

Oct. 7, 1952

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2,612,839

VARIABLE-DELIVERY PUMP

Filed Sept. 2, 1947

2 SHEETS—SHEET 1

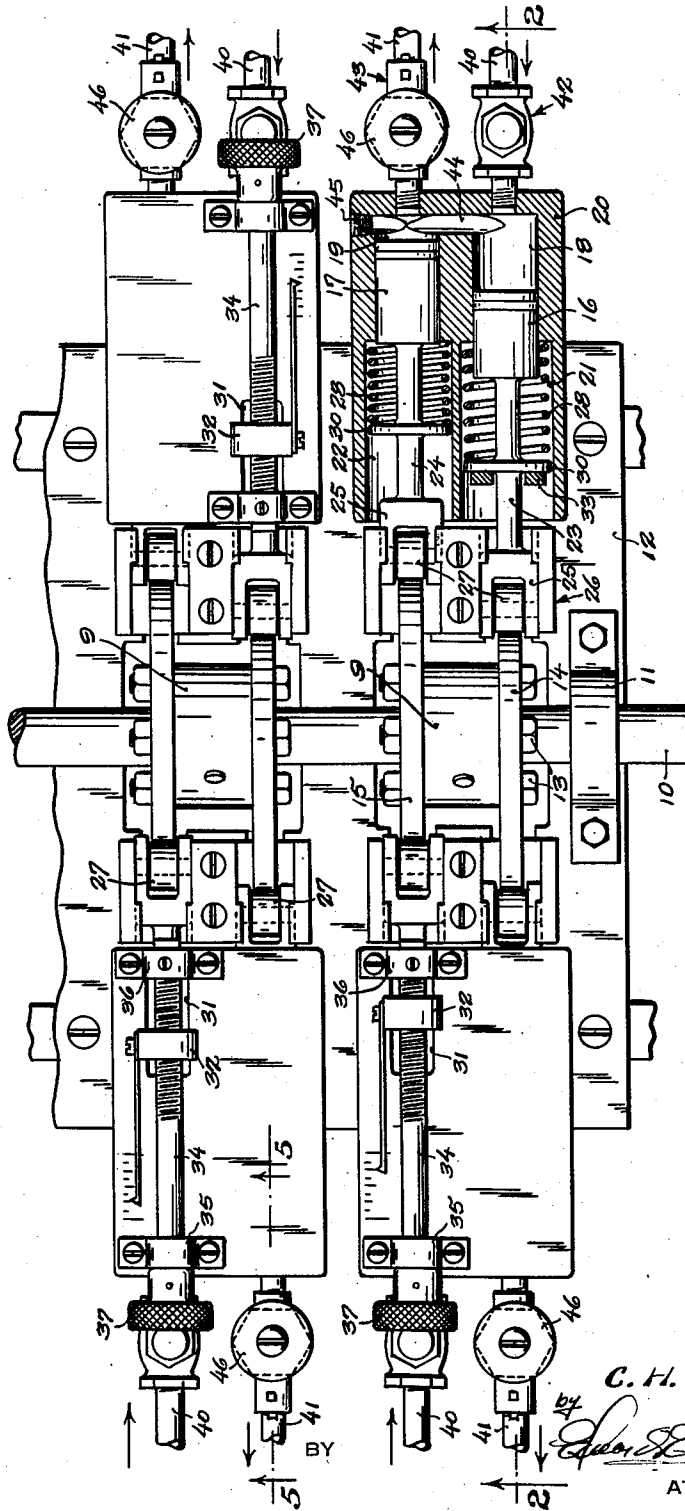


Fig. 1.

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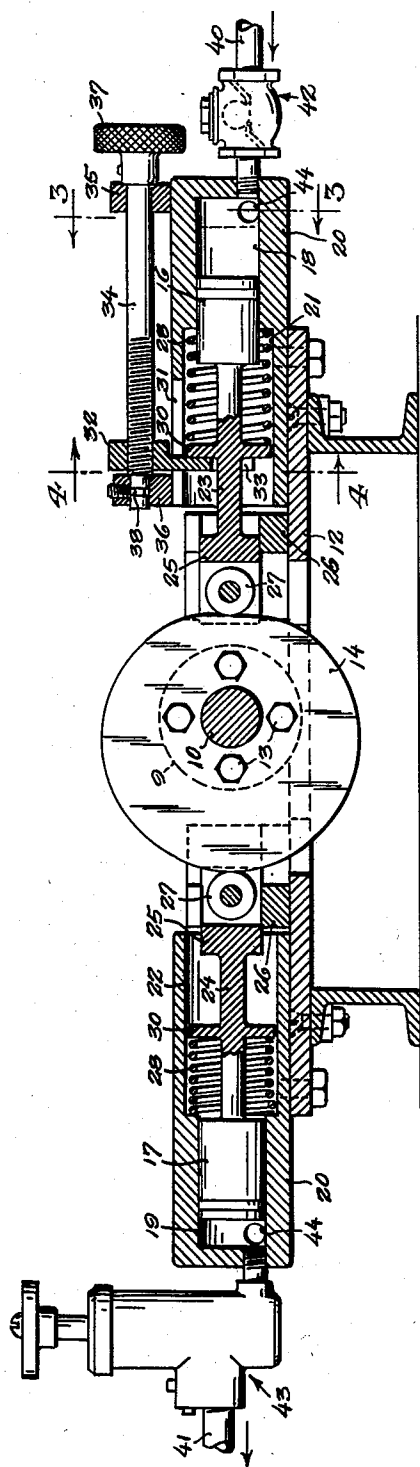


Fig. 2.

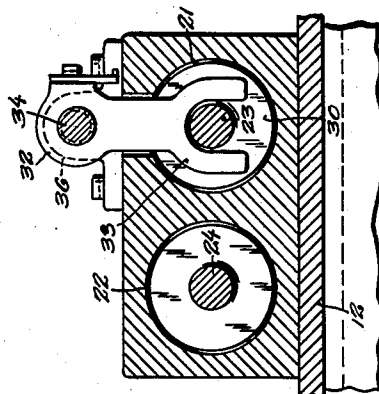


Fig. 4.

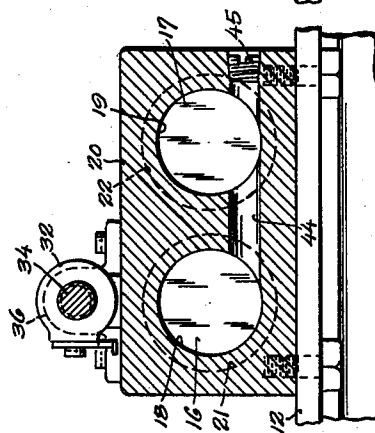


Fig. 3.

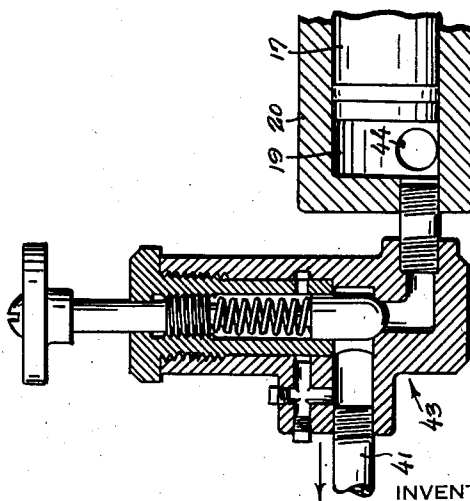


Fig. 5.

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VARIABLE-DELIVERY PUMP

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4 Claims. (Cl. 103—38)

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This invention relates to variable-delivery pumps, and has for its principal object the provision of a perfected pump of this nature employing paired reciprocally-mounted pumping pistons, one piston working opposite to the other with the two cylinders therefor having circulatory connection, and providing means by which one of the two pistons of a pair may be regulated at will from substantially zero to full working stroke.

It is a further and important object of the invention to provide a pump for the purpose described particularly designed in a manner which permits a battery of pumping units to be compactly assembled together and driven from a single power shaft common to all, reserving to each pump, however, complete independence in respect of pumping output.

With the above and other objects and advantages in view, which will appear and be understood in the course of the following description and claims, the invention consists in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the drawings:

Figure 1 is a view partly in top plan and partly in horizontal section illustrating a battery of four pumping units constructed to embody the preferred teachings of the present invention.

Fig. 2 is a vertical sectional view on line 2—2 of Fig. 1; and

Figs. 3, 4 and 5 are fragmentary vertical sectional views on lines 3—3 of Fig. 2, 4—4 of Fig. 2, and 5—5 of Fig. 1, respectively.

According to the present invention there is provided a suitably driven power shaft 10 journaled in bearings 11 carried upon the bed plate 12 of a machine frame, and either fixedly secured to or made an integral part of this shaft are one or more concentric hubs 9. Secured, as by the bolts 13, to opposite end faces of these hubs are eccentrics 14 and 15. The mounting of these eccentrics, which are identical, is such that the low point of one coincides with the high point of the other, and which is to say that one eccentric is shifted about the axis of the shaft 180° from the other.

As before stated, each pumping unit is comprised of a pair of reciprocating pistons placed one to the front and the other to the rear of a transverse median line taken through the hub, and there is provided one such pair of pistons at each side of each pair of eccentrics with the pair at one side being directly opposed to the

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pair at the other side. One eccentric operates one piston of each of the two units while the other eccentric acts upon the other piston of each said unit. Inasmuch as the structural nature of the several pumping units is identical, it will suffice to describe in detail only a single said unit.

The pistons in question are denoted 16 and 17 and work in respective cylinders, as 18 and 19, bored from the inner end of a single block 20 rigidly bolted to the bed-plate, and also provided in the block are relatively deep counter-bores, as 21 and 22. Piston rods 23 and 24, rigid with the pistons, extend axially through the counter-bores, and made rigid with the outer ends of these rods are forked cross-heads 25 journaled for end-wise movement in slide-ways of a guide-block 26, the guide-block occupying a position between the cylinder block and the driven eccentrics and, as with the cylinder block, being rigidly bolted to the bed-plate of the machine frame. Received between the fork arms of the respective cross-heads is a rotatively-journaled roller 27 arranged to track upon the related eccentric, and to yieldingly urge these rollers into engagement with the eccentrics there is provided a respective spring 28 bearing at one end against the end wall of the counter-bore and at the other end against a collar 30 rigid with the related piston-rod.

In the instance of one of the two counter-bores, the upper wall is slotted longitudinally for the major part of the length, and received through and more or less closely fitting this slot, which I denote 31, is an arm formed as an integral dependency of a traveler nut 32, the arm having a furcate extremity 33 straddling the piston-rod at the outer side of the collar 30. Functional to the traveler nut is a feed-screw designated 34 which finds a rotary journal at its two ends in bearings 35 and 36 bolted to the cylinder block. For turning the feed-screw a knurled knob 37 is pinned or otherwise fixedly secured thereto, and acting as a complement to the knob for resisting endwise thrust transmitted from the piston rod to the traveler nut is a pin 38 working in a circumferential groove of the feed-screw.

Induction and eduction pipes for the pump are indicated by 40 and 41, respectively, and I have shown these pipes as connecting one with one cylinder and the other with the other cylinder of a pumping unit, introducing to each said pipe a non-return valve, as 42 and 43. In order that both the induction and the eduction pipes will

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be made common to both cylinders, the block 20 is illustrated as having a circulatory connection 44 extending between the cylinders, and to form this connection I follow the more or less usual practice of drilling the block transversely from the outside, then closing the external opening by inserting a plug 45 (see Fig. 3). If desired, this drilling step might be dispensed with and the required communication established by providing an outside manifold common to both cylinders and having both the induction and the eduction pipes connect through non-return valves with this manifold. While using simply a ball check as the non-return valve for the induction side of the pump, I find it desirable to employ a spring-closing valve for the eduction side, incorporating a control wheel 46 for regulating the pressure of the spring.

The operation of the pump is as follows:

Assuming that the traveler nut 32 is shifted by operation of the control knob 37 to bring the nut to the end limit of its travel working toward the closed end of the slot 31, the collar 30 of the piston-rod 23 will be then responsively retracted to a degree which places the roller 27 of its cross-head 25 radially at or beyond the outermost compass of the eccentric 14, and the result is to immobilize the piston 16, the piston 17 meanwhile working through its full stroke in opposite directions of reciprocation. This working travel draws into the cylinder in each intake stroke a volume of fluid corresponding to the full displacement of the piston, and in the following discharge stroke such volume of fluid is expelled to the eduction pipe. This discharge represents the maximum pumping capacity of the pump. Now assuming that it is desired to reduce the output, the operator simply turns the feed-screw to shift the traveler nut inwardly toward the eccentrics, and the reduction in output will then correspond to the relative degree to which the immobilized piston is now permitted to move as its related roller 27 is brought into the operating sphere of the eccentric 13, this permitted movement counter-acting a corresponding travel of the other piston 17 and the pumping efficiency being consequently reduced to that amount of fluid which the piston 17 will displace in its remaining travel. Should the traveler now be shifted rearwardly to the full extent of its sliding movement and such, more especially, as to bring the same into the position in which it is shown in Fig. 2, the related cross-head 25 will then reciprocate through the full degree of its permitted travel and responsively transmit to the piston 16 a stroke travel exactly corresponding but converse to the reciprocal movement of the piston 17, the fluid then simply circulating from the one to the other cylinder with zero pumping output.

It will be apparent from an inspection of Fig. 1 that each of the multiple pumping units admits of being independently controlled, and a system such as I have here described hence becomes especially advantageous as applied to operations which call for the simultaneous pumping of a severalty of different fluids for delivery in necessary predetermined ratios. The fact of the several pumps each having a common powering instrumentality and working under identical conditions gives positive assurance that the pumping output, relatively speaking, will remain absolutely constant.

The invention should be clear from the foregoing description of my now-preferred and illustrated embodiment. Modifications may, however,

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be resorted to without departing from the spirit of the invention, and I accordingly intend that the hereto annexed claims be read with the broadest scope commensurate with the language used.

What I claim is:

1. In a variable-delivery pump: the combination of a rotary drive shaft; a pair of identical eccentrics fixedly secured in axially spaced relation upon the drive shaft with the high point of one placed to coincide with the low point of the other; a pair of identical fluid pumps placed radial to the shaft in side-by-side relation and each comprising a cylinder and a reciprocally acting piston working in the cylinder and with the pumping chambers of the two cylinders in constant communication; a guide-block between the pistons and the eccentrics; piston-rods rigid with the pistons and each carrying a forked cross-head slidably journaled in the guide-block; respective rollers arranged to track upon the periphery of the eccentrics and journaled for rotary movement between the fork arms of the cross-heads; springs acting upon the cross-heads to yieldingly hold the rollers against the eccentrics; and adjustable means acting counter to the thrust of one of said springs and operating upon the piston-rod to serve as a stop for variably limiting the stroke travel of the rod.

2. The structure of claim 1 in which the piston-rods are each provided with a collar arranged to receive the thrust of the related spring, and wherein the stop means comprises a feed-screw and a traveller-nut working upon the feed screw and providing an arm extending into the path of travel of one of the collars to interrupt the collar as the latter moves by the thrust of the spring from the high to the low point of the related eccentric.

3. In a variable-delivery pump: a pair of fluid pumps each comprised of a reciprocally movable piston and a cylinder for the piston and characterized in that the pumping chambers of the cylinders are in constant communication, one of said pistons having a constant stroke travel while the other piston admits to adjustment of its stroke travel; means for imparting reciprocatory movement to said constant travel piston; means including a power-driven eccentric and a counter-acting spring for imparting reciprocatory movement to the adjustable-travel piston, the arrangement being such that the direction of movement, pumping function considered, is opposite as between the two pistons; and adjustable means acting counter to the thrust of said spring and operating as a stop for the related piston variably limiting the stroke travel thereof, said fluid pumps both having an identical maximum fluid displaced.

4. In a variable-delivery pump, in combination: a rotary drive shaft; an eccentric secured upon the drive shaft; a fluid pump placed radial to the shaft and comprising a cylinder and a reciprocally acting piston working in the cylinder; a guide-block between the piston and the eccentric; a piston-rod rigid with the piston and carrying a forked cross-head slidably journaled in the guide-block; a roller arranged to track upon the periphery of the eccentric and journaled for rotary movement between the fork arms of the cross-head; a spring acting upon the cross-head to yieldingly hold the roller against the eccentric; adjustable means acting counter to the thrust of said spring and operating upon the piston-rod to serve as a stop for variably limit-

ing the stroke travel of the rod; a second fluid pump which likewise comprises a cylinder and a reciprocally moving piston working in the cylinder and having its pumping chamber in constant communication with the pumping chamber of the first-named fluid pump; and means activating the piston of said second-named fluid pump and so operatively interconnected with the eccentric as to cause the two pistons to work in timed concert but with the direction of movement, pumping function considered, being opposite as between the two pistons.

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