July 27, 1965 E. WAGNER 3,196,502

CONTROL APPARATUS FOR AUTOMATIC SUPERVISION OF THE WORKING CYCLE OF A CASTING MACHINE

Filed Nov. 26, 1962 2 Sheets-Sheet 1

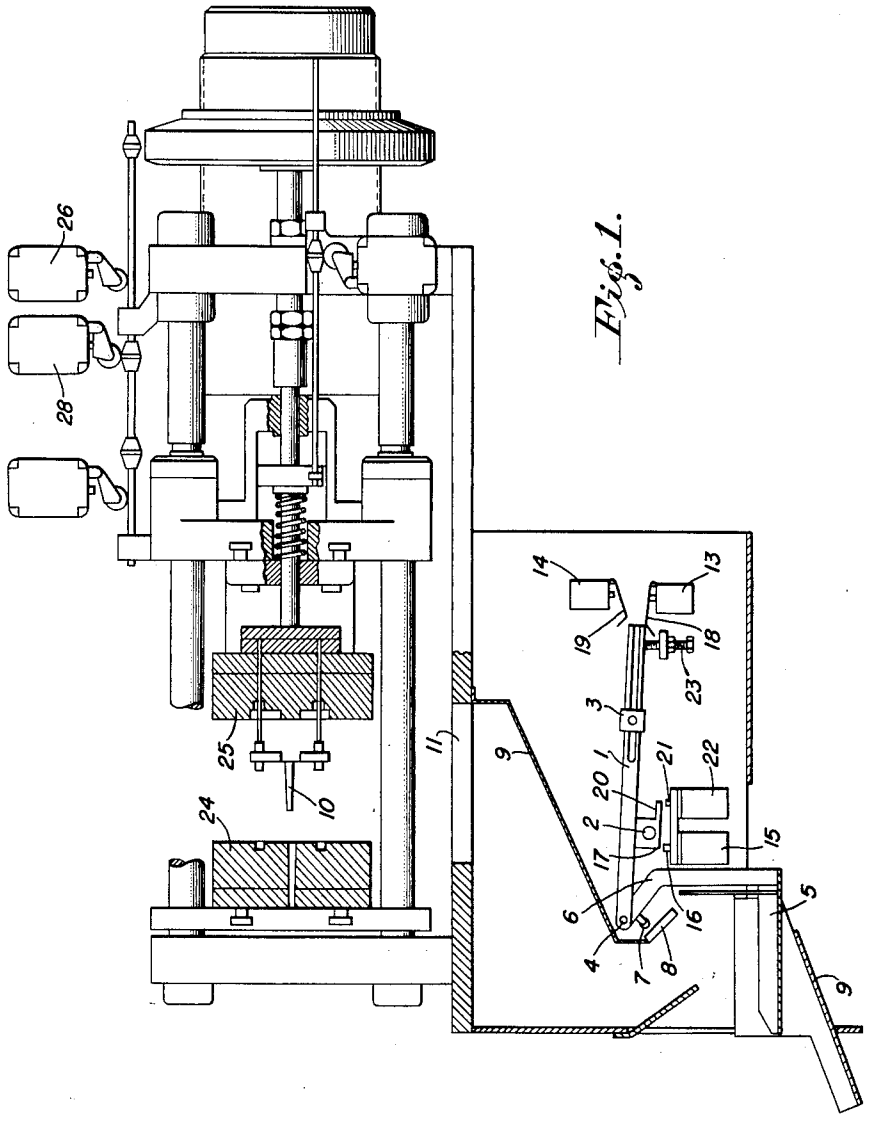

Fig. 1.

INVENTOR
ERNST WAGNER
BY Kenyon, Palmer
Stewart & Estabrook
ATTORNEYS

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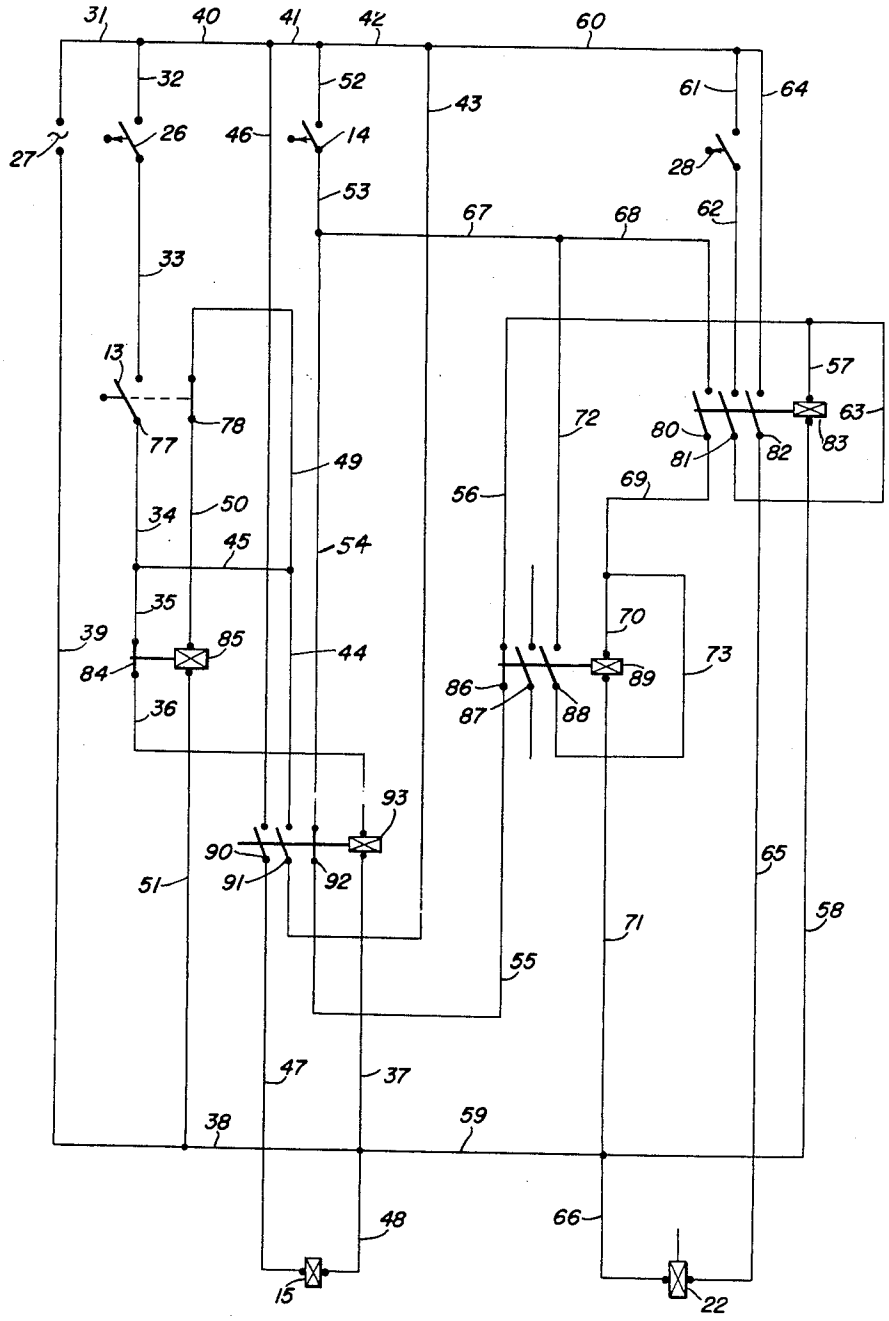

Fig. 2.

INVENTOR
ERNST WAGNER
BY Kenyon, Palmer, Stewart & Estabrook
ATTORNEYS

United States Patent Office 3,196,502 Patented July 27, 1965

3,196,502

CONTROL APPARATUS FOR AUTOMATIC SUPERVISION OF THE WORKING CYCLE OF A CASTING MACHINE

Ernst Wagner, Huechling, Lauf (Pegnitz), Germany, assignor to Gebr. Eckert G.m.b.H., Maschinenfabrik, Nurnberg, Germany, a firm

Filed Nov. 26, 1962, Ser. No. 240,099
Claims priority, application Germany, Nov. 29, 1961, E 22,030
9 Claims. (Cl. 22—68)

The invention relates to a method for the automatic supervision of the working cycle of a casting machine. Methods for this purpose are already known. The object of the invention is to devise a supervising method by which damage to the mold of a casting machine during the closing operation, due to castings sticking in the mold, is prevented automatically.

This is attained for example by devising a method which determines the filled state of the mould after the casting operation and causing the result to act on the working cycle and/or to give a signal to the operator.

According to another feature of the invention the filled state of the mold is determined by weighing the casting removed from the mold.

According to another suggestion of the invention the ascertained weight of the casting is caused to act on the mold closing movement of the casting machine.

Assuming that the mold is entirely free from pieces of the casting when the casting removed has the maximum weight including the feedhead or sprue, the object of the invention can be attained by blocking the mold closing movement of the casting machine when the weight of the casting is less than its theoretical weight and releasing the mold closing movement only when the casting has its theoretical or correct weight.

Such a weighing operation can, according to one embodiment of the invention, take place in the following manner:

The casting is ejected from the open mold and allowed to drop on an automatic weighing mechanism. The movement of the balance beam will first be checked or restrained for a certain time until it has oscillated, after which the beam is released and it will be ascertained whether the weighing machine shows the full theoretical weight or not, whereupon, if the correct weight is recorded, the mold closing movement is released and the casting is removed from the platform of the weighing machine by the tilting of the balance beam, and, after the balance beam has returned into its initial position and the mold has been completely closed, the blocking mechanism is again rendered operative.

At the same time it is possible to construct the electric switching installation, preferably used for controlling these operations, so that a closing movement once commenced is continued and only the next following closing movement is arrested if, after weighing the casting by which the first-mentioned closing movement was initiated, the casting remains hanging on the weighing mechanism and holds the balance platform in its lower extreme position.

A device which enables this operation to be carried out preferably consists of an automatically controlled casting machine with a supervising arrangement for the sequence of the working operations, whereby, according to the invention, the control thereof cooperates with an automatic weighing mechanism.

Moreover, this device can again be coupled with another automatically operating arrangement for ejecting the casting from the open mold and conducting it on to the balance scale platform.

An example of a weighing mechanism for attaining the object of the invention may comprise a balance scale having a platform and a balance beam with sliding counterweight, wherein the movement of the balance beam is temporarily limited and, on being released, operates a limit switch in each extreme position, one of said switches initiates the tipping of the balance scale platform when the casting resting thereon is of correct weight.

Another advantageous feature of the invention consists in that the balance scale platform in tipping comes into contact with a surface inclined to the horizontal and as a result is subjected to a tilting moment through which the paltform of the balance scale comes parallel to a chute above the same.

An embodiment of the invention is hereafter described by way of example with reference to the accompanying drawings in which

FIG. 1 is a diagrammatic view, partly in section, of the apparatus according to the invention, and

FIG. 2 is a wiring diagram showing the circuit arrangement for actuating the apparatus illustrated in FIG. 1.

A balance beam pivoted on the axle **2** is designated by **1** and carries an adjustable sliding weight 3. On the balance beam **1** at the end on the left-hand side of the drawing, a balance scale platform **5** is pivotally mounted by means of an angle lever **6**. On the upper end of this lever **6** a roller **7** is mounted which, during the downward movement of the left arm of the beam **1**, comes into contact with a stationary inclined surface **8** thereby causing the bent lever **6** to swing towards the right side of the drawing with the balance scale platform **5** so that the under surface of the platform **5** is brought parallel to a chute **9** thereby enabling the workpiece to slide off the weighing mechanism.

The right arm of the balance beam **1** is, according to its position, in engagement either with a switch **13**, a switch **14** or with neither of these two switches.

An electromagnet **15** is so constructed that when current is fed to the magnet its core **16**, visible in the drawing, is shifted upwards to the position shown in the drawing. An abutment **17** on the balance beam **1** is so arranged that when the magnet **15** is energized and the core is in the position shown in the drawing (moved out) the balance beam can oscillate for a time determined by a time relay between the trigger cams **18** and **19** of the limit switches **13** and **14** without striking these cams. If the magnet **15** then becomes dead, the core **16** drops with the result that the blocking of the balance beam is removed so that its right hand end can come into engagement with the trigger cam **19** of the limit switch **14**.

The core **21** of the electromagnet **22** is shifted upwards from the position shown in the drawing when the magnet coil is energized and then, by coming into contact with the extension **20** of the balance beam **1**, causes it to swing in anticlockwise direction thereby also tilting the balance scale platform **5**.

23 designates an adjustable stop which limits the downward oscillation of the right hand end of the balance beam **1**.

The two mold halves of the casting machine are designated by **24** and **25**.

FIG. 2 shows, by way of example, a circuit arrangement capable of effecting the operations according to the invention.

This arrangement comprises nine circuits which are connected to a common source of current **27**.

These circuits are built up substantially in the following manner:

The first circuit is composed of the wires **31** to **39**. The limit switch **26** is arranged therein between the wires **32** and **33** and is closed when the mold is closed

completely (FIGS. 1 and 2). The lower limit switch 13 is also located in the first circuit between the wires 33 and 34 and actuates two contact banks 77 and 78 of which only 77 is located in the first circuit, as well as the switch 84 connecting the wires 35 and 36 when the contactor or magnetic switch 85 is currentless. The magnetic switch 93 is also connected up in the first circuit between the wires 36 and 37.

The second circuit is composed of the wires 31, 40 to 45 and 35 to 39. It incorporates the switch 91 which is actuated by the magnetic switch 93, as well as the switch 84 actuated by the magnetic switch 85 and the coil of magnetic switch 93. The third circuit is composed of the wires 31, 40, 46 to 48 as well as 38 and 39. It includes the switch 90, which in closed state connects the wires 46 and 47. The field coil of the blocking magnet 15 (FIGS. 1 and 2) is arranged between the wires 47 and 48. The fourth circuit is composed of the wires 31, 40 to 44, 49, 50, 51 and 39. It incorporates the switch 91 actuated by the magnetic switch 93, and the switch 78 which is actuated by the lower limit switch 13 of the weighing mechanism and is closed when this is inoperative.

A timing relay 85 is also arranged in this circuit between the wires 50 and 51.

The fifth circuit comprises the wires 31, 40, 41, 52 to 59, as well as 38 and 39. Arranged therein are the upper limit switch 14 for the balance beam 1, the switch 92 which is closed when the magnetic switch 93 is currentless, the switch 86 which is actuated by the magnetic switch 89 and is closed when the latter is currentless, and finally the field coil of the magnetic switch 83 which can close the switches 80, 81 and 82 when under current.

The sixth circuit is formed by the wires 31, 40 to 42, 60 to 63, 57 to 59 as well as 38 and 39. This circuit incorporates the limit switch 28 (FIGS. 1 and 2), the switch 81 controlled by the magnetic switch 83 and the coil of magnetic switch 83 automatically holding this switch 81 closed.

The seventh circuit is composed of the wires 31, 40 to 42, 60, 64 to 66, 59, 38 and 39. It includes the switch 82 connecting the wires 64 and 65 and which is controlled by the magnet switch 83, as well as the field coil of the ejector magnet 22.

The eighth circuit is formed by the wires 31, 40, 41, 52, 53, 67 to 71, 59, 38 and 39. Arranged therein are upper limit switch 14 of the weighing mechanism (FIGS. 1 and 2) connecting the wires 52 and 53 as well as the switch 80 controlled by the magnetic switch 83 and the coil of the magnetic switch 89.

Finally the ninth circuit consists of the wires 31, 40, 41, 52, 53, 67, 72, 73, 70, 71, 59, 38 and 39. Arranged therein are the upper limit switch 14 of the weighing mechanism as well as the switch 88 for connecting the wires 72 and 73 which is controlled and held by the magnetic switch 89.

The mechanical and electrical operations take place in the following manner:

When the mold of the casting machine is closed, the switch 26 is also closed. If no casting is then on the balance platform 5 the lower limit switch 13 is in contact with the end of the balance beam 1 on the right of the drawing, because the counterweight 3 pulls the beam downwards until it is in contact with the stop 23. However, as soon as the limit switch 13 is struck, its contact bank 77 in the first circuit is closed while at the same time its other contact bank 78 in the fourth circuit is opened. As the switch 84 in the first circuit is closed when the time relay 85 is dead, the closing of the limit switch 13 has also effected the closing of the first circuit so that the magnetic switch 93 is energized and closes the contacts 90 and 91 while opening the switch 92. By the closing of the switch 91 the second circuit is also closed. The magnetic switch 93 therefore receives current and is held via the switch 91 itself. The opening of the switch 92 has at first no effect. The closing of the switch 90 causes the closing of the third circuit. The magnet 15 (FIGS. 1 and 2) is therefore energized so that its armature 16 is pushed upwards and blocks the weighing mechanism (FIG. 1).

When the mold is open, the limit switch 26 (FIGS. 1 and 2) is also open and the first circuit interrupted. However the magnetic switch 93 does not drop because it is itself held by the switch 91.

Now if, with the mold opened for example by hand or by means of an automatic arrangement, a casting 10 drops on the balance platform 5, the end of the balance beam 1 on the right in the drawing moves upwards and the lower limit switch 13 of the weighing mechanism is opened so that its contact bank 77 separates the wires 33 and 34, while the contact bank 78 connects the wires 49 and 50. The fourth circuit is now closed with the result that the time relay 85 simultaneously commences to operate. The time set corresponds to that which is required for the oscillation of the balance beam after the casting 10 has dropped onto the platform 5.

On the expiration of the time set, the switch 84 opens and interrupts the second circuit. As a result the magnetic switch 93 becomes currentless and opens the switches 90 and 91 at the same time closing the switch 92. Through the opening of the switch 91 the fourth circuit is interrupted and the time relay 85 switched off. The switch 90, on the other hand, interrupts the third circuit so that the blocking magnet 15 becomes currentless and removes the blockage of the weighing mechanism. However, the closing of the switch 92 has no effect on the plant.

The casting 10 on the balance platform 5 now acts because the blocking is removed, the limit switch 14 is operated by the upward swinging of the right-hand end of the balance beam and as a result the fifth circuit is closed. This makes the magnetic switch 83 operative and closes the switches 80 to 82. As the limit switch 28 is closed when the mold is open, the sixth circuit is closed by the closing of the contact 81 with the result that the magnetic switch 83 holds automatically.

The seventh circuit is closed by the switch 82 and the magnet 22 energized. Its armature 21 is consequently pushed upwards and comes into engagement with the extension 20 of the balance beam 1 so that this is swung in anti-clockwise direction and the balance platform 5 is tilted. As a result the casting slides off the weighing mechanism on to the lower chute 9 (FIG. 1).

At the same time, however, the switch 80 has also closed the eighth circuit so that the magnetic switch 89 receives current and opens the switch 86 and closes the switches 87, 88.

By the closing of the switch 88 the ninth circuit is closed which constitutes the holding circuit for the magnetic switch 89.

On the other hand the switch 86 breaks the fifth circuit on opening. The magnetic switch 83 is, however, not influenced thereby because it is held by its holding circuit, the sixth circuit, through the intermediary of the switch 81.

The circuit connected to the switch 87 may be connected, for example, to the automatic control mechanism of the machine for initiating the closing movement of the mold.

At the commencement of the mold closing movement, the switch 28 is opened and therefore interrupts the eighth circuit so that the magnetic switch 83 drops and the switches 80 and 82 are opened.

As a result the eighth circuit is interrupted at the switch 80. No effect takes place because the magnetic switch 89 is held via the switch 88.

By the opening of the switch 82 the seventh circuit is broken and the magnet 22 cut off. Therefore the weigh-

ing mechanism can return into its initial position under the influence of the counterweight 3. If the casting has actually slid off the balance scale 5 the balance beam 1 again comes into contact with the limit switch 13 under the action of the counterweight 3 with the result that its contact bank 77 is closed and the contact bank 78 opened.

The upper limit switch 14, however, is not contacted, so that the ninth circuit is also interrupted and the magnetic switch 89 drops. Therefore the switches 86 to 88 are now once more in their initial positions.

As soon as the mold has again closed completely and as a result the limit switch 26 is also closed, the switching cycle commences afresh. However the successive switching can only proceed when the switch 13 opens the contact bank 78 by the casting arriving on the balance platform 5.

The disturbances or irregularities which can be detected with the aid of the weighing mechanism according to the invention are the following:

(a) the casting does not drop onto the balance scale,

(b) the casting is too light, for example on account of blowholes or pieces of the casting sticking in the mold,

(c) the casting remains on the scale after the latter has been tilted, for example because it has got wedged.

In the case of the disturbances (a) and (b) the reaction is the same because the condition is not met that the weight of the casting overcomes the action of the counterweigh 3 in order to release the limit switch 13 of the weighing mechanism. This switch remains closed and the switch bank 78 remains open so that the cycle of switching cannot continue with the result that switch 87 releasing the closing movement of the mold is not closed. Consequently the machine remains at a standstill. This draws the attention of the operator to a possibility of a fault connected with the weight of the casting, which requires rectifying.

If, on the other hand, the disturbance (c) occurs, the balance scale being pulled down, the limit switch 13 is not contacted and the contact bank 77 cannot be closed while the contact bank 78 can also not be opened. Consequently the switching cycle can likewise not continue in this instance because the first circuit is not already closed. As, however, the mold closing movement is only released after the switching by the switch 87 has taken place, the machine in this case also remains open.

By connecting in series a plurality of switches of the different magnetic switches it is also possible to operate an alarm system with the aid of another time relay, so as to draw the attention of the operator, who may possibly have to serve several machines, to some disturbance on the machine by an acoustic signal.

What I claim is:

1. Control apparatus for supervising the operation of a casting machine in which a mold part is movable from an ejection position to a molding position and back to the ejection position, power means responsive to an initiating signal for operating said movable mold part through a complete molding cycle, a weighing device positioned to receive a casting ejected from said machine, and including a balance beam mounted to pivot about a tilting axis under the weight of a casting, blocking means controlled in timed relation with the operation of said power means for holding said balance beam in its normal casting-receiving position during the ejection period of said molding cycle and for a predetermined time thereafter, and means responsive to tilting of said balance beam under the weight of a casting of a predetermined weight for controlling said power means to initiate another molding cycle.

2. Control apparatus according to claim 1 wherein said blocking means comprises oppositely acting tilting means acting on said balance beam on opposite sides of the tilting axis thereof and tending to tilt said beam in opposite directions.

3. Control apparatus according to claim 2 wherein said oppositely acting tilting means comprises electromagnets having movable cores which engage the balance beam on opposite sides of the tilting axis thereof.

4. Control apparatus according to claim 3 and including circuits for energizing said electromagnets, each circuit including a normally open contact, the contact of one circuit being positioned to be closed by the balance beam in its normal position, and the contact of the other circuit being positioned to be closed by the balance beam in its tilted position.

5. Control apparatus according to claim 4 wherein the electromagnet controlled by the balance beam in tilted position operates to tilt the beam to a greater angle in the same direction to effect removal of the casting from the weighing device.

6. Control apparatus according to claim 1 and including electromagnetic means energized in response to said balance beam moving into tilted position to effect tilting of said beam to a greater angle in the same direction to effect removal of the casting from the weighing device.

7. Control apparatus according to claim 1 wherein said blocking means comprises an electromagnet having a movable core positioned to engage said balance beam at a point on one side of its tilting axis and tending to hold said beam in its normal position.

8. Control apparatus according to claim 7 and including electromagnetic means energized in response to said balance beam moving into tilted position to effect tilting of said beam to a greater angle in the same direction to effect removal of the casting from the weighing device.

9. Control apparatus for supervising the operation of a casting machine in which a mold part is movable from an ejection position to a molding position and back to the ejection position, power means responsive to an intiating signal for operating said movable mold part through a complete molding cycle, a weighing device positioned to receive a casting ejected from said machine, and including a balance beam mounted to pivot about a tilting axis under the weight of a casting means responsive to tilting of said balance beam under the weight of a casting of a predetermined weight for controlling said power means to initiate another molding cycle, and including electromagnetic means energized in response to said balance beam moving into tilted position to effect tilting of said beam to a greater angle in the same direction to effect removal of the casting from the weighing device.

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J. SPENCER OVERHOLSER, *Primary Examiner.*

MARCUS U. LYONS, *Examiner.*