March 20, 1928. 1,663,513

C. L. HOWSE

RAM DRIVE FOR UNDERFEED STOKERS

Filed March 2, 1922 2 Sheets-Sheet 1

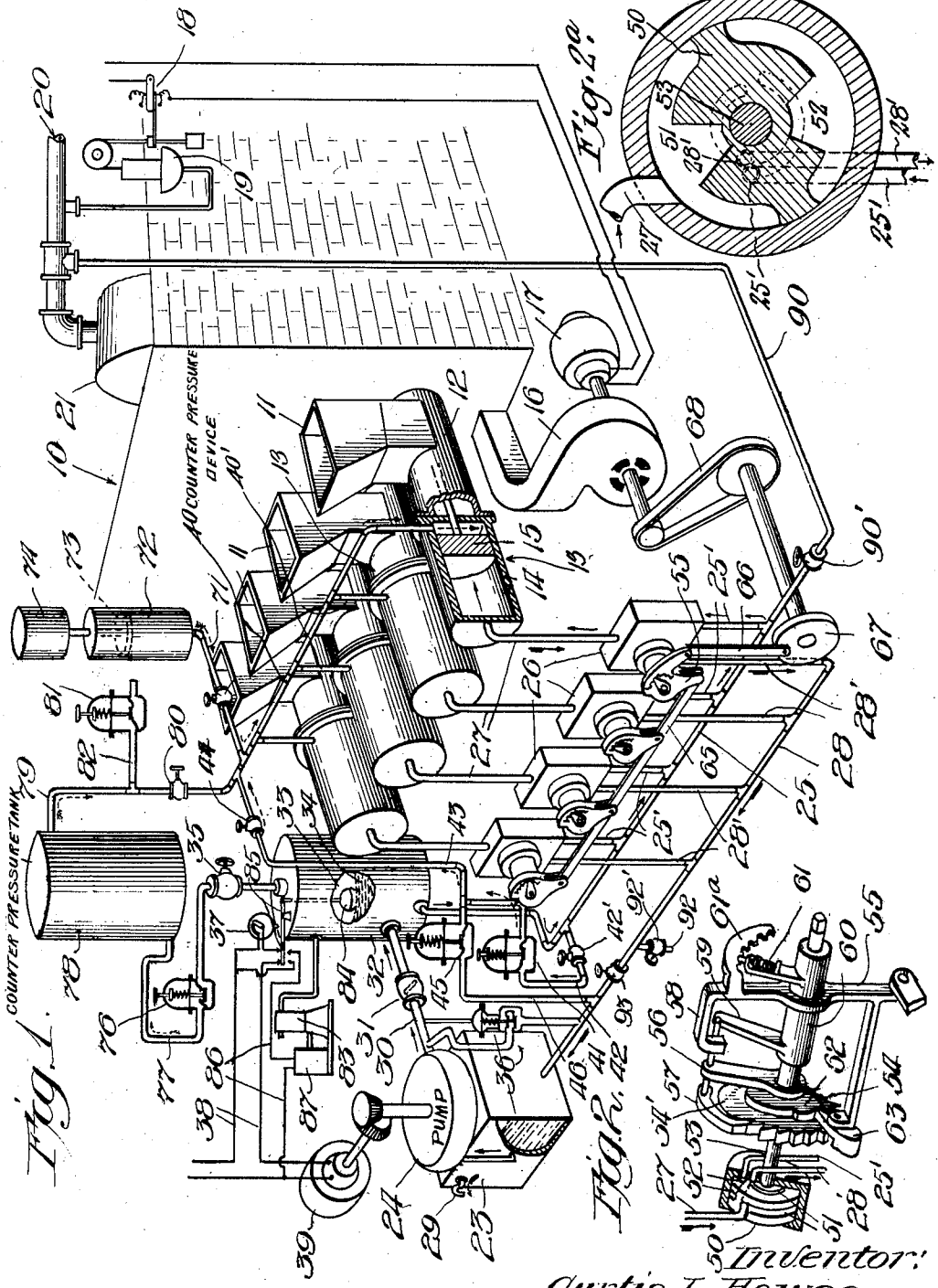

Fig. 1.

Fig. 2a.

Fig. 2.

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Fig. 3.

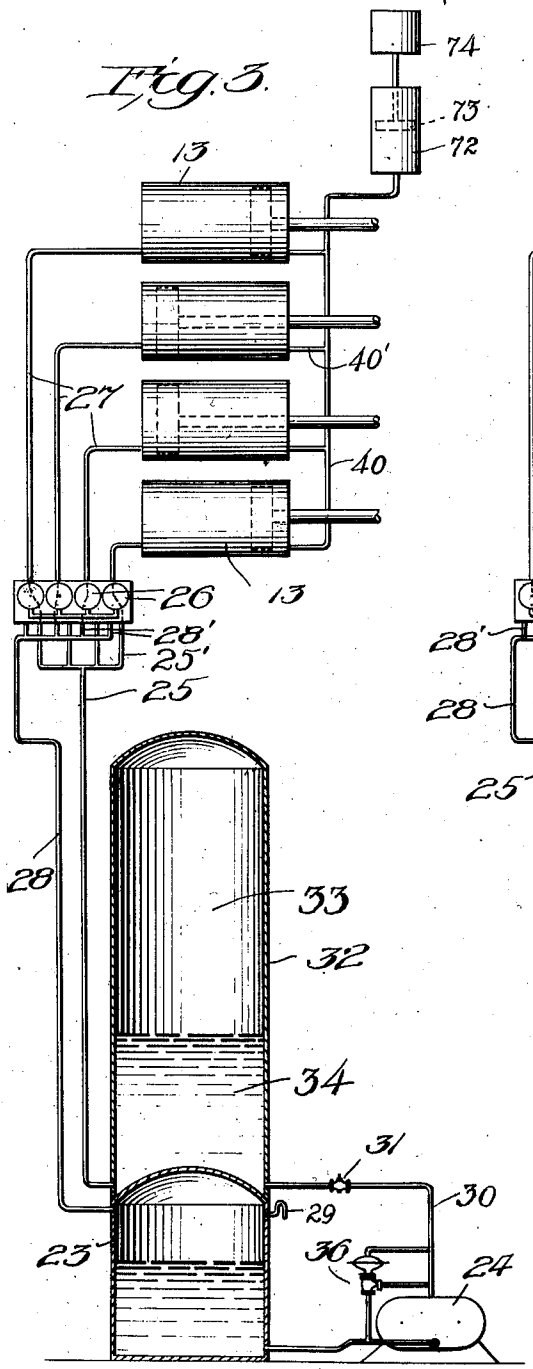
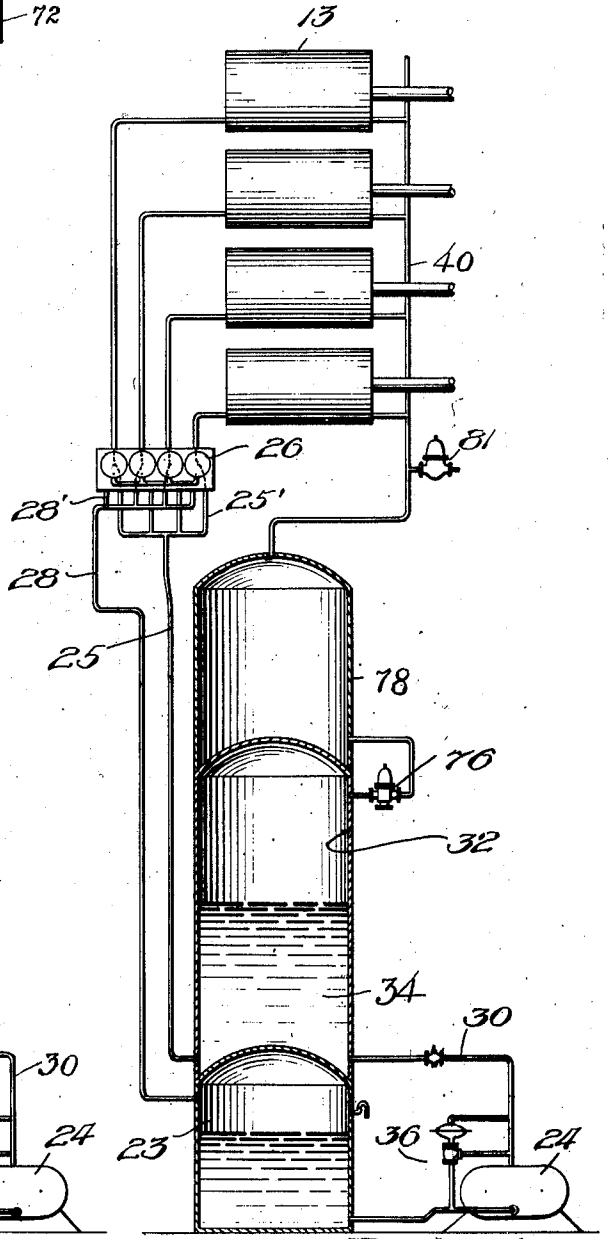


Fig. 4.



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UNITED STATES PATENT OFFICE.

CURTIS L. HOWSE, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RILEY STOKER CORPORATION, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

RAM DRIVE FOR UNDERFEED STOKERS.

Application filed March 2, 1922. Serial No. 540,646.

My invention has for its general object to provide an improved drive for the rams of underfeed stokers, and in some particulars relates more especially to hydraulic drives for this purpose.

In attainment of some of its objects, my invention provides hydraulic means for operating the rams of a battery of underfeed-stoker retorts, each at such intervals as are predetermined for it regardless of the intervals between operations of other rams of the group, but with the timing of operation of all rams generally harmonized with the demand of the steam boiler, requisite for maintenance of proper steam pressure therein. Other objects of my invention are to provide a ram drive installation made up of units of relatively simple construction, in coordination and arrangement accommodating simplicity and convenience in the placement of piping, location of operating parts and flexibility of adaptation to widely varying detail requirements; and further objects of the invention will become apparent from the following description taken in conjunction with the accompanying drawings.

In the drawings I have illustrated my invention in diagrammatic form only for ease of understanding, since proportions and details will be widely varied according to the needs of the particular plant. In such drawings, Fig. 1 is a diagrammatic perspective of a system embodying my invention, having several sources of return-pressure supply which may be used alternatively or supplementally one to the other; Fig. 2 is a skeletonized diagram of a valve construction showing its operating parts spread out somewhat; Fig. 2^a is a conventionalized detail of the valve showing its port-arrangement; Fig. 3 is a simplified diagram showing an accumulator only as the return-pressure supply-source, and Fig. 4 is a similar simplified diagram showing an air-pressure return-actuation.

The furnace 10 may have each of its underfeed retorts, not shown, supplied with fuel from a hopper 11 by means of a ram-structure 12 of known design, the plunger of which is reciprocable by a suitable engine 13. This may comprise a suitable cylinder 14 closed at both ends and containing the piston 15 connected to the ram plunger. Air may be supplied to the wind-chamber below the retorts by a fan 16, the speed of which may be varied automatically for increase of the air supply as boiler pressure drops, and decrease as the pressure rises. As one means for this purpose the fan 16 may be driven by an electric motor 17 the speed of which is controlled by a rheostat 18 which is governed by a pressure regulator 19 connected with the steam header 20 of a suitable boiler 21. It is desirable that the fuel also be fed at an increased rate as boiler-pressure drops, and to this end the feed-controlling appliances should be governed in accordance with boiler pressure, so that conveniently this regulation may be effected from the fan shaft as will hereafter be described. Also it is desirable that this control be supplemented by control of the periodicity of operation of each ram individually, and this requirement, too, is accommodated in my present system.

The rams are actuated on their feed stroke hydraulically, preferably against a constant counter-pressure which, when the hydraulic feeding pressure is relieved, will return the piston on its idle stroke or out-stroke. In the specific construction shown, the liquid employed, such as oil, is drawn from a supply source or tank 23 by a pump 24 which may be of any suitable construction adapted to develop the requisite pressure, and is forced to tank 32 from which it flows through a supply header 25 and respective branch pipes 25′ to the valves 26, respective to the several engines (as indicated by solid, featherless arrows), which valves 26 will operate at appropriate times to open communication between said pressure pipes and the pipes 27 which lead from the respective valves, each to the head end or outer end of its engine cylinder. At another period in the operation of each valve it may connect said pipes 27 with a respective branch pipe 28′ of the return header or relief pipe 28, which leads back to the supply chamber 23. This relief pipe may stand normally under atmospheric pressure, as by the provision of a vent 29 for the supply chamber above the normal liquid level; pressure-relief course being indicated by solid half-feathered arrows.

It is generally desirable to employ a pressure tank between the pump and the high pressure header 25, and the pump is illus-

trated as connected by pipe 30, which includes a check-valve 31 for prevention of reverse flow, with the pressure tank 32 which will contain a body of compressed air in the space 33 above the liquid body 34. For present purposes this pressure chamber may be regarded as closed at its upper end, as it will be upon closure of the manual valve 35. Pipe 25 is directly connected with the tank below the liquid level. In some instances, also, it is desirable to insure very positively against the development of too high a pressure in the hydraulic system, and this may be done by connecting a suitable "unloading valve" or by-pass valve 36 between pipe 30 and return pipe 28, and also by providing a pressure gauge 37 having switch contact included in the electric circuit 38 for a motor 39 utilized to drive the pump. It will be understood that the pump may be otherwise operated and yet conveniently subjected to pressure control.

Return pressure, substantially less than the feeding pressure, may be constantly supplied to the inner or ram end of the respective cylinders through branch pipes 40′ of a low pressure header 40, and substantially constant low pressure may be supplied to this header in various ways. If desired, the pressure of high pressure pipe 25, reduced by suitable valve mechanism, may be applied to pipe 40, and to this end I have illustrated a conventional pressure reduction valve 41 connected by pipe 42 with high pressure header 25 and by pipe 43, containing manual valves 42′ and 44, with the low pressure header 40. The course of counter-pressure through these connections is indicated by featherless dotted arrows. To insure against development of too high a pressure in the header 40 a relief valve 45 may be connected by pipe 46 between said pipe 43 and the relief header 28.

Now it will be apparent that with pressure in header 40 maintained at say 40 pounds, and the pressure in pipe 25 maintained at approximately 120 pounds, the opening of a valve 26 to establish communication between pipes 25 and 27 will cause the piston to be forcibly impelled on its instroke or feeding stroke, and as soon as valve 26 cuts off this connection and opens communication between pipe 27 and relief pipe 28, the lower return pressure will force the piston back on its idle or out-stroke, expelling the liquid from the head end of the cylinder for return to the supply tank 23.

For the stated valve-operation, I preferably utilize a form of ratchet-advance valve that is generically known, each such valve having means for individual adjustment of its step-length. In the skeletonized construction shown in Fig. 2 the rotary valve 50 may, through its ports 51 and 52, establish communication between pipe 27 and either of pipes 25′ and 28′. This valve is rotated by shaft 53 on which is fixed a ratchet wheel 54. A rocking frame 55, coaxial with the shaft throws back and forth the loosely pivoted arm 56 of the actuating pawl 57 for the ratchet, step length being variable by lost-motion adjustment between the two abutments 58 and 59 of said frame which work on opposite sides of the pawl-arm, the one abutment to retract it, the other to advance it. One of these abutments is provided on a sleeve 60 rotatable with respect to the frame and adapted to be fixed in adjusted position by a suitable latch 61 coacting with an indexing rack 61ª on the main frame structure. In order to insure, however, that the port 52 for the high pressure supply will always be brought into full register with pipe 27 by a single step motion of the rocking frame, and carried fully out of register on the next step motion, ratchet 54 has a stripped portion 54′ and has fixed to it a two-toothed supplemental ratchet 62 coacting with a pivoted pawl 63 non-adjustably carried by the frame 55. At one period of operation the pawl 57 acts on the last tooth of the main ratchet 54, and this brings the first tooth of the two-toothed ratchet 62 into position to be engaged by pawl 63. Such pawl imparts two full-stroke movements to the valve-shaft, with the result above stated.

Provision is preferably made for rocking the frame of each valve at a rate consistent with the speed of rotation of the fan shaft. To this end the valve frames are all connected together by links 65 to rock in unison, and one of them is operated by a link 66 from a crank member 67 which is driven from the fan shaft, as through speed reducing belting and pulleys 68.

In the operation of the equipment thus far described, the pump 24 maintains liquid under high pressure in the pressure tank 32, preferably employed, and in the supply line 25, and also maintains in the pipe 40 a lower liquid pressure, this return pressure being supplied through the pressure reducing valve 41 when cut-off valves 42′ and 44 are open, the maximum pressure that may exist in the header 40 being determined by the relief valve 45 which is set consistently with and very slightly above the pressure-setting of valve 41. Valves 26 have their ratchet operating mechanisms constantly driven, as by connections from the fan shaft as a convenient source of power, and, with the construction shown in Fig. 2, each valve may be adjusted so that its ratchet mechanism will take either a long step or a short step according to the lost motion permitted between abutments 58 and 59. Thus, after a predetermined number of steps, the valve is brought to position to connect high pressure branch pipe 25′ with the cylinder-pipe 27, and the liquid under high pressure (act-

ing through the pressure-connections as shown in solid, featherless arrows, Fig. 1) drives the piston 15 of the appropriate ram engine 13 to in-stroke position as shown in section in Fig. 1. The liquid under lower pressure that normally fills the inner or ram-end of the cylinder is forced out by way of pipes 40, 43 and 46, through the relief valve 45, to the return header 28, to flow back into the liquid supply chamber 23. Since the provision of two-toothed auxiliary ratchet 62 in the valve operating mechanism insures that the stated valve connection between pipes 25 and 27 will always be fully opened by a single step-movement of the valve frame 55, and in the next succeeding oscillation of the frame will fully close said connection but open connection between pipes 27 and 28', the ram is retracted immediately after its power stroke. The opening of this connection between the engine pipe 27 and the branch 28' of the return header 28 frees the piston 15 for its return movement, and under the substantially constant-return-pressure supplied to header 40, and its branch 40' to the engine, the piston 15 is driven on its out-stroke, expelling the liquid from the head end of the cylinder through said pipes 27 and 28 back to the supply chamber 23, (as shown by solid, half-feathered arrows, Fig. 1). Through suitable pressure responsive means, the rapidity of oscillation of the actuating frames 55 of the several valves 26 may be increased as boiler pressure drops and decreased as boiler pressure rises, the specific construction illustratively shown providing for pressure regulation of the speed of the fan, and consequently of the valve mechanism driven by the fan-shaft.

If absolute uniformity of return pressure in the header 40 be desired, the provision heretofore described for liquid supply to said header from the pipe 25 through the reducing valve 41 may be put out of service by closure of cut-off valves 42' and 44 (or such provision eliminated) and the return pressure header 40 may be connected through pipe 71 (including a cut-off valve 71') with an accumulator 72 in which a liquid body is maintained under constant pressure in a cylinder by the action of piston 73 borne upon by a constant weight 74. Of course by closing off the valve 71 this auxiliary or supplemental source of pressure supply may be put out of service, instead of delivering counter-pressure in the course indicated by a dotted, full-feathered arrow.

As a further or alternative source of return-pressure supply a connection may be established between a properly-maintained source of air pressure and the header 40, and in the specific construction shown the air space 33 of supply tank 32 is shown as connectible through the cut-off valve 35 and through a suitable pressure-reducing valve 76, both of which are connected in a pipe 77, with an air chamber 78, the outlet pipe 79 of which may be opened through a manual cut-off valve 80 to the header 40 (as indicated by dotted half-feathered arrow, Fig. 1). A relief valve 81 set consistently with and for a pressure slightly above the pressure setting of valve 76 governs an outlet connection 82 from the pipe 79 to atmosphere.

Where a pressure tank 32 containing both air and liquid is employed, and the air is subject to leakage or other escape, provision may further be made for insuring maintenance of a sufficient body of air in the chamber, as by means of an air pump 83, and this is especially useful where the air pressure from chamber 32 is utilized for returning the ram-engine pistons. Thus, in the specific construction diagrammatically illustrated in Fig. 1 a liquid-level-responsive device in chamber 32, such as the float 84, may suitably control the operation of pump 83 as by working the switch 85 controlling the circuit 86 for an electric motor 87 that drives the air pump. This switch may also control the circuit 38 for the motor of the liquid pump. Upon rise of the liquid body 34 to a predetermined level the liquid pump 24 ceases to operate and the air pump is thrown into operation, by virtue of the action of switch 85 in opening the circuit for the motor 39 and closing the circuit for the motor 87. Of course by closing the manual cut-off valves 35 and 80 the air system for supplying return pressure may be put out of operation.

While it is preferable and highly desirable to use hydraulic actuating means for driving the ram engines on their power-strokes, provision may be made for steam actuation in emergency, as in the event of a break-down of the main liquid pump 24. Thus, as shown in Fig. 1, a steam supply pipe 90 tapped from steam header 20 or other suitable source of supply but normally closed by a cut-off valve 90', may be connected to the normally dead end of the high pressure pipe 25, a connection 92, controlled by a manual valve 92' that normally stands closed, may be made from the return pipe or header 28 to any suitable point of utilization of exhaust steam, and the manual cut-off valve 93 (normally open) may be provided between this connection 92 and the liquid supply chamber 23.

Fig. 3 shows, in simplified diagram, such of the parts illustrated in Fig. 1 (and identified by like numerals) as will incorporate the accumulator 72 as the sole source of counter-pressure; and Fig. 4 shows, in like manner, such parts of Fig. 1 as would make the air chamber 78 the sole source of counter-pressure.

It will be understood that by providing a rotary pump having a suitable maximum pressure capacity, which will not injure the system in any event, some of the protective provisions herein suggested may be eliminated, but a system as hereinbefore described may be operated with any suitable form of pump, with adequate protection to all of the devices employed, and with insurance of very prompt forceful operation of the ram-engine for efficient results automatically attained.

While I have herein set forth in some detail particular embodiments of my invention, some details of which I may claim for their specific advantages, it will be understood that I do not limit my invention in its broader aspects to details of the specific mechanisms as set forth and that changes in construction and arrangement of parts may be made without departure from the spirit of my invention within the scope of the appended claims.

I claim:

1. In a driving system for stoker rams, the combination with a plurality of rams, of respective reciprocating engines therefor, means including a hydraulic pump and a storage tank to serve all of said rams for developing engine-operating high pressure, high pressure connections between said tank and one end only of each said engine and including for each said engine an automatic controlling valve, each said valve being operable to connect said end only of its engine with the high pressure and alternately to relieve pressure therein, means for operating said valves, settable individually as to periodicity of operation of each said valve, and means independent of said valves for supplying lower pressure to the other end of each engine for effecting its return stroke when the high pressure is relieved as aforesaid.

2. In a driving system for stoker rams, the combination with a plurality of rams, of respective reciprocating engines therefor, means including a hydraulic pump and a storage tank to serve all of said rams for developing engine-operating high pressure, high pressure connections between said tank and one end only of each said engine and including for each said engine an automatic controlling valve, each said valve being operable to connect said end only of its engine with the high pressure and alternately to relieve pressure therein, means for operating said valves, settable individually as to periodicity of operation of each said valve, and means independent of said valves for supplying lower, constant hydraulic pressure to the other end of each engine for effecting its return stroke when the high pressure is relieved as aforesaid.

3. The combination with a reciprocating ram-engine, of a source of hydraulic high pressure supply, a pressure tank connected therewith normally to contain a body of liquid and a body of air under pressure, a ram-engine controlling-valve and connections therefor, said valve being automatically operable to connect one end of the ram-engine with the liquid supply area of the pressure tank and, alternately, with the suction side of the pump, pump driving means, means for supplying air under pressure to said supply tank, and liquid-level responsive means controlling the operation of said air supply means.

4. The combination with a reciprocating ram-engine, of a source of hydraulic high pressure supply, a pressure tank connected therewith normally to contain a body of liquid and a body of air under pressure, a ram-engine controlling-valve and connections therefor, said valve being automatically operable to connect one end of the ram-engine with the liquid supply area of the pressure tank and, alternately, with the suction side of the pump, pump-driving means, means for supplying air under pressure to said supply tank, and liquid-level responsive means controlling the operation of said air supply means and said engine-operating means.

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