

Sept. 13, 1949.

R. M. CONKLIN
VARIABLE DELIVERY GEAR PUMP

2,481,646

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3 Sheets-Sheet 1

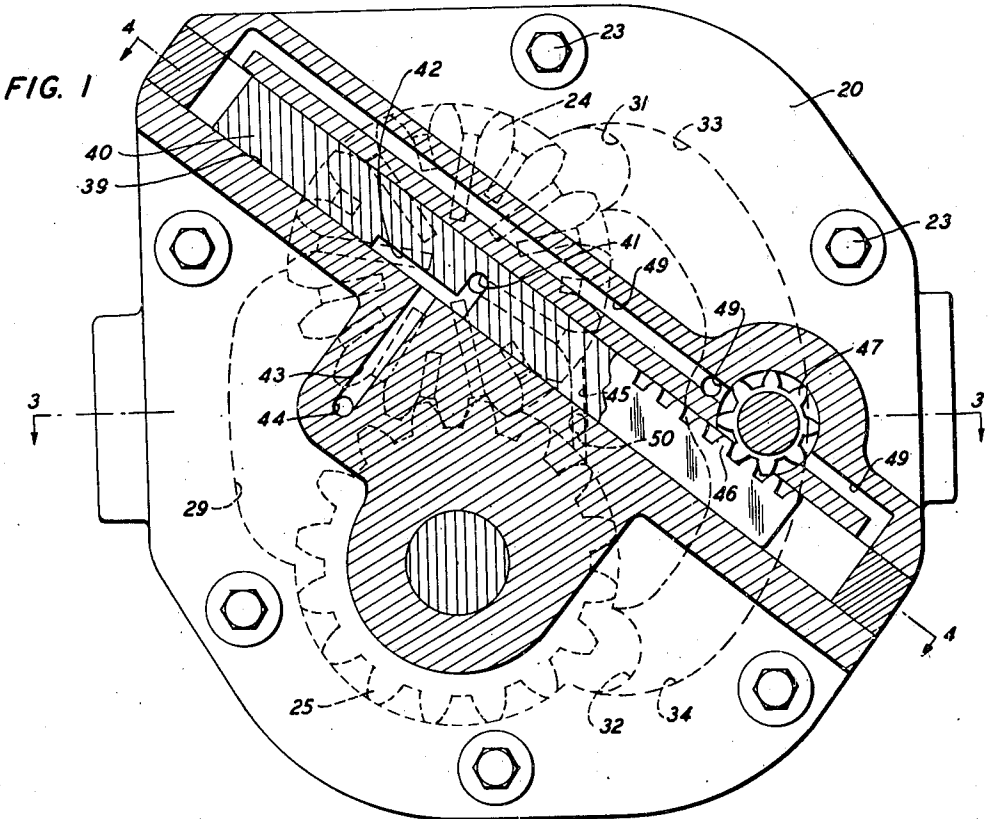
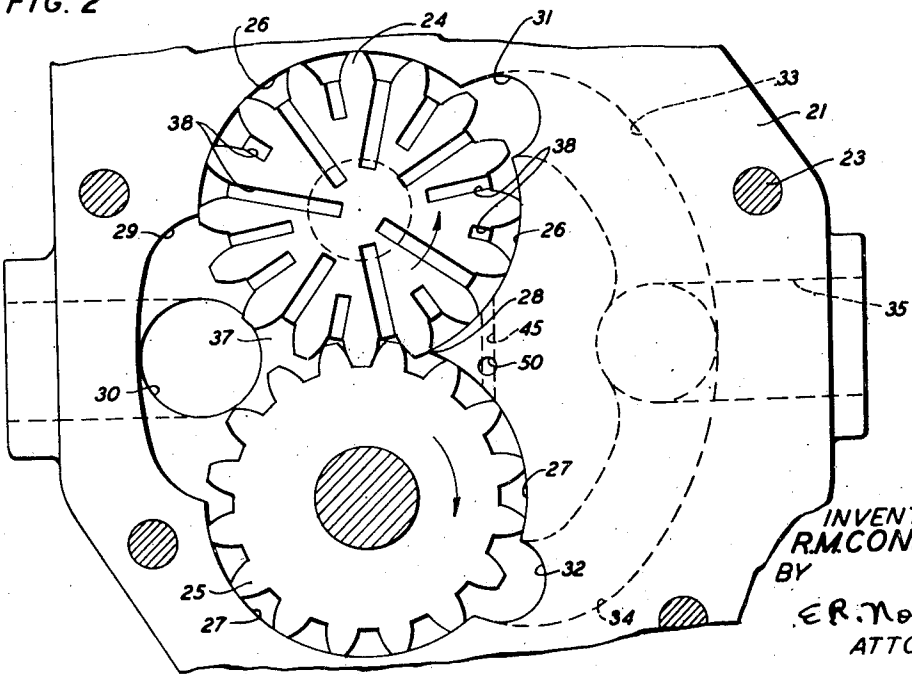


FIG. 2



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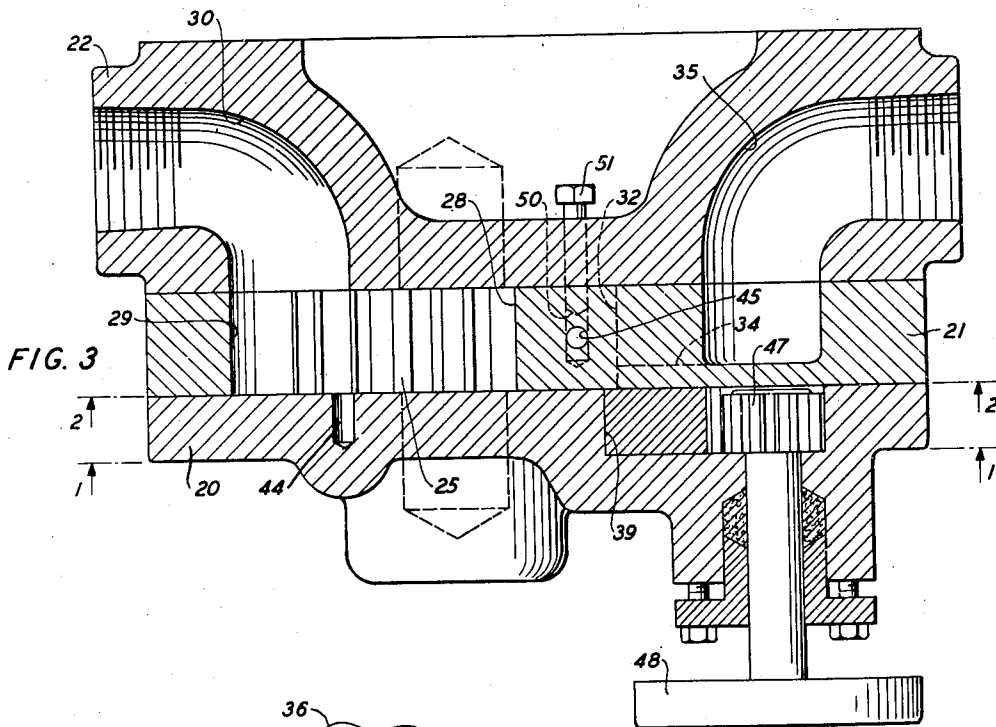
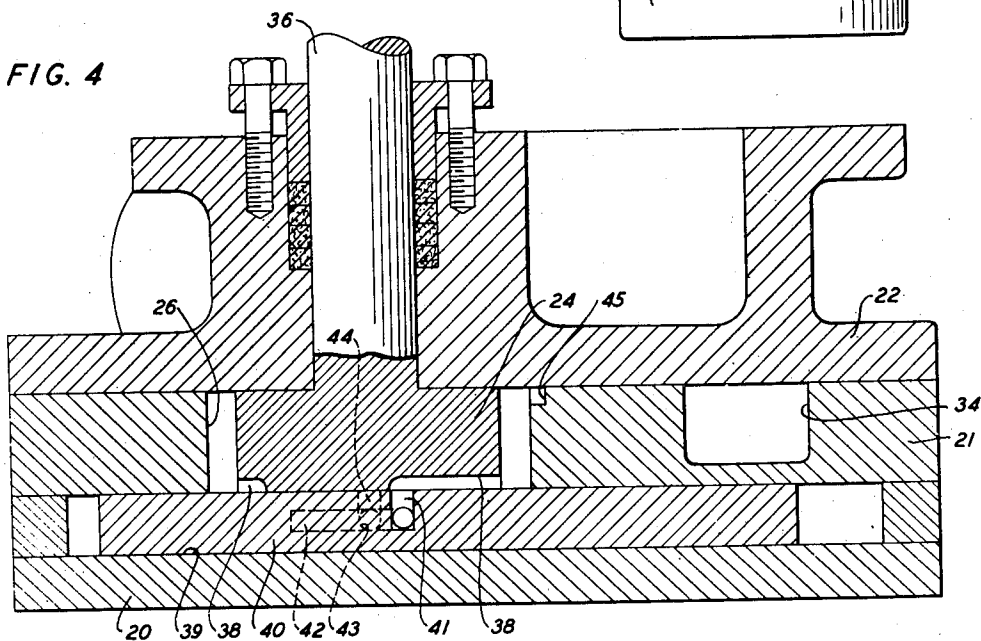
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3 Sheets-Sheet 3

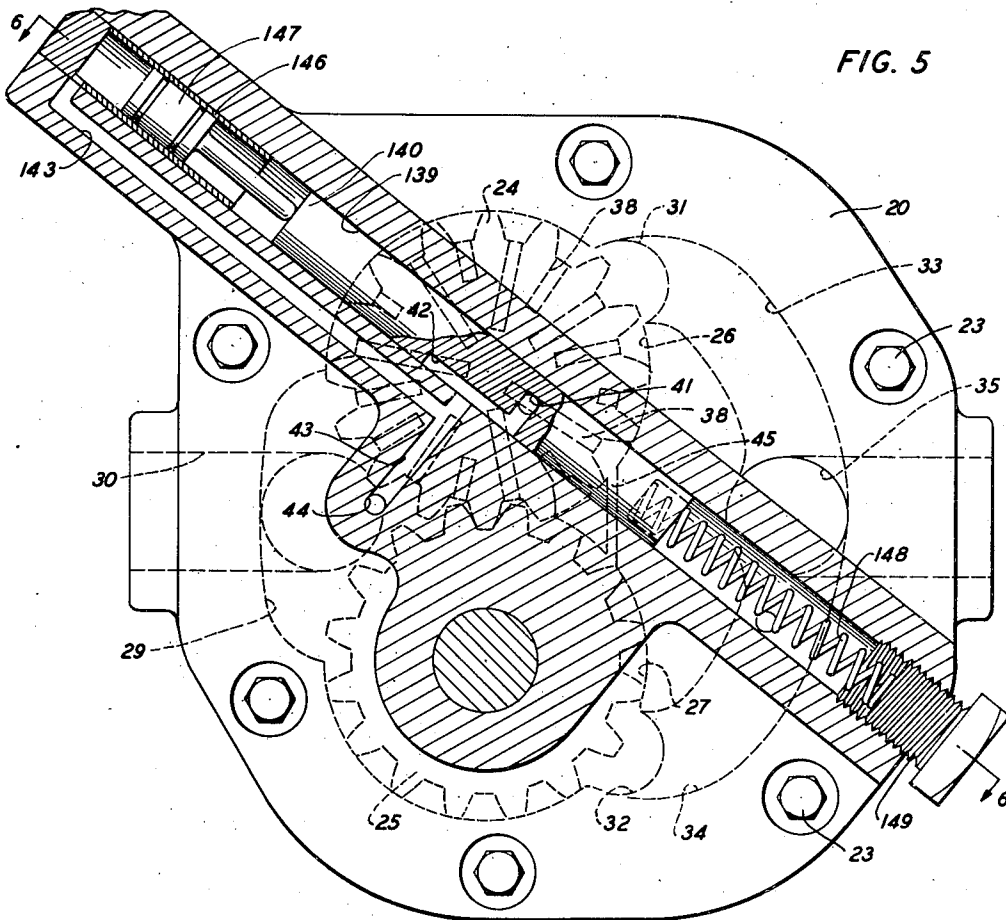
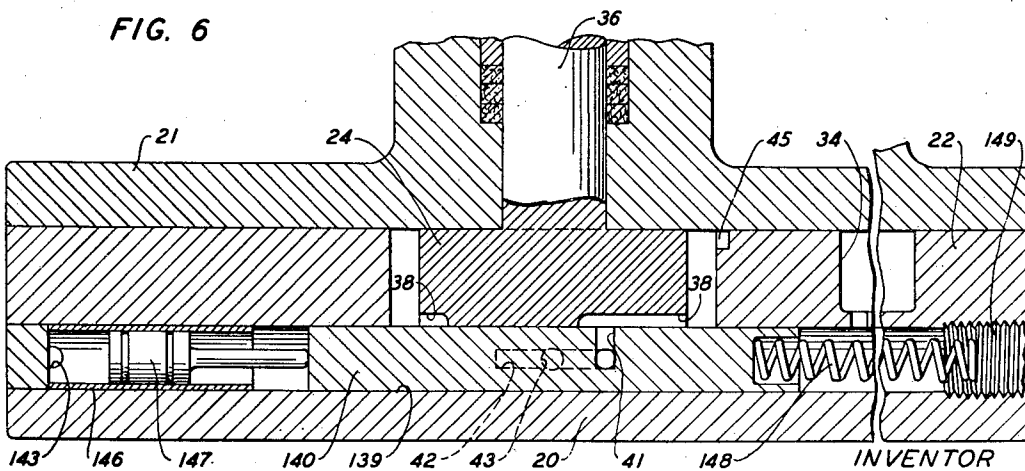


FIG. 6



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VARIABLE DELIVERY GEAR PUMP

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1 Claim. (Cl. 103—120)

1

This invention relates to pumping apparatus, and more particularly to a gear pump for pumping a liquid and adapted either to deliver an adjustably variable constant volume at constant speed of operation or to deliver a variable volume of adjustably variable constant pressure at constant speed of operation.

The familiar ordinary gear pump comprising essentially a pair of intermeshed gears running in a suitable housing has certain characteristic useful properties. In particular, its pumping action is positive within certain limits. So long as it runs and is supplied with liquid on its intake side, it delivers regardless of variations in resistance, and the volume delivered is accurately proportional to the speed of operation. It occupies relatively little space; requires little attention, and has no continuously operating valves to give trouble. Coupled with these good points are limitations. It is inflexibly invariable in operation. While it runs at any given speed, it delivers so much, no more, no less, regardless of demand. Its delivery volume can be varied only by varying its speed.

An object of the present invention is to provide a gear pump having means whereby the output volume of the pump at constant speed may be adjustably varied as desired.

Another object of the present invention is to provide a gear pump having means whereby the output volume of the pump at constant speed may be automatically varied inversely to the liquid pressure at the delivery side of the pump to produce delivery of constant pressure.

With the above and other objects in view, the invention may be embodied in a gear pump having a channel in the housing from the delivery side of the pump and controllable means, to connect the channel to one or more evacuated inter-tooth spaces of one or both gears during each revolution of the gears, to fill these spaces with liquid from the delivery side of the pump before they can be filled from the intake side.

Other objects and features of the invention will appear from the following detailed description of embodiments thereof taken in connection with the accompanying drawings in which the same reference numerals are applied to identical parts in the several figures and in which

2

vertical section on the line 1—1 of Fig. 3 of a gear pump constructed in accordance with the invention;

Fig. 2 is a section on the line 2—2 of Fig. 3;

Fig. 3 is a section on the line 3—3 of Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a view similar to Fig. 1 of a modified form; and

Fig. 6 is a section on the line 6—6 of Fig. 5.

In the structure illustrated in Figs. 1 to 4 inclusive, there is a casing or housing put together of three principal members, a front cover 20, an intermediate body 21, and a rear cover 22, held together by screws 23, and finished on their mutually abutting faces to form liquid-tight joints between the several members. The body member 21 is formed with a large central opening to create a chamber in the housing when assembled, the side walls of the aperture forming various generally arcuate recesses as hereinafter described. A pair of equal-sized mutually intermeshing gears 24 and 25, having the same thickness as the slab-like member 21, is housed in this chamber, the gears being journaled in the cover members 20 and 22. The teeth of the gear 24 run along the surface of an arcuate recess 26 in the upper side of the chamber; and the teeth of the gear 25 run along the surface of a similar recess 27 in the lower side, the teeth in each case forming a liquid-tight seal against the recess wall. At the right, the walls of the two recesses come together in a point about where the teeth of the two gears disengage. At the left, a third recess 29 forms an outlet space to communicate with a delivery passage 30 formed in the rear cover member 22. Similarly, two smaller recesses 31 and 32 formed in the walls of the recesses 26 and 27 respectively, above and below the point 28 respectively, communicate through branch passages 33 and 34 respectively with an intake passage 35 formed in the rear cover member 22, the passages 33 and 34 being formed in the body member 21.

As thus far described, the apparatus is a complete gear pump well known in the prior art. The gear 24 being driven through its shaft 36, by any suitable means not shown, counterclockwise as indicated by the arrows, drives the gear 25 clockwise. The interspaces of the gear teeth after disengagement at 28 are empty. As the

Fig. 1 is a view in side elevation and partly in

teeth pass over the recesses 31 and 32 respectively, liquid present in these recesses from some supply (not shown) communicating with the passage 35, fills the space between the teeth and is swept along over the walls of the recesses 26 and 27 to the outlet space 29. As the teeth reengage at the right hand side of the space 29, liquid contained in the intertooth spaces is forced out into the space 29 and so eventually out through the delivery passage 30. As long as the intake recesses 31 and 32 are kept filled with liquid from the supply, each interspace of the gears will be filled with liquid at these spaces and their liquid content forced out of them into the delivery space 29, where the teeth reengage at 37. Hence if the supply be sufficient to keep the passages 35, 33 and 34 and the recesses 31 and 32 full, the pump will deliver liquid through the passage 30 at a volume rate directly proportional to the rotary speed of the gears. At constant speed such a pump delivers constant volume.

In accordance with the invention, the gear 24 is provided on its front face with radially disposed slots 38 running inwardly toward the center from the bottoms of the several intertooth spaces of the gears and of graduated length. A diagonal closed ended slot 39 is cut in the rear face of the front cover 20 running diagonally and diametrically across the front face of the gear 24, and a slide 40 is fitted to be reciprocable in this slot. A transverse bore 41 running from the rear face of the slide horizontally partway through the slide, and of about the same diameter as the slots 38 communicates at its inner end with a longitudinal slot 42 formed in the under face of the slide 40. A passage 43 in the member 20 at right angles to the slot 39 communicates at one end with the slot 42 and at the other end with a bore 44 in the member 20 which opens into the delivery space 29. There is also a passageway 45 across the point 28, so located that an intertooth space of the gear 24, shortly after passing the point 28 and on coming into registration with the mid line of the slide 40, communicates through the passageway 45 with a corresponding intertooth space of the gear 25. The lower right hand end of the slide 40 is formed with a rack 46 engaged by a pinion 47 actuable by a knurled hand wheel 48 to adjust the slide 40 longitudinally in the slot 39. Passageways 49, 49 communicating with the ends of the slot 39 beyond the ends of the slide 40 and with the housing chamber of the pinion 47 and with the intake passage 35, serve to keep empty parts of the slot 39 filled with liquid and the slide 40 hydraulically balanced in all positions.

These various elements are so dimensioned and related, as illustrated, that when the slide 40 is in its extreme upward and leftward position, the bore 41 in the slide is substantially coaxial with the gear 24 and cannot communicate with any of the slots 38 in the face of the gear. In such position of the parts, the operation of the pump is unchanged from that described above. As the slide is moved downwardly and rightwardly by turning the adjusting handle, the slide reaches the position illustrated, in which, as the longest only of the slots 38 passes the mid line of the slide 40, that particular slot 38 only comes into registration with the mouth of the bore 41 and hence is put into communication with the delivery space 29 through the passages 42, 43 and 44. The outer end of this particular slot 38 communicates permanently with a specific intertooth space of the gear 24, which, at this moment, is empty, having just been disengaged from a tooth

of the gear 25. Hence as soon as the described communication is established, liquid flows under pressure from the space 29 to fill the evacuated particular intertooth space now being considered and, having filled this space, passes on through the passage 45 to fill the correspondingly situated intertooth space of the gear 25. As the gears continue to rotate the communication of the particular slot 38 with the bore 41 and hence with the space 29 is broken. When these two particular intertooth spaces of the two gears come to the intake recesses 31 and 32, they are already filled with liquid from the space 29 and do not take up any liquid from the intake side of the pump but pass on to return to the delivery side the liquid they have received from the delivery side. Thus the delivery volume of the pump is cut down by a fraction whose numerator is one and whose denominator is the number of intertooth spaces on either of the gears. The action of none of the other intertooth spaces is affected, with the parts in the position shown, for none of the other slots 38 is long enough to reach the bore 41. However, by adjusting the slide 40 further rightwardly and downwardly a position is reached where both the longest and the second longest of the slots 38 register with the bore 41. Then the pumping action of two intertooth spaces on each gear is annulled. By successive such adjustments, the volume delivered by the pump per revolution of the shaft 36 or per unit of time at constant speed can be adjustably set from maximum to zero by as many steps as there are teeth in either gear 24 or 25. Thus the ordinary gear pump, whose volume delivered is fixedly and directly proportional to the speed of rotation of its pumping gears, is converted, in accordance with the present invention, into a gear pump having its delivery volume adjustably proportional to its speed.

If a threaded bore 50 be made in the members 21 and 22 intersecting the bore 45 as shown, and be closed, as shown, by a screw 51 insufficiently long to close the bore 45, the pump operates as described. If the screw 51 be replaced by one long enough to close the bore 45, then only the intertooth spaces of the gear 24 have their pumping action annulled in the manner described, while those of the gear 25 continue to pump. Under these conditions the slide may be adjusted to vary the pump output at constant speed as before but only from maximum to half maximum by steps as many and half as large as before.

In the modified form shown in Figs. 5 and 6, the rack 46, pinion 47 and hand wheel 48 are omitted and a compression spring 148 is interposed between the right end of the slide 140 and the end wall of the slot 139. In the left end of the slot 139 is mounted a cylinder 146 to contain a piston 147 which acts to drive the slide 140 against the urge of the spring 148. A passage 143 communicates from the passage 43 to the upper or left side of the piston.

Assume now that the shaft 36 is being driven at constant speed, with the parts generally in the position shown. The pump is then delivering a constant volume which is some fraction of its maximum delivery capacity depending upon the position of the slide 140. Assume now that the resistance to the output diminishes because of some increase in demand. The fluid pressure in the space 29 then begins to fall off. This decrease in pressure is transmitted through the channels 43 and 143 to the upper side of the piston 147 and the spring 148 drives the slide 140 up to the left. Thus the number of slots 38 in the gear 24 com-

5

municating with the bore 41 at each revolution of the gear, is diminished and the volume output of the pump is increased. Thus, in this arrangement, the pump regulates its own output volume at constant speed to maintain its output pressure constant. Means such as the adjustable abutment 149 for the spring 148 may be provided to render the pressure to which the pump adjusts itself adjustably variable.

An ordinary gear pump driven at constant speed delivers constant volume against increasing pressure up to the stalling point of the driving means. By application of the present invention in this second form the pump is made to adjust its delivery volume to maintain substantially constant output pressure.

The particular embodiments illustrated and described above show the invention as applied in a specific design and structure of commercial ordinary gear pump. Modifications and variations necessary to embody the invention in other well known forms of gear pump are believed to be within the spirit and scope of the invention as described and particularly pointed out in the appended claims.

What is claimed is:

In a gear pump for pumping a liquid and having a housing and a pair of intermeshing pumping gears therein and formed with an intake chamber at one side of the gears and a delivery chamber at the other side of the gears, means to cause the pump while running at constant speed to deliver liquid at substantially constant pressure and in volume variable substantially in inverse ratio to the resistance to delivery, the said means comprising a plurality of radially spaced, radial slots of graduated lengths formed in the

6

side of one of the pumping gears and each communicating at one end with an intertooth space of the gear, a slide positioned in the housing alongside and against the said slotted face of the said gear and diametrically across the said face and movable longitudinally of itself and formed with a transverse bore positionable by motion of the slide to communicate with a variable number of the slots in the gear, the slide being further formed with a longitudinal slot in an outer surface thereof communicating with the said bore, a compression spring bearing against one end of the slide to urge the same longitudinally in one direction of the motion thereof, and a piston in a cylinder in the housing and bearing against the other end of the slide to drive the same against the urge of the said spring, the housing being further formed with a bore communicating with the pressure face of the piston in the cylinder and with the longitudinal slot in the outer face of the slide and with the delivery chamber of the housing.

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