolas superiores, procediéndose seguidamente a la soldadura circunferencial de ambas virolas tras lo que se eliminan las grapas procediéndose también al cierre mediante soldadura de los huecos dejados por las mismas, para finalmente descender los gatos hasta nivel extremo inferior, acoplando sus ganchos (39) al borde inferior de la última virola y elevando el conjunto para repetir nuevamente el ciclo operativo.

En el caso de tener que fabricar varios depósitos se ha previsto la posibilidad, ya comentada, de que a la salida de la bancada de impulsora (3) se establezca un carril doble, en forma de Y, de manera que mientras se está soldando una pareja de virolas de un depósito, se está conformando una nueva virola para el segundo depósito, y viceversa.

No se considera necesario hacer más extensa esta descripción para que cualquier experto en la materia comprenda el alcance de la invención y las ventajas que de la misma se derivan.

Los materiales, forma, tamaño y disposición de los elementos serán susceptibles de variación siempre y cuando ello no suponga una alteración en la esencialidad del invento.

Los términos en que se ha redactado esta memoria deberán ser tomados siempre en sentido amplio y no limitativo.

REIVINDICACIONES

1. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, que partiendo de una mesa volteadora donde se produce la soldadura de las chapas constitutivas de cada virola del tanque, en disposición perfectamente plana para dichas piezas, que tras su unión son suministradas a una guía circunferencial que da la definitiva configuración cilíndrica a cada virola y donde se efectúa la soldadura de cierre con la que concluye la misma, colaborando con dicha guía circunferencial una alineación perimetral de gatos, que elevan cada virola ya conformada, y más concretamente el sector ya construido del tanque, para conformación bajo el mismo de una nueva virola, esencialmente se **caracteriza** porque los citados gatos (7) son físicamente independientes entre sí, materializándose en una guía vertical (26), convenientemente establecida en una estructura soporte (27), regulable, guía (26) en el seno de la cual es desplazable una tuerca (32) que, a través de una pareja de soportes (35) provistos de ruedas (37) de deslizamiento sobre la guía (26), arrastra a un gancho (39) unido articulamente a los soportes (35) con la colaboración de un casquillo (40) y un pasador (38), todo ello de forma que cada gato, y más concretamente cada gancho (39) es desplazable manualmente hacia una situación de acoplamiento al borde inferior de la virola (6), contando además cada gato (7) con un moto-reductor (30-31) con el que se produce la elevación de dicha virola, conjuntamente con la parte ya conformada del tanque, habiéndose previsto que los motores (30) correspondientes a los diferentes gatos (7), estén debidamente sincronizados.

2. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque dentro de cada gato (7), con la tuerca operativa (32) colabora una tuerca de seguridad (33) que mantiene operativo el gato ante una eventual rotura de la primera tuerca.

3. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque la impulsora (5) o arrastradora de la chapa múltiple (2) que ha de constituir cada virola (6) está provista de múltiples rodillos, preferentemente en número de cinco, distribuidos al tresbolillo, para facilitar el arrastre de las chapas sin deslizamiento de las mismas.

4. Instalación para la construcción y montaje "in situ", de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque a la salida de la mesa volteadora (1) se establece un bastidor (3) que la relaciona con la zona de conformación del tanque (8) y por la cual es desplazable la máquina impulsora (4).

5. Instalación para la construcción y montaje "in situ", de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque en la zona de cierre de cada virola (6) se establecen mordazas determinantes del aplanamiento y coplanaridad de los extremos de la chapa múltiple constitutiva de cada virola, durante la fase de soldadura correspondiente al cierre de la misma.

6. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque sobre el borde superior de la virola (6) recién cerrada, se establecen una pluralidad de grapas que constituyen distanciadores en el descenso y apoyo del resto del tanque (8) sobre la citada virola (6) extrema inferior, para permitir el desacoplamiento de los ganchos de sustentación (39) de los gatos (7), grapas que son eliminadas tras la soldadura circular o perimetral de dicha virola (6) al resto del tanque (8).

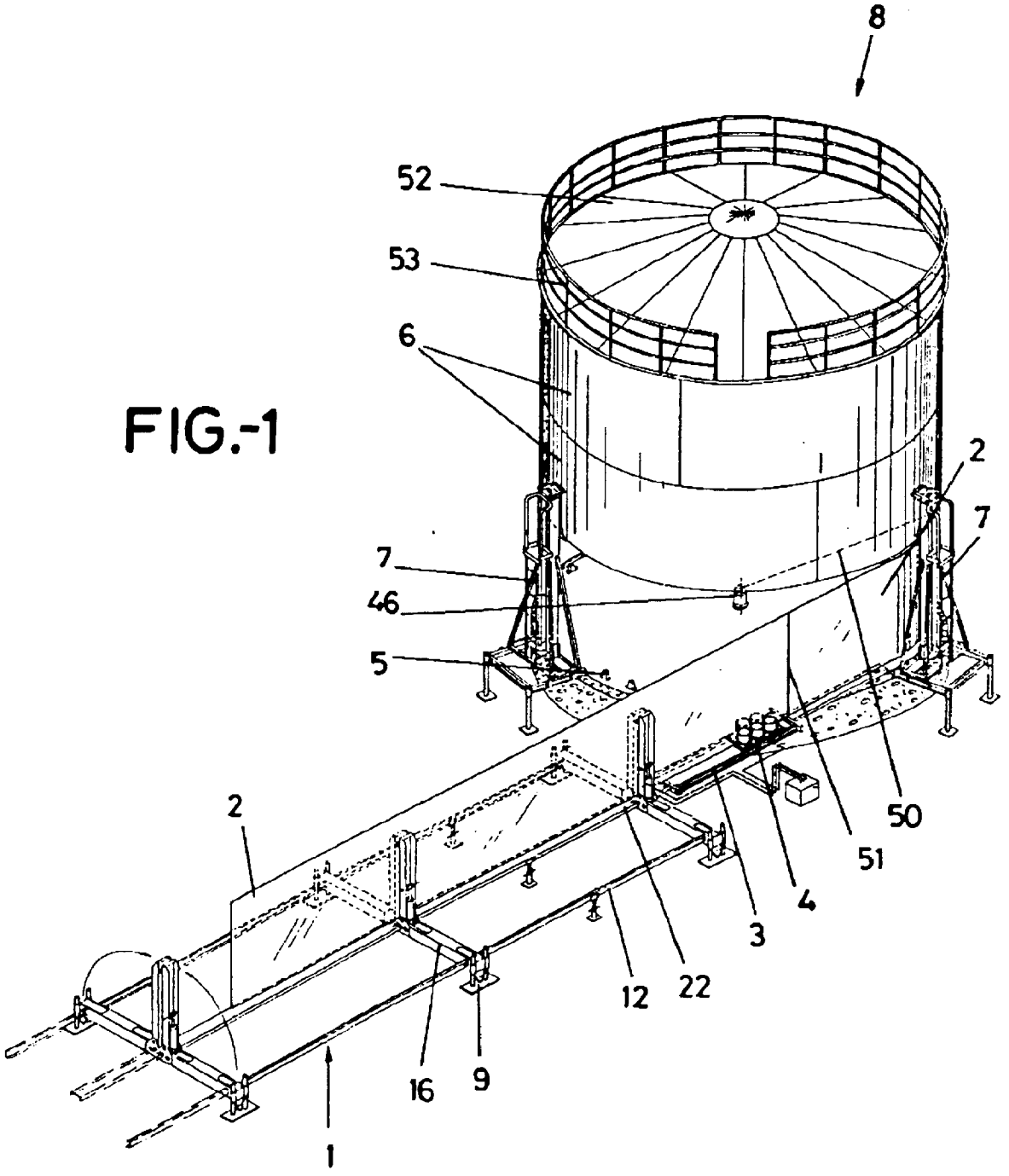
7. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicación 1ª, **caracterizada** porque en correspondencia con el imaginario eje del tanque (8) se establece un nudo (46) provisto de un eje (48) con libertad de giro, rematado en una orejeta (49) a la que es solidario un brazo radial (50) que actúa como guía para la extremidad frontal o anterior de la chapa múltiple (2) durante la maniobra de conformación de la virola, concretamente para facilitar el acceso de dicho frente a las roldanas (44) de guiado de la chapa.

8. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicaciones anteriores, **caracterizada** porque cuando el diámetro del tanque (8) es grande, se ha previsto la disposición de una segunda impulsora, complementaria de la impulsora (4), a nivel medio del desarrollo de dicho tanque.

9. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicaciones anteriores, **caracterizada** porque la mesa volteadora (1) es susceptible de sustitución por una desbobinadora, cuando existan problemas de espacio para la implantación de la primera.

10. Instalación para la construcción y montaje "in situ" de tanques de eje vertical, según reivindicaciones anteriores, **caracterizada** porque en el supuesto de montaje simultáneo de varios tanques, a la salida de la volteadora (1) se establece una viga con carril en forma de Y, cuyas dos ramas se dirigen hacia las bases de dos tanques (8) a conformar.

FIG.-1



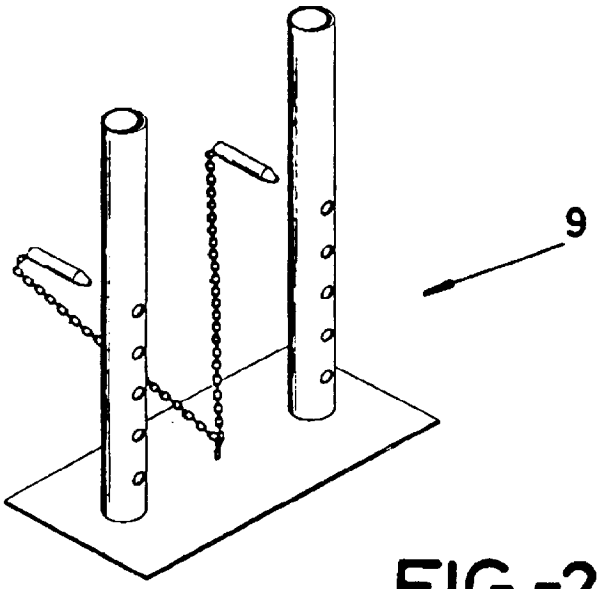


FIG.-2

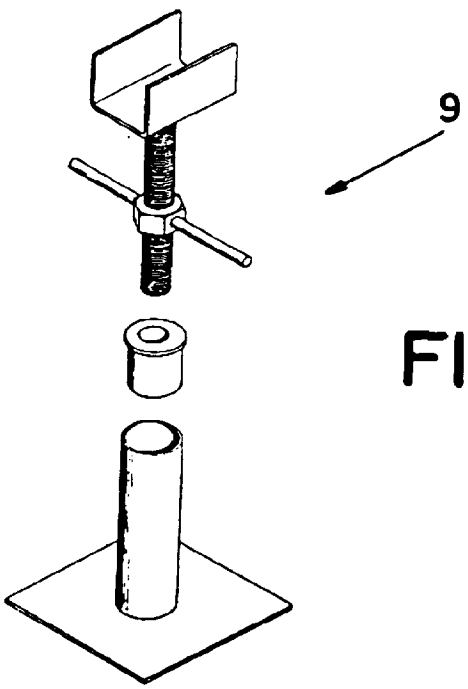


FIG.-3

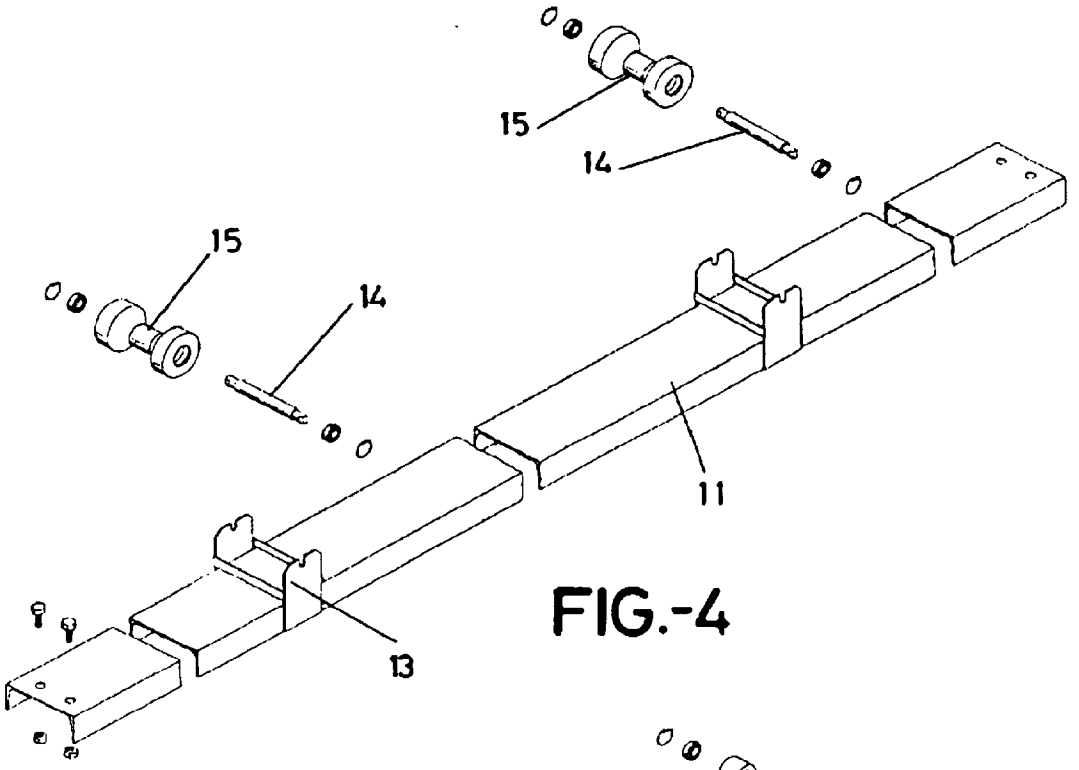


FIG.-4

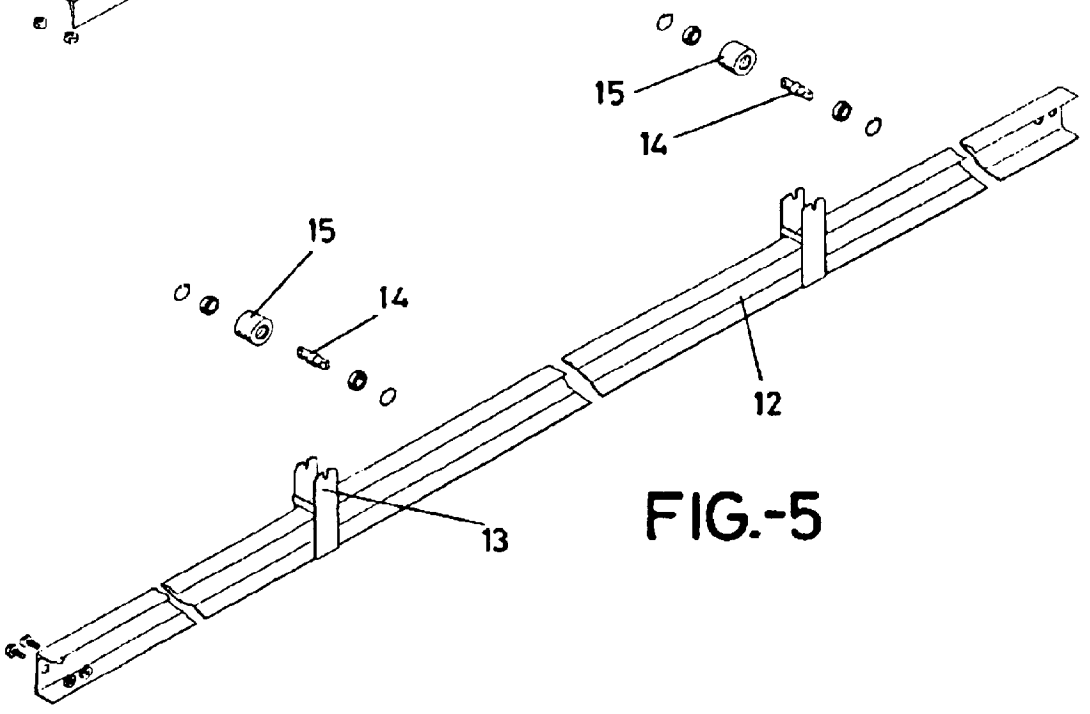


FIG.-5

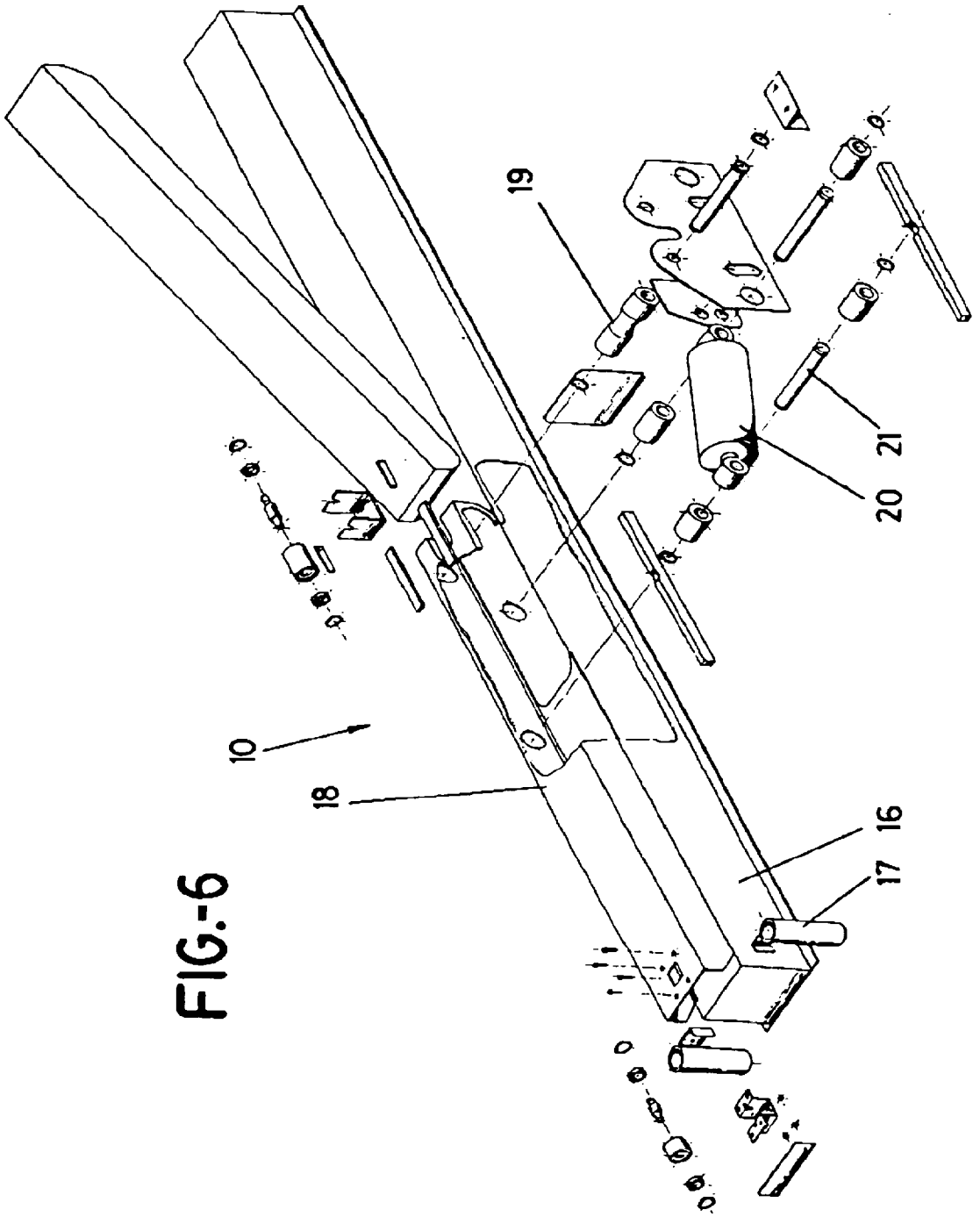


FIG-6

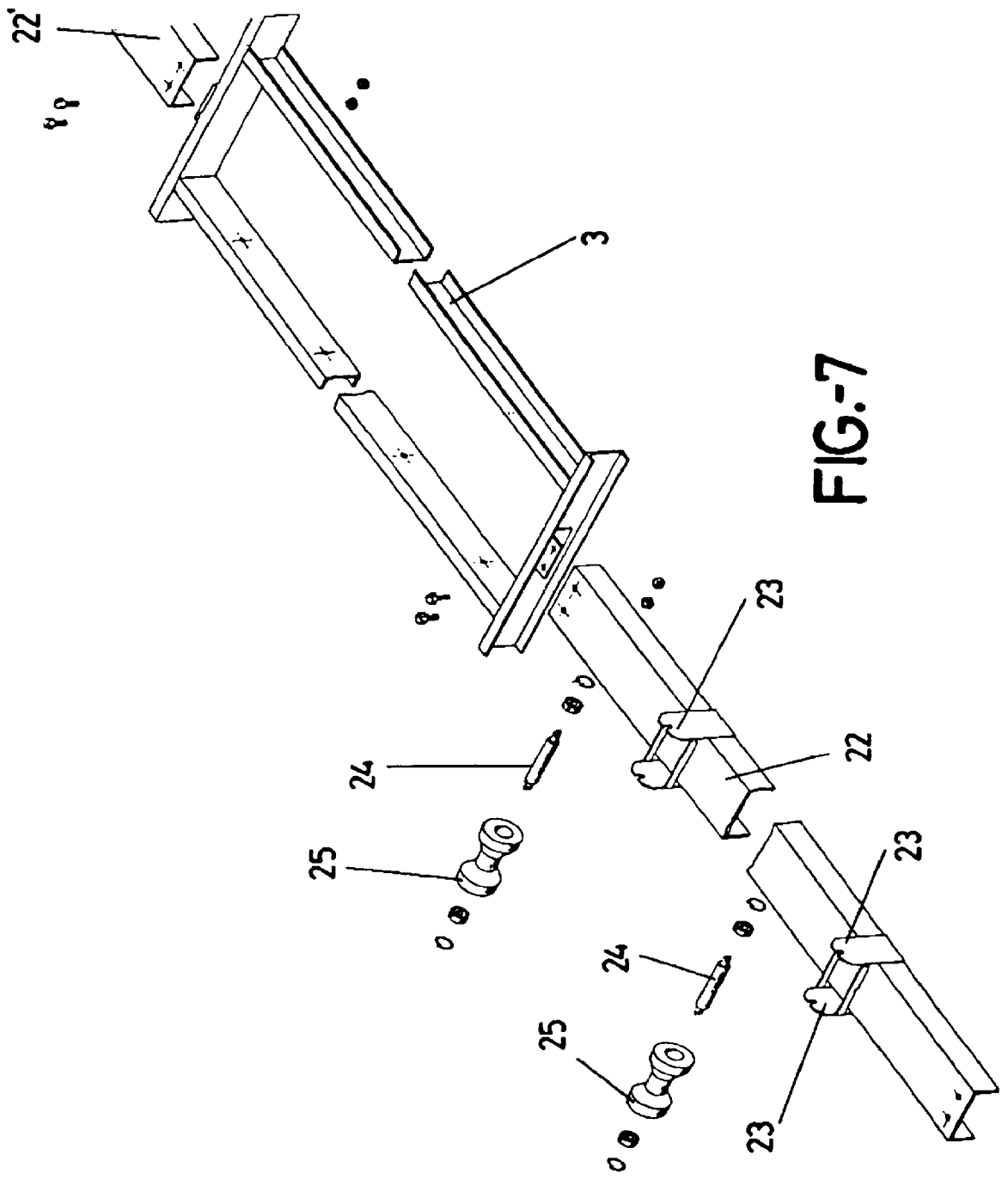


FIG.-7

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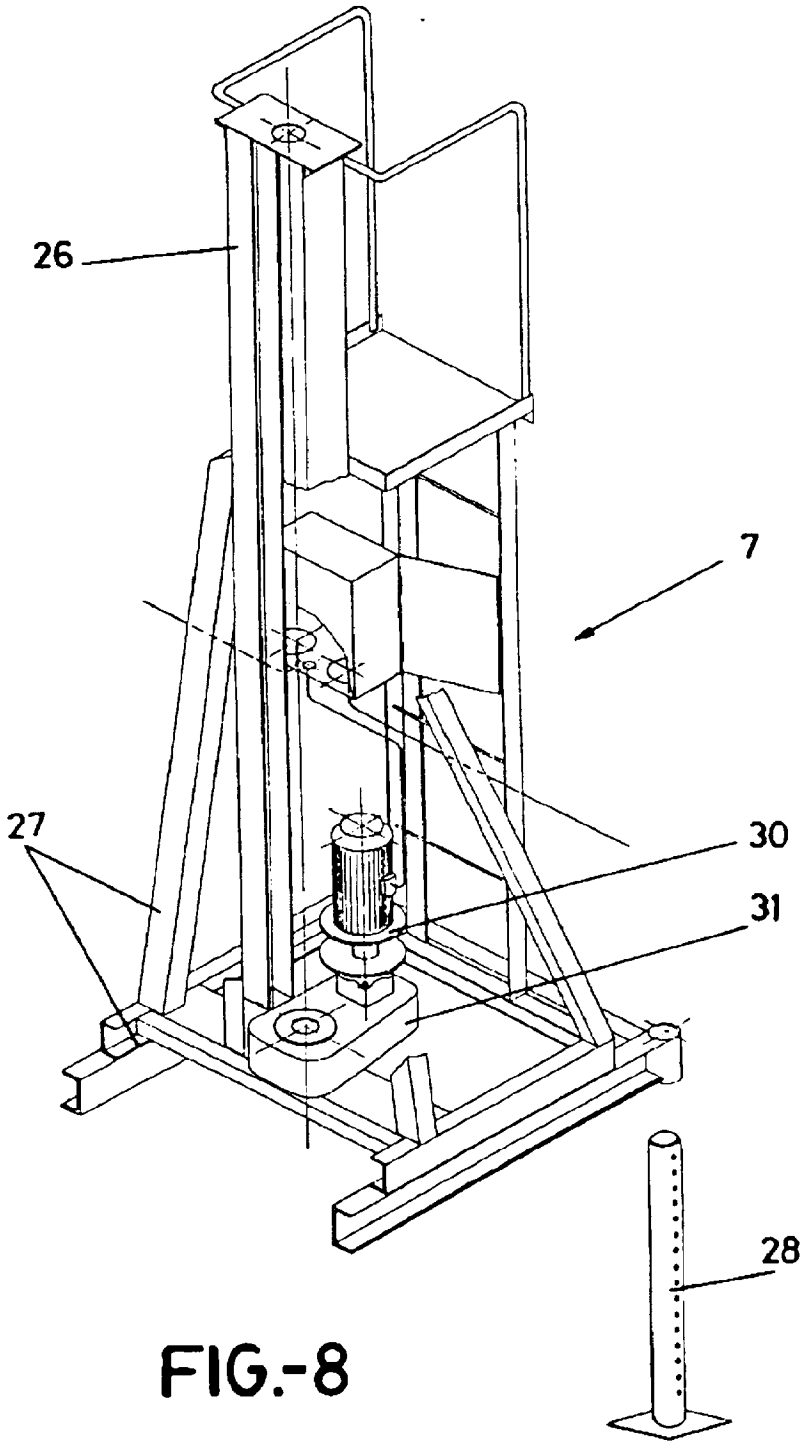

FIG.-8

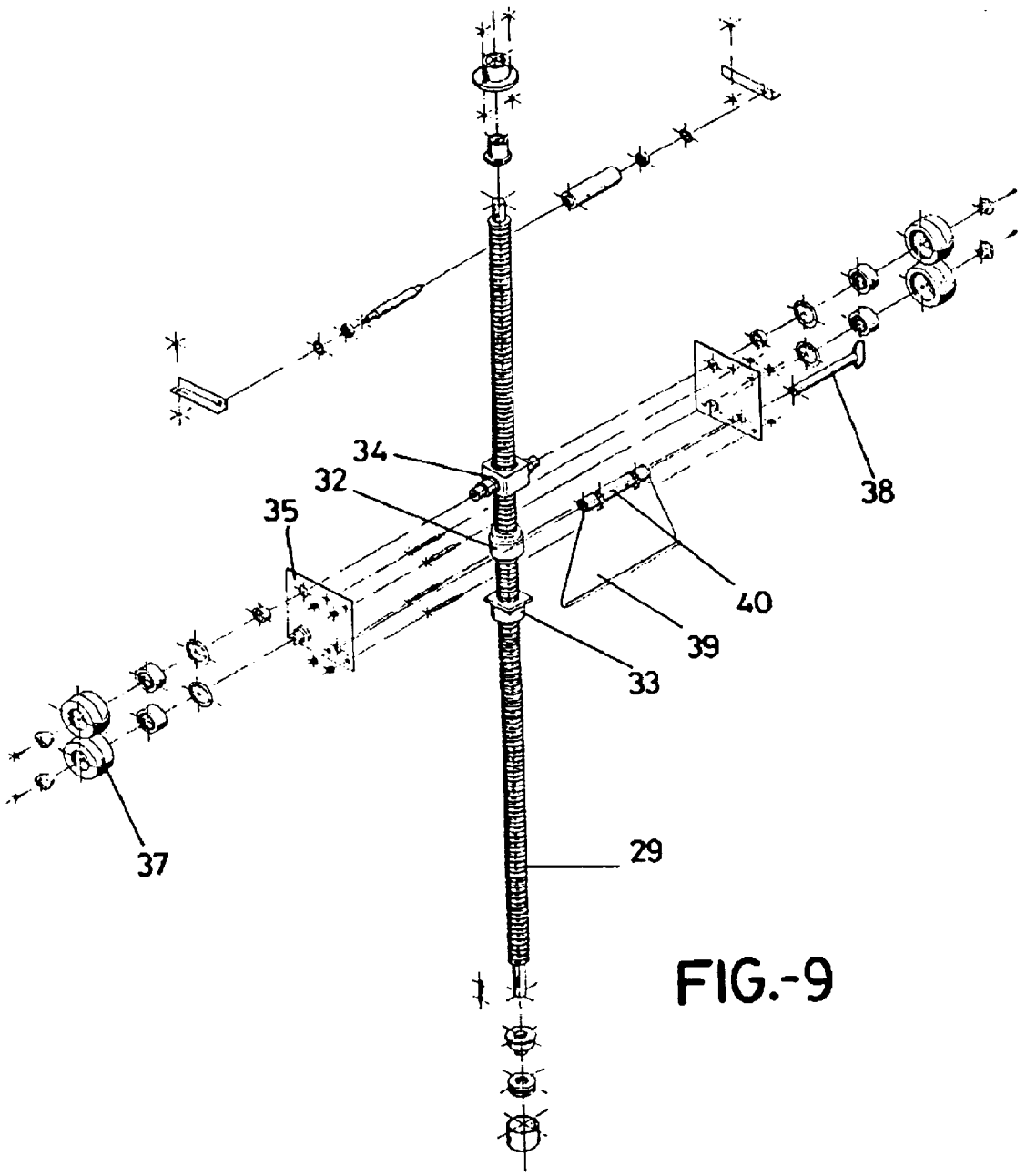

FIG.-9

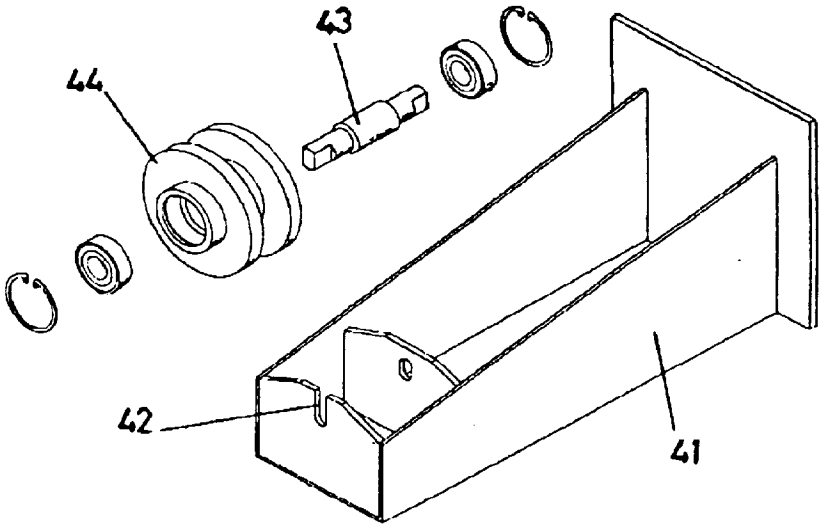

FIG.-10

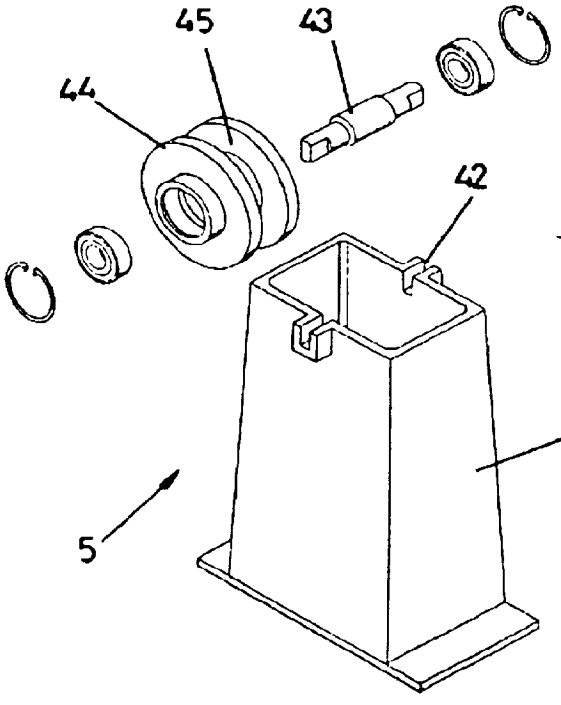

FIG.-11

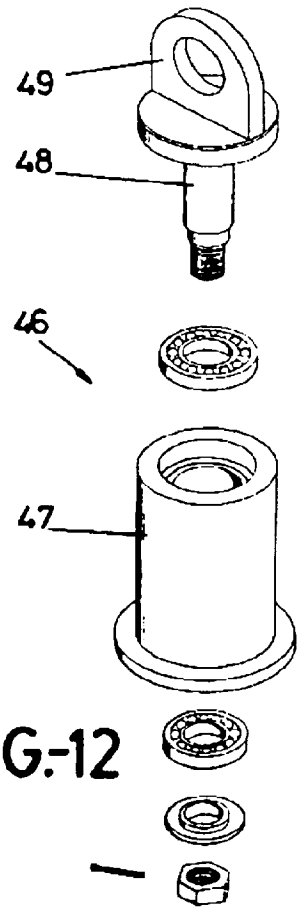

FIG.-12

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DE PATENTES Y MARCAS

ESPAÑA

(11) ES 2 134 107

(21) N.º solicitud: 9601333

(22) Fecha de presentación de la solicitud: **14.06.96**

(32) Fecha de prioridad:

INFORME SOBRE EL ESTADO DE LA TECNICA

(51) **Int. Cl.**[6]: E04H 7/06, 7/30, B65D 88/08, 90/08

DOCUMENTOS RELEVANTES

Categoría	Documentos citados	Reivindicaciones afectadas
A	ES 2031994 T3 (OOSTWOUDER) 14.09.1988, columna 3, línea 49 - columna 8, línea 35; figuras 1-6.	1,3,9
A	ES 8602456 A1 (CONSTRUCTIONS SOUDÉES DU COTEAU) 10.12.1985, página 5, línea 22 - página 11, línea 10; figura 1.	1,3,9
A	US 3380147 A (Mc DONALD) 30.04.1968, columna 1, línea 60 - columna 3, línea 12; figuras 1-6.	1,3,7,9
A	ES 455737 A1 (ANCHORTANK) 10.01.1978, página 4, línea 16 - página 13, línea 9; figuras 1-8.	1,3,9
A	BE 838202 A (GARCIA) 28.05.1976, páginas 3-5; figuras 1-4.	1,3,9

Categoría de los documentos citados

X: de particular relevancia

Y: de particular relevancia combinado con otro/s de la misma categoría

A: refleja el estado de la técnica

O: referido a divulgación no escrita

P: publicado entre la fecha de prioridad y la de presentación de la solicitud

E: documento anterior, pero publicado después de la fecha de presentación de la solicitud

El presente informe ha sido realizado

[x] para todas las reivindicaciones

[ ] para las reivindicaciones nº:

Fecha de realización del informe	Examinador	Página
07.07.99	F. Monge Zamorano	1/1

(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

(19) Organisation Mondiale de la Propriété Intellectuelle
Bureau international

(43) Date de la publication internationale
7 novembre 2002 (07.11.2002)

PCT

(10) Numéro de publication internationale
WO 02/087804 A1

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PCT/FR01/01312

(22) Date de dépôt international : 27 avril 2001 (27.04.2001)

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(26) Langue de publication : français

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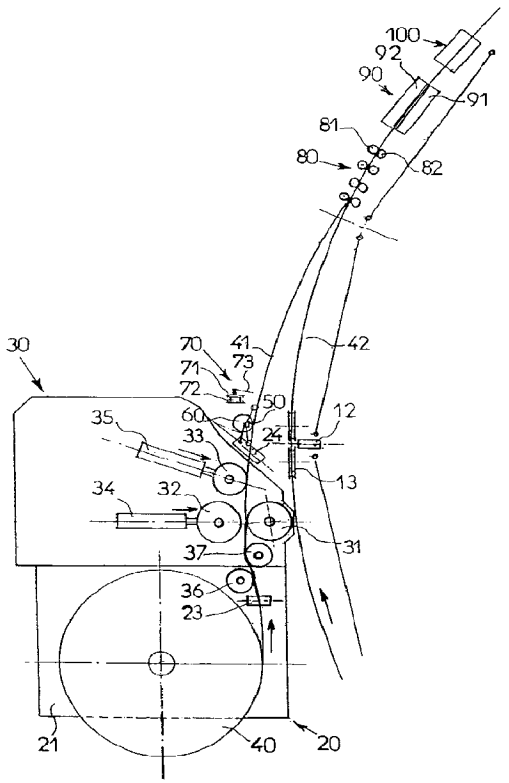
(81) États désignés *(national)* : AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ,

[Suite sur la page suivante]

(54) **Title:** METHOD AND DEVICE FOR SEMI-AUTOMATIC ON-SITE PRODUCTION OF METAL TANKS

(54) **Titre :** PROCEDE ET DISPOSITIF DE REALISATION SEMI-AUTOMATIQUE, SUR SITES, DE RESERVOIRS METALLIQUES



(57) Abstract: The invention concerns a method whereby a steel strip (41) derived from a roll is gradually straightened out, cambered and engaged on rollers (13) supported on cylinders (12), until, after the corresponding perimeter is obtained, the ends are separated and welded together, then in lifting with the actuators (12) said first hoop to a height sufficient for production, then gradually assembling by welding a second hoop by the above process. All those operations are managed by a programmable automaton.

(57) Abrégé : Une bande de tôle (41) provenant d'une bobine (40) est progressivement redressée, courbée et engagée sur des galets (13) soutenus par des vérins (12), jusqu'à séparation après obtention du périmètre correspondant et soudage des extrémités entre elles, puis élévation par les vérins (12) de cette première virole à une hauteur suffisante pour permettre la réalisation, puis l'assemblage progressif par soudage d'une seconde virole en procédant comme indiqué ci-dessus. Toutes ces opérations sont gérées par un automate programmable.

WO 02/087804 A1

NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) États désignés *(régional)* **:** brevet ARIPO (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), brevet eurasien (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), brevet européen (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), brevet OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Publiée :

— *avec rapport de recherche internationale*

En ce qui concerne les codes à deux lettres et autres abréviations, se référer aux "Notes explicatives relatives aux codes et abréviations" figurant au début de chaque numéro ordinaire de la Gazette du PCT.

Procédé et dispositif de réalisation semi-automatique, sur sites, de réservoirs métalliques

L'invention concerne un procédé et un dispositif de réalisation semi-automatique, sur sites, de réservoirs métalliques cylindriques de grande capacité.

Des problèmes d'ordre économique se posant pour la réalisation de réservoirs en acier de grand diamètre, du fait qu'il est exclu, pour des raisons d'encombrement, de les réaliser ailleurs que sur sites, les constructeurs sont contraints d'ouvrir un chantier spécifique sur les lieux mêmes de l'implantation, en déplaçant une équipe parfois importante d'ouvriers spécialisés (chaudronniers industriels, soudeurs etc.) ne disposant, pour mener à bien leur tâche, que d'un matériel de base, facilitant le formage, l'oxycoupage et le soudage de plaques de tôle dont les dimensions doivent être limitées, pour faciliter la manutention et l'assemblage. Il résulte de cela une perte de temps se traduisant par des prix de revient élevés et des problèmes, quant au respect du délai imposé par le donneur d'ordre, relativement au planning préalablement établi avec les représentants des autres corps de métier.

On connaît déjà un procédé et un dispositif de réalisation de réservoirs cylindriques et de viroles à partir de tôle, tels que ceux décrits dans le brevet européen n° **0136581** avec lesquels les viroles sont obtenues par plaquage de bandes de tôle contre le rebord d'un plateau tournant, de diamètre approprié,

sur lequel les dites bandes sont introduites progressivement au fur et à mesure du déroulement de la bobine et du redressement de la tôle.

Ce procédé et ce dispositif ne peuvent cependant être utilisés que pour la réalisation de viroles de faible épaisseur, compte-tenu de la flexibilité de la tôle exigée par ce mode de formage.

On connaît aussi un procédé et un dispositif de réalisation semi-automatique de réservoirs et de viroles correspondant au préambule de la revendication 1 (Brevet européen n° **0727264**). Le procédé consiste à effectuer, dans l'ordre, les opérations suivantes :

a) Réalisation d'une première virole.

b) Mise en place et solidarisation d'un toit sur la première virole.

c) Levage de l'ensemble réalisé à l'opération précédente à une hauteur correspondant à la largeur de la bande de tôle.

d) Réalisation d'une seconde virole sous le premier.

e) Solidarisation progressive de la virole réalisée à l'opération (a) à celle réalisée à l'opération précédente (d).

f) Répétition des opérations (c) (d) et (e) autant de fois que nécessaire pour obtenir la hauteur de cuve désirée.

g) Mise en place de l'ensemble, réalisé en suivant les opérations ci-dessus sur un fond de diamètre

correspondant et solidarisation de celui-ci à la dernière virole.

Les viroles sont réalisées par cintrage, cambrage, au fur et à mesure de l'entraînement et du déroulement de la bobine de tôle. Lors de la réalisation d'une virole, directement sous la précédente, la bande de tôle est progressivement solidarisée à la bobine précédente, qu'elle entraîne en rotation, cette solidarisation étant précédée d'une mise en appui tout aussi progressive de cette virole précédente sur le chant de la bande de tôle en cours de défilement jusqu'à réalisation complète de cette virole suivante. Le contrôle du cambrage de la bande de tôle, selon le rayon exigé, est assuré en permanence, au fur et à mesure de l'entraînement et du défilement de celle-ci.

Le dispositif d'application du procédé ci-dessus évoqué, est caractérisé principalement par l'utilisation de moyens d'entraînement et de cambrage d'une bande de tôle provenant d'un rouleau et de galets associés à des vérins de levage répartis régulièrement sur une circonférence pour constituer un manège, de diamètre correspondant à celui des viroles à réaliser, destiné à soutenir progressivement la tôle après cambrage, la tôle étant entraînée par un tracteur à galets motorisés.

Si le procédé et le dispositif tels qu'ils viennent d'être décrits, permet indéniablement la réalisation des viroles directement à partir de rouleaux de tôle, en respectant de façon suffisamment précise le rayon

exigé et la concordance de viroles afin d'obtenir une étanchéité rigoureuse à chaque niveau, ils ne permettent cependant pas, à eux seuls, de réduire l'effectif de l'équipe d'ouvriers spécialisés ni d'avoir une influence déterminante sur la durée de la réalisation.

La présente invention a pour but de remédier à ces inconvénients. Cette invention telle qu'elle est caractérisée dans les revendications, résout le problème consistant à définir un procédé et à créer un dispositif permettant la réalisation semi-automatique dans un temps très court, par un effectif d'ouvriers spécialisés très réduit, de réservoirs de tôle de grande capacité, à partir de rouleaux de tôle du commerce.

Le procédé de réalisation sur sites de réservoirs métalliques cylindriques de grande capacité, à partir de bobines de tôle mettant en œuvre un moyen d'entraînement, de cambrage et de défilement de la bande de tôle ainsi que des moyens de découpe transversale, d'accostage et de soudage longitudinal des bandes de tôle, consistant à réaliser les viroles par cintrage, cambrage progressif en fonction du diamètre recherché, au fur et à mesure de l'entraînement et du déroulement de la bande de tôle et à réaliser successivement les viroles du haut vers le bas en réalisant chacune d'elles directement sous la précédente en entraînant celle-ci en rotation par solidarisation progressive de la bande de tôle en cours de formage, cette solidarisation étant précédée

d'une mise en appui tout aussi progressive de la virole précédente sur le chant de la bande de tôle au cours du défilement jusqu'à réalisation complète de la virole suivante, le toit étant fixé sur le chant supérieur de la première virole après réalisation de celle-ci ou des deux premières viroles ; la paroi étant solidarisée au fond dès que celle-ci a atteint la hauteur désirée, se caractérise, selon l'invention, principalement :

1°) en ce que la réalisation des viroles est précédée des opérations suivantes:

a) Réalisation d'un fond par oxycoupage circulaire d'un assemblage de bandes de tôle préalablement solidarisées latéralement par référence à un point **C**, déterminé arbitrairement sur la surface de cet assemblage de tôles.

b) Matérialisation de l'axe de symétrie des viroles par soudage d'un dispositif de référence d'axe vertical **Y** coïncidant exactement avec le point **C** défini sur la surface du fond à l'étape précédente.

c) Positionnement précis, par rapport à l'axe **Y** du dispositif de référence, de tous les moyens concourant à l'entraînement, au défilement, au guidage, à l'accostage et au soudage des bandes de tôle et au levage de l'ensemble au fur et à mesure de la réalisation.

2°) En ce que la position verticale des galets de défilement des moyens de levage est contrôlée à distance de façon très précise, individuellement et collectivement, en fonction de la progression des opérations d'assemblage et des séquences imposées par celles-ci.

3°) En ce que la position respective des dispositifs de soudage interne et externe est indiquée en permanence de façon très précise au cours de leur utilisation, avec indication immédiate des décalages pouvant apparaître entre les deux dispositifs, afin que ce décalage puisse être immédiatement annulé en vue de conserver en permanence une parfaite concordance des points de soudure interne et externe lors de la progression de ce cordon de soudure en corniche.

4°) En ce que la solidarisation par soudage du toit sur le chant correspondant de la virole supérieure est accompagnée de la rotation de l'ensemble sur 360° à une vitesse contrôlée compatible avec la progression idéale du cordon de soudure.

5°) En ce que le soudage de l'ensemble sur le fond est précédé de la mise en appui sur taquets mobiles du chant libre de la virole inférieure, du démontage des galets de défilement, du déplacement coordonné vers le bas des dits taquets mobiles jusqu'à mise en appui dudit chant libre de la virole inférieure, sur le pourtour du fond, puis de l'évacuation par le trou

d'homme des équipements inutilisables pour cette opération finale.

Le dispositif, selon l'invention, permettant l'application du procédé ci-dessus exposé, se caractérise principalement en ce que tous les moyens utilisés pour le déroulement, le redressement, le formage, l'entraînement, la découpe, le soudage et le levage, sont gérés par un automate programmable, contrôlable à distance par un boîtier de commande sans fil, en respectant des données prédéterminées.

La position des électrodes des dispositifs de soudage est contrôlée par des détecteurs reliés à un moniteur qui mesure et affiche, en temps réel, les éventuels écarts de position en vue de leur annulation immédiate.

Les avantages obtenus, grâce à cette invention, consistent essentiellement en ce que tous les paramètres de formage, de découpage, d'assemblage et de soudage sont déterminés préalablement de façon très précise et introduits dans l'automate programmable avant l'ouverture du chantier, tout en laissant aux opérateurs le contrôle de la totalité du déroulement du processus par l'intermédiaire de moyens de commande à distance non filaires, ce qui permet donc bien de ne déplacer sur sites qu'un nombre très limité de personnes, réduit le plus souvent à trois, tout en diminuant le temps de réalisation étant donné l'élimination préalable des temps morts antérieurs

résultant de la préparation des réglages, des manutentions et des tâtonnements.

D'autres caractéristiques et avantages apparaîtront dans la description qui va suivre d'un procédé et d'un dispositif de réalisation de cuves destinées à l'industrie chimique, donnés à titre d'exemple non limitatif au regard des dessins annexés, sur lesquels:

- Les figures **1** à **6** illustrent schématiquement les principales étapes du procédé.
- La figure **7** représente une vue en élévation schématique d'une cuve en cours de réalisation.
- La figure **8** représente une vue de dessus schématiquement partielle d'une virole en cours de réalisation.
- La figure **9** représente une vue de dessus du système de déroulement de cambrage de découpage, d'accostage et de soudage.

Le dispositif de réalisation de cuves, selon l'invention, comporte principalement, un manège **10** constitué d'un fond **11** sur lequel sont montés des vérins **12** associés à des galets **13**, ainsi qu'une dérouleuse **20** constituée d'un châssis **21**, avec vérin de mise à niveau supportant le porte bobine, ainsi que la machine de déroulement et de cambrage **30** constituée, essentiellement, de trois rouleaux **31**, **32**, **33** dont un fixe et motorisé **31**, un mobile motorisé **32**, ou inversement, assurant le pincement de la tôle **41** contre le rouleau fixe **31**, sous l'action d'un vérin **34**, et un mobile non motorisé **33** assurant le cintrage

de la tôle **41**, avec contrôle du rayon de cintrage et du défilement de la tôle **41** par l'intermédiaire, d'une part, pour ce qui concerne le contrôle de rayon de cintrage, d'un détecteur de proximité **50**, disposé au sommet et dans l'alignement de la bissectrice de l'angle obtus, formé par deux bras solidarisés l'un à l'autre et comportant, à leur extrémité libre, un galet calibré, les dits galets calibrés étant rappelés en permanence contre la face extérieure de la tôle par un compas rappelé en position d'ouverture par un vérin à gaz, et d'autre part, pour ce qui concerne le contrôle du défilement de la tôle **41**, d'une roue codeuse **60** rappelée contre la face extérieure de la tôle **41** par un bras articulé par rapport à l'axe de liaison de l'extrémité de la tige du vérin à gaz à l'élément articulé du compas, un poste de découpe transversale **70**, un poste d'accostage de tôle **80** constitué de galets **81** situés à l'extérieur du manège **10** et de galets **82** situés à l'intérieur de celui-ci, en concordance les uns par rapport aux autres, un poste de soudage longitudinal **90**, à dispositif de soudage interne **91** et externe **92** et un tracteur à galets motorisés **100**.

En examinant plus en détail les figures **1** à **6**, illustrant les principales étapes du procédé utilisé, à la lumière des figures **7**, **8** et **9**, on remarque qu'une première virole **42** est tout d'abord réalisée par entraînement de la tôle **41** de la bobine **40** par les rouleaux fixe **31** et presseur **32** motorisés et cintrage de la dite tôle **41** par le rouleau cintreur **33**, qui est positionné en fonction du rayon à obtenir. L'amorce de

la virole étant ainsi faite, il est alors nécessaire de faire le point zéro du déroulement par la coupe précise du début de bande, puis de faire défiler celle-ci avec engagement successif sur les galets **13** du manège **10**, jusqu'à ce que le périmètre correspondant au diamètre choisi soit atteint, le poste de découpe **70** sectionne alors la bande de tôle **41** pour la séparer de la bobine **40**, l'assemblage vertical et la soudure correspondante sont alors réalisés, la première virole **42** est alors terminée. Il suffit ensuite comme le montre la figure **2**, de souder un toit **44**, puis, selon la figure **3**, d'assurer le levage de l'ensemble, à l'aide des vérins **12** et des galets **13**, d'une hauteur correspondant à la largeur d'une bande de tôle, pour permettre, par engagement successif, la présentation d'une nouvelle bande de tôle **41** sur les galets **13** des vérins **12** progressivement abaissés, au fur et à mesure du défilement de la tôle **41**, comme le montrent les figures **4** et **5**, pour obtenir la réalisation d'une seconde virole **43**, supportant entièrement la première virole **42** équipée de son toit **44**, comme le montre la figure **6**, ceci en procédant en tous points comme cela a été indiqué ci-dessus pour la réalisation de ladite première virole **42**.

On comprend que l'ensemble constitué, après soudage, des viroles **42** et **43** et du toit **44** peut être à nouveau soulevé à l'aide des vérins **12** associés aux galets constituant le manège, en vue de l'adjonction d'une troisième virole, en procédant comme illustré aux figures **3** à **6**.

Lors du déroulage à nouveau, pour réaliser la ou les viroles additionnelles **43**, la bande de tôle **41** est engagée, comme on vient de le voir, sous la première virole **42**, puis accostée à l'aide des galets **81**, **82** du poste d'accostage **80**, qui viennent ainsi presser la virole **42** et la bande de tôle **41**. Après le franchissement du dernier galet du poste d'accostage **80**, un poste de soudure **90** assure le soudage par points automatiques, à mesure de l'avancement de la tôle. Le défilement de la bande de tôle **41** est arrêté avant chaque poteau du manège **10**, le vérin **12** supportant la virole est descendu, la bande avance jusqu'au poteau suivant, et ainsi de suite. La soudure en corniche assurant la liaison et l'étanchéité entre les deux viroles **42** et **43**, est réalisée automatiquement par une station fixe (non représentée).

Pendant ces opérations, la virole tourne sur elle-même à l'aide de tracteurs à galets motorisés **100**, ainsi que sous l'action des galets motorisés **81**, **82** du poste d'accostage **80**.

En examinant maintenant la figure **9** en relation avec les figures **7** et **8**, on remarque que, après avoir introduit dans l'automate programmable (non représenté) les données relatives aux diamètres de viroles à réaliser et à la longueur de bandes à dérouler, correspondant au périmètre de la dite virole **42**, une fonction automatique positionne le rouleau cintreur **33** par l'intermédiaire du vérin **35**, après

engagement de l'extrémité de la bande de tôle **41** sous le dit rouleau **33**. Après passage sur le galet **24**, la bande de tôle **41** est introduite sur le manège **10**, après passage devant les moyens de redressement **23,36,37** de contrôle du rayon de cintrage et de défilement **31,32,33** qui vont maintenant être évoqués.

On remarque tout d'abord, que la position du rouleau cintreur **33** est contrôlée par le détecteur de proximité **50**, qui mesure, de façon précise, la distance le séparant de la surface externe de la bande de tôle **41**, ce qui permet d'obtenir, par soustraction, la mesure exacte, entre les galets d'appui calibrés de la flèche communiquée à la bande de tôle par le rouleau cintreur **33**. Des corrections, en plus ou en moins, sont ainsi en permanence transmises automatiquement au système d'alimentation du vérin **35**, assurant le positionnement du rouleau cintreur **33**. La roue codeuse **60**, quant à elle, transmet en permanence à l'automate programmable par l'intermédiaire d'un générateur incrémental par exemple, qu'elle entraîne, la longueur exacte de bande de tôle **41** déjà formée, afin de commander, le moment opportun, l'arrêt précis de l'entraînement des rouleaux motorisés **31** et **32**, précédant la commande de déclenchement du sectionnement par le poste de découpe transversale **70**, constitué d'une glissière **71** avec chariot motorisé **72**, supportant un outil de coupe **73**.

En se rapportant maintenant à nouveau aux figures **1** à **6** illustrant le procédé, on remarque que comme cela a déjà été évoqué plus avant :

1°) La réalisation des viroles **42**, **43** est précédée des opérations suivantes :

a) Fabrication d'un fond **11** par oxycoupage circulaire d'un assemblage de bandes de tôle, préalablement solidarisées latéralement, par référence à un point **C** déterminé arbitrairement sur la surface de cet assemblage de tôle.

b) Matérialisation de l'axe de symétrie des viroles **42**, **43** par soudage d'un dispositif de référence, d'axe vertical **Y** coïncidant avec le point **C** déterminé à l'étape précédente.

c) Positionnement précis, par rapport à l'axe **Y** du dispositif de référence, à l'aide d'un gabarit de tous les moyens concourant à l'entraînement, au défilement, au guidage, à l'accostage et au soudage des bandes de tôle et au levage de l'ensemble au fur et à mesure de la réalisation.

2°) La position verticale des galets de défilement **13** des vérins de levage **12** est contrôlée à distance de façon très précise, individuellement et collectivement, en fonction de la progression des opérations d'assemblage et des séquences imposées par celle-ci.

3°) La position respective des dispositifs de soudage interne **91** et externe **92** est indiquée en permanence de façon très précise au cours de leur utilisation, avec indication immédiate sur un moniteur, des décalages pouvant apparaître entre les deux dispositifs de soudage **91**, **92**, afin que ce décalage puisse être immédiatement annulé en vue de conserver en permanence une parfaite concordance des points de soudure interne et externe, lors de la progression du cordon de soudure en corniche.

4°) La solidarisation par soudage du toit **44** sur le chant correspondant de la virole supérieure **42** s'accompagne de la rotation de l'ensemble sur 360° à une vitesse contrôlée compatible avec la progression idéale du cordon de soudure.

5°) Le soudage de l'ensemble sur le fond **11** est précédé de la mise en appui de la virole inférieure, sur taquets mobiles se substituant aux galets de défilement **13** préalablement démontés.

On comprend que pour obtenir un parfait parallélisme des viroles **42**, **43** entre elles et par rapport au fond **11** utilisé momentanément comme référence, les vérins **12** de manœuvre des galets de défilement **13** et des taquets (non représentés) doivent être de caractéristiques strictement identiques et que les débits d'huile auxquels ils sont soumis, tant à l'entrée qu'à la sortie, doivent être parfaitement

contrôlés afin d'obtenir des courses très précises des tiges de vérins.

REVENDICATIONS

1. Procédé de réalisation sur sites de réservoirs métalliques cylindriques de grande capacité, à partir de bobines de tôle (40) mettant en œuvre un moyen (30) d'entraînement, de cambrage et de défilement de la bande de tôle (41) ainsi que des moyens de découpe transversale (70), d'accostage (80) et de soudage longitudinal (90) des bandes de tôle, consistant à réaliser les viroles (42, 43) par cintrage, cambrage progressif en fonction du diamètre recherché, au fur et à mesure de l'entraînement et du déroulement de la bande de tôle (41) et à réaliser successivement les viroles (42, 43) du haut vers le bas en réalisant chacune d'elles (42) directement sous la précédente (43) en entraînant celle-ci en rotation par solidarisation progressive de la bande de tôle en cours de formage, cette solidarisation étant précédée d'une mise en appui tout aussi progressive de la virole précédente (43) sur le chant de la bande de tôle (41) au cours du défilement jusqu'à réalisation complète de la virole suivante (42), le toit (44) étant fixé sur le chant supérieur de la première virole (42) après réalisation de celle-ci ou des deux premières viroles ; la paroi étant solidarisée au fond (11) dès que celle-ci a atteint la hauteur désirée, caractérisé principalement :

1°) En ce que la réalisation des viroles est précédée des opérations suivantes :

a) Réalisation d'un fond (**11**) par oxycoupage circulaire d'un assemblage de bandes de tôle, préalablement solidarisées latéralement, par référence à un point **C** déterminé arbitrairement sur la surface de cet assemblage de tôles.

b) Matérialisation de l'axe de symétrie des viroles par soudage d'un dispositif de référence, d'axe vertical **Y** coïncidant exactement avec le point **C** défini sur la surface du fond (**11**) à l'étape précédente.

c) Positionnement précis, par rapport à l'axe **Y** du dispositif de référence, de tous les moyens concourant à l'entraînement, au défilement, au guidage, à l'accostage et au soudage des bandes de tôle et au levage de l'ensemble au fur et à mesure de la réalisation.

2°) En ce que la position verticale des galets de défilement (**13**) des moyens de levage (**12**) est contrôlée à distance de façon très précise individuellement et collectivement en fonction de la progression des opérations d'assemblage et des séquences imposées par celles-ci.

3°) En ce que la position respective des dispositifs de soudage interne (**91**) et externe (**92**) est indiquée en permanence de façon très précise au cours de leur utilisation, avec indication immédiate des décalages pouvant apparaître entre les deux dispositifs, afin que ce décalage puisse être

immédiatement annulé, en vue de conserver en permanence une parfaite concordance des points de soudure interne et externe, lors de la progression du cordon de soudure en corniche.

4°) En ce que la solidarisation par soudage du toit sur le chant correspondant de la virole supérieure s'accompagne de la rotation de l'ensemble sur **360°** à une vitesse contrôlée compatible avec la progression idéale du cordon de soudure.

5°) En ce que le soudage de l'ensemble sur le fond **(11)** est précédé de la mise en appui sur taquets mobiles, du chant libre de la virole inférieure **(43)** du démontage des galets de défilement **(13)**, du déplacement coordonné vers le bas des dits taquets mobiles, jusqu'à mise en appui dudit chant libre de la virole inférieure **(43)** sur le pourtour du fond **(11)** puis de l'évacuation par le trou d'homme des équipements inutilisables pour cette opération finale.

2. Dispositif de mise en œuvre du procédé selon la revendication 1 comportant des moyens d'entraînement, de cambrage **(30)** et de contrôle permanent **(60)** du cambrage et du défilement de la bande de tôle **(41)** ainsi que des moyens de découpe transversale **(70)** de soudage transversal d'accostage **(80)** et de soudage longitudinal **(90)** de la tôle, les moyens d'entraînement et de cambrage de la bande de tôle **(41)** étant constitué de deux rouleaux motorisés **(31, 32)** dont l'un est fixe **(31)** et l'autre **(32)** est rappelé vers celui-ci par un vérin **(34)** et d'un rouleau mobile

(33) situé en aval des deux premiers (31, 32) dont le déplacement est assuré par un vérin (35) en fonction de la courbure à donner à la tôle, les moyens de contrôle permanent du cambrage et de défilement de la bande de tôle (41) étant constitués respectivement d'un détecteur de proximité (50) et d'une roue codeuse (60) ; les moyens de défilement étant constitués de galets (13) associés à des vérins de levage (12) répartis régulièrement sur une circonférence pour constituer un manège (10) de diamètre correspondant à celui de la virole (42) à obtenir, ces galets (13) étant destinés à soutenir progressivement la tôle (41) après cambrage, lors de son entraînement par un tracteur à galets motorisés (100) caractérisé en ce que les moyens d'entraînement (31, 32, 34) de cambrage (33, 35), de découpe transversale (70), de contrôle permanent du contrôle et du défilement (50, 60), de découpe transversale (70), de soudage (90) et de soutien de la tôle au cours du défilement (12, 13) ainsi que le tracteur à galets motorisés (100) sont gérés par un automate programmable contrôlable à distance par un boîtier de commande sans fil et en ce que la position des électrodes des dispositifs de soudage (91, 92) est contrôlée par des détecteurs reliés à un moniteur qui mesure et affiche, en temps réel, les éventuels écarts de position en vue de leur annulation immédiate.

FIG 1

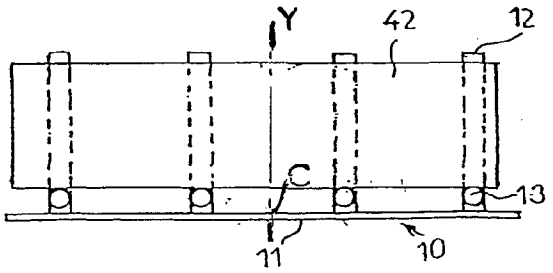


FIG.2

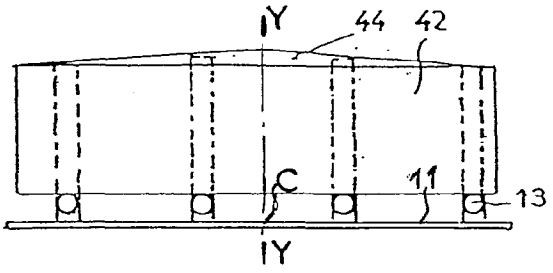


FIG.3

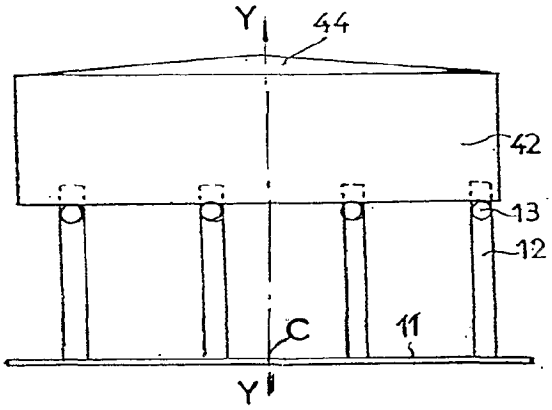


FIG.4

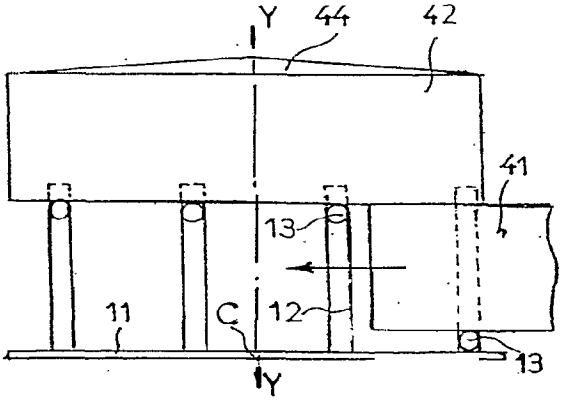


FIG.5

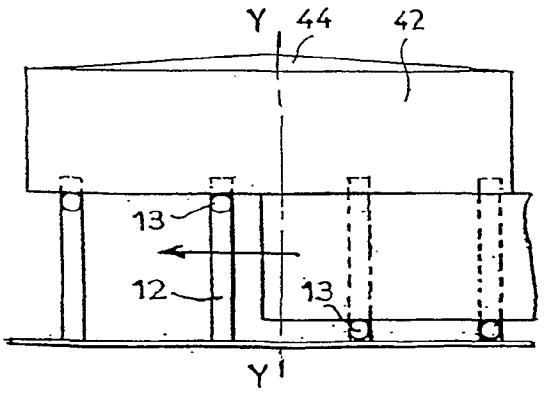


FIG.6

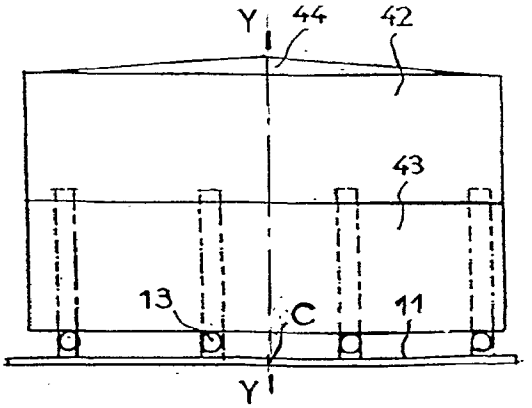


FIG.7

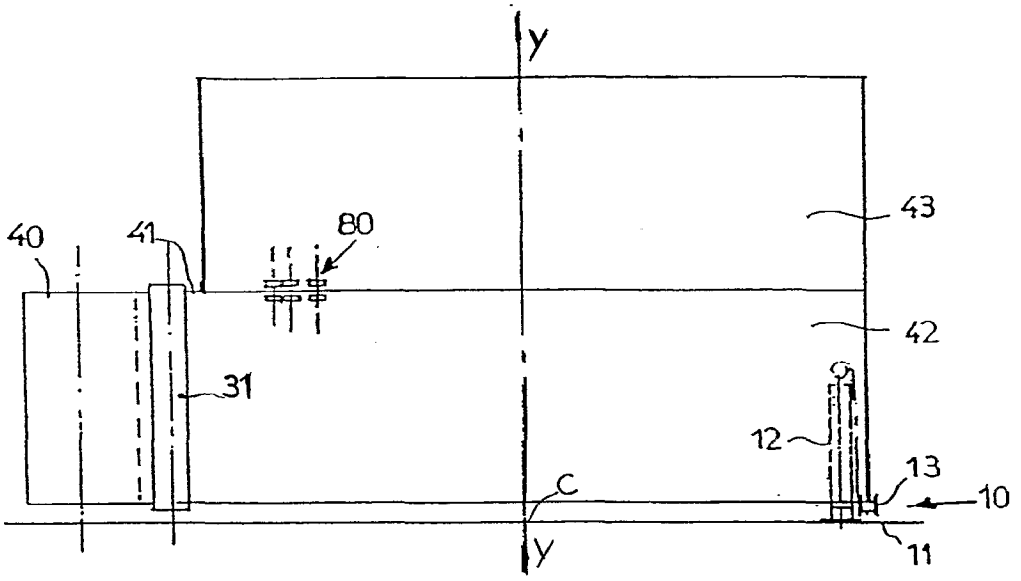

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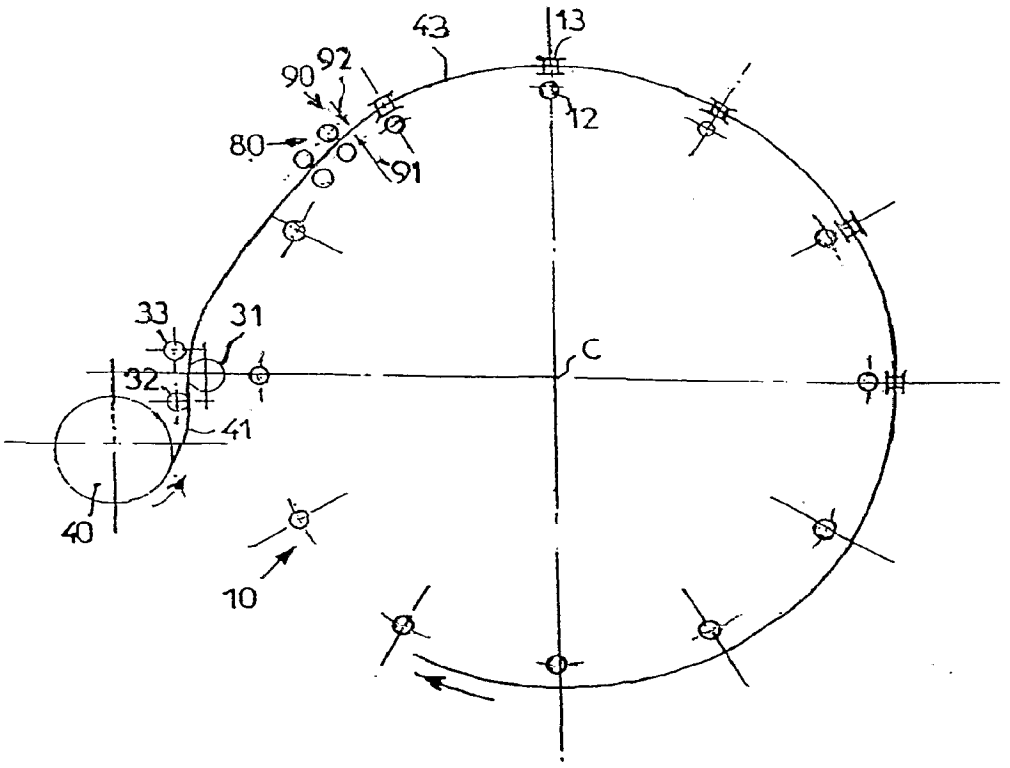
FIG.8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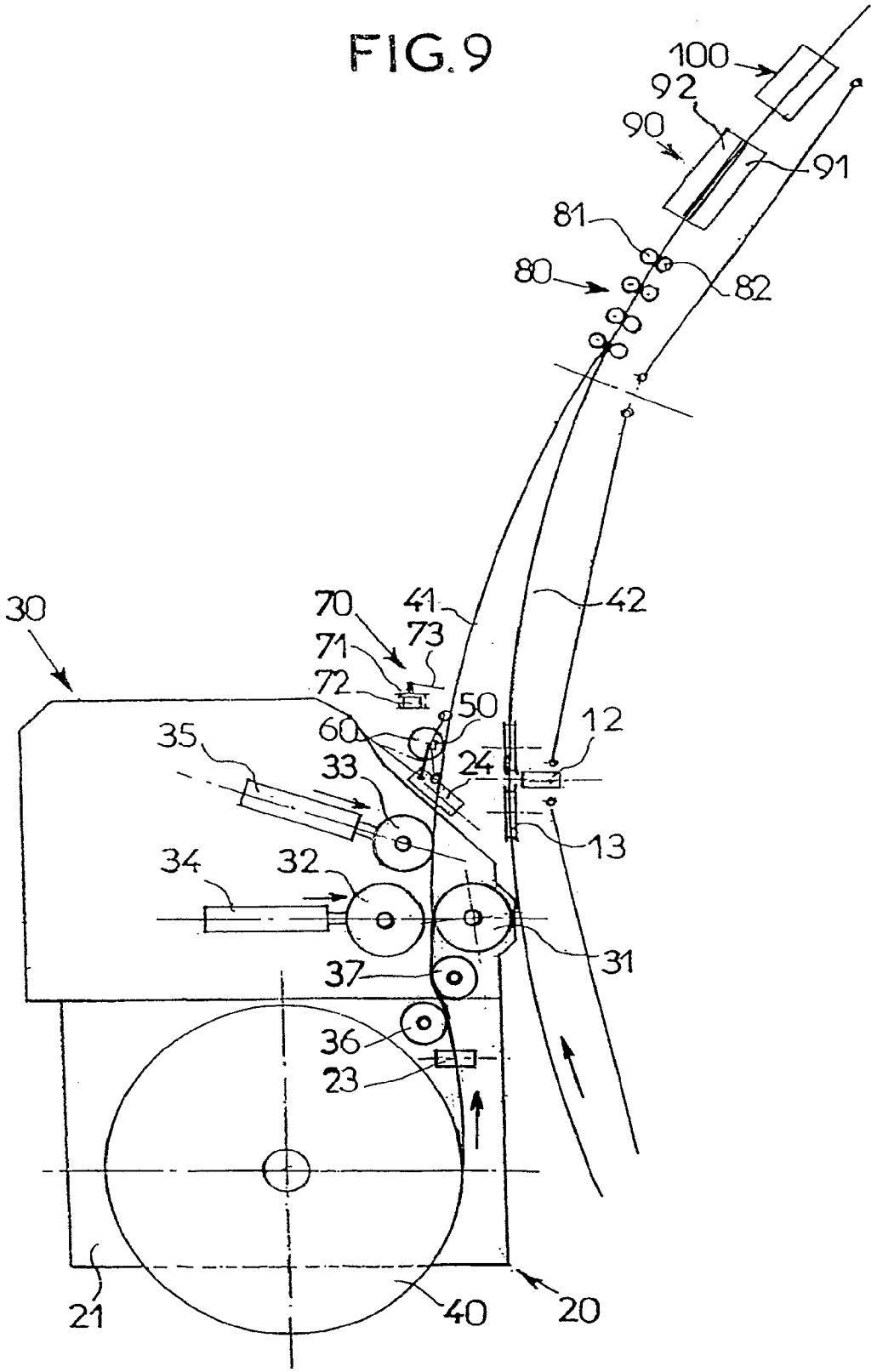
3/3

FIG.9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INTERNATIONAL SEARCH REPORT

International Application No
PCT/FR 01/01312

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B21D51/18 E04H7/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B21D E04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 727 264 A (STCM SARL) 21 August 1996 (1996-08-21) cited in the application the whole document	1,2

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"E" earlier document but published on or after the international filing date

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 November 2001	06/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Ris, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/FR 01/01312

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0727264 A	21-08-1996	FR 2730652 A1	23-08-1996
		DE 69600249 D1	28-05-1998
		DE 69600249 T2	11-03-1999
		EP 0727264 A1	21-08-1996
		ES 2115416 T3	16-06-1998

RAPPORT DE RECHERCHE INTERNATIONALE

Demande Internationale No
PCT/FR 01/01312

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
CIB 7 B21D51/18 E04H7/06

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
CIB 7 B21D E04H

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si réalisable, termes de recherche utilisés)
EPO-Internal

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie °	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
A	EP 0 727 264 A (STCM SARL) 21 août 1996 (1996-08-21) cité dans la demande le document en entier	1,2

☐ Voir la suite du cadre C pour la fin de la liste des documents

☒ Les documents de familles de brevets sont indiqués en annexe

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"T" document ultérieur publié après la date de dépôt international ou la date de priorité et n'appartenenant pas à l'état de la technique pertinent, mais cité pour comprendre le principe ou la théorie constituant la base de l'invention

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"&" document qui fait partie de la même famille de brevets

Date à laquelle la recherche internationale a été effectivement achevée	Date d'expédition du présent rapport de recherche internationale
29 novembre 2001	06/12/2001

Nom et adresse postale de l'administration chargée de la recherche internationale	Fonctionnaire autorisé
Office Européen des Brevets, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ris, M

Formulaire PCT/ISA/210 (deuxième feuille) (juillet 1992)

RAPPORT DE RECHERCHE INTERNATIONALE

Renseignements relatifs aux membres de familles de brevets

Demande Internationale No
PCT/FR 01/01312

Document brevet cité au rapport de recherche	Date de publication	Membre(s) de la famille de brevet(s)	Date de publication
EP 0727264 A	21-08-1996	FR 2730652 A1	23-08-1996
		DE 69600249 D1	28-05-1998
		DE 69600249 T2	11-03-1999
		EP 0727264 A1	21-08-1996
		ES 2115416 T3	16-06-1998

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H04L 12/66 (2006.01)

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PCT/US2009/039371

(22) International Filing Date:
2 April 2009 (02.04.2009)

(25) Filing Language: English

(26) Publication Language: English

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61/055,417	22 May 2008 (22.05.2008)	US
61/100,578	26 September 2008 (26.09.2008)	US
61/156,751	2 March 2009 (02.03.2009)	US
61/156,746	2 March 2009 (02.03.2009)	US

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(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LAWSON, Jeffrey** [US/US]; 548 Market #14510, San Francisco, CA 94104 (US). **WOLTHUIS, John** [US/US]; 548 Market Street #14510, San Francisco, CA 94104 (US). **COOKE, Evan** [US/US]; 548 Market #14510, San Francisco, CA 94104 (US).

(74) Agent: **SCHOX, Jeffrey**; 730 Florida Street #2, San Francisco, CA 94110 (US).

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[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS

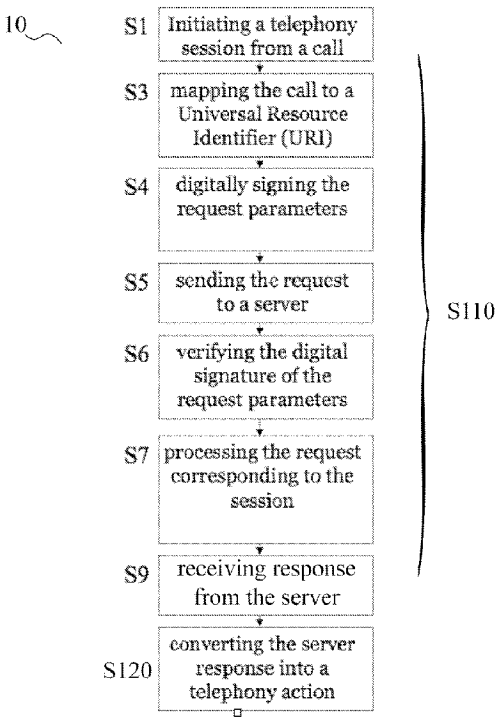

FIGURE 1

(57) Abstract: In one embodiment, the method of processing telephony sessions includes: communicating with an application server using an application layer protocol; processing telephony instructions with a call router; and creating call router resources accessible through a call router Application Programming Interface (API). In another embodiment, the system for processing telephony sessions includes: a call router, a URI for an application server, a telephony instruction executed by the call router, and a call router API resource.

WO 2009/124223 A1

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

SYSTEM AND METHOD FOR PROCESSING TELEPHONY SESSIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of the following: US Provisional Application number 61/041,829 filed 02 April 2008 and entitled "System and Method for Processing Telephony Sessions"; US Provisional Application number 61/055,417 filed on 22 May 2008 and entitled "System and Method for Processing SMS Messages", US Provisional Application number 61/100,578 filed on 26 September 2008 and entitled "System and Method for Processing Telephony Sessions", US Provisional Application number 61/156,746 filed on 02 March 2009 and entitled "System and Method for Processing Telephone Sessions", and US Provisional Application number 61/156,751 filed on 02 March 2009 and entitled "System and Method for Processing Telephony Sessions", which are all incorporated in their entirety by this reference.

TECHNICAL FIELD

[0002] This invention relates generally to the telephony field, and more specifically to a new and useful system and method for processing telephony sessions in the telephony field.

BACKGROUND

[0003] In the last decade, legislation and the advent of Voice over Internet Protocol (VOIP) have revolutionized the communication industry with new technologies, business models, and service providers. Software and commodity

hardware now provide an alternative to expensive carrier equipment. One can implement extensible call switching and voice application logic in Open source software applications, such as Asterisk and FreeSwitch. These new application stacks, however, usher in new complexities and challenges, requiring new skill sets to deploy, develop, and maintain. Deploying telephony services requires knowledge of voice networking and codecs, hardware or services to bridge servers to the public phone infrastructure, capital investment in hardware, and ongoing collocation of that hardware. These burdens are a mere prerequisite to developing the actual application, which requires developers to train in new languages, tools, and development environments. Even telephony applications that currently try to leverage a model more similar to web-development such as Voice Extensible Markup Language (VoiceXML), require the dedication to learn a new language and understand telephony interaction. Ongoing operation and maintenance of these services requires teams to adopt new analysis tools, performance metrics, and debugging methodologies. Developing even the simplest of voice services (such as a so-called "phone tree") requires significant upfront and ongoing investment in specialized infrastructure, skills, and operations. Thus, there is a need in the telephony field to create a new and useful system and method for processing telephony sessions. This invention provides such a new and useful system and method.

SUMMARY

[0004] The method of the preferred embodiment for processing telephony sessions include the steps of communicating with an application server using an

application layer protocol, processing telephony instructions with a call router, and creating call router resources accessible through an Application Programming Interface (API). The method and system of the preferred embodiments enables web developers to use their existing skills and tools with the esoteric world of telephony, making telephony application development as easy as web programming. The method and system use the familiar web site visitor model to interact with a web developer's application, with each step of the phone call analogous to a traditional page view. Within this model, developers reuse their existing tools and techniques, including familiar concepts such as HTTP redirects, accessing resources through an API, cookies, and mime-type responses to construct complex telephony applications. The method of processing telephony instructions and creating call router resources accessible through an API (a call router API) cooperatively function to enable a stateless and simple telephony language with more call router resources and information provided through the call router (preferably a REST API as is familiar to many web developers). In one embodiment, the telephony instructions set may have fewer than dozen verbs, simplifying the language so that developers can quickly learn and implement telephony applications, while the call router API compliments the simple telephony instructions to enable complex telephony applications.

BRIEF DESCRIPTION OF THE FIGURES

[0005] FIGURE 1 is a flowchart representation of a preferred method of the invention.

[0006] FIGURES 2A, 2B, 3A and 3B are schematic representations of preferred embodiments of the invention.

[0007] FIGURES 4A – 4C are examples of a HTTP GET request, a HTTP POST request, and a HTTP GET request, respectively.

[0008] FIGURES 4D – 4F are examples of a HTTP requests.

[0009] FIGURES 5A and 5B are examples of XML responses.

[0010] FIGURE 6 is an example of a call Router request and response.

[0011] FIGURES 7-15 are schematic representations of various applications that incorporate the principals of the preferred method of the invention.

[0012] FIGURE 16 is a flowchart representation of the sub-steps relating to the digital signature aspect of the preferred method of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The following description of the preferred embodiments of the invention is not intended to limit the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

1. Method for Processing Telephony Sessions

[0014] As shown in FIGURES 1, 2A, 2B, 3A, and 3B, the method 10 of the preferred embodiment for processing telephony sessions include the steps of communicating with an application server using an application layer protocol S110, processing telephony instructions with a call router S120, and creating call router resources accessible through an Application Programming Interface (API) S130. The preferred method may also include other steps and/or sub-steps, as explained below.

1A. Communicating with an Application Server

[0015] As shown in FIGURE 1, the step of communicating with an application server using an application layer protocol S110 preferably includes the following sub-steps: initiating a telephony session S1, mapping a call to a Universal Resource Identifier (URI) S3, sending a request to a server associated with the URI S5, processing the request corresponding to the state of a telephony session S7, and receiving a response from the server S9. One of the challenges of using the familiar web site visitor model is that a third party web application may expose URIs that contain sensitive data or that suggest actions that could maliciously manipulate the application database. In the preferred embodiment, the call router cryptographically signs outbound requests to customer web applications using an account-specific key. More specifically, the step of communicating with the application server includes the additional steps of digitally signing the request parameters S4 and verifying the digital signature of the request parameters S6. Only the call router and the application server know that key, so any request that includes parameters (URL, POST data, headers, etc) signed with that key can be checked for authenticity before allowing such operations. This method also provides verification of authenticity over insecure links (HTTP) with low CPU overhead.

[0016] Step S1, which recites initiating a telephony session, functions to accept an incoming message. The message is preferably a call from a PSTN-connected (Public Switched Telephone Network) or Internet addressable devices, such as landline phones, cellular phones, satellite phones, Voice-Over-Internet-Protocol (VOIP) phones, SIP devices, Skype, Gtalk, or any other suitable PSTN-connected or Internet addressable voice device. The message may alternatively be a Short Message Service (SMS) message. A SMS gateway server may alternatively connect to a SMS

network through a Short Message Service Center ("SMS-C"), directly to the Signaling System #7 (SS7) telephony network, or by any other suitable SMS gateway provider, and the message is preferably received from the gateway by the call router and translated into a format (such as a URI) that can be sent over the public Internet such as HTTP, based on the recipient address of the SMS, such as a short code, or Direct Inward Dialing (DID), or other suitable unique recipient identifier. The message may alternatively be a multimedia message, a facsimile transmission, an email, or any other suitable messaging medium. The originating phone number of the PSTN device is preferably captured using caller ID, but any other suitable ID may be captured, such as a VOIP provider ID, SMS device number, email address, or a short code. The dialed phone number, the EIN, and/or billing identifier, and/or the date and time of the call are also preferably included in the session information. An authentication ID may additionally or alternatively be included in the session information.

[0017] In one variation, Step S1 also functions to initiate a telephony session (such as a phone call) via an HTTP or other request sent to a call router from an application running on a third-party server. In this variation, the application running on the server preferably specifies an initial URI for the call router to use for telephony session in step S3, as well as the phone number (or other addressable destination) to dial and the source phone number (caller id). In this variation, the call router API is preferably used by the application server to request an outgoing call from the call router.

[0018] Step S3, which recites mapping the call to a Universal Resource Identifier (URI), functions to enable a telephony session to be converted into a

format that may be handled with standard web servers and web applications. The mapping is preferably performed using a call router. The initial URI is preferably pre-specified at the call router by a web application (which may be running on a third party server) or call router account owner. More preferably, the initial URI is assigned to the call via a unique identifier for the call destination, such as a DID (Direct Inbound Dial) phone number, or a VOIP SIP address. The URI may alternatively be specified by a remote server or other suitable device or method. In one variation, the URI may be used to encapsulate state information or a portion of state information from the initiated telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, geographic location of the caller (e.g. country, city, state, and/or zip), and/or the unique call ID. The information included in the URI may be included in the form of a URI template. For example the URI default template could be: http://demo.twilio.com/myapp/{dialed phone number}/{originating phone number} or http://demo.twilio.com/myapp/foo.php?dialed_number={dialed phone number}& originating_number={originating phone number}.

[0019] Step S4 functions to digitally sign the request parameters. As shown in FIGURE 16, Step S4 preferably determines the call router account owner and, more preferably, looks up the account owner's unique ID or secret key and signs a set of request parameters. Step S4 is preferably accomplished by generating a cryptographic hash of the request parameters, preferably including the URI as well as any request body parameters (in the case of an HTTP POST, for example) with the unique key associated with the call router account owner. The cryptographic hash is preferably generated by appending the hash of the request parameters to the original

set of request parameters. The hash is preferably appended to a URL, but if the hash is particularly long (i.e. for a very large number of parameters) the hash may be included in an HTTP header, where there is no limitation on size. In a variation of Step S4, at least one sensitive parameter may be individually encrypted using the account owner's secret key before the hash is processed. In another variation, a cryptographic credential delgation system, such as Oauth (oauth.net), may alternatively be used to electronically sign the request.

[0020] Step S5 functions to send the request to a server. Preferably, the request is sent to a URI and, more preferably, the request is sent to the URI mapped in S3. The request preferably includes a cryptographic hash computed from the set of request parameters (acting as a digital signature), but the request may alternatively include individually encrypted request parameters if the parameters are determined to contain sensitive data. The server is preferably a third party server and, more preferably, the server is running a web application. The request is preferably sent to a server over a network. In one variation, the request is sent to a local server on a local area network. In another variation, the request is sent to a server running locally on the device originating the call. In yet another variation, the request may be sent to multiple servers. The request preferably encapsulates at least a portion of the state information from the initiated telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, geographic location of the caller (e.g. country, city, and/or state, zip), and/or the unique call ID. The request, more preferably, encapsulates all the state information of the call, but may alternatively include no state information or partial state information. The state information from the initiated telephony session is preferably sent via HTTP POST in

the request body, HTTP GET in the request URI, HTTP header parameters to mimic the data flow of a web browser, or by any combination or suitable alternative way. If new state information is generated in the course of the operation of the call router, a request to the application server is preferably made to communicate the new state and to request new telephony instructions. Preferably, new state information is not kept or acted upon internally by the call router, but is passed to the application server for processing. Alternatively, partial state information is preferably stored on the call router until a fully updated state is achieved, and then communicated to the application server. For example, the application server may specify that multiple digits should be pressed on the keypad, not just one, before new call state is derived and communicated to the application server. In one variation, the information from the initiated telephone session may be a web-form submission included in the HTTP POST request. The request may include any state information from the telephony session, such as the originating phone number, the dialed phone number, the date and time of the call, and/or the unique call ID, the current status of the phone call (pending, in-progress, completed, etc.), or the results of a telephony action, including Dual Tone Multi Frequency (DTMF) digit processing, or a representation of or a link to a sound recording, or the status of the last command, or other call state. Examples of a HTTP GET request, a HTTP POST request, and a HTTP GET request are shown in FIGURES 4A, 4B, and 4C, respectively. Further examples of HTTP communication used for SMS messaging are shown in FIGURES 4D, 4E, and 4F. The HTTP request (or any suitable request communication) to the server preferably observes the principles of a RESTful design. RESTful is understood in this document to describe a Representational State Transfer architecture as is known in the art. The RESTful

HTTP requests are preferably stateless, thus each message communicated from the call router to the application server preferably contains all necessary information for operation of the application server and response generation of the application server. The call router and/or the application server preferably do not need to remember or store previous communications to be aware of the state. Documents, media, and application state are preferably viewed as addressable resources, combined with data provide to the resource via request parameter, such as HTTP GET or HTTP POST parameters, or request body contents. Such request data may include an updated representation of the call resource, or other call state data generated as a result of call router operation, such as digits pressed on the keypad or audio recordings generated. State information included with each request may include a unique call identifier, call status data such as whether the call is in—progress or completed, the caller ID of the caller, the phone number called, geographic data about the callers, and/or any suitable data. However, a varying level of a RESTful communication (statelessness) may be used, such as by using cookies, session tracking, or any suitable devices to simulate a normal website visitor model. Preferably, data sent with each request may fully enable the application server to determine the next state of the call to execute. RESTfulness preferably does not preclude using external datasource, such as a database, to lookup additional data to log call meta data, or determine application logic.

[0021] Step S6 functions to verify the digital signature of the request parameters. As shown in FIGURE 13, after the request is received at the server, the request parameters are preferably checked and/or parsed for a hash. The cryptographic hash is preferably included in the URL of an HTTP request, but may

alternatively be included in the HTTP header of the request. If the request does not include a hash, and the web application server has enabled the hash function checking as a security measure, the request is preferably determined to be fraudulent, which would include – for example – malicious requests, mis-routed requests, corrupted requests and any other requests not intended for the application server. If the set of request parameters includes a hash, the hash is preferably extracted from the request, and the secret key of the customer web application (i.e. the same key that is stored on the call router as the customer account secret key) is preferably used to generate a server side cryptographic hash of the parameters received. The server side cryptographic hash is preferably compared to the hash included with the request and if the hashes do not match, the request is preferably determined to be fraudulent. However, if the server side cryptographic hash matches the request hash, the request is preferably determined to be authentic and ready for further processing at the application server. In the variation mentioned above in Step S4, where sensitive parameters may have been encrypted using the secret key, Step S6 preferably includes decrypting the sensitive parameters. The application server and the third parties operating the application are preferably responsible for completing this verification step, but the verification may alternatively be completed by a single party, such as when a single party operates the application server and the call router. The application server may alternatively be configured to ignore a hash included with the request parameters if request authentication is not important to the application.

[0022] Step S7, which recites processing the request corresponding to the state of a telephony session, functions to perform processing functions on at least a

portion of the data included in the request. The processing functions are preferably performed on a third party server. The processing functions may include recording the data included in the request and/or metadata about the call session, routing to another URI, performing a database lookup of at least one portion of the data included in the request, voice recognition processing, or any other suitable processing function. The processing functions may re-use logic and data from other business applications, such as customer databases and/or shopping cart applications, which may be linked using caller-id or caller provided information. State information is preferably communicated with each request from the call router, and application state is preferably not required on the application server. Alternatively, the application server may store state between each request related to the call, by using HTTP cookies, sessions, and/or database records. In some cases, such as the case of a static HTML page running on a server or a stored media file such as an mp3 or wav file stored on a server, Step S7 may be simplified, and a file mapped to disk by the URI may be simply returned.

[0023] Step S9 recites receiving a response from the server. This response is preferably an HTTP response. The response is preferably sent as XML, audio binary, or raw text, but may alternatively be any sort of messaging format, including HTML, delimited text, key/value text or binary encoded format. The HTTP response preferably includes directions to perform telephony actions. The response may alternatively or additionally include a new URI or a new URI template to use with the telephony action in Step S3. An additional example XML response is shown in FIGURES 5A and 5B.

1B. Processing Telephone Instructions

[0024] The step of processing telephone instructions with a call router S120 preferably functions to convert the server response into telephony actions or executable operations during a telephony session. The telephony actions may include, for example, playing a pre-recorded sound file at a server-specified URI (such as a static mp3 file located at http://demo.twilio.com/myapp/1234.mp3), reading text to the caller using text-to-speech technology, calling another number (such as creating a new voice connection through the PSTN, SIP/VoIP, or other IP technology system), collecting digits via DTMF input, recording voice response audio, TTY or other inputs, sending an SMS message, or any suitable combination or sequence of these or other suitable actions. This conversion of the server response is preferably performed at a call router. Preferably, Step S120 includes processing the response mime-types associated with the server response. For example, if the response mime-type is XML, it is considered to be a set of call router instructions. If the response mime-type is MP3, it is considered a sound file to be played for the caller. If the response type is plain text, it is considered to be text to be read, via Text-To-Speech, to the caller.

[0025] Contents of the server response, such as an XML document, are preferably converted into a telephony action by processing the document sequentially (e.g. line by line). Telephony instructions are preferably contained within the document in the form of a markup language, such as XML as shown in FIGURES 5A and 5B. This sequential approach to processing a document of telephony instructions is enabled when the communication is stateless and all the necessary information is contained within the URI. This stateless communication

preferably allows telephony instructions (verbs or commands) to be used as the programming interface for a server application performing telephony services. Algorithmic interpretation (based on the state of the communication) of the telephony verbs or the document is preferably not necessary. The telephony actions are preferably executed in the order of telephony instructions found in the contents of the server response. For example, an XML document may include the necessary verbs to carry out the telephony actions of reading text to a caller, monitoring keys pressed by the caller, and redirecting the caller to a new URI using the pressed keys as part of the data within the new URI. Preferably, the telephony action (such as digits pressed) results in new state information, which may result in a repetition of some steps of the method, preferably beginning at Steps S3. The next URI is preferably provided by the server as part of the processing instructions. In another variation, the last URI is reused if the server fails to specify a next URI. In yet another variation, no repetition occurs if the server fails to specify a next URI, and processing continues below at the next call router instruction. The behavior may be determined by the nature of the call router instruction; for example, instructions that generate no new state information would not need to have a next URI since they don't trigger communication with a remote server. More preferably, the telephony actions result in the repetition of step S3 with the new URI resulting from Step S11, but may alternatively initiate a repetition of one or more steps (Steps S5, S7, S9, or S11) of the method. Step S3 is preferably repeated using all new phone session state information resulting from execution of a telephony action, such as digits pressed, a recorded audio file, or the success or failure of any telephony action requested. Repetition also includes all state information that remains relevant during the course

of the session, such as Caller, Called, unique Call ID, and call status. The state information may also be represented in the form of a URI Template. For example, if the server response specifies that the call router should collect DTMF digits, and specifies that the next URL is the URI Template http://demo.twilio.com/foo.php?digits={Digits}, and the caller presses 1234, the resulting URI is http://demo.twilio.com/foo.php?digits=1234. Similarly, if the server response specifies the URI Template: http://demo.twilio.com/myapp/{Digits}.mp3, the resulting HTTP Request could be to a static mp3 file located at: http://demo.twilio.com/myapp/1234.mp3. Thus, a call may be controlled by one server that issued the telephony instruction and a second server that processes the response, as shown in FIGURES 13 and 14. Such call control hand-offs constitute the transfer of state information between servers in the form of a URI and accompanying request data, such as GET, POST, and/or request body. Preferably, all state communications conform to a syntax established by the call router to facilitate integration between multiple servers. For example, digits pressed on the keypad are preferably communicated to application servers in an identical fashion, thus minimizing the need for coordination between a multiple application servers with regard to how state is transferred. Alternatively, call router instructions may dictate the method of communicating new state information, such as the names and types of variables to send representing new state.

1C. Creating Resources Accessible by a Call Router API

[0026] The step of creating call router resources accessible through an Application Programming Interface (API) S130 preferably functions to expose

information and/or functionality of the call router. The interaction from outside parties is preferably performed via the API (call router API). The Call Router API may additionally cooperate with the use of telephony instructions to function as a storage and retrieval format for data generated or required by the call router's operation. The Call Router API is preferably an application programming interface (API) such as a REST API (Representational State Transfer) as is known in the art, but the Call Router API may alternatively be a SOAP (Simple Object Access Protocol) API or any suitable programmatic communication interface. The Call Router API preferably may be used by an application asynchronously to the execution of a call (such as to later query the call records or retrieve recordings). Alternatively, the Call Router API may be used synchronously during the course of a call (such as to alter the state of the call, hanging up a call, initiating call recording, etc.). The Call Router API preferably stores state information in a persistent URI for a resource. The persistent URI preferably contains all the necessary state information, and this preferably makes data persistent, queryable, and recoverable. The Call Router API is preferably used for modifying resources to alter state of call router and for interacting with media of the call router. An application server can use the Call Router API to preferably query meta-data of call records, caller identification, call media (such as recordings, text transcripts, etc.), account information, transfer or interact with in-progress communications in the call router, and/or any suitable data generated by or required to operate the call router. The Call Router API preferably involves communication between an application server and a call router, but may alternatively be communication from any suitable device to the call router. The Call Router API preferably resides on the same hardware as the call router, but may

alternatively reside on remote hardware or on any suitable hardware environment. The communication is preferably HTTP, but alternatively HTTPS or any suitable communication protocol may be used. The Call Router API may additionally be compatible with any HTTP client. The telephony system of the preferred embodiment preferably implements a Call Router API that includes a Call Router API request format, a Call Router API response format, and a plurality of API Resources representing types of data generated by or used by the Call Router.

[0027] The Call Router API request of the preferred embodiment functions as a communication message sent from an application server to an API resource of the call router. The Call Router API request is preferably sent from an application server to a call router, but may be sent from any suitable device to the call router. The Call Router API request is preferably similar to a REST API request, but the Call Router API request may alternatively conform to any suitable programming principle, such as SOAP. The Call Router API request preferably uses HTTP to interface with a resource, but HTTPS or any suitable communication protocol may be used. Preferably the HTTP or HTTPS method of GET is used to retrieve a resource or resource information, and the HTTP or HTTPS method of PUT or POST is used to create or update a resource. In some cases, PUT or POST may be used to affect the functionality of the call router by modifying the state of a resource. Alternatively, a method parameter may be included in the URI of the resource to identify a requested action for the resource, or any suitable commands or methods may be used to interface with an API resource. The Call Router API request preferably includes authentication such as basic HTTP or HTTPS authentication, by including message

authentication information in the URI, such as a cryptographic hashing of the request content using a shared key, or by any suitable method.

[0028] The Call Router API response of the preferred embodiment functions as a communication sent in response to a method performed on an API resource. The Call Router API response is preferably sent from the call router to an application server, or any suitable device. The Call Router API response is preferably sent in response to a Call Router API request, and the response is preferably sent to the originating device. The Call Router API response is preferably similar to a REST API response, where the response is a representation of the requested resource. The Call Router API response may alternatively conform to any suitable programming principle such as SOAP. The Call Router API response is preferably returned as formatted XML with information corresponding to the HTTP status code, a message, error codes, and/or any suitable information related to the resource. The Call router API response may alternatively be represented as Comma-separated values list (CSVs), HTML, JSON, or any suitable format. In one variation, the response format is determined by a portion of the requested URI, such as a file extension. In one variation, an API resource may be a binary data resource, and the Call Router API response is preferably formatted in a native binary format (e.g., a wav or mp3 audio file), an XML meta-data description, and or any suitable format.

[0029] The API resource of the preferred embodiment functions as an addressable representation of call router meta-data, internal call router state, or the state of a given resource used by the call router. An API resource is preferably addressed by a persistent URI. Preferably, the API resource responds to at least one HTTP action of POST, PUT, GET, or DELETE. The API resource may alternatively

respond to multiple HTTP actions. The API resource may alternatively respond to any suitable method(s) that are preferably included in the Call Router API request. Consistent with the RESTful conventions, a GET request of a resource may return the current state of a resource, while PUT may update the state, PUT or POST may be used to create a new resource, and DELETE may be used to destroy a resource. The call router API may alternatively be used to affect the functionality of an in-progress call in addition to modifying data. The API resources of the preferred embodiment include an account resource, caller ID resource, incoming address resource, call resource, media resource, and/or any suitable resource of the call router. The API resources may alternatively be any suitable combination of the listed resources or other suitable resources. An API resource is preferably a preconfigured (or "static") resource, such as account information, or a resource actively in use by the call router, such as a phone call. Modifying the state of a resource via the API may additionally affect the operation of the call router in real-time, affect the state or capabilities of the call router in the future, and/or have any suitable effect.

[0030] The account resource of the preferred embodiment functions to allow an application to retrieve and/or modify account information. An account is preferably created by a telephony service provider, such as the operator of the call router. Information such as account name, usage information, contact information, initial URI, setup parameters, or any suitable account information may be retrieved or edited by an application using the account resource.

[0031] The caller ID resource of the preferred embodiment functions to allow an application to retrieve, modify, register new caller ID's (phone numbers), and/or delete caller identification information. The caller identification information is

preferably for the phone number associated with out-going calls made by an application and/or user (i.e. where the application appears to be calling from). The numbers for outgoing calls are preferably assigned or verified prior to being used as a caller ID. As an alternative, to prevent fraudulent use of caller ID phone numbers in applications, a verification step may be used by the API before adding a new caller ID resource. A request to add a caller ID may be initiated via a request to the API, wherein a random validation code is generated and returned in the API response. The validation code is preferably provided to an end user. A phone call is placed to the given phone number (caller ID), requesting that the validation code be entered via keypad digits or spoken. Entry of the validation code verifies possession of the phone number, or the device associated with the phone number, at the time of the request. Use of the caller ID resource may additionally be presented in a user interface, such as a web browser, by displaying the verification code. User interface may be provided by the operator of the call router, or may be provided by any suitable application using the API. Any suitable method may also be used for verification of a caller ID. In another alternative, where multiple parties are involved in a call, the caller ID of one of the existing party members may be assigned for additional outgoing calls during that call session.

[0032] The incoming address resource of the preferred embodiment functions to allow an application to get, modify, or provision new inbound DID phone numbers, SMS short codes, SIP Addresses, etc. for use with applications. PUT or POST may be used to set the initial URI associated with the inbound address. DELETE may be used to release the resource. The incoming address resource may be

used for real-time provisioning of phone numbers or other addressable inbound identifiers.

[0033] The call resource of the preferred embodiment functions to allow an application to get or modify the state of a telephony session in the call router. A telephony session or call may be in-progress, completed, failed, not yet initiated, and/or in any suitable call status. A call resource can preferably change the state or connection of an in-progress call. State changes preferably include: hanging up or terminating existing telephony sessions, transfering one or more existing telephony sessions from one contextual group of sessions to another, merging or spliting an existing group telephony sessions, transfering one or more telephony sessions from one communications medium to another (such as from one URI to a second URI), injecting an event or notification into a existing session or group of sessions, recording or ceasing to record the audio from one or more parties on a call, and/or any suitable call action. Call information or call log data can preferably be retrieved by sending a GET to the call resource or by alternatively sending any suitable method. Outgoing calls may also be initiated by using a POST or any suitable method that preferably indicates that a new call resource is to be created. When using the call resource to initiate a call, information may be provided as required to place a phone call, such as a caller ID to present, a phone number to call, and/or a URI to handle the call, but alternatively any suitable information may be provided. A call instruction XML document may alternatively be provided to the API instead of a URI, which is to be used for call instructions. The Call Router API may additionally respond with the status of a call such as if the call is answered, if a machine answered the phone, busy signal, no answer, call failure, and/or any suitable call status. The

response may alternatively indicate that the new call request was accepted, but has not yet been initiated. In the example shown in FIGURE 6, caller information and caller ID are included in a POST request to the call resource. This step would initiate an outgoing call to the phone number designated in the caller information. The Call Router API response includes available state information regarding the call, such as whether the call has commenced yet, the call start time, end time, price, caller info, and the Call Router API response could alternatively include any suitable information. Additionally, information about the call returned at any point by the API may depend on the status of the call. For example, a call start time would not be given if the call has not yet begun, or the call end time, duration or price would not be given if the call had not yet ended.

[0034] Additionally or alternatively, the call resource of the preferred embodiment may be used to transfer a call to a new URI by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, a call is preferably transferred to the new URI for new call instructions. The API may preferably be used to issue asynchronous changes in call state, unlike the synchronous communication between the call router and application server for synchronous URI requests and responses. The call resource, in this alternative, functions to allow a call to be asynchronously directed to URIs. Examples of various applications of the call resource include initiating a new telephony session, terminating an existing telephony session, call waiting, call holding, call queuing, call parking, private call sessions within a conference, carry on multiple call sessions, and/or any suitable application. Any situation where asynchronous events affect the call status, such as a call agent becoming available, or a person returning to the

phone after placing a caller on hold. The currently executing call router instruction may be allowed to complete, or may be immediately terminated, before requesting the provided URI. New call state resulting from the last call instruction executed by the call router, such as digits pressed on the keypad or audio recorded from the caller, may be provided to the new URI in a form POST or GET parameters, or may alternatively be discarded by the call router and not provided. As shown in FIGURE 15, call waiting may be implemented by an application sending a Call Router API request to the call resource that POSTs a new URI for the call. The caller is then directed to the new URI for instructions. A second Call Router API request is sent to the call resource that POSTs the original URI for the call, and thus brings the caller back to the first call session. The call resource may alternatively be used in any suitable application.

[0035] As an alternative embodiment of the call resource, a calls resource may implement a plurality of individual calls as distinct subresources. For example, a URI ending in "/Calls" may be a list of many calls performed by the account, and a URI ending in "/Calls/12345" may represent one specific call, uniquely identified by the key "12345". The calls resource preferably allows retrieval of many call records and/or creating new calls, while a single-call resource represents a single call. The calls resource preferably accepts a request to create a new call resource, as is common in RESTful architectures, which in the Call Router API, preferably serves to initiate one or more new calls. A calls resource may be used to both list current and previous calls using the GET method, as well as initiate a new outbound call using the POST method. Using RESTful principles such as POST or PUT to alter the state of an individual call resource can preferably change the state of an in-progress call,

affecting the realtime activities of the call, such as by hanging up, transferring control to a new URI, joining the call with another call, or any suitable telephony action.

[0036] The media resource of the preferred embodiment functions to allow an application to retrieve and/or access information of media stored, cached, created, and/or used during a call. In one variation, the media resource is preferably a recording resource to access information and recordings made during a call via recording call instructions, or asynchronously via the Call Router API. In another variation, the media resource may alternatively include call transcripts, text messages, key press logs, faxes, a binary-coded resource, and/or any suitable media. The media resource may alternatively include a URI of the binary-coded file (such as a wav, mp3 audio file or PDF document file). In one variation, the media resources may additionally be integrated with the telephony instructions (or markup language) such that a telephony instruction may instruct the call router to perform an action that creates a media resource. The call router preferably sends a response to the application server with the URI of the created media resource. For example, when the call router is instructed to record a message, the call router preferably sends a response to the application server with a unique URI of the recorded message within the API. The media URI preferably responds to GET requests to return the media in a number of formats, such as binary or XML meta-data representations. The media resource may accept requests to delete a media resource. In one variation, the media resource preferably requires authentication to access the resource. In another variation, the media resource may not require authentication to enable URI embedding in a variety of applications, without exposing authentication credentials. In yet another variation, authentication is preferably performed via cryptographic

hashing, such that credentials are not exposed to client applications that consume the media resources. In another variation, the media resource allows the initiation of transcription of audio resources to text using transcription technology. The audio resource used for transcription is preferably generated during telephony sessions (such as by using the record instruction) and hosted on the Call Router API. The media resource preferably allows retrieving or deletion of audio transcriptions generated from recorded media. The media resource may additionally allow centralized hosting of media files, and the resource URIs are preferably exchanged between the call router and the application server, instead of the large media files themselves. The media resource may alternatively be used for any suitable media.

[0037] Additionally or alternatively, a join resource of the preferred embodiment may be used to join one or calls into a shared session that allows the parties to communicate (i.e., a conference) by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, one or more calls are preferably join together such that they are in a conference. The join resource may alternatively be a subresource or part of the call resource.

[0038] Additionally or alternatively, a split resource of the preferred embodiment may be used to split shared sessions (e.g., a conference) into individual call sessions by a single call resource receiving a POST, PUT, and/or any suitable method. In this alternative, one or more shared sessions involving two or more calls are preferably split such that one or more calls are split into separate calls or into on or more separate conferences. The split resource may alternatively be a subresource or part of the call resource.

2. System for Handling Telephony Sessions

[0039] As shown in FIGURES 2A, 2B, 3A, and 3B, a system 20 and 30 of the preferred embodiment for handling telephony sessions includes a call router 22, a URI 23 for an application server, a telephony instruction 27, and a call router resource 29. As shown in FIGURES 2A and 2B, a first configuration 20 is initiated by a telephony device (such as a telephone call, fax or SMS message). As shown in FIGURES 3A and 3B, a second configuration 30 is initiated by an application developer side (i.e., server 26 calling out). The telephony system of the preferred embodiment preferably additionally implements a Call Router API 28 that includes a Call Router API request format, a Call Router API response format and a plurality of resources substantially similar to those described above.

[0040] The call router 22 functions to initiate or receive calls from the telephony device and connect to a web-application server. The call router 22 is preferably connected to a PSTN device over the PSTN network, such that it can receive and make calls from PSTN-connected devices 21, such as landlines, cellular phones, satellite phones, or any other suitable PSTN-connected devices, as well as non-PSTN devices, such as Voice-Over-Internet-Protocol (VOIP) phones, SIP devices, Skype, Gtalk, or other Internet addressable voice devices. The call router 22 may alternatively or additionally function as or include a message router for use with SMS messages. The call router 22 can preferably connect to an SMS network, such that it can receive and send messages from SMS network devices 21, cellular phones, computers, smartphones, or any suitable SMS network devices. The call router 22 may also send or receive text messages, multimedia messages, emails, faxes and other suitable PSTN-compatible communication messages. The call router 22

preferably communicates with the application server 26 using an application layer protocol, more preferably using the HTTP, or secure HTTPS, protocol. The communication between the application server 26 and the call router 22 is preferably stateless and any state information (e.g., call state) or data is preferably located in a URI or the request parameters, such as HTTP headers, GET URI parameters, POST request body parameters, or HTTP cookies. Available state information is preferably transmitted by call router requests to the application server for stateless processing, and the application server preferably stores no state. Alternatively, the application server preferably stores local state information, such as databases or sessions, as is common in web development. The call router 22 preferably stores state information in call router resources 29. The call router resources 29 are preferably accessible by the application server 26 and other devices through the call router API 28. The call router resources 29 are preferably similar to those described above. The call router 22 preferably associates each incoming phone number with a starting URI 23, more preferably the URI 23 is provided by the application server 26, still more preferably the URI 23 is provided by the application developer before a call is received at the call router 22 by associating the initial URI with the incoming call address (such as DID, SIP address, etc.) or by the application upon initiation of an outgoing call. The call router 22 preferably sends call data such as the caller number (obtained via Caller ID), caller geographic data (country, city, and/or state, zip) the number dialed, the time of the call, or any other suitable information or parameter. The call data is preferably digitally signed with a secret key 25 stored on the call router 22. A cryptographic hash of the information is preferably included along with the information as a digital signature. The call router 22 may also encrypt sensitive

information (either before or after the cryptographic hash is computed) using the secret key to allow sensitive information to be sent across the network. The call data is preferably sent as an HTTP POST request to the application server 26. Call data may also be sent in URL (GET) variables, or encapsulated in HTTP headers. An example HTTP request containing the information in the header is shown in FIGURE 4A and 4D. As shown in FIGURE 4B, further inputs (such as voice recording or DTMF button pressing) from the PSTN-device may be subsequently submitted to the application server 26 as HTTP requests (GET or POST). As shown in FIGURE 4C, the inputs from a phone keypad may be included in an HTTP GET request. As shown in FIGURE 4E, the content of an SMS message received by the call router may be sent to the application server 26 as an HTTP request. As shown in FIGURE 4F, the inputs from the text message are included in an HTTP GET request. The request data may alternatively be simultaneously sent in the URI (query string), message body (POST) and message headers, or any combination of the above.

[0041] The application server 26 functions to provide data processing logic for requests received from the call router 22. The application server 26 is preferably connected to the call router 22 via a network 24, more preferably via the Internet. The application server 26 is preferably a third party server operated outside of the system, but the system may alternatively include the application server 26. The URI 23 is preferably associated with an application server 26 or an application on an application server 26. The application server 26 preferably communicates with the call router 22 using an application layer protocol, more preferably using the HTTP protocol, or more secure HTTPS protocol. The application server 26 preferably receives HTTP requests from and sends HTTP responses to the call router 22. The

application server 26 preferably runs on a standard stack of programming languages, hosting providers, operating systems and databases to handle HTTP requests, as if the caller were a website visitor in a web browser. The application server 26 also preferably verifies the digital signatures of the call data received in the requests using the secret key to compute a cryptographic hash from the received information and the hash received. If the computed hash and the received hash do not match, or no hash is received with the request, then the application server 26 preferably determines the request is fraudulent, and the request is preferably discarded. If the computed hash and received hash match, the application server 26 preferably determines that the request is authentic and proceeds further with the processing of the request. The application server may alternatively choose to ignore the hash if security is not important. The application server preferably uses call state data communicated by the call router request to determine the next call router instructions, without requiring call state stored on the application server. The application server may alternatively use call state data sent by the call router, such as the caller ID of the caller or the unique ID of the call, to reference additional or external state data, such as rows in a database or session data stored on the application server. The application server 26 preferably responds to HTTP requests received from the call router 22 by generating telephony instructions 27 for the call router 22. The application server preferably replies to the call router in XML, however, any suitable machine-readable message format may be used, including HTML, key/value pair text, delimited text or binary encoding. The XML preferably includes the telephony instructions 27 for the call router 22 such as connecting to another number, playing a recorded greeting, reading text, and/or requesting DTMF

digit entry from the caller. The telephony instruction 27 may alternatively be related to SMS messaging, Multimedia Messaging Service (MMS) messaging, email, or any suitable messaging task. The telephony instruction 27 may additionally be used to send an outgoing SMS message, arrange a phone call from a specific phone number, arranging for a callback, setting up a conference call (connecting multiple numbers), sending an email, interfacing with a calendar or scheduling system, purchasing goods, or services, or any other suitable instruction. The XML instructions are preferably a set of commands to be executed in order, one at a time (i.e., sequentially). An example XML response is shown in FIGURES 5A and 5B. In single telephony session (e.g. one initiated by a PSTN-device or an SMS device) a response from an application server can initiate an outgoing telephony call and/or a SMS message. That is, a single XML response preferably provides the ability to interact with both the SMS network and the voice telephony network (PSTN, SIP/VoIP, etc) sequentially or simultaneously. In addition, audio or video files sent to the call router 22 can be converted to text by an automatic speech-to-text engine, human or other technique, and sent back in text form as an SMS message or an attachment to an MMS. In one variation, an application running on a server may be a simple static XML page and static sound files, deployed on basic web servers where no development or scripting environment is available. This variation preferably uses URI Templates (a current IETF proposal for HTML5), which essentially includes URLs with placeholders for variable data, like this: http://www.twilio.com/audio/{Digit}.mp3 where the call router 22 would substitute the digits pressed for the {Digit} placeholder in the URI Template, GET the file at the resulting URI, and play the static sound file in response. This allows an entire

application to be authored offline in a What-You-See-Is-What-You-Get (WYSIWYG) html editor. For example, if the server response specifies the URI Template: http://demo.twilio.com/myapp/{Digits}.mp3, and the caller presses digits 1234, the call router 22 would GET the static mp3 file located at: http://demo.twilio.com/myapp/1234.mp3 and play it to the caller. The variables used for substitution in the URI Templates preferably correspond to the names of variables defined for state submission in HTTP GET, POST and/or header requests from the call router. From the previous example, {Digits} would be associated with a parameter named "Digits" that is preferably generated as a result of a "gather" telephony instruction (collection of DTMF digits). In the preferred embodiment for the second configuration, the call is initiated by the application server 26 (through the call router 22), and the second configuration 30 is substantially similar to the first configuration 20, such that the call routing is preferably handled identically to an incoming call, namely via URI requests from call router 22 to the server 26 upon call state changes. The application server preferably additionally is able to make calls to the Call Router API as described above.

3. Example Applications

[0042] Call router applications are preferably web applications, implementing the most common phone system features with full APIs for administration. Each Call Router Application object has a unique URI. A call may be transferred to that object instance by specifying its URI as a call destination. The call router applications preferably include: the AutoAttendant application (in FIGURE 7), the Follow Me application (in FIGURE 8), the Conference application (in FIGURE 9), the

AutoConference application (in FIGURES 9-11), the Device application, the Person application, the VoicemailBox application, the Group application, and the Queuing application (in FIGURE 12).

[0043] The AutoAttendant application, as exemplified in FIGURE 7, plays a recorded greeting, and waits for the caller to press one or more digits on the keypad. Based on the input, the AutoAttendant preferably directs the call to another AutoAttendant, one or more of phones of a person, a voicemail box or any other valid calling destination.

[0044] The Follow Me application, as exemplified in FIGURE 8, enables a person to be reached at multiple devices, such as a work number, a cellular phone number, a landline, and/or a VOIP device. The Follow Me Application preferably calls these devices in order or simultaneously in an attempt to reach the person.

[0045] The Stay With Me application enables a person to transfer an in-progress call between multiple phone devices, such as a cellular phone and a home phone. For example, a user may wish to transfer a call from a more expensive cellular call to a less expensive landline phone, or may wish to transfer a call to a landline phone if a cellular phone battery is running low.

[0046] The Conference application, as exemplified in FIGURE 9, preferably allows three or more callers to participate in a call simultaneously, while providing mechanisms to control who can join and speak during the call. The Conference application may alternatively or additionally incorporate SMS messaging control. The Conference application upon receipt of an SMS message including multiple phone numbers, may initiate a conference call to one or more parties, using the single SMS.

[0047] The AutoConference application preferably allows a conference administrator to initiate a conference call with two or more parties by performing one action, such as selecting a button on a website, selecting a button on a phone device, dialing a phone number, or scheduling the call prior to its initiation. Examples of the AutoConference application implemented using the preferred method of the invention are shown in FIGURE 9 (viewed from the PSTN-device side), FIGURE 10 (viewed from the application server side), and FIGURE 11 (initiated by an application server using the call router API).

[0048] The Device application represents a telephone used within the phone system, and may be a hard phone (hardware) or soft phone (software), a VOIP phone or a traditional PSTN phone. The Device application handles configuration details and device status (Do Not Disturb, Busy, etc.).

[0049] The Person application represents a human-being user of a telephone system. The Person may have one or more extensions, devices, and/or voicemail boxes, and may have a preferred order in which to ring their phones or voicemail. A person may have a username and password with which to login and update these settings.

[0050] The VoicemailBox application preferably plays a greeting, and allows the caller to record a message. Once complete, the recorded message may be stored for later listening, emailed as an audio link or attachment, or both. A list of current messages for a VoicemailBox may be retrieved by dialing in, via API, via RSS feed, and/or any other suitable method or device. In one variation, the audio recording may be automatically transcribed, transforming speech to text. The text is preferably

included in the email or text message along with the audio link, attachment, and/or retrievable later by any suitable means of the API.

[0051] The Group application preferably represents a logical grouping of other Call Router Application objects, including other Groups. The Group preferably defines the behavior of calls directed to the group, including queuing, hunting for the first available party, and simultaneously ringing multiple parties.

[0052] The Queuing application preferably, upon receipt of a phone call or an SMS message, enters the message sender to a telephony call queue and the message sender is called back via the PSTN, SIP/VoIP network or other telephony network, as exemplified in FIGURE 12. The call may be placed either at the message' originating number or another pre-specified number, either when a human/operator/service is available (customer service applications) at a pre-scheduled time, such as a wake-up call, anniversary reminder, birthday reminder.

[0053] The call router applications may additionally or alternatively include:

[0054] a Busy Signal Buster service that, upon receipt of an SMS message or phone call transmitting a number to be called that is currently busy, and calls the SMS message sender back at the message' originating number or another pre-specified number when the number is no longer busy;

[0055] a SMS Reader/TTY application that, upon receipt of an SMS, translates the text into audio, using a text-to-speech engine to a caller or the members of an audio conference (e.g., to tell them you will join the call in a few minutes), or for the hearing impaired to use instead of TTY services;

[0056] a Translation application that, upon receipt of an SMS message containing a phrase in a language, translates the language of the SMS message into

another language (either manually by a human or automatically by a program) and sends a response message via SMS or email; and

[0057] a Programming application that, upon receipt of an SMS message containing programming code, could compile the code and execute the code, update a website, update a programming project, return data from a database, return a generated computer graphics object as an MMS message, or any other suitable program compilation or computation.

[0058] The call router applications may additionally or alternatively include a Status/Notification application that allows users to get or send the status of an object, task, or process by sending an SMS message and receiving a call back via the PSTN, SIP/VoIP network or other telephony network. The service may be used by an operator sending an SMS message with the name of a particular server and then get a call back on her mobile phone and hear the status of that server read aloud. The service may also be used for notification, i.e. to call other parties. For example, a store manager may want to let employees know what time a store is opening the next day. The manager could send an SMS message that would then call each employee and tell him or her over the phone the time when the store was opening the next day, and or what time they needed to arrive at work.

[0059] The call router applications may, however, include any collection and/or permutation or these or other suitable prebuilt telephony functions and features.

[0060] Applications of the preferred method may include simple PBX functionality, such as auto-attendant voice menus, employee extensions, and voicemail features. The application may also include other, unconventional,

applications such as an Interactive Hold application, a Conference Calling application, an Independent Music Hold Channel, a Voting/Fundraising application, a Sales Application, a Blog by phone service and a Call Annotation application.

[0061] The Interactive Hold application preferably includes interactive activities, such as a playing a quiz game to be played while on hold (with or without the ability to be played against other callers), listening to news headlines or podcasts of the choice of the listener, and using a phone keypad as a synthesizer to create music in realtime. The Conference Calling application may, as an example, include selecting particular (or random) users from a phone book and instantly substantiating a conference call to the group, with the ability to save the group for future calling. The Independent Music Hold Channel preferably allows independent artists to upload, classify, and grant permission for their works to be played while a caller is on hold. The Voting/Fundraising application preferably connects willing callers (calling to encourage voting or to raise funds for a cause), to potential voters and/or donors respectively, preferably including an interface for the caller to display information about the voter/donor and to make notes about the voter's response to the call. The Sales Application preferably allows sales organizations to quickly integrate inbound and outbound calls with customer relationship management (CRM) applications, or read order details from a shopping cart application. Finally, the Call Annotation application allows call participants to append meta-data, such as reference URIs used in the phone conversation, to a specific call and a timestamp within the call. Participants on the call with a suitable user agent could view the annotations during the call, and people listening to a later replay of the call audio could also receive such annotations at the same timestamp during the playback. The

Call Annotation may be used, for example, to facilitate conference call note taking, employee training, sales team collaboration, and/or customer support collaboration.

[0062] Applications may alternatively include hold or park functionality, where a caller is placed in a waiting state until an external event resumes the call, such as another party becoming available. One variation of this application is the call queue, where callers wait for an available attendant to answer a call. Applications of the preferred method may alternatively include other conventional or unconventional PBX functionality.

[0063] As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims. It is possible, and indeed hoped, that additional applications will be designed and built upon this technology platform (the preferred method and/or system of the invention) that would not otherwise be possible using conventional telephony platforms.

CLAIMS

We Claim:

1. A method of processing telephony sessions of a network including an application server and a call router, the method comprising the steps of:
   - communicating with the application server using an application layer protocol;
   - processing telephony instructions with the call router; and
   - creating call router resources accessible through a call router Application Programming Interface (API).

2. The method of claim 1, further including the step of mapping a telephony session to a Uniform Resource Identifier (URI), wherein the URI is associated with the application server.

3. The method of claim 2, further including the step of embedding state information of the telephony session into the URI.

4. The method of claim 3, wherein all state information required by the application server is embedded in the URI.

5. The method of claim 2, further including the steps of sending a request to the application server; embedding state information of the telephony session in the request; and receiving a response from the application server; wherein the response contains the telephony instructions.

6. The method of claim 5, wherein the steps of sending and receiving are performed using a Hypertext Transfer Protocol (HTTP).

7. The method of claim 6, wherein the telephony instructions are encoded in Extensible Markup Language (XML).

8. The method of claim 5, further including the step of sending a digital signature with the request, wherein the digital signature is adapted to be used for account verification by the application server.

9. The method of claim 8, wherein the digital signature is a cryptographic hash generated by a key, wherein the key is shared by a call router and the server, and wherein the cryptographic hash is included in the URI.

10. The method of claim 5, further including the step of processing telephony instructions sequentially.

11. The method of claim 10, further including the step of initiating the telephony session from a phone number through the Public Switched Telephone Network (PSTN).

12. The method of claim 10, further including the step of initiating the telephony session from a message received from a Short Message Service (SMS) system.

13. The method of claim 10, further including the step of initiating the telephony session by an application server through the call router API; wherein the initial URI mapped to the telephony session is provided by the application server.

14. The method of claim 10, wherein the call router resources are accessible by outside devices at an addressable URI.

15. The method of claim 14, wherein the call router API is substantially a Representational State Transfer (REST) API.

16. The method of claim 14, including the steps:

- storing state information in the URI of a call router resource;
- modifying call router resources to alter the state of the call router; and
- interacting with media of the call router according to the call router API.

17. The method of claim 14, including the steps:

- receiving an API request from the application server for interaction with a resource; and
- responding to an API request based on the interaction with a resource.

18. The method of claim 17, including creating a resource selected from the group consisting of: a call resource, a media resource, an incoming address resource, an account resource, and a caller identification (ID) resource.

19. The method of claim 18, including:

- altering the state of the telephone session with the call resource;
- accessing media with the media resource;
- modifying incoming addresses with an incoming address resource;
- modifying account information with the account resource; and
- modifying caller ID information with the caller ID resource.

20. The method of claim 18, wherein the telephony instruction is selected from the group consisting of: connecting to a telephony device, playing a media file, converting text to speech, detecting input from a telephony device, and connecting to a new URI.

21. The method of claim 17, including creating a call resource; wherein the call resource is used for altering a connection of the telephony session.

22. The method of claim 21, wherein altering a connection of a call session includes: joining telephony sessions, splitting a telephony session, and transferring a telephony session.

23. A system for processing telephony sessions comprising:

- a call router that connects to a telephony device and communicates with an application server using an application layer protocol;
- a URI for an application server, associated with a telephony address;
- a telephony instruction executed sequentially by the call router; and
- a call router API resource created by the call router and accessible by the application server through a call router API.

24. The system of claim 23, wherein the application layer protocol is a HTTP protocol, and wherein the telephony instruction is encoded in XML.

25. The system of claim 24, wherein the request encapsulates a state of a call.

26. The system of Claim 25, wherein the call router API is a REST API.

27. The system of Claim 26, wherein the resources are selected from the group consisting of: a call resource, a media resource, an account resource, an incoming addresses resource, and a caller ID resource.

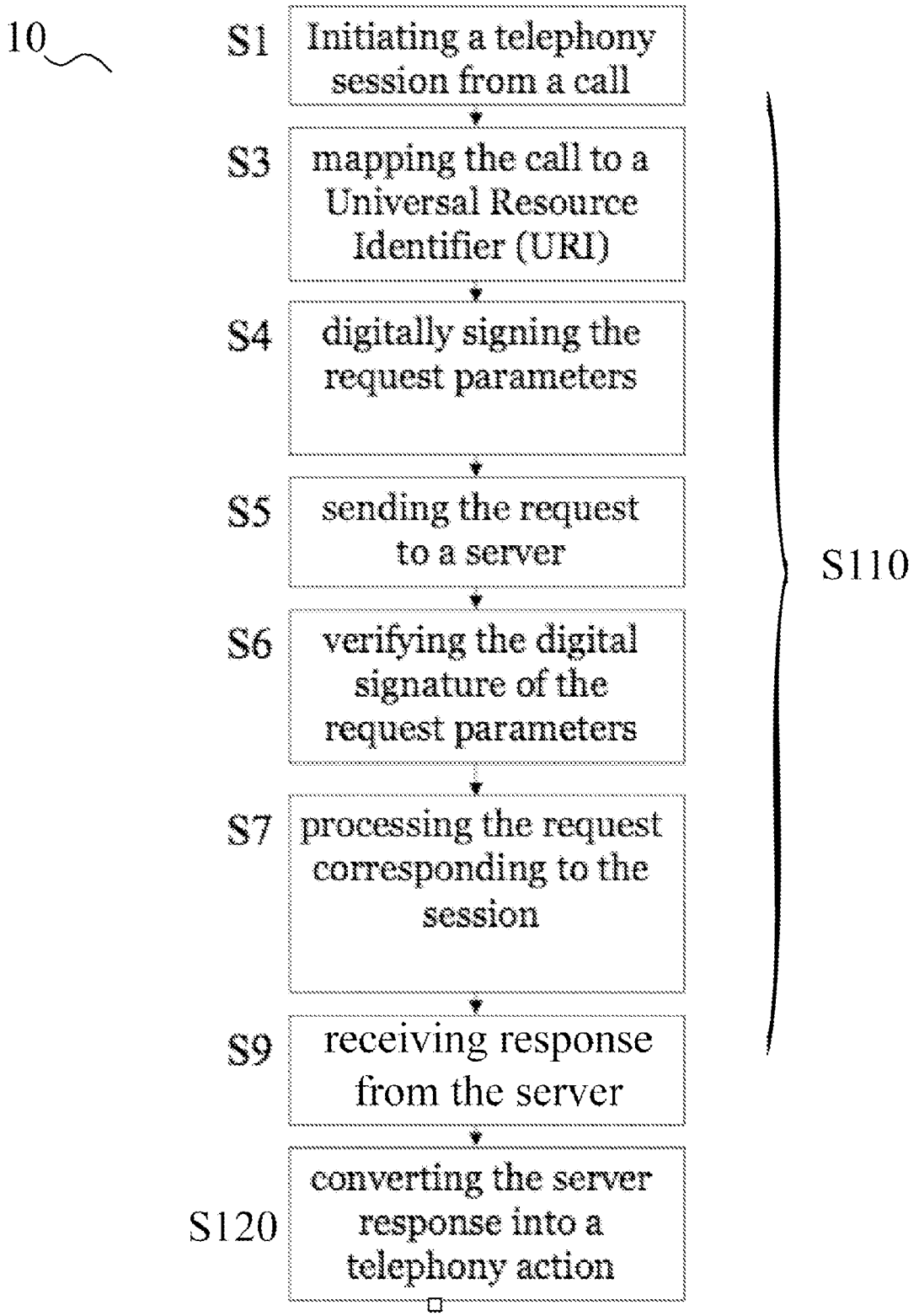

FIGURE 1

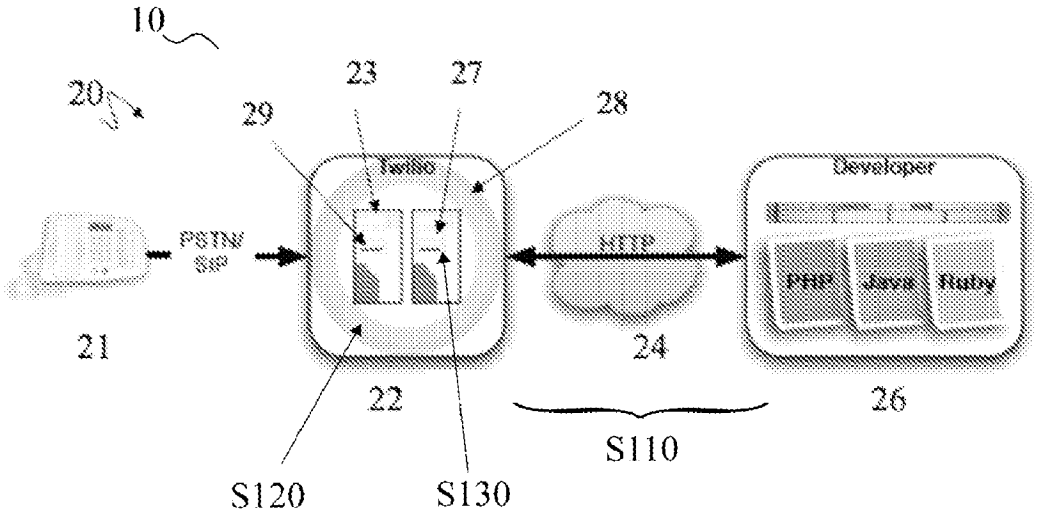

FIGURE 2A

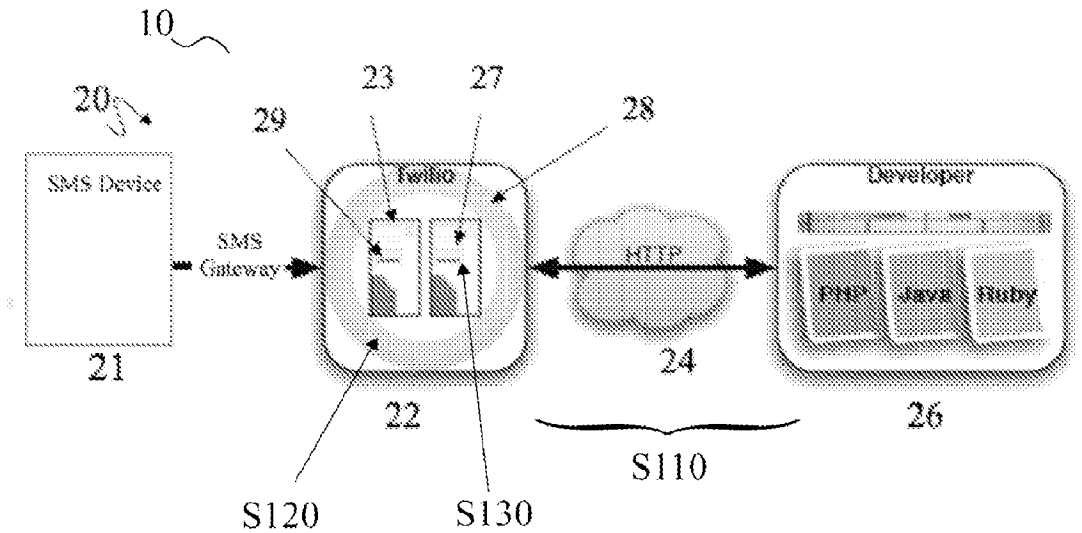

FIGURE 2B

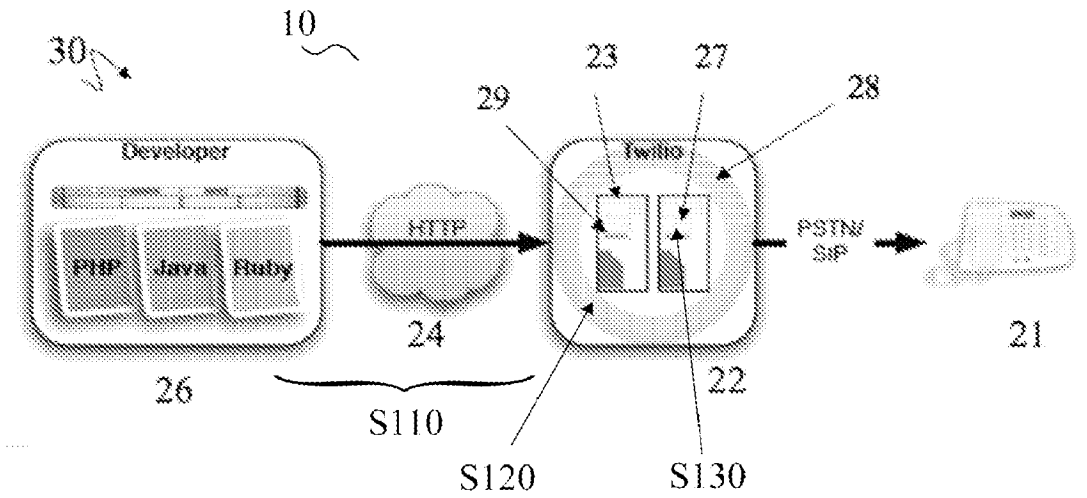

FIGURE 3A

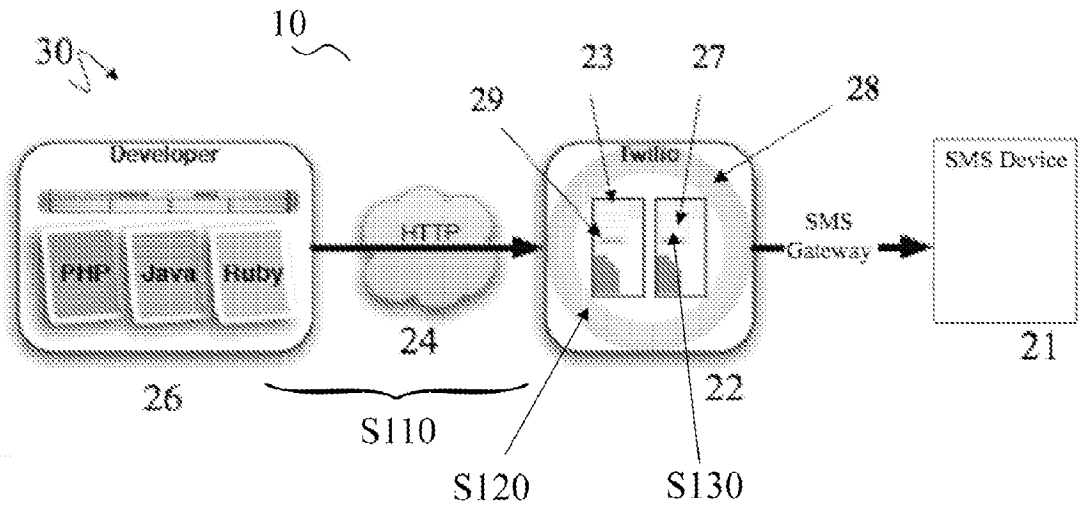

FIGURE 3B

```
GET /foo.php HTTP/1.1
Host: demo.twilio.com
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIGURE 4A

```
POST /foo.php HTTP/1.1
Host: demo.twilio.com
Content-Type: application/x-www-form-urlencoded
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 11

 Digits=1234
```

FIGURE 4B

```
GET /foo.php?digits=1234 HTTP/1.1
Host: demo.twilio.com
X-Twilio-CallGuid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-CallerId=415-555-1212
X-Twilio-NumberCalled=415-867-5309
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIGURE 4C

```
GET foo.php HTTP/1.1
Host: demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderId=415-555-1234
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIGURE 4D

```
GET foo.php HTTP/1.1
Host: demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderId=415-555-1234
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 21

message=statusrequest
```

FIGURE 4E

```
GET foo.php?message=statusrequest HTTP/1.1
Host: demo.twilio.com
X-Twilio-SMSid=DE870AD708ED70AE87D0AE7DAD7
X-Twilio-SMSSenderId=415-555-1234
X-Twilio-SMSShortCode=11111
X-Twilio-AccountId=AAF4AF5AF8A9A885449F7A647AF84
Content-Length: 0
```

FIGURE 4F

XML Response

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
        <Collect
                successUrl="http://www.example.com/phonetree.php"
                numDigits="1"
                timeout=20
        >
                <Say voice="female">
For sales press one. For support press two. For the operator, press three.
                </Say>
        </Collect>
</Response>
```

FIGURE 5A

XML Response

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
        <sms address=415-555-5555>
                thanks for the your text, will call at 5 PM.
        </sms>
        <CallAtTime=“17:00PST">
                Today
                <Dial>415-555-5309</Dial>

        </CallAtTime>
</Response>
```

FIGURE 5B

```
POST /2008-08-01/Accounts/AC309475e5fede1b49e100272a8640f438/Calls HTTP/1.1
        Caller=4155555309&Called=4155551212&Url=http://www.myapp.com/myhandler.php


<TwilioResponse>
        <Call>
                <Sid>CA42ed11f93dc08b952027ffbc406d0868</Sid>
                <CallSegmentSid/>
                <AccountSid>AC309475e5fede1b49e100272a8640f438</AccountSid>
                <Called>4155551212</Called>
                <Caller>4155555309</Caller>
                <PhoneNumberSid>PN01234567890123456789012345678900</PhoneNumberSid>
                <Status>0</Status>
                <StartTime>Thu, 03 Apr 2008 04:36:33 -0400</StartTime>
                <EndTime/>
                <Price/>
                <Flags>1</Flags>
        </Call>
</TwilioResponse>
```

FIGURE 6