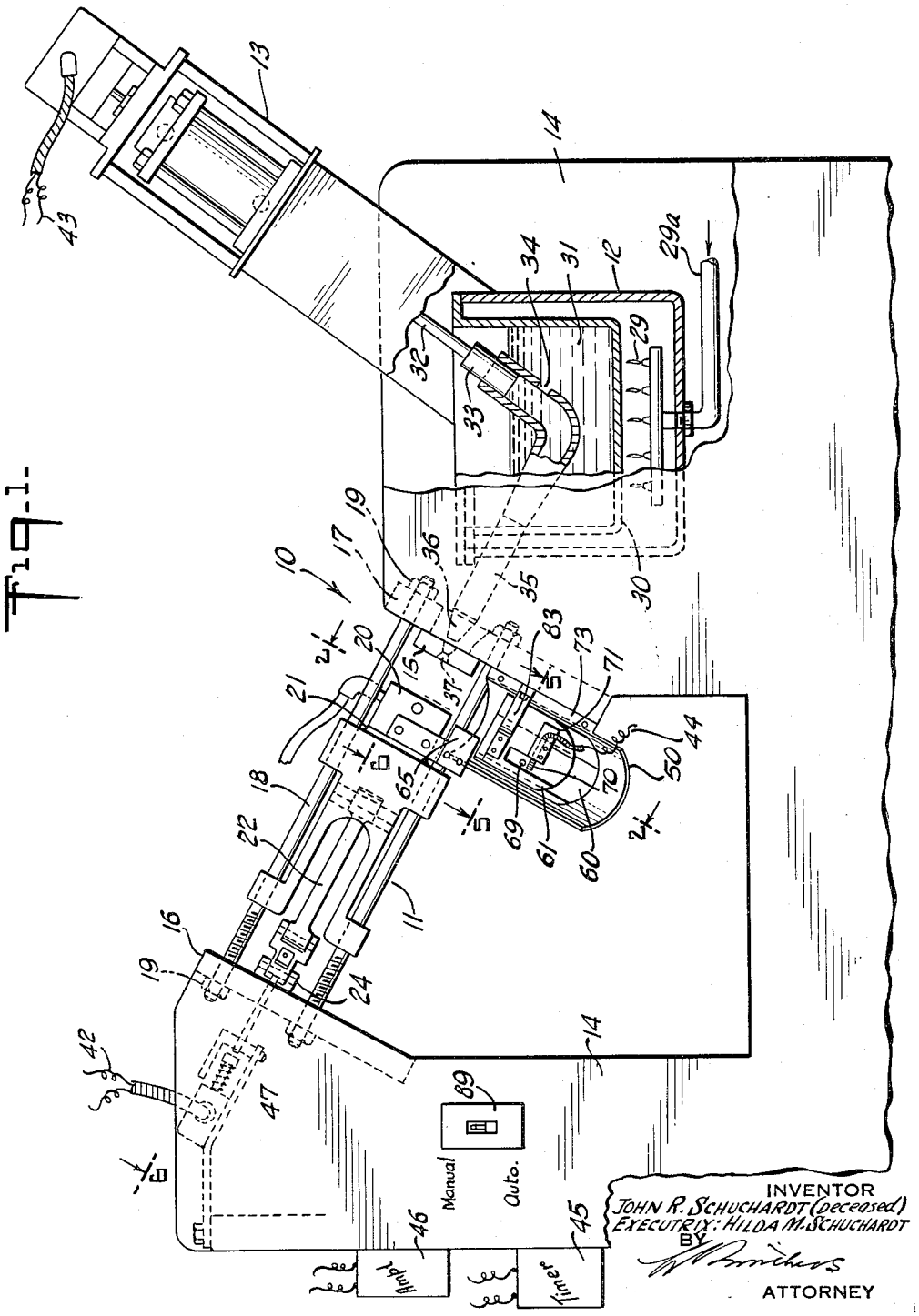
Aug. 1, 1961 J. R. SCHUCHARDT 2,994,115

SAFETY DEVICE FOR DIE CASTING MACHINES

Original Filed Feb. 21, 1958 4 Sheets-Sheet 1

Fig. 1.



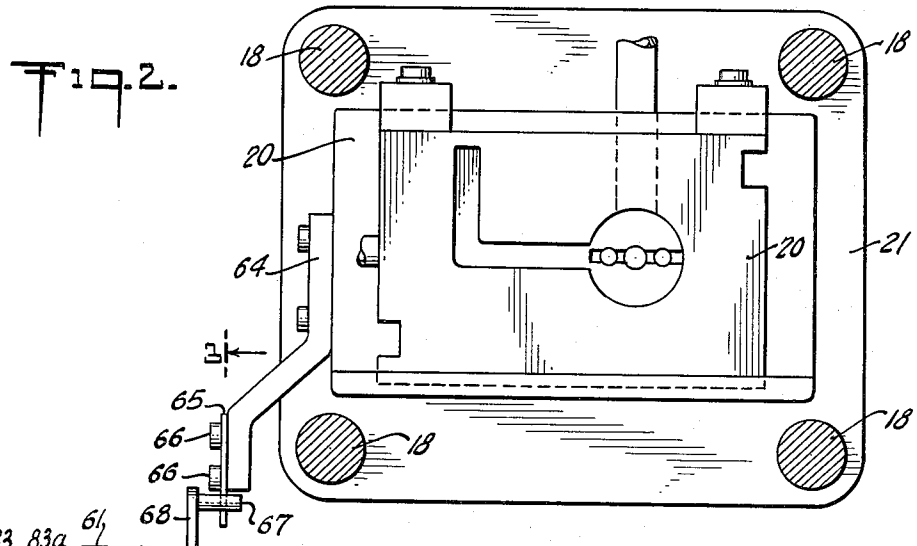
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SAFETY DEVICE FOR DIE CASTING MACHINES

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Fig. 2.



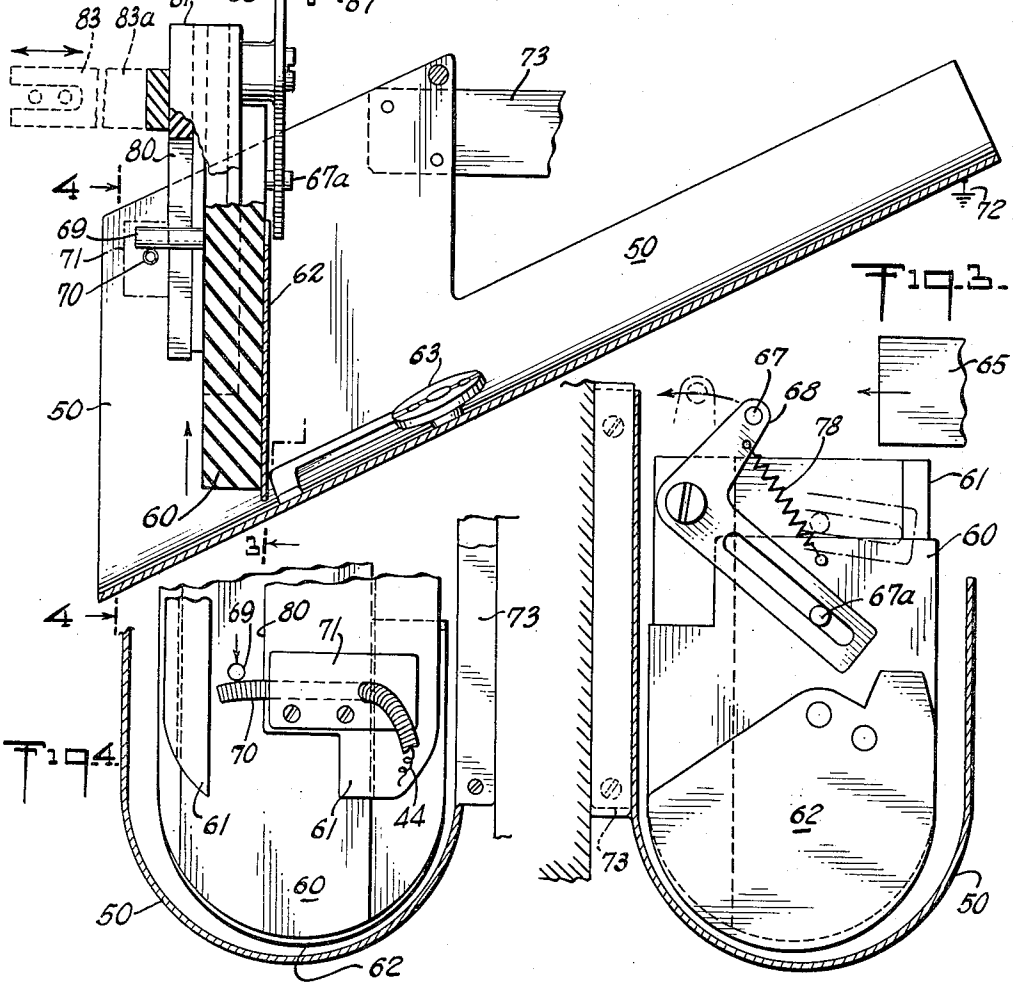


Fig. 3.

Fig. 4.

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FIG. 5

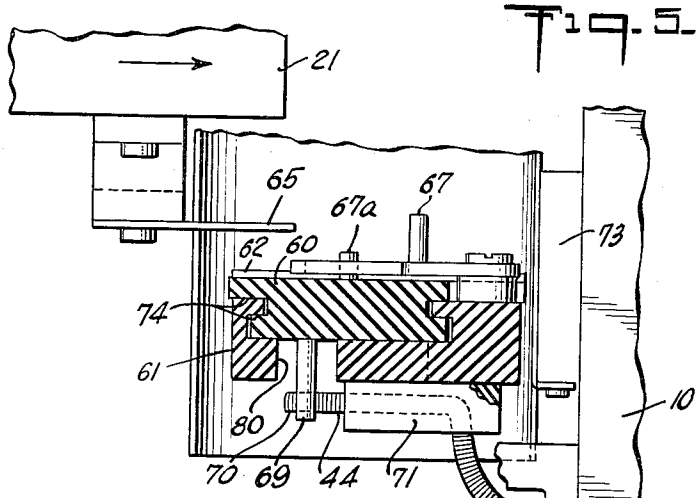
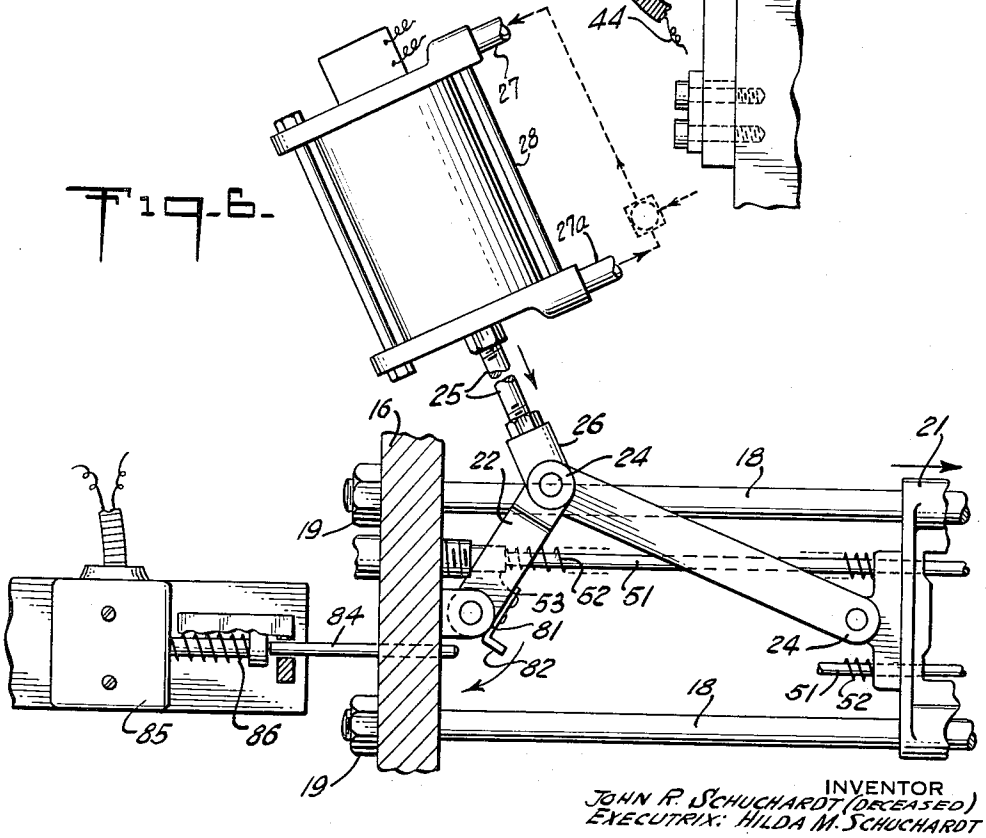


FIG. 6



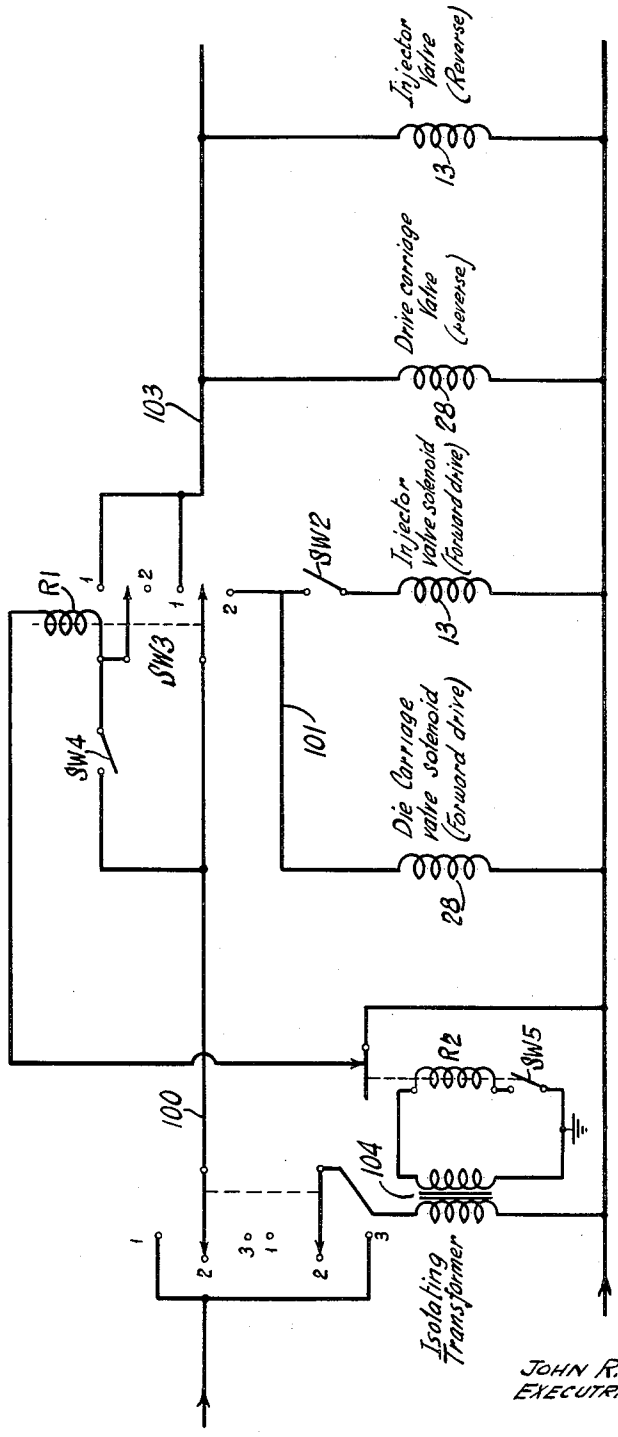
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SAFETY DEVICE FOR DIE CASTING MACHINES

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Fig. 7.



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2,994,115

SAFETY DEVICE FOR DIE CASTING MACHINES

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Continuation of application Ser. No. 716,740, Feb. 21, 1958. This application Sept. 15, 1959, Ser. No. 840,198

3 Claims. (Cl. 22—68)

This invention pertains to the art of die casting and is directed particularly to machines useful in the art wherein undetected failure to eject a casting after a die forming operation may result in damage to expensive parts and machinery or in personal injury to operators.

This application is a continuation of application Serial 716,740, filed February 21, 1958, now abandoned.

Conventional die casting operations normally require attendance of an operator at each machine. This is essential where castings are large because the size of the formed product necessitates manual removal of the processed part from between the dies. At smaller machines, however, those in which one-half pound or less of metal is consumed per cast, attendance of operators is dictated largely by considerations of safety. Despite the fact that nearly all modern, high speed die casting machines are equipped with automatic mold ejectors, failures to expel formed castings from between the dies quite commonly cause serious damage to expensive impression cores or subject unwary operators to sever burns due to squirting hot metal under high pressure from between the obstructed die halves. Such damage is inevitable unless the faulty die closure is immediately detected and the machine is shut down prior to another injection of the molten metal. Damage of this sort is particularly prevalent in high speed machines. To date, manual cut off is the only remedial expedient. Various automatically operable devices such as photocell detectors, "cat whisker" contacts and a variety of gauging-signalling apparatus for sensing the presence or absence of a casting after forming have been tried, but none of the prior art safety devices has proven completely reliable and none appears to have achieved commercial success.

Devices responsive to photoelectric effects have proven undependable because light receptors frequently fail to discriminate and shut down machines in response to inadvertent oil or grease spatter normally experienced in all die casting operations. Fine wire whiskers or other extremely sensitive detectors extended across the path of disposal of ejected castings frequently fail to respond within proper time intervals or may fail completely to detect the passage of formed items ejected at high speeds, particularly when such items are small in size. Further, none of the known safety apparatus suggested has been equipped to disclose maladjustments within its own structure or position which might cause failure to signal the presence or absence of a casting with consequent delay, damage or personal injury.

The present invention overcomes the aforementioned inadequacies of prior safety devices as applied to die casting machine operation by utilizing an electrical pulse of extremely low voltage, the derivation of which is independent of time or passage restrictions and other shortcomings which hitherto have hampered the development of a substantially fool-proof device for the purposes described. The pulsed signal which, when amplified or otherwise conditioned and transmitted to the machine

cycling control, is derived while the casting is motionless. Consequently, identification of the presence or absence of a casting is positive. The apparatus may be an integral part of a die casting machine or it may comprise an attachment adaptable to machines of a wide variety of types or makes whether automatic or manual in operation.

Accordingly it is an object of the invention to provide a positive control responsive to faulty operation of a die casting machine.

It is another object of the invention to provide an electrically operable safety attachment for a die casting machine in which the casting itself bridges contacts formed by relatively movable members and in which failures of one of the members to assume correct position with respect to the path of fall of the casting is immediately detectable and will, of itself, stop the machine.

It is likewise an object of the invention to provide an automatic cut-off device for a die casting machine in which the presence of an ejected casting is detectable by the apparatus only after falling motion of a casting ejected automatically from between the dies has been stopped.

It is a still further object of the invention to provide an automatic cut-off device which is alternately positionable in and withdrawn from the path of fall of an ejected casting by positive, mechanical contact between a member fixed to a movable die carriage and an actuator for the intercepting member.

For better understanding of the invention together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings, while the scope will be pointed out in the appended claims.

FIG. 1 is a side elevation of an automatic die casting machine having integral molten metal heating means and including the casting interceptor of the invention.

FIG. 2 is a fragmentary side elevation along lines 2—2 of FIG. 1, of the interceptor door here shown in a closed position with respect to a chute defining the path of fall of a casting from an ejector die.

FIG. 3 is a fragmentary plan view along lines 3—3 of FIG. 2, of the rear of the interceptor showing fixed and slidable portions thereof.

FIG. 4 is a fragmentary plan view of the front of the interceptor and showing means for opening and closing thereof during a machine cycle.

FIG. 5 is a top plan along lines 5—5 of FIG. 1 of the interceptor and actuator contact members.

FIG. 6 is a fragmentary side elevation along lines 6—6 of FIG. 1, of a die casting machine actuator.

FIG. 7 is a schematic representation of electrical circuitry adapted to operation of the apparatus of the invention.

In accordance with the invention and as shown in FIG. 1, an automatic die casting machine, generally designated **10**, may include die forming apparatus **11**, metal heating furnace **12**, molten metal injecting means **13**, firmly supported in any suitable manner upon a rigid base structure **14**. As is customary in machines of the type under consideration, a stationary cover die **15**, is fixed to a base plate **17**, spaced from head plate **16**, by guide rods **18**, firmly anchored between the plates by bolts **19**. An ejector die **20**, and its supporting carriage **21**, are movable relatively to the cover die and along the guide rods by arms **22**, **23**, of a conventional toggle linkage having connections **24**, and supports **26**, for actuation by power drive rod **25**, as is more clearly indicated in FIG. 6. The actuator for the drive rod may be a

compressed air cylinder 28, though it will be understood that other driving means could be applied without departing from the spirit of the invention. In FIG. 1, the dies are shown in open position.

Positioned upon support 14, is a metal furnace 12, with burner 29, and fuel supply line 29a, beneath a kettle 30, in which casting metal 31, is reduced by heat to fluid state adaptable to action by conventional metal injecting apparatus 13, having a piston rod 32, operably connected to piston 33, to force the molten metal entering through aperture 34, into injection cylinder 35, and through nozzle 36, under pressure and between the closed dies via passage 37, to form a casting after a suitable cooling and hardening interval. The action of the injector may be precisely timed with respect to die opening and closure movement by a timer 45, through the medium of electrical connections 42, 43, which serve to open and close valves or otherwise to render effective means of actuation in a known manner in response to sequentially timed signals from the timer.

Electrical amplifier 46, may include conventional cathode ray circuitry, a thyratron or other means capable of delivering magnified power means in response to a signal of short duration such as an electrical pulse in a manner and for a purpose to be described. It will be understood that a transformer may be substituted for the amplifier or other means may be utilized to effect the necessary power transfer for drive rod 25, and piston 32, via solenoids or other conrtols exemplified by connections 42, 43.

Depending from the frame of the casting machine as by suspension from supporting plate 17, is a metal chute 50, angularly positioned by a bracket 83, with respect to forming dies 15, and 20, to provide a controlled path of fall for castings ejected from the movable die while in motion by the action of ejector pins 51, more clearly indicated in FIG. 6. The pins extend through suitable borings in carriage plate 21, and die 20, to contact a casting retained in the die as it moves on the withdrawal stroke. One or several pins may be applied. The pins or rods are held stationary by supports on plate 16, paralleling the guide rods along which the die and its carriage slide until, at an appropriate instant in the withdrawal stroke, the pins project through the die thereby thrusting the casting outwardly of the die form. Cushioning springs soften the impact between the pins and the casting.

Disposed within the chute and adapted to sliding movement with respect thereto so as to completely block the path of fall of a casting ejected as described, is an interceptor 60. As shown in FIG. 2, this door-like element may be of wood, plastic or other insulating material, has a fixed portion 61, and a sliding portion 60, the latter having a metallic, electrically conductive face plate 62, fixed to one side of the sliding portion. When closed, the interceptor door and its attached plate completely block the chute. When raised, the chute is unblocked and an intercepted casting is free to continue its fall for disposal in any suitable manner.

Extending through an aperture in the interceptor member 60, is an electrically conducting pin or projection 69, held rigidly in permanent contact with face plate 62. When at rest and intercepted by the face plate, a casting thus becomes a bridging connector between the chute grounded at 72, and the face plate, thereby permitting the flow of electrical current from a suitable low voltage source (not shown), through the chute and casting to pin 69, and conductor 44, to deliver a pulse or signal to an amplifier or power transforming means capable of recycling the machine.

To accommodate castings of different form or dimension, the position of the entire interceptor assembly may be angularly altered with respect to the chute by manipulation of manually adjustable member 74 cooperating with suitable means on bracket 83.

In FIGS. 3 and 4, details of the front and back of the interceptor member respectively are indicated in greater detail. Bracket 73, supports the chute rigidly upon the frame of the machine, and, as indicated in FIG. 1, bracket 83, serves the same purpose for attachment of fixed member 61, of the interceptor, to the chute. Plate 65, rivetted or otherwise fixed by members 66, to movable die carriage 21, as shown in FIG. 2, serves as actuator for the interceptor. Upon closure contact between element 65, and bell crank pin 67, bell crank 68, is moved to the position shown in shadow detail in FIG. 3, thereby raising pin (67a), and sliding member 61, with its conducting plate 62, to open position with respect to the chute. It will be obvious that as the die carriage and the plate 65, move in the opposite direction, tension of resilient member 78, will return the bell crank to the solid line position of FIG. 3, and the interceptor will return to casting blocking position.

In FIG. 4, the position of electrically conducting member 44, with respect to pin 69, and the position of the bottom of face plate 62, with respect to the base of the chute is to be noted. If, for any reason, the interceptor should fail to reach completely closed position, for example, due to jamming of slide 60, or because of an obstruction between the interceptor and the surface of the chute, pin 69, could not be brought into contact with electrically conducting member 70, and no path of flow for signal current between plate 62, and amplifier 46, and recycling devices would be available. As will be pointed out in greater detail in connection with operation of the apparatus the combined functions of the interceptor as a positive indicator of the presence of an ejected casting and concomitantly, as an indicator of its own correct casting blocking position, constitute an important feature of the invention, which, so far as is known, are not to be found in any of the prior art safety devices.

In FIG. 5, the interceptor and its actuators are viewed from above the chute. Insulated sliding member 60, is grooved as at 74, to dovetail with similarly grooved, stationary member 61. Slot (80), providing a path of movement for pin 69, fixed to the slider and in contact with plate 62, for movement with the slider is clearly indicated. As viewed here, carriage 21, and actuator 65, fixed thereto, are moving in the direction of the arrow. Contact between the actuator plate and arm 67, of bell crank 68, will move the slider of the interceptor upwardly as previously described. This action occurs when the carriage and die are moving to closed position, the effect being to release a casting formed during the prior cycle of the machine. In other words, since the casting ejected during the prior cycle arrives at the interceptor 60 substantially immediately after the separation of the cover die 15 and the ejector die 20 and is arrested by the interceptor 60 while the dies are moving to fully open position and returning toward closed position during the succeeding operating cycle, each ejected casting is positively arrested by the interceptor 60 for a substantial portion of each operating cycle. As shown, stationary frame 61 may be an integral part of the machine or the chute or the entire door interceptor assembly may be applied as an interchangeable attachment adaptable to any die casting mechanism exhibiting a guided path of disposal of casting.

In FIG. 6, compressor cylinder 28, has air inlets and outlets 27, 27a, arranged to deliver air under pressure in response to signals from the timer 45. Drive rod 25 is thus movable to effect movement of toggle link arm 22, 23, to slide die carriage 21, along guide rods 18, and along the ejector pins 51, cushioned for a purpose previously described by surrounding springs in contact with support 55. When the links are forced to straight line position and parallel to guide rods, it will be understood that the carriage and its supported die are in closed position with respect to the stationary cover die and the apparatus is ready for a "shot" of molten metal.

Bracket 81, fixed to arm 22, of the toggle, has a surface 82, adaptable to contacting the end of actuator 84, the instant the dies close to move member 86, of a conventional switch 85, to close or to reverse the position of valves controlling the flow of air in lines 27, 27*a*, thereby reversing the direction of air pressure within the cylinder and causing reversal of movement of the drive rod 25, to withdraw the die carriage and the ejector die with the casting positioned therein. The action of the switch 85, is purely illustrative. It will be apparent that it comprises but one of a number of schemes which may be applied to control the movement and sequence of operations of a die casting machine with or without the intercession of a timing device.

Electrical circuitry for manual or automatic operation of the apparatus of the invention is shown in "Off" position in FIG. 7. A three positional, double acting switch SW1, actuatable by element 89, of FIG. 1, delivers electrical current from a suitable source over conductor 100, with the switch in manual drive position 1. With switch SW3, in closed position 2, air valve solenoid of cylinder 28, is energized by current through conductor 101, to move carriage 21, and die 2, to close. Completion of the carriage forward movement closes SW2, in any suitable manner to deliver power to operate solenoid valve of injector 13, to move the injector piston forward. Completion of the injector forward stroke closes SW4, by any suitable means to energize relay R1, thereby transferring double pole switch SW3, to 1 position and activating carriage and injector valve reversal to permit withdrawal of the carriage and die and of the injector piston. Switch SW4, may be re-opened by reverse movement of the injector driving elements or by a switch or other actuator (not shown). Upon completion of the die withdrawal stroke, switch SW3, will remain in position 1, by virtue of continued energization of relay R1, until switch SW1, is manually turned to "Off" position 2.

Up to the completion of die withdrawal stroke, to all intents and purposes, the sequence of operational steps is identical to the procedure described for manual control except that SW1, is moved to position 3, to initiate the automatic cycle. When the machine is thus operated, at a suitable instant in the die withdrawal stroke, ejector pins 51, emerge to expel the casting from the form of the die and the casting falls into the chute where it comes to rest against conductor plate 62, which has previously been moved to closure position by release of the bell crank. Electric current from source is then conditioned by isolating transformer 104, through grounded chute 50, and plate 62, via the casting 53, to pin 69, and conductor 44, all of which parts are componentially illustrated as switch SW5, of FIG. 7, to energize relay R2, thereby opening the relay contacts to de-energize relay R1, switch SW3, then drops back to recycling position 2, and the next casting cycle is started.

It will be understood that the circuitry of FIG. 7 is merely exemplary and is not intended to preclude a different arrangement of elements or apparatus to perform the essential casting functions described. Ancillary functions consistent with safety or improved mechanical working of the apparatus may likewise be incorporated without limiting the features of novelty listed in the claims.

Operation of the apparatus as applied to die casting machines includes a starting member 89, adapted to motivation of a carriage 21, and an ejector die 20, to closed position. Approaching die closure position, an element fixed to the die or carriage contacts the lever of an actuator 68, moving same to open an interceptor 60, slidably maintained in a metal chute 50, which predetermines the path of fall of a casting subsequently to be ejected from the movable die. Molten metal is injected between the closed die pair and power is transferred to reverse the movement of the carriage, die and injector driving members to start the withdrawal stroke. Movement of the

die and carriage releases actuator 68, returning the interceptor 60, to closed position. Immediately thereafter, the formed casting is expelled from the die and falls into chute 50, where it is stopped abruptly by electrically conductive face plate 62, on the interceptor. As described in connection with FIG. 7, the chute, face plate, pin 69, and contacts 44, constitute contacts bridgeable by casting 63, which elements are schematically designated switch SW5, in the figure. Closure of the switch breaks contact to the die carriage and injector driving solenoids an instant after the withdrawal stroke has been completed causing switch SW3, to reinitiate another cycle of the machine.

For manual operation, recycling will be accomplished by moving element 89, to a suitable driving connection. With either manual or automatic cycling, it will be apparent that interceptor 60, will work independently of electrical apparatus. A casting formed during one cycle of the machine will be released by the interceptor on the next succeeding cycle. The positive, mechanically impelled movement of the interceptor is an important feature of the invention in that it assures complete stoppage of movement of an expelled casting for a time sufficient to enable the associated electrical or air motivated apparatus to operate.

It will likewise be observed that if, for any reason, the closure movement of element 60, should be obstructed or otherwise prevented from reaching its completely closed position, conductor 70, will not be contacted by plate pin 69, as shown in FIG. 4, and no path for the transmission of a signal or for the flow of current from chute through casting and plate 62, will be provided. Essentially the same results will be achieved should no casting be ejected from the die. Relay contacts thus will remain unbroken and switch SW3 will prevent further cycling until member 89, is manually manipulated. Where one operator is responsible for supervision of a battery of machines, a light or any other appropriate signalling device such as an audible warning signal may, of course be incorporated in the circuitry described, to direct his attention to malfunctions causing shut down.

Having described the apparatus of the invention and its method of operation, what is desired to be protected is set forth in the following claims:

What is claimed is:

1. Safety apparatus for a die casting machine including a discharge channel into which completed castings are ejected comprising; a stop member to be disposed at the exit of said channel for completely arresting an ejected casting for a substantial portion of the operating cycle of the machine; an electrical circuit for controlling the succeeding casting cycle after the ejection of a casting; and a circuit controlling element responsive solely to the presence of an arrested casting in positive contact with said stop member, said circuit controlling element being included in said circuit for controlling a succeeding casting cycle.

2. Safety apparatus for a machine for die casting metallic objects including a discharge channel into which completed castings are ejected comprising; a stop member having an electrically conductive facing to be disposed across said channel for completely arresting an ejected casting for a substantial portion of the operating cycle of the machine; and an electrical circuit for controlling the succeeding casting cycle after the ejection of a casting, said circuit including said conductive facing and an arrested metallic casting in positive contact therewith for controlling a succeeding casting cycle.

3. Safety apparatus for a die casting machine including a forming member, a reciprocable carriage for said forming member and a discharge channel into which completed castings are ejected comprising; a stop member to be disposed at the exit of said channel and connected to be withdrawn by said carriage a short interval after the ejection of a casting and re-positioned before the ejec-

tion of a succeeding casting; an electrical circuit for controlling the succeeding casting cycle after the ejection of a casting; and a circuit controlling element responsive jointly to the presence of an arrested casting in positive contact with said stop member and to the re-positioning of said stop member and included in said circuit for controlling a succeeding casting cycle.

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