Dec. 5, 1950 F. HALWARD 2,532,768

PISTON LOCK

Filed April 17, 1948 2 Sheets-Sheet 1

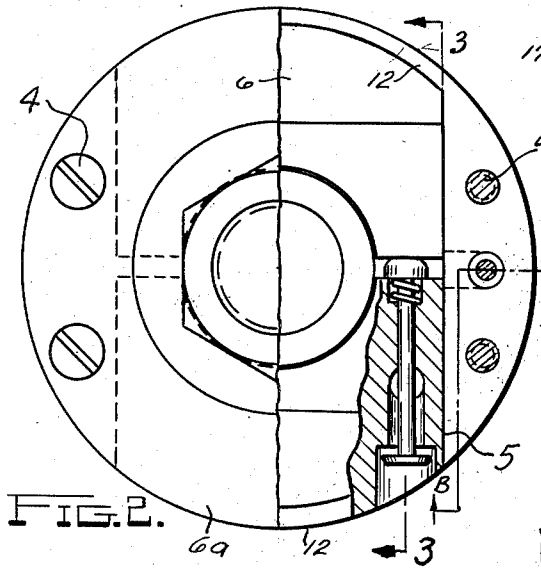


FIG. 2.

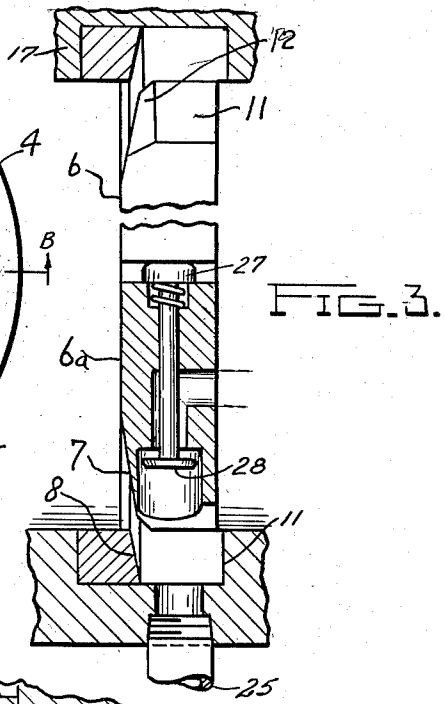


FIG. 3.

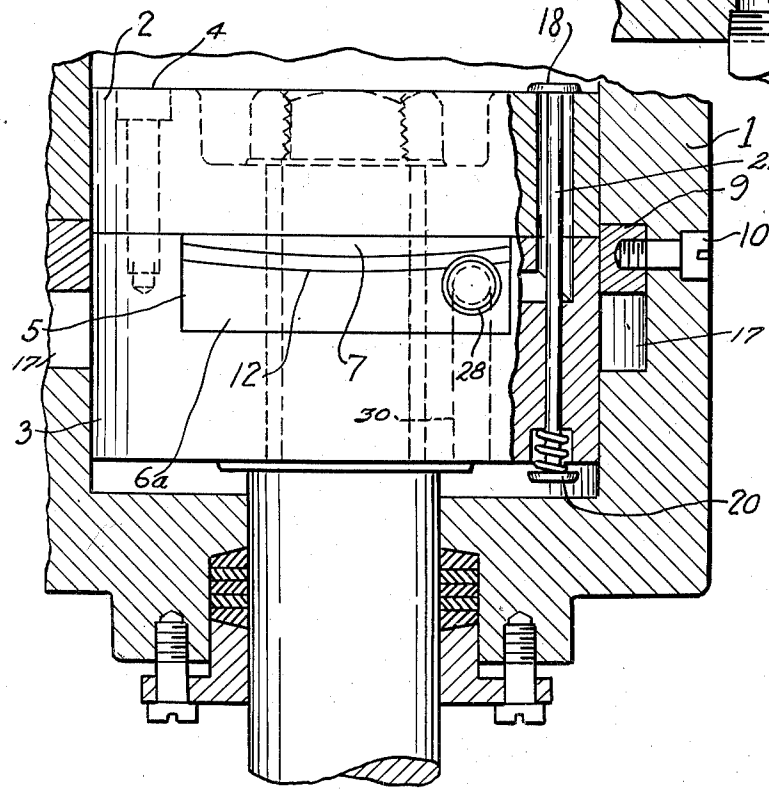


FIG. 1.

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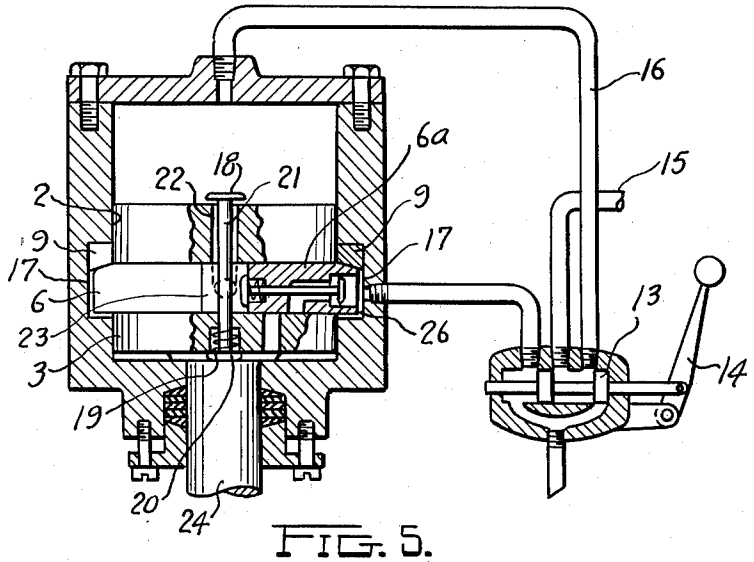


FIG. 5.

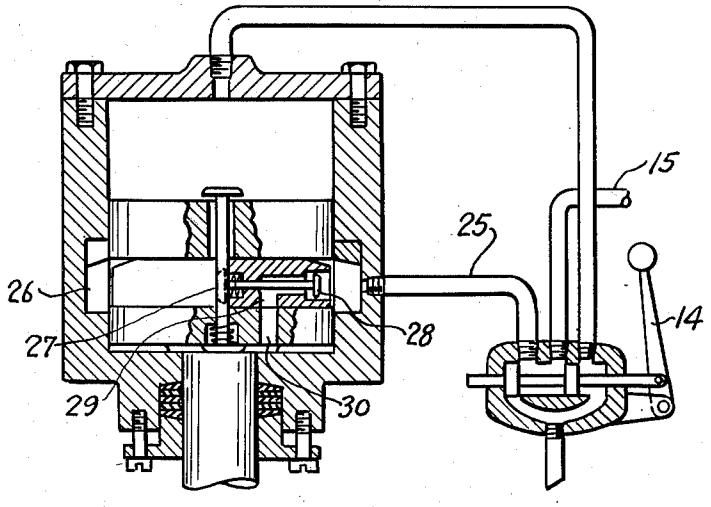


FIG. 4.

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PISTON LOCK

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7 Claims. (Cl. 121—40)

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This invention relates to a self-locking piston and cylinder. It can be used in different forms of mechanisms where it is desirable to have a power transmission member move to a definite position and then dwell before the power member retreats to its former position. For instance in power presses, particularly sheet metal standard presses, it is usual to have either a crank press or a toggle operated press. The ram is caused to move down to the operating position either by a crank or toggle arm.

In die casting toggle arms are used for causing the die supports or carriers to move the dies together and lock them together in die casting. The pressure of the metal in the dies may vary from a few hundred pounds for some metal or alloys to as much as 25,000 pounds. It requires a very positive lock and a very secure piece of mechanism to hold the die casts against this great pressure. Another way of holding the dies from separating is to use hydraulic pressure on a ram to hold the dies together, but in order to hold the dies against such high pressure in the mold cavities, it is necessary to have a piston and cylinder of very considerable cross sectional area because the operating fluid for the piston cannot practically be at any such pressure per square inch as the molten metal in the dies. With such an arrangement there is always the chance the pressure in the die cavities and the area of the die cavities will result in a total pressure that may exceed the overall pressure of the hydraulic fluid pressing the dies together and the dies will blow apart and a bad accident occur.

It is the object of the present invention to provide power transmission of the fluid type which is self-locking and capable of successfully resisting the tremendous separating pressure put on die casting apparatus. The mechanism is hydraulically operated and comprises specifically a self-locking hydraulically operated piston. It is particularly useful in die casting operations, but obviously has a greater field of usefulness. It can be used whereby an application of power is required and at the same time locking of the power driven member.

Referring to the drawings

Figure 1 is a vertical section partly in elevation showing the cylinder and the self-locking piston, the sectional part is taken on line B—B of Figure 2.

Figure 2 is a plan view of the piston with the right half of the view showing the top section of the piston removed and part shown in section.

Figure 3 is a section on the line 3—3 of Figure 2 showing additionally the side walls of the cylinder.

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Figure 4 shows the apparatus partly in section with the hydraulic valve thrown to lift the piston.

Figure 5 is a similar view showing the valve thrown to push the piston down and showing the piston locked in the downward position.

1 designates the cylinder in which a piston made up of upper section 2 and lower section 3 reciprocates. These two sections are secured together by screws 4. The lower section has a recess or guideway 5 in which the locking slides 6 and 6A slide. These slides have their ends beveled off or chamfered at 7. This chamfer is a relatively small angle so as to be an angle of repose. In other words the angle is such that any force coming at right angles and acting on the slides cannot reverse the movement of the slides. This angle of repose depends on the amount of the force, the friction and the nature of the materials, etc. An angle of approximately 7% or less will usually be an angle of repose. This chamfered surface 7 is arranged to wedge under the undercut surface 8 of the hardened ring segments 9 which are secured to the cylinder by screws 10. The chamfer on or angle of repose does not extend clear to the arched ends 11 of the slides, there is a chamfer 12 to provide clearance on the ends of these locking slides or wedges so that the two chamfered or beveled surfaces 7 and 8 of the slides and segments may be freely jammed together when the power operates to slide the locking slides or wedges.

The chamfered faces of the blocks 6 and 9 have a very useful function in increasing the pressure that is resisting the separation of the dies if the piston block is used on a die casting machine. Very often the pressures used in die casting machines are relatively very great and consequently it is necessary to oppose these pressures by a counter-pressure that is greater than the pressure tending to separate the dies. As already stated, one way of doing this is to provide a piston of greater area to oppose the separation of the dies which are of much less area, but this is not possible where economy of space is desirable or where the pressure in the die casting machine is very much greater than the pressure in the hydraulic line. I find with the machine that is shown in the drawings, that the pressure of the piston is greatly multiplied by the mechanical advantage afforded by a wedge. For instance, if the pressure in the hydraulic line be 1,000 lbs. per sq. in., and the area of the piston head be 12½

sq. in., the normal pressure on the piston would be approximately 12,566 lbs. But I find that with my arrangement where the hydraulic pressure is admitted behind the block 6 to drive the blocks outwardly so that the tapered or chamfered edges engage the chamfered faces of the blocks 9, the pressure is greatly multiplied. For example, I find that with a 5° angle of the faces of the blocks, the mechanical advantage afforded at this angle would provide an additional pressure of 57,150 lbs. to the normal pressure of 12,566 lbs., making a total pressure of 69,716 lbs. resisting the separation of the dies. With a 7° angle of the faces of the blocks, the mechanical advantage afforded would provide an additional pressure of 40,721 lbs. to the normal pressure of 12,566 lbs. making a total pressure of 53,287 lbs. resisting the separation of the dies. With a 10° angle of the faces of the blocks, the mechanical advantage afforded would provide an additional pressure of 28,355 lbs. to the normal pressure of 12,566 lbs. making a total pressure of 40,921 lbs. resisting the separation of the dies. With a 15° angle of the faces of the blocks, the mechanical advantage afforded would provide an additional pressure of 18,660 lbs. to the normal pressure of 12,566 lbs., making a total pressure of 31,226 lbs. resisting the separation of the dies.

The apparatus operates as follows: when the slide valve 13 has the valve operating lever 14 thrown to the right the pressure source pipe 15 is connected with the pipe 16 which connects with the top of the cylinder. Piston 2 and 3 is caused to move downwardly in the cylinder. This cylinder has locking annular recess 17 near the bottom and in this is the hardened ring 9. Valve 18 is normally completely closed by spring 19 that operates against a head 20 on the lower end of valve stem 21. This condition of valve 18 is shown in Figure 1. When the lower head 20 of the valve strikes the bottom of the cylinder as shown in Figure 5 valve 18 is pushed open and passageway 22 is now open to the pressure fluid above the piston. This passageway 22 leads to the chamber 23 between the slides 6 and 6A, consequently, the fluid pressure pushes these slides apart as shown in Figure 5 with all the pressure that is in the fluid line. This causes the chamfered surfaces 7 on the upper portions and at the ends of the sliding blocks to wedge in contact with the undercut angular surfaces 8 of the ring segments and firmly lock the segments in place and also lock the piston against any pressure coming through the piston rod 24 reversing the direction of the piston. With this piston rod 24 is connected with a movable die holder or carrier even such great pressure as obtained in some die casting operations will not and cannot reverse the movement of the piston. The piston is firmly locked and the dies are held firmly together.

To reverse the movement of the piston and unlock the same it is only necessary to throw the lever 14 to the left as shown in Figure 4, this connects the source of fluid pressure 16 to pipe 25. This establishes pressure in the clearance space 26. At the ends of the sliding locking blocks this causes the blocks to retreat inwardly to the position shown in Figure 4 at which point the cylindrical ends of each block has considerable clearance with respect to the cylinder wall, further movement of the slides together is blocked by the head 27 of the valve 28 being jammed between the two blocks at their inner ends. As shown in Figure 4 valve 28 is open and when the locking blocks or slides are in their inner position. Passageway 29 guarded by valve 28 now registers with passageway 30 leading to the bottom of the piston and the fluid pressure is now furnished to the bottom of the piston and will lift the piston to its uppermost position.

By having valve 28 the fluid pressure does not reach passage 30 and the bottom of the cylinder to lift the piston until the slides or blocks have been completely withdrawn into the piston and the piston is free to lift.

What I claim is:

1. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder.

2. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, a second passageway from a controlled source of fluid pressure to the piston and through said block, said passage allowing fluid under pressure to engage the block to cause the same to retreat into the piston, a passageway through the piston with which the passage through the block registers when the block is in retreat allowing pressure to get behind the piston to reverse the movement.

3. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, a second passageway from a controlled source of fluid pressure to the piston and through said block, said passage allowing fluid under pressure to engage the block to cause the same to retreat into the piston, a passageway through the piston with which the passage through the block

registers when the block is in retreat allowing pressure to get behind the piston to reverse the movement and a valve guarding the passage through the block and opened when the block has retreated into the piston.

4. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, a second passageway from a controlled source of fluid pressure to the piston and through said block, said passage allowing fluid under pressure to engage the block to cause the same to retreat into the piston, a passageway through the piston with which the passage through the block registers when the block is in retreat allowing pressure to get behind the piston to reverse the movement and a valve guarding the passage through the block and opened when the block has retreated into the piston, the first mentioned valve having a head on the outer end of the piston guarding the passageway into the chamber behind the block and having a stem extending clear through the piston to be engaged by the end wall of the cylinder thereby lifting the valve head off its seat when the piston reaches the bottom of the cylinder.

5. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, the first mentioned valve having a head at the outer end of the piston guarding the passageway into the chamber behind the block and having a stem extending clear through the piston to be engaged by the end wall of the cylinder thereby lifting the valve head off its seat when the piston reaches the bottom of the cylinder.

6. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber

on the piston a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, the said block provided with a passageway passing through the side thereof and then through the face thereof and said piston provided with a passageway adapted to register with the passageway through the sliding block when the block is driven in by the pressure fluid and to thereby admit fluid under pressure to the underside of the piston to reverse the movement.

7. A pressure fluid servo-motor having in combination, a cylinder, a piston reciprocating in the cylinder and means for locking the piston at one end of its stroke comprising a pressure chamber on the piston and a locking block forced out of the piston by fluid pressure admitted to said chamber into engagement with the wall structure of the cylinder when the piston has reached the limit of its motion, a valve located in the piston guarding a passageway into the piston and to the chamber containing said block, the said valve automatically tripped when the piston reaches the limit of its movement to allow fluid pressure to flow into the chamber to throw the block out into engagement with the wall structure of the cylinder, the said block provided with a passageway passing through the side thereof and then through the face thereof and said piston provided with a passageway adapted to register with the passageway through the sliding block when the block is driven in by the pressure fluid and to thereby admit fluid under pressure to the underside of the piston to reverse the movement, the said passageway through the block being guarded by a valve which is closed when the block is projected and which valve is automatically opened when the block is in its position of retreat and which then allows passage of the fluid through the passageway in the block and then through the passageway in the piston to the end of the piston to reverse its movement.

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