April 15, 1930. P. DISERENS 1,754,743

PUMPING ENGINE

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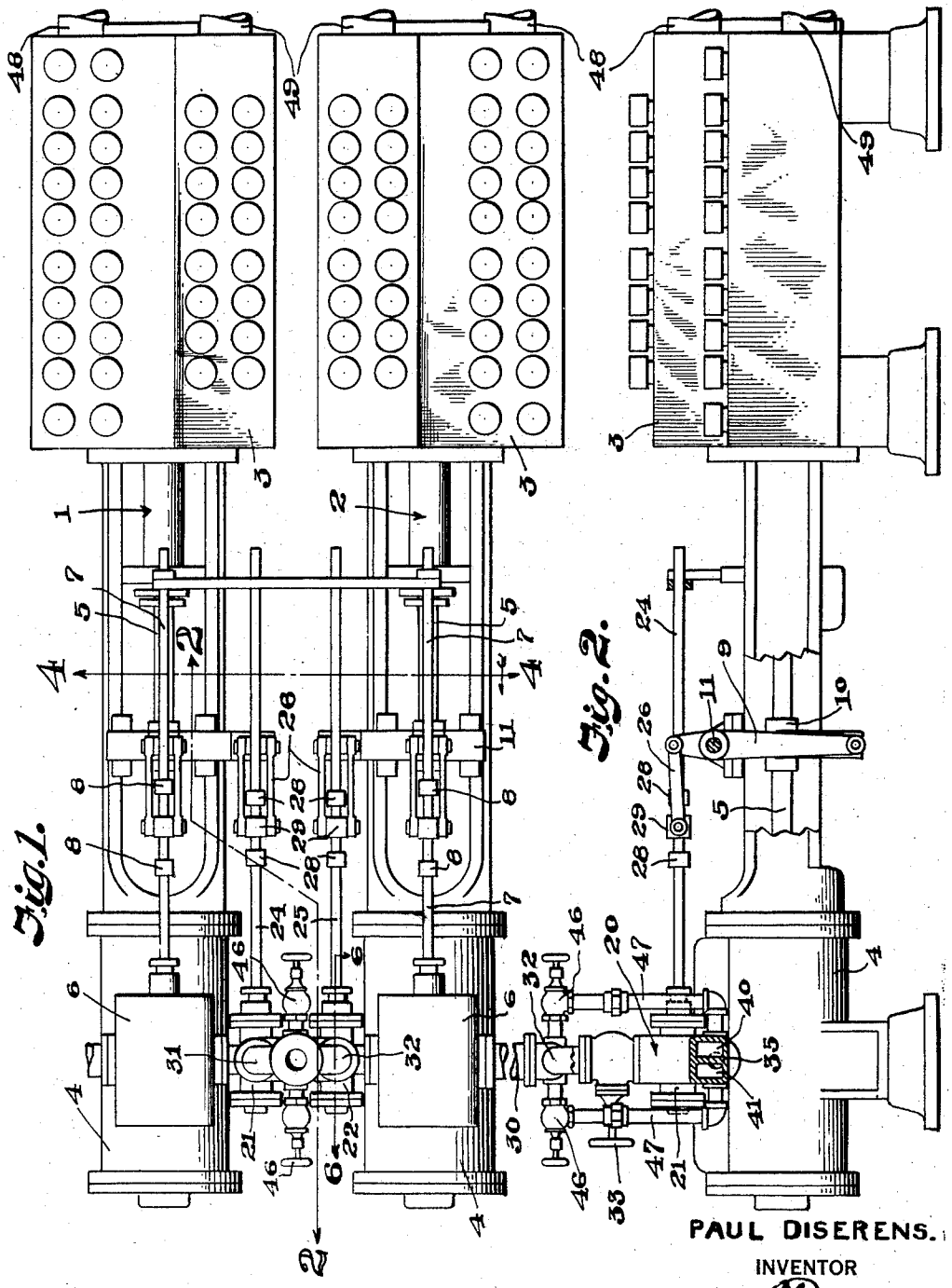


Fig. 1.

Fig. 2.

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Fig. 3.

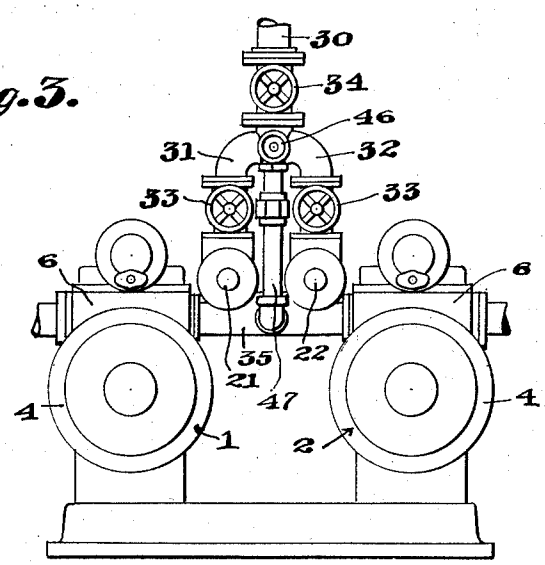
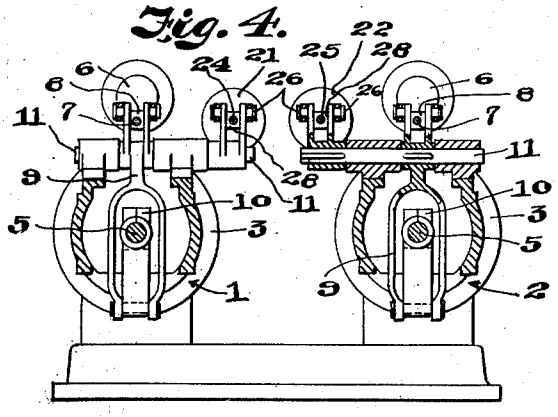


Fig. 4.



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Fig. 5.

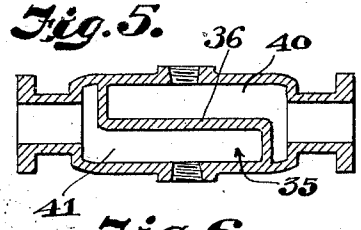


Fig. 6.

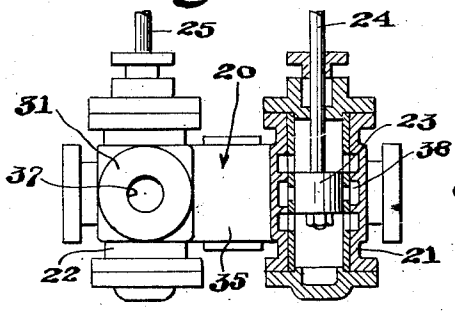


Fig. 7.

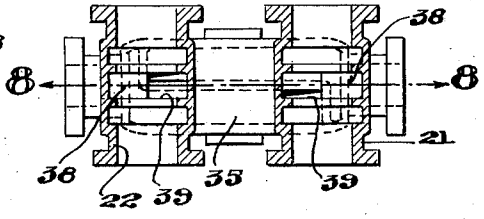


Fig. 8.

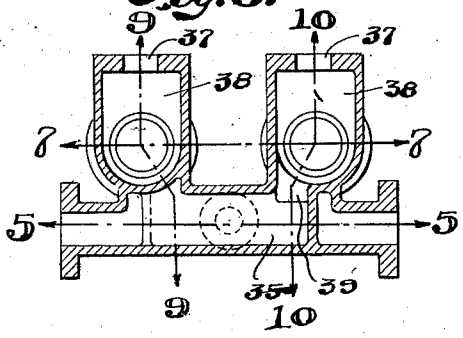


Fig. 9.

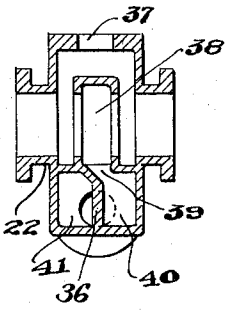
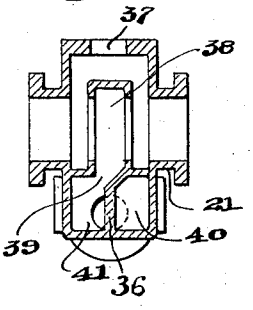


Fig. 10.

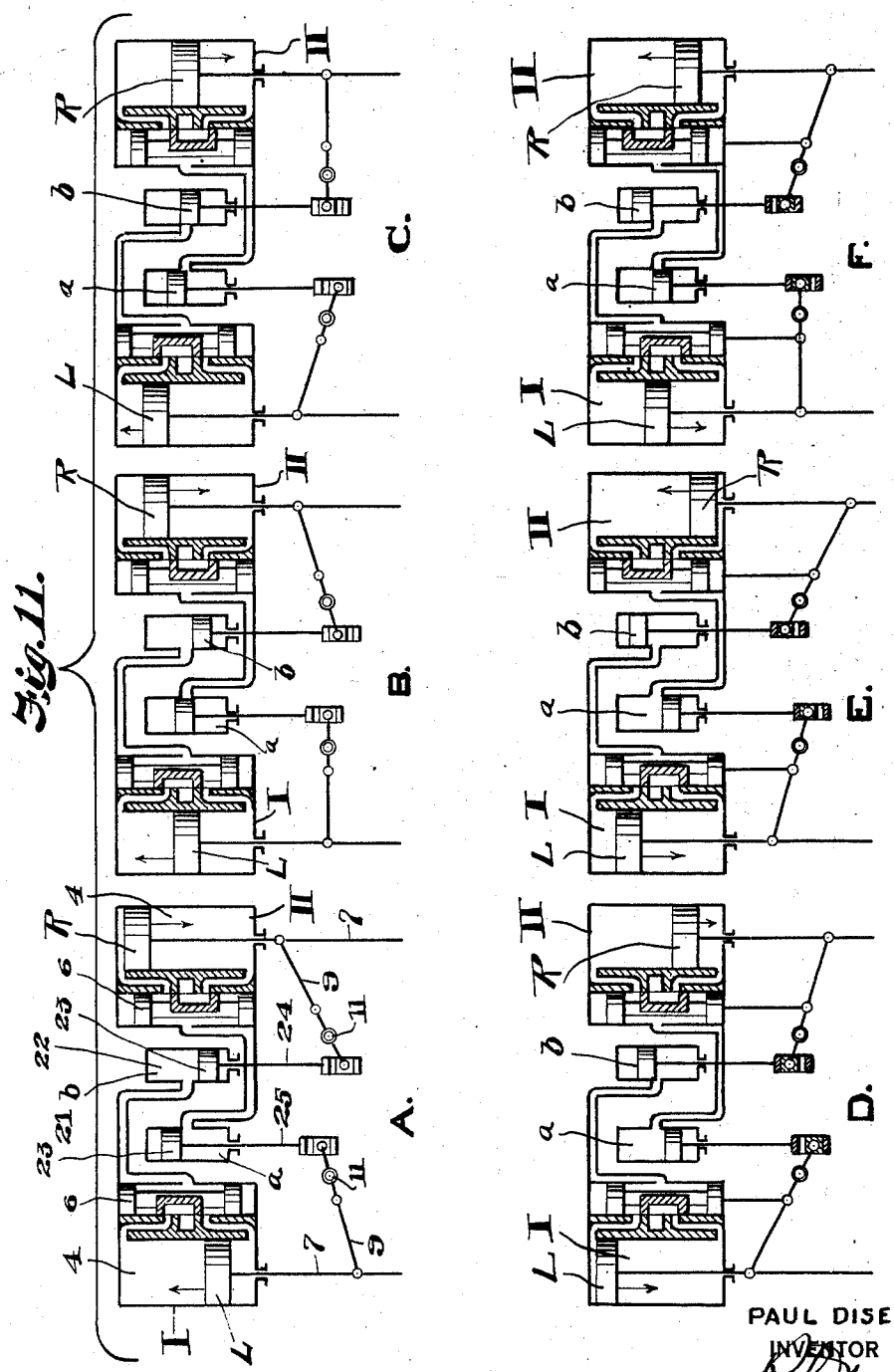


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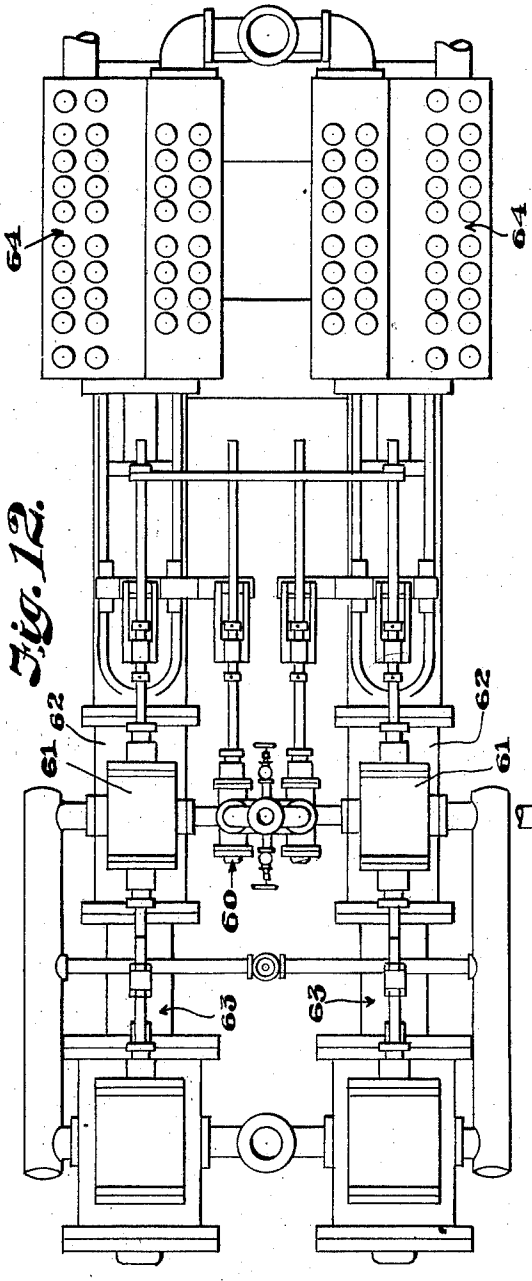


Fig. 12.

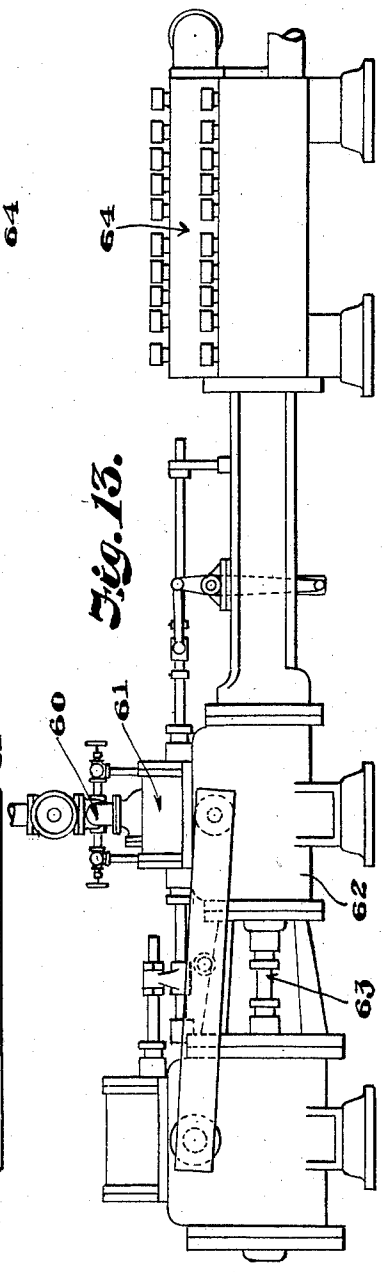


Fig. 13.

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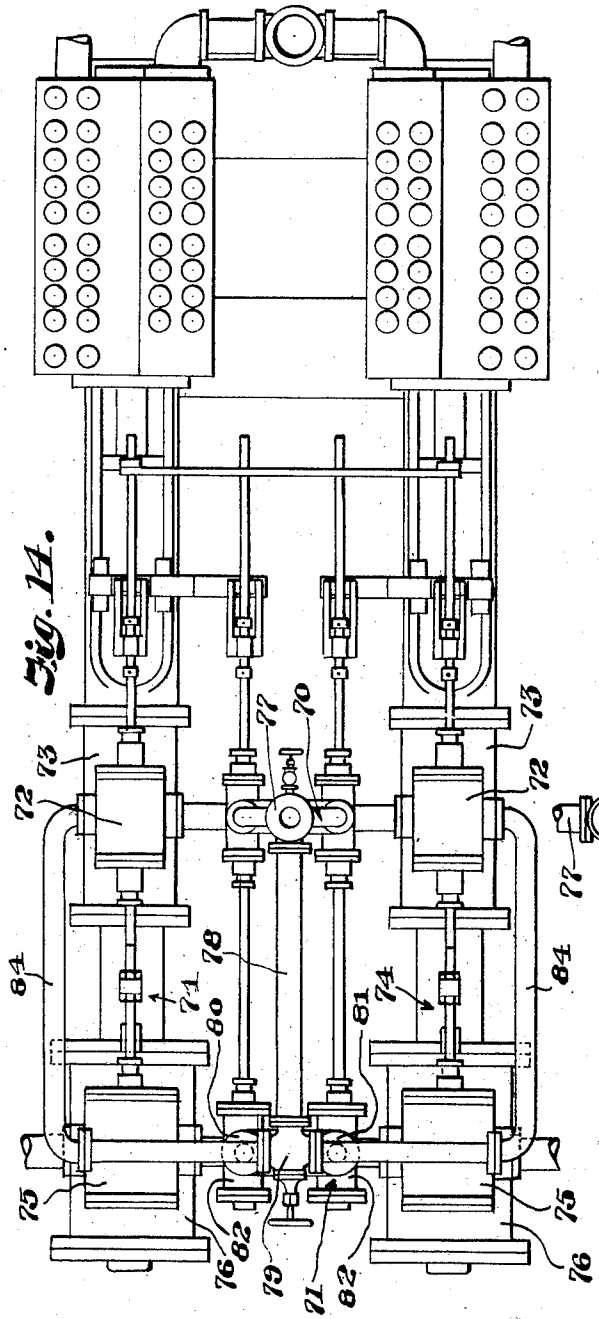


Fig. 14.

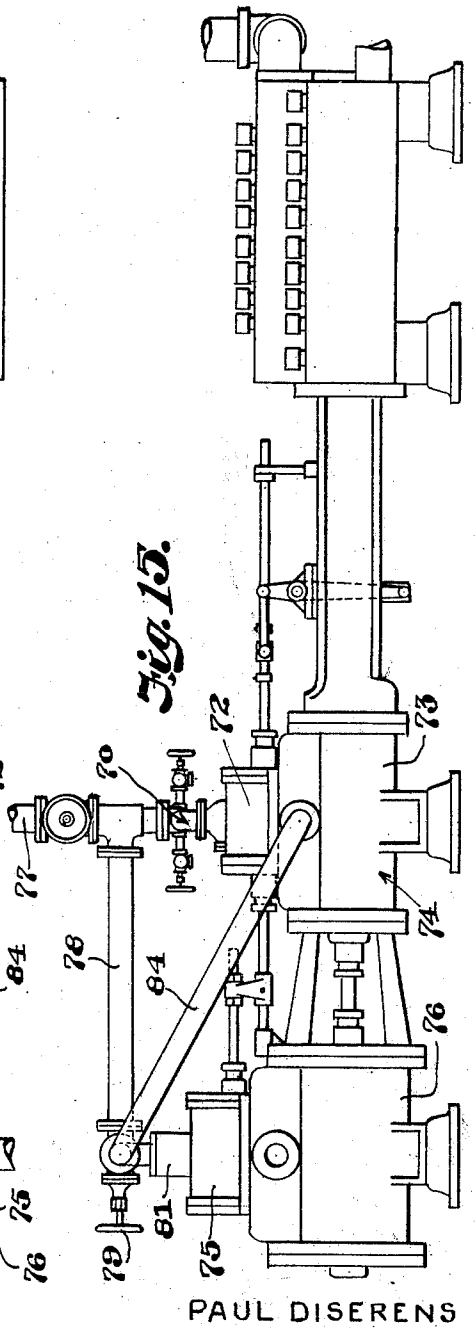


Fig. 15.

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UNITED STATES PATENT OFFICE

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PUMPING ENGINE

Application filed January 24, 1927. Serial No. 163,028.

This invention relates to pumps and more particularly to pumps of the displacement type and an object of the invention is the provision of a pumping unit embodying a plurality of single pumps connected in synchronism and providing uniform flow in a common discharge line, and means controlling the operation of such pumps whereby, in case of accident to one of the pumps the other pump or pumps will continue to operate automatically and to function at its full rated speed.

Single direct acting pumps of approved design embody the advantages over other approved types of displacement pumps such as the duplex pumps in that they are simpler in construction, embody fewer parts and less mechanism; however, their disadvantage is an interrupted flow of liquid in the suction and discharge pipes. This latter disadvantage is overcome by duplex pumps, but in the duplex pump construction, when one of the valve gears becomes inoperative the entire pump structure stops and loss of time, loss of use of the equipment with which the pump is associated, etc., is caused until the pump is repaired.

The present invention provides a pump structure in which the advantages of simplicity of construction of the single direct double or single acting pump are embodied, as well as the advantages of the duplex pump, such as the steady flow of liquid through the suction and discharge pipes, and it further embodies the advantage in that, if one of the pumps is rendered inoperative the station need not shut down as the other pump will continue to operate.

Other objects of the invention are to provide a pumping unit as specified which may handle fluids from separate sources of supply and discharge into a common discharge line; a pumping unit which is relatively simple in construction and embodies no levers to change, or adjustments to be made in the change-over effected in case of accident to one pump.

More specifically the present invention embodies two or more single direct acting pumps each equipped with its own single valve motion including steam and actuating valve gear, and duplex valve gear connected in series with the single valve gears for controlling the flow of steam or motive fluid to the single valve gears of the pumps, together with manually operated control means whereby one of the pumps may be cut out or stopped while the other continues to operate, the said pumps being connected so as to compel them to operate in unison, or as one unit, that is to say so that each pump will make the same number of cycles per minute, each piston lagging a certain percentage of the stroke behind another. The amount of the lap may be adjusted by valve rod clearance or lost motion, or by giving the piston valve of the duplex or synchronizing valve gear a pre-determined amount of lap depending upon service and conditions of the pump installation.

With these objects in view, the invention consists in various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a pump of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings—

Figure 1 is a top plan of the preferred form of the improved pump.

Figure 2 is a side elevation partly in section of the improved pump and taken on the line 2—2 of Figure 1.

Figure 3 is an end view of the pump.

Figure 4 is a vertical cross-section taken on the line 4—4 of Figure 1.

Figure 5 is a longitudinal section through a part of the synchronizing gear of the pump and taken on the line 5—5 of Figure 8.

Figure 6 is a view partly in plan and partly in section of the synchronizing gear, the sectional part being taken on the line 6—6 of Figure 1.

Figure 7 is a section through the synchronizing gear taken on the line 7—7 of Figure 8.

Figure 8 is a vertical section through the gear taken on the line 8—8 of Figure 7.

Figure 9 is a section taken on the line 9—9 of Figure 8.

Figure 10 is a section taken on the line 10—10 of Figure 8.

Figure 11 is a group of diagrammatic figures illustrating the motion or operation of the pump.

Figure 12 is a top plan of a modified form of the pump, showing the duplex or synchonizing gear connected to the high pressure cylinders of a compound pump.

Figure 13 is a side elevation of the modified form of pump shown in Figure 12.

Figure 14 is a top plan of a further modified form of the pump, showing duplex or synchronizing gears connected in series with the valve gears of both the high and low pressure cylinders of a compound engine.

Figure 15 is a side elevation of the form of pump shown in Figure 14.

Referring more particularly to the drawings, the improved pumping unit comprises two or more single direct acting displacement steam pumps 1 and 2 which may be either double or single acting and which are shown positioned in parallel relation to each other and while only two pumps are illustrated in the drawings, it is to be understood that any number of pumps may be connected to form the pumping unit as desired, and that the relative positions of the individual pumps may be varied.

Each of the direct acting steam pump structures 1 and 2 comprises the pump end 3 of any approved type which is connected to the steam or propelling end 4 by the piston rod 5. The steam or propelling end 4 of the pump may be of any approved structure or type and in one form includes the valve gear 6 of approved single direct acting type which is controlled through the medium of the valve rod 7, adjustable tappets 8 and lever 9 which is connected to the cross head 10 mounted upon the piston rod 5 and the operation of this mechanism is the same as in any approved type of direct acting displacement pump.

In the present invention the valve gears 6 have a synchronizing or duplex valve gear structure 20 associated therewith so as to compel the pumps 1 and 2 to operate in synchronism, or as one unit, so that each pump must make the same number of cycles per minute and the synchronizing valve gear structure 20 and its companion mechanisms are arranged so that the piston of one of the pumps will lag a certain percentage of the stroke behind the other piston, in a manner generally regarded as typical of duplex or double direct acting steam pumps.

The duplex or synchronizing valve gear structure includes the parallel steam chests or cylinders 21 and 22 in which the piston valves or slides 23 reciprocate, and the piston valves or slides 23 have piston rods 24 and 25 connected thereto which extend parallel to the valve rods 5 and which are connected through the medium of suitable links 26 with the fulcrum pins 11 of the mechanism of the single pumps, as clearly shown in Figures 1 and 4 of the drawings. Tappets 28 are adjustably mounted upon the valve rods 24 and 25 and they are adjusted in relation to the collars 29 which are connected to the links 26 and move over the valve rods and to the tappets 8 so as to permit the desired amount of lost motion or lap in the operation to provide the desired difference or lagging of one of the pump pistons behind the other during the operation of the pumping unit. The steam or motive fluid for operating the engine or propelling ends of the pump structure enters the steam chests 21 and 22 from the supply pipe 30 through the branch pipes 31 and 32 which may have manually operated valves 33 positioned therein to permit manual control of the steam to either of the pump structures. A valve 34 is provided in the steam supply pipe 30 to permit manual control of the steam or motive fluid to both of the propelling ends 4 of the pump structures. The passage of the steam from the steam chests into the guide 35 is controlled by operation of the pistons or slides 23 and the pistons or slides are, in turn, operated through the medium of the valve rods 24 and 25. It will be noted by particular reference to Figures 5, 8, 9 and 10 of the drawings that the synchronizing valve structure 21, which is operated by the valve rod 24, which is, in turn, controlled by operation of the pump structure 1, controls the passage of the operating fluid or steam into the steam chest 6 of the pump structure 2, while the valve piston 23 controls the passage of the operating fluid or steam into the valve chamber 6 of the pump 1, this cross-over of the steam being effected by the partition 36 formed in the guide 35. The steam enters the steam chests 21 and 22 through the inlets 37 and its passage from the interior of the steam chests, through the spaces 38 and connecting passages 39 into the respective chambers 40 and 41 of the distributor 35 is controlled by the pistons 23.

The steam chests and companion mechanism valve gear are connected in series with the single direct acting valve gears 6 of the pumps 1 and 2, and in cross-over relation as clearly shown in Figure 11 and as above described to provide operation of the pumps in a manner generally regarded as typical of duplex direct acting steam pumps.

The various diagrams A, B, C, D, E and F of Figure 11 of the drawings illustrate the motion or operation of the pump when one piston R lags a pre-determined percentage, for example 25%, of the stroke behind the other piston L. In this case, which is given merely as an example of an indefinite number of possibilities, the piston L is going ahead at full speed until it has travelled about three-fourths of its stroke when the synchronizing valve *b* closes and cuts off the supply to the cylinder I, retarding the pis-

ton L which position is shown in diagram C. At such time piston L cannot finish its stroke until the piston R has re-opened the valve *b*, as shown in diagram D, admitting a fresh charge of steam to the cylinder I, so that the piston L can finish its stroke and reverse its own valve motion 6.

Piston R on the other hand is shown in the dead center and just starting off under a full head of steam with the valve *a* opened but closing rapidly and retarding the piston R. When the piston L has travelled three-fourths of its stroke it will open the valve *a* and admit fresh steam to the cylinder II so that the piston R is permitted to finish its stroke.

The two steam engines 4 will be operated by the same steam pressure and will be working under the same load; naturally they will be operating at substantially the same speed and the synchronizing valve motion is adjusted so as to exert only a slight retardation upon one piston or the other. This adjustment is permitted by means of by-pass valves 46 which will always admit a certain amount of steam to each cylinder through the by-pass pipes 47 and prevent stoppage of the pistons, counteracting the effect of the synchronizing valve mechanisms the proper amount so as not to interfere with the pump controlling operation of the synchronizing valves. The by-pass valves 46 are manually controlled and by their operation the action of the pump may be adjusted to varying suction conditions which might obtain in the pumps 1 and 2 when each pump is handling fluid from a separate source of supply.

The suction to the pump ends 3 of the pumps 1 and 2 is through the suction pipes 48 while the discharge is through the discharge pipes 49 and it will be evident that with this arrangement of pumping unit the pumps 1 and 2 may pump fluid from the same or separate sources and they may discharge into the same discharge line or into separate discharge lines, these features being arranged wholly by the piping connections (not shown).

From the foregoing description taken in connection with the accompanying drawings, it will be noted that the operating fluid or steam supply to the pump structures goes first through the duplex or synchronizing gear structure 20 and then through the standard or approved type of single pump valve gear. Thus, the length of stroke of each of the pumps 1 and 2, the character of reversal and steadiness of the action of each pump is quite independent of the other pump, the only effect of the duplex or synchronizing gear structure 20 being to keep the pumps in step or in proper operative relation and to insure true duplex action of the pump unit to provide a more uniform flow in the suction and discharge pipes. If anything should happen or an accident occur to either of the pumps 1 or 2, causing it to stop or fail to function in any way the other pump would continue to run as a single acting displacement pump, its operation depending only on its own valve gear structure 6. The unaffected pump will not only continue to operate but it will operate at its full rated speed because its steam supply will come not only through its by-pass valve 46 but also through the part of the synchronizing valve structure 20 which supplies its cylinder because the latter is so arranged that only in remote instances can it stop in its closed position, and in such remote instances the valve 46 may be operated to admit the necessary amount of steam through the valve gear 6 of the unaffected pump to permit its operation.

If it is so desired, the flow of steam or motive fluid through the duplex or synchronizing valve gear and the single valve gear 6 may be cut off by manual operation of the valve 33 to cut out or stop operation of either one of the pumps in case of accident or if it is desired to operate only one of the single pumps.

In Figures 12 and 13 of the drawings the duplex or synchronizing valve gear structure 60 the construction and operation of which is the same as the construction and operation of the duplex or synchronizing valve gear structure 20 illustrated in Figures 1 to 10 of the drawings and previously described, is shown as connected in series with the single direct acting valve gear structures 61 of the high pressure steam cylinders 62 of the compound engine structures 63. The compound engine structures 63 are shown connected to each other and to the pump structures or pump ends 64 in the approved manner now in use. The two compound pump structures are arranged connected in the same manner as the single direct acting pump structures 1 and 2 and the operation of the synchronizing or duplex valve gear 60 in connection with the high pressure cylinder valve mcehanism 61 is the same as its operation in connection with the valve gears 6 and connects the two compound pumps for operation in synchronism.

In Figures 14 and 15 two duplex or synchronizing valve gear structures 70 and 71 are illustrated, showing the duplex or synchronizing valve gear structure 70 with the valve gears 72 of the high pressure cylinders 73 of the compound steam engines 74 while the synchronizing valve and gear structure 71 is connected to the valve gears 75 of the low pressure cylinders 76 of the engines 74. The steam inlet pipe 77 of the duplex or synchronizing valve gear structure 70, which inlet pipe corresponds to the pipe 30 in Figure 2 of the drawings is connected by a branch pipe 78, through a valve structure 79 with the branch pipes 80 and 81 which lead to the steam

chests 82 of the synchronizing valve gear structure 71 so that in case the high pressure ends 73 of the compound pumps 74 break down the valve 79 may be opened to permit live steam to pass through the duplex or synchronizing valve gear structure 71 to the low pressure cylinders 76 of the compound engines 74 and at such times the pistons in the high pressure cylinders 73 will be balanced by having high pressure steam on each side thereof. In Figures 14 and 15 pipes 84 are provided for conducting the exhaust steam from the high pressure cylinders 73 to the synchronizing or duplex valve gear structures 71 and through this valve gear structure to the valve gears 75 of the low pressure cylinders for permitting control of the operation of the low pressure cylinders through the duplex or synchronizing valve gear structure 71.

While steam is referred to specifically in the foregoing specification and in the claims, it is to be understood that any motive fluid may be employed for operating the pumps and that wherever the word steam is used it is to be considered as covering any suitable motive fluid such as steam, compressed air, etc.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that these may be modified widely within the invention defined by the claims.

What is claimed is:

1. The combination, with a pair of direct acting pump engines, each having a steam valve gear, of a duplex valve gear connected in series with said valve gears of the engines for controlling flow of motive fluid to the single valve gears, and by-passes to permit passage of a limited amount of motive fluid to said single valve gears independently of the duplex valve gear.

2. The combination, with a pair of direct acting pumping engines and their steam valve gear, of a synchronizing valve gear connected in series with said valve gears, and means connecting said synchronizing valve gear to said engine valve gears whereby the operation of one engine will control the passage of motive fluid to the other engine through said synchronizing valve gear.

3. The combination, with a pair of direct acting pumping engines and their steam valve gear, of a synchronizing valve gear connected in series with the valve gears of the engine, means connecting said synchronizing valve gear to said engine valve gears whereby the operation of one engine will control the passage of motive fluid to the other engine through said synchronizing valve gear, and means associated with said synchronizing valve gear to permit continued operation of one engine upon stoppage of the other engine.

4. The combination, with a pair of direct acting pumping engines and their single direct acting valve gears, of a synchronizing valve gear for controlling the supply of steam to said single valve gears, means connecting said synchronizing valve gear to said engines whereby the operation of one engine will control the passage of motive fluid to the other engine through said synchronizing valve gear, said means arranged to control said synchronizing valve gear whereby each engine piston will lag a pre-determined amount behind the other at certain stages of each cycle of operation of the engine.

5. The combination, with a pair of direct acting pumping engines, and their single direct acting valve gears, of a synchronizing valve gear for controlling the supply of steam to said single valve gears, means connecting said synchronizing valve gear to said engines. whereby the operation of one engine will control the passage of motive fluid to the other engine through said synchronizing valve gear. and means independent of said synchronizing valve gear for controlling the flow of motive fluid to either of said engines.

6. The combination, with a pair of direct acting pumping engines, and their single direct acting valve gears, of a synchronizing valve gear for controlling the supply of steam to said single valve gears, said synchronizing valve gear including a valve structure for each engine, means connecting said valve structures to said engines for operating the valve structures by operation of the engines, and a guide receiving the motive fluid from the valve structures and directing it to the single acting valve gear of the engine other than the one operating the respective valve structure.

7. The combination, with a pair of direct acting pumping engines, and their single direct acting valve gears, of a synchronizing valve gear for controlling the supply of steam to said single valve gears, said synchronizing valve gear including a valve structure for each engine, means connecting said valve structures to said engines for operating the valve structures by operation of the engines, a guide receiving the motive fluid from the valve structures and directing it to the single valve gear of the engine other than the one operating the respective valve structure, and by-passes to permit a limited amount of motive fluid to flow to the single valve gears of the engines independently of the synchronizing valve gear.

8. The combination, with a pair of direct acting pumping engines, and their single direct acting valve gears, of a synchronizing valve gear for controlling the supply of steam to said single valve gears, said synchronizing valve gear including a valve structure for each engine, means connecting said valve structures to said engines for operating the valve structures by operation of the engines,

a guide receiving the motive fluid from the valve structures and directing it to the single valve gear of the engine other than the one operating the respective valve structure, by-passes to permit a limited amount of motive fluid to flow to the single valve gears of the engines independently of the synchronizing valve gear, and valves in said by-passes for regulating the amount of motive fluid flowing to the single valve gears, whereby one engine may continue to operate upon stoppage of the other engine.

9. The combination, with a pair of direct acting pumping engines, each having a steam valve gear, of a duplex valve gear connected in series with said valve gears of the single engines for controlling flow of motive fluid to said steam valve gears, and manually controlled valves for controlling the flow of motive fluid to either of said engines whereby one engine may be stopped independently of the other.

10. The combination, with a pair of direct acting pumping engines and their steam valve gear, of a synchronizing valve gear connected in series with the valve gears of the engine, means connecting said synchronizing valve gear to said valve gears whereby the operation of one engine will control the passage of motive fluid to the other engine through said synchronizing valve gear, by passes to permit passage of a limited amount of motive fluid to said single valve gears independently of the duplex valve gear to permit continued operation of one pump upon stoppage of the other pump, and manually controlled valves for controlling the flow of motive fluid to either of said pumps whereby one pump may be stopped independently of the other.

11. The combination, with a pair of compound direct acting pumping engines, each having high and low pressure steam cylinders and the steam valve gears for said cylinders, of duplex valve gears connected one in series each with the steam valve gears of the high pressure cylinders and one with the steam valve gears of the low pressure cylinders for controlling flow of motive fluid to said steam valve gears, and a valved by-pass to permit delivery of motive fluid to the duplex valve gear connected to the steam and actuating valve gears of the low pressure cylinder without passage through the duplex valve gear connected to the steam valve gears of the high pressure cylinders.

In testimony whereof I affix my signature.

PAUL DISERENS.