July 3, 1923.

1,460,586

C. L. HOWSE

HYDRAULIC DRIVE FOR STOKER RAMS

Filed March 2, 1922

4 Sheets-Sheet 1

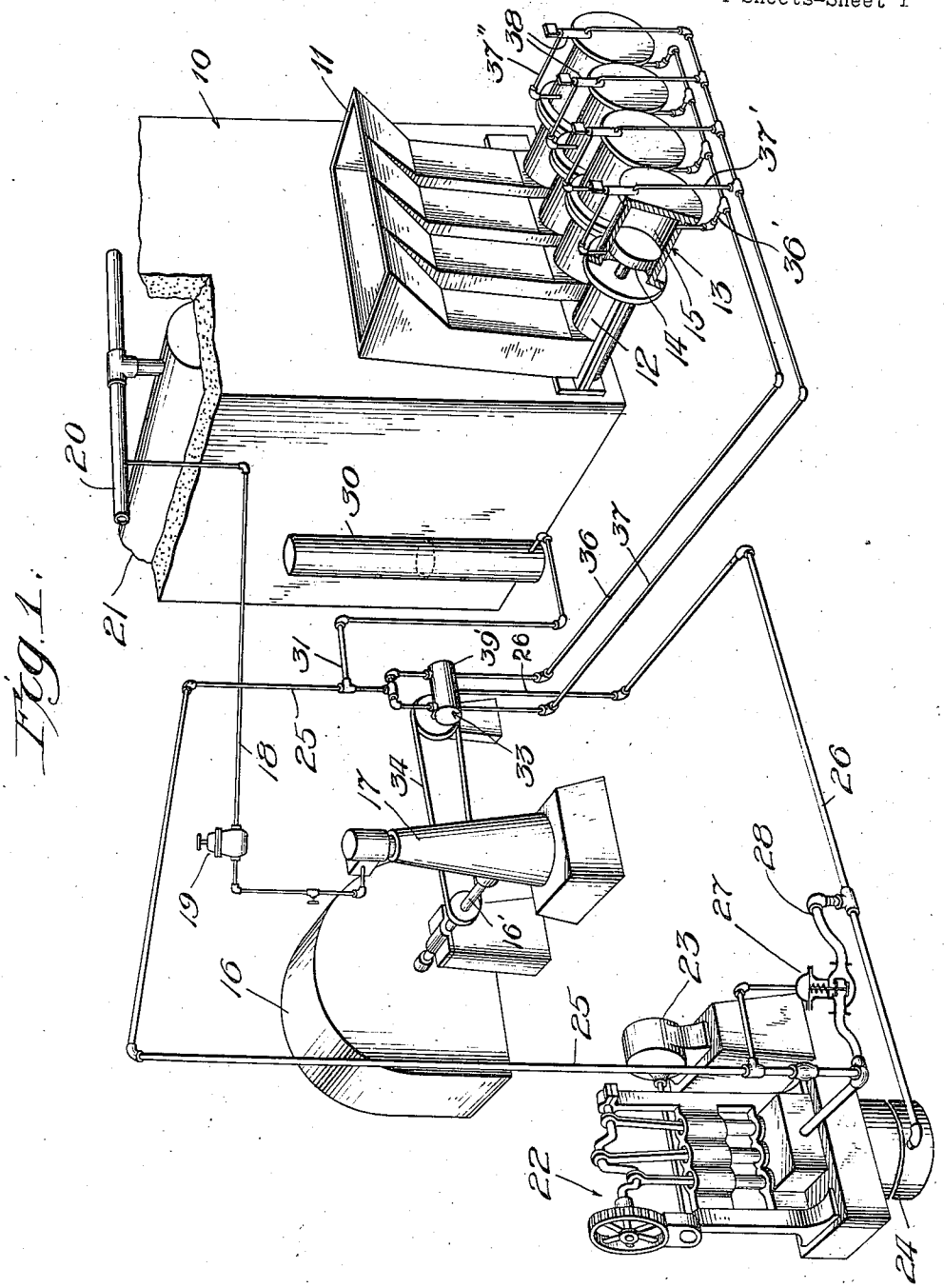


Fig. 1.

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Fig. 4.

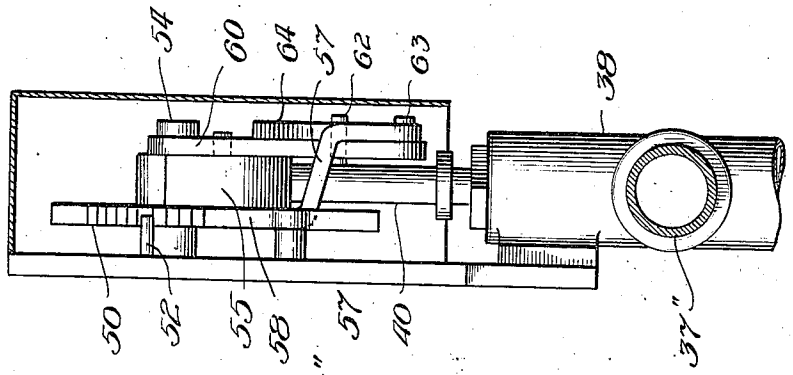


Fig. 3.

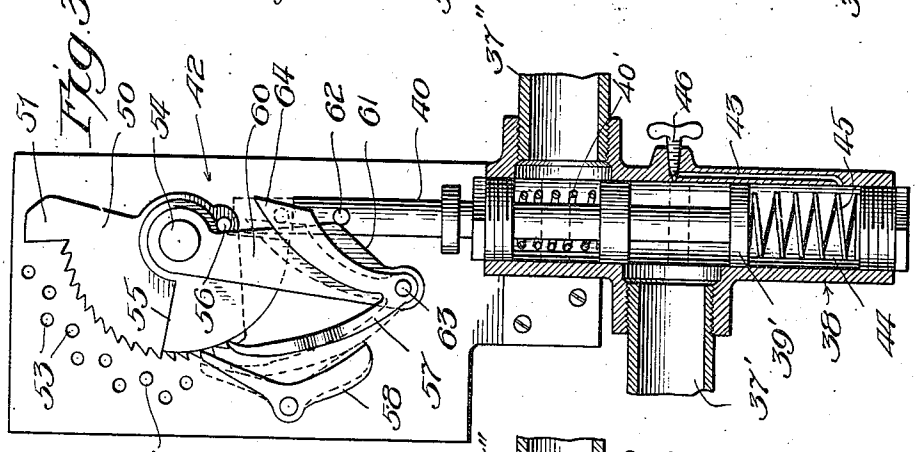
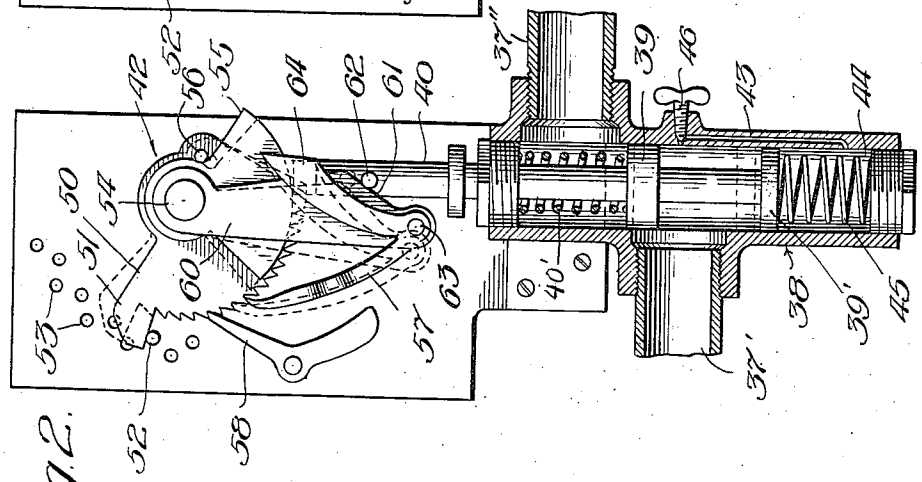


Fig. 2.



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Fig. 6.

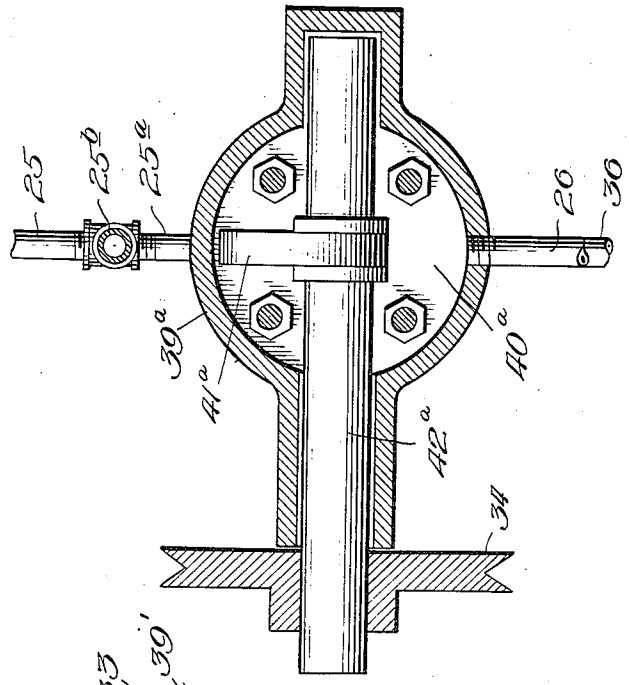
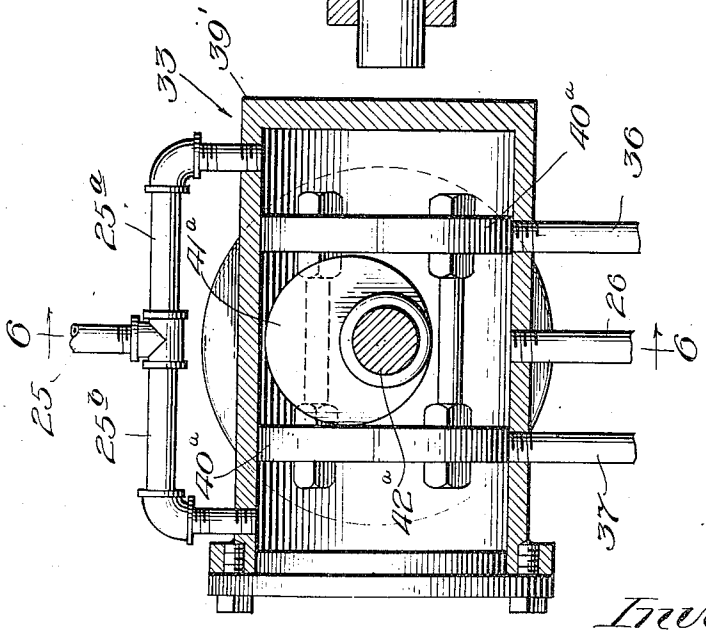


Fig. 5.



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Fig. 7.

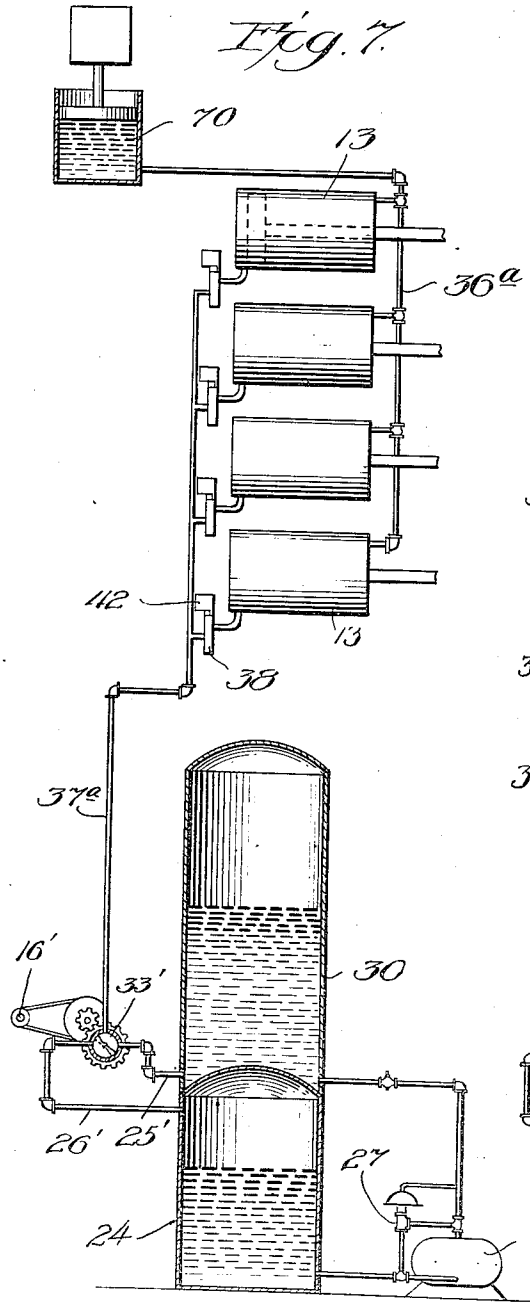
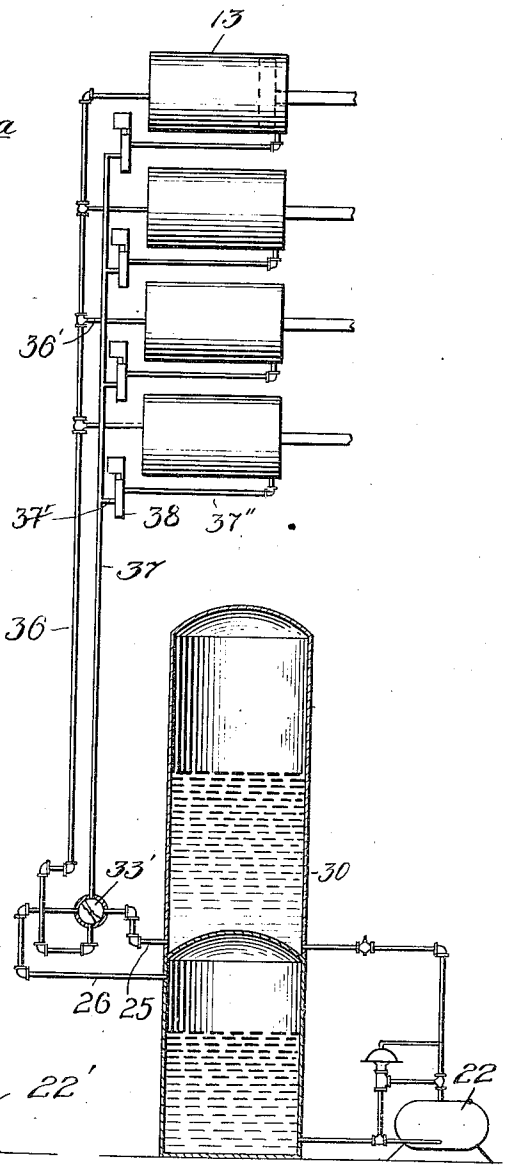


Fig. 8.



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Patented July 3, 1923. 1,460,586

UNITED STATES PATENT OFFICE.

CURTES L. HOWSE, OF DETROIT, MICHIGAN, ASSIGNOR TO THE UNDERFEED STOKER COMPANY OF AMERICA, A CORPORATION OF NEW JERSEY.

HYDRAULIC DRIVE FOR STOKER RAMS.

Application filed March 2, 1922. Serial No. 540,647.

To all whom it may concern:

Be it known that I, CURTES L. HOWSE, a citizen of Great Britain, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Hydraulic Drives for Stoker Rams, of which the following is a specification.

My invention relates to a hydraulic system of stoker-ram actuation, and has for its general object to provide novel, efficient, economical and flexible equipment by means of which the rams may be automatically operated. For attainment of these and other objects which will become apparent hereinafter, I provide advantageous means for supplying pressure impulses at regular intervals, preferably automatically variable as to time, in a piping system with which the ram-engines and controlling mechanisms are connected, and provide advantageous controlling means whereby each ram engine is actuated periodically, in accordance with selectively predetermined numbers of impulses.

In the drawings wherein I have illustrated embodiments of my invention in diagrammatic form, for clarity, without attempt at delineation of exact proportions or details, which may vary with different installations; Fig. 1 is a perspective diagram showing a complete driving system for a plurality of stoker rams; Figs. 2 and 3 are front elevations with parts broken away showing an impulse-actuated valve in different positions of operation; Fig. 4 is a side elevation of the valve mechanism; Fig. 5 is a section through an impulse-controller taken on line 5—5 of Fig. 6; Fig. 6 is a section therethrough taken on line 6—6 of Fig. 5; Fig. 7 is a diagrammatic view showing a modified embodiment of my invention; Fig. 8 is another diagrammatic view showing another modified embodiment of my invention.

Referring to Fig. 1, the furnace 10 may be equipped with any suitable character of underfeed stoker, fuel being fed to the retorts (not shown) from the hoppers 11 by means of ram mechanisms 12 each of which is reciprocable by a hydraulic engine 13 comprising a piston 14 connected with the ram and a cylinder 15 closed at both ends. Air to support combustion may be supplied from a suitable fan 16 that preferably is driven at a speed variable in accordance with the demand requisite for maintaining a given steam pressure in the boiler, one available form of construction, as shown, providing a variable speed fan-engine 17 the steam-line 18 of which is governed by a suitable pressure regulator 19 and is connected to the steam header 20 for a suitable boiler 21. As steam pressure drops in the boiler, engine speed and consequently fan speed are augmented, and vice versa.

It is usually desirable that the rate of fuel supply to all of the retorts shall likewise be varied, to increase the fuel supply when the boiler pressure drops and to decrease it as such pressure rises, and as one means for this accomplishment I illustrate a controlling part of the hydraulic system as speed-controlled from the fan shaft.

In the hydraulic system, the pump 22 of suitable construction may be driven in any desired fashion as by an electric motor 23, operating to draw liquid, such as oil, from a supply source or chamber 24 and deliver it to the main pressure pipe 25 for utilization in operating the ram-engine, the liquid so pumped ultimately returning to the supply source through a return-pipe 26. In order that, if desired, a maximum pressure may be established under which the hydraulic system will work, an unloading valve 27 may be provided connected by pipe 28 between pipes 25 and 26 to open, for short-circuiting the fluid flow, should the pressure in pipe 25 tend to rise too high. To secure uniformity in fluid pressure application a pressure tank 30, in the upper end of which air or other compressible gas is pocketed, may be connected as by pipe 31 at any suitable point to the pressure supply pipe 25.

The fan shaft 16′, as a suitable device operating at speed regulated in accordance with boiler pressure, drives an automatic reversing valve 33 by suitable power connections 34 such as belt and pulley, such reversing valve operating periodically to connect two engine pipes 36 and 37 with respectively the pipes 25 and 26, and then to reverse this connection. The valve may be constructed in various ways, Figs. 5 and 6 showing a simple construction in which the cylinder 39^a contains a double-headed piston 40^a mechanically reciprocated by an eccentric 41^a carried by shaft 42^a which is driven by the stated power connections 34. Pipe 25 has two branches 25^a and 25^b opening respectively to opposite ends of the cyl-

inder; pipe 26 leads to the middle of the cylinder, and pipes 36 and 37 open to the cylinder midway between the three ports mentioned, so that as the piston is thrown to either side of the dead center position illustrated, it opens one of the pipes 36 or 37 to the high pressure connection 25 and the other thereof to the return pipe 26.

Pipe 36 has open branch connections 36′ to one end of each cylinder 15, preferably the outer or head end, so that the pistons stand normally at the ram-end of their cylinders, and branch pipes 37′ of pipe 37 are connectible at intervals with the ram-ends or inner ends of the cylinders. In Figs. 2 to 4 is shown a form of impulse valve suitable normally to close a pressure pipe 37′ but actuatable to open it to the engine cylinder after a selectively determinable number of impulses. A vertical cylinder 38 has opening to it at different levels the pressure pipe 37′ and the piping connection 37″ which communicates with the ram end of the cylinder. Communication between pipes 37′ and 37″ is normally prevented by a piston 39 having a piston rod 40 which extends through the end wall of the valve casing for cooperation with a ratchet-movable stop mechanism 42. At each throw of the piston 39 in response to a pressure impulse communicated through pipe 37′, the piston rises against the tension of spring 40′ from position shown in Fig. 2 to position shown in Fig. 3, enough to operate the ratchet mechanism, but not enough to open the passage between the valved pipes. The ratchet mechanism, thus advanced, carries along with it the stop for the valve stem 40, so that after a predetermined number of these impulses have been thus transmitted to the ratchet mechanism, the stop is completely removed from the path of the valve stem, and on the next succeeding pressure impulse the valve is free to rise to the dotted line position shown in Fig. 3, opening communication between the two valved pipes.

In the specific mechanism shown the piston rod is provided with a second, balancing piston 39′ below the level of the pipe 37′; a duct 43 leads through the valve casing wall from the chamber between said pistons to the otherwise-closed bottom chamber 44 in which is arranged a spring 45 which stands fully expanded when the parts are in the position shown in Fig. 3. A needle-restriction 46 may be employed to adjust the capacity of such duct. Thus the valve is practically balanced, except for the pressure communication to the bottom of piston 39′ effected through the duct 43, and the valve may thus be prevented from receiving too spasmodic an actuation; its rapidity of response to pressure application being variable by adjustment of the restriction 46.

In the ratchet mechanism 42, a ratchet sector 50 initially stands with its projecting finger 51 resting against the pin 52 which is adjustable to any one of a series of indexing holes 53, and whenever the ratchet is freed from its pawls, it turns on its shaft 54 under the influence of gravity until caught by such pin 52. A stop sector 55 is pivoted on shaft 54, and, when in position shown in Fig. 1, is interposed in the path of movement of valve-stem 40 to limit the upward movement of said stem. This sector may be carried clockwise by the ratchet sector 50, as by a pin 56 in the ratchet, but gravity tends to return it always to the position shown in Fig. 1. When the ratchet reaches the position shown in Fig. 3 the stop sector 55 is removed from the path of vertical motion of the valve stem 40. With the ratchet sector there cooperates an active or moving pawl 57 and a holding pawl 58 which cooperate with each other and with the valve stem 40 in such fashion that as the valve stem rises to the brief extent permitted before it encounters stop 55, the live pawl 57 is caused to advance the ratchet one step, but when the valve stem, freed from the restraint of the stop 55, makes a full excursion, both the live pawl and the holding pawl are thrown out of engagement with the ratchet so that it, and the stop sector, may both be gravity returned to initial position. In the specific construction shown pawl-carrier 60 is pivoted on shaft 54 and normally hangs in such position that its cam face 61 is interposed in the path of upward movement of a pin 62 on the valve stem. The live pawl 57 is pivoted at 63 to the carrier and has a tail 64 which projects beyond the cam face 61 of its carrier but above the level to which pin 62 may rise if the valve stem be stopped by the stop sector 55. The pawl 57 works so close to holding pawl 58 that if the former be thrown materially away from the ratchet, it will carry the holding pawl out of engagement with the ratchet also.

The operation of the system above described will now be apparent: The pump 22 and pressure tank 30 maintain substantially constant pressure in the pipes 25^a and 25^b of the reversing valve which, operating with a frequency determined by the demands of the boiler pressure by virtue of its actuation from the pressure-governed engine, serves to supply pressure impulses alternately through the pipes 36 and 37, that pipe which is not so receiving pressure being connected through the reversing valve with a return pipe 26 leading to the source of liquid supply. Impulses communicated through pipe 36 ordinarily do nothing, as the pistons 14 stand normally at the ram-ends of their cylinders. But each impulse transmitted through pipe 37′ to one of the ram-engine

valves thrusts upwardly upon the vertical valve structure, causing its stem to rise and tend to open communication between pipes 37′ and 37″ so that the pressure impulse may act upon the ram side of piston 14 to retract the latter. Each such impulse raises the valve stem until it is stopped by the stop sector 55, the range of motion being indicated in dotted lines in Fig. 2, and the pin 62 on the valve stem working against the cam surface 61, moves the pawl carrier so that the active pawl 57 advances the ratchet sector one step. The number of steps necessary to be taken before the valve can fully open is determined by the preliminary adjustment of the pin 52. Finally, however, the rise of the valve stem is freed from restraint of the holding sector 55 and the valve stem may pass by the position shown in full lines in Fig. 3 to that shown in dotted lines in Fig. 3, rising on its full stroke to open the stated communication between pipes 37′ and 37″ and to enable pin 62 to strike the tail 64 of pawl 57, throwing both it and the holding pawl out of engagement with the ratchet. While this condition endures, both the ratchet sector and the stop sector tend to return by gravity to their initial position, the ratchet sector effecting an intermediate return, and the stop sector returning as soon as the valve stem 40 drops out of its way. Under these conditions a pressure impulse of suitable duration is communicated to the ram end of the cylinder to retract the ram, the liquid normally is in the outer end of the cylinder 15, finding escape through branch pipe 36′, pipe 36 and the reversing valve 33 to the return pipe 26. Upon the occurrence of the next pressure impulse through pipe 36′ the ram is driven on its in-stroke, the liquid which was in the ram-end of the cylinder being forced out through pipes 37″ and acting, against the tension of light spring 45 and dash-pot effect of the restricted duct 43, to force the valve 39 downward, opening communication to pipe 37′ and thence through pipe 37 and the reversing valve 33 to the return pipe 26.

It will be observed that the requisite mechanisms are very simple, rugged and inexpensive, and that with minimum piping requirement the installation may be made with the greatest flexibility as to the placement of the respective parts of the apparatus.

In Fig. 7 I have diagrammatically illustrated a system employing a pump 22′, illustrated as a rotary pump, supplying liquid from reservoir 24 to pressure tank 30, the pressure supply pipe 25′ and return pipe 26′ being alternatively connectable by a rotary reversing valve 33′ with a single pipe 37ª serving all of the valves 42 as heretofore described for the several engines, each such valve being arranged to control the pressure impulses to the head end of the engine 13. Piston return pressure is supplied through pipe 36ª from an accumulator 70, the constant pressure of the accumulator being less than the pressure supplied from the chamber 30.

In Fig. 8 a construction generally similar to that shown in Fig. 1 is illustrated in simplified form save that a rotary pump 22′ and a rotary valve 33′ are indicated in lieu of the reciprocating pump and the reciprocating reversing valve.

While I have herein described in some detail a specific embodiment of my invention, some features of which I may claim for their particular advantage, it will be understood by those skilled in the art that in the broader aspects of my invention it is not restricted to details of construction and arrangement illustratively pointed out, but that many changes in construction and arrangement may be made without departure from the spirit of my invention within the scope of the appended claims.

I claim:

1. In a stoker-ram drive, the combination with a ram, of an engine therefor, pressure-impulse supply means for one end of said cylinder including a reciprocable, normally closed valve movable within its closed condition by the pressure impulses, and movable to open a pressure-transmitting connection to the engine cylinder when unrestrained, and means for normally restraining the movements of said valve operatable by the movement of said valve within its closed range, to remove the valve-restraint after a predetermined number of impulses.

2. In a stoker-ram drive, the combination with a ram, of an engine therefor, means for supplying pressure impulses, connections therefrom to one end of the engine cylinder including an impulse-movable valve, means to limit the valve movement within its closed range, and a step-by-step mechanism operatable by such limited movements of the valve for moving said restraining means to free the valve.

3. In a stoker-ram drive, the combination with a ram, of an engine therefor, means for supplying pressure impulses, connections therefrom to one end of the engine cylinder including a valve normally closing said connections and pressure-movable to open the same, stop means for preventing opening of the valve, and means operated by the valve for periodically disabling said stop means.

4. The combination of a plurality of stoker-ram engines, means for supplying hydraulic pressure impulses, connections from said means to each of said engines including for each engine a pressure-movable valve closing said connections when the valve is moved to a limited range and opening said connection when said valve is moved through

a larger range, a stop mechanism for each valve normally limiting its movement to the closed range, and means operable by the valve for moving such stop to inoperative position.

5. The combination of a plurality of stoker-ram engines, means for supplying hydraulic pressure impulses, connections from said means to each of said engines including for each engine a pressure-movable valve closing said connections when the valve is moved to a limited range and opening said connection when said valve is moved through a larger range, a stop mechanism for each valve normally limiting its movement to the closed range, and means operable by the valve for moving such stop to inoperative position, said means being selectively settable to predetermine the number of impulses requisite to free the valve for opening operations.

6. The combination with a ram-engine and a pressure-impulse transmitting means, of a valve connected between said transmitter and engine, and, when unrestrained, pressure-movable to open the connections, movable means normally restraining said valve against opening, and automatic, self-restoring step-by-step mechanism for moving said movable means to inactive position.

7. The combination with a stoker-ram engine, and impulse-transmitting means, connections between them including a pressure-moved valve adapted to open said connections upon full movement of the valving element thereof, and means actuated by said valve for periodically preventing the opening movement of said valve on the one hand and permitting the full opening movement of the valve on the other hand.

8. The combination of a ram-engine, means for supplying pressure impulses thereto, a pressure-responsive valve adapted to open said connections under pressure from said transmitting means or from the engine, and automatic means for periodically freeing said valve to open under pressure from said impulse-transmitting means but normally restraining said valve against such opening.

9. The combination with a ram-engine having a piston and cylinder, means for supplying pressure impulses to one end of said cylinder including a controlling valve, said controlling valve being pressure operatable to open said connections under pressure toward the engine or from the engine, means normally restraining said valve against opening under pressure toward the engine operatable periodically to free said valve for such opening movement, and pressure-supply connections for the other end of said engine.

10. The combination of a stoker-ram engine, a valve therefor adapted to open under pressure, means normally restraining said valve against such opening movement including a self-restoring step-by-step mechanism and a stop for limiting the valve movement, said stop being movable to inoperative position by said step-by-step mechanism.

11. The combination with a stoker ram engine, means for supplying pressure impulses, and connections therebetween including a valve, said valve comprising a cylinder having non-aligning ports and a valve proper slidable therebetween and provided with a valve stem; ratchet and pawl mechanisms operated by said valve stem, and stop-mechanisms for said valve stem movable to free the valve for opening movement after predetermined actuation of the ratchet mechanism.

12. The combination with a ram-engine of means for supplying pressure impulses, connections therebetween including a valve, said valve having a cylinder with non-aligning ports, a balanced-piston valve in said cylinder with its piston spanning the port connected to the source of pressure-impulses, and said piston having a ram extending out of said cylinder; a ratchet and pawl mechanism operatable from said piston rod and a stop mechanism, operatable by said ratchet and pawl mechanism for normally limiting the movement of said valve and periodically freeing said valve for opening movement.

13. The combination with a boiler furnace, a plurality of stoker rams therefor, and respective engines for said rams, of a hydraulic pump, means for connecting said pump with said engine including in a common portion of said connection a pressure-interrupting valve, means governed by the boiler pressure controlling the periodicity of operation of said valve, and, for each engine, an impulse-responsive valve in said connection pressure-operatable to open such connection, each such valve provided with means actuated by the valve and controlling the periodicity of its opening movement.

14. The combination with a steam boiler furnace fuel feeding rams therefor and respective ram-engines, of a hydraulic pump having a pressure pipe and a return pipe, engine-pipes connectable with opposite ends of the several engines, a reversing valve for connecting one said engine pipe with the pressure pipe and the other said engine pipe with the return pipe and then reversing said connection; means controlled by boiler pressure for governing the frequency of operation of said reversing valve, and, for each engine a valve controlling the operation of one of said engine pipes therewith, and settable means, actuated by such valve, for individually determining the periodicity of opening of said valve.

CURTES L. HOWSE.