No. 629,611.

Patented July 25, 1899.

J. ROBERTSON.

HYDRAULIC APPARATUS.

(Application filed June 16, 1898.)

(No Model.)

2 Sheets—Sheet 1.

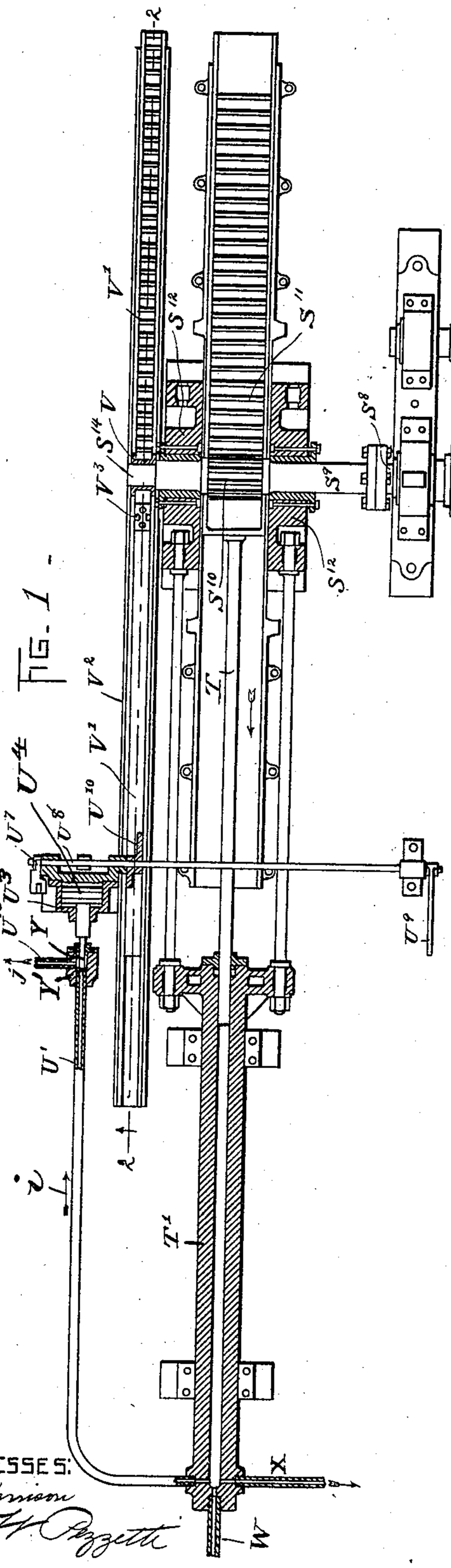

FIG. 1.

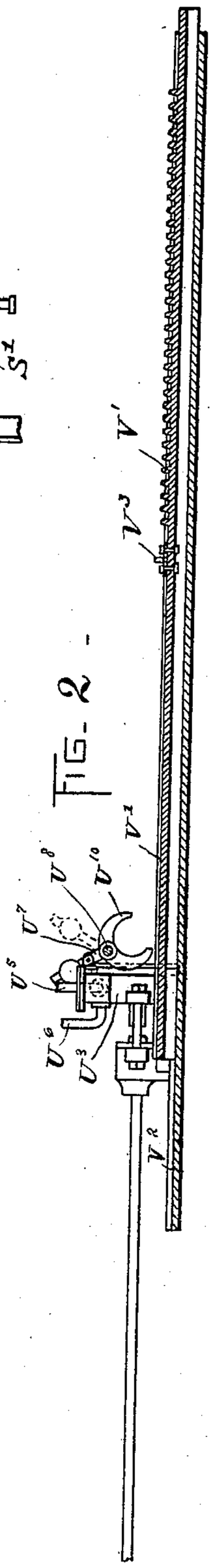

FIG. 2.

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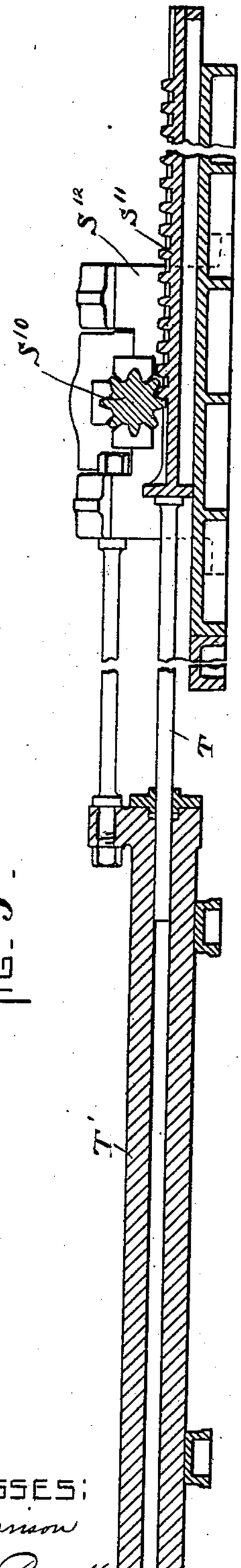

FIG. 3.

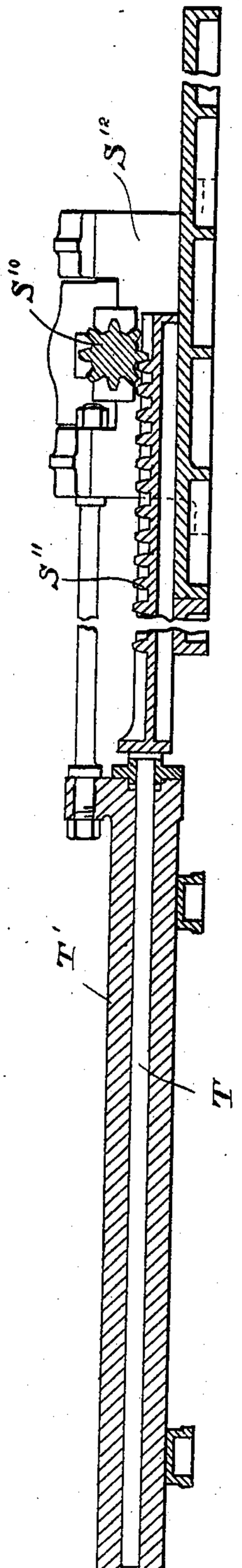

FIG. 4.

Witnesses:
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UNITED STATES PATENT OFFICE.

JAMES ROBERTSON, OF RAINHILL, ENGLAND.

HYDRAULIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 629,611, dated July 25, 1899.

Original application filed June 14, 1897, Serial No. 640,644. Divided and this application filed June 16, 1898. Serial No. 683,553. (No model.)

To all whom it may concern:

Be it known that I, JAMES ROBERTSON, of Rainhill, in the county of Lancaster, England, have invented certain new and useful Improvements in Hydraulic Apparatus, (for which I have received Letters Patent of Great Britain, No. 3,054, dated February 11, 1896,) of which the following is a specification.

This application is a division of my application for United States Letters Patent for improvements in methods of and apparatus for forming metal articles, filed June 14, 1897, Serial No. 640,644. Said application describes certain improvements in the manufacture of metal articles from billets or blanks of metal heated to softness. The heated blank is placed in a strong container and is given the desired form by introducing a forcing liquid under heavy pressure into the interior of the container and forcing the blank against a suitable forming tool or member.

It is the object of the present invention to provide a liquid-forcing or hydraulic apparatus capable of furnishing a very heavy pressure for a short period of time, such as that required in the above-noted process, such apparatus being also suited for the operation of hydraulic pushing draw-benches and other machinery.

The mechanism hereinafter described as illustrating an embodiment of my invention resembles in some of its features that described in Letters Patent of the United States No. 560,935, granted to me May 26, 1896, but differs therefrom in the provisions made for securing a reversing action, as well as in other particulars.

In carrying out the present invention a moderately powerful steam-engine or other motor is employed, which rotates a heavy fly-wheel continuously at a high speed. Clutch arrangements are made whereby the fly-wheel shaft may be thrown into and out of gear with a toothed rack which operates the piston or plunger of a pressure-cylinder, and hydraulic reversing devices are provided for returning the rack after a stroke.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a top plan view, partly in section, of an improved liquid-forcing apparatus constructed in accordance with my invention. Fig. 2 represents a median longitudinal section of the same. Fig. 3 represents a view similar to Fig. 2, showing a different position of the parts. Fig. 4 represents a longitudinal section, taken parallel with the section shown in Fig. 2, through another portion of the apparatus.

The same reference characters indicate the same parts in all the figures.

Referring to the drawings, in Fig. 1 I show one corner of the bed-plate of a steam-engine, of which S′ designates the crank, S^2 the crank-shaft, and S^3 a heavy fly-wheel mounted on said shaft. To the shaft S^2 is secured a pinion S^4, which meshes with the teeth of a large gear-wheel S^5, loosely mounted on a shaft S^8. The hub of said gear-wheel is formed to constitute the driving half S^6 of a claw-clutch. The other half S^7 of said clutch is splined to the shaft S^8 and is provided with an operating-lever S^{13} for moving it into and out of engagement with the driving half S^6.

S^9 is a shaft coupled to and forming a continuation of the shaft S^8 and journaled in bushings, which are mounted in strong housings S^{12}. The shaft S^9 is provided with a pinion S^{10}, adapted to mesh with the teeth of a sliding rack S^{11}, which latter is mounted in strong housings similar to those used in a plate-rolling mill. To the end of the rack is affixed the ram or plunger T of a long hydraulic cylinder T′, from the forward end of which a pipe X leads to the metal-shaping devices. Figs. 1 and 2 show the positions of the parts at the beginning of a stroke. The clutch member S^7 is shown thrown into engagement with the clutch member S^6 on the revolving gear-wheel S^5.

The teeth of the pinion S^{10} engage the teeth of the rack S^{11}, and said rack is caused to slide forward on its bed-plate and force the ram T through the cylinder T′. The water from said cylinder escapes through the pipe X to the machine or apparatus which it is desired to operate. If the pressure in the cylinder T′ is not relieved during the stroke of the ram T, the rack S^{11} travels forward to the full extent of its stroke and is automatically thrown out of gear when the last tooth is reached, as shown in Fig. 4. The strain

on the clutch members S^6 S^7 being thus relieved, the said members may be disengaged and the rotation of the shaft S^8 S^9 stopped. The motion of the rack may then be reversed, and said rack returned to its initial position by admitting water from a small hydraulic pump into the cylinder T′ through a pipe W, which is provided with a check-valve. The apparatus is then ready for another stroke. I provide means, however, for relieving the pressure in the cylinder T′ at any point in the forward stroke of the rack, the said means including an outlet-pipe U′, leading from said cylinder, a valve-chest Y′, and a valve Y therein controlling said outlet-pipe. The pressure in the cylinder T′ may be instantly relieved by opening the valve Y and allowing the water from the cylinder to escape through a waste-pipe U^2. The valve Y is connected with and arranged to be operated by the piston U^4 of a small steam-cylinder U^3, having a supply-pipe U^5 and an exhaust-pipe U^6. The steam-supply to said cylinder is regulated by a suitable slide-valve operated through the medium of a lever U^7, an operating-rod U^8, upon one end of which the lever U^7 is mounted, and an operating-handle U^9, mounted on the other end of said rod. The steam-pressure from a boiler acting on the rear of the piston U^4 serves to normally keep the valve Y closed, and it will be noted also that by reason of this the valve Y acts as a safety-valve for the hydraulic cylinder T′.

As previously stated, the above-described valve arrangements permit the pressure in the hydraulic cylinder to be relieved at any time during a stroke, it being only necessary to manipulate the handle U^9 at the proper moment. The clutch members S^6 S^7 may then be disengaged and the travel of the rack stopped, or they may be left in engagement and the rack allowed to proceed to its full stroke, while the water in the hydraulic cylinder escapes through the waste-pipe U^2, following the direction of the arrows *i j*.

I further provide means for automatically relieving the pressure in the hydraulic cylinder, the said means including a pinion V, mounted on the end of the shaft S^9 and having the same diameter at pitch-line as the pinion S^{10}, a light rack V′, having teeth which mesh with the teeth of the pinion V and adapted to slide in a channel-plate V^2, and an adjustable lug or boss V^3, secured to the rack V′ and adapted to act as a trip to engage a "kicking-cam" U^{10}, attached to the rod U^8. The lug V^3 may be adjusted on the rack so as to trip the lever U^7 at any desired point in the stroke and cause the relief-valve Y to be opened.

It will be seen from the above description that I have provided a water-forcing apparatus particularly suited for furnishing a momentary water-supply at great pressure and high speed. I have heretofore used reversing steam-engines for most of my metal-shaping operations, and in high-power instalments for operating upon billets of large diameter the large engines used have proved to be very expensive; but in certain processes, such as the metal-shaping process described in the application of which this is a division, a heavy pressure is required for only a few seconds at a time, and I am therefore enabled to use a comparatively small steam-engine and store the power therefrom by revolving a heavy fly-wheel at a high speed. The momentum of the fly-wheel causes a very heavy pressure in the hydraulic cylinder during the forming stroke, which usually lasts from one to three seconds in the process alluded to, and in the interim between that and the next stroke, which is ordinarily about one minute, the fly-wheel, whose speed has been reduced by the effort of the stroke, regains its normal speed.

Having thus explained the nature of my invention and described a way of constructing and using the same, although without having attempted to set forth all the forms in which it may be embodied or all the modes of its use, I declare that what I claim is—

1. In an apparatus of the character described, in combination, a liquid-pressure cylinder and its ram or plunger, a motor, a clutch adapted to effect a driving connection between said motor and the plunger, means for throwing the parts of said clutch into and out of engagement, and a relief-valve connecting with the pressure-cylinder and adapted to be opened to relieve the pressure in said cylinder due to the forcing of the plunger therethrough, and thereby permit the disengagement of the parts of the clutch to throw the motor out of connection with the plunger.

2. In an apparatus of the character described, in combination, a liquid-pressure cylinder and its ram or plunger, a motor, a clutch adapted to effect a driving connection between said motor and the plunger, means for throwing the parts of said clutch into and out of engagement, a relief-valve connecting with the pressure-cylinder and adapted to be opened to relieve the pressure in said cylinder due to the forcing of the plunger therethrough and thereby permit the disengagement of the parts of the clutch to throw the motor out of connection with the plunger, means operating simultaneously with said plunger for automatically opening the relief-valve at a predetermined point in the stroke of the plunger, and a manually-controlled operating device connected with the valve, whereby said valve may be opened at any point in the stroke of said plunger.

3. In an apparatus of the character described, in combination, a liquid-pressure cylinder and its ram or plunger, a motor, a clutch adapted to effect a driving connection between said motor and the plunger, means for throwing the parts of said clutch into and out of engagement, a relief-valve connecting with the pressure-cylinder and adapted to be

opened to relieve the pressure in said cylinder due to the forcing of the plunger therethrough and thereby permit the disengagement of the parts of the clutch to throw the motor out of connection with the plunger, a kicking-cam connected with the valve, and a rack and pinion operating simultaneously with the plunger, said rack having provision for engaging said kicking-cam to automatically open the valve at a predetermined point in the stroke of said plunger.

4. In an apparatus of the character described, in combination, a liquid-pressure cylinder and its ram or plunger, a motor, a clutch adapted to effect a driving connection between said motor and the plunger, means for throwing the parts of said clutch into and out of engagement, a relief-valve connecting with the pressure-cylinder and adapted to be opened to relieve the pressure in said cylinder due to the forcing of the plunger therethrough and thereby permit the disengagement of the parts of the clutch to throw the motor out of connection with the plunger, a steam-cylinder and a piston therein connected with the valve, a valve for controlling the admission of steam to said cylinder, and operating means for said steam-valve controllable manually, and also automatically by the plunger-operating means.

In testimony whereof I have affixed my signature in presence of two witnesses.

JAMES ROBERTSON.

Witnesses:
ATHUEL-HALL,
JOHN W. THOMAS.