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(54) **CONTROLLER FOR CONTROLLING COMBINATION OF HOT-RUNNER SYSTEM AND MOLD ASSEMBLY**

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(52) **U.S. Cl.** **700/197**; 425/145

(58) **Field of Classification Search** 700/197, 700/200

See application file for complete search history.

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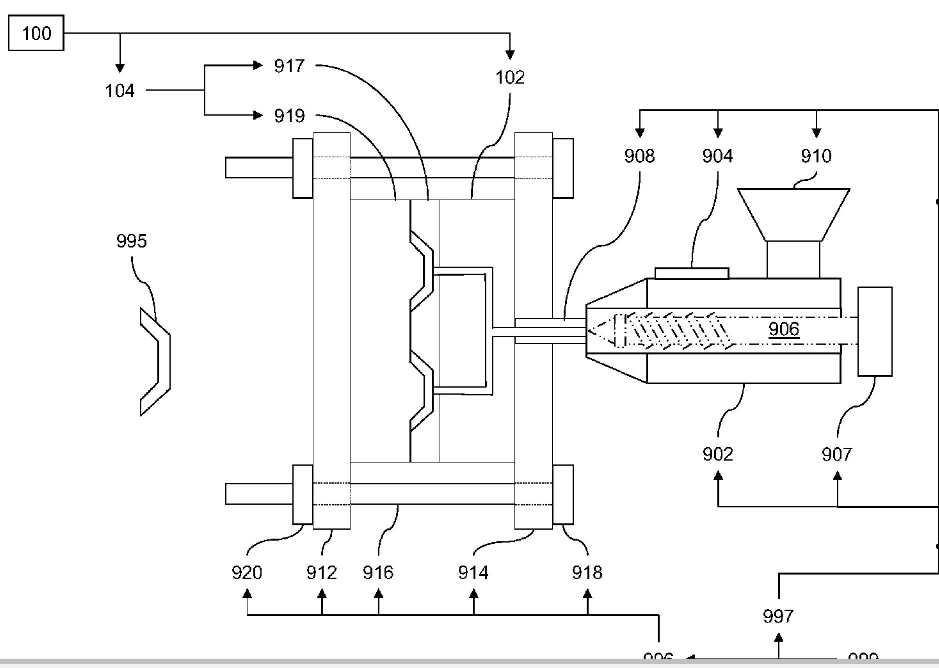
(57) **ABSTRACT**

A single stand alone controller system (**100**) for controlling combination of hot-runner system (**102**) and mold assembly (**104**), assembly (**104**) connectable to system (**102**), controller system (**100**) comprising: processor (**110**); interface modules (**112**) configured to operatively couple to system (**102**) and assembly (**104**), processor (**110**) connected with modules (**112**); and controller-usable medium (**114**) embodying instructions (**116**) executable by processor (**110**), processor (**110**) connected with said medium (**114**), instructions (**116**) including: executable instructions for directing said processor (**110**) to control said system (**102**) and said assembly (**104**).

7 Claims, 2 Drawing Sheets



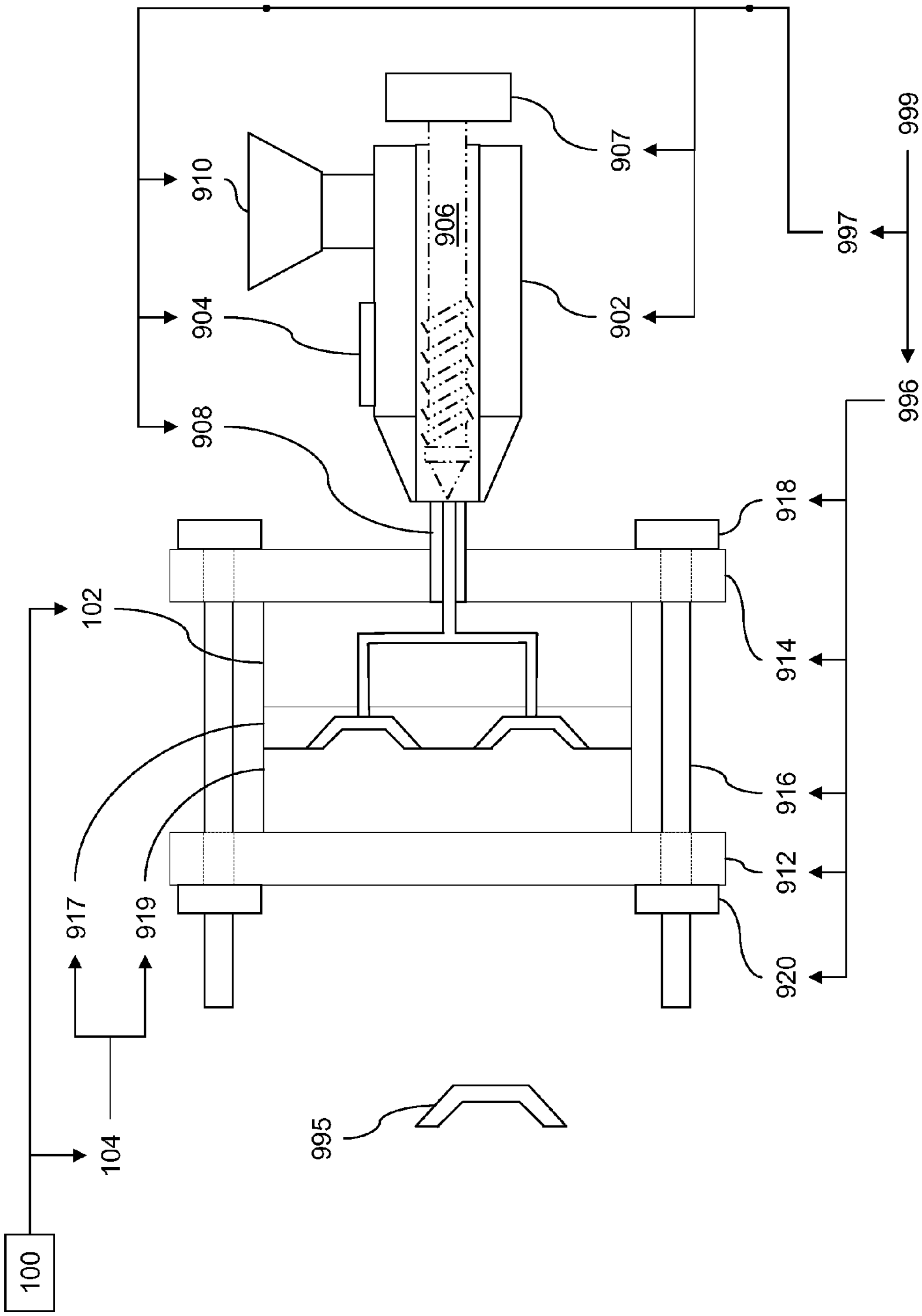

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FIG. 1

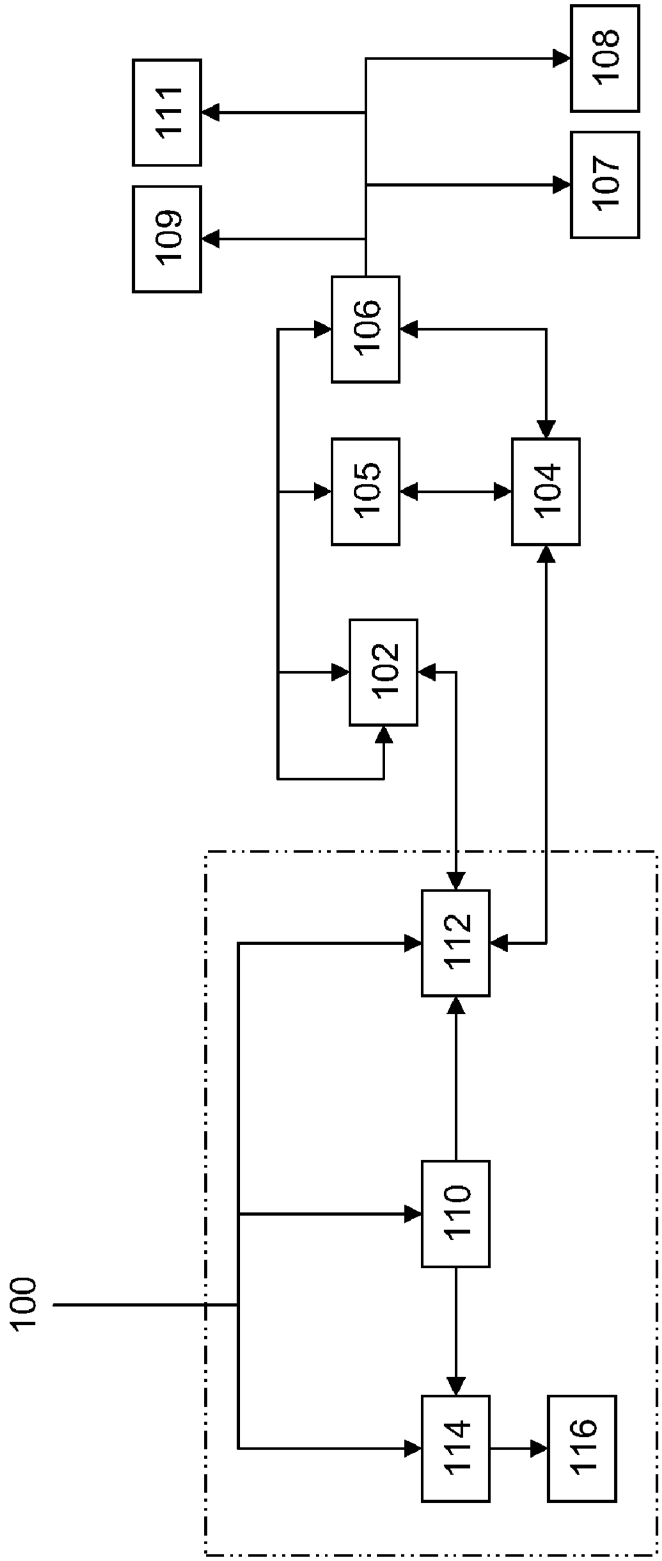

FIG. 2

CONTROLLER FOR CONTROLLING COMBINATION OF HOT-RUNNER SYSTEM AND MOLD ASSEMBLY

TECHNICAL FIELD

An aspect of the present invention generally relates to (but is not limited to) a controller for molding systems including (but not limited to) a controller for controlling a combination of a hot-runner system and a mold assembly.

BACKGROUND

The first man-made plastic was invented in Britain in 1851 by Alexander PARKES. He publicly demonstrated it at the 1862 International Exhibition in London, calling the material Parkesine. Derived from cellulose, Parkesine could be heated, molded, and retain its shape when cooled. It was, however, expensive to produce, prone to cracking, and highly flammable. In 1868, American inventor John Wesley HYATT developed a plastic material he named Celluloid, improving on PARKES' invention so that it could be processed into finished form. HYATT patented the first injection molding machine in 1872. It worked like a large hypodermic needle, using a plunger to inject plastic through a heated cylinder into a mold. The industry expanded rapidly in the 1940s because World War II created a huge demand for inexpensive, mass-produced products. In 1946, American inventor James Watson HENDRY built the first screw injection machine. This machine also allowed material to be mixed before injection, so that colored or recycled plastic could be added to virgin material and mixed thoroughly before being injected. In the 1970s, HENDRY went on to develop the first gas-assisted injection molding process.

Injection molding machines consist of a material hopper, an injection ram or screw-type plunger, and a heating unit. They are also known as presses, they hold the molds in which the components are shaped. Presses are rated by tonnage, which expresses the amount of clamping force that the machine can exert. This force keeps the mold closed during the injection process. Tonnage can vary from less than 5 tons to 6000 tons, with the higher figures used in comparatively few manufacturing operations. The total clamp force needed is determined by the projected area of the part being molded. This projected area is multiplied by a clamp force of from 2 to 8 tons for each square inch of the projected areas. As a rule of thumb, 4 or 5 tons per square inch can be used for most products. If the plastic material is very stiff, it will require more injection pressure to fill the mold, thus more clamp tonnage to hold the mold closed. The required force can also be determined by the material used and the size of the part, larger parts require higher clamping force. With Injection Molding, granular plastic is fed by gravity from a hopper into a heated barrel. As the granules are slowly moved forward by a screw-type plunger, the plastic is forced into a heated chamber, where it is melted. As the plunger advances, the melted plastic is forced through a nozzle that rests against the mold, allowing it to enter the mold cavity through a gate and runner system. The mold remains cold so the plastic solidifies almost as soon as the mold is filled.

Mold assembly or die are terms used to describe the tooling used to produce plastic parts in molding. The mold assembly are used in mass production where thousands of parts are produced. Molds are typically constructed from hardened steel, etc.

providing material to a mold, such as in an injection molding system, wherein the settings for controlling the molding operation are retained in a non-volatile memory in a hot-half of the mold.

European patent Number 0967063 (Inventor: Moss et al.; Filed: 24 Jun. 1999) discloses a pressure transducer used to sense the pressure in the manifold bore downstream of the valve pin head.

U.S. Pat. No. 6,000,831 (Inventor: TRIPLETT; Filed: 14 Dec. 1999) discloses injection mold hot runner control devices and more particularly to an injection molding control device which eliminates the conventional control cables to improve the quality of feedback signals received by the controller and the safety of the environment in which such systems are used.

U.S. Pat. No. 6,529,796 (Inventor: Kroeger, et al.; Filed: 21 Jul. 1999) discloses an injection mold apparatus having multiple injection zones, each zone having at least one heater and at least one temperature sensor generating a temperature indicating signal.

U.S. Pat. No. 6,421,577 (Inventor: TRIPLETT; Filed: 15 Oct. 1999) discloses injection mold hot runner control devices and more particularly to an injection molding control device which eliminates the conventional control cables to improve the quality of feedback signals received by the controller and the safety of the environment in which such systems are used.

U.S. Pat. No. 6,589,039 (Inventor: DOUGHTY et al.; Filed: 2000-10-30) discloses a system and method in which the rate of material flow to a plurality of gates can be controlled by a single controller.

United States Patent Publication Number 20030154004 (Inventor: KROEGER, et al.; Filed: 23 Jan. 2003) discloses an injection mold apparatus having multiple injection zones, each zone having at least one heater and at least one temperature sensor generating a temperature indicating signal.

U.S. Pat. No. 7,214,048 (Inventor: KIM; Filed: 25 May 2004) discloses control for a valve pin through a linear motor controlled by a pulse signal and through a cooling block, so that an opening/closing amount of a gate can be precisely managed.

U.S. Pat. No. 7,258,536 (Inventor: OLARU, et al.; Filed: 21 Jun. 2004) discloses a control module attached to a machine platen of an injection molding machine. The control module is coupled to at least one sensor that reports a value of a processing condition associated with an injection mold and is disposed within the injection mold. The control module is also coupled to at least one controllable device that varies the processing condition of the injection mold and is disposed within the injection mold. The control module collects and processes sensor output, and provides a control signal to at least one controllable device. A display interface module is linked to the control module. The display interface module accepts user-entered data set-points, provides the user-entered data set-points to the control module, and collects the processed sensor output from the control module for display to a user.

United States Patent Publication Number 20060082009 (Inventor: Quail, et al; Filed: 19 Oct. 2004) discloses an intelligent molding system that makes use of data directly associated with a molding environment or particular mold.

United States Patent Publication Number 2008/0290541 (Inventor: BAUMANN; Filed: 25 May 2007) discloses an injection molding system including a hot runner comprising a

United States Patent Publication Number 2008/0006955 (Inventor: NIEWELS; filed: 5 Jul. 2007) discloses a piezoceramic actuator actuated so as to supply the force to seal the side acting core insert against the core insert during a molding operation. Sensors are used to detect pressure between mold components and to transmit sense signals to a controller.

SUMMARY

It is understood that the scope of the present invention is limited to the scope provided by the independent claims, and it is also understood that the scope of the present invention is not limited to: (i) the dependent claims, (ii) the detailed description of the non-limiting embodiments, (iii) the summary, (iv) the abstract, and/or (v) description provided outside of this document (that is, outside of the instant application as filed, as prosecuted, and/or as granted). It is understood that "comprising" means "including but not limited to the following".

According to one aspect, there is provided a single stand alone controller system (**100**) for controlling a combination of a hot-runner system (**102**) and a mold assembly (**104**), the mold assembly (**104**) being connectable to the hot-runner system (**102**), the single stand alone controller system (**100**) comprising: a processor (**110**); interface modules (**112**) being configured to operatively couple to the hot-runner system (**102**) and the mold assembly (**104**), the processor (**110**) being connected with the interface modules (**112**); and a controller-usable medium (**114**) embodying instructions (**116**) being executable by the processor (**110**), the processor (**110**) being connected with the controller-usable medium (**114**), the instructions (**116**) including: executable instructions for directing the processor (**110**) to control the hot-runner system (**102**) and the mold assembly (**104**).

Other aspects and features of the non-limiting embodiments will now become apparent to those skilled in the art upon review of the following detailed description of the non-limiting embodiments with the accompanying drawings.

DETAILED DESCRIPTION OF THE DRAWINGS

The non-limiting embodiments will be more fully appreciated by reference to the following detailed description of the non-limiting embodiments when taken in conjunction with the accompanying drawings, in which:

FIG. **1** depicts a schematic representation of the single stand alone controller system (**100**); and

FIG. **2** depicts another schematic representation of the single stand alone controller system (**100**).

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details not is necessary for an understanding of the embodiments (and/or details that render other details difficult to perceive) may have been omitted.

DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

The single stand alone controller system (**100**) may include components that are known to persons skilled in the art, and these known components will not be described here; these known components are described, at least in part, in the following reference books (for example): (i) "*Injection Molding Handbook*" authored by OSSWALD/TURNG/GRA- 0-412-99381-3), (iii) "*Injection Molding Systems*" 3rd Edition authored by JOHANNABER (ISBN 3-446-17733-7) and/or (iv) "*Runner and Gating Design Handbook*" authored by BEAUMONT (ISBN 1-446-22672-9).

FIG. **1** depicts the schematic representation of the single stand alone controller system (**100**). The single stand alone controller system (**100**) may be hereafter referred, from time to time, as the "controller system (**100**)". An injection molding system (**999**) is depicted as having the single stand alone controller system (**100**). The injection molding system (**999**) includes (but is not limited to): an extruder assembly (**997**) and a clamping assembly (**996**). The extruder assembly (**997**), which is also called an injection unit, includes (but is not limited to): a barrel assembly (**902**), a heater assembly (**904**), a screw assembly (**906**), a drive assembly (**907**) for driving the screw assembly (**906**), a machine nozzle (**908**) connected to an exit end of the barrel assembly (**902**), and a hopper (**910**) connected to an entrance end of the barrel assembly (**902**). The clamping assembly (**996**) includes (but is not limited to): a movable platen (**912**), a stationary platen (**914**), tie bars (**916**), clamp units (**918**), lock units (**920**). A machine controller (not depicted, but known) is connected to the components of the injection molding system (**999**). The injection molding system (**999**), also known as an injection press, is a machine for manufacturing plastic products by the injection molding process. The injection molding system (**999**) can fasten the mold assembly (**104**) in either a horizontal or vertical position. Usually, the mold assembly (**104**) is horizontally oriented. Vertical orientation of the mold assembly (**104**) is used in some niche applications such as insert molding, allowing the machine to take advantage of gravity.

FIG. **2** depicts another schematic representation of the single stand alone controller system (**100**). The single stand alone controller system (**100**) is used for controlling a combination of a hot-runner system (**102**) and a mold assembly (**104**). The mold assembly (**104**) is connectable to the hot-runner system (**102**). The single stand alone controller system (**100**) includes (but is not limited to): (i) a processor (**110**); (ii) interface modules (**112**), and (iii) a controller-usable medium (**114**).

The processor (**110**) may be referred to as a central processing unit (CPU), which is an electronic circuit that can execute computer programs. The CPU or processor is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions. This term has been in use in the computer industry at least since the early 1960s. The form, design and implementation of CPUs have changed since the earliest examples, but their fundamental operation remains much the same. The fundamental operation of most CPUs, regardless of the physical form they take, is to execute a sequence of stored instructions called a program. The program is represented by a series of numbers that are kept in some kind of computer memory. There are four steps that nearly all CPUs use in their operation: fetch, decode, execute, and writeback. The first step, fetch, involves retrieving an instruction (which is represented by a number or sequence of numbers) from program memory. The location in program memory is determined by a program counter (PC), which stores a number that identifies the current position in the program. In other words, the program counter keeps track of the CPU's place in the current program. After an instruction is fetched, the PC is incremented by the length of the instruction word in terms of memory units. Often the instruction to be fetched must be retrieved from relatively slow memory, caus-

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