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L. A. CATLIN ET AL

2,296,907

PNEUMATICALLY OPERATED DIE-CASTING MACHINE

Filed Sept. 29, 1941

4 Sheets-Sheet 1

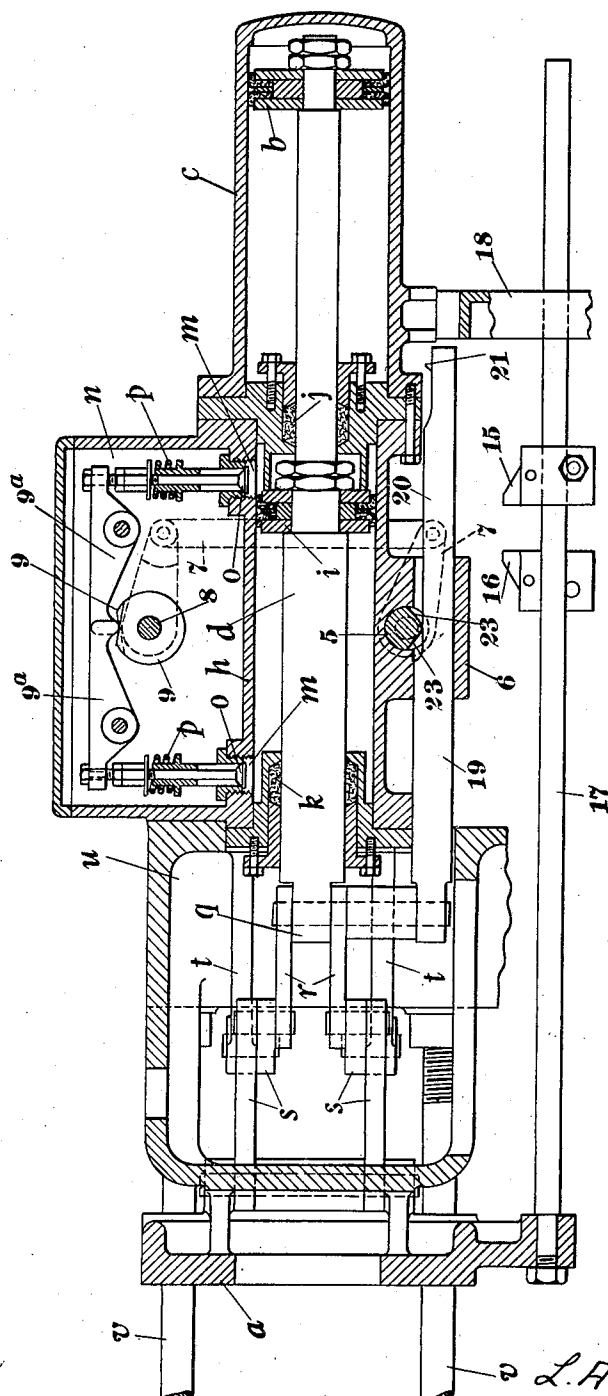


Fig. 1

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4 Sheets-Sheet 2

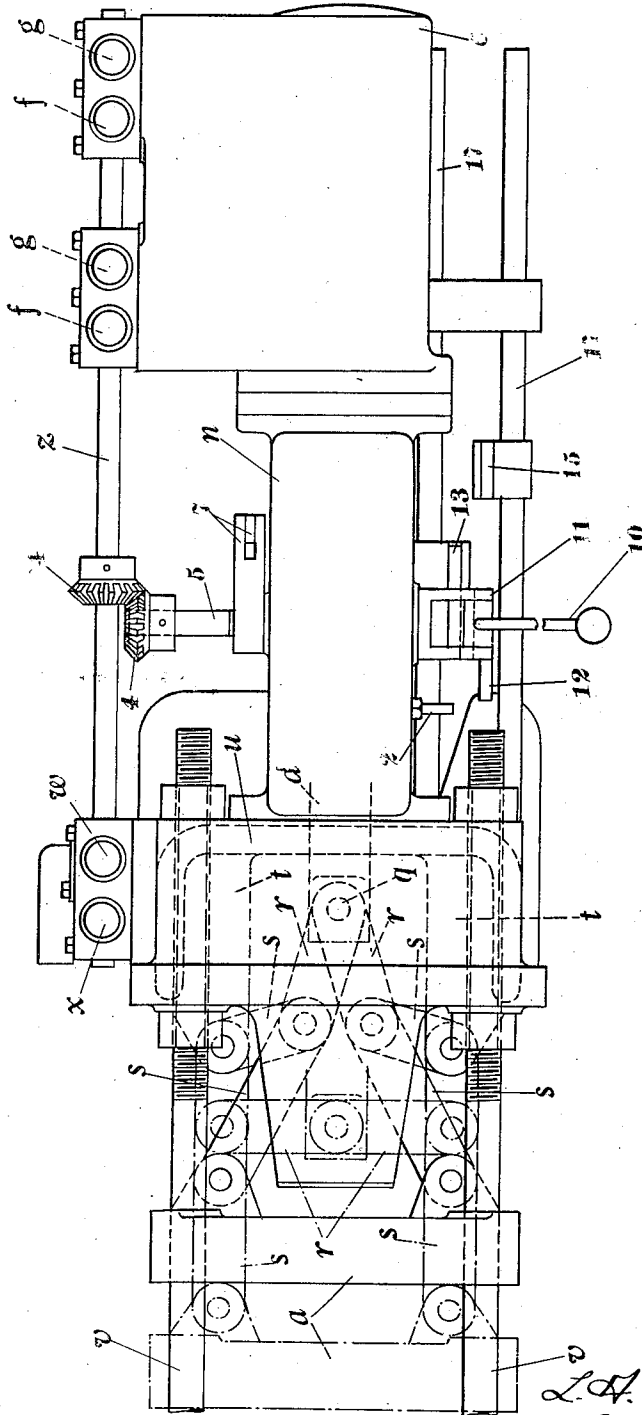


Fig. 2

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4 Sheets-Sheet 3

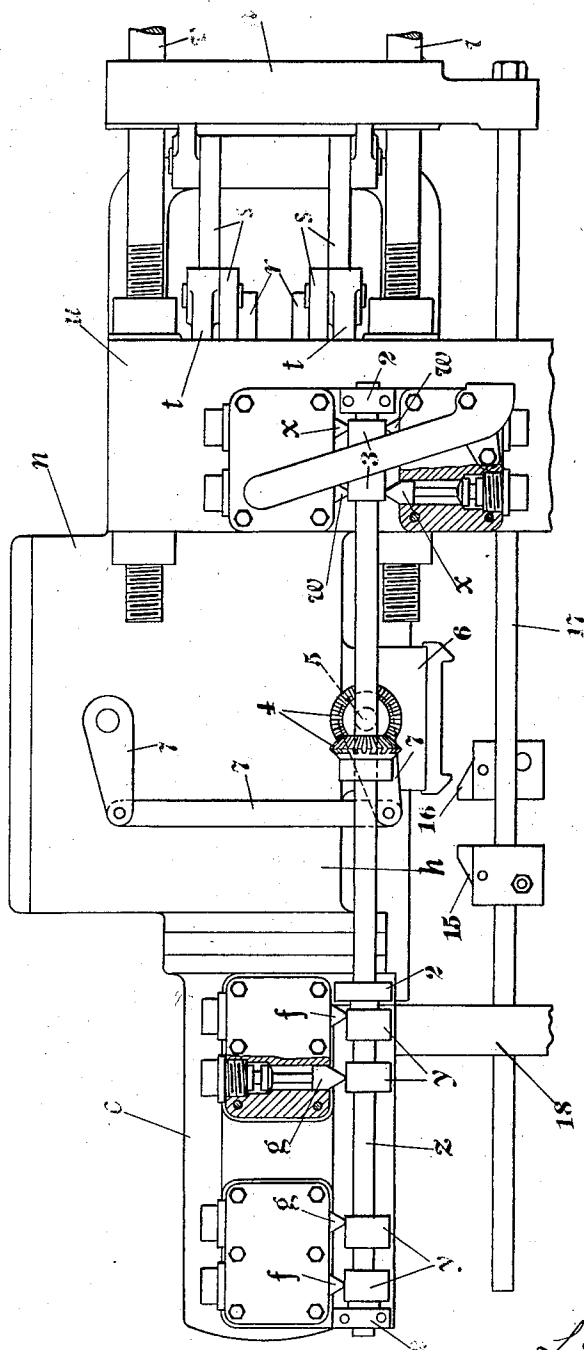


Fig. 3

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4 Sheets-Sheet 4

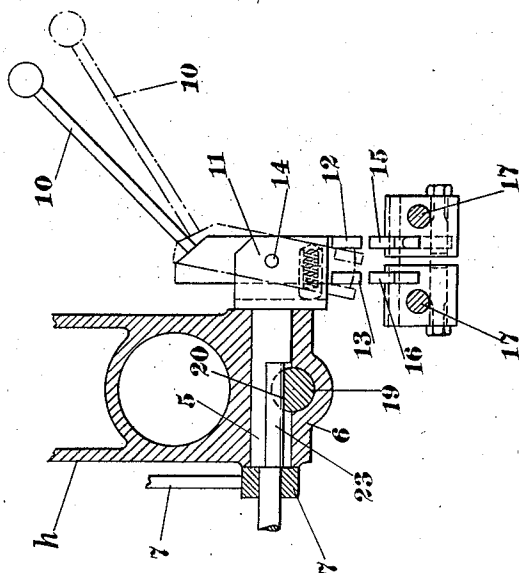


Fig. 5

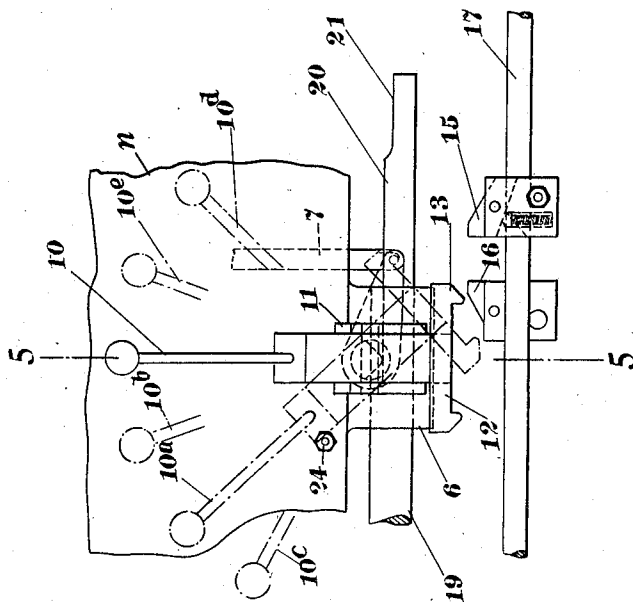


Fig. 4

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UNITED STATES PATENT OFFICE

2,296,907

PNEUMATICALLY OPERATED DIE-CASTING MACHINE

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Application September 29, 1941, Serial No. 412,880
In Great Britain August 1, 1941

7 Claims. (Cl. 22—68)

This invention relates to pneumatically operat-
ed die-casting machines of the kind in which
metal, such as zinc or aluminium, or other mould-
able material, such as cellulose acetate, is in-
jected in a molten, liquefied or plastic condition
between the die parts under the action of com-
pressed air.

In the specification of our patent application
No. 341,978 there is described and claimed means
for controlling a die-casting machine, the said
means comprising the combination with a pneu-
matically operable and relatively slidable piston
and cylinder for actuating the movable die head
of the machine, and means operable by the at-
tendant for controlling flow of air to and from
the said cylinder, of a hydraulic locking device
for interrupting the movements of the said die
head at desired positions, and controlling means
therefor.

When the die-casting machine to be controlled
is of the kind specified above, it is necessary not
only to prevent the molten, liquefied or plastic
material from being injected between the die
parts while the latter are open, but also to pre-
vent the die parts from being opened while the
said material is under air pressure.

To satisfy these conditions the supply of com-
pressed air for effecting the injecting operation
is controlled, according to our prior specifica-
tion aforesaid, by a rotatable shaft which is op-
erable by the attendant only when the die head
is in the closed position, and which serves to pre-
vent actuation of a member for controlling the
movement of the die head when the shaft occu-
pies any position other than that in which the
supply of injecting air is interrupted, the said
shaft being provided with its own operating
handle.

The object of the present invention is to enable
the above mentioned conditions to be satisfied
in a simpler and more convenient manner than
heretofore.

The invention comprises the combination of a
pneumatically operable and relatively slidable pis-
ton and cylinder for actuating the movable die
head of the machine, valve means for controlling
the flow of compressed air to and from the cyl-
inder, additional valve means for controlling the
flow of compressed air whereby the material can
be injected into the die of the machine, a hy-
draulic locking device for interrupting the move-
ments of the die head at desired positions, an os-
cillatory shaft operable by the attendant for con-
trolling the operations of both the first and sec-
ond mentioned valve means and the hydraulic

locking device, and a slidable interlocking rod
arranged at right angles to the shaft and respon-
sive to the relative movement between the piston
and cylinder whereby movement of the shaft for
controlling the second mentioned valve means can
only occur when the die head is in the closed
position, the said shaft and rod being adapted
to co-operate with each other to limit the ex-
tent of the movement that can be imparted to
the said shaft by the attendant when the die head
is in the open position.

In the accompanying sheets of explanatory
drawings:

Figure 1 is a sectional front elevation, Figure 2
a plan, and Figure 3 a part sectional rear ele-
vation, of means constructed in accordance with
the invention for controlling a die-casting ma-
chine of the kind specified.

Figure 4 is a fragmentary front view illustrat-
ing the various positions to which the controlling
member is movable by the attendant.

Figure 5 is a fragmentary sectional view taken
on the line 5—5 of Figure 4.

In carrying the invention into effect as shown,
we employ for actuating the movable die-head *a*
of the machine a piston *b* which is slidable in a
horizontal cylinder *c* under the action of com-
pressed air, and which is secured on a rod *d*.
On the rear side of the cylinder *c* are mounted
two pairs of spring-loaded valves *f, g*. The valves
f serve to admit to opposite ends of the cylinder
c, compressed air for actuating the piston *b*, and
the valves *g* serve to release air from opposite
ends of the cylinder.

Arranged coaxially with and secured to one end
of the air cylinder *c* is a second cylinder *h*,
and slidable in the second cylinder is a second
piston *i* on the piston rod *d*, the latter being ar-
ranged to pass through a gland *j* between the
adjacent ends of the two cylinders and another
gland *k* at the other end of the second cylinder.
At each end of its upper side the second cylinder
h is provided with an opening *m* leading to an
oil or other liquid container *n* on the upper side
of this cylinder, the latter being filled with oil
at both sides of its piston *i*. The openings *m* are
controlled by a pair of vertically slidable poppet
valves *o*, and these valves are loaded by springs
p which tend to hold the valves in closed posi-
tions for interrupting communication between the
liquid cylinder *h* and container *n*.

At its outer end the piston rod *d* is connected
by a vertical pivot pin *q* to pivotal links *r* forming
part of a toggle linkage through which motion can
be imparted from the piston rod to the die head *a*.

The other part of this linkage is formed by pivotal link *s* which are pivotally interconnected in pairs, and which at their junctions are connected to the adjacent ends of the first mentioned links *r*, the opposite ends of each of the said pairs of links being connected to the die head *a* and a fixed anchorage *t* respectively. The anchorages *t* are formed or provided on a housing *u* which is secured to the end of the liquid cylinder *h* remote from the air cylinder *c*, and which serves as a protective cover for the outer end of the piston rod *d* and the adjacent parts of the toggle linkage *r, s*, the die head *a* being slidably supported by fixed horizontal guides *v* which at one end are secured to the said housing. In Figure 2 the die head *a* is shown in full lines in one extreme position and in broken lines in the other extreme position.

On the rear side of the housing *u* are mounted two pairs of spring-loaded valves *w, x*, for controlling the supply of air to and from a pneumatically operable and relatively slidable piston and cylinder whereby the molten metal or other material to be cast is injected into the die of the machine. As this piston and cylinder (herein termed the injecting piston and cylinder) are of known form and constitute no part of the present invention, they are not illustrated in the drawings. The valves *w* serve to admit compressed air to opposite ends of the injecting cylinder, and the valves *x* serve to release air from opposite ends of this cylinder.

For actuating the air valves *f, g*, associated with the air cylinder *c* we employ two pairs of cams *y* on a horizontal shaft *z*, the latter being rotatably supported by bearings *2* on the rear sides of the air cylinder and the housing *u* above-mentioned. This cam shaft *z* also carries another pair of cams *3* for actuating the air valves *w, x*, associated with the injecting cylinder. Also the cam shaft *z* is connected by bevel gearing *4* to a transverse operating shaft *5* which extends through an aperture in and is rotatably supported by a projection *6* on the under-side of the liquid cylinder *h*. The operating shaft *5* is connected by a link and lever mechanism *7* to a second cam shaft *8* which extends transversely across and is rotatably supported by the liquid container *n* on the upper side of the liquid cylinder *h*. The second cam shaft *8* carries cams *9* for actuating the liquid valves *o* associated with the liquid cylinder *h*, these cams being adapted to act on the adjacent ends of a pair of rockers *9^a* which are mounted on parallel axes within the liquid container *n*, and which at their other ends are adapted to act on the liquid valves.

Mounted on the front end of the operating shaft *5* is a hand lever *10* through the agency of which the operating shaft can be oscillated by an attendant for actuating the air valves *f, g*, and *w, x*, and the liquid valves *o*. The hand lever *10* is formed or provided at its lower end with a pair of abutments *12, 13* arranged in different vertical planes, and at a position adjacent to this end is pivotally connected by a pin *14* to a slotted member *11* on the front end of the operating shaft *5*, so that the lever is capable of pivotal movement in a plane containing the axis of the operating shaft. Another pair of abutments *15, 16* are adapted to co-operate with the lever abutments *12, 13* for actuating the lever *10* in the manner hereinafter described. The abutments *15, 16* are adjustably mounted in spaced relationship and in different vertical planes on rods *17* which are connected at one end to the die head *a*, and which

are slidably supported near the other end by a fixed bracket *18*. Normally the lever abutments *12, 13* are situated in the paths of the corresponding abutments *15, 16* as shown in full lines in Figure 5, but they can be moved out of these paths by appropriate movement of the lever *10* about its pivot axis in a forward direction.

For limiting the amount of angular movement that can be imparted to the operating shaft *5* when the die head *a* is in the open position we arrange in association with the underside of this shaft an interlocking member *19* in the form of a slidably mounted horizontal rod which is situated at right angles to the shaft and is responsive to the movement of the die head *a*. One end of this rod *19* is attached to the lower end of the pivot pin *q* which connects the piston rod *d* to the toggle linkage *r, s*, and the other end of the rod is slidably supported at a position beneath the operating shaft in another aperture formed in the projection *6* on the underside of the liquid cylinder *h*. The part of the rod *19* adapted to slide through the projection *6* has its upper side cut away or otherwise shaped to provide a pair of horizontal flats *20, 21* situated end to end at different levels, the lowermost flat (*21*) being situated nearest to the end of the rod remote from the die head *a*. Also the part of the operating shaft *5* situated adjacent to the interlocking rod *19* is cut away or otherwise shaped to provide a pair of oppositely inclined flats *23* and a curved portion between the adjacent ends of these flats as shown. Moreover the arrangement is such that when the die head *a* is in the open position the flat *20* on the interlocking rod *19* is situated beneath the operating shaft *5* and angular movement of the latter in either direction is limited by contact of one of the flats *23* on the shaft with the flat *20* on the interlocking rod, but when the die head is in the closed position the flat *21* on the rod is situated beneath the operating shaft and angular movement of the latter is unobstructed by the rod.

In the initial position of the parts above described the die head *a* is in the open position shown in full lines in the drawings, the hand lever *10* is in the central or idle position shown in full lines in Figure 4, and the valves *f, g, o, w, x*, are closed. Also the flat *20* on the interlocking rod *19* is situated beneath the operating shaft *5*. To impart a forward or die-closing movement to the head *a*, the hand lever *10* is moved in a counter-clockwise direction to the position *10^a* shown in the broken lines in Figure 4, the extent of this movement being determined by contact of one of the flats *23* on the operating shaft *5* with the flat *20* on the interlocking rod *19*. As a further precautionary measure we also prefer to provide on the front of the liquid cylinder *h* a fixed stop *24* against which the lever *10* can abut at the end of the movement above mentioned, and which serves to minimize wearing of the flats *20, 23* by hard usage. If the lever *10* is now pulled forwards it can be caused to assume a position in which its further movement in a counter-clockwise direction is unobstructed by the stop *24*, but such further movement is still prevented by contact of the above mentioned flat *23* on the operating shaft *5* with the flat *20* on the interlocking rod *19*. During the movement of the lever *10* from its idle position to the position *10^a* it passes another position *10^b* also shown in broken lines in Figure 4. The movement of the lever between its idle position and the position *10^b* causes one pair of the cams *y* to open the appropriate valves *f, g*, for admitting com-

pressed air to the outer end of the cylinder *c*, and releasing air from the inner end of this cylinder. The piston *b*, however, cannot be moved by the action of the compressed air until the valves *o* associated with the liquid cylinder *h* are opened, this being effected by the cams *9* during the movement of the lever *10* from the position *10^b* to the position *10^a*. When the lever *10* reaches the latter position the piston *b* commences to move the die head *a* towards the closed position, and this movement continues until the abutment *15* comes into contact with the lever abutment *12* and, by acting on the latter, returns the lever to the position *10^b* for re-closing the valves *o* associated with the liquid cylinder *h*. The closing of these valves *o* interrupts the flow of liquid between the cylinder *h* and the container *n*, and thereby prevents further movement of the piston *i*, the liquid in the cylinder serving as a hydraulic lock. Consequently the movement of the air piston *b* and the die head *a* is interrupted. For enabling the piston *b* and die head *a* to continue their movement, the hand lever *10* is pulled forwards against the action of a return spring *25* (Figure 5) and returned to the position *10^a* before being released, the forward movement of the lever causing it to move about its pivot axis into a position in which the lever abutments *12*, *13* are out of the paths of the movable abutments *15*, *16*, as shown in Figure 5. The die head *a* is now moved by the piston *b* to its closed position as shown in broken lines in the drawings. When the die head *a* reaches its closed position the flat *21* on the interlocking rod *19* is situated beneath the operating shaft *5*, and by pulling the lever *10* forwards until it is unobstructed by the stop *24* the lever can be moved still further in a counter-clockwise direction to the position *10^c*. During this further movement of the lever *10*, which cannot take place unless the die head *a* is in its closed position, one of the cams *3* opens the corresponding air valves *w*, *x* for causing the injecting piston above-mentioned to move in the direction for injecting the molten metal or other material into the die.

When it is required to return the die head *a* to its open position, the hand lever *10* is pulled forward and moved in a clockwise direction past the central or idle position to the position *10^d* shown in broken lines in Figure 4. During the first part of this clockwise movement of the lever *10* the previously actuated air valves *w*, *x*, are released and the others of these valves are actuated by the corresponding cam *3* for causing the injecting piston to be returned. In moving from the central or idle position to the position *10^d* the lever *10* moves past another position *10^e*. The movement of the lever between the idle position and the position *10^e* causes the other pair of the cams *y* to open the appropriate valves *f*, *g*, for admitting compressed air to the inner end of the cylinder *c*, and releasing air from the outer end of this cylinder. But the piston *b* cannot be moved by the action of the compressed air until the valves *o* associated with the liquid cylinder *h* have been opened, this being effected during the movement of the lever *10* from the position *10^e* to the position *10^d*. During the return movement of the die head *a* the abutment *16* coacts with the lever abutment *13* to return the lever *10* to the position *10^e* for interrupting the movement of the die head, the lever being subsequently pulled forwards as above described and again moved to the position *10^d* for enabling

the return movement of the head to be completed by the action of the compressed air on the piston *b*. By suitably adjusting the positions of the abutments *15*, *16* on the rods *17* the movements of the die head *a* can be interrupted at any desired positions for enabling cores to be inserted into or withdrawn from the die. Moreover, the abutments *15*, *16* can be moved to inoperative positions when this is required.

By this invention we are able not only to satisfy the required conditions in a very simple and convenient manner, but also to provide controlling means of robust and compact form for die-casting machines of the kind specified.

The invention is not limited to the example above described as subordinate details may be varied as required.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. Controlling means for a die-casting machine of the kind specified, comprising the combination of a pneumatically operable and relatively slidable piston and cylinder for actuating the movable die head of the machine, valve means for controlling the flow of compressed air to and from the cylinder, additional valve means for controlling the flow of compressed air whereby the material can be injected into the die of the machine, a hydraulic locking device for interrupting the movements of the die head at desired positions, an oscillatory shaft operable by the attendant for controlling the operations of both the first and second mentioned valve means and the hydraulic locking device, and a slidable interlocking rod arranged at right angles to the shaft and responsive to the relative movement between the piston and cylinder whereby movement of the shaft for controlling the second mentioned valve means can only occur when the die head is in the closed position, the said shaft and rod being adapted to co-operate with each other to limit the extent of the movement that can be imparted to the said shaft by the attendant when the die head is in the open position.

2. Means as claimed in claim 1, in which the shaft and rod are formed with flats which co-operate with each other to limit the extent of the movement that can be imparted to the said shaft by the attendant when the die head is in the open position.

3. Means as claimed in claim 1, in which the shaft and rod are formed with flats which co-operate with each other to limit the extent of the movement that can be imparted to the said shaft when the die head is in the open position, the said rod being formed with another flat for enabling further movement of the shaft to be effected when the die head is in the closed position.

4. Means as claimed in claim 1 and having in combination, toggle linkage through which the die head is movable by the relative movement between the piston and cylinder, and means whereby the said movement is imparted directly to the interlocking rod.

5. Means as claimed in claim 1 and having in combination a rod on which the piston is mounted and which is movable by the piston, toggle linkage through which the die head is movable by the piston rod, and means connecting the piston rod to the interlocking rod.

6. Means as claimed in claim 1 and having in combination a rod on which the piston is mounted, and which is movable by the piston, toggle

linkage through which the die head is movable by the piston rod, and a pin connecting both the toggle linkage and interlocking rod to the piston rod.

7. Means as claimed in claim 1 and having in combination with the oscillatory shaft, a cam shaft, cams on the shaft for actuating both of the valve means, a second cam shaft, cams on

the second shaft for controlling the operation of the hydraulic locking device, gearing interconnecting the oscillatory shaft and the first mentioned cam shaft, and link and lever mechanism interconnecting the oscillatory shaft and the second mentioned cam shaft.

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