(Model.) 2 Sheets—Sheet 1.

W. R. PARK & B. T. WILLISTON.

INSPIRATOR.

No. 492,944. Patented Mar. 7, 1893.

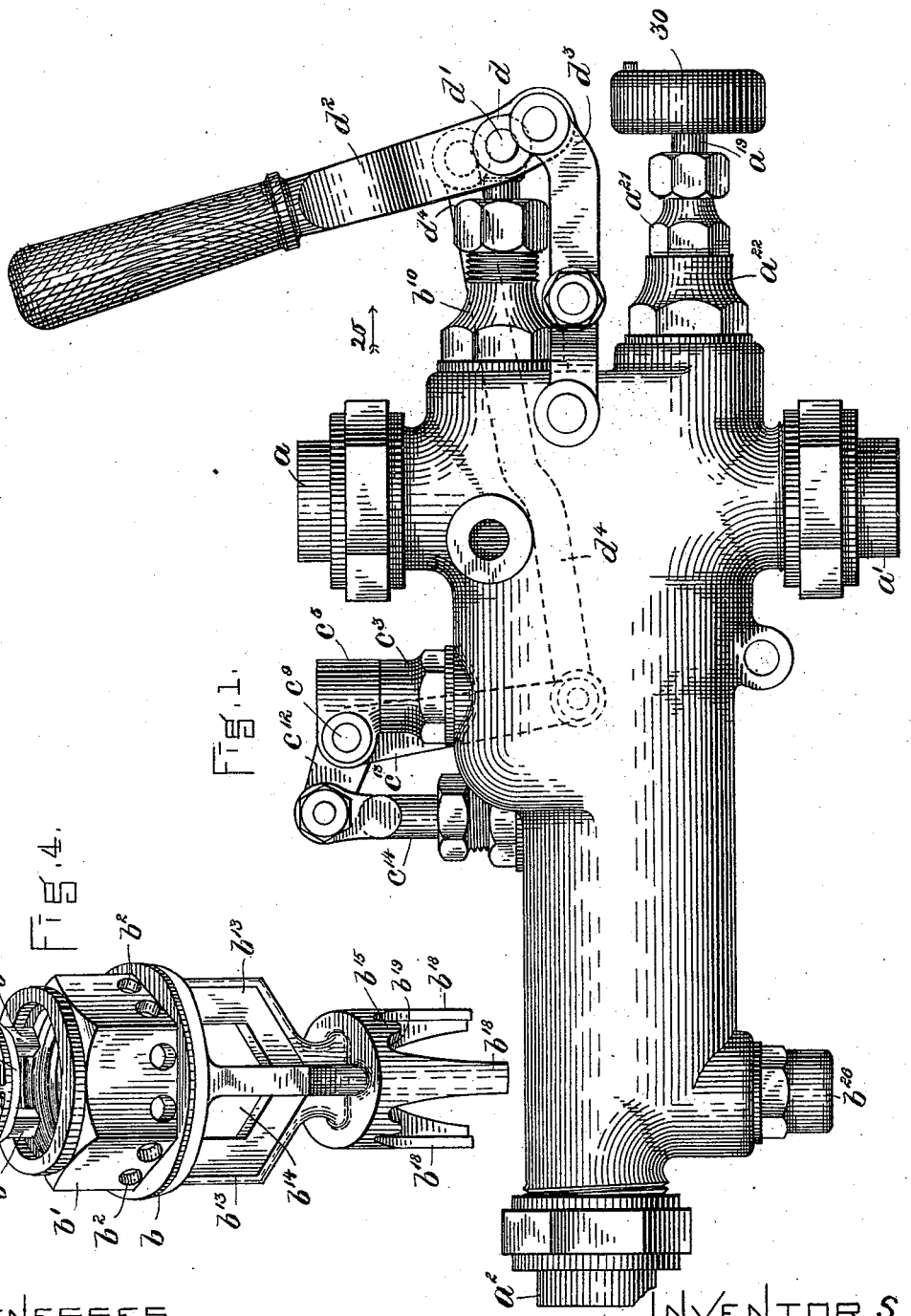

Fig. 1.

Fig. 4.

WITNESSES.

L. Henry Marsh.

J. Murphy.

INVENTORS

William R. Park

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By Jas. H. Churchill

Atty.

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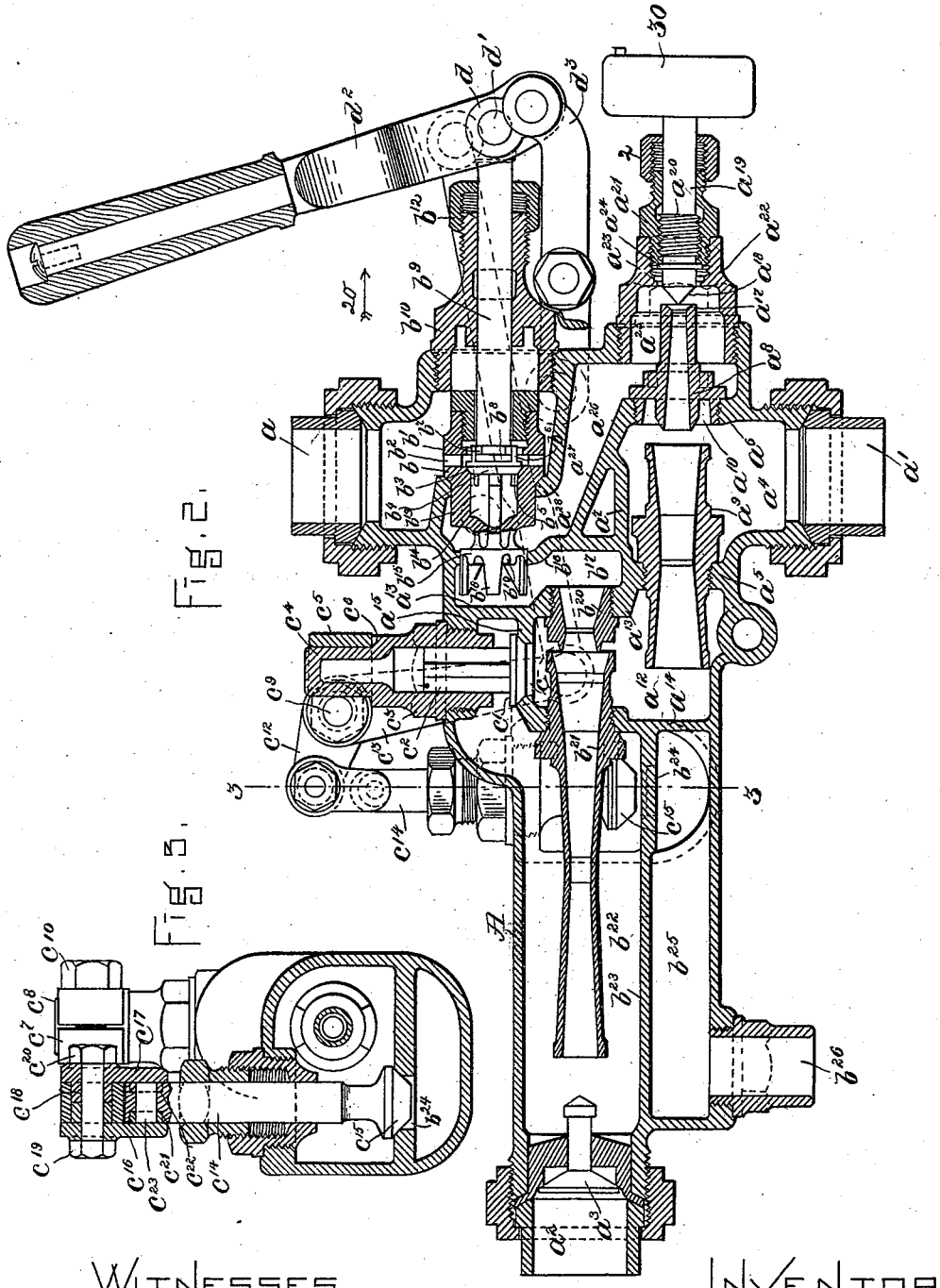

Fig. 2.

Fig. 3.

WITNESSES.

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UNITED STATES PATENT OFFICE.

WILLIAM R. PARK, OF TAUNTON, AND BELVIN T. WILLISTON, OF SOMERVILLE, ASSIGNORS TO THE HANCOCK INSPIRATOR COMPANY, OF BOSTON, MASSACHUSETTS.

INSPIRATOR.

SPECIFICATION forming part of Letters Patent No. 492,944, dated March 7, 1893.

Application filed November 3, 1892. Serial No. 450,854. (Model.)

To all whom it may concern:

Be it known that we, WILLIAM R. PARK, residing at Taunton, in the county of Bristol, and BELVIN T. WILLISTON, residing at Somerville, in the county of Middlesex, State of Massachusetts, have invented an Improvement in Inspirators, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to injectors of that class in which a lifting apparatus is combined with a forcing apparatus, and arranged with relation thereto, so that the lifting apparatus shall take water from a well or other supply, and deliver it to the forcing apparatus, to be forced thereby into the boiler or against a resistance even greater than the pressure of the actuating steam, the injector being operated by the manipulation of a single lever.

Our present invention has for its object to improve and simplify the construction of injectors of the class referred to, and in accordance with our invention, the injector is provided with an intermediate chamber, into which the lifter combining tube delivers the water from the tank or well, and from which the forcer combining tube takes its supply, which chamber is provided with a port or opening connecting the said chamber with an overflow chamber, and controlled by an automatically operating valve located outside of the said intermediate chamber, the said valve in the operation of starting the apparatus being automatically opened by the water discharged from the intermediate chamber to the overflow chamber by the lifter, and being automatically closed when the current is sufficiently established through the forcer combining tube to create a pressure in the overflow chamber, and the automatic valve and its seat are located above the inlet end of the forcer combining tube, so that, in starting the injector, the forcer combining tube shall be flooded with water.

Our invention further consisting in providing an injector of the class referred to, which has a steam admission valve and a final overflow valve and devices connecting them, whereby by the operation of a single lever, as the steam admission valve is opened, the final overflow valve is gradually closed, and vice versa, with the intermediate chamber and a port opening therefrom into the overflow chamber, and an automatic valve constructed, located and operating as above set forth.

Our invention further consists in special features of construction, as will be pointed out in the claims at the end of this specification.

Figure 1, is a side elevation of an injector embodying our invention. Fig. 2, a longitudinal section of the injector shown in Fig. 1. Fig. 3, a transverse section of the injector on the line 3—3, Fig. 2, the final overflow valve being shown as seated or closed, and Fig. 4, details to be referred to.

The main body or casing A, provided with steam inlet passage a, the water inlet passage a' and the water outlet a^2, communicating with the boiler, not herein shown, and proprovided with the cheek valve a^3, may be of any usual or well-known construction. The water inlet a' communicates with a chamber a^4, formed in the casing by the partitions a^5, a^6, a^7, and in which chamber is extended the discharge end of the lifter steam jet tube a^8, and the inlet end of the lifter combining tube a^9. The lifter steam inlet tube a^8, as herein shown, forms part of a threaded annular coupling or ring a^{10}, which is screwed into a threaded opening in the partition a^6, and the lifter combining tube is also provided with screw threads, which engage a threaded opening in the partition a^5, the discharge or delivery end of the lifter combining tube terminating in a chamber a^{12}, (which is herein called the intermediate chamber) formed substantially near the longitudinal center of the casing A, by the partition a^5, a second partition a^{13} forming practically a continuation of the partition a^5, a partition a^{14}, and a top wall or partition a^{15} joining the partition a^{14}. to the partition a^{13}.

The inlet passage to the lifter steam jet tube is provided, as herein shown, with a conical valve seat a^{17}, with which co-operates a conical valve a^{18}, hereinshown as forming an integral part of a valve stem or rod a^{19} provided with screw threads a^{20}, which engage a threaded nut or sleeve a^{21}, which is itself

screwed into a bonnet or coupling a^{22}, provided with a seat a^{23}, against which an annular flange a^{24} on the valve stem a^{19} is adapted to strike, to limit the forward movement of the said stem, the said valve stem being also extended through the usual stuffing box 2, and provided with the hand-wheel 30.

The coupling a^{22} is screwed into a threaded opening in one end of the casing A, and forms with the annular ring of the lifter steam jet tube, a steam passage a^{25}, which communicates with a passage a^{26} formed by the partitions a^{27}, a^{28}, this latter partition being provided with an opening through which is extended a main steam valve b, adapted to seat on the partition a^{28} and cut off communication between the passage a^{26} and the steam inlet a.

The main steam valve b is made, as herein represented, as a wing valve having a tubular extension b', provided with a series of holes or ports b^2 arranged around its circumference and constituting, auxiliary steam inlets to the interior of the main steam valve. The main steam valve b on its interior is provided with a valve seat b^3, with which co-operates a supplemental disk valve b^4, provided on one side with guiding lugs or ears b^5, and on its other side with a substantially tubular extension b^6, cut away at its front portion to form an opening, and provided on its inner circumference with an annular flange b^7, which forms with the disk valve b^4 an annular groove b^{80}, into which is extended a collar b^8 on the valve stem b^9, the latter being extended through the nut or bonnet b^{10} and through the usual stuffing box b^{12} secured to the said nut or bonnet.

The wings b^{13} of the main steam valve b form ports b^{14}, through which the steam may pass into the passage a^{26} leading to the steam jet tube of the lifter. The wings b^{13} are secured to or form part of a piston valve b^{15}, extended through a cylindrical opening in a partition or wall b^{16}, which cuts off the steam passage a^{26} leading to the lifter steam jet tube, from the steam passage b^{17} formed by the partition b^{16} and the partition a^{13}, the piston valve being provided with extended wings b^{18} and also with grooves, serrations or notches b^{19} to afford a gradually increasing opening of the piston valve, as will be described.

The partition a^{13} is provided with a threaded opening, into which is screwed the forcer steam jet tube b^{20}, which co-operates with the forcer combining tube b^{21}, screwed into a threaded opening in the partition a^{14}. The forcer steam jet tube communicates with the steam passage or chamber b^{17} and with the chamber a^{12}, and the forcer combining tube also communicates with the chamber a^{12}, it having its inlet end terminating in the chamber a^{12}. The forcer combining tube b^{21} terminates in a chamber b^{22}, which is herein called the overflow chamber formed by the main casing A and a longitudinal partition b^{23} connecting the partition a^{14} with the discharge end of the casing A, the partition b^{23} being provided with a port or opening b^{24}, which connects the overflow chamber b^{22} with the final overflow passage b^{25}, formed by the partition b^{28} and the lower part of the casing A, the final overflow passage b^{25} communicating with the atmosphere through the nozzle b^{26}.

The overflow chamber b^{22} is connected directly to the intermediate chamber a^{12}, by a port or opening c in the partition a^{15}, which port or opening is controlled by an automatically operating valve c', located outside of the chamber a^{12} and provided with a fluted cylindrical stem, c^2, extended up into a cap or sleeve c^3 screwed into a threaded opening in the upper part of the main casing. The cap or sleeve c^3 has its upper end reduced in diameter to form a journal c^4, upon which is placed a split collar or ring c^5 normally resting upon a shoulder c^6 of the said sleeve.

The split collar c^5 is provided with annular ears c^7, c^8 (see Fig. 3) through which is extended a pivot pin or rod c^9, provided at one end with screw-threads, which are engaged by a nut c^{10}. The pivot pin c^9 is extended through an elbow lever having arms c^{12}, c^{13}, the arm c^{12} being secured to the valve stem c^{14} of a valve c^{15} controlling the final overflow port or passage b^{24}. The arm c^{12} is secured to the valve stem c^{14} by a connection of special construction, consisting of two arms c^{16}, c^{17} (see Fig. 3) provided at their upper ends with openings through which the connecting pin c^{18} is passed, the said pin being provided at one end with a head c^{19}, and at its other end with screw-threads which are engaged by a nut c^{20}.

The arms c^{16}, c^{17}, at their lower end and on the inner side thereof, are provided with annular lugs c^{21}, c^{22}, adapted to enter annular sockets in the upper end of the valve stem c^{14}, one of the said lugs being provided with an opening adapted to receive the end of a pin c^{23}, secured to the other arm and extended through an opening in the valve stem c^{14}. The main valve stem b^9 is secured to a sleeve or hub d, loosely mounted on a rod d' secured to the forked arms of a main lever d^2, the said forked arms being pivotally mounted in arms d^3 secured to the main casing. The main lever d^2 is also connected to the arm c^{13} of the elbow lever by a connecting link d^4 (see Fig. 1).

As represented in Fig. 2, the valves are shown in the position they occupy when the injector is not in operation. To operate the injector, the lever d^2 is first moved sufficiently, in the direction indicated by arrow 20, to draw the auxiliary or lifter steam valve b^4 away from its seat in the main steam valve b, thereby permitting steam from the main steam inlet a to pass through the annular ports b^2, into the main valve, and thence through the ports b^{14} formed by the wings of the said valve, into the passage a^{26}, from whence the steam passes through the steam passage a^{25} and lifter steam jet tube a^8 into the lifter combining tube a^9, and from thence into the intermediate chamber a^{12}, from which

a portion of the steam passes through the port c into the overflow chamber b^{22}, the valve c' being automatically lifted from its seat by the force of the steam, and a portion of the steam will pass through the forcer combining tube b^{21} and into the overflow chamber b^{22}. The steam passes from the overflow chamber b^{22} through the port b^{24}, the valve c^{15} being open, and into the overflow passage b^{25}, and thence to the atmosphere. The steam passing through the apparatus as thus described, forces the air from the same, and lifts the water from the well or source of supply, through the water inlet a' and through the lifter combining tube a^9 into the intermediate chamber a^{12}, from whence the water follows the same course as did the steam, and, when the water appears at the overflow b^{26}, the lever d^2 should be moved farther, whereby the main steam valve b is opened, and a larger quantity of steam supplied to the lifter, and at the same time, the forcer steam valve b^{15} is partially opened, and the steam passes through the notches or serrations b^{19} into the chamber b^{17} and thence through the forcer steam jet tube b^{20} and forcer combining tube b^{21}, carrying with it water from the intermediate chamber a^{12} the water being discharged from the overflow chamber b^{22}, from whence it passes through the overflow port b^{24}, controlled by the final overflow valve c^{15}, into the overflow passage b^{25}, and thence to the atmosphere through the nozzle b^{26}. After steam has been admitted to the forcer as described, and a current of water has been established through the forces to the atmosphere, the valve c^{15} will be sufficiently closed to cause a pressure in the chamber b^{22} in excess of the pressure in the intermediate chamber a^{12}, which will permit the valve c' to close by gravity, and while the injector continues to operate, it will remain closed. The final overflow valve c^{15} is connected to and operated by the lever d^2 by means of the link d^4 and elbow lever c^{12}, connected to the stem valve c^{14}. As the lever d^2 is pulled outwardly, it opens the steam valve b and closes the final overflow valve c^{15}. The movements of these valves are so timed, that the final overflow valve is being gradually closed as the forcer steam valve is being opened, and by the time that the final overflow valve has reached its seat, the current through the forcer combining tube will have been so well established, that it will open the check valve a^3 and pass into the boiler. This gradual closing of the final overflow valve creates a gradually increasing pressure in the overflow chamber b^{22}, which ultimately (when the final overflow valve is closed) exceeds the boiler pressure. The intermediate overflow valve c' is therefore held to its seat by gravity, and by the excess of pressure in the overflow chamber b^{22} over that in the intermediate chamber c^{12}, due to the steam which enters from the forcer steam jet tube, and when the injector is in operation, the said valve is held to its seat by the full boiler pressure. The intermediate overflow port c and its valve c' are also so located relatively to the inlet end of the forcer combining tube, that, when the apparatus is set in a substantially horizontal position, as it is designed to be used, the water discharged from the lifter into the intermediate chamber a^{12} must flood the inlet end of the forcer combining tube b^{21}, before it can escape through the intermediate overflow port c. Therefore, when steam is admitted through the forcer steam jet tube b^{20} (which is not done until after the lifter has been got to work) it finds water at once to act on, and the forcer readily starts. The location of this intermediate overflow port and its valve relative to the inlet end of the forcer combining tube and also to the passage from the forcer combining tube to the final overflow port, substantially as described, constitutes the chief improvement herein, as it is by reason of this new location assigned to these parts, that the apparatus is made to readily and certainly start, and to continue in operation without being disturbed by the jars and shocks to which an instrument of this class is subjected, when used on locomotives.

We are aware that injectors of this class have been provided with an intermediate overflow port communicating with the final overflow chamber, and provided with an automatic valve to close the intermediate overflow port, but such prior injectors have been so unreliable as to be commercially useless, on account of the location of the said intermediate overflow port and its valve relatively to the inlet end of the forcer combining tube, which, under certain conditions, permitted the water discharged from the lifter, to run off through the forcer overflow chamber without passing through the forcer combining tube, in which cases, the injector could not be made to feed to the boiler, because the forcer cannot be got to start, unless water is delivered to it at the inlet end of its combining tube.

The quantity of water raised and delivered by the lifter can be regulated to some extent by the hand-wheel 30, carrying the conical-shaped valve a^{18} toward the conical inlet for the lifter steam jet tube a^8, to thereby vary the area of the inlet to said tube.

The novel construction of the valve which controls the admission of steam to the forcer, materially increases the ease of operating the injector, and enables it to be started with greater certainty. As has been herein before described, this valve b^{15} is a piston valve capable of reciprocation in the cylindrical seat and is provided with notches or serrations b^{19}. These notches so register with the seat formed in the partition, b^{16}, that when the valve is first opened, but a small quantity of steam is permitted to pass into the forcer steam jet tube, and as it is opened farther, a gradually increasing quantity of steam is admitted, until, when the notches are withdrawn wholly from the seat, the valve is fully open. The steam thus gradually admitted, gradually im-

parts velocity to the water with which it comes in contact in the forcer combining tube, and gradually increases that velocity, and thereby the forcer is got into operation with increased certainty and without shock.

We claim—

1. In a combined lifting and forcing injector, a main casing provided with a chamber intermediate of the steam and water inlets and the overflow chamber of the forcer, and into which the lifter discharges, and from which the forcer is supplied with water, an overflow port from said intermediate chamber to the overflow chamber, of the forcer and an automatically operating valve controlling said port and located on the outside thereof, the said valve and its seat being located above the inlet end of the forcer combining tube, whereby the forcer combining tube will be flooded with water in starting the apparatus, substantially as described and shown.

2. In an injector provided with a lifter and forcer, in which the lifter delivers water to the forcer, a port opening from the passage or chamber into which the lifter discharges into the overflow chamber, of the forcer a valve which automatically opens and closes said port and is located on the outside of said chamber, a steam admission valve and a final overflow valve, and devices connecting them with an operating lever, whereby the final overflow valve shall be gradually closed as the steam admission valve is opened, and the overflow from the lifter shall be automatically controlled, substantially as shown and described.

3. In a combined lifting and forcing injector, a main casing A provided with the steam inlet a and water inlet a' and outlet a^2, partitions a^5, a^6, a^7, within the casing forming a chamber a^4 communicating with the water inlet, partitions a^{14}, a^{15}, a^{13}, forming the chamber a^{12}, partitions a^{27}, a^{28}, forming the lifter steam inlet passage a^{26}, the partitions b^{16} forming with the partition a^{13} the forcer steam inlet passage b^{17}, the partition b^{23} forming with the casing A the overflow chamber b^{22} and the final overflow passage b^{25}, the valve b^{15} controlling admission of steam to the passage b^{17}, the valve b and the auxiliary valve b^4 controlling admission of steam to the passage a^{26}, the lifter steam jet tube communicating with the passage a^{26} and with the chamber a^4, the lifter-combining tube extended through the partition a^5 and having its inlet end in the chamber a^4 and its outlet end in the chamber a^{12}, the forcer steam jet tube extended through the partition a^{13} and connecting the forcer steam inlet passage b^{17} with the chamber a^{12}, the forcer combining tube extended through the partition a^{14} and having its inlet end in the chamber a^{12} and its outlet or discharge end extended into the overflow chamber b^{22}, an overflow port c for the chamber a^{12}, a valve c' controlling said port located outside the chamber a^{12} and having its stem extended into a sleeve c^3, a final overflow port b^{24} in the partition b^{23}, a valve to control said final overflow port, an operating lever connected to the steam valves, and mechanism connecting the final overflow valve with the said lever, substantially as described.

4. In a combined lifting and forcing injector, a main casing, a sleeve c^3 detachably secured to said casing, an automatically operated valve c' having its stem c^2 extended into said sleeve, a final overflow valve c^{15} having its stem extended through the main casing, a collar or ring, mounted on the said sleeve and provided with ears c^7, c^8, a pin or rod extended through said ears, an elbow lever mounted on said pin, arms c^{16}, c^{17}, pivotally secured to one arm of the said elbow lever, hubs c^{21}, c^{22}, on the inner side of the said arms extended into sockets in the stem of the final overflow valve, and a pin c^{23} secured to one of the said arms, and extended through the hole in the valve stem of the final overflow valve and into a hole or socket in the hub on the other of said arms, substantially as described.

5. In an injector, a piston valve for the admission of steam provided with notches or serrations, as b^{19}, substantially as and for the purpose described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM R. PARK.
BELVIN T. WILLISTON.

Witnesses:
JOHN E. BLAKEMORE,
WILLIAM A. SARGENT.