Feb. 7, 1928.

1,658,049

C. L. HOWSE

STOKER OPERATING SYSTEM

Filed March 2, 1922

3 Sheets-Sheet 1

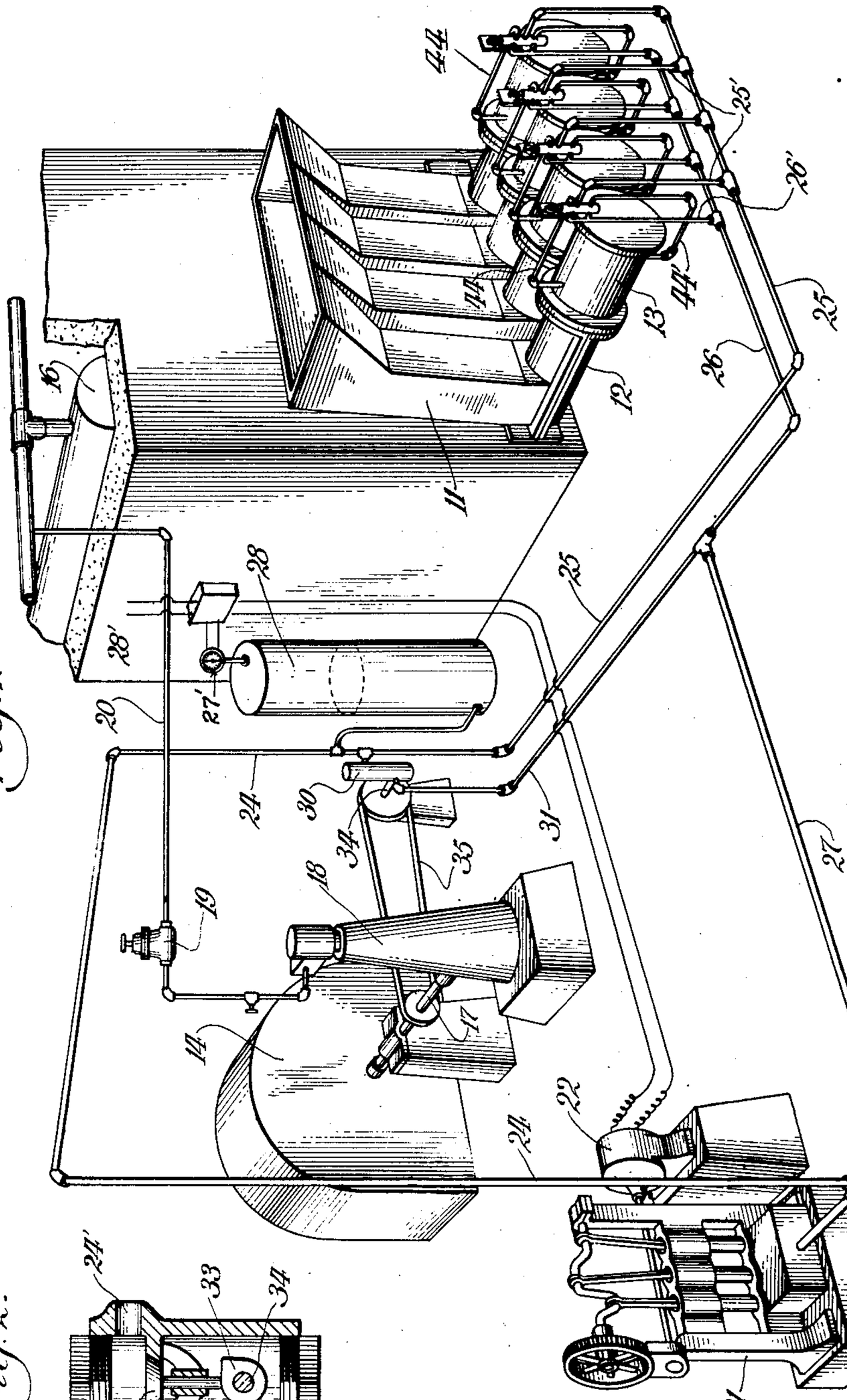


Fig. 1.

Fig. 2.

Inventor.
Curtis L. House
By Redor Gibbon Davis & Macauley
Attys

Feb. 7, 1928. 1,658,049

C. L. HOWSE

STOKER OPERATING SYSTEM

Filed March 2, 1922 3 Sheets-Sheet 2

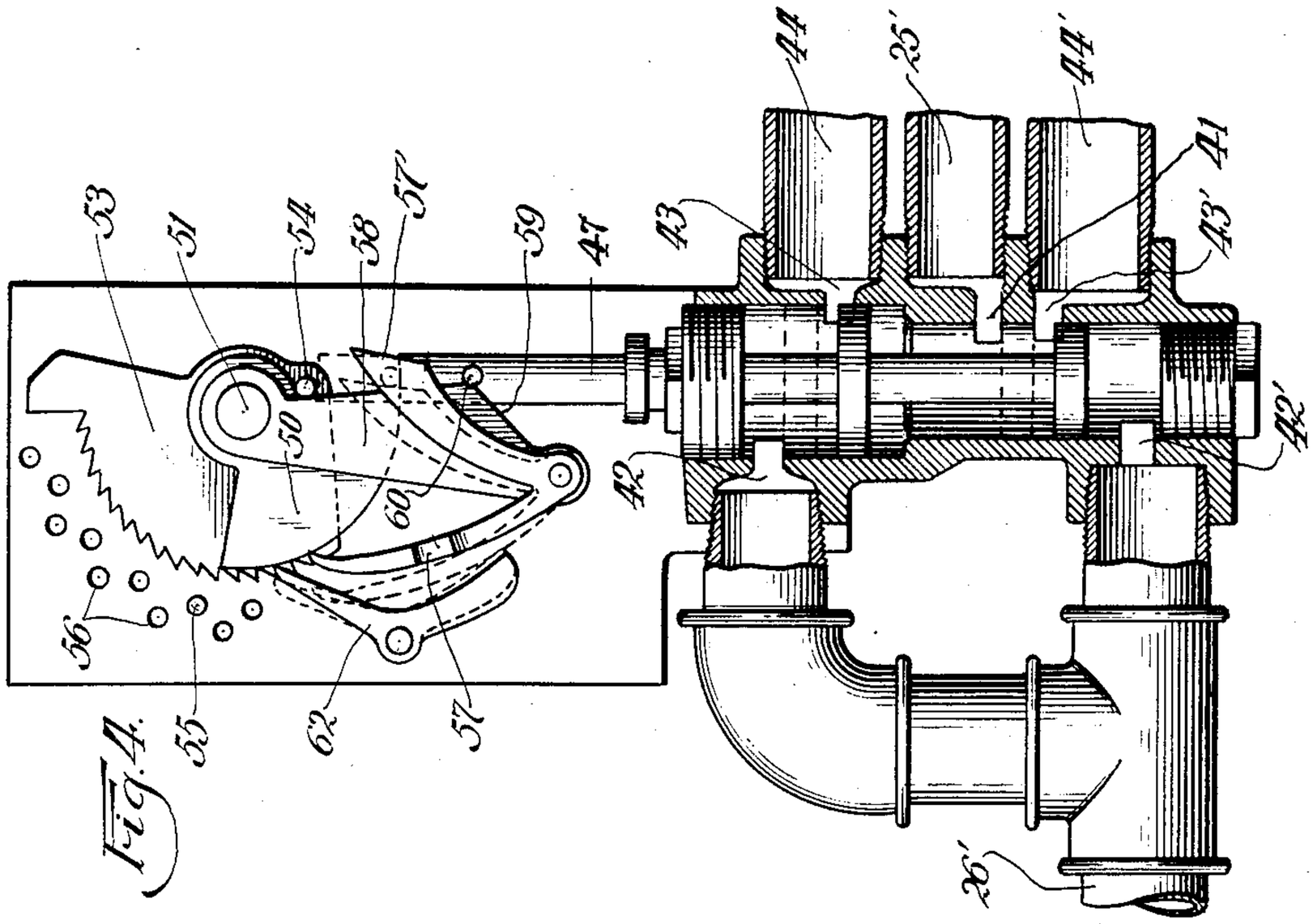


Fig. 4.

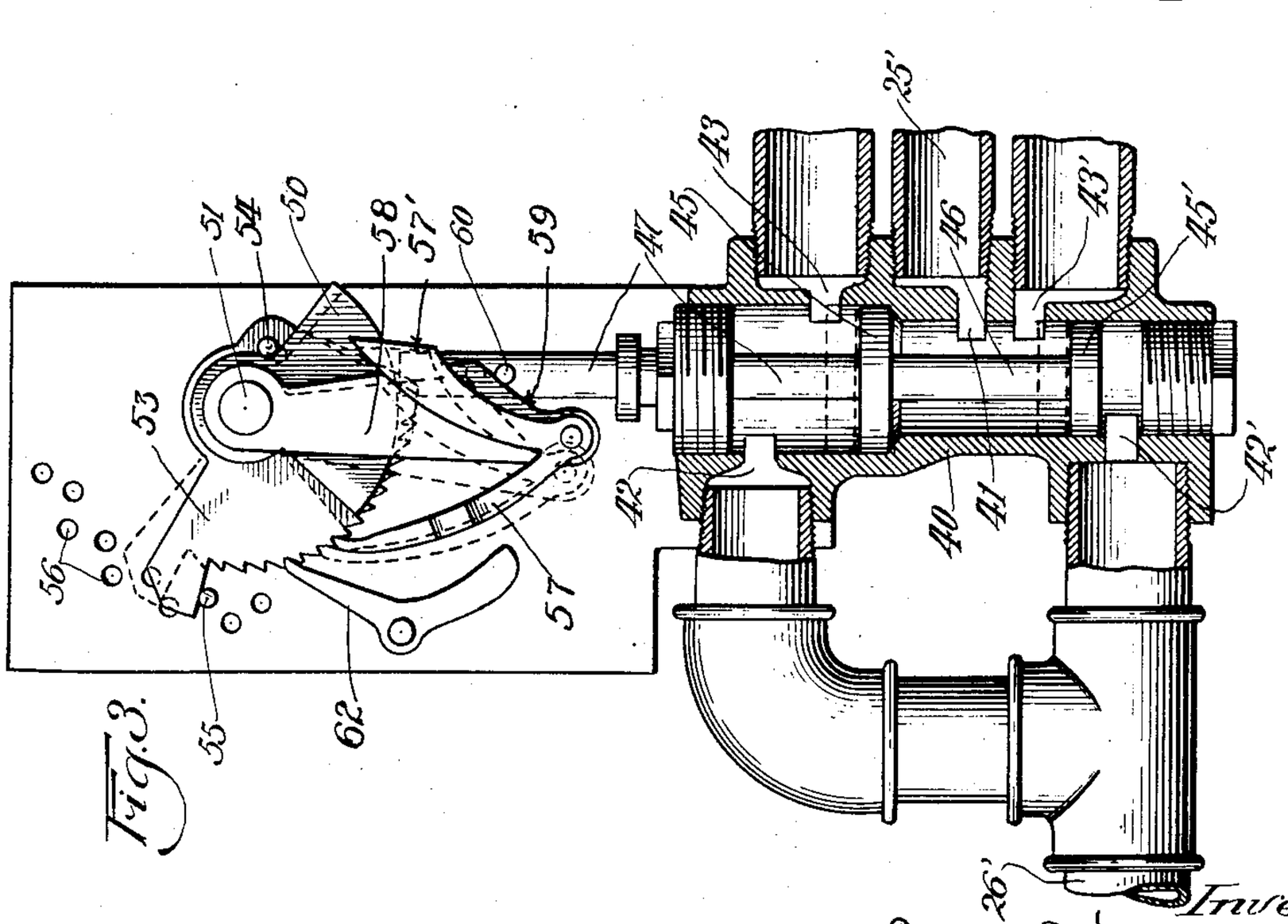


Fig. 3.

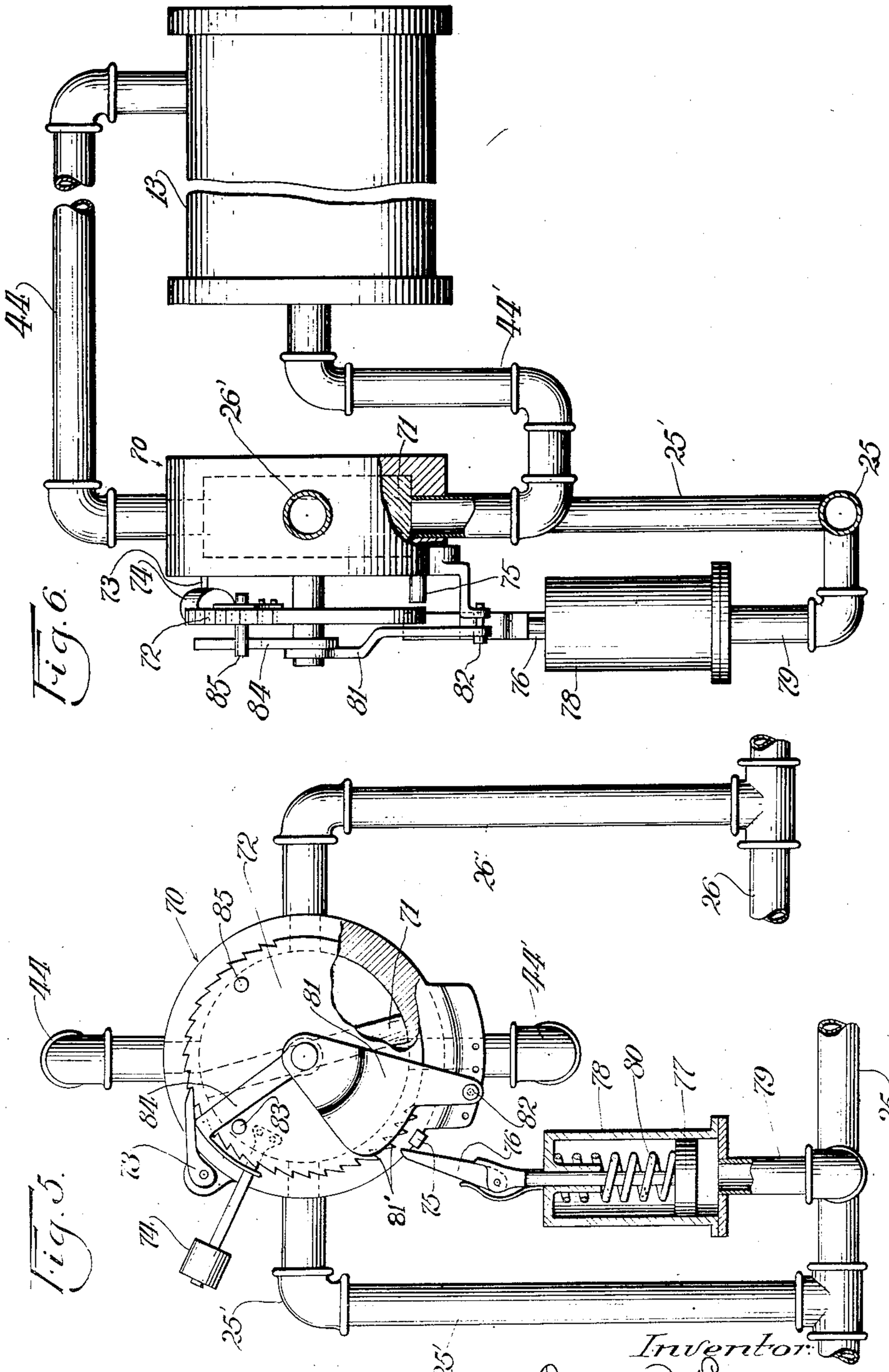
Inventor:
Curtis L. Howse
By Fitzgerald Sibley Davis & Macauley
Attys.

Feb. 7, 1928. 1,658,049

C. L. HOWSE

STOKER OPERATING SYSTEM

Filed March 2, 1922 3 Sheets-Sheet 3



Inventor:
Curtis L. Howse
By Rector Hibben Davis & Macauley
Att'ys

Patented Feb. 7, 1928. 1,658,049

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.

STOKER-OPERATING SYSTEM.

Application filed March 2, 1922. Serial No. 540,648.

My invention relates to the hydraulic operation of stoker-ram engines, and provides a system that is simple in its parts, flexible in its capability for taking care of widely varying sizes of plants and for convenient placement of its mechanical elements, economical in installation and operation, and positive and efficient in its functioning. For the attainment of these and other objects which will become apparent to those skilled in the art from the following description, my invention consists in the combinations and arrangements and constructions of parts hereinafter described and claimed.

In the drawings I have illustrated an embodiment of my invention, chiefly by diagrammatic illustration without attempted illustration of exact proportions and locations of parts which will be varied to suit the needs of the particular plants.

In such drawings, Fig. 1 is a diagrammatic perspective typifying a convenient installation as to the principal elements; Fig. 2 is a vertical section through a controlling valve; Fig. 3 illustrates an engine-valve with parts broken away; Fig. 4 is a similar view showing the valve in a different position. Figs. 5 and 6 are front and side elevations of a modified engine valve organization.

The furnace 10 may be equipped with any suitable automatic stoker to which fuel is supplied from hopper 11 by the usual ram mechanisms 12, equal in number to the number of retorts employed, each such ram being driven by an engine 13. Air to support combustion may be supplied by a fan 14 which preferably is driven at a speed suitable to the demand evidenced by steam pressure in boiler 16, fan speed increasing as boiler pressure drops, and decreasing as boiler pressure rises. As one means to this end the fan shaft 17 is shown as driven by an engine 18 operated at varying speeds consistent with the boiler demand as aforesaid by the interposition of a pressure regulator of any suitable automatic type indicated at 19, in the supply connection 20 of said engine with the boiler.

For hydraulically operating the ram engines 13, I provide a pump 21 suitably driven, as by electric motor 22, to take liquid, preferably oil, from the sump or supply tank 23 and deliver it through pipe 24 to a supply header 25 for the engines, return connections being made by return header 26 to pipe 27 running back to the sump 23. For stabilizing the pressure conditions in the supply pipe 24 a pressure tank 28 may be connected thereto and, if desired, the pump-motor 22 may have its circuit controlled by a pressure gauge 27′ on the tank as one available means of insuring against the development of excessive pressure.

Normally full operating pressure exists in pressure header 25, but this pressure may effectively be made to be impulsive rather than steady by the provision of a pressure-interrupting valve 30, connected to the union of the pipes 24 and 25 and having a relief connection 31 to the return pipe 27. As shown in Fig. 2 this valve may in principle be a simple lift valve with its valving element 32 normally closing communication between the pressure port 24′ which is connected to pipe 24 and the relief port 31′ which is connected to pipe 31. The valve is lifted by a cam 33 on shaft 34, and in order that the impulse-frequency shall vary in accordance with the demand for maintenance of boiler pressure (such frequency increasing as boiler pressure drops and decreasing as boiler pressure rises) the shaft 34 is preferably driven by a suitable connection with fan shaft 17, such as connecting belt 35 and suitable pulleys on said shafts.

Thus, periodically, the lifting of valve 32 opens communication between pipe 24 (and the pressure tank 28) and the return pipes 31 and 27, so relieving header 25 from pressure during such time as the valve is open, and the periodicity of this reduction of pressure in header 25 will depend upon the pressure conditions in the boiler, governing the speed of operation of the fan. Thus pipe 25 is subjected to impulsive pressure, the frequency of pressure relief being automatically varied.

In connection with each engine 13 I provide an automatic, pressure-impulse controlled valve, normally establishing connection between one end of the engine and the pressure header 25 and between the other end of the engine and the return header 26,

but operatable periodically, after occurrence of a predetermined number of impulses, automatically to reverse these connections; provision being made for selective setting of the number of impulses prerequisite to such reversing action of the valve.

In the drawings I have shown two forms of valve mechanisms, that illustrated in Figs. 1, 3 and 4 utilizing the valving element itself for actuation of the selectively settable reversal-controlling mechanism, and that illustrated in Figs. 5 and 6 showing a rotary valve provided with extraneous impulse-translating mechanism.

In the construction shown in Figs. 1, 3 and 4 a vertical valve casing 40 is provided, preferably adjacent the respective engines, providing at different elevations or vertical stages a central port 41 communicating with the branch pressure-pipe 25′ for that engine; near its top and bottom with respective ports 42, 42′ both connected with the branch 26′ of the return pipe 26; and intermediate the stated three ports respective upper and lower ports 43 and 43′ connected by pipes 44 and 44′ with opposite ends of the cylinder of engine 13. Specifically the upper and lower ports 43, 43′ are shown as connected respectively with the ram-end and the head-end of the engine. The valve casing 40 is made with a bore of two diameters for respective cooperation with the larger and smaller heads 45 and 45′ of a valving element 46 the stem 47 of which extends through the top of the casing. Normally the larger head 45 stands interposed between pressure port 41 and engine port 43, while smaller head 45′ is interposed between engine port 43′ and relief port 42′, but the space between the valve heads under these conditions establishes communication between pressure port 41 and engine port 43′. Owing to the unbalanced pressure-receptive surfaces of the valve, each pressure impulse communicated through pipe 25′ tends to raise the valve to the position shown in dotted lines in Fig. 4, where it will establish connection between ports 41 and 43; cut off connection between ports 42 and 43; establish connection between ports 43′ and 42′, and cut off connection between port 43′ and port 41. The valve has, however, a limited range of permissive motion without varying the normal port-conditions first stated and will return to lowest position when the pressure-impulse ends.

Associated with the valve is selective mechanism, operated by the valve movement for restraining the pressure-responsive motion of the valve to its closed range during that number of impulses for which the mechanism is set, and then releasing the valve for full movement to connection-reversing position, such mechanism being self-restoring after the full movement has taken place. A stop-sector 50 pivoted at 51 stands normally interposed in the path of reciprocation of valve stem 47, but is movable to position to free the valve stem for full-stroke, by means of a ratchet sector 53, the pin 54 of which may carry the stop sector in clockwise direction. This ratchet sector, when freed from its pawls is gravity-returnable into contact with an adjustable pin 55 which may be positioned in any one of the holes 56 for determination of the number of impulses requisite for reversing operation of the valve. Ratchet-advance is effected by a feed pawl 57 pivoted to the lower end of a pawl-carrier 58 that hangs normally pendent with a cam-surface 59 interposed in the path of vertical reciprocation of pin 60 on the valve stem so that as the valve stem rises until stopped by the sector 50, pawl 57 is caused to advance the ratchet sector a definite distance, preferably one step. Should the stop sector 50 not be in the path of the valve stem, the pin 60, passing the end of the cam surface 59, strikes the tail 57′ of pawl 57 and rocks the pawl out of engagement with the ratchet to the releasing or abnormal position shown in dotted lines in Fig. 4. A holding pawl 62, cooperating with the ratchet, is so positioned that this abnormal movement of the feeding pawl 57 will cause it to strike the holding pawl and move it out of ratchet-engagement.

Now it will be apparent that in the operation of the system set forth, the pump supplies hydraulic pressure, steadied by the provision of pressure tank 28, to the pipe-line 24, and this is communicated direct to engine pressure-header 25 and to the branch pipes 25′, except at those intervals when the valve 30, operating with a periodicity determined by boiler-pressure conditions, opens the "short-circuiting" connections from pipe 24 through pipe 31 directly into the return pipe 27, thus making the pressure in pipe 25 impulsive. Normally this impulsive pressure is communicated through ports 41 and 43′ of the engine-valve to the head end of the engine, so holding the ram in innermost position. Each impulse moves the engine valve within its closed range limited by the engagement of valve stem 47 with the stop sector 50, on account of the unbalanced relation between the valve heads 45, 45′. Each such movement of the valve stem advances the ratchet mechanism until stop 50 is retracted from operative position, whereupon the valve makes a full stroke on its next impulse-reception, moving to the position shown in dotted lines in Fig. 4 and communicating the pressure impulse, through connections 41 and 43, to the ram end of the engine, such pressure impulse serving to drive the ram on its out-stroke, and the liquid from the head end of the engine cylinder finding escape to the return

pipe 27 through the communicating ports 43 and 42′ of the valve and the return header 26.

In Figs. 5 and 6 I have illustrated another form of engine valve for serving a like purpose, in which an ordinary four-port rotary valve 70 is employed, its plug 71 or valve-proper being movable from position shown where pipes 25′ and 44′ and 26′ and 44 are connected to position reversing the communication of the pressure and return pipes with the engine pipes 44, 44′. The valve stem is provided with a ratchet wheel 72 self-returnable, when released from the holding pawl 73, by the action of weight 74, the home position of which is determined by a stop pin 75. The ratchet is advanced from home position a certain number of steps by the active pawl 76 carried by the rod of piston 77 in cylinder 78 which is connected as at 79 to an impulse-receiving pipe such as pipe 25. The plunger 77 thus will be impulse-raised and may be returned by spring 80, thereby to actuate the ratchet wheel through a number of steps normally determined by the adjustment of shield 81 which is rotarily settable by means of pin 82. In order to insure that the valve will always pass through an arc sufficient completely to sweep by a port as the result of a single impulse, high teeth 81′ may be provided on the ratchet to project beyond the shield 81 at an appropriate critical point, so insuring that the ratchet will receive a full movement on the critical stroke of the reversing action, regardless of the setting of shield 81. On this critical movement a pin 83 on the ratchet moves a releasing arm 84 to trip out the holding pawl 73, freeing the ratchet for return movement as soon as the live pawl 76 retracts. The releasing arm 84 stays in this position until carried back to normal position by the pin 85 of the ratchet wheel substantially upon completion of the return movement of the ratchet.

It will thus be seen that in the broader aspects of my invention the conversion of impulse in the pressure pipe into movements of a selective device for determining the periodicity of reversal of the valve of the engine may be effected from a pressure-responsive part that either is a portion of the valve proper or is extraneous to the valve proper, and the details of construction, in this regard as in many others, may be widely varied within the scope of the appended claims.

I claim:

1. In a stoker-ram driving system, the combination with a ram and its engine, of high-pressure and return connections reversibly connectible with opposite ends of the engine, a source of hydraulic pressure associated with said connections to supply the engine-operating power therethrough, automatic means for periodically interrupting the pressure-supply through said high-pressure connection to create pressure-impulses therein, and impulse-responsive and valving means operatively associated with said connection and acting in response to said pressure impulses therein periodically to reverse said engine connections.

2. A structure as set forth in claim 1 wherein said automatic means for periodically interrupting the pressure supply includes a valve for short-circuiting the high pressure connection to the return connection.

3. The combination with a steam boiler, a stoker ram, and a ram-engine, of high pressure and return connections reversibly connectible with the opposite ends of said engine, a source of hydraulic pressure associated with said connections to supply the engine-operating power therethrough, means for periodically interrupting the pressure-supply through said high-pressure connection to create pressure-impulses therein, impulse-responsive and valving means operatively associated with said connection and acting in response to said pressure-impulses therein to reverse said engine-connections, and means responsive to variations of boiler pressure for operating said pressure-interrupting means with varying frequency.

4. In a stoker-ram driving system, the combination with a stoker ram and its engine having a piston, of high-pressure and return connections for said engine, automatic means associated with said connections for creating periodic pressure-impulses in said high-pressure connection, a valve movable to open said high pressure connection to one end of the engine and the return connection to the other end thereof in one valve position and to reverse these connections in another valve position, self-restoring ratchet mechanism to control said valve, and a pressure-responsive device connected to said high pressure connection for actuating said ratchet mechanism.

5. A structure as set forth in claim 4 wherein said reversing valve is self-restoring upon self-restoration of said ratchet mechanism, whereby the engine-piston is movable from normal position by only a single impulse.

6. In a stoker ram driving system, the combination with a ram, of its engine, a source of hydraulic pressure supply, high pressure and return connections therefor, a valve for opening direct connection between said high pressure and return connections, impulse-responsive and valving means communicating with said connections beyond the first said valve, arranged normally to open the pressure and return connections respectively to opposite ends of the engine cylinder and responsive to pressure impulses periodically to reverse said connections, said means in-

cluding a reversing valve, self-restoring ratchet mechanism for controlling the same, and ratchet-operating mechanism movable in response to pressure-impulses in the high pressure pipe.

7. In a stoker-ram driving system, the combination with a plurality of stoker rams, of respective engines therefor, a common pump for hydraulic pressure supply, a pressure tank associated therewith, a common pressure pipe having branches for the respective engines, a common return pipe having branches to the respective engines, valved means for connecting the common portion of said pipes to determine impulse-frequency in the branch pressure pipes, and, in association with each engine, impulse-responsive and valving means normally opening said pressure and return branches respectively to opposite ends of the engine cylinder and responsive to pressure impulses in the pressure branch periodically to reverse said connections.

8. In a stoker ram driving system, the combination with a stoker ram, of its engine, a high pressure pipe, a return pipe, automatic means for periodically engendering pressure impulses in said high pressure pipe, and valve mechanism normally establishing connections between said high pressure pipe and one end of the engine and between said return pipe and the other end of the engine and automatically operatable to reverse these connections comprising an unbalanced, two-piston valve movable by a pressure impulse to effect such reversal and means operated by partial movements of the valve for restraining said valve against full movement to reversing position during a predetermined number of impulses and then freeing said valve for full movement.

CURTIS L. HOWSE.