

July 11, 1961

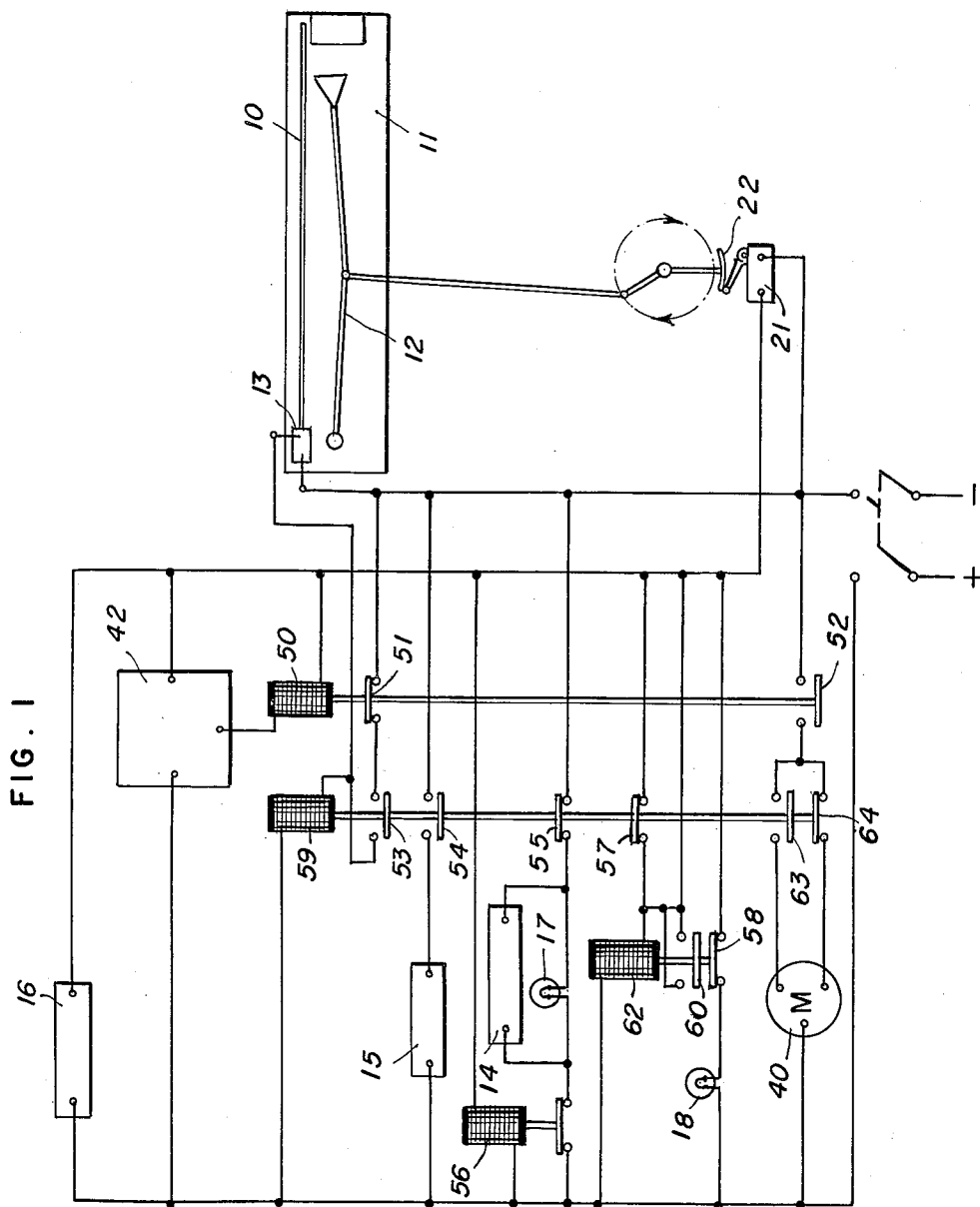
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2,991,531

MONITORING SYSTEM FOR PRESSES AND THE LIKE

Filed Jan. 18, 1957

4 Sheets-Sheet 1



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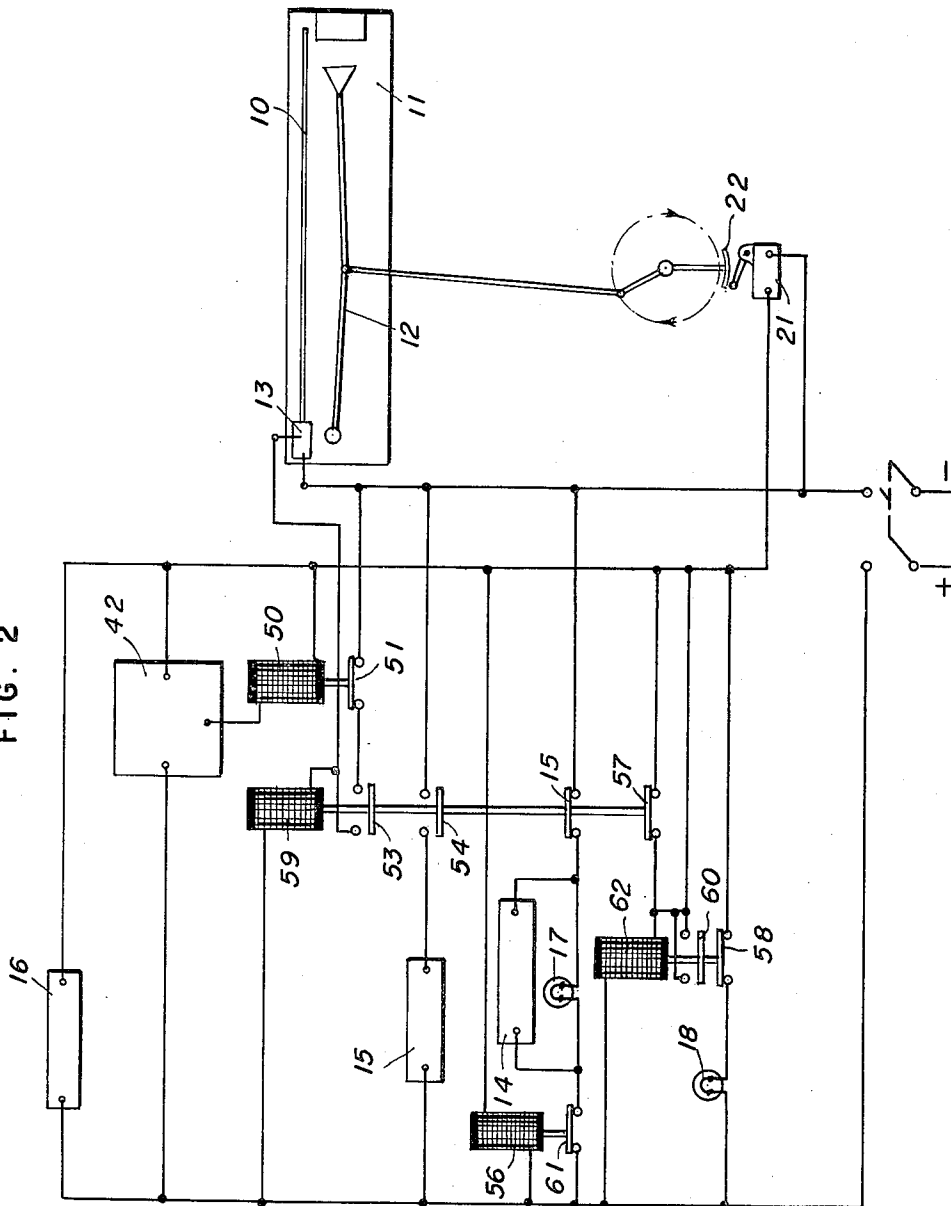
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MONITORING SYSTEM FOR PRESSES AND THE LIKE

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FIG. 2



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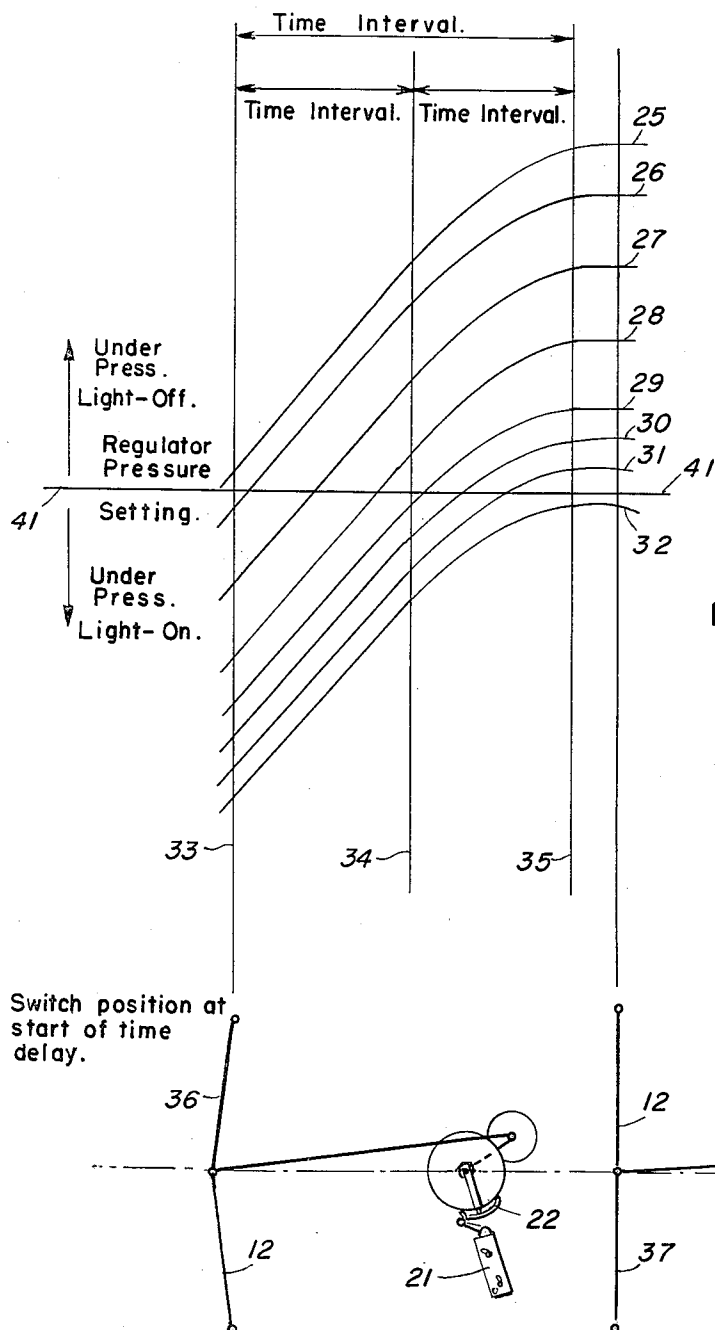
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4 Sheets-Sheet 3



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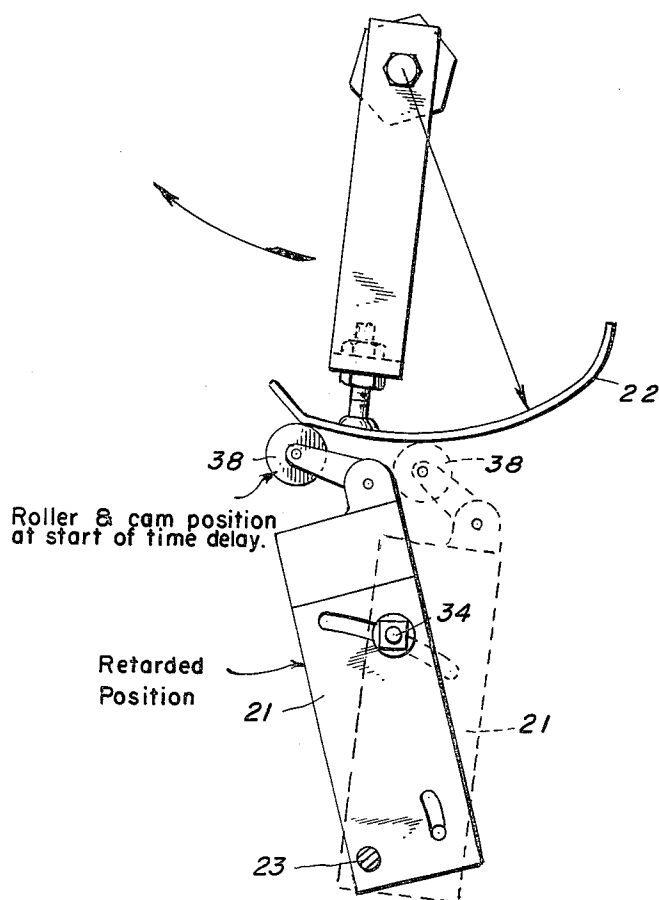
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FIG. 4



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2,991,531

MONITORING SYSTEM FOR PRESSES
AND THE LIKE

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6 Claims. (Cl. 25-45)

This invention relates to apparatus for applying forces in the fabrication or treatment of products.

An element of the apparatus which is subject to stress in the application of such forces, is employed to control means for indicating or registering whether such forces have been adequate, deficient or excessive. The further nature of the invention and details thereof will readily appear from the following description of one embodiment of the invention illustrated in the accompanying drawings.

In said drawings:

FIG. 1 is a diagram of a press equipped with a device for indicating and registering whether the force applied to the product pressed in the press, has been proper, insufficient or excessive, and including circuits for controlling mechanism for correcting improper conditions;

FIG. 2 is a similar diagram indicating and/or registering the condition of the pressed product without means for correcting improper conditions;

FIG. 3 is a diagram illustrating the manner of determining whether the applied forces have been insufficient, sufficient or excessive; and

FIG. 4 is a detail on an enlarged scale of the mechanism for operating and adjusting the control switch.

In my prior Patent 2,293,815, I disclosed means for regulating the operation of presses to minimize the production of products, such as brick, which were either excessively or inadequately pressed. The present apparatus in effect monitors the operation of a press or the like to indicate which products have been improperly pressed, thereby providing an opportunity if desired, to segregate such products from those properly pressed. As will presently appear, the apparatus of the present invention may be used either with (as in FIG. 1) or without (as in FIG. 2) that of my aforesaid patent.

In the case of brick, such as fire-brick, which are "dry"-pressed and which require very substantial pressures in their manufacture, the pressures applied thereto by a toggle press depend on the condition of the clay in the mold and on the degree of perfection in filling the mold. Since the clay is never completely uniform, the amount and distribution of the clay in the mold, varies, resulting in corresponding variation in the pressure applied to the brick. The regulator of my aforesaid patent operated to reduce the clay in the mold if the preceding brick was over-pressed, and to increase the clay in the mold, if the preceding brick were under-pressed; but there was no signalling means to enable the operator to segregate under- or over-pressed brick.

As in said patent, an element of the press which is stressed proportionally to the pressure applied, is employed as a controlling means. In the present case, the side bar of the press is employed to act as an elastic element and is stretched (according to Hooke's law) proportionally to the pressure applied to the product. While the amount of stretch is very small, it is, nevertheless, appreciable, and by use of appropriate means will serve as a device for effecting or controlling indication or register, or both, of the nature of the force applied, i.e. whether the force has been insufficient, sufficient or excessive.

In the present instance, the stress responsive means is here represented by an extensometer 10 (which may be similar to that employed in my said patent) applied to a side bar 11 of a conventional press, here represented diagrammatically by a toggle press 12 (FIGS. 1, 2 and

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3). It should be understood, however, that other forms of stress responsive means may be employed to control the circuits presently described. If the strain in the side bar of the press is not sufficient in amount to actuate a so-called micro or other switch 13 (which is sensitive to very small movements) it may be multiplied by appropriate levers associated with the extensometer 10 or its equivalent. In the present instance, the extensometer bar 10 is long enough so that the strain (elongation) of side bar 11 in relation to the extensometer, is sufficient in magnitude to operate a micro switch or the like, such as switch 13.

As here shown, the pressure sensitive switch 13 controls signal means which signal or count or both, the several conditions of the product, i.e. whether the product is under-pressed, properly pressed, or over-pressed, such means being here represented by electrically operated counters 14, 15 and 16; and by signal lights 17 and 18. In the present instance, over-pressed products are included in the total counter 16, the number of over-pressed products being determined by subtracting the under- and properly pressed products from the total on counter 16. The visual signal gives the operator the opportunity, if desired, to discard or segregate, under- or over-pressed products. There is no need for a signal for properly pressed products, and none is provided in the present apparatus, since there would be no occasion for discarding or segregating properly pressed products. In this instance, counter 14 and light 17 count and signal under-pressed products; counter 15 counts properly pressed products; and light 18 signals over-pressed products. Counter 16 counts the total of all pressed products.

During the fraction of the cycle when pressure is being applied to the product, and preferably substantially in advance of the completion of the pressing portion of the cycle (which in a toggle press occurs approximately when the toggle arms are fully extended, see FIG. 3), the controlling circuits are activated by operation of timer switch 21. This occurs at a predetermined point in the cycle, and in the illustrative apparatus, it occurs when the cam 22 carried by the press operating crank actuates switch 21. The time delay switch 42 presently described, keeps the circuits operative for a limited interval thereafter (independently of the length of timer actuating cam 22). As illustrated in the larger scale view of FIG. 4, the switch 21 is adjustable in phase to permit its contact (actuation) by cam 22 to be either advanced or retarded. This is effected in this instance by pivoting the switch at 23 so that its position may be adjusted from the retarded position shown in full lines to the advanced position shown in dotted lines. Adjustment of the phase and length of the timed interval could also be effected by varying the length and phase position of cam 22; but adjustment with a time delay switch such as 42, seems preferable.

During the timed portion of the cycle, the following conditions, among others, may be encountered:

(1) The timer switch operates before the extensometer operates pressure switch 13 (which operation does not occur until the pressure applied reaches a predetermined magnitude). Under these conditions, presently described circuits are established to actuate a counter to register a properly pressed product. It is not necessary in the case of properly pressed products to give a signal because the operator would not in any event, discard it.

(2) If during a pressing cycle (after switch 21 is closed), the pressure does not reach a level sufficient to operate regulator switch 13: Such product is under-pressed and circuits are established to register and indicate or signal an under-pressed product. The operator thus has the opportunity of discarding or segregating such product.

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(3) The regulator switch 13 may be actuated before the timer switch 21 is actuated. This occurs when high pressures develop so early in the pressing portion of the cycle, that switch 13 is actuated before the beginning of the timed interval of the cycle, and signals an over-pressed product.

The foregoing as well as other conditions are diagrammatically represented in FIG. 3 wherein pressure curves 25 to 32 (both inclusive) represent respectively successive pressure diagrams from the maximum stressed condition to the minimum. The portions of these curves between vertical lines 33, 34 and 35 represent the portions of the pressure cycle which fall within the adjusted timed interval (advanced, lines 33—35; or retarded, lines 34—35) of the such cycle; and the corresponding positions of the toggle arms for lines 33 and 35 are shown at 36 and 37 respectively. Whether the timed portion (interval) of the cycle begins at line 33 or line 34 depends on the phase adjustment of the timer switch 21 and its operating cam roller 38 (FIG. 4). When the latter is in the dotted line position of FIG. 4, switch 21 is operated in its most advanced position represented by line 33; and when in its most retarded or full line position, it operates in the retarded position represented by line 34. It is held in either extreme or intermediate adjusted positions by clamping nut 39. The distances between vertical lines 33 and 35, or 34 and 35 represent the length of the timed portion (interval) of the cycle, and determines the range of pressures which are regarded as within the limits of a properly pressed product. At the beginning of the timed portion of the cycle, represented by lines 33 or 34 the timing switch is closed. Whether the pressure switch 13 is closed at all during the limited portion of the cycle, or whether it closes before or after the actuation of timer switch, depends on the pressure conditions represented by the several curves. The horizontal line 41 represents the pressure at which pressure switch 13 is actuated.

Although the timed interval can be varied as to phase by mounting switch 21, and as to length by the length of cam 22, it is advantageous to be able to change the length of the timed interval without changing the length of cam 22. For this purpose, a time delay switch 42 (FIG. 1) is employed. Such a switch is of conventional design and available on the market. One such switch operates by a solenoid with which is associated a diaphragm having an adjustable air gap which causes a delay in actuation after the switch solenoid is energized. With this arrangement it is possible to use the setting of switch 21 to increase or decrease the pressure at which the "over-pressed" signal will operate.

Referring to FIGS. 3 and 4, the following are examples of the different conditions which may occur:

(A) In the advanced position of switch 21 (where cam roller 38 is actuated at line 33 and the timed interval lies between lines 33 and 34):

(a) Curve 25 and greater pressures represent over-pressed products;

(b) Curves 26 to 28 represent the range of properly pressed products;

(c) Curve 27 represents the ideal pressure, and it is this pressure which the regulating apparatus tries to maintain;

(d) Curve 32 and lower pressures represent under-pressed products.

(B) In the aforesaid advanced position, but where the timed interval extends from line 33 to line 35:

(a) Same as (a) above;

(b) Curves 26 to 31 represent the range for a properly pressed product;

(c) Curve 28 represents the ideal pressure, and it is this pressure which the pressure regulating apparatus tries to maintain;

(d) Same as (d) above.

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(C) When the timed interval and its phase position is represented by lines 34 and 35:

(a) Curve 28 and higher pressures represent over-pressed products;

(b) Curves 29 to 31 represent the range of pressures for a properly pressed product;

(c) Curve 30 represents the ideal pressure, and it is this pressure which the pressure regulating apparatus tries to maintain;

(d) Same as (d) above.

In the diagram of FIG. 1, which discloses circuits including that for operating the aforesaid reversible pressure regulator motor 40 of my former patent, the pressure line 41 (FIG. 3) represents the pressure above which the motor (when energized during the timed interval) operates to reduce maximum pressure on the product and below which it operates to increase pressure. Moreover the degree of adjustment attempted by motor 40 is generally proportional to the extent by which the pressure is either above or below that represented by line 41. As disclosed in greater detail in said patent; the pressure regulator motor reduces or increases the pressure on a succeeding article by varying the mold depth, an increase in depth increasing pressure and a decrease reducing pressure. It should be understood, however, that the present invention is not limited either to a system wherein the pressure is regulated (as in said patent) or to regulation of pressure by varying mold depth, since this may be accomplished in other ways. In the diagram of FIG. 3, when the pressure curve lies above line 41 during the time interval represented by the distance between 33—34; 33—35 or 34—35, the regulator motor 40 is operated to reduce pressure by adjusting the mold depth; and when the pressure curve lies below line 41 (during this time interval), the motor operates to adjust the mold depth to increase pressure.

It is evident from the diagram of FIG. 3 that the portion of the pressure cycle within the timed interval, actually forecasts the maximum pressure which will be reached in a particular instance, before the end of the cycle, and therefore, whether the maximum pressure reached in such instance will be sufficient, insufficient or excessive. It is not essential, therefore, that the timed portion of the cycle embrace the maximum pressure reached in the operation of the press, because, as stated above, the nature of the maximum pressure is forecast with enough accuracy in advance, to serve as a means for determining the final character of the product. This is because the pressure reached at the beginning of the timed interval bears a definite relation to the maximum pressure reached in the cycle.

Referring to FIGS. 1 and 2, here follows a description of the operation of the apparatus under illustrative conditions. In such diagrams the operating circuits, the source of power, solenoids and switches operated thereby, are represented by conventional symbols, and need not therefore be described in detail:

(A) Assume that conditions are such that an under-pressed product will result: The pressure in such case is represented by curve 32. In that event, pressure switch 13 remains open. The operation of the timer switch 21 by contact of cam 22 with roller 38 causes solenoid 50 to operate (during the timed interval determined by the time delay 42) thereby opening normally closed switch 51 and closing normally open switch 52. In the circuits shown in FIG. 1, this would cause motor 40 to operate to increase the mold depth. It should be noted in this connection, that solenoid 50 is controlled by the previously described time delay switch 42.

(a) If the product of the previous pressing cycle were under-pressed, then normally open switches 53 and 54 are open and normally closed switches 57 and 55 are closed (signal 17 and counter 14 are energized). Then the closing of switch 21 will energize solenoid 56 which opens normally closed switch 61 and consequently de-

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energizes counter 14 (last ½ of counter cycle) and signal light is extinguished. In this instance the counters are of the conventional type which register the first ½ of the count when energized and complete the count when de-energized. Closing of switch 21 also initiates the timed interval and energizes solenoid 62 which opens switch 58, and closes switch 60. Switch 60 locks solenoid 62 until switch 21 opens. In this connection it should be understood that when switch 21 opens, switch 61 will close (switch 55 being closed) and will energize signal 17 and counter 14 (first half of cycle). This condition will exist until switch 21 is next closed. Underpress signal 17 and counter 14 can only be energized when switch 21 is open.

(b) If the previous product were pressed hard enough to have operated pressure switch 13, then switches 53 and 54 would be closed and switches 55 and 57 would be open. Closing of timer switch 21 would operate solenoid 50, opening switch 51 and breaking the circuit to solenoid 59, opening switches 53 and 54, the latter effecting the last ½ operation of counter 15 for properly pressed products. The closing of switch 55 would not affect "under-pressed" counter 14 and its signal light 17 because the closing of timer switch 21 would have energized solenoid 56, thereby opening switch 61. The delay in closing of switch 57 (because solenoid 59 must be de-energized) causes a slight flash of "over-pressed" light 18 before solenoid 62 is energized to operate switch 58, but this would be too short to be interpreted as an "over-pressed" signal.

(B) Assuming that mold fill conditions are such that a properly pressed article will result following production (a) of an underpressed article, and (b) of a properly pressed article:

(a) *Under-pressed article.*—Switches 53 and 54 are open and 57 and 55 are closed (signal 17 and counter 14 are energized). Then the closing of switch 21 will energize solenoid 56 which opens switch 61 and consequently de-energizes counter 14 (last ½ of cycle) and light 17. Closing of switch 21 also initiates the timed interval and energizes solenoid 62 which opens switch 58, closes switch 60. Switch 60 locks solenoid 62 until switch 21 opens. Regulator switch 13 closes upon pressing of a good article. The closing of switch 13 energizes solenoid 59 which in turn opens switches 55, 57, and closes switches 53, 54. Closed switch 53 locks in solenoid 59 (only after the time interval has expired) through switch 51 which is actuated by the time delay relay 42. Closing switch 53 energizes counter 15 (first ½ of cycle). No change occurs until the next pressing cycle when switch 21 is again closed.

(b) *Properly pressed article.*—Switches 53 and 54 will be closed and 55 and 57 open. Therefore, the same conditions as previously described in A(b) above, are present and the same circuits established until the pressure regulator switch 13 is closed. This would reverse the switches, opening 55 and 57 but not affecting the "under-pressed" counter 14 or its signal 17 since when timer 21 is closed solenoid 56 opens switch 61. The closing of switch 54 would energize "properly pressed" counter 15 for ½ count and the closing of switch 53 would create a holding circuit for solenoid 59 until switch 51 was opened at the next cycle.

(C) Assume conditions are such that an over-pressed article will result: The pressure regulator switch 13 closes first. Switches 53 and 54 are closed and 55 and 57 are open. Therefore switch 58 is closed and "over-pressed" signal 18 is energized. It can only be energized when switch 21 is closed and remains energized only as long as switch 21 remains closed.

In this connection it should be noted that the timed interval begins when timer switch 21 is closed, and ends when time delay switch 42 opens the circuit to solenoid 50, but in any event it must end when switch 21 opens since that would de-energize solenoid 50.

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The foregoing applies also to the circuits of FIG. 2 which are identical with those of FIG. 1 except those relating to the operation of reversible motor 40 of my patent. The circuits of FIG. 2 signal (and count) products just as in the diagram of FIG. 1, with no attempt to adjust conditions for succeeding cycles as in FIG. 1. To simplify understanding of the diagram of FIG. 2, switches and solenoids corresponding to those in FIG. 1 have been given like reference numbers.

Obviously, the invention is not limited to the details of the illustrative apparatus herein described, since these may be variously modified. Moreover, it is not indispensable that all features be used conjointly, since various features may be used to advantage in different combinations and sub-combinations.

Having described my invention, I claim:

1. In a press for applying pressure to articles, the combination comprising a mechanically operating press for applying increasing pressures during the pressing portion of its cycle of operations, pressure responsive measuring means on the press including an electric switch responsive to the pressure applied by said press, electric signalling means for signalling under-pressing of the article, electric signalling means for signalling over-pressing of the article, electric switch means responsive to the pressure applied by said pressure applying means for controlling the operation of said signalling means, a timer switch for timing a substantial interval of the pressing portion of the cycle in advance of the application of maximum pressures and during which a substantial range of pressures are applied, said timer energizing said pressure responsive switch during said interval, said pressure responsive switch having circuits energized by the sequence with which said pressure responsive switch and said timer switch are closed for actuating said signalling means.

2. In a press of the character described, the combination comprising a mechanically operating press for applying increasing pressures to an article over a period of time, pressure responsive means on the press including an electric switch responsive to the strain in the press created by the application of said pressures to the article, means including an electric timer actuated by said mechanically operating press at a predetermined point in its cycle for timing a substantial interval of the pressing period in advance of the application of maximum pressure to the article and for rendering said pressure responsive means and said electric switch operative for said interval, a plurality of electric signalling devices for signalling respectively whether the article is under-pressed or over-pressed, electric circuit means controlled by the sequence of operation of said switch and timer for actuating the over-pressed signal when said switch is actuated before the beginning of said timed interval, and other circuit means controlled by said sequence of operation for actuating said under-pressed signal when said switch is actuated after said timed interval.

3. In a toggle press, the combination comprising mechanism including toggle arms for applying increasing pressures to material in a mold, a strain sensitive device on the press including an electric switch responsive to strain in the press created by the operation of said toggle arms in applying pressure to said materials in the mold, means including a timer actuated by said mechanism at a predetermined point in its cycle for rendering said strain sensitive device and said switch operative for a timed interval in the pressing cycle of said toggle arms substantially in advance of the application of maximum pressure to said materials, electric signalling means for signalling under-pressing of the article, electric signalling means for signalling over-pressing of the article, and electric circuit means controlled by the sequence of operation of said switch and timer for actuating said over-pressed signal when said switch is operated before the beginning of said timed interval and for actuating said

under-pressed signal when said switch is operated after the end of said timed interval.

4. In a press of the character described, the combination comprising a mechanically operating press for applying increasing pressures to an article over a period of time, pressure responsive means on the press including an electric switch responsive to the strain in the press created by the application of said pressures to the article, means including an electric timer actuated by said mechanically operating press at a predetermined point in its cycle for timing a substantial interval of the pressing period in advance of the application of maximum pressure to the article and for rendering said pressure responsive means and said electric switch operative for said interval, a signalling device for signalling whether the article is over-pressed, and electric circuit means controlled by the sequence of operation of said switch and timer for actuating said over-pressed signal when said switch is operated before said timer.

5. In a press of the character described, the combination comprising a mechanically operating press for applying increasing pressures to an article over a period of time, pressure responsive means on the press including an electric switch responsive to the strain in the press created by the application of said pressures to the article, means including an electric timer actuated by said mechanically operating press at a predetermined point in its cycle for timing a substantial interval of the pressing period in advance of the application of maximum pressure to the article and for rendering said pressure responsive means and said electric switch operative for said interval, a signalling device for signalling whether the article is under-pressed, and electric circuit means controlled by the sequence of operation of said switch and

timer for actuating said under-pressed signal when said switch is actuated after said timer.

6. In a press of the character described, the combination comprising mechanically operating press for applying increasing pressures to an article over a substantial period of time, pressure responsive means on said press responsive to strain in the press created by the application of said pressures to the article and including an electric switch, an electric timer operated by said switch at a predetermined point in the cycle of operation of said mechanically operating press for timing a substantial interval of the pressing period in advance of the application of maximum pressure to the article and during which a substantial range of pressures are applied; an under-pressed signalling means and an over-pressed signalling means for signalling respectively the pressed condition of said article in relation to said timed interval, electric circuit means controlled by the sequence of operation of said electric switch and said timer for actuating said signalling means.

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