Oct. 31, 1950 G. F. WALES 2,528,198

ACTUATING APPARATUS FOR PUNCH PRESSES

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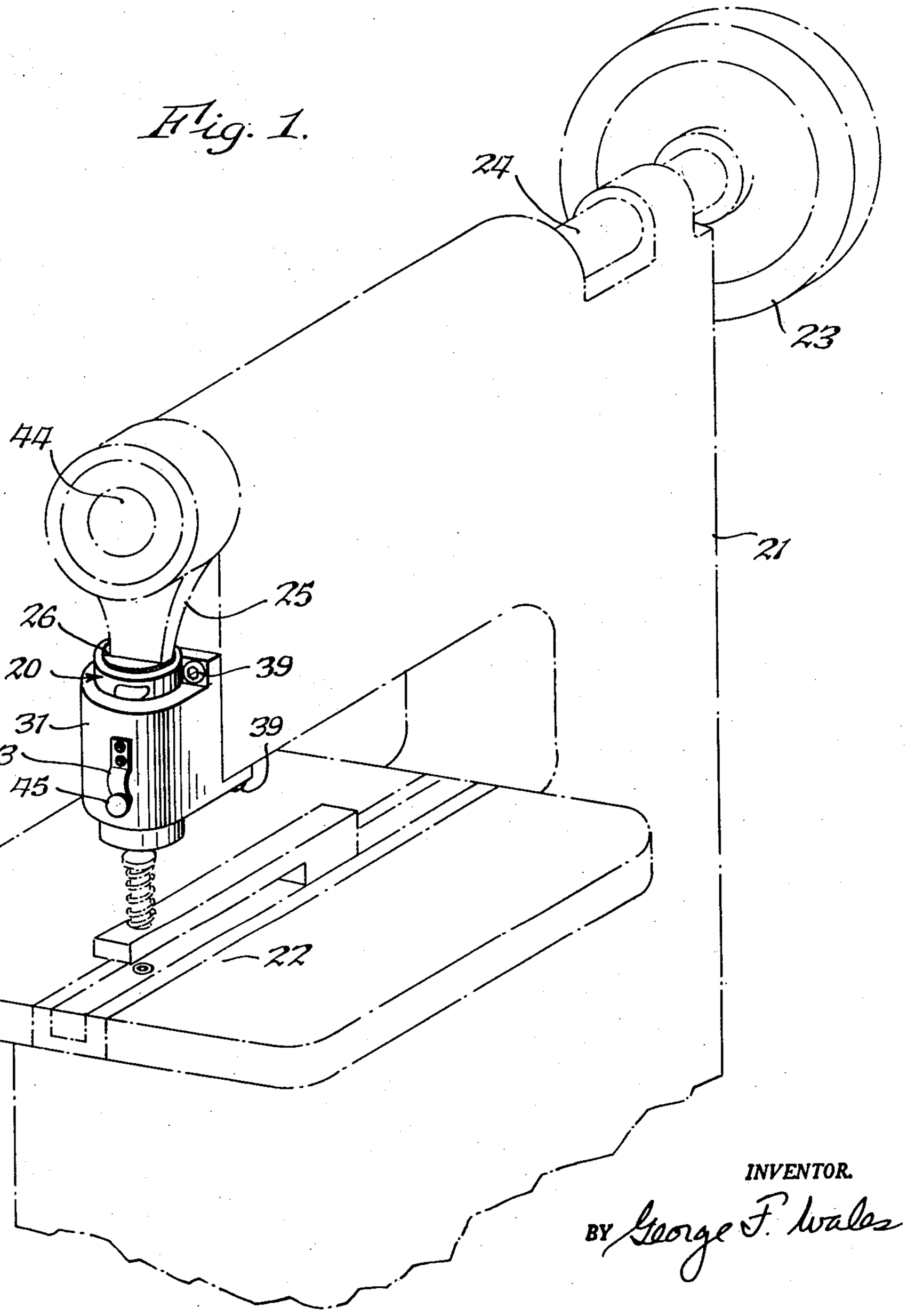
Fig. 1.



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BY George F. Wales

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ACTUATING APPARATUS FOR PUNCH PRESSES

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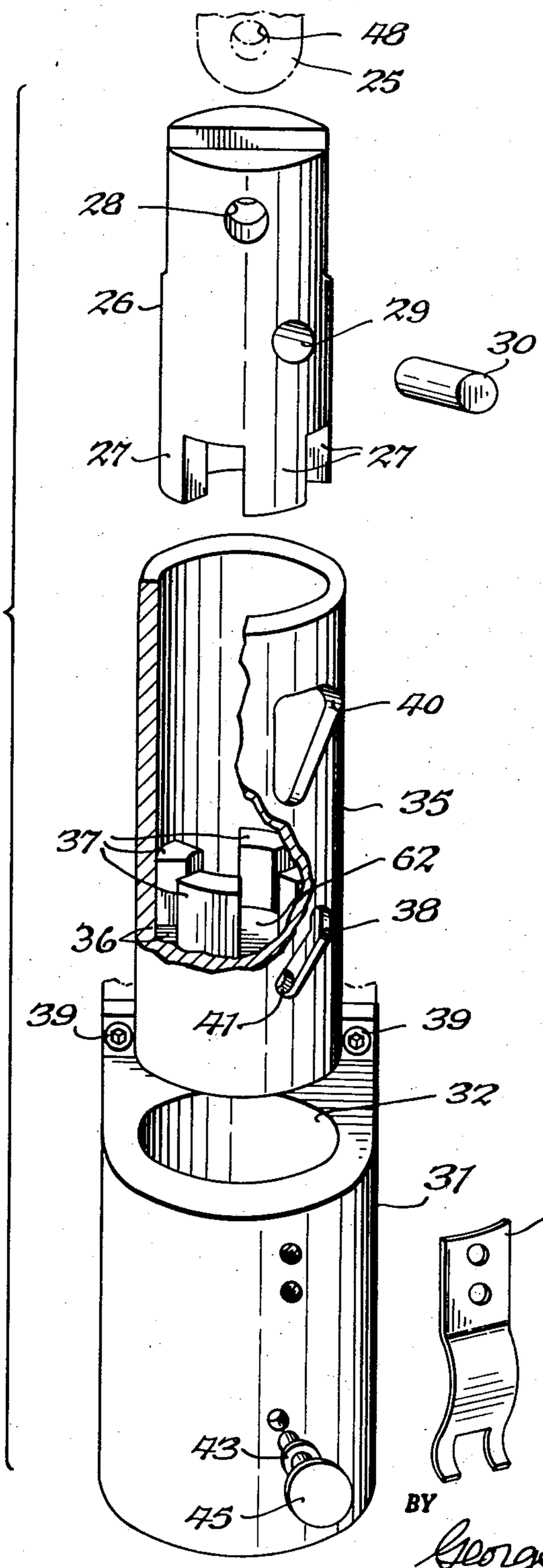
Fig. 2.



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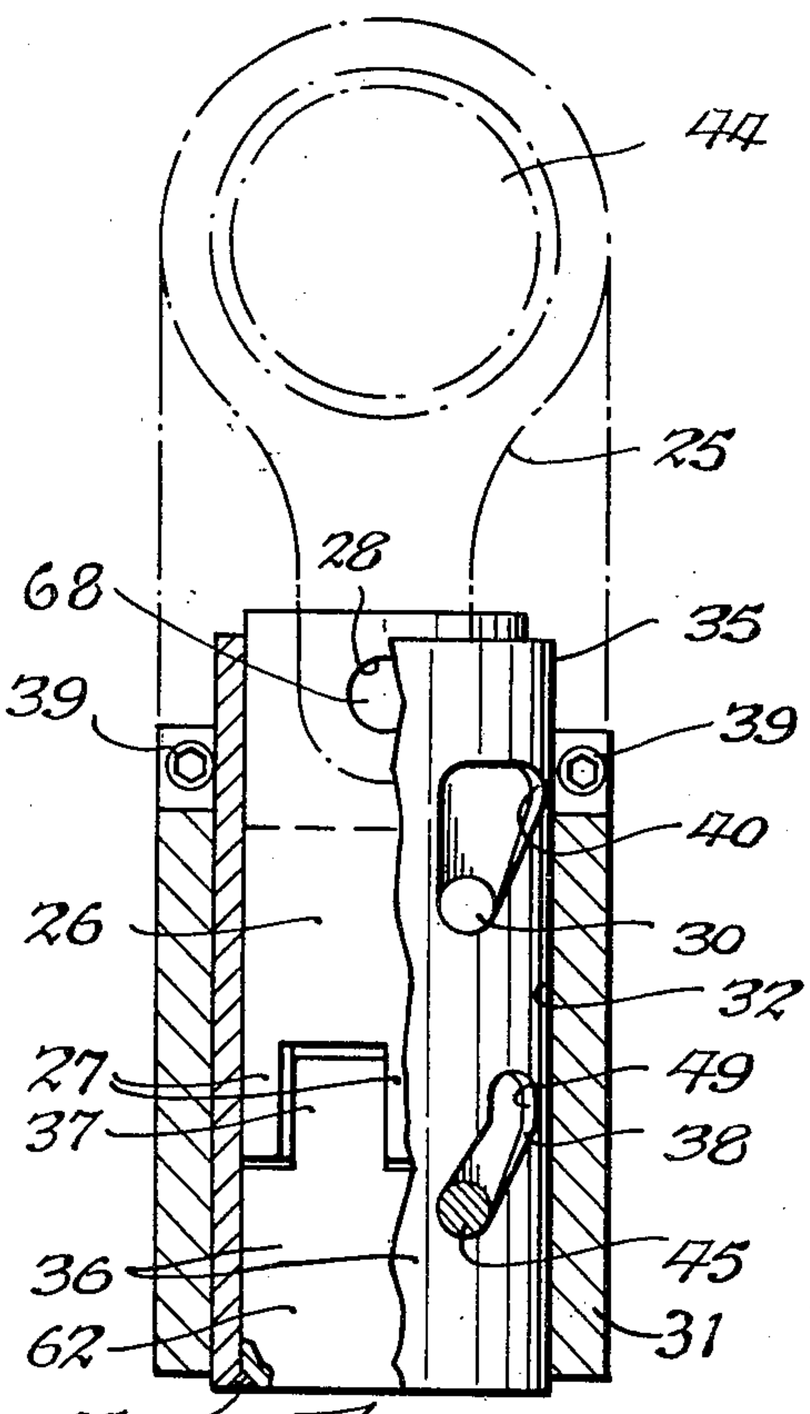

Fig. 3.

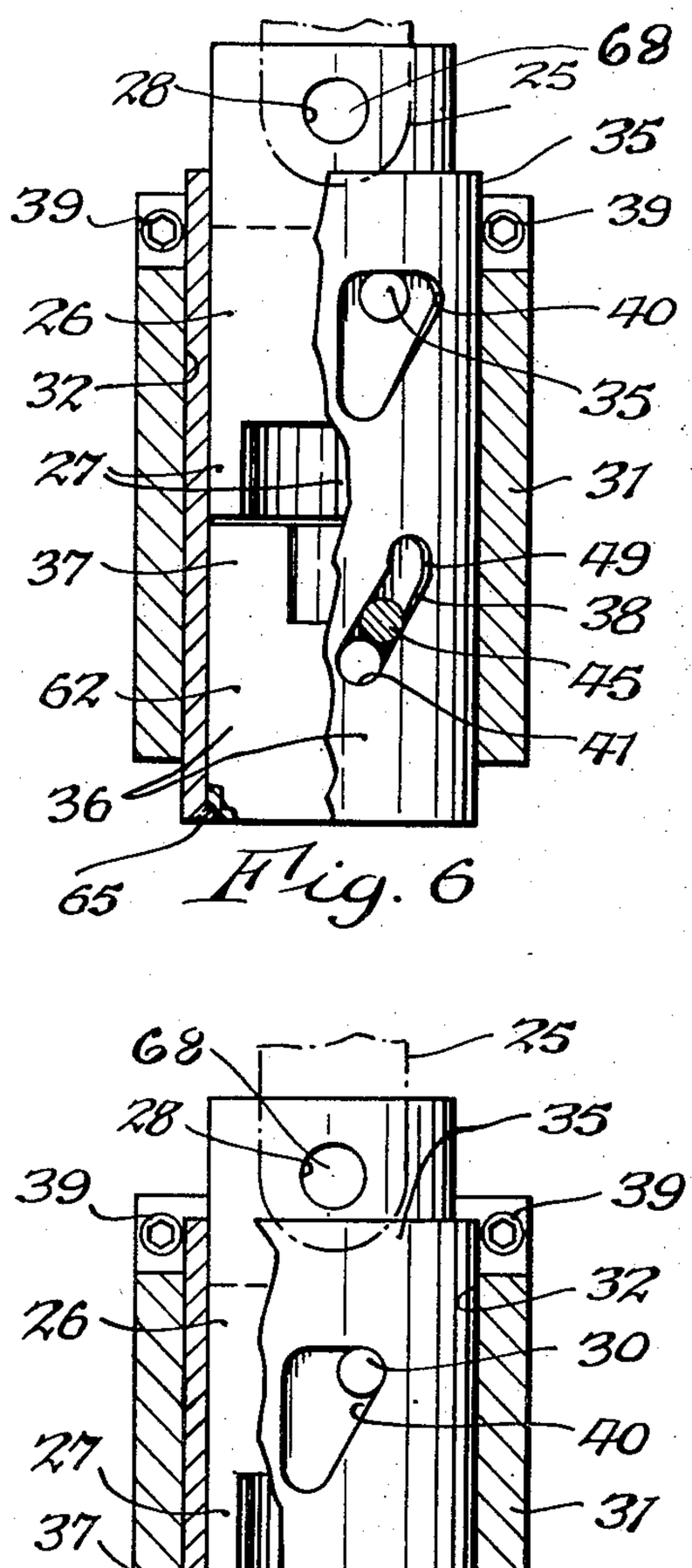

Fig. 6

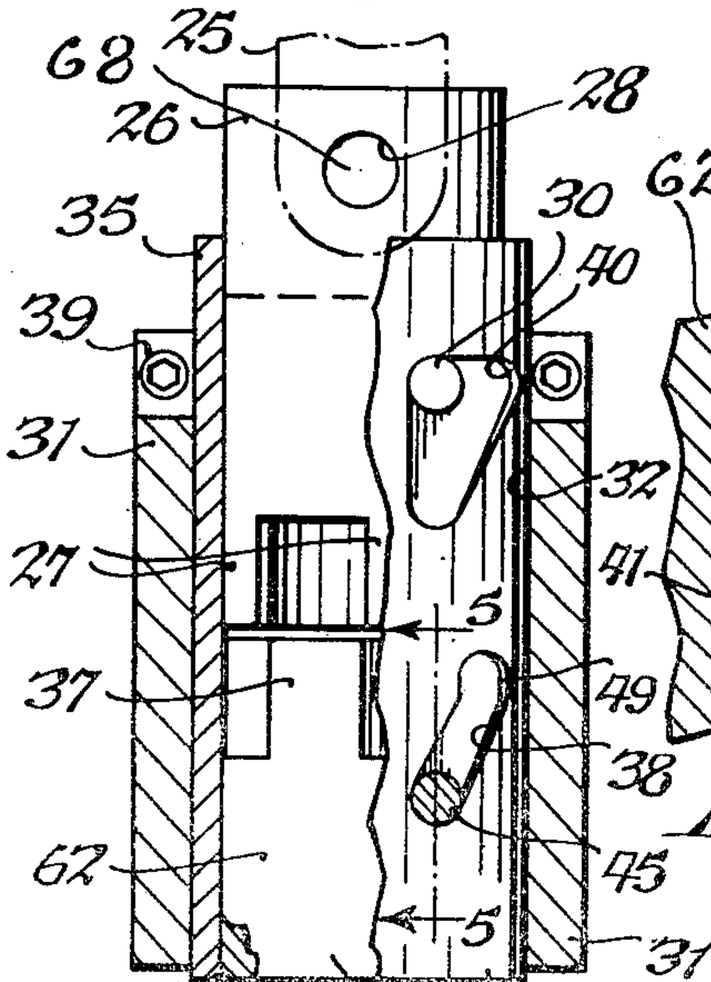

Fig. 4.

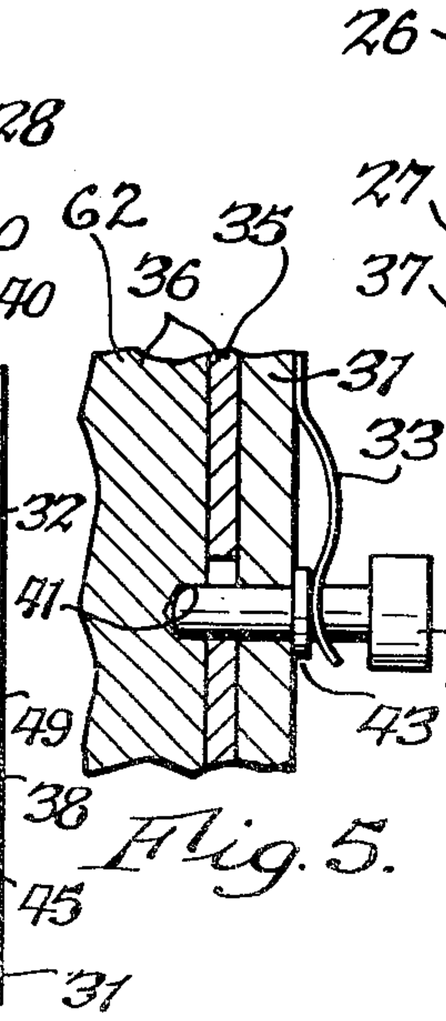

Fig. 5.

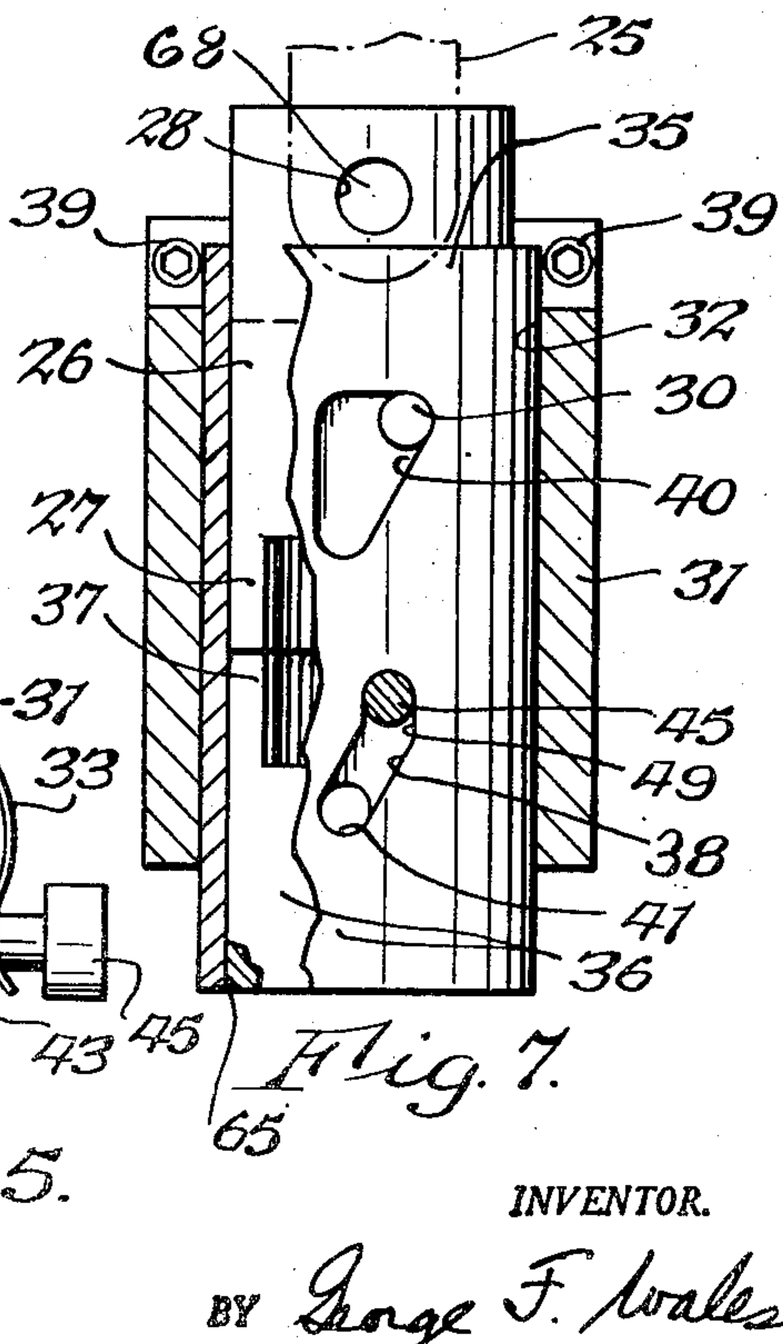

Fig. 7.

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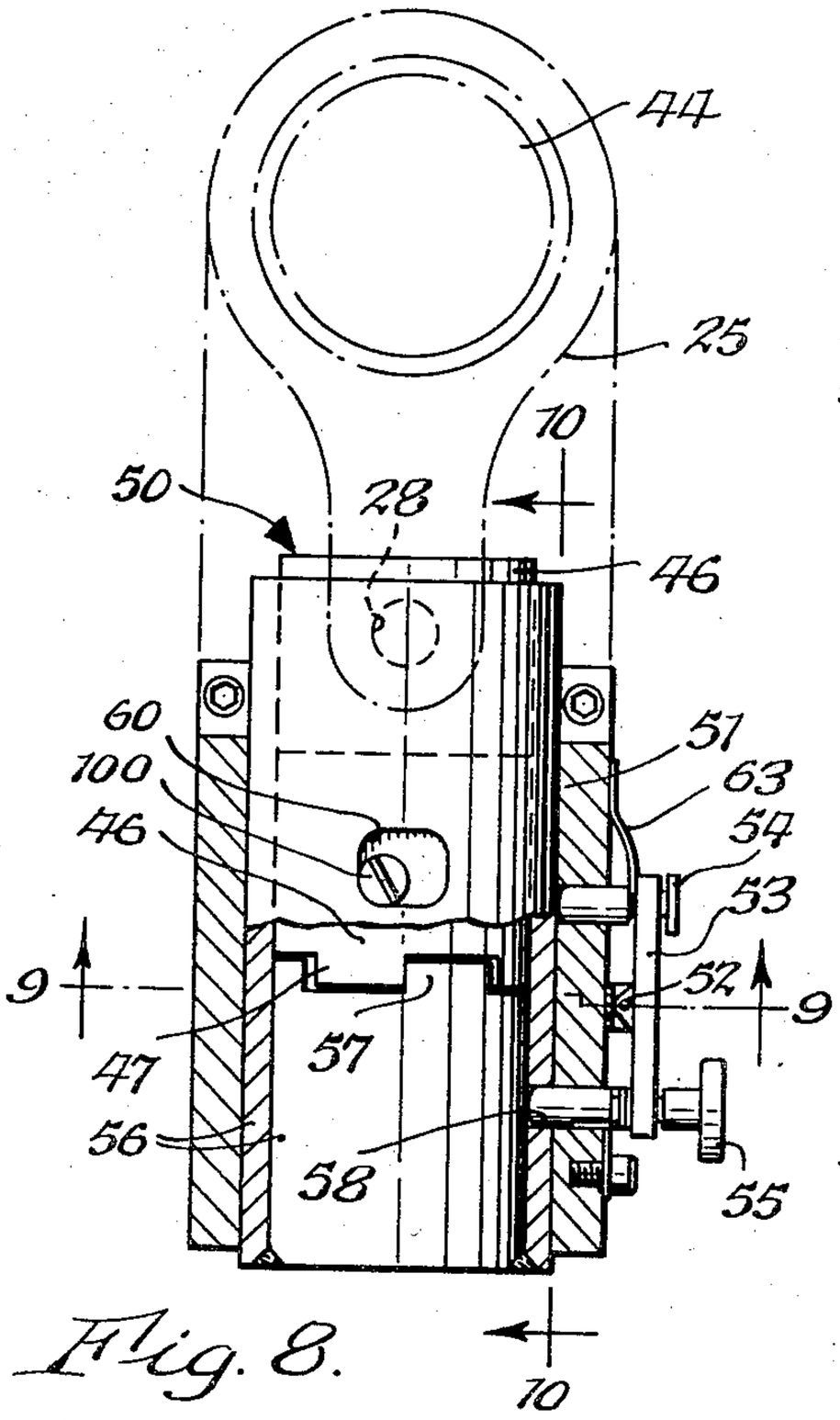
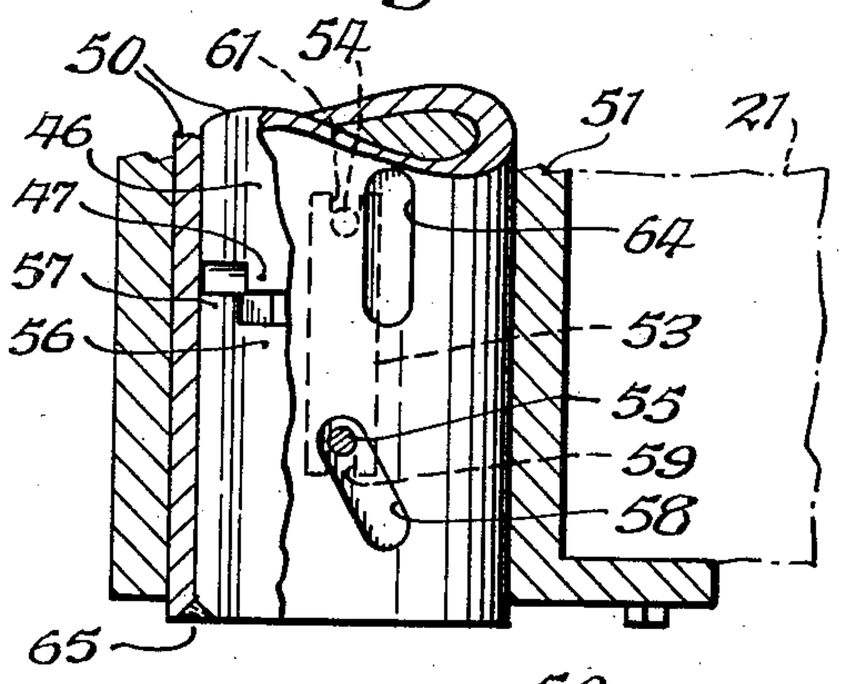


Fig. 8.

Fig. 10.



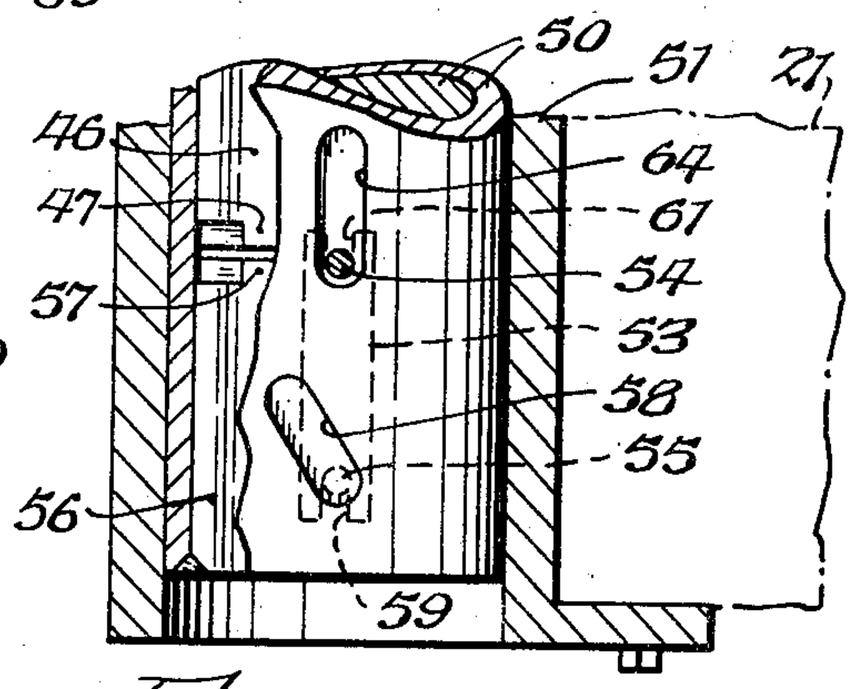


Fig. 11.

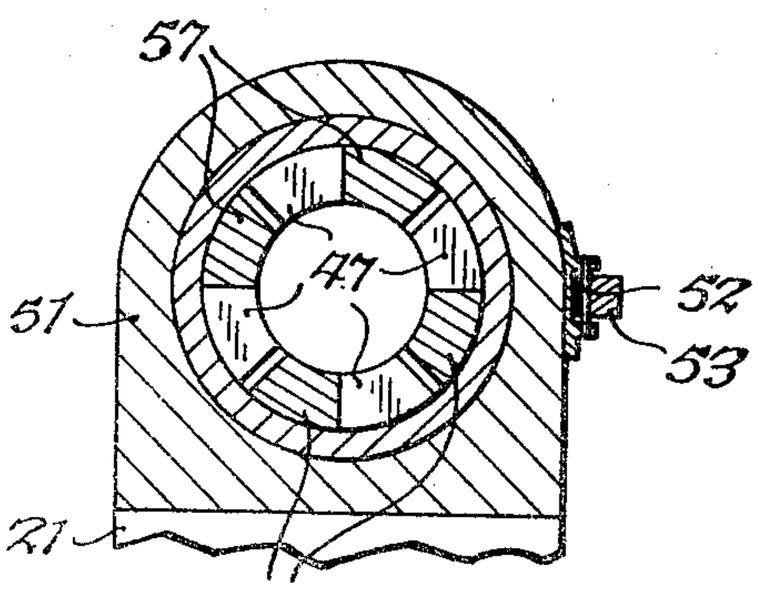
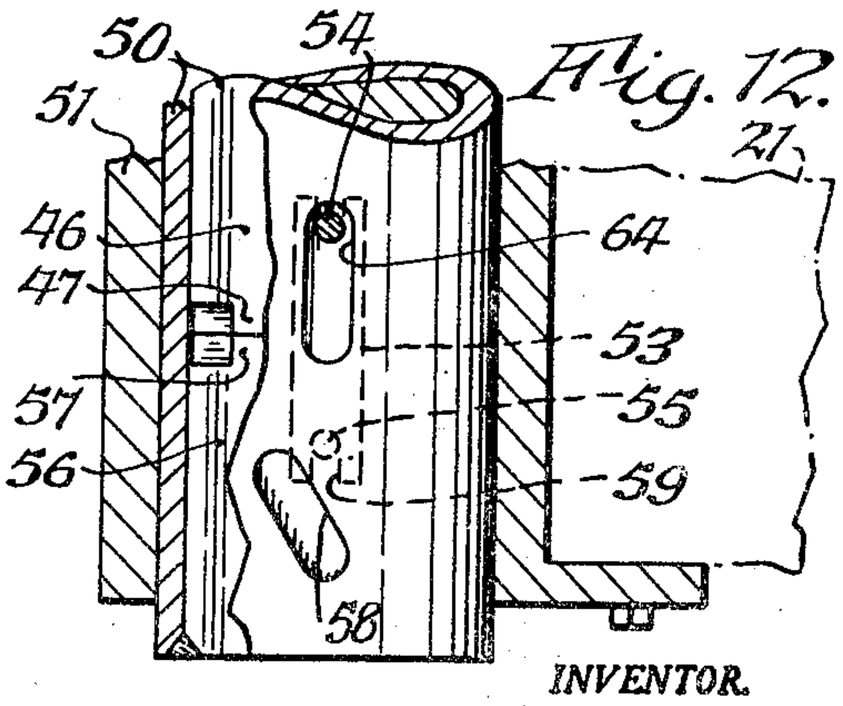


Fig. 9.

Fig. 12.



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ACTUATING APPARATUS FOR PUNCH PRESSES

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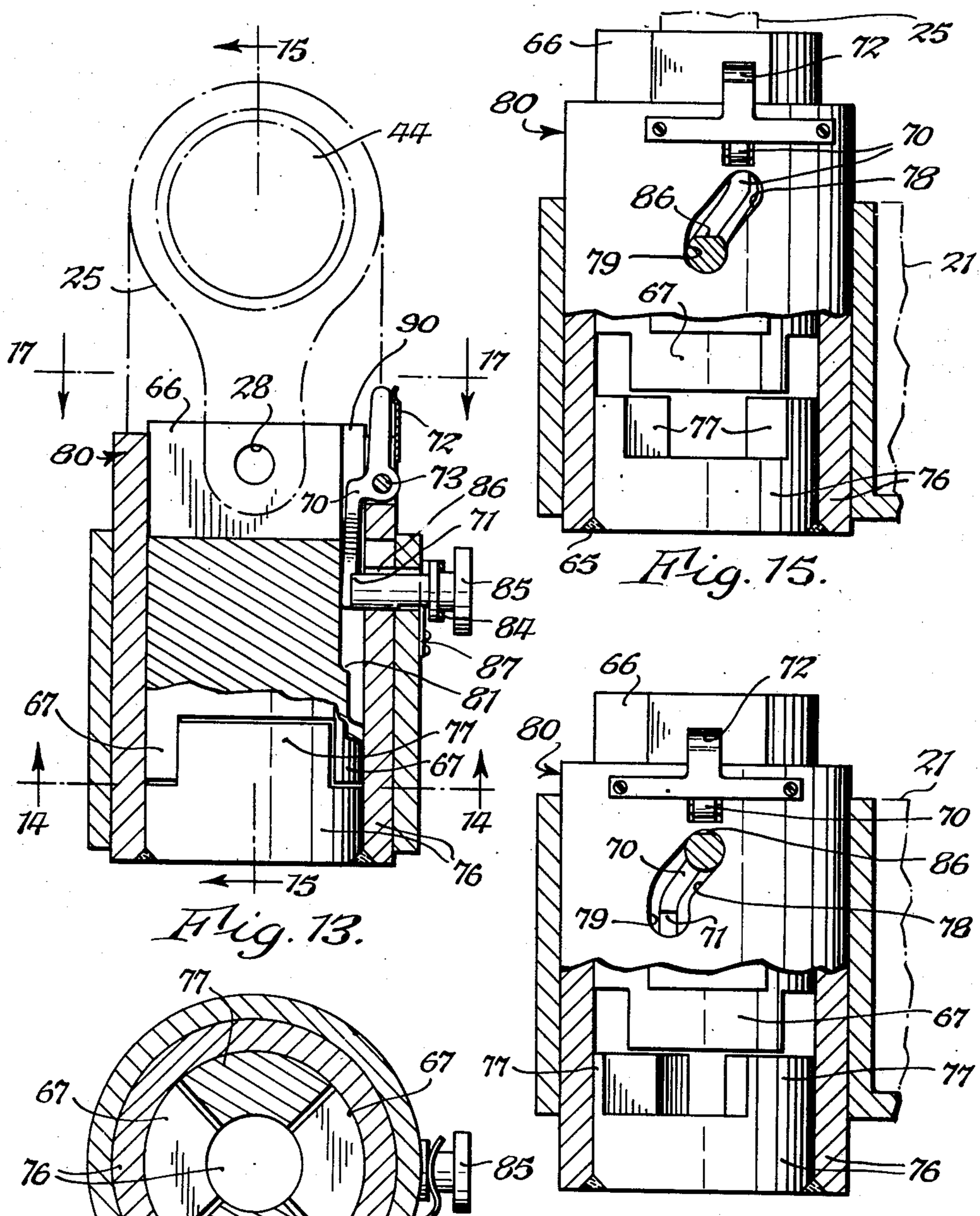

Fig. 13.

Fig. 15.

Fig. 14.

Fig. 16.

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ACTUATING APPARATUS FOR PUNCH PRESSES

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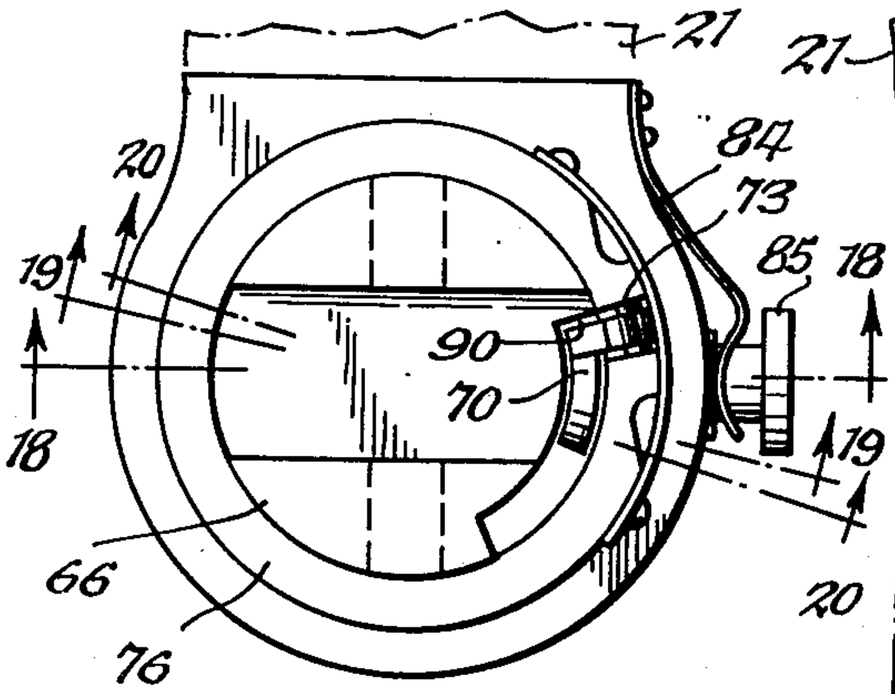

Fig. 17.

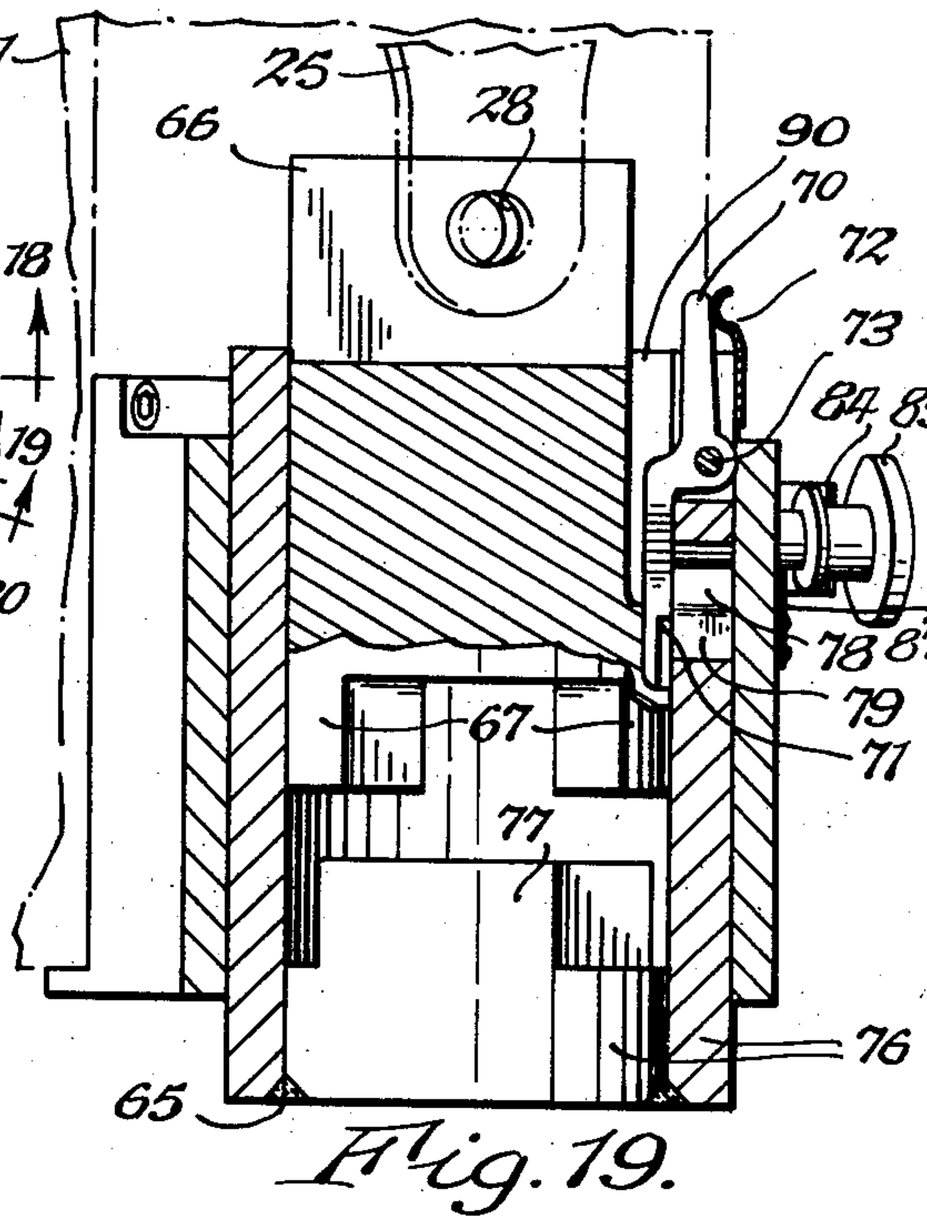

Fig. 19.

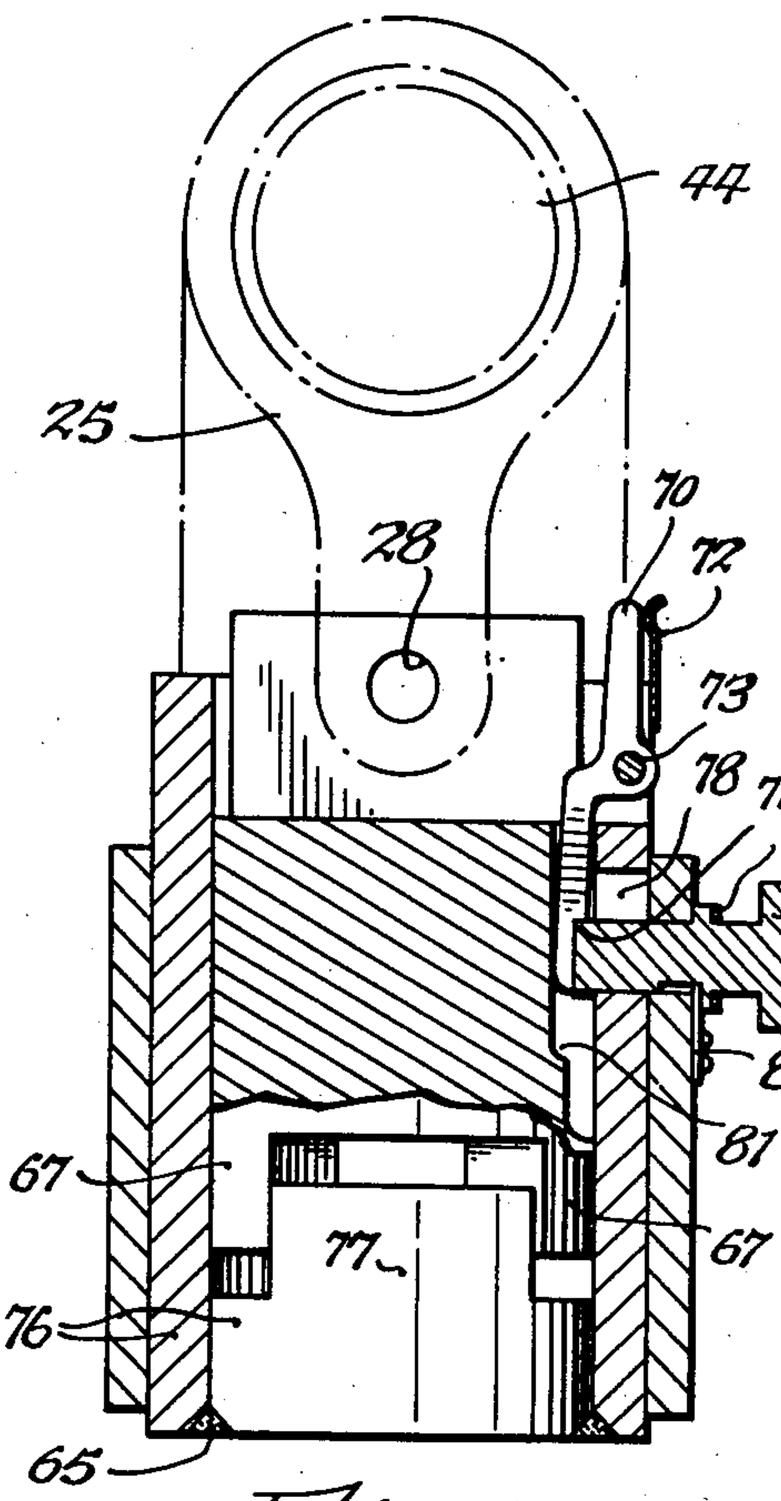

Fig. 18.

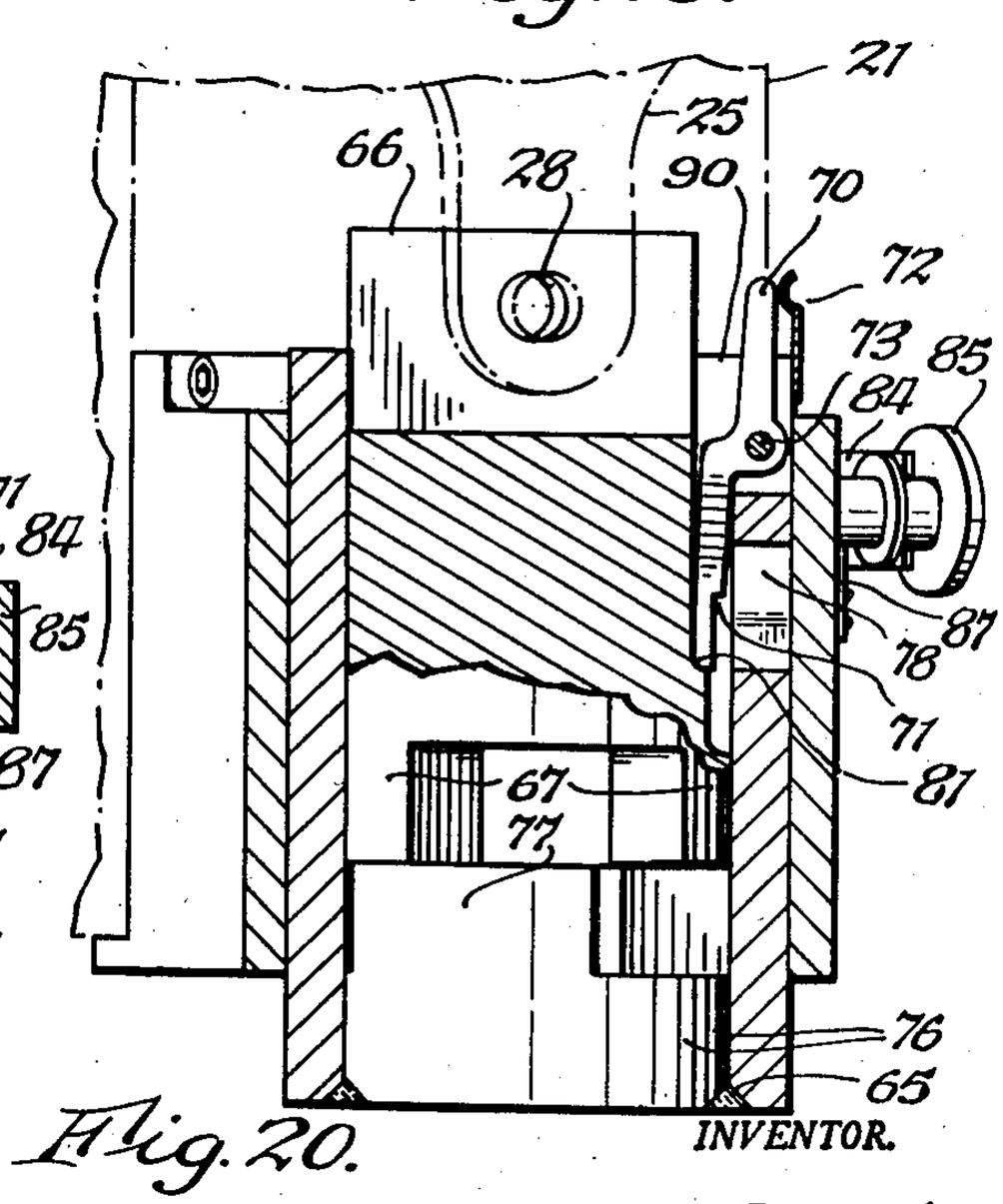

Fig. 20.

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UNITED STATES PATENT OFFICE

2,528,198

ACTUATING APPARATUS FOR PUNCH PRESSES

George F. Wales, Kenmore, N. Y.

Application June 4, 1947, Serial No. 752,433

28 Claims. (Cl. 74—110)

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This invention relates generally to apparatus for transmitting the energy from a rotating eccentric to a reciprocating member and more particularly to improvements in mechanisms for controlling the reciprocation of some moving part such as the ram of a press-working machine tool.

At present, there are two basic classes of mechanism for transmitting energy from a rotating eccentric to a reciprocal ram in general use for machine tools, such as punch presses and the like. The older class of apparatus comprises the inserted wedge or spacer type and variations thereof which basically consists of a spacer which can be inserted between a rotating eccentric and the ram of the punch press so as to drive the ram downward from the cam action of the rotating eccentric. The second class of mechanism, which is generally known as a one revolution dog clutch, comprises a toothed member carried by the flywheel, which is engaged by a mating toothed member slidable on and keyed for rotation with the crankshaft of the machine. A plurality of cam means, associated with the crankshaft, assures the sequence of engagement and disengagement of the toothed members following actuation. Although this second class of mechanism is more complex and more costly to fabricate and service than the inserted wedge type of apparatus, it has largely supplanted the first class of mechanism because of its greater safety, more rapid action and the resulting increased machine tool speed.

Inasmuch as my present invention is of the first class of apparatus it is my intention to briefly discuss herein the various configuration of the two classes of mechanism and the advantages of my invention over the previous mechanisms of its type and the dog-type clutch. It will then be apparent that my invention possesses many of the advantages of the dog-type of clutch and yet retains the simplicity and lower costs inherent in the inserted wedge type of apparatus.

Considering first the original inserted wedge or spacer type of apparatus and later variations thereof, it is apparent to those skilled in the art that the early versions of this arrangement required slow machine speed as well as considerable skill on the part of the operator in order to insert the wedge or spacer at the proper position of the eccentric. In addition, the open mechanism, necessary for observation and insertion of the wedge or spacer, compelled the operator to be extremely alert at all times to prevent accidents in its use. By present safety standards, these early devices would be judged unsafe.

In the later versions of apparatus of this type

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these disadvantages were partially overcome by incorporating resilient means to bias the wedge or spacer, from the operator force applied to said biasing means which made it possible to increase the machine speed somewhat and partially cover the mechanism with a housing. Still later improved versions of this apparatus employ a reciprocating or idling ram which moves in response to the eccentric on the crankshaft and a working ram which moves when the spacer or wedge device is inserted between the idling and working ram. It was possible in these later versions to completely enclose the mechanism by providing a wedge or spacer actuating button which extends through the housing. However, the various actuating devices described herein all embodied defects in that because of the sequence of necessary movements of the elements and the limitations on the speed of engagement of these elements, the revolutions per minute of the eccentric had to be at a comparatively slow rate. This factor, coupled with only one possible engagement per revolution, reduced the capacity of the machine to produce rapid press-working strokes for high production. These limitations on machine tool speed in turn necessitated the use of a much heavier flywheel to provide the same press-working load. This raised the space requrements of the machine tool which is contrary to present good design requirements. In addition, the slowness of operation of the machine was disturbing to the operator as he was never sure that the mechanism would trip when expected to and this sometimes resulted in spoilage of work. This condition was aggravated by excessive wear which in time made operation hazardous. In particular, the wedge or spacer was subjected to excessive wear from insufficient engagement with the respective rams. To reduce this excessive wear close fits and accurate machining were required by the inserted wedge or spacer and the mating components of the apparatus. These close fits made the parts difficult to machine, assemble and adjust which increased the costs.

Because of the above difficulties and disadvantages, with respect to the actuating mechanisms, the safer, more satisfactory dog clutch has largely supplanted it. However, as in all mechanisms, the dog clutch also has numerous disadvantages as will be discussed herein. From a cost standpoint the complex accurately machined clutch parts and friction brake are generally more expensive than the above apparatus. In addition, since the dog clutch is preferably positioned adjacent the flywheel, in many installations a series

of actuating links are required in order to transmit operator force to the actuating mechanism of the clutch. As present mass-production techniques require that components of a mechanism be installed as operative sub-assemblies, the separate installation of elements of the dog clutch, friction brake and actuating linkage, with adjustment on the machine to operative condition, entails additional manufacturing expense when compared with the earlier self-contained actuating apparatus. The additional linkage and parts, required with the dog-type clutch, also increases the frequency of adjustment as well as the time required for servicing the clutch with a resultant increase in press down time. A further disadvantage of the plurality of actuating links is entailed in the additional operator force required to overcome the friction of the plurality of links and joints. In some instances, the additional force required made it mandatory to utilize booster mechanisms where women press operators were employed. An additional disadvantage of the dog clutch is the noise created when the high speed toothed members engage.

In order to overcome the disadvantages of the inserted wedge or spacer type mechanism as previously discussed, so that its numerous advantages over the dog-type of clutch could be fully realized, I have invented the improved actuating mechanism which is illustrated, described and claimed herein. Since this mechanism is particularly advantageous when used in conjunction with an end-wheel gap-type press of the character illustrated in Fig. 13 of my Patent No. 2,364,011, I prefer to discuss its use with such a press. However, it will be apparent that it can easily be modified to other like applications with ease and I intend that all such modifications be included.

In the end-wheel gap-type construction, the present dog-type clutch and flywheel are positioned at the back of the machine and drive a long crankshaft which actuates the ram positioned at the front of the machine. This increases the mechanical difficulties as a much heavier crankshaft is required for torsional rigidity and to transmit the same energy over a long span. This, in turn, raises the shock loads encountered when the dog clutch is actuated, as the crankshaft is instantly accelerated when the dog clutch engages and the heavier crankshaft increases the clutch engagement load. The frictional force required to stop the heavier crankshaft, when the dog clutch disengages, is also greater. As a result, all the operating parts of a press of this type, particularly when employing the dog-type clutch, must be more rugged to withstand the greater loads imposed thereon.

Having discussed the foregoing disadvantages of the existing actuating mechanisms and mechanical dog-type clutches, particularly as applied to end-wheel gap-type press-working machines, the advantages of my present device will now be apparent.

The primary object of this invention is to provide a simple, economical apparatus for transmitting energy from a rotating shaft to a reciprocating member which is positive in action and rugged and durable in use.

A companion object of this invention is to provide a quiet apparatus wherein the customary clutch engagement noise is eliminated.

Still another object of this invention is to provide a simple integral apparatus which may be assembled or disassembled as a unit from the main press assembly.

Yet another object of this invention is to provide an apparatus which may be easily serviced.

Still a further object of this invention is to provide an integral apparatus adapted to be positioned adjacent the work area of a machine tool whereby the customary actuating linkage may be dispensed with.

Still a further object of this invention is to provide a self-contained sequence assuring mechanism for apparatus utilized for actuating a machine tool.

A related object of this invention is to provide an actuating mechanism which can be utilized on a high speed machine tool.

A companion object of this invention is to provide an actuating mechanism requiring less space.

Still another object of this invention is to provide an actuating mechanism of this type, in which the wedge or spacer is eliminated thereby reducing costs.

Other objects and advantages of this invention will appear from the following descriptions and claims.

Fig. 1 is a perspective phantom view of an end-wheel gap-type punch press with one version of the actuating mechanism operably mounted thereto.

Fig. 2 is an exploded view, in partial section, of one version of this novel actuating mechanism.

Fig. 3 is a front elevational view, in partial section, which illustrates the lowest intermeshed position of the serrated idling ram with respect to the serrated working ram in the idling condition of the mechanism.

Fig. 4 is a similar view but with the serrated idling ram at the top of the intermeshing idling stroke which is the position at which the working ram of this version can begin its press-working stroke.

Fig. 5 is a fragmentary sectional view, taken as noted of Fig. 4 and illustrating the actuating pin engaged with the bore at the extremity of the cam slot to retain the working ram inoperative.

Fig. 6 is a view similar to Fig. 4 but after actuation of this mechanism which illustrates the action of its components during their initial movement prior to punching and showing the turning of the lower working ram and its cylinder so that the serrated teeth of the rams are abutted rather intermeshed.

Fig. 7 illustrates the clutch components at the bottom of the punching stroke and showing the complete engagement of the extreme surfaces of the teeth on the serrated upper and lower rams.

Fig. 8 illustrates a modified version of my actuating device which assures the positioning of each tooth over the other prior to actuation and provides a shorter, stronger serrated ram structure.

Fig. 9 is a sectional view, taken as noted of Fig. 8, and illustrating the construction of the serrated sections of the rams and their clearance.

Fig. 10 is a partial sectional view, taken as noted of Fig. 8 to illustrate the punching and idling cams, the actuating and punching pins and the walking beam connected thereto which is shown in phantom, and illustrating the position of the serrated teeth when they are just out of intermeshed engagement.

Fig. 11 is a view similar to Fig. 10 with the teeth of the serrated sections directly in line for punching and the actuating pin lined up for engagement with the punching cam at the moment of clutch actuation, which is the extreme up-stroke position of the eccentric, idling ram and working ram.

Fig. 12 is a view similar to Figs. 10 and 11 which illustrates the position of the clutch components at the bottom of the punching stroke and with the actuating plunger engaged with the punching cam.

Fig. 13 is a front partial sectional elevation of another version of my novel actuating mechanism having a modified lifting device associated with the lower serrated working ram for selectively engaging the idling ram to return the working ram following a punching stroke.

Fig. 14 is a sectional view, taken as noted of Fig. 13, which illustrates the fewer teeth of the serrated section of this modified device.

Fig. 15 is a side elevational view of this device, taken as noted of Fig. 13, and illustrating the position of the teeth of the serrated rams at the top of the idling stroke.

Fig. 16 is a view similar to Fig. 15 illustrating the position of the components of this apparatus at the bottom of a punching stroke.

Fig. 17 is a sectional end elevation of this device in the idling position and taken as noted in Fig. 13 which illustrates the clearance space for the novel lifting device.

Fig. 18 is a front elevation in partial section taken as noted of Fig. 17, and similar to Fig. 13, except that the idling ram is partially displaced in its idling stroke.

Fig. 19 is a view taken as noted of Fig. 17 after actuating the apparatus, which illustrates the initial rotating movement of the lower working arm and the separation of the serrated teeth of the idling and working rams which is made possible with this modified lifting device, while the idling ram is still on its up-stroke and positioned as in Fig. 18.

Fig. 20 is a view, taken as noted of Fig. 17, which illustrates the position of the clutch components at the bottom of the punching stroke similar to Fig. 16, but with the lifting device reset to assure lifting of the working ram on the return stroke of the idling ram.

In Fig. 1 I have illustrated my apparatus **20** as it would appear when operably mounted to an end-wheel gap-type press **21** of the same general character as is illustrated in Fig. 13 of my Patent No. 2,364,011. Actuating apparatus **20** has replaced the conventional clutch **131** and eliminated the non-repeat and clutch actuating linkage **132**, illustrated in that patent, as, actuating button **45** of my present device is readily operated since it is in juxtaposition to the working area **22.8** A further comparison of the installation of clutch assembly **131** to press **121** of my former patent will reveal that whereas actuating apparatus **20** is a complete sub-assembly mounted to the press **21** and eccentric **44** of shaft **24**, after flywheel **23** and shaft **24** have been previously assembled to the press **21**, clutch **131** must be assembled to the press **121** prior to flywheel **130** and linkage **132** must then be adjusted on the press **121**. It will also be obvious, to one skilled in the art, that in my present invention shaft **24** is continuously revolving and pitman arm **25** is continuously reciprocating with upper ram **26** so that only the inertia of working ram **36** must be overcome when the mechanism is actuated, whereas in my former patent the inertia of the long crankshaft, pitman arm and clutch mechanism must also be overcome by clutch **131**.

In accordance with this invention, I employ the customary eccentric crankpin **44** at the end of the crankshaft **24** which drives a pitman arm **25** connecting the crankshaft **24** to my apparatus for actuating the press ram. The pitman arm **25** is pivotally joined to a serrated upper ram, within my novel device, which slidably reciprocates in a cylindrical ram having an upstanding object engaging or serrated portion with which the object engaging or serrated portion of the upper ram intermeshes in the idling condition. To actuate the press ram, the lower ram is released allowing it to drop and to rotate in accordance with a cam path in its cylindrical surface until the serrated portions of the upper and lower portions are abutting the ends of each mating serration. This causes the lower or working ram to be displaced downward a distance equal to the height of its serrated portion. A connection between the upper idling ram and lower working ram limits movement of the lower working ram with respect to the upper idling ram so that on the return stroke of the upper idling ram the lower working ram is reset in the inoperative position. The essential differences in the three versions of my device illustrated herein merely resides in the methods of resetting the lower ram and the sequence of rotating the lower working ram into engagement with the upper idling ram from their intermeshed positions.

In Figs. 1 through 7, one embodiment of my invention illustrated. Actuating apparatus **20** is a completely self-contained unit within the separable housing **31** which with pitman arm **25** can be removed or assembled to the press frame **21** as an operable unit assembly. This is accomplished by sliding pitman arm **25** on to the eccentric **44** of shaft **24** and attaching the four hold-down bolts **39**. Actuating apparatus **20** is then operable by actuating button **45** without other attachments or operations. It will now be obvious, to those skilled in the art, that assembly **20** is more compact and easily installed when compared with other apparatus or clutches for this purpose. This arrangement provides a suitable sub-assembly for the mass-production techniques as well as a rapid means of servicing the apparatus by substituting bench tear-down and inspection for the more costly servicing and inspection while on the machine.

For the construction of the first embodiment of my invention, reference is first made to Fig. 2 which illustrates the position of the components of this apparatus in exploded relationship. Pitman arm **25** is pivotally joined to idling ram **26** through their respective bores **48** and **28** and a pin **68** which has been omitted from this view for clarity. A working ram **36** is provided which is assembled by inserting a serrated **37** cylindrical portion **62** in sleeve **35** and welding **65**, to provide the illustrated integral assembly as is detailed in subsequent Figs. 3 through 7. Idling ram **26** is slidable within this upstanding cylindrical sleeve **35** of working ram **36**. Idling ram **26** has a serrated lower portion comprising a plurality of teeth **27** which co-act with the mating serrated portion comprising a like plurality of teeth **37** on working ram **36**. In the idling condition of my apparatus, teeth **27** of idling ram **26** are intermeshing with teeth **37** of the work-

ing ram 36 which is maintained stationary. In the punching condition the extremities of teeth 37 on working ram 36 are caused to abut the extremities of the teeth 27 on idling ram 26 as will be described later in this specification.

Means for resetting the position of working ram 36 with respect to the idling ram 26 is provided by the pin 30 retained in the bore 29 of idling ram 26 which engages the triangular cut-out 40 in the cylindrical portion 35 of working ram 36. The above assembly of idling ram 26 and working ram 36 is in turn, slidable within the bore 32 of the housing 31. In this position the actuating pin 45 in housing 31, engages the cam slot 38 or the bore 41 of the working ram 36 in the sequence and for the purposes described later in this specification. Resilient means 33 is attached to housing 31 by means of screws 34 and bears against the shoulder 43 of actuating pin 45 to bias it towards engagement with bore 41.

In Figs. 3 and 4 the extreme idling position of the components of this apparatus are illustrated. In this condition the lower working ram 36 remains stationary since the pin 45 in housing 31 is engaging the bore 41 of working ram 36, as detailed in Fig. 5 to retain it inoperative, and the serrated teeth 27 of idling ram 26 are intermeshing with teeth 37 of working ram 36. To actuate the apparatus the pin 45 is pulled, slidably withdrawing it from bore 41. In this position pin 45 is still within cam slot 38 of working ram 36. This action releases working ram 36 to permit it to drop and rotate in accordance with the engagement of pin 45 of housing 21 with the cam path 38. However, this action cannot take place while the teeth 27 of idling ram 26 are still intermeshing with teeth 37 of working ram 36 so rotation is prevented until teeth 27 clear teeth 37 on the extreme up-stroke, as shown in Fig. 4. At this position, working ram 36 moves downward slightly ahead of ram 26 and rotates so that its teeth 37 abut the extremities of teeth 27. Further downward motion of idling ram 26 drives working ram 36 ahead of 26 and rotates working ram 36 for greater interference of the extremities of the mating teeth 27 and 37 prior to the punching stroke as shown in Fig. 6. It will be observed that the cam path 38 in working ram 36 has a straight portion 49 of a length equal to the desired punching stroke. Because of straight portion 49 of cam 38, rotation of working ram 36 with respect to idling ram 26 is arrested before the punching stroke so that the respective components move straight downward to the bottom of the punching stroke, as illustrated in Fig. 7. On the return stroke of idling ram 26 the reset pin 30, carried by idling ram 26, engages the upper edge of triangular cut-out 40 in sleeve 35 and lifts working ram 36 while it is being simultaneously rotated in accordance with the engagement of its cam path 38 with pin 45 until it reaches its former idling position of Fig. 4. At this point, actuating pin 45 again engages bore 41, because of the biasing force of resilient means 33, and the working ram 36 is maintained inoperative while idling ram 26 reciprocates between the position of Figs. 3 and 4.

In Figs. 8 through 12, I illustrate a modified version 50 of my basic apparatus 20 in which the working ram oscillates on the idling stroke. The vertical component of this oscillating movement is made equal to the vertical component of the apparatus previously described for that portion of the stroke of my previous apparatus governed

by cam path 38 or when the working ram is rotating. The idling and punching strokes remain the same in both devices. As in my other embodiment of this invention, during the idling stroke the serrated teeth are caused to intermesh and in the punching stroke they are caused to interfere. However, the shorter, stronger serrated teeth of this version provide clearance which I utilize to affect the rotation of the working ram on the up-stroke of the idling ram. Thus, on each idling stroke the working ram is caused to oscillate until its serrated teeth are directly under the serrated teeth of the working ram at the top of the stroke and back to intermeshed position near the bottom of the idling stroke. By providing simple, selective key means for assuring actuation only at the top of the idling stroke, I obtain complete engagement of the teeth at all times during the punching stroke. I thereby eliminate the wearing of the edge of the teeth of my previously described device, during initial contact of its mating teeth on the punching stroke, by providing for complete engagement on the entire punching down-stroke. In this second version of my apparatus if the device is not actuated, the serrated teeth of the idling ram abut the serrated teeth of the working ram and move the working ram down to where the serrated teeth will again intermesh. Thus contact of small areas of the serrated teeth are limited to disengagement in this version rather than engagement as in the previously discussed device.

Referring first to Figs. 8, 9, and 10, it will be apparent that the idling ram 46 has the lower serrated toothed portion 47 and the working ram 56 has the serrated toothed portion 57 similar to the previous apparatus 20, but that the teeth 47 and 57 are shorter. As illustrated in these views, housing 51 mounts to press 21 in the same manner as housing 31. Pitman arm 25 is pivotally connected to idling ram 46 and working ram 56 is connected loosely to idling ram 46 through the reset pin 100 and the square opening 60 of working ram 56. Actuating button 55 engages an idling cam slot 58 in working ram 56 and a slot 59 in the walking beam 53 which is pivotal 52 on housing 51. A punching pin 54 in housing 51 is engaged by a slot 61 in walking beam 53 so that it will be actuated therewith.

In Fig. 10, the moving components of this apparatus are illustrated partially on the up movement of the idling stroke with the teeth 57 of working ram 56 just clearing teeth 47 of idling ram 46. In this position working ram 56 begins to rotate since reset pin 100 of idling ram 46 is engaging the upper edge of cut-out 60 of working ram 56 so that working ram 56 is raised while being maintained in juxtaposition to the moving idling ram 46. This action causes actuating pin 55, which is engaging cam slot 58, to rotate working ram 56 to the position of Fig. 11 at which point the serrated teeth 57 of ram 56 are directly under serrated teeth 47 of idling ram 46. Only at this position can the pin 55 be withdrawn from cam slot 58 since pin 54 cannot enter slot 64 until then and walking beam 53 prevents movement of pin 55 without opposing movement of pin 54. When this position is reached, pin 54 enters vertical slot 64 of working ram 56 which then moves straight down ahead of idling ram 46 through the punching stroke illustrated in Fig. 12 and returns to the position of Fig. 11 at which time resilient means 63 biases actuating pin 55 into engagement with cam slot 58 simultaneously withdrawing pin 54 from slot 64. The working

ram 56 again returns to its combination idling oscillating movement and dwell characterized by the oscillation of movement between the positions shown in Figs. 10 and 11 and a period of dwell between the positions of Figs. 8 and 10 when the teeth of idling ram 46 are meshing with the stationary teeth 57 of working ram 56. It will be apparent, from the above description, that this version provides for complete engagement of the mating teeth of the serrated components of the idling ram 46 and working ram 56 during the entire punching stroke thus eliminating possible wearing of the teeth of the first version of my device due to the initial engagement of only the edge of the teeth prior to extensive rotation of the working ram.

In Figs. 13 through 20, a preferred version of my novel apparatus 80 is illustrated which embodies the simplicity of my first version 20 with the assurance of trouble-free operation of the second version 50. In this version the fixed combination of the reset pin 30 and the cut-out 40, of the first apparatus 20, has been replaced by a selective reset apparatus which permits the working ram to drop and rotate considerably prior to the down-stroke of the idling ram. Thus, when the idling ram begins its down stroke the working ram is already positioned so that the mating serrated teeth of the rams are substantially in interference for the punching stroke. This provides adequate contact of each mating tooth at the beginning of the punching stroke.

Selective engagement of the reset mechanism is accomplished by utilizing a lever pivoted on the working ram which is resiliently biased into engagement with the actuating pin and out of engagement with the reset slot in the idling ram. The resilient biasing force applied to the reset lever is less than the resilient biasing force of the actuating pin so that the actuating pin biases the reset lever into engagement with the reset slot in the idling ram except when the operator withdraws the actuating pin. When this occurs, the reset lever permits the working ram on which it is pivotal to drop without regard to the position of the idling ram. However, the working ram cannot drop beyond the position permitted by its cam slot configuration until the idling ram has reached the position wherein the intermeshing teeth of the respective serrated portions are clear, permitting the working ram to then drop and rotate in accordance with the action of the cam path on the actuating pin.

In Fig. 13 I illustrate this embodiment of my invention in which idling ram 66 has the serrated teeth 67 which co-act with the serrated teeth 77 of working ram 76. In this version I employ fewer teeth to illustrate one possible arrangement but it will be obvious, to those skilled in the art, that any number could be so employed without changing the functions of this apparatus. Reset lever 70 has a dog-leg configuration and is pivotal 73 on the working ram 76. It is biased towards engagement with actuating pin 85 by the resilient means 72 carried on working ram 76. A recess 71 is notched out of the reset lever arm 70 which is adapted to engage a flat 86 on actuating pin 85 for retaining working ram 76 in the stationary idling position. Idling ram 66 has a recess 90 formed therein which has a reset shoulder portion 81 for engaging reset lever 70 to return working ram 76 to its idling position as will be described later. A resilient means 84 biases actuating pin 85 into engagement with reset lever 70

and a stop 87 limits movement of actuating pin 85 therewith.

To illustrate the respective actions and functions of the components of this apparatus, reference is first made to Figs. 13 and 15 in which the extreme positions of the idling stroke of idling ram 66 are shown while working ram 76 remains stationary. In this version actuating pin 85 can be withdrawn at any time in the above stroke. However, the working ram 76 cannot drop until the idling ram 66 reaches the position in its upstroke illustrated in Fig. 18. At this point working ram 76 can drop because of the straight portion 79 of its cam slot 78 which permits this amount of down travel of working ram 76 prior to rotation. Since serrated teeth 77 of working ram 76 will clear serrated teeth 67 of idling ram 66 at this point, working ram 76 can continue to drop and rotate in accordance with the action of its cam slot 78 on actuating pin 85 until reset lever 70 strikes the bottom of reset recess 90 in idling ram 66. On the down-stroke of idling ram 66, serrated teeth 67 of idling ram 66 abut serrated teeth 77 of working ram 76 and the working ram 76 is driven down to the position of Figs. 16 and 20. In this position reset lever 70 again engages shoulder 81 of reset recess 90, as shown in Fig. 20, because of the biasing force of spring 84 which overcomes the bias of spring 72, bearing on reset lever 70. This action of reset lever 70 causes the idling ram 66 on its return stroke to reposition working ram 76 so that the flat 86 of actuating key 85 again engages notch 71 of reset lever 70 to retain working ram 76 inoperative.

It will now be obvious, to those skilled in the art, that I have described a novel, simple apparatus for selectively actuating a reciprocating member which overcomes the disadvantages of the previous devices of this class and requires less parts as well as less accurate machining on the parts utilized. In addition, my apparatus provides greater safety by assuring the sequence of the functions of the elements without requiring judgment or care on the part of the operator.

Although I have illustrated three modifications of my device, it will be obvious that various interrelated components of my device could be interchanged or modified and the apparatus would be equally operable. For instance, the cam paths in the working ram could be positioned in the housing for the apparatus and engaged by a fixed pin on the working ram and the apparatus would be equally operable. These and other equivalent modifications are possible within the scope and spirit of the specifications and claims relating to my invention. I intend that these and all such modifications be included in the following claims.

I claim:

1. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate and means operably associated with said housing and one of said object engaging members for displacing said member, said means including a plurality of cam surfaces on one and means for engaging the cam surfaces on the other whereby said object engaging members abut one another to produce the desired reciprocal movement of the driven member from the reciprocation of the driving member.

2. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, means operably associated with said housing and one of said object engaging members for displacing said member upon slidable movement with respect to said housing said means comprising a cam slot on one and means for engaging said cam slot operatively associated with the other, and coupling means, joining said object engaging members, for assuring the degree of movement of the displaceable member with respect to the movement of the reciprocal member.

3. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, dual cam means formed in one of said members, engaging means slidable in said housing for engaging said cam means whereby said member will be displaced out of intermeshed relation with said other member upon slidable movement with respect to said housing and coupling means joining said object engaging members for assuring the degree of movement of said displaceable member with respect to the movement of the reciprocal member.

4. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, coupling means joining said object engaging members for limiting movement of one with respect to the other, cam means formed in one of said members, an object engaging bore formed at one end of said cam means and pin means in said housing which is adapted to engage said bore or said cam means to assure inoperativeness or the sequence of reciprocal movement of one of said members from the other upon actuation of said pin means.

5. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, an enlarged opening in one of said members, a fixed pin in said other member which extends into said opening, cam means formed in one of said members and pin means slidable in said housing for engaging said cam means whereby said member may be displaced from intermeshed relation with said other member.

6. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, stop means extending from one member, a clearance opening for said stop means in said other member, cam means formed in one of said members, a bore formed at one end of said cam means and pin means slidable in said housing for engaging said bore or said cam means whereby said member may be displaced from intermeshed relation with said other member upon disengaging said pin from said bore.

7. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a cam slot in the other object engaging member, a pin slidable in said housing for engaging said cam and means for coupling said object engaging members after displacement of the one for reciprocation by the other.

8. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a plurality of cam means and a bore formed on said other object engaging member and pin means in said housing for engaging said cam means or said bore whereby said member may be displaced upon actuation of said pin means for reciprocation by the other.

9. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, selective displacement means between one of said object engaging members and said housing which includes pin means on one adapted to engage cam means and a bore on the other, means for releasing said pin from said bore to effect displacement of said object engaging member and coupling means, interposed between said object engaging members, for resetting the displaceable member for engagement of the bore by the pin from the reciprocation of the other.

10. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, means for displacing the other object engaging member for abutting reciprocation by the other which includes a cam slot in said member, object engaging means formed in juxtaposition to said cam slot, means operatively associated with said housing for selectively engaging said object engaging means or said cam slot and coupling means between said object engaging members for resetting said displaceable member following reciprocation by the other.

11. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member, slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, means for displacing the other object engaging member for abutting reciprocation by the other which includes a cam slot in said member, object engaging means formed in juxtaposition to said cam slot, means operatively associated with said housing for selectively engaging said object engaging means or said cam slot, means for resiliently biasing said

means into engagement with said object engaging member and coupling means between said object engaging members for resetting said displaceable member following reciprocation by the other.

12. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a loose coupling attachment between said first and second object engaging members, a cam slot formed in one of said members, a bore formed in said member at one extremity of said cam slot, a pin slidable in said housing for engaging said bore and said cam slot and means for biasing said pin into engagement with said bore.

13. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, an enlarged opening in one of said members, a fixed pin in said other member which extends into said opening, a cam slot formed in one of said members, a bore formed in said member in operative relation to said cam slot, a pin slidable in said housing for engaging said bore and means for biasing said pin into engagement with said bore.

14. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a plurality of cam slots formed in one of said members, object engaging means slidable in said housing and adapted to selectively engage said cam slots and loose coupling means for assuring a proportionate movement of the other.

15. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a plurality of cam slots formed in one of said members, a plurality of object engaging pins slidable in said housing and adapted to selectively engage said cam slots and means coupling said members whereby one member has an amplitude of reciprocation in direct proportion to the other.

16. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, a plurality of cam slots formed in one of said members, a plurality of pins slidable in said housing and adapted to engage said cam slots, means connecting said pins whereby when one pin is withdrawn from one cam slot the other pin simultaneously enters the other and means coupling said members for proportional reciprocation of one from the reciprocation of the other.

17. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said

housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, cam means formed in one of said members, a second cam means pivoted on said member for operative association with said first cam means and said other member and pin means slidable in said housing and adapted to engage one of said cam means for assuring the rotation of one member for abutting reciprocation by the other or engaging both said cam means for assuring the resetting of one member inoperative from the reciprocation of the other.

18. Means for transmitting energy in a reciprocal direction comprising a stationary housing, an object engaging member slidable in said housing, a second object engaging member adapted to slidably intermesh with said first object engaging member, means for causing one of said members to reciprocate, cam means formed in one of said members, a second cam means pivoted on said member for operative association with said first cam means and said other member, pin means slidable in said housing and adapted to engage one of said cam means for assuring the rotation of one member for abutting reciprocation by the other or engaging both said cam means for assuring the resetting of one member inoperative from the reciprocation of the other and means on said housing for biasing said pin into said attitude.

19. Means for transmitting energy in a reciprocal direction comprising a housing, a plurality of slidable members positioned in said housing, a plurality of object engaging serrated portions on each slidable member in juxtaposed relation to each other, means for reciprocating one of said members, coupling means joining said slidable members for limiting movement of one with respect to the other, cam means in one of said members, object engaging means in juxtaposition thereto and actuating means slidable in said housing and adapted to selectively engage said object engaging means or said cam means in said member, to assure inoperativeness or reciprocation of said member.

20. Means for transmitting energy in a reciprocal direction comprising a housing, a plurality of slidable members positioned in said housing, a plurality of object engaging serrated portions on each slidable member in juxtaposed relation to each other, means for reciprocating one of said members, an enlarged opening on one of said members, object engaging means positioned on said other member for engagement with said enlarged opening for limiting movement of one member with respect to the other, a plurality of associated object engaging means formed in one of said members, pin means slidable in said housing and adapted to selectively engage said object engaging means in said member for maintaining said member inoperative or displacing it whereby it can be reciprocated through a punching stroke from the reciprocation of said reciprocal member.

21. Means for transmitting energy in a reciprocal direction comprising a housing, a plurality of slidable members positioned in said housing, a plurality of object engaging serrated portions on each slidable member in juxtaposed relation to each other, means for reciprocating one of said members and means for controlling the movement of said other member with respect to the housing which means includes a slidable

pin formed in one of said elements, a bore and cam path formed in the other, for engagement by said pin, whereby the member is maintained inoperative or operative upon slidable movement of said pin.

22. Means for transmitting energy in a reciprocal direction comprising a housing, a plurality of slidable members positioned in said housing, a plurality of object engaging serrated portions on each slidable member in juxtaposed relation to each other, means for reciprocating one of said members, means for coupling one member for limited movement with respect to the other and means for controlling the movement of said member with respect to the housing which means includes a slidable pin positioned in one of said elements, and object engaging means formed in the other whereby said member can be retained inoperative or displaced for movement with said reciprocal member upon movement of said pin.

23. An apparatus for transmitting, at will, the power thrust of a driven piston to a ram, including a stationary cylinder, a ram dwelling in the cylinder, means for retaining the ram in a retracted stationary position in said cylinder, a piston for reciprocation in the bore of the ram while said ram is in said stationary position, means for releasing said ram from its retracted position at will, and means for engaging said piston mechanically with said ram to temporarily interlock said piston and said ram whereby the power thrust of the piston is transmitted to the ram.

24. An apparatus according to claim 23 and including means for returning the ram to its retracted stationary position, means for disengaging the interlocking means between the piston and ram, and means for engaging said ram-retaining means to hold said ram in said retracted position.

25. An apparatus according to claim 24 where said means for engaging the piston mechanically with the ram comprises projections and recesses on the end face of the piston which fit projections and recesses formed inside the bore of the ram, said projections and recesses intermeshing with each other when the piston reciprocates while the ram is stationary and said projections being made to abut to provide said temporary interlock between piston and ram to move said ram whereby the power thrust of the piston is transmitted to the ram.

26. An apparatus according to claim 25 in which the projections on the piston and within the ram are made to abut by causing the ram to turn sufficiently around the piston while in reciprocating motion and means associated with said ram and said cylinder to cause said turning.

27. An apparatus according to claim 25 in which the projections on the piston and within the ram are made to abut or intermesh by causing the ram to oscillate sufficiently around the piston while in reciprocating motion and means associated with said ram and said cylinder to cause said oscillation.

28. An apparatus for transmitting the power thrust of a driven piston to a sleeve including a piston within a sleeve, the sleeve within a cylinder and means for functionally engaging said sleeve with said piston including members on said piston which intermesh with companion members within said sleeve and which upon being prevented from intermeshing, cause said engagement.

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