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EJECTOR MECHANISM FOR A PLASTIC INJECTION MOLDING MACHINE OR THE LIKE

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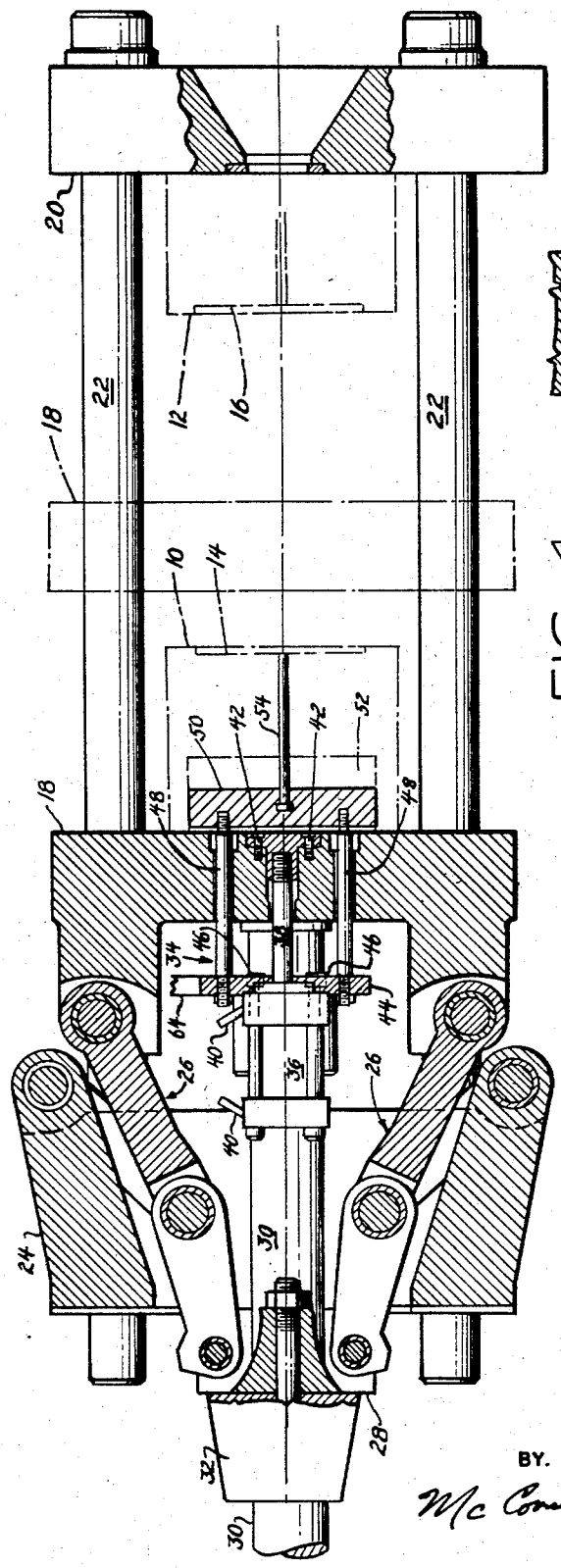


FIG. 1

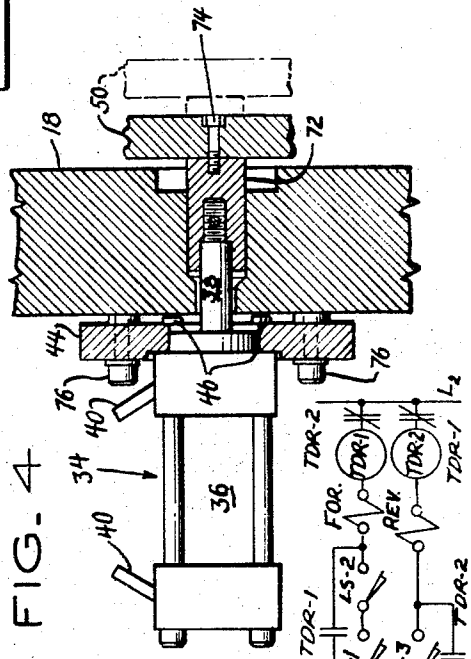


FIG. 4

FIG. 3

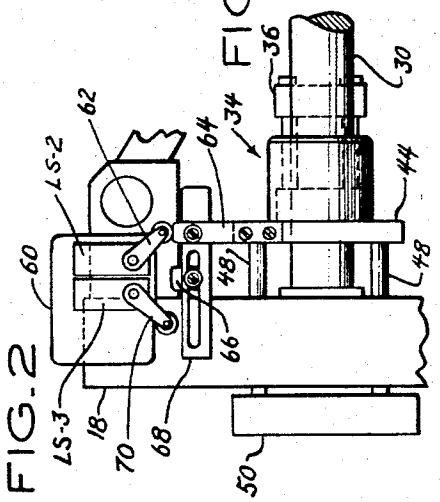


FIG. 2

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EJECTOR MECHANISM FOR A PLASTIC INJECTION MOLDING MACHINE OR THE LIKE

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This invention relates to improvements in a plastic injection molding machine or the like and, more particularly, to an improved ejector mechanism for such machines.

In machines such as plastic injection molding machines and die casting machines, there is a movable die member reciprocable relative to a fixed die member, the said members being closed or engaged to define the die or mold cavity in which a part is cast. The die members are usually so constructed that the movable member carries the cast or molded part away from the fixed die member when they are separated. A conventional mechanism for ejecting the part from the movable die member includes at least one and generally a plurality of ejector rods which are slidable through the movable die and its support plate. The rear ends of these rods are generally fastened to a common ejector plate which is spring-biased rearwardly of the die support plate and which will engage a wall or some other abutment just prior to the completion of the rearward movement of the die to thrust the ejector rods forwardly to eject the part.

This is known as "bumper" ejection and it has certain disadvantages. For example, the slamming and banging and the wear on the parts is undesirable, and it is necessary to provide new ejector rod apertures through the movable die support plate to accommodate a different die having a different die cavity for the making of a different part.

It is the general object of the present invention to provide a self-contained automatically operable ejector mechanism which does not have to strike a wall or otherwise depend upon "bumper" actuation with its disadvantages and which is readily adaptable for use with various dies without modification of the movable die support plate.

As will be described in greater detail hereinafter, the ejector mechanism includes a reversible fluid motor having a cylinder element and a piston element, one of which is secured to the rear of the die support plate. The other element has at least one rod connected thereto which is slidable through the die support plate, and an ejector plate is disposed forwardly of the die support for movement by the said rod. One or more ejector rods are connected to the ejector plate and slide through the die to the die cavity in the ejecting operation. Whenever a die is changed, it is only necessary to change the ejector plate and the ejector rods for the new die and die cavity.

The drawing shows preferred embodiments of the invention and such embodiments will be described, but it will be understood that various changes may be made from the constructions disclosed, and that the drawing and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawing:

FIG. 1 is a vertical cross-sectional view taken through the movable die area and its operating linkage in a plastic injection molding machine;

FIG. 2 is an elevational view taken from the rear and showing the ejector mechanism of this invention;

FIG. 3 is a wiring diagram providing a schematic illustration of an exemplary control for the ejector mechanism; and

FIG. 4 is a vertical cross-sectional view taken through

the movable die area showing a modified form of ejector mechanism according to the present invention.

In FIG. 1 a portion of a plastic injection molding machine is shown, and this includes a movable die half **10** and a fixed die half **12**. When these die halves are engaged, they cooperate to define a die or mold cavity for the making of a plastic part by injection, and each die half defines a part of the cavity, the cavity section in the die half **10** being identified by the number **14**, and the section in the die half **12** being identified by the number **16**.

As more fully described in my copending U.S. application, Ser. No. 559,861, filed June 23, 1966, and entitled Operating Linkage for a Plastic Injection Molding Machine or the Like, such a machine includes a movable die support plate **18** and a fixed die support plate **20**. A plurality of tie rods **22**, **22** extend rearwardly from the fixed die support plate **20** to a rigid stock or base **24**, and the movable die support plate **18** moves horizontally forwardly over the tie rods **22** to engage the movable die half **10** with the fixed die half **12** and the movable die support plate **18** is then retracted or drawn rearwardly toward the position shown in FIG. 1. In keeping with conventional practice, the die cavity section **14** in the movable die **10** is formed to retain the finished or cast part as the movable die is retracted so that the part is withdrawn from the machine by being ejected from the movable die half **10**.

The mechanism for reciprocating the movable die support plate **18** and thus the movable die **10** includes the linkage structure indicated generally by the reference number **26**, and this linkage is actuated by moving a crosshead **28** forwardly and rearwardly along a guide rod or beam **30** which moves with the movable die support plate **18** through an extension **32** on the stock **24** which is disposed rearwardly of the said stock as more fully described in my said copending application.

The ejector mechanism provided in accordance with the present invention is indicated generally by the reference number **34** and it is adapted to operate to eject a molded part from the movable die member or half **10** when the movable die support plate **18** is moved rearwardly to the fully retracted position shown in FIG. 1 or selectively to operate for ejection when the said plate has been withdrawn to an intermediate position. The said mechanism **34** includes a fluid motor (preferably an hydraulic motor) comprising a cylinder element **36** and a piston element **38**. The said fluid motor is reversible, and to this end fluid conduits or hose connections **40**, **40** are provided at each end of the cylinder **36** to accommodate reversible fluid flow therethrough. Either the said cylinder element or the said piston element is fixedly secured to the rear face of the movable die support plate **18** and the other element is reciprocable relative thereto.

In the preferred form shown in FIGS. 1 and 2, the piston element **38** is fixedly secured to the movable die support plate **18** as by screws **42**, **42** so that the cylinder **36** can move forwardly toward and rearwardly from the movable die support plate. A cylinder plate **44** is connected as by screws **46**, **46** to the front end of the cylinder element **36**, and a plurality of rods **48**, **48** are fastened to the cylinder plate to project forwardly therefrom and to slide through suitable openings provided in the movable die support plate **18**.

The cylinder plate rods **48**, **48** are operatively associated with an ejector plate **50** at their front ends. This ejector plate is movable forwardly and rearwardly within an opening **52** provided on the rear face of the movable die **10**, and the ejector plate carries one or more ejector rods, such as the rod **54** which is movable slidably through an opening in the movable die **10** to project

into the die cavity area **14** and thus to eject a molded part therefrom when the ejector plate **50** is thrust forwardly. The said ejector plate can be spring-biased rearwardly in the die opening **52** and thrust forwardly by engagement from the front ends of the cylinder plate rods **48, 48** to effect "bumper" ejection. However, in the preferred form, the cylinder plate rods **48, 48** are threaded in the rear surface of the ejector plate **50** adjacent the front surface of the die support plate **18** so that the said ejector plate will move forwardly and rearwardly in the die space **52** with forward and rearward movement of the cylinder **36**.

In keeping with this invention, the ejector mechanism **34** is to be operated automatically whenever the movable die support plate **18**, and thus the movable die **10**, reaches a predetermined or preselected rearward position relative to the fixed die **12**. This position of the movable die support plate **18** for operation of the ejector mechanism is determined when a limit switch LS–1 (FIG. 3) is engaged and closed. As explained in another of my copending applications, Ser. No. 572,010, filed Aug. 12, 1966, and entitled Control Switch Actuating Apparatus for a Plastic Injection Molding Machine or the like, the limit switch LS–1 can be located on the machine frame for direct engagement and operation by the support plate **18**, or it can be remotely located and actuated by means movable with the said die support plate.

There are a variety of control circuits that can be provided for automatic operation of the ejector mechanism **34**, and that shown in FIG. 3 is merely exemplary. In the said exemplary arrangement, the limit switch LS–1 is normally open and is arranged to be closed when the movable die support plate member **18** reaches the desired position for the start of the ejector cycle. The said limit switch is connected in series with a second normally open limit switch LS–2, a solenoid adapted to operate a control valve (not shown) for effecting forward movement of the cylinder **36**, a time delay relay designated TDR–1, and the normally closed contacts of a second time delay relay TDR–2. Normally open contacts operated by the relay TDR–1 bridge the limit switches LS–1 and LS–2 so that the forward operating solenoid will remain energized for the time delay period set in the relay TDR–1 which is sufficient to complete the forward movement of the cylinder **36** and thus to complete the ejection. The limit switch LS–2, as shown in FIG. 2, is mounted on a bracket **60** carried by the movable die support plate **18**. This limit switch has an operating arm **62** arranged to be engaged and actuated by a cam **64** carried by the cylinder plate **44**. The said operating arm **62** is engaged and the limit switch LS–2 is closed by the cam **64** when the cylinder **36** is in its fully retracted or rearward position shown in FIG. 1. Thus, with the cylinder **36** retracted, when the movable die support plate **18** moves rearwardly to a position wherein the limit switch LS–1 is closed, the forward solenoid is energized and the cylinder **36** moves forwardly to eject the part, and it will continue to move forwardly to the limit of its movement within the time permitted by the time delay relay TDR–1.

At the completion of the forward or ejection stroke, a second cam **66**, adjustably mounted on a bracket **68** secured to the first cam **64**, will engage and actuate an operator **70** for a third limit switch LS–3 which is also mounted on the bracket **60** as shown in FIG. 2. As shown in FIG. 3, the limit switch LS–3 is normally open but it is actuated to close upon completion of the forward or ejector stroke, and it is connected in series with a reversing solenoid, the second time delay relay TDR–2 and the normally closed contacts TDR–1 of the first-mentioned time delay relay. The time delay relay TDR–2 has normally open contacts which bridge the limit switch LS–3 and which will close to maintain the reversing solenoid energized for the timed period of the relay TDR–2. The reversing solenoid operates to move the cylinder **36** rearwardly, and it is able to do this because the relay TDR–2 when energized will open its contacts in circuit with the forward solenoid to deenergize the same. As the cylinder **36** moves rearwardly, the limit switch LS–3 will be open but the rearward movement of the cylinder will continue for the period of the time delay relay TDR–2. In the meantime, in repetitive cycle operation, the movable die support plate **18** will have assumed a new position and the limit switch LS–1 will be open. When the cylinder is fully withdrawn to the limit of its movement relative to the piston **38**, the cam **64** will have engaged the operator **62** to again close the limit switch LS–2 so that a repeated cycle of operation can take place whenever the limit switch LS–1 is again closed.

In the alternative form of construction shown in FIG. 4, the piston or piston rod **38** is not connected to the movable die support plate **18** but instead has an extension **72** which slides through a suitable opening in the support plate to extend to the front surface thereof wherein it is connected to the ejector plate **50** as by one or more screws **74**. Also in this modified or alternative form, the cylinder plate **44** has no rods extending through the die support plate and it is rigidly connected to the die support plate as by screws **76, 76**. Thus, in the alternative form the piston reciprocates relative to the die support plate while the cylinder remains stationary. In this embodiment as in the first embodiment, the ejector plate **50** carries one or more ejector rods projecting through and slidable through suitable openings in the movable die half **10**. Here again, the ejector plate **50** can be spring-biased rearwardly and merely engaged by the forward end of the piston rod extension **72** for "bumper" ejection, but preferably the ejector plate is connected to said extension for positive ejection operation.

In the alternative form of FIG. 4, wherein the cylinder plate **44** does not move, the limit switches LS–2 and LS–3 cannot be engaged and actuated by movement of the cylinder plate. An equivalent structure can be employed by having similar limit switches engaged and operated by suitable means carried by the ejector plate **50**. In such arrangement, the limit switches are preferably supported on the movable die member **10**, and the automatic control or operation will be the same.

The invention claimed is:

1. An ejector mechanism for a plastic injection molding machine or the like having a plate supporting a first die half for movement forwardly into engagement with a fixed second die half to define a cavity therewith and rearwardly to carry a part molded in the cavity away from the fixed die half, said mechanism comprising a reversible fluid motor including a cylinder element and a piston element, one of said elements being secured to the rear of said die support plate and the other element having at least one rod connected therewith and slidable through said die support plate, an ejector plate disposed forwardly of said die support plate for reciprocation relative to said first die half and movable forwardly by said rod, and at least one ejector rod secured to said ejector plate and slidable through said first die half to eject said molded part with forward movement of said other element, and wherein the piston element is secured to the rear of the die support plate, a cylinder plate is secured to said cylinder and has more than the said one rod secured thereto and slidable through said die support plate.

2. Ejector mechanism as defined in claim **1** including automatic means for controlling ejector operation, said control means comprising first and second electrical switches operable when said die support plate and said cylinder, respectively, are in predetermined rearward positions to cause said cylinder to move forwardly for ejection, and a third switch operable when said cylinder has moved forwardly to effect ejection to cause said cylinder to more rearwardly.

3. The ejector mechanism defined in claim **2** wherein said second and third switches are supported by said die

support plate and wherein switch actuating means is carried by said cylinder plate to engage and operate said second and third switches.

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U.S. Cl. X.R.

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