

(No Model.)

N. T. GREENE.  
STEAM ENGINE.

No. 548,753.

Patented Oct. 29, 1895.

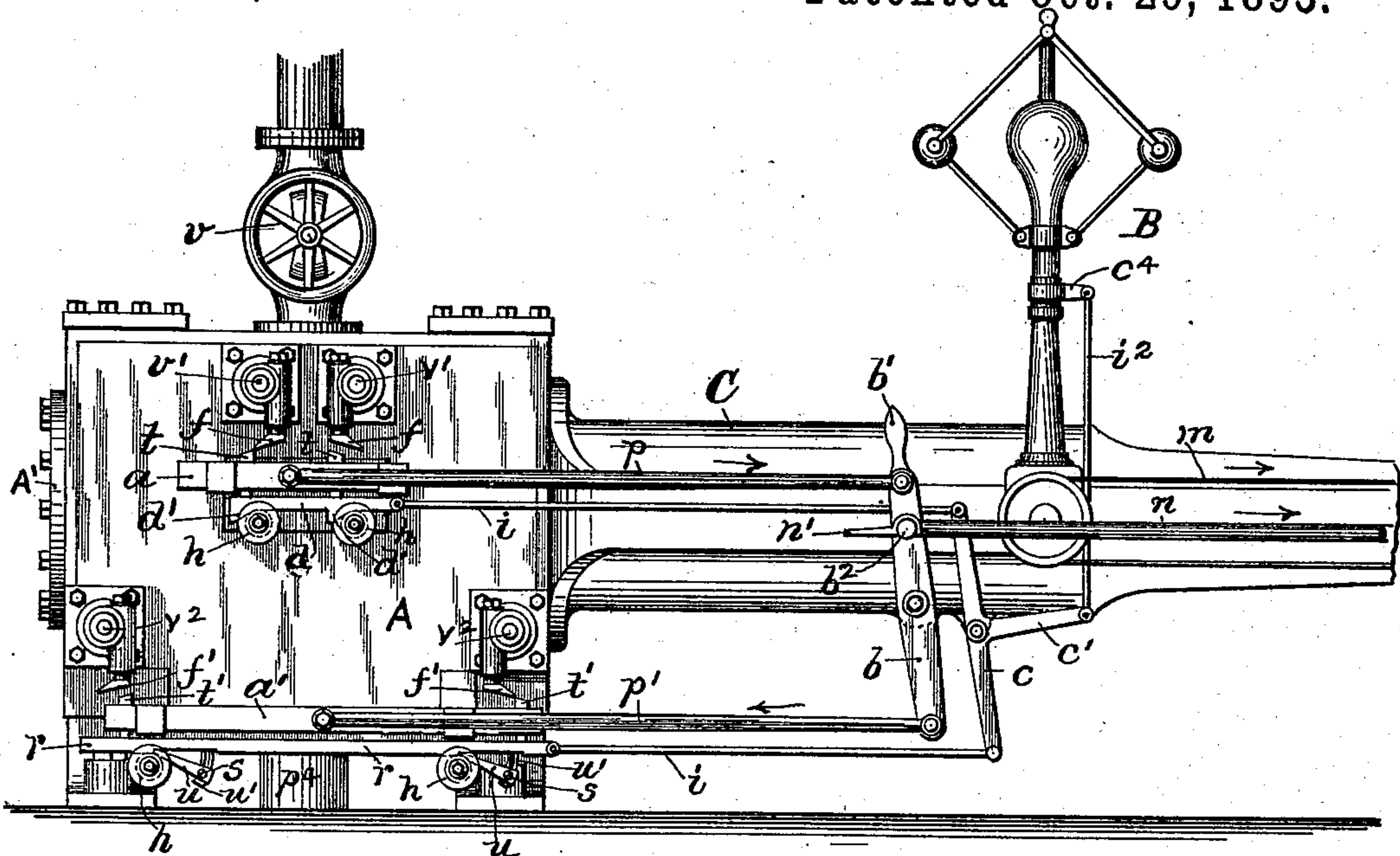


Fig. 1.

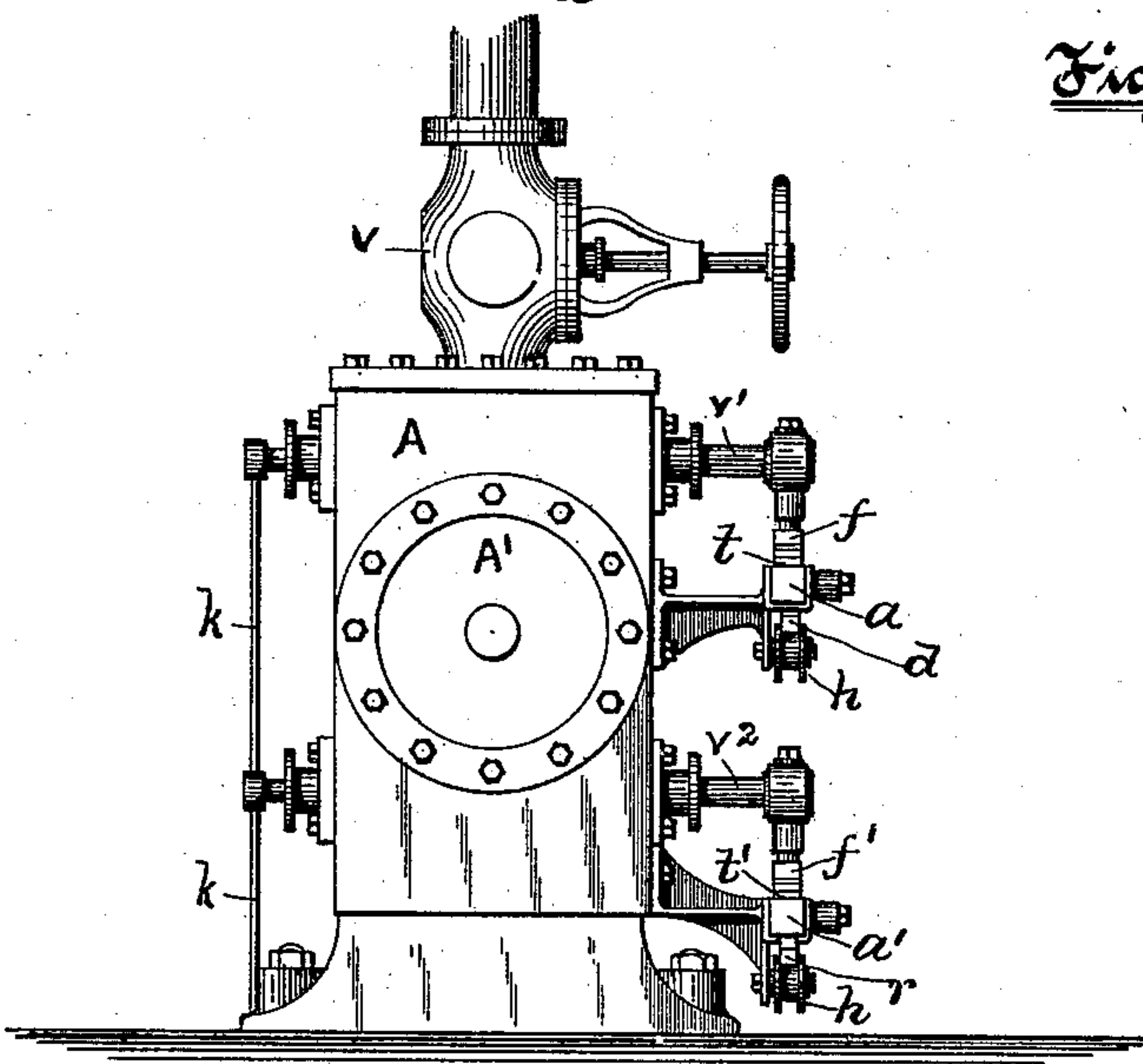


Fig. 2.

Witnesses.

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# UNITED STATES PATENT OFFICE.

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## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 548,753, dated October 29, 1895.

Application filed August 3, 1895. Serial No. 558,102. (No model.)

*To all whom it may concern:*

Be it known that I, NOBLE T. GREENE, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in steam-engines of the class having automatically-controlled liberating valve-gear for the steam-inlet valves; and it consists, essentially, in the combination, in a steam-engine, with the steam-cylinder having self-closing steam-valves, means for opening said valves, and liberating valve-gear through which the steam-valves are capable of being tripped or released automatically at different points in the stroke of the engine by the action of the governor, of self-closing exhaust-valves, mechanism for opening said exhaust-valves, detachable valve-gear through which the exhaust-valves are tripped or released, and means connected with and actuated by the governor for effecting such release of the exhaust-valves automatically, all as will be more fully hereinafter set forth and claimed.

In steam-engines of the automatic cut-off type provided with cylinders in which steam is used expansively and having independent steam and exhaust valves it has been usual hitherto, so far as I am aware, to employ positive-action exhaust-valves—that is, exhaust-valves so set or adjusted that the point of steam-release from the cylinder is practically invariable and having no fixed relation to the point at which the live steam entering the cylinder is cut off.

I have discovered that the exhaust-valves of an engine should work substantially in unison with the inlet or steam valves both in opening and closing. In engine-valves as usually constructed and arranged an amount of steam and heat is taken from the engine

which is not utilized. Consequently there is a loss in economy and regulation.

The principal object I have in view is to save or utilize to a greater extent the steam entering the cylinder of the engine and at the same time effect a better regulation of the engine. To that end I apply a liberating valve-gear to the exhaust-valves. This can be worked by a slide-bar provided with tappets, the latter being controlled by the governor, &c., in such manner that the exhaust-valves are opened and closed automatically in unison with the steam-valves.

In the accompanying sheet of drawings, Figure 1 is a partial side elevation of a steam-engine embodying my improvements, and Fig. 2 is an end view of the same.

Again referring to the drawings, A indicates a four-valved cylinder, C the frame or bed piece, and B the governor of a steam-engine.

The cylinder may be provided with piston, piston-rod, packing, valves, bonnets, and head, substantially as common. In the drawings I have represented the steam-cylinder as provided with valve actuating and liberating valve-gear of the Greene type, although other kinds of automatically-operating cut-off valve-gear may be employed. As drawn, the rotative rods  $v'$  of the two steam-valves carry on their rear ends, as seen in Fig. 1, suitably-mounted "toes"  $f$ . These in turn are adapted to engage the upper ends of corresponding "tappets"  $t$ , vertically movable in the supported horizontal slide-bar  $a$ . A positive reciprocating movement is imparted to the slide-bar by means of the connection  $p$ , jointed to a rock arm or lever  $b$ , fulcrumed in the frame C, the rock-arm itself being oscillated by a rod  $n$ , adapted to be actuated by an eccentric mounted on the engine-shaft, as usual. The free end of the eccentric-rod  $n$  is hooked onto a pin  $b^2$ , secured to lever  $b$ . In order that the valve-gear may be worked by hand—say as in starting and stopping the engine—the lever  $b$  is provided with a handle  $n'$ , all constructed substantially as common.

The fly ball-governor B is actuated by a belt  $m$ , capable of being driven by the engine-shaft, as usual. A T-shaped lever  $c$  is piv-



oted to the frame C, the same having an arm member  $c'$  extending therefrom, to which is jointed a light vertical rod  $i^2$ , the upper end of the latter being jointed to a slidable collar  $c^4$  of the governor. Thus it will be seen that the fluctuations of the governor will move the collar up or down, thereby causing the lever  $c$  to oscillate in unison with it through the medium of said rod  $i^2$  and arm  $c'$ .

Below the slide-bar  $a$ , carrying the said tappets  $t$ , is located a "gage-bar"  $d$ , the same being provided with inclined or cam-shaped dogs  $d'$ , supported on suitably-mounted rolls  $h$ . The lower ends of the tappets rest upon the gage-bar, the latter being connected to the governor-lever  $c$  by a link  $i$ . Thus it will be seen that the action of the governor upon the gage-bar will cause the hook ends of the tappets to be brought nearer to or farther from the ends of the toes  $f$ , thereby producing a correspondingly longer or shorter period of contact with the toes and vibrating the valve-rods  $v'$  a corresponding extent, and thus at the same time open or uncover the steam-ports a corresponding amount; or, in other words, the positive travel of the slide-bar  $a$  back and forth carries the tappets past the toes  $f$ , the latter during such movement swinging upward until the tappets slide from them, thereby at the same instant detaching or liberating the corresponding steam-valve, which valve is immediately closed by a weight or vacuum-pot connected with an arm on the front end of the valve-rod, as usual.

$k$ , Fig. 2, indicates a rod or connection for such purpose. I would add that the shanks of the toes, or, if desired, the tappets themselves, are usually provided with springs, so that the parts will yield sufficiently to permit the ends of the tappets to pass freely beneath the toes upon the return stroke of the slide-bar.

In my improved steam-engine I provide the exhaust-valves with detachable valve-gear. In the drawings the two valve rods or stems  $v^2$  of the exhaust-valves are provided with toes  $f'$ , arranged to engage or contact with tappets  $t'$ , mounted in a suitably-supported slide-bar  $a'$ . Reciprocating motion is imparted to the bar  $a'$  by a connection  $p'$ , jointed thereto and to the lower end of the said rock-lever  $b$ . The vertical movements of the tappets are influenced by a gage-bar  $r$ , supported on rolls  $h$ , actuated by the said governor-controlled lever  $c$  and the lower connecting link or rod  $i$ .

As it is found to be desirable at times to change or adjust the time and amount of opening of the exhaust-valves with respect to the steam-valves, so as to get more or less "lead," I provide the under side of the gage-bar at each end with a swinging adjustable dog or cam  $u$ . These dogs are adapted to bear upon the rolls  $h$  and are held in position after adjustment by screws or bolts  $s$ , located in the

curved slotted lugs  $u'$ , extending from the lower side of the bar. (See Fig. 1.)

By means of my improvement the exhaust as well as the steam valves are provided with liberating valve-gear, and being under the control of the governor as to the time or point of release. The exhaust-valves are closed by weights or vacuum-pots, substantially as before described with respect to the steam-valves.

I do not limit my invention to the precise form, construction, and arrangement of the valve-gear and connections represented in the accompanying drawings, as other kinds of detachable valve-gear may be employed for the steam and exhaust valves of a steam-engine without departing from the spirit of the invention.

I claim as new and desire to secure by United States Letters Patent—

1. In a steam engine of the automatic cut-off type, having a steam cylinder provided with multiple self-closing steam and exhaust valves through which steam is admitted into and released from the cylinder, a liberating valve-gear for opening the steam valves, a liberating valve-gear for opening the exhaust valves capable of working in unison with said steam valve-gear, and a single governor or regulating device and suitable connections arranged and adapted to coact with both said liberating valve mechanisms in tripping or releasing all of the valves at different points in the engine's stroke.

2. In an automatic cut-off steam engine having a steam cylinder provided with two self-closing steam valves and two self-closing exhaust valves, the combination therewith of liberating valve-gear mechanism for opening all of said valves, and governor-controlled means capable of coacting with said valve-opening mechanism for automatically tripping all the several valves at variable points in the stroke of the engine.

3. In an automatic cut-off steam engine, the combination with the steam cylinder, self-closing independent steam and exhaust valves mounted therein, and positively driven detachable valve-gear for all of said valves, of governor-controlled mechanism capable of coacting with said valve-gear for automatically limiting or determining the point, or points, at which all the said steam and exhaust valves shall close, and having the said governor-controlled mechanism further provided with means whereby the points at which the exhaust valves close may be adjusted with respect to the steam valves, substantially as described.

4. In a cut-off steam engine provided with self-closing steam and exhaust valves, oscillating valve-rods having toes mounted thereon through which the said valves are actuated, two reciprocating slide-bars carrying tappets



adapted to contact with said toes for opening  
all of the said steam and exhaust valves, a  
pair of movable governor-controlled gage-bars  
provided with dogs or cams capable of chang-  
5 ing the vertical position of the tappets with  
respect to the toes, and having the dogs or  
cams of the lower or exhaust valve gage-bar  
further arranged to be set or adjusted, sub-

stantially as hereinbefore described and for  
the purpose set forth.

In testimony whereof I have affixed my sig-  
nature in presence of two witnesses.

NOBLE T. GREENE.

Witnesses:

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REMINGTON SHERMAN.