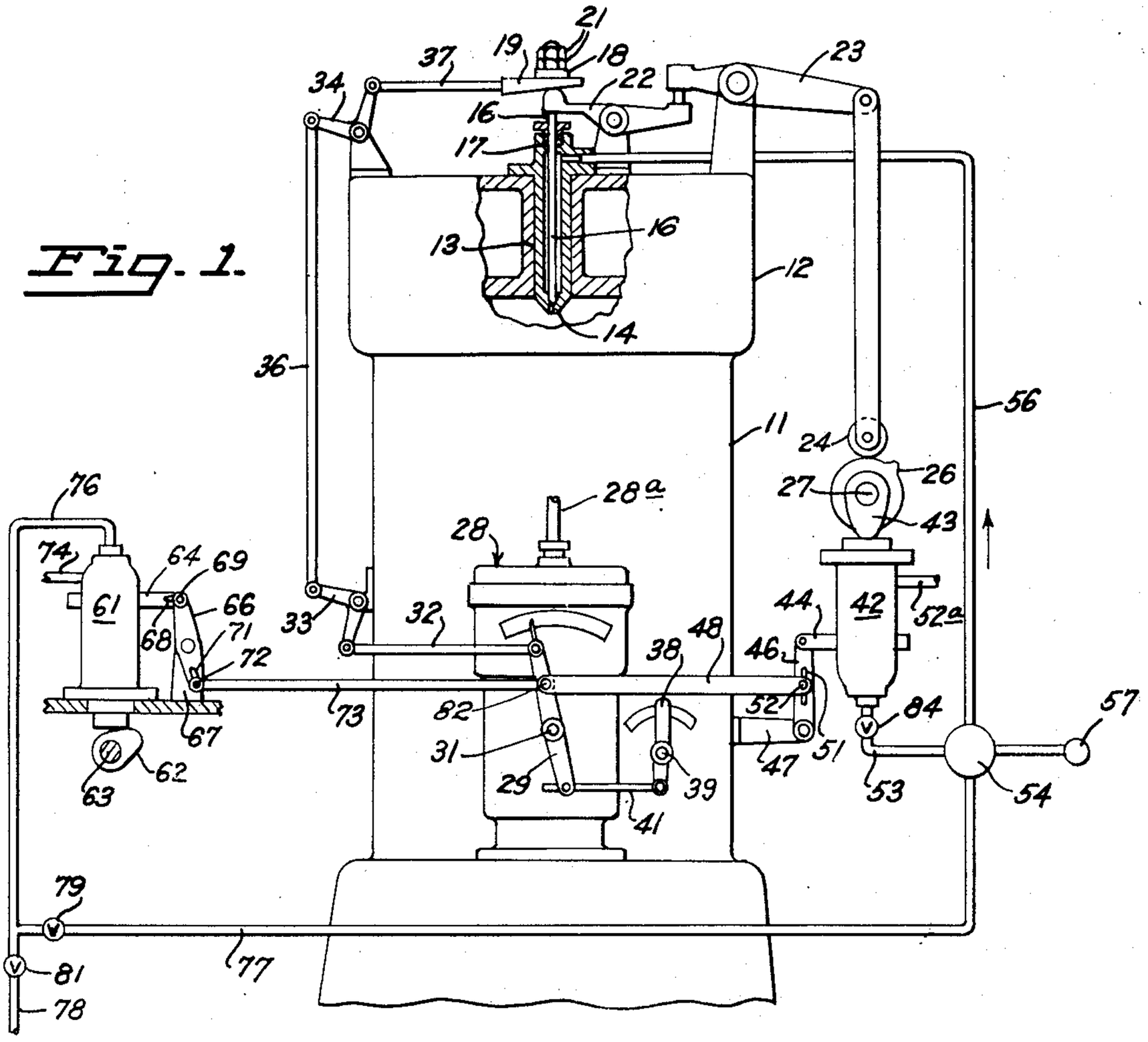
Feb. 17, 1953 S. W. NEWELL 2,628,607

CONTROL SYSTEM FOR DIESEL ENGINES

Filed May 20, 1947 2 SHEETS—SHEET 1

Fig. 1.



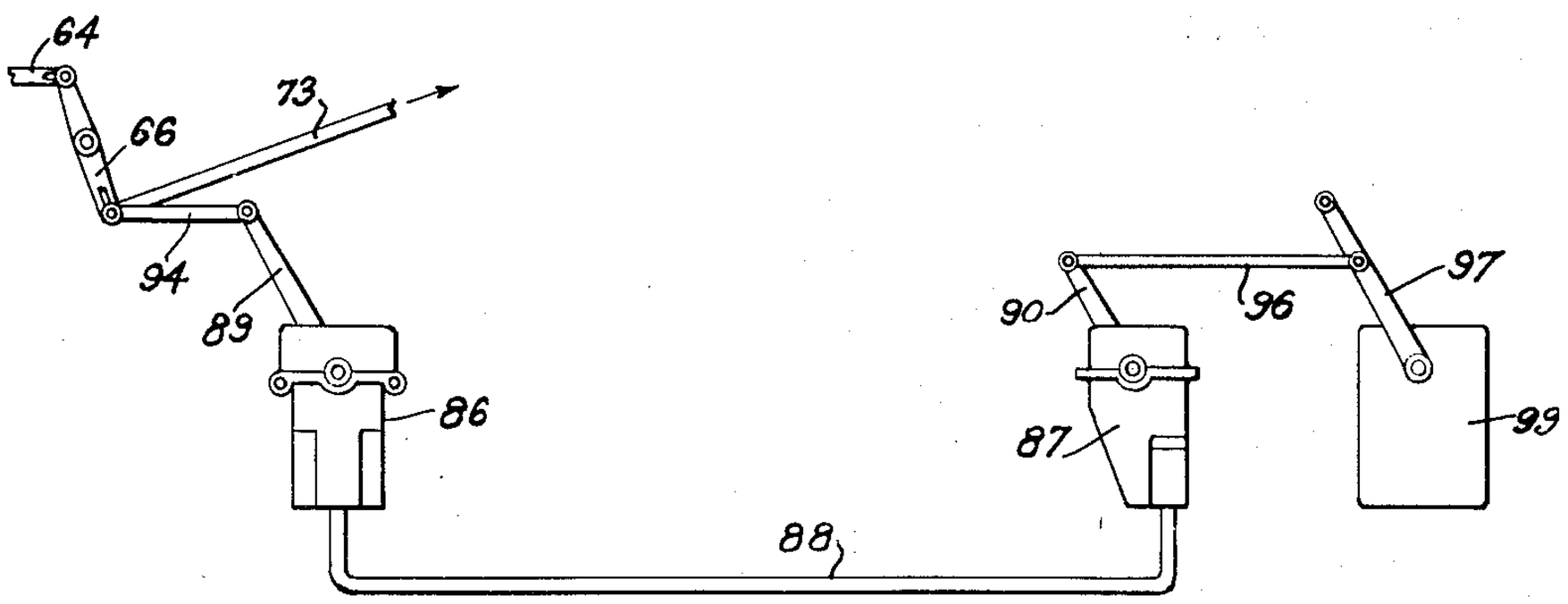


Fig. 2.

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Fig. 4.

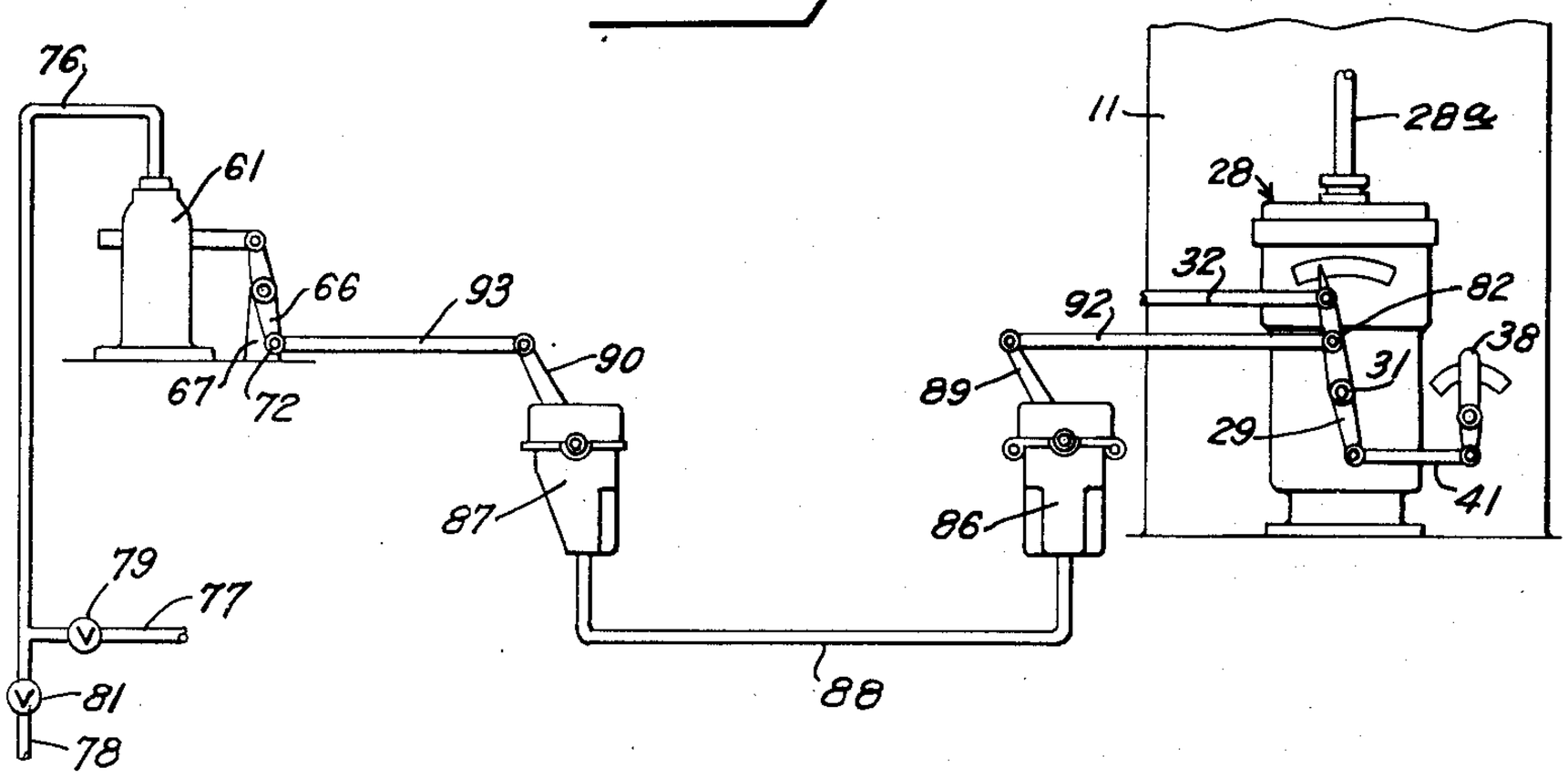
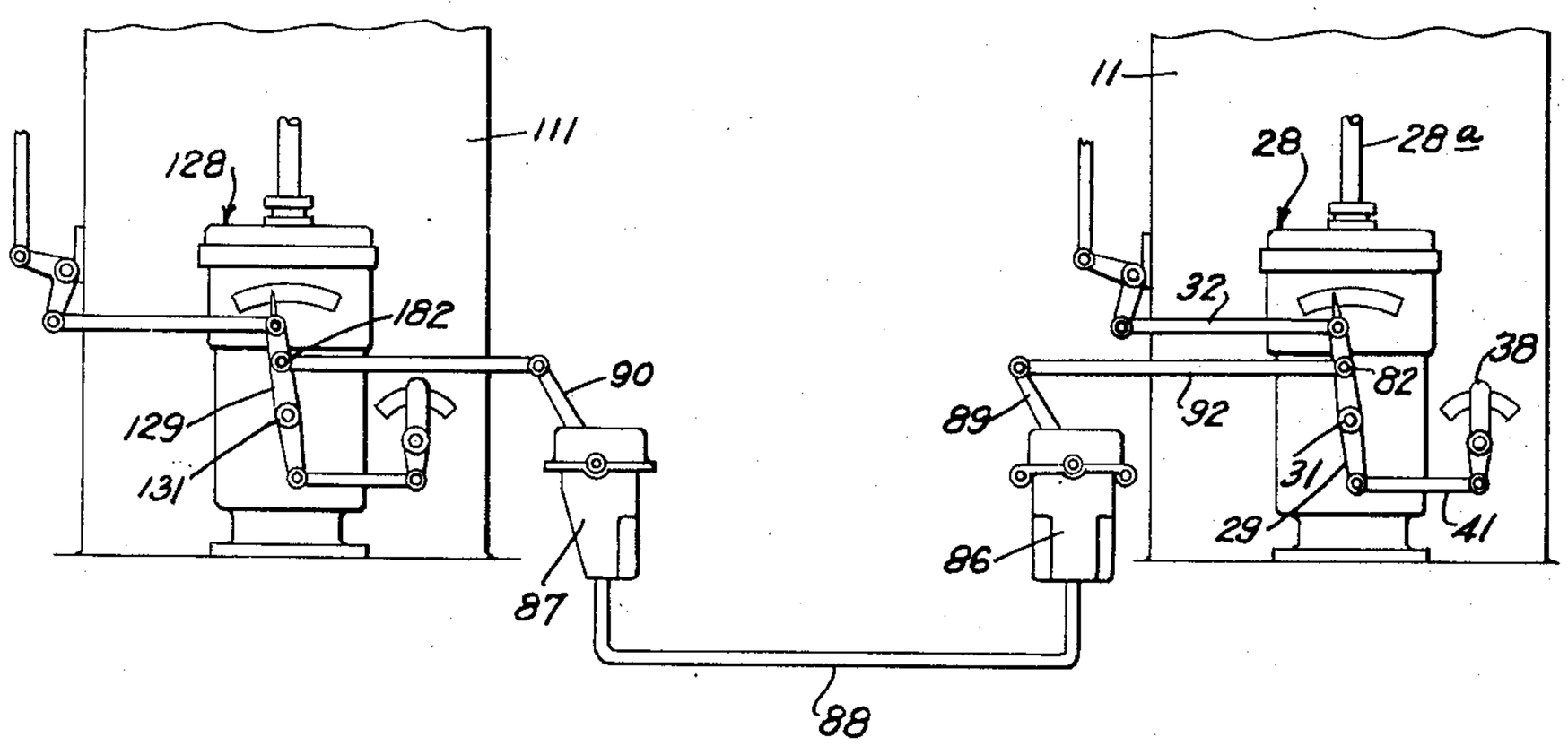


Fig. 3.



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CONTROL SYSTEM FOR DIESEL ENGINES

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2 Claims. (Cl. 123—140)

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This invention relates to fuel supply systems of diesel engines, and is an improvement over that described in United States Letters Patent No. 1,747,578, issued February 19, 1930, to Davison et al.

Continuous operation of large marine and stationary diesel installations over long periods of time is generally required, but failure of the fuel supply systems results at times in shutdowns of uncertain duration which depends on the period of time required to repair the supply system used.

An object of this invention is to provide means to avoid such shutdowns. Another object of this invention is to provide means which will avoid shutdowns for extended duration. Still another object of this invention is to provide a standby fuel supply system which will supply the necessary fuel in the necessary manner, even though the main fuel supply system fails. A further object of this invention is to supply means whereby the fuel supply system of a diesel engine can be used to supply the necessary fuel in the necessary manner to another diesel engine when the fuel supply system of such other engine fails. A still further object of this invention is to supply means whereby the fuel supply system of a diesel engine can supply fuel not only to its own engine but simultaneously also to another diesel engine.

Other objects of this invention are to provide a fuel supply system which is flexible and adaptable to change of circumstances and conditions of use; which is comparatively simple in function; and which may be manufactured, installed and serviced with minimum expenditure of time, effort and special skill.

Other objects of this invention will be apparent on reading this specification, taken in connection with the accompanying drawings which show the preferred embodiments of the invention.

Referring to the drawings:

Fig. 1 is a side elevation, partly broken away, of a cylinder of a diesel motor and related parts, with one embodiment of the invention applied thereto.

Fig. 2 is a side elevation, with parts broken away, showing a different embodiment of a control.

Fig. 3 is a similar view of a still different embodiment of a control.

Fig. 4 is a similar view of yet another different embodiment of a control.

The diesel engine comprises a cylinder 11, through the head 12 of which projects a spray nozzle 13, terminating in a spray tip 14, for injecting fuel, under pressure, into the cylinder. A

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needle valve 16 normally forms a closure for the spray tip but is movable to open it at the proper time. This needle projects through a stuffing box 17 and its upwardly projecting end is provided with a collar 18 which is engaged by a wedge-shaped member 19 below it. Nuts 21 limit the height of the collar 18 on the needle valve 16.

Engaging the wedge-shaped member 19, at its underside, is an intermediate rocker arm 22 which is actuated by a main rocker arm 23. The arm 23 carries a roller 24 at its lower end, this roller riding on a fuel cam 26 secured on an engine-driven shaft 27. The needle valve is thus raised intermittently with relation to the spray tip so as to permit injection of the fuel into the cylinder 11. The quantity of fuel injected determines the power output of the cylinder, and as engines of this character are subjected to varying load conditions, means are provided for regulating the open period of the needle valve, this comprising the wedge-shaped member 19. The latter is actuated by a governor 28 which is driven by its shaft 28a and which is in turn driven by the diesel engine. This moves the wedge longitudinally, that is horizontally, whereby the period of time that the needle valve 16 is lifted and at open position is determined. The action of the governor on the wedge is through a link and crank assembly. This comprises an arm 29 fastened intermediate its ends to a shaft 31, the rotary position of which is controlled by the governor 28.

The structure described so far is very similar to that of Patent No. 1,747,578, referred to previously. A link 32 is pivoted at its ends to the upper end of the arm 29 and to an arm of a bell crank 33, the other arm of which is connected to an arm of another bell crank 34 by means of a link 36. To the other arm of the bell crank 34 is pivoted a rod 37, to which the wedge-shaped member 19 is attached. Changing the rotary position of the shaft 31 thus places a thicker or thinner part of the wedge 19 under the collar 18 to control the time and period of opening of the needle valve. A manually operable lever 38 is pivoted intermediate its ends to a fixed support (not shown), as at 39, and its lower end is connected to the lower end of the arm 29 by a link 41. Control of the needle valve can thus be automatic or manual, the former by the governor and the latter by the lever 38.

There is a fuel pump 42 which is actuated periodically by a cam 43 which is on and rotated by the shaft 27, so that this pump is actuated periodically in predetermined relation to the periodic

operation of the fuel injection spray nozzle 13. A control rack 44 controls characteristics of the fuel forwarded to the engine cylinder by the pump 42 by its position with respect to such pump. A link 46 is pivotally connected to the rack 44 and to a supporting arm 47. A link 48 is pivotally connected to the link 46 and also to the arm 29 on the same side of the shaft 31 as that to which the link 32 is connected for controlling the position of the wedge 19. The link 46 has a slot 51, in which a pin 52, attached to the link 48, rides, this type of connection preventing any possible jamming when the arm 29 is rotated in either direction through the desired angle.

The pump 42 has a fuel inlet 52ª and feeds fuel through a pipe 53 into a rail or manifold 54 from which the fuel passes through a pipe 56 to the spray nozzle 13. The position of the arm 29 thus not only controls the spray nozzle but also the feed of fuel thereto. Connected to the manifold 54 is a spring-loaded relief valve 57, which discharges any excess of fuel forwarded by the pump 42 over that which can pass through the spray nozzle 13 into the engine cylinder.

In the operation of diesel engines, as well as of other engines, load and speed conditions of operation are subject to great variation. For the best operation of diesel engines, there should be varying regulation of various characteristics of feed of fuel into the engine cylinder. These include varying controlled regulation of the amount of fuel sprayed into the cylinder in each complete cycle of engine operation, including all the phases thereof, and also the pressure at which it is sprayed. The amount of the fuel injected can be conveniently controleld by variably regulating either the lift or open period of the spray valve needle or the quantity and speed of flow of the fuel delivered by the pump to the spray nozzle, or by both together.

The apparatus of Patent No. 1,747,578 functions to regulate variably the duration of time that the spray nozzle is open as well as the amount and pressure of the fuel delivered by the pump to the spray nozzle. Such apparatus also functions to regulate such valves in unison with each other in a manner coordinated with variations in load and speed conditions of the engine. Such regulation is automatic by means of a governor driven by the engine, or it can be accomplished manually.

The governor, in the case of stationary diesel engines, usually operates to take care of varying load and speed conditions, no matter what causes the variation; while in the case of marine diesel engines it usually operates only on engine overspeeds such as are due to the ship's propeller coming out of the water as sometimes happens in heavy weather.

The apparatus of the present invention, so far as it has been described up to this point, has a structure somewhat similar to that of the patent referred to above, and it controls variably the same fuel feed characteristics in the same manner as does the apparatus of such patent.

The present invention involves modification of the control means in such manner as to attain its objects, and it permits the use of any suitable governor, any suitable spray nozzle, and any suitable pump. Thus devices of these kinds which are on the market can be obtained quickly and assembled into the combination with little effort. For example, a conventional governor, such as the Massey Machine Company's type H–3, hydraulic isochronous governor, illustrated in cut

H–245 on page 14 of its descriptive booklet can be used and is preferred. There must be means to control variably the amount of fuel forwarded by each feed cycle of the pump and it is preferably of the scroll type.

Another fuel pump 61 (Fig. 1) is provided and this may be an additional standby pump or it may be the fuel pump of another diesel engine. Also, it may be near by or remote. For example, fishing boats frequently have a plurality of diesel engines, one to drive the boat and one to run refrigeration apparatus. The pump of either such engine can, of course, function in cooperation and feed fuel to its own engine, but by means of this invention it can be used to feed fuel to and function in cooperation with the other engine, in case of a breakdown. This other fuel pump 61 may be conveniently adjacent to the engine which it is to feed, or it may be remote therefrom and yet controlled by the governor of such engine.

Fig. 1 shows the other fuel pump 61 adjacent to the engine which it is to run. This pump is operated by a cam 62 on a shaft 63 and has a control rack 64, all as in the pump 42. The rack is moved by a lever 66 pivoted intermediate its ends on a supporting arm 67. The rack has a slot 68, through which a pin 69, which is attached to the lever arm 66, projects. The other end of the lever arm 66 has a slot 71, through which a pin 72, on an end of the outer link 73, projects. The other end of the link 73 is to be attached to the arm 29 which can conveniently be at the same point as link 48. The pump 61 has a fuel inlet 74 and discharges into the pipe 76 which can discharge into the pipe 77 which leads into the rail or manifold 54. The pipe 76 can, if and when desired, discharge into a pipe 78 leading to a rail or manifold of another engine (not shown). Valves 79 and 81 in the pipes 77 and 78, respectively, will control the course of the fuel forwarded by the pump 61. Either of the links 48 or 73 may or may not be disconnected, as desired, when the pump which it controls is not in use.

With this in view, a single removable pin 82 may be used to connect these links to the lever arm 29. In certain instances the shaft 63 may be the shaft 27, particularly in the case of an additional standby pump closely adjacent to the pump 42. The pipe 53, which connects the discharge of the pump 42 with the rail or manifold 54, is provided with a valve 84 which is to be closed when the pump 61 is to function in place of the pump 42. The fuel pumps 42 and 61 and parts appurtenant thereto are thus easily interchangeable in a very short period of time by a proper choice of the links 48 and 73 and of the valves.

A remote control connection is substituted for the link 73 to connect the pins 72 and 82 operatively to each other, if the pump 61 is remote from the engine 11, and, again, the pump 61 may be an added pump or may be the pump of another engine. The remote control connection is preferably of the hydraulic type and that manufactured and sold by Sperry Products, Inc., is suitable.

Referring to Fig. 4, such a connection comprises containers 86 and 87 for hydraulic liquid connected together by a pipe 88 filled with such liquid and having levers 89 and 90, respectively, so arranged that when the lever 89 is moved, by application of external force, the other lever 90 moves likewise. The assembly 86, 89 is called

the "transmitter" and the assembly 87, 90 the "receiver." The transmitting lever 89 is connected to the arm 29 by a link 92 which is pivoted to the lever 89 and also to the arm 29 by the pin 82. The receiving lever 90 is connected to the lever 66 by a link 93. Thus, the links 92 and 93 may be considered as parts of the link 73 with the remote control device between them. Thus, a diesel cylinder can operate with its feed pump replaced by a standby feed pump or by that of another diesel engine regardless of whether the replacing pump be near or remote, care being taken, of course, that the valves are properly adjusted. This can be accomplished by having the governor of the running diesel engine control the governor of the other engine, and through it the fuel feed pump of that other engine. This is illustrated in Fig. 3 where the cylinder 11 is to be fed by a pump of another engine 111. For the sake of simplicity both engines may be considered as being alike and having the same construction and functioning of governors, pumps, and other appurtenant parts.

The parts related to the engine 111 have reference numbers one hundred greater than like parts related to the cylinder 11. The transmitter lever 89 is connected in the same manner as in Fig. 4. The receiver lever 90 is connected by the pin 182 to the arm 129 on the shaft 131 of the governor 128. This governor, however, controls the pump that normally feeds the cylinder 11 and controls it no matter where the fuel it pumps is led. When it is led to the cylinder 11, the governor 28 controls the governor 128 and thereby the flow of fuel to the cylinder 11, even though it is forwarded by a pump of the cylinder 111.

Referring to Fig. 2, the parts 64, 66, 73, 86, 87 and 88 are similar to those previously described and having, respectively, the same reference indicia. The link 73 is actuated by the governor 28 of the diesel engine 11 to control a fuel feed pump (not shown) as described with respect to Fig. 1. A link 94 is connected to the lever 66 and to the lever 89 of the remote control transmitter 86. The lever 90 of the receiver 87 is connected by a link 96 to an arm 97 on a shaft 98 of a governor 99 of another diesel engine.

The governors 28 and 99 of the different engines thus can be made to function in phase with each other, as can the governors 28 and 128 shown in Fig. 3. With the governors functioning in phase with each other, they cause simultaneous opening and closing of the corresponding spray tips of the different engines. This is done in proper phase relation to the operation of the pump of either engine. Thus the feed pump of one engine can supply its own engine and another engine simultaneously with fuel.

Certain details have been illustrated and described for the purpose of explaining the invention, but some of them may be added to, changed, or omitted without departing from the spirit of the invention of which the scope is defined in the appended claims.

I claim:

1. A fuel supply system for diesel engines in combination with a diesel engine having at least one cylinder to which fuel is to be supplied via a spray nozzle associated with said cylinder comprising; a first pump connected via a fuel conduit to said spray nozzle, a first driving means individually associated with said first pump for driving said first pump, a second pump connected via a fuel supply conduit to said spray nozzle, a second driving means individually associated with said second pump independent of said first driving means for driving said second pump, an engine governor operatively associated with said engine, a first connecting mechanism for individually disconnectably linking said first pump to said governor for controlling the action of said pump in coordinated relation to the load and speed conditions of said cylinder, a second connecting mechanism for individually disconnectably linking said second pump to said governor for controlling the action of said pump in coordinated relation to the load and speed conditions of the cylinder, and valve means comprising shut-off valves individually associated with said first and second pumps and the fuel supply conduits for individually and independently controlling the supply of fuel from said pumps to said spray nozzle.

2. A system according to claim 1 and wherein said second connecting mechanism for disconnectably linking said second pump to said governor includes hydraulically actuated transmitter and receiver assemblies.

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