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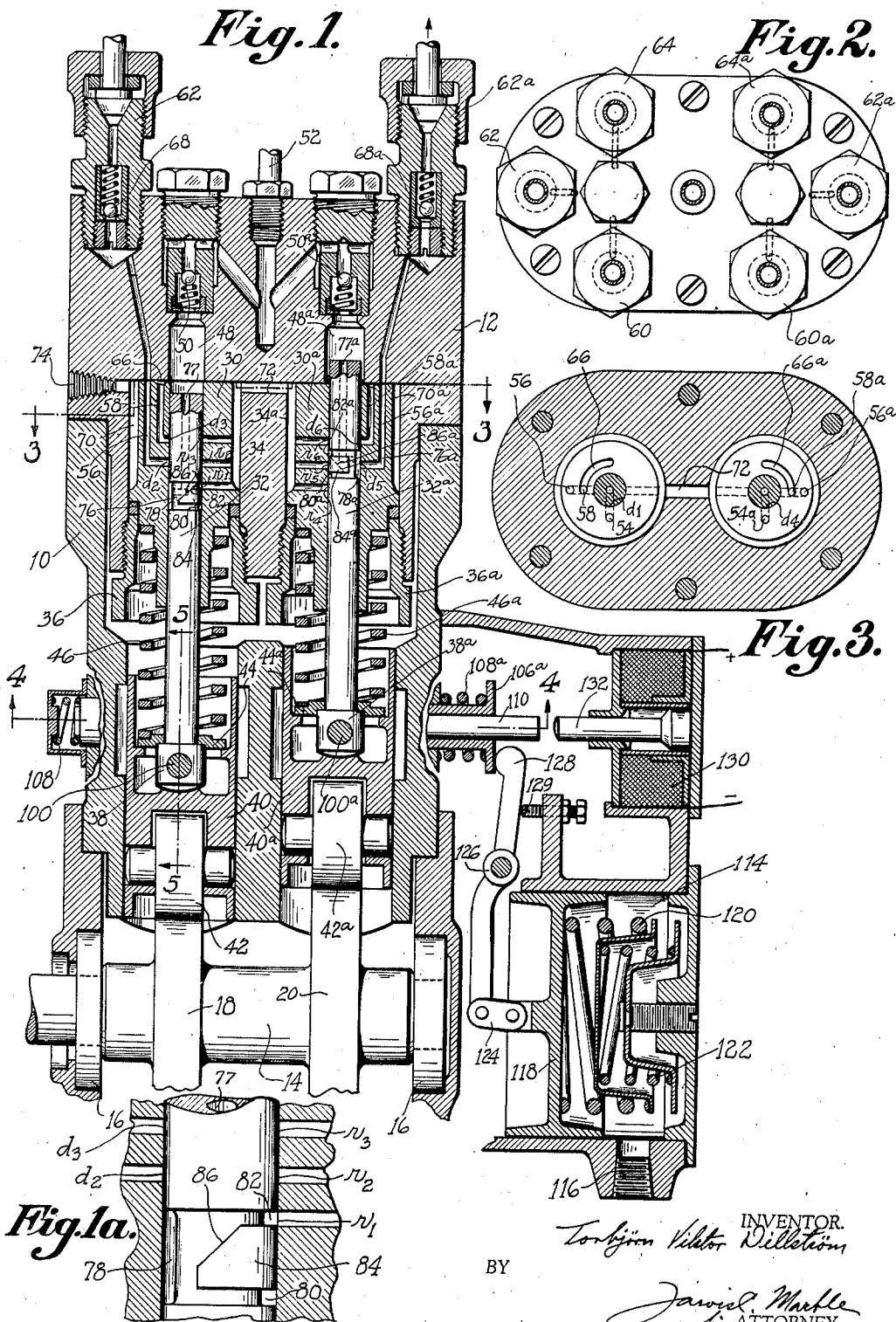
T. V. DILLSTRÖM

2,223,758

PUMP

Filed Aug. 10, 1938

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 4.

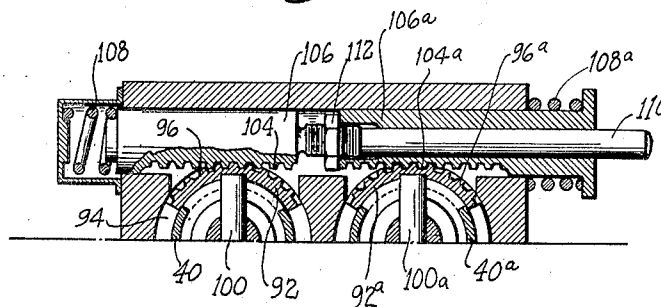


Fig. 5.

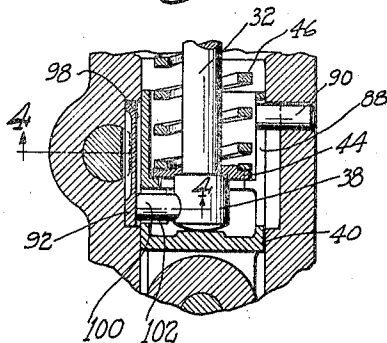


Fig. 6.

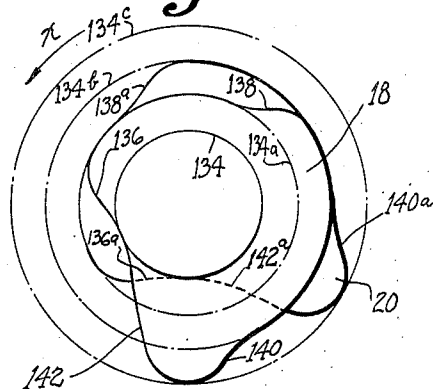


Fig. 7.

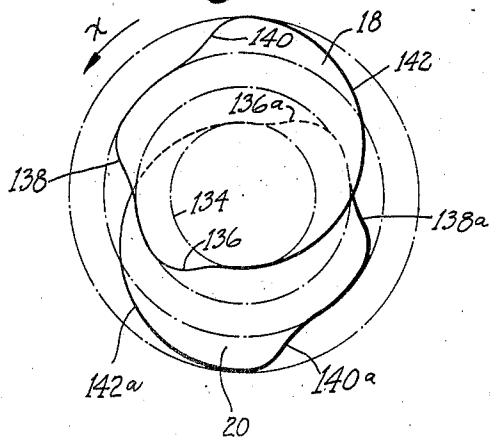
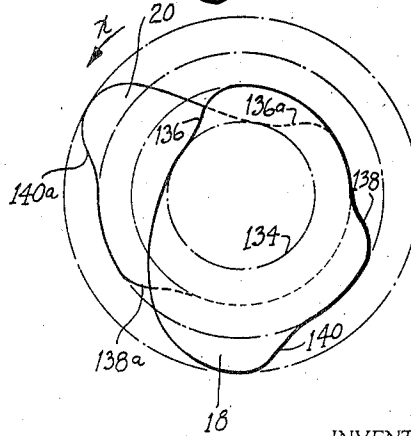


Fig. 8.



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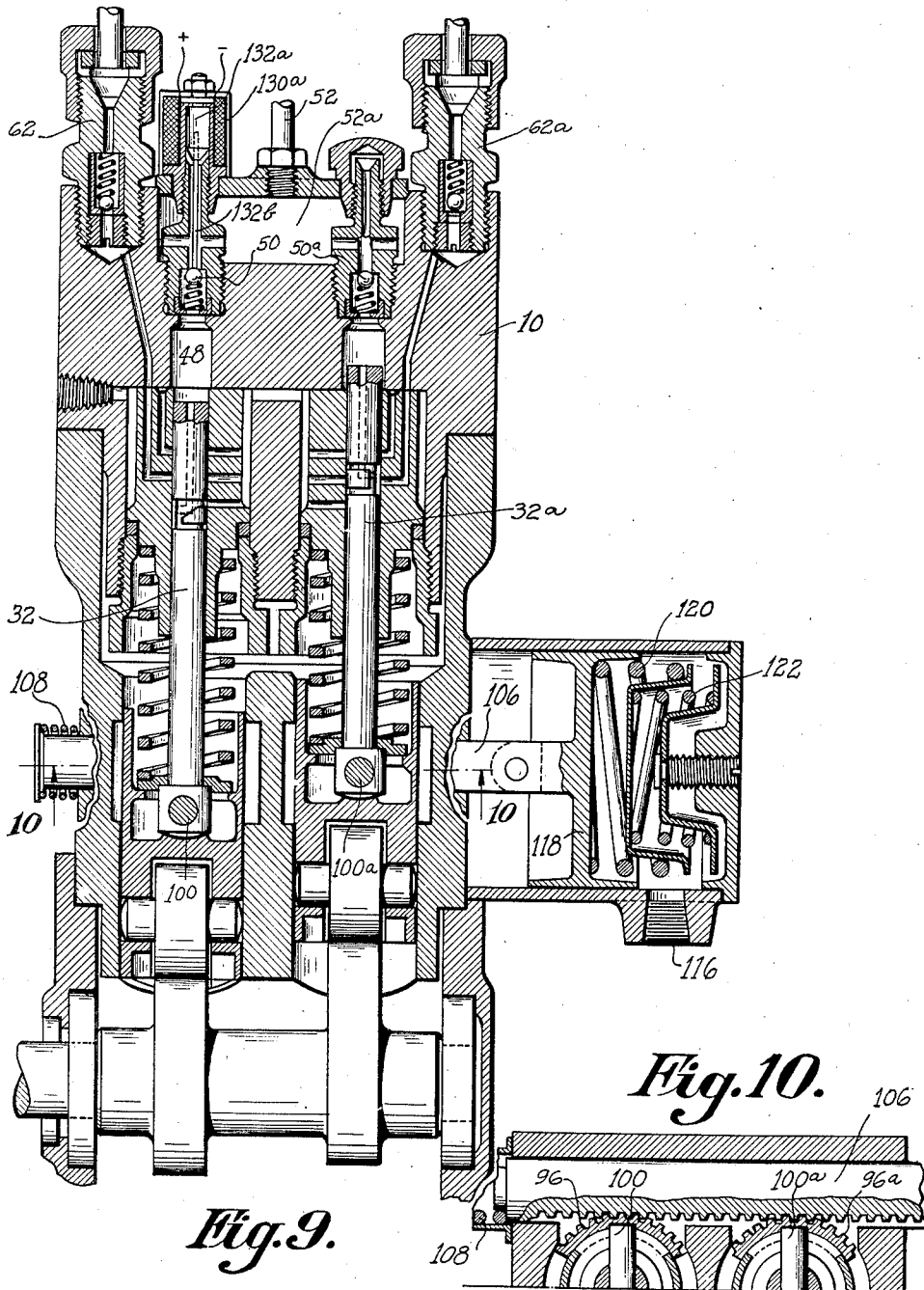


Fig. 10.

Fig. 9.

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UNITED STATES PATENT OFFICE

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PUMP

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Application August 10, 1938, Serial No. 224,213
 In Sweden September 28, 1937

11 Claims. (Cl. 103—41)

The present invention relates to plunger pumps and has particular reference to plunger pumps of the type in which liquid is supplied to a plurality of places of consumption from a common pump cylinder. Still more particularly, the invention relates to pumps of the above type adapted to supply fuel oil under high pressure to the injection nozzles of different cylinders of a multiple cylinder internal combustion engine of the solid or airless injection type.

Generally speaking, pumps of the above character are capable of practical employment when the number of independent places of consumption such as injection nozzles, supplied from a common pump cylinder, is relatively limited, as for example, not over four. If it is attempted to supply more places of consumption from a common cylinder, which is theoretically possible, the pump cylinder and plunger necessary become so long and the construction thereof so cumbersome and complex that the advantages of simplification to be derived from supplying a plurality of points of consumption from a common cylinder are outweighed by the undesirable characteristics of design required to provide such a cylinder which will supply a large number of independent consumption points. Also, and particularly in the case of high speed engines, the magnitude and character of the forces needed to effect and control movement of the pump parts and the fuel columns involved, make for added complexities of design in the case of pumps in which it is attempted to supply large numbers of pump outlets from a common cylinder.

The present invention has for its general object the provision of a novel form of plunger pump, capable of supplying liquid such as fuel oil to a relatively large number of points of consumption as for example to the injectors of an engine having six or more cylinders, and in which a plurality of pump cylinders are provided, each of which supplies liquid to a number of different points of consumption in succession, and in which the advantages to be derived from the supplying of a number of different points of consumption from a common pump cylinder are retained in a pump unit which is relatively simple and inexpensive of construction and easy to operate and control.

The manner in which the above general object and other and more detailed objects are attained, together with the advantages to be derived from the use of the invention, may best be understood by reference to the ensuing portion of this specification in which by way of example there

is described a suitable embodiment of construction for a pump adapted to supply fuel to the injection nozzles of a six cylinder engine.

In the accompanying drawings forming a part hereof, Fig. 1 is a central longitudinal section through a pump embodying the invention;

Fig. 1a is a fragmentary view on enlarged scale of part of the pump structure shown in Fig. 1;

Fig. 2 is a top plan view of the pump shown in Fig. 1;

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

Fig. 4 is a half section taken on lines 4—4 of Figs. 1 and 5;

Fig. 5 is a fragmentary section taken on the line 5—5 of Fig. 1;

Figs. 6 to 8, inclusive, are diagrams showing different cam arrangements suitable for use in a pump of the kind shown in Fig. 1;

Fig. 9 illustrates a pump like that shown in Fig. 1 but equipped with a somewhat simpler form of regulator and further provided with a different arrangement for preventing delivery of liquid from one or more but not all of the pumps carried in the pump casing; and

Fig. 10 is a section taken approximately on the line 10—10 of Fig. 9.

Referring now more particularly to Fig. 1, the pump illustrated comprises a pump casing having a main body portion 10 and a head portion 12. In the lower part of the body portion a cam shaft 14 is rotatably mounted in suitable bearings indicated at 16 and adapted to be driven from any suitable source of power. Cam shaft 14 is provided with two cams 18 and 20.

The pump illustrated comprises two similarly constructed pump units, one of which comprises a pump cylinder or barrel 30 and cooperating plunger 32 and the other of which comprises a corresponding barrel 30a and plunger 32a. Since the construction of the pumps is similar it will be sufficient to describe one.

The pump barrel 30 is retained in a recess or well 34 in the head portion 12 of the pump casing by means of a threaded nipple 36 and the lower end of the pump plunger is provided with an enlarged foot 38 resting on the bottom of a recess in a tappet 40 slidably mounted in the casing portion 10 and carrying a roller 42 contacting cam 18. The head of the plunger is maintained in contact with the tappet by means of a retaining washer 44 between which and the pump barrel is located the pump spring 46 for causing the plunger and tappet to follow the

contour of the cam. As will hereinafter be described more in detail, the plunger is mounted for turning as well as reciprocating movement in the pump cylinder.

5 A pump chamber 48 is provided at the inner end of the pump plunger, to which fuel is admitted through the suction valve 50, the inlet side of which is in communication with the supply pipe 52 by way of suitable passages drilled in the head portion 12 of the casing.

10 The pump barrel 30 is provided with a series of delivery ports, in the present case three, d_1 (Fig. 3), d_2 , and d_3 , which communicate respectively with delivery passages 54, 56, and 58 formed in the pump barrel. The corresponding delivery ports in the barrel 30a are shown at d_4 , d_5 , and d_6 , these ports forming the inlets of the delivery passages 54a, 56a, and 58a respectively, in the barrel 30a. As will be observed from Figs. 1 to 3 of the drawings, the several delivery passages communicate with separate pump outlets, passages 54, 56, and 58 communicating respectively with the outlet connections 60, 62, and 64, while the passages 54a, 56a, and 58a communicate respectively with outlets 60a, 62a, and 64a.

25 In order to symmetrically arrange the outlets as shown in Fig. 2, the portions of the delivery passages 56, formed in the barrel and in the head of the pump casing, are displaced 90° and brought into communication by means of a groove 66 cut in the top of the barrel. A similar groove 66a serves to connect the portions of the delivery passage 58a. The delivery ports are longitudinally spaced along the wall of the cylinder bore, the spacing being indicated by the two ports appearing in Fig. 1. If simultaneous delivery is desired to two outlets from the same pump cylinder, two or more ports may be provided at the same level in the cylinder barrel, each such port, of course, communicating with an independent delivery passage. Each delivery passage is provided with a pump outlet or delivery valve, the valves 68 and 68a for passages 56 and 56a, respectively, being shown in Fig. 1.

45 The pump barrel 30 is further provided with a series of longitudinally spaced relief or overflow ports r_1 , r_2 , and r_3 which provide communication with an annular overflow chamber 70 formed between the outer wall of the cylinder barrel and the recess in which it is seated. As will be noted from Fig. 1, ports r_2 and r_3 are opposite ports d_2 and d_3 . Port r_1 is at the same level as delivery port d_1 , which appears only in Fig. 3. Barrel 30a is provided with corresponding relief ports r_4 , r_5 , and r_6 which are respectively at the same levels on delivery ports d_4 , d_5 , and d_6 in this barrel. The latter relief ports communicate with the overflow recess 70a, and recesses 70 and 70a communicate through a groove 72 cut in the top of the casing part 10. Discharge of overflow liquid from the pump is through overflow outlet 74 which communicates with the overflow chamber 70. Plunger 32 is provided with a recess 76 intermediate its ends which recess is placed in communication with the pump chamber by means of a passage 77 formed in the plunger. One portion of the recess provides a circumferentially extending plunger delivery port 78 extending part way around the circumference of the plunger and adapted to register successively with the several delivery ports on the delivery stroke of the plunger. As will be observed from Fig. 1 the delivery port 78a of the plunger 32a is in registry with the cylinder delivery port d_5 . The recess 76 also provides two longitudinally

spaced plunger overflow ports 80 and 82 adapted to register successively with the relief ports r_1 — r_3 during the delivery stroke of the plunger. The space between these plunger overflow ports is filled by an island-like projection 84 the surface of which is in sliding contact with the cylinder bore and which provides an inclined control edge 86 for varying the point of cut off for overflow communication between the pump chamber and the overflow passage, in different positions of rotation of the pump plunger, whereby to effect part load regulation of the quantity of liquid delivered to the several delivery ports.

15 The port arrangement in the cylinder and plunger form per se no part of the present invention and constitute the claimed subject matter of my copending application Serial No. 224,211, filed August 10, 1938. The operation of this part of the apparatus is briefly as follows, assuming the pump chamber to have been filled with liquid on a preceding suction stroke. Considering first the plunger 32, this plunger is shown at substantially the bottom of its stroke and about to ascend on its delivery stroke. The delivery port in the plunger is in registry with the cylinder delivery port d_1 and delivery through this port will commence as soon as the plunger port 82 moves out of registration with the cylinder overflow port r_1 . Delivery through port d_1 will continue until the plunger port 80 comes into registration with overflow port r_1 . Overflow will then continue because of registration of port 80 with port r_1 , or of port 82 with port r_2 , or both, until the plunger reaches a position where the delivery port 78 in the plunger registers with delivery port d_2 and ports 80 and 82 are both out of registration with overflow ports, when the second delivery period will occur and will continue until overflow registration again takes place. Delivery during this second period is illustrated by the position of plunger 32a, which is effecting delivery through delivery port d_5 and will continue to effect such delivery until port 80a comes into registration with overflow port r_5 . From the foregoing brief description it will be evident that each plunger on its discharge stroke serves to direct liquid first to a delivery port, then to overflow, then to a second delivery port, again to overflow and follows this sequence to the end of its stroke.

50 The plungers have been shown in full load position in Fig. 1, in which the distance between overflow ports in the plungers, which are controlling with respect to duration of the delivery periods, is maximum. It will be apparent that if the plungers are turned so that some portion of the inclined control edges 86, 86a respectively is in line with the respective lines of cylinder overflow ports, the duration of the several delivery periods will be reduced, as for example is required for part load injection to an engine.

Referring now more particularly to Figs. 4 and 5, the mechanism for effecting turning as well as reciprocating movement to the plungers is illustrated. The tappet 40 is provided with a vertically extending slot 88, for the reception of a locating pin 90 fixed in the pump casing for preventing turning movement of the tappet. Outside the upper portion of the tappet there is situated a segment 92 movable in a recess 94 in the casing surrounding the upper portion of the tappet and having external teeth 96. This segment is provided on its inner face with a vertically extending slot 98 into which projects one end of a pin 100 the opposite end of which is fixed in the

foot 38 of the plunger. Pin 100 extends through an arcuate horizontal slot 102 in the wall of the upper part of the tappet. The tappet construction for the other unit of the pump is similar to that just described.

In the embodiment illustrated the teeth 96 and 96a of the two sectors engage teeth 104 and 104a of a rack which in the form shown comprises two separable rack parts 106 and 106a. Part 106 is urged to the right as seen in Fig. 4 by a retracting spring 108 and part 106a is likewise urged in the same direction by spring 108a. The rack part 106a is hollow and a pin portion 110 on part 106 passes through part 106a and projects from the outer end. The part of the pin portion 110 between the two rack parts is threaded to receive an adjusting nut 112. As will be evident from Fig. 4 the position of this nut serves to adjust the positions of rotation of the two pump plungers relative to each other when the adjusting nut 112 is in abutting contact with the end of the rack part 106a, as shown in this figure.

The amount of turning movement for the plungers required to effect adjustment from full load to minimum load capacity for the pump is relatively slight and the construction is particularly adapted, when the pump is used as a fuel injection pump, for control of pump capacity by means of variations in pressure in the intake passage leading to the cylinders of the engine to which the pump is supplying fuel. A control of this kind is shown in Fig. 1, which provides a cylinder 114 having an opening 116 for connection with the air intake passage of the engine and a piston 118 exposed to atmospheric pressure on one of its faces and loaded by springs 120 and 122 against movement to the right as viewed in Fig. 1 under the influence of a vacuum in the intake passage. Piston 118 is connected by link 124 to a suitably pivoted lever 126 the arm 128 of which abuts against the flanged end of the rack part 106a. Movement of the lever arm 128 under the influence of the springs in the vacuum cylinder is limited by the adjustable stop 129 which determines full load position of rotation of the pump plungers. It will be evident that a reduction in air intake pressure resulting from throttling of the engine at part load will result in movement of the control lever 128 to the left in Fig. 1. This will result in movement to the left in Fig. 4 of both the rack parts 106 and 106a and consequent turning of the pump plungers to positions bringing the inclined control edges of the overflow ports into registration with the respective sets of cylinder overflow ports for part load delivery. In some instances it may be desirable under predetermined conditions to cut off the fuel supply from some cylinders while not affecting fuel supply to other cylinders. In the embodiment illustrated this is accomplished through the medium of the two piece rack and the control pin 110 passing through one part of the rack. As will be noted from Fig. 1 a solenoid 130 is provided the armature 132 of which is provided with a portion projecting in alignment with the end of the pin 110. If the solenoid is energized by either automatic or manual closing of the circuit of which it forms a part, the armature will be moved to the left as viewed in Fig. 1 and by reference to Fig. 4 it will be evident that the control pin 110 will operate to move the rack part 106 to the left without affecting the position of the rack part 106a. This will result in turning plunger 32 to no load position in which

the pump chamber is kept in continuous or substantially continuous communication with the overflow ports in the pump barrel during the entire delivery stroke of the plunger, so that no delivery occurs. At the same time the plunger 32a will remain in the position of rotation determined by the position of the main control means comprising the vacuum cylinder 114. When the solenoid 130 is de-energized spring 108 acts to return the rack part 106 to a position in which nut 112 is in contact with part 106a and in which position the two pump plungers are adjusted relative to each other to effect the same quantities of delivery through their respective delivery ports.

Referring now to Figs. 6 to 8 there is illustrated various alternative cam arrangements for actuating the pump plunger. Each of the sets of cams illustrated in these figures is adapted to be used in a pump of the kind shown in Fig. 1, having two pump cylinders each of which is provided with three delivery ports through which fuel is to be delivered in sequence during the delivery stroke of the respective pump plungers. In these figures 134 represents the base circle of the cams and around the base circle lie concentric circles 134a, 134b and 134c to portions of which the cam profiles rise along pressure or delivery portions 136, 138 and 140 on one cam and corresponding portions 136a, 138a and 140a on the other cam. The direction of rotation of the cams is indicated by the arrow X and the falling portions 142, 142a of the respective cams provide for the suction strokes of the plungers whose movement is governed by the cams. As will be evident from Fig. 6, the cam arrangement shown therein provides for delivery in alternation from each of the two pump cylinders. If it be assumed that the cam which is in front in Fig. 6 is cam 18 of Fig. 1 and the other cam is cam 20 it will be evident that delivery will be in alternation from the two pump cylinders shown in Fig. 1. This is a particularly advantageous arrangement when it is desired to provide for cutting off the fuel supply to some of the cylinders of an engine by means of a regulating mechanism of the kind hereinbefore described. With the cam arrangement of Fig. 6 cylinders 1, 3 and 5 (in the order of their ignition timing) might be supplied with fuel from pump cylinder 30, under the control of cam 18 while cylinders 2, 4 and 6 could be supplied with fuel from pump cylinder 30a under the control of cam 20. With this arrangement if pump cylinder 30 is rendered inoperative, three cylinders of the engine, which are fired at equally spaced intervals in the cycle of operation of the engine will be supplied with fuel by the remaining pump cylinder and even engine operation will be secured. In the arrangement shown in Fig. 7 the cams are formed and arranged so that three deliveries are made in sequence from one pump cylinder during one-half of the cycle of operation of the pump and the remaining three deliveries are made in sequence from the other pump cylinder during the remaining half of the cycle of pump operation. As will be seen from Fig. 7 the three pressure or delivery steps 136, 138 and 140 of one cam, for example cam 18, occur within 180 degrees of cam travel and the corresponding pressure or delivery steps 136a, 138a and 140a also occur within 180 degrees of cam travel of the second cam, the two cams being set 180 degrees apart. The advantage obtained by this arrangement, as will be observed by comparing Fig. 7 with Fig. 6, is that the falling por-

tion of each cam may be extended around a larger proportion of the circumference of the cam than is the case with a cam construction such as shown in Fig. 6. By extending the falling portion of the cam over a larger portion of the cam profile the slope of this portion and consequently the velocity of the pump plunger on its suction stroke at a given speed of operation of the pump may be made lower, which is particularly advantageous in pumps in which the length of the plunger stroke must be sufficiently great to permit a series of delivery periods to be effected during a single delivery stroke. The cam arrangement may be varied in any desired manner and as an example of a further arrangement there is shown in Fig. 8 a cam construction in which the two pumps are operated in a sequence in which the first pump delivers once, the second pump delivers once, the first pump then delivers twice in sequence and the second pump then delivers twice in sequence to complete the cycle. Referring to Fig. 8 it will be observed that with this arrangement the delivery portion 136 of cam 18 acts first, followed next by the delivery portion 136a of cam 20. The next deliveries are those effected by portions 138 and 140 of cam 18 operating in sequence and the last two deliveries of the cycle are effected by portions 138a and 140a of cam 20 acting in sequence.

In the embodiment illustrated in Figs. 9 and 10 the pump is provided with an integral rack 106 to which the piston 118 of the regulator is positively connected.

In order to provide for cutting off the delivery of liquid from one of the pumps, in this case the pump having chamber 48, a solenoid 130a is located above the pump suction valve 50. The armature 132a of the solenoid is provided with a pin-like portion 132b passing through the suction channel above the valve ball 50. If the solenoid is energized, the armature with the pin 132b will move downwardly and hold the suction valve open by forcing the ball 50 downwardly off its seat. The result of this is that when plunger 32 moves upwardly on its discharge stroke it will force the liquid in the pump chamber back into the suction lines during those periods when delivery through the delivery ports would otherwise occur and also will force liquid back into the suction lines during what would otherwise be the overflow periods if the pressure in the suction lines is less than in the overflow passages. It will be evident that with the suction valve held open through the discharge stroke, this pump will be rendered ineffective to effect any delivery and the pump having the plunger 32a will be the only one continuing to operate, thus effecting delivery through outlets 60, 62a, and 64a only.

While pumps embodying the present invention have been hereinbefore described chiefly in conjunction with their use as fuel pumps, it will be apparent that the pump can be employed in many other ways as, for example, the oil pump for lubricating systems and the like.

Evidently many changes in specific design and arrangement may be made without departing from the scope of the invention and it will further be evident that certain features of the invention may be used to the exclusion of others. It is accordingly to be understood that the scope of the invention is not limited by the forms of construction described herein by way of example, but is applicable to all forms of apparatus falling within the scope of the appended claims

when they are construed as broadly as is consistent with the state of the prior art.

What is claimed is:

1. A pump unit for supplying liquid to a plurality of pump outlets comprising a plurality of plunger pumps less in number than the number of pump outlets, each of said pumps being provided with port means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet, and common pump actuating means for actuating said plungers in out-of-phase relation with respect to each other and correlated with respect to said port means to cause the delivery periods of each pump to occur during overflow periods of the remainder of the pumps.

2. A pump unit for supplying liquid to a plurality of pump outlets comprising a plurality of plunger pumps less in number than the number of pump outlets, each of said pumps being provided with means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet, and plunger actuating means arranged to time certain delivery periods of different pumps in alternating sequence during the cycle of operation of the pump unit.

3. A pump unit for supplying liquid to a plurality of pump outlets comprising a plurality of plunger pumps less in number than the number of pump outlets, each of said pumps being provided with means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet, and plunger actuating means arranged to time all of the delivery periods of different pumps in alternating sequence during the cycle of operation of the pump unit.

4. A pump unit for supplying liquid to a plurality of pump outlets comprising a plurality of plunger pumps less in number than the number of pump outlets, each of said pumps being provided with means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet, and plunger actuating means arranged to time all of the delivery periods of each pump in sequence in the cycle of operation of the pump unit.

5. A pump unit for supplying liquid to a plurality of pump outlets comprising a plurality of plunger pumps, each of said pumps being provided with port means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet, and pump actuating means comprising a plurality of cams, there being a different cam for each plunger and each of said cams having a profile providing for stepwise advance of its associated plunger during the delivery stroke of the plunger, the portions of the cam profiles providing the stepwise advances of different plungers being in out-of-phase relation, whereby to cause the advance of different plungers to occur at different times in the cycle of operation of the pump unit to effect deliveries and intermediate portions of the

cam profiles providing for out-of-phase dwell of the plunger during overflow periods.

6. A pump unit for supplying metered quantities of liquid to a plurality of pump outlets comprising a plurality of plunger pumps each having a plunger reciprocably and turnably mounted in a cooperating pump cylinder, each pump being provided with means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet and each plunger being provided with a port controlling portion operative to vary the quantity of liquid delivered by the pump during each such delivery period as the plunger is turned in the cylinder, actuating means for reciprocating the plungers and operable to effect the delivery periods of the different pumps in out-of-phase relation, and control mechanism for simultaneously turning said plungers to effect like changes in the quantities of liquid delivered during all of the delivery periods of all of the pumps.

7. A pump unit for supplying metered quantities of liquid to a plurality of pump outlets comprising a plurality of plunger pumps each having a plunger reciprocably and turnably mounted in a cooperating pump cylinder, each pump being provided with means arranged to cause liquid to be delivered in a series of alternating delivery and overflow periods during one delivery stroke of the plunger and each such delivery period effecting delivery to a different pump outlet and each plunger being provided with a port controlling portion operative to vary the quantity of liquid delivered by the pump during each such delivery period as the plunger is turned in the cylinder, actuating means for reciprocating the plungers and operable to effect the delivery periods of the different pumps in out-of-phase relation, control mechanism for simultaneously turning said plungers to effect like changes in the quantities of liquid delivered during all of the delivery periods of all of the pumps, and auxiliary control mechanism operable to turn at least one of said plungers independently of the remainder to a no-load position to thereby cut off delivery to a plurality of said outlets less than the total number thereof.

8. A pump unit for supplying liquid to at least six pump outlets comprising two plunger pumps each constructed to deliver liquid to a different outlet during a series of different delivery periods alternating with overflow periods during the delivery stroke of the plunger, there being half as many delivery periods during each plunger delivery stroke as the total number of said outlets, a camshaft having two cams thereon for actuating said plungers, said cams having like profiles and being set 180° out-of-phase, each of said cams having a series of rising portions corresponding to the number of delivery periods of its associated plunger and the rising portions of each

of said cams being located to one side of an axial plane passing through the axis of rotation of the cam.

9. A pump unit for supplying metered quantities of liquid to a plurality of pump outlets comprising a plurality of plunger pumps each having a plunger reciprocably mounted in a cooperating pump cylinder, each pump being ported to provide a series of delivery periods to different pump outlets, said delivery periods alternating with overflow periods during one delivery stroke of the pump plunger, and actuating means for reciprocating the plungers, said actuating means including a cam for each pump, each cam having a plurality of rising sections, one for each delivery period of the pump actuated by it, and said cams being set in out-of-phase relation with respect to each other so that the delivery periods effected during one cycle of operation of the pump unit are effected in sequence by different pumps.

10. A pump unit for supplying liquid to a plurality of separate pump outlets comprising two plunger pumps each supplying a plurality of outlets and each constructed to deliver liquid to a different one of its outlets during a series of separate delivery periods occurring in alternation with overflow periods during the delivery stroke, and a cam shaft having two cams thereon for actuating the respective plungers, each of said cams having a series of rising cam sections thereon corresponding in number to the number of outlets of the pump actuated thereby and said cams being set in out-of-phase relation so that the rising sections of the cams actuate their respective plungers in alternation during the complete cycle of operation of the pump.

11. A pump unit for supplying metered quantities of liquid to a plurality of pump outlets comprising a plurality of plunger pumps each having a plunger reciprocably and turnably mounted in a cooperating pump cylinder, each pump being ported to provide a series of delivery periods to different pump outlets, said delivery periods alternating with overflow periods during one delivery stroke of the pump plunger and each plunger being provided with a port controlling portion operative to vary the quantity of liquid delivered by the pump during each such delivery period as the plunger is turned in the cylinder, actuating means for reciprocating the plungers and operable to effect the delivery periods of the different pumps in out-of-phase relation, control mechanism for simultaneously turning said plungers to effect like changes in the quantities of liquid delivered during all of the delivery periods of all of the pumps, and auxiliary control mechanism operable independently of the first mentioned control mechanism for rendering at least one of said plungers, but less than the total number thereof, inoperative to effect delivery through a plurality of said outlets less than the total number thereof.

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