

[54] **AUTOMATIC DEVICE FOR DISCRETE COMPENSATION OF THE METALLOSTATIC PRESSURE IN MACHINES FOR CASTING WITH GAS PRESSURE**

[75] Inventors: **Ivan Dimov Nikolov; Gueorgui Nikolov Rasheev; Ferdo Atanasov Sivov; Nikolai Yonkov Nikolov; Chavdar Asenov Hristov**, all of Sofia, Bulgaria

[73] Assignee: **Institut Po Metaloznamie I Technologia Na Metalite**, Sofia, Bulgaria

[22] Filed: **Apr. 26, 1972**

[21] Appl. No.: **247,716**

[30] **Foreign Application Priority Data**

Apr. 29, 1971 Bulgaria ..... 17444

[52] U.S. Cl. .... 137/624.11

[51] Int. Cl. .... F16k 31/00  
 [58] Field of Search ..... 137/624.11

[56] **References Cited**  
**UNITED STATES PATENTS**

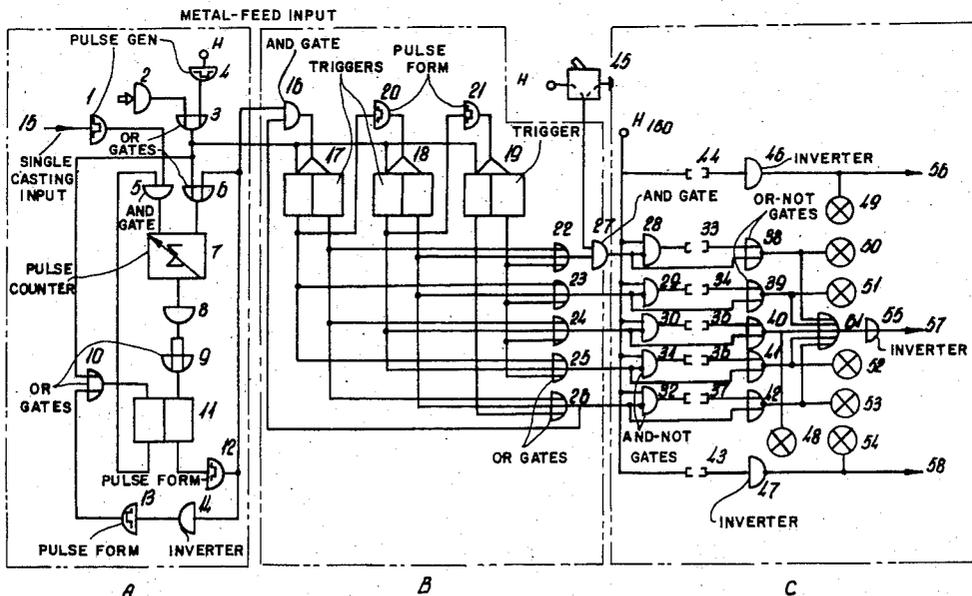
3,741,246 6/1973 Braytenbah ..... 137/624.11

Primary Examiner—Henry T. Klinksiek  
 Attorney, Agent, or Firm—Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

An automatic system for discretely adjusting the metallostatic pressure of a metal-casting machine operating under a pressure differential receives an input to its ring counter from the casting unit representing the number of casting cycles. The output of the ring counter is applied to the shift register which, in response to the count, operates an output circuit to provide a control signal adjusting the differential pressure in accordance with a number of castings produced.

1 Claim, 3 Drawing Figures



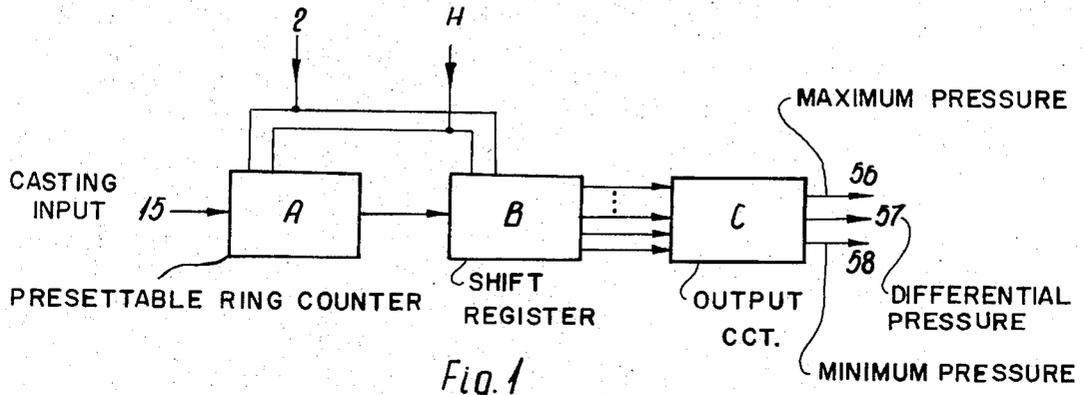


Fig. 1

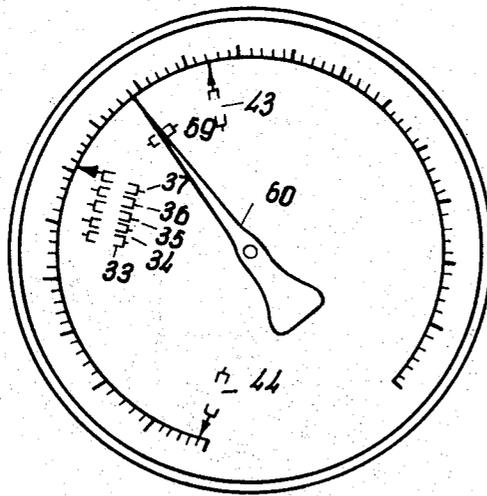


Fig. 3

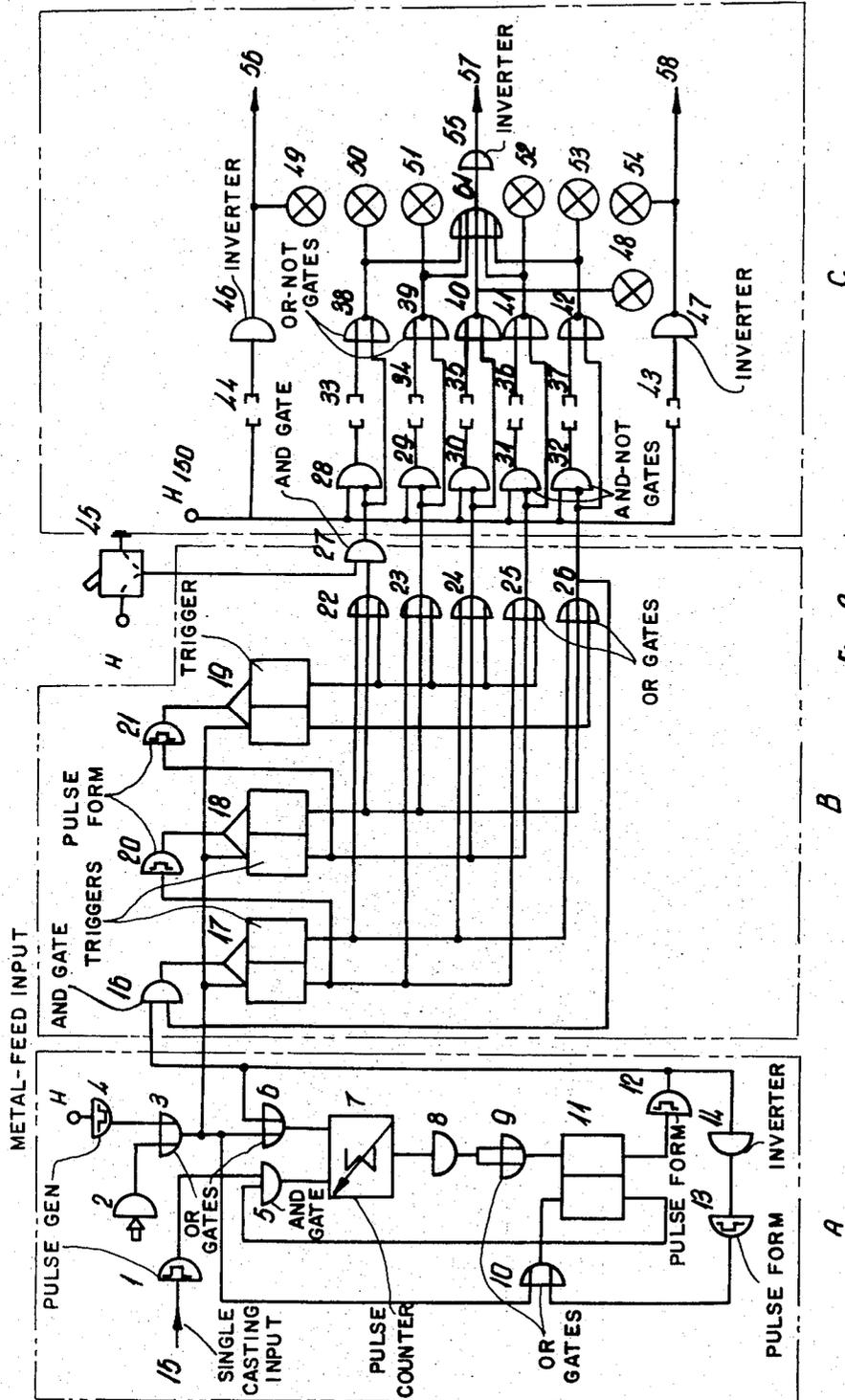


Fig. 2

## AUTOMATIC DEVICE FOR DISCRETE COMPENSATION OF THE METALLOSTATIC PRESSURE IN MACHINES FOR CASTING WITH GAS PRESSURE

The present invention relates to a system for the establishment of discrete pressure differentials in apparatus for the casting of metals under gas pressure so as to vary in increments the differential pressure effecting the casting with the decreasing level of metal in the crucible.

In the casting of molten metals under differential pressure, metal can be forced from a crucible at a high pressure through a tube into a mold in a chamber at relatively low pressure so that the molten metal is displaced at least in part under the pressure differential. The metallostatic pressure, of course, depends upon the head of molten metal which must be overcome to displace the metal through the tube. As the molten metal in the crucible is discharged, i.e. at level drops, with the production of castings, the differential pressure applied to the system must be varied so as to maintain casting uniformity.

This compensation of the pressure differential can be carried out by hand and a pneumatic fluidics transducer for this purpose has been described in Bulgarian Pat. No. 14,499 filed Oct. 17, 1969. In this system the differential pressure may be set at either of two levels manually by setting two systems of pneumatic nozzles which establish respective differential pressures. It is not possible with this system to automatically vary the differential as the level of molten metal decreases in the crucible so that, after a certain number of casting cycles, the product is unsatisfactory and must be scrapped.

It is the object of the invention to provide a system for discretely adjusting the pressure differential in accordance with the variation of the level of molten metal in the crucible and thereby avoid the disadvantages of the earlier system.

The system of the present invention provides for automatic switchover from one operating (pressure-controlling) nozzle to another in succession in accordance with a manometer reading and in response to variation in the level of molten metal in the crucible (determined by counting the number of castings made).

The system has been found to permit full utilization of the metal in the crucible, casting at a constant pressure as seen in the mold and regulation over a wide range of the initial value of the differential pressure. The system thus can be used in a variety of machines for casting metals under pressure, independently of the size of the crucible or the type of metal cast.

Another advantage is that the number of nozzle sets (differential-pressure increments) is not limited so that a large variety of differential pressures may be employed and the rate at which the differential pressure increments are changed can be varied.

The invention is best described in conjunction with the drawing in which:

FIG. 1 is a block diagram illustrating the basic elements of the present invention;

FIG. 2 is a circuit diagram showing the various logic elements employed in the block diagram of FIG. 1; and

FIG. 3 is a diagram illustrating the manometer and the nozzle arrangements used therewith.

As illustrated in FIG. 1, the system according to the present invention consists basically of a presettable ring counter (A) receiving an input 15 upon the completion of each casting operation, the input therefore representing the incremental decrease in the level of the metal in the crucible represented by each single casting. The output of this ring counter is applied to a shift register B generating an enabling signal when the count reaches a predetermined level to signal a differential pressure change to the output circuit C. The signal is supplied as will be apparent from FIG. 2, to logic elements insuring stepped differential pressures as established by selective nozzles of a fluidics or baffle nozzle control system for the differential pressure which is applied to the casting machine in the manner described in the aforementioned patent.

Referring now to FIG. 3 it will be apparent that the manometer has a dial face over which is shiftable the temperature-indicating pointer 16 which carries a partition or movable vane or baffle 59 adapted to pass between juxtaposed sets of nozzles which are effective to generate a signal as described at page 419 of *SERVO-MECHANISM PRACTICE*, McGraw Hill Book Co., 2nd Edition, 1960. The signal from the shift register is combined with the fluid pressure signal from the nozzles to generate an output which is obtained at 57 and represents the set differential pressure. Outputs 56 and 58 represent, respectively, the preset maximum pressure and the preset minimum pressure corresponding to nozzle sets 43 and 44 respectively.

The ring counter A (FIG. 2) basically comprises a pulse former or shaper 1 which converts the input signal 15 into an electrical pulse of well-defined waveform which is applied to one input of an AND gate 5 feeding a digital pulse counter or summer 7. The AND gate 5 passes the signal 15 when it receives a clock signal from a trigger or clock-pulse generator 11 which may be of the multivibrator type. Hence the pulse counter 7 gives an output signal only when the number of input pulses from the AND gate exceeds the digit preset at the counter 7.

The output signal is applied to an inverter 8 which supplies both inputs of an OR gate 9 to deliver a signal to the trigger circuit 11. The output signal, representing a count beyond the number preset in counter 7, is applied through the pulse shaper 12 to an AND gate 16 at the input to the shift register B. Simultaneously, the pulse is applied to an inverter 14 and a pulse shaper 13 which feeds one input of the OR gate 10. This operates the trigger 11 to enable the AND gate 5 for the next count. In addition, the signal from pulse shaper 12 is applied to a two-input OR gate 6 to reset the counter 7 and renders it effective for the next counting cycle.

The other input to counter 6 is a grounding pushbutton 2 via an OR gate 3 designed to allow manual reset. A feeding pressure input signal represented at H is transformed by the pulse shaper 4 into a signal which is also applied through the OR gate 3 and the OR gate 6 to the counter for resetting the latter when the crucible is refilled and the next operation cycle is to begin.

As indicated, when the preset count at counter 7 is exceeded, an input is applied to the AND gate 16 of the shift register B. When the AND gate 16 is enabled by

an input from the last OR gate 26 as will be described in greater detail hereinafter, it delivers a signal to the single input trigger 17 (flip-flop) which, in accordance with shift register principles, delivers a signal after an initial change of state which is applied through the pulse shaper 20 to the next trigger or flip-flop 18. The latter likewise delivers its signal following a change of state to the trigger or flip-flop 19. Each of the triggers 17 - 19 may be reset either by the pushbutton 2 or by the pressure signal H via the OR gate 3.

In accordance with shift register principles the application of five successive pulses by the AND gate 16 to the flip-flop 17 - 19 will result in five different states of the flip-flops and hence different variations of output signals to an array of four three-input OR gates 22 - 26. As a consequence, a zero signal (null) is applied to only one of the prohibitive gates 28 - 32 (AND gates having a negation or inversion input). Thus only one output renders the associated set of nozzles 37 - 33 effective. This set of nozzles is thereby rendered effective and cooperates with the movable vane in the manner described in SERVOMECHANISM PRACTICE cited earlier to control the pressure. The output signal of the operating nozzle is fed through the OR-NOT gate 38 - 42 and to a five input OR gate 61 and an inverter 55 for supplying the other control circuits of the machine with a signal 57 representing the differential pressure.

A common feed for all of the nozzles is provided at H<sub>150</sub> and an indicator 48 - 54 is provided with each nozzle to permit visual indication of the effective set of nozzles or pressure. A switch 55 applies a signal through the AND gate 27 to the nozzle 28 to override, if desired, the automatic compensation system. The pneumatic nozzles 33 - 37, 43 and 44 can be adjustable in a slot of the dial of the manometer.

We claim:

1. A system for controlling in discrete increments the differential pressure of a casting apparatus operating

under a pressure differential in response to changes in the level of molten metal in a crucible, said system comprising:

- a ring counter receiving a sequence of input pulses representing successive castings by said apparatus and corresponding reduction in the level of molten metal in said crucible producing an output pulse upon the detection of an input pulse following a predetermined number of input pulses of said sequence;
- a pulse shaping device receiving said output pulse and an AND gate responsive to the shaped output pulse for producing a stepping pulse;
- a shift register comprising a plurality of sequentially connected bistable triggers having output states corresponding to the number of trigger pulses produced by said AND gate, said triggers each having two outputs;
- a plurality of multiple input OR gates each having a respective input connected to an output of each of said triggers, said OR gates each having an output, the output of the OR gate corresponding to the final state of said shift register being connected to the input of said AND gate;
- means for selectively energizing respective fluidic differential-pressure controllers from each output of the respective OR gate;
- means for producing an output signal representing the differential pressure selected by the respective OR gate;
- a further AND gate receiving an output from one of said OR gates and interposed between said one of said OR gates and the respective fluidic pressure differential controller; and
- switch means connected to a second input of said further AND gate for terminating automatic setting of the differential pressure.

\* \* \* \* \*

40

45

50

55

60

65