(No Model.) 5 Sheets—Sheet 1.

H. T. GILES.

BALANCED SLIDE VALVE.

No. 373,182. Patented Nov. 15, 1887.

Fig. 1.

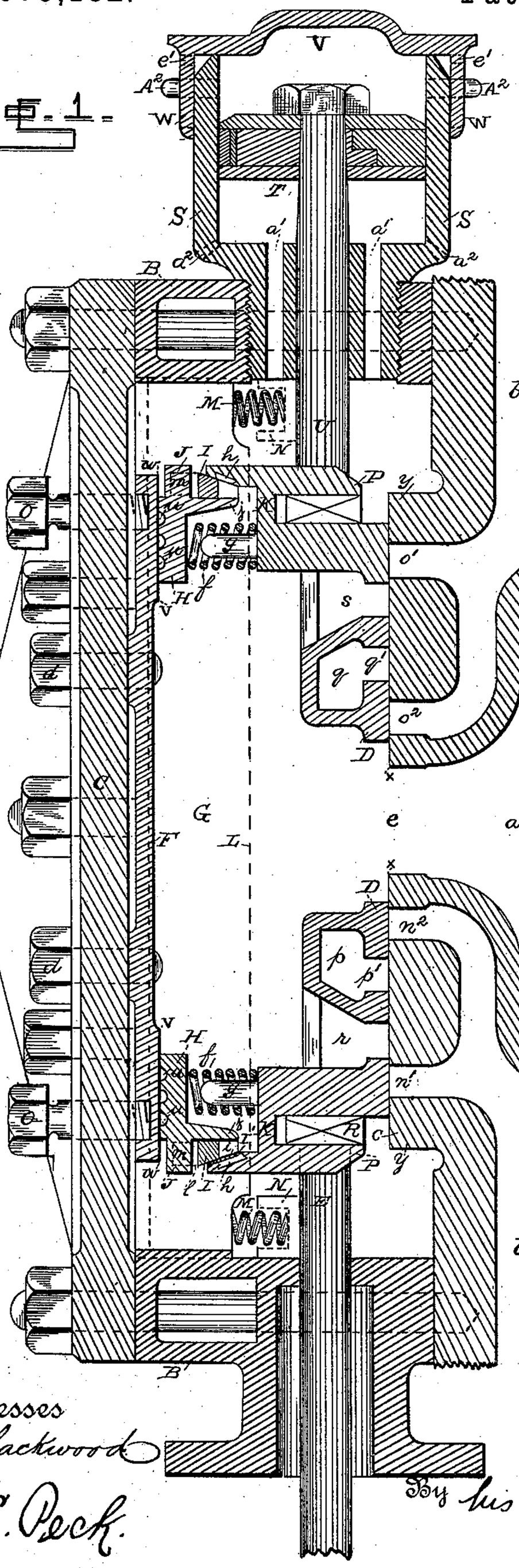


Fig. 6.

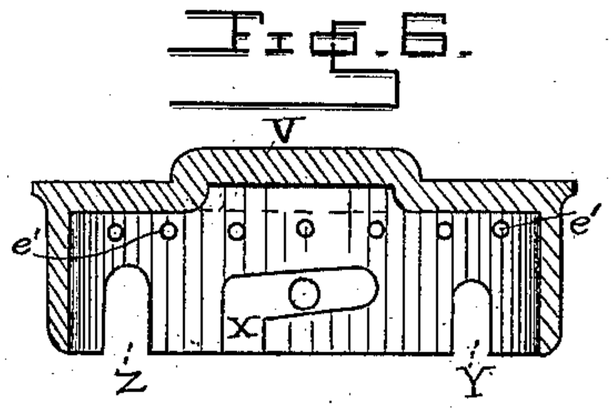
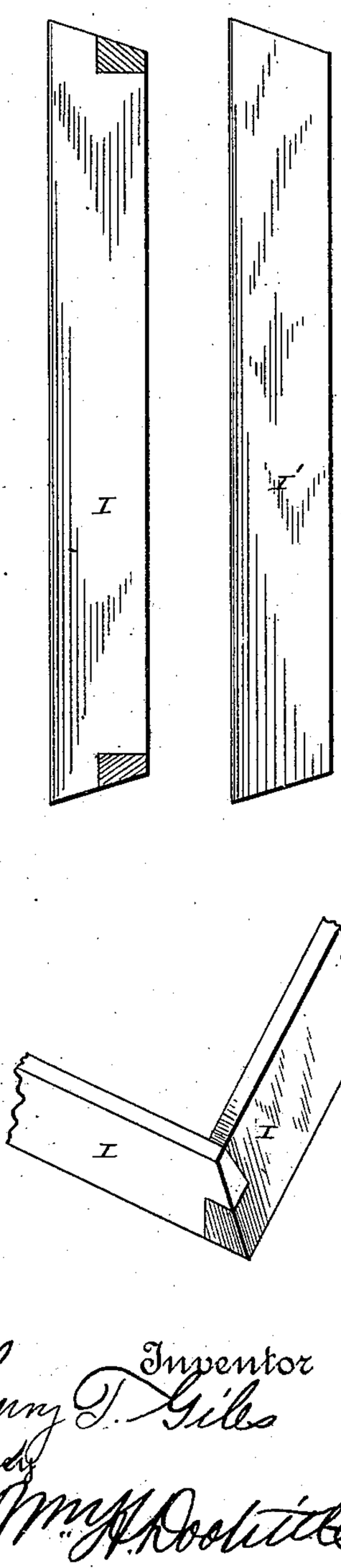


Fig. 7.



Witnesses
Jos. H. Blackwood
H. E. Peck.

Inventor
Henry T. Giles
By his Attorney
Wm. H. Doolittle

(No Model.) 5 Sheets—Sheet 2.

H. T. GILES.

BALANCED SLIDE VALVE.

No. 373,182. Patented Nov. 15, 1887.

Fig. 2.

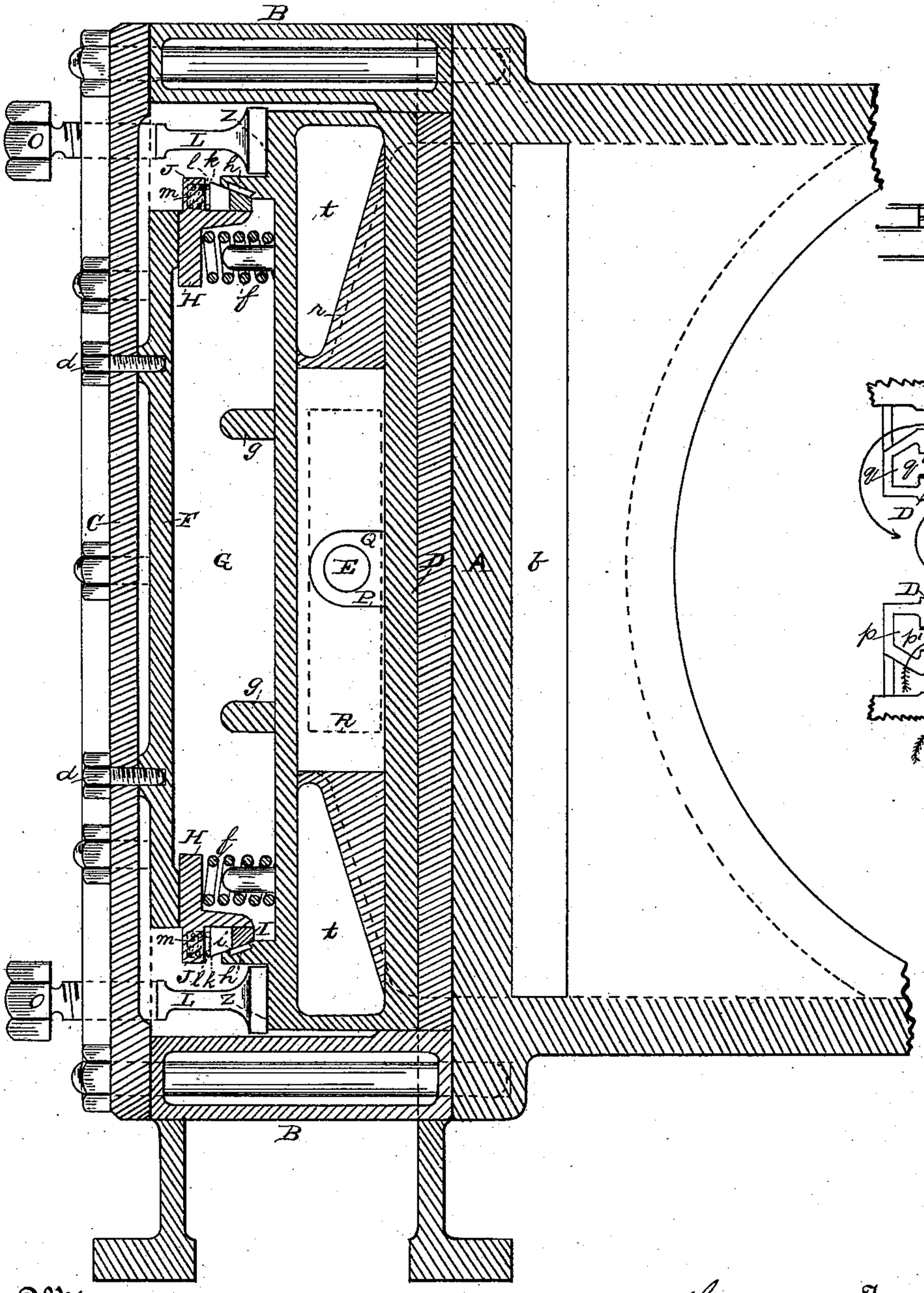
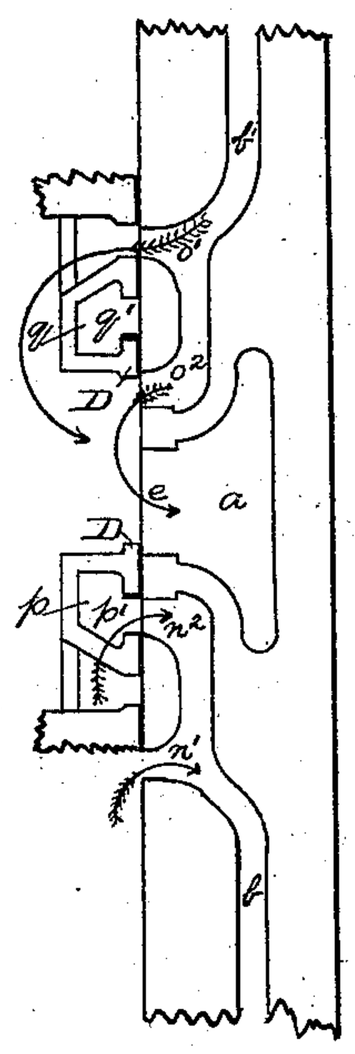


Fig. 5.



Witnesses:
Jos. H. Blackwood
H. E. Peck

Inventor
Henry T. Giles
By his Attorney
Wm. H. Doolittle

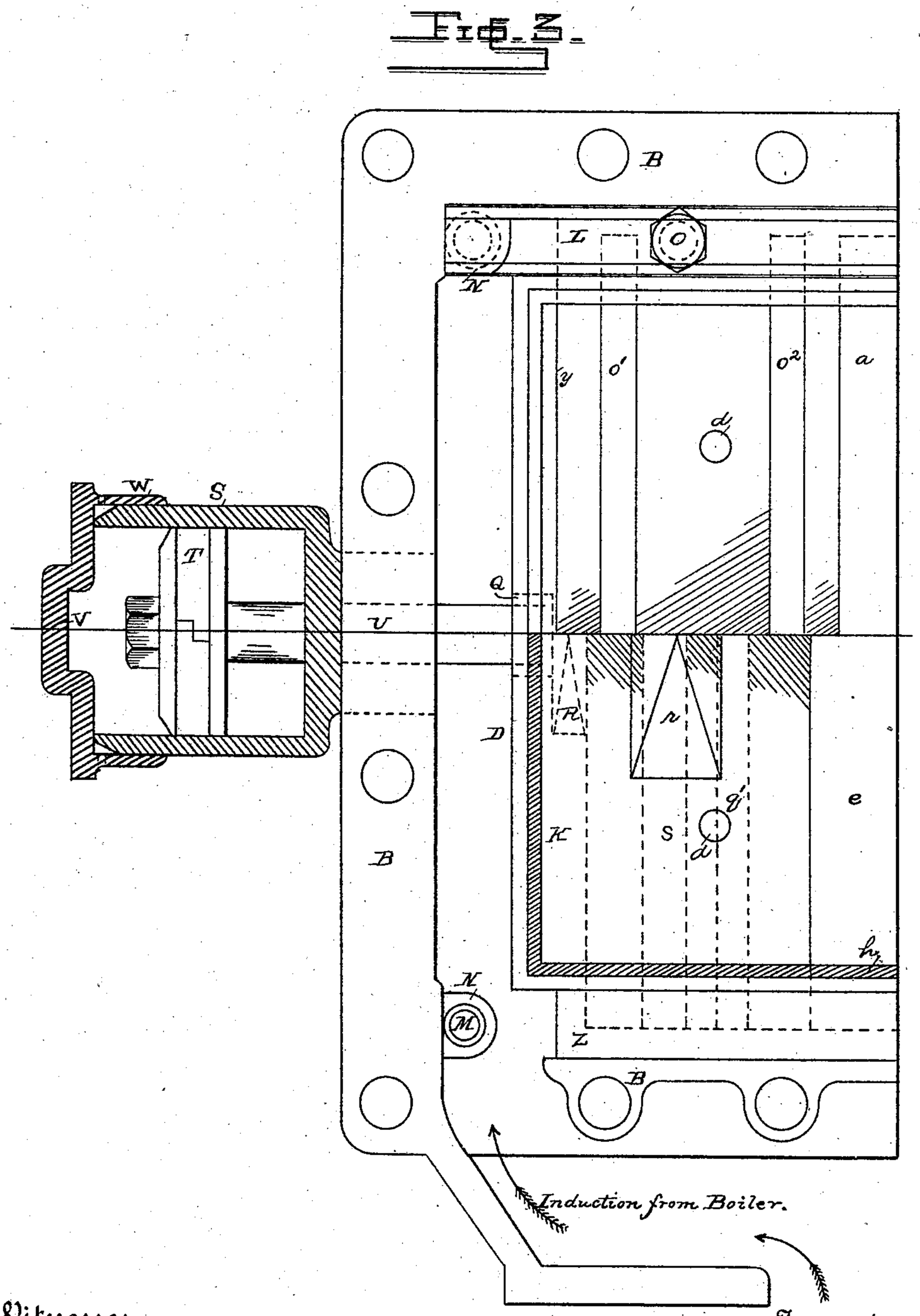
(No Model.) 5 Sheets—Sheet 3.

H. T. GILES.

BALANCED SLIDE VALVE.

No. 373,182. Patented Nov. 15, 1887.

Fig. 3.



Witnesses
Jos. H. Blackwood
H. E. Peck

Inventor
Henry T. Giles
By his Attorney
Wm. H. Doolittle

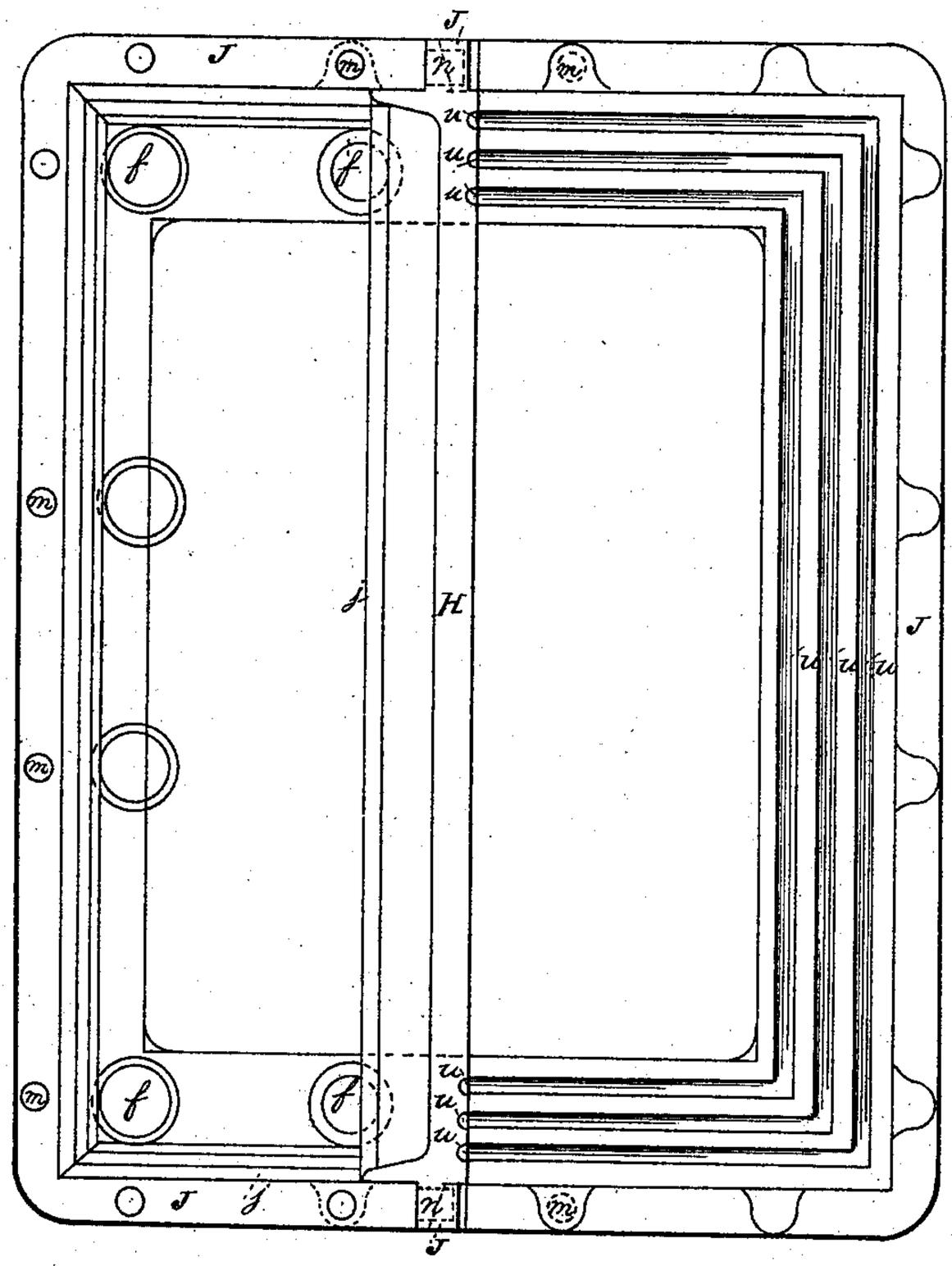
(No Model.) 5 Sheets—Sheet 4.

H. T. GILES.

BALANCED SLIDE VALVE.

No. 373,182. Patented Nov. 15, 1887.

Fig. 4.



Witnesses
Joel H. Blackwood.
H. E. Peck.

Inventor
Henry T. Giles.
By his Attorney
Wm. H. Woolcott

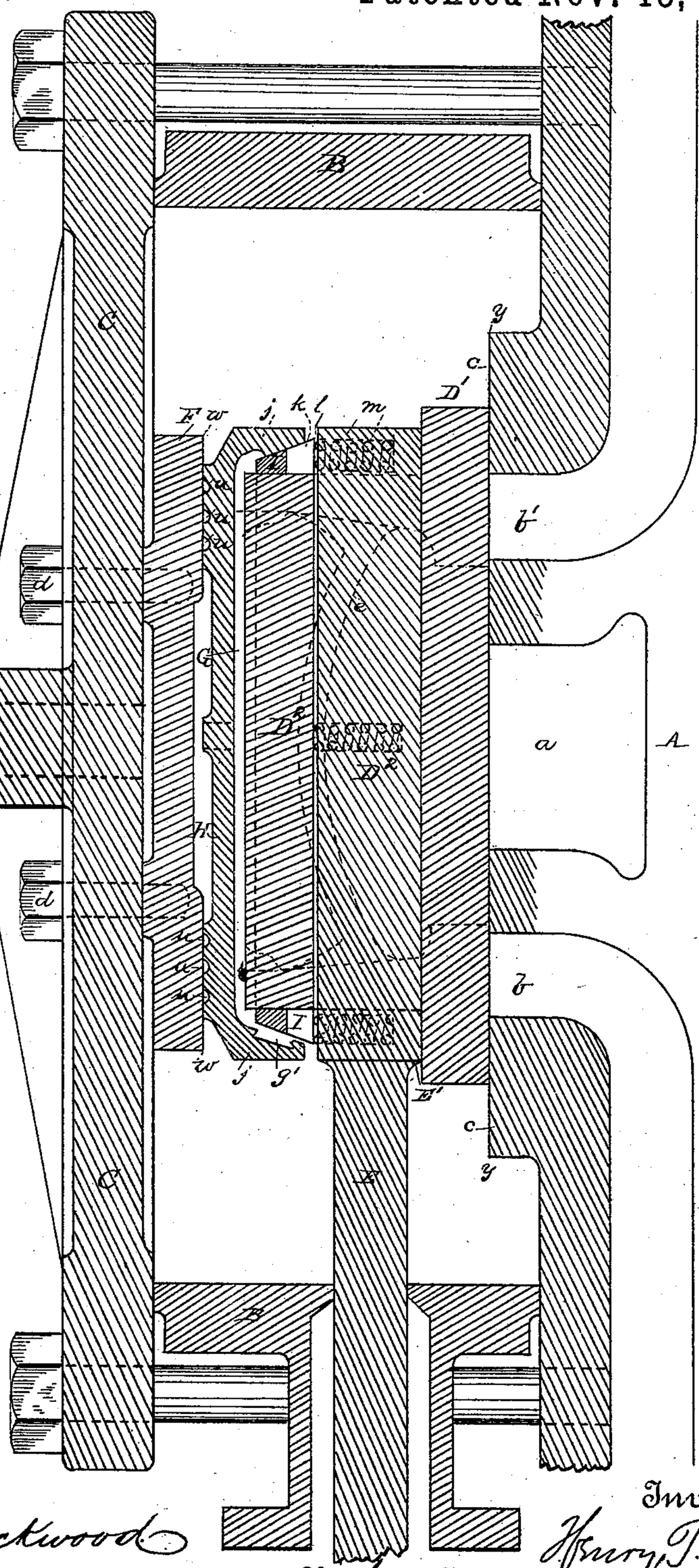
(No Model.) 5 Sheets—Sheet 5.

H. T. GILES.

BALANCED SLIDE VALVE.

No. 373,182. Patented Nov. 15, 1887.

Fig. 8.



Witnesses
Joe H. Blackwood
H. E. Peck.

Inventor
Henry T. Giles
By his Attorney
Wm. W. Woodside

UNITED STATES PATENT OFFICE.

HENRY T. GILES, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR OF ONE-FOURTH TO ALBERT M. COWELL, OF SAME PLACE.

BALANCED SLIDE-VALVE.

SPECIFICATION forming part of Letters Patent No. 373,182, dated November 15, 1887.

Application filed October 20, 1886. Serial No. 216,772. (No model.)

To all whom it may concern:

Be it known that I, HENRY T. GILES, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Balanced Slide-Valves; 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.

This invention relates to the slide-valves of steam-engines; and it consists in mechanism and construction for balancing the same. In the case of the usual slide-valve used in most engines the outer side of the valve is acted upon by the steam in the steam-chest, which presses the valve on its seat with great force. This not only renders the valve difficult to operate, but also wears the valve and its seat very rapidly; and in cases where these valves are used in vertical engines—such as marine engines, for example—the weight of the valve and its connections, which is very great in large engines—has to be borne by the valve-rod and its connections, subjecting their joints to rapid wear, requiring expenditure of power for the operation of the valve, and necessitating a heavy valve-rod and connections.

The present invention consists, primarily, in balancing the valve against the steam-pressure in the steam-chest in all kinds of engines using a slide-valve, and, secondarily, in balancing the weight of the valve in upright engines.

Many constructions of slide-valves have been devised to balance the same against the steam-pressure—such as, for example, fitting the valve with an elastic balance-plate movable therewith, which slides beneath a fixed balance-plate secured to the steam-chest; but, so far as I am aware, none of them have practically succeeded in perfectly balancing the valve. The main difficulty lies in providing against currents in the steam and back-pressure, which, in case the valve is perfectly balanced, or nearly so, lifts the valve from the seat, thus admitting the live steam into both ends of the cylinder and into the exhaust. In such an emergency, which is of frequent occurrence where the valves are nearly perfectly balanced, it is necessary to cut off the steam entirely before the valve will again reseat itself. Therefore it has been in practice only attempted to partially balance the valve. Now, in the present invention, the opposite areas of the valve are made exactly equal, or approximately so, and the valve is constructed so that this equality will be preserved in all positions of the valve, and an important feature of the invention consists in the means for holding the valve against back-pressure.

The present invention is more particularly adapted to valves of the Allen type, wherein double entrance-ports in the valve are provided, and the invention itself is a development of those balanced valves which have a sliding balance-plate carried by the valve, operating in connection with a fixed balance-plate secured to the steam-chest cover.

The invention also includes an improved arrangement of the ports, which assists in the balancing of the valve, and means for lubricating the bearing-surface of the sliding balance-plate.

In the accompanying drawings, Figure 1 is a longitudinal central section of the valve and steam-chest. Fig. 2 is a cross-section of the valve. Fig. 3 is a plan view of the valve and valve-seat, one half of the figure showing the upper side of the valve, the other half showing the valve-seat. Fig. 4 is a view of the sliding balance-plate, showing the upper and lower sides thereof. Fig. 5 is a view of the valve, showing it in a different position from that shown in Fig. 1. Fig. 6 is a sectional view of the valve-cap of the balancing-cylinder. Fig. 7 are details of the packing-strips, and Fig. 8 is a view of a modificaiton.

A is a portion of the steam-cylinder; B B, the side walls of the steam-chest; C, the removable top plate of the steam-chest; *a*, the exhaust-steam port, and *b b'* the main induction-steam passages.

D is the slide-valve, E is the valve-rod, and *c* is the valve-seat or surface of the cylinder on which the valve rests and slides.

F is the stationary balance-plate, adjustably secured to the top plate of the valve-chest for taking up wear by set-screws *d d*.

The valve proper, D, only occupies a portion

of the space between the seat *c* and the balance-plate F, a space or chamber, G, being left between them. The exhaust opening or passage *e* of the valve is entirely open to this chamber.

H is the sliding balance-plate, which slides with the valve. This sliding plate is held in contact with the stationary balance-plate by means of coiled springs *f f*, which are carried by the valve and supported by pins or studs *g g* on the valve.

In order to form a steam-tight connection between the valve and sliding balance-plate, so as to render impossible communication between the live steam in the steam-chest and the exhaust-chamber G, the valve is provided with a perpendicular rim, *h*, projecting toward the balance-plate and beveled on its inner face, *i*. The sliding balance-plate H is also provided with a rim, *j*, projecting toward the valve and overreaching and inclosed by the rim *h* on the valve. Each of the rims *h j* is straight in outline, and four straight spaces are formed between them. These spaces are filled with four packing-strips, I I, which form a steam-tight joint between the two rims *h j*. Each strip has one beveled face, *k*, corresponding with the beveled face *i* of the rim *h*, so that any wear between the packing-strips and the rims may be taken up. To hold these packing-strips firmly against their seats when the steam is cut off coiled springs *l l* are used, the steam-pressure in the steam-chest holding the strips in place when the steam is on. These springs are held in recesses *m*, formed in an overhanging and projecting flange, J, formed on the sliding balance-plate, and which bear against the outer wider surfaces of the packing-strips. These packing-strips not only form a steam-tight joint, but prevent any movement between the valve and the sliding balance-plate, so that the valve and plate move together.

In addition to the packing-strips I I, there are also used thin sheet-metal auxiliary packing-strips, I′ I′, which are placed between the beveled faces *i k*. These strips, which are only used in case the packing-strips I are made of metal, assist in making the joint steam-tight, and can easily be replaced by thicker ones to take up wear.

In the valve shown in the principal figures of the drawings the passages *b b′*, leading to the steam-cylinder, have each two ports, *n′ n″* and *o′ o″*, respectively, and the valve is so constructed that both ports on the steam side are open simultaneously, so as to admit the steam in double quantities to the cylinder on the first opening of the ports. The valve shown is also constructed so that double openings to the exhaust are provided. In the present valve the arrangement of the ports in the valve are utilized to assist in balancing the valve. The outside ports, *n′ o′*, are uncovered by the movement of the valve, so that they have direct communication with the steam-chest. The travel of the valve is, however, not sufficient to directly uncover the inner ports, n^2 o^2, so that live-steam passages *p q* are formed in the valve to establish communication at the proper times between the said ports and the steam-chest. These passages *p q* extend through the end walls of the valve, and are at all times filled with live steam. Between the port-openings *p′ q′* of the passages *p q* and the ends of the valve are located the auxiliary exhaust ports and passages *r s*. These ports are always open to the exhaust-chamber G. These exhaust-passages *r s* are arranged to coincide with the ports *n′ o′*, respectively, the ports *n″ o″* being uncovered directly to the exhaust by the movement of the valve.

It is desirable that the several port-openings *p′ q′ r s* should have an area at least equal to their respective ports *n″ o″ n′ o′*, and in order to permit the passages *p q* to pass the passages *r s* the latter are contracted in width as they approach the chamber G, as indicated in dotted lines in Fig. 2, and at the same time widened in the other direction, as shown in Fig. 1. Each live-steam passage *p q* branches and passes on both sides of the passages *r s*, having two openings, *t t*, in the ends of the valve, as shown in Fig. 2.

The operation will be readily understood. At the instant that the port *n′* is uncovered by the valve the port *p′* opens the port n^2, and when the valve uncovers port o^2 to the exhaust, port *s* also opens the port *o′* to the exhaust, and vice versa on the movement of the valve in the opposite direction. Both passages *p q*, it will be thus seen, are always filled with live steam, and they thus balance the valve to the extent of the area of the ports *p′ q′*.

To lubricate the sliding balance-plate its upper or bearing surface is provided with longitudinal grooves *u u*, and the stationary balance-plate is recessed on its inner surface, forming shoulders or ledges *v v*. The widths of the bearing-surfaces of the sliding and stationary balance-plates are so proportioned to the travel of the valve that at the extreme movement of the valve in one direction the outer groove *u* passes beyond the edge *w* of the balance-plate, and when the valve is at its extreme travel in the opposite direction the inner groove *u* passes beyond the inner ledge *v* of the stationary balance-plate. When the grooves *u u* are thus free from the stationary balance-plate, they fill with steam and oil, which constitute the lubricant.

In proportioning the valve and the sliding balance-plate the design is to make their areas exactly equal, or nearly so, since it is designed to have the valve perfectly balanced. In the valve shown the areas of the ports *p′ q′* are to be deducted from the valve-area, since they assist in balancing the valve.

Slide-valves are usually made the full width of the steam-chest. In my construction the

balance-plate must be narrower than the valve, so as to provide for the reception of the back-pressure bars, hereinafter described. In order, then, to render the areas equal, the other or lengthwise dimension of the sliding balance-plate must be greater than that of the valve. As has been before described, the balance-plate is held within projections *h h* on the valve, and in order that these projections on the ends of the valve may be extended beyond the bearing-surface of the valve, the valve on its side next the balance-plate is formed with outwardly-projecting flanges K K on its ends, whereby the lengthwise dimension of the sliding balance-plate is increased without increasing the area of the bearing-surface of the valve. In this manner it is possible to balance the valve as nearly perfect as can be. When the sliding balance-plate H, during the travel of the valve, passes beyond the edges *w v* of the stationary balance-plate, as it must do in order to lubricate the balance-plates, the balance of the valve would naturally be destroyed. The parts are, however, so constructed as to provide against this. The area of the exhaust-port *a* in the steam-cylinder is so constructed that when the sliding balance-plate reaches the shoulders *v v* the edges of the valve at the opening *e* reach the edges *x x* of the exhaust-port. At opposite ends of the steam-chest the outer surface of the steam-cylinder is cut away, as shown, leaving ledges or shoulders *y y* at the ends of the valve-seat. The valve travels beyond these ledges *y y* in its movement to an amount exactly equal to the travel of the sliding balance-plate beyond the edges *w w* of the stationary balance-plate. In this way the valve is at all times as perfectly balanced as the varying condition of the steam-pressure will allow. As stated at the beginning of this specification, there are, however, practical objections to a perfectly-balanced valve, since such a valve will be lifted from its seat by back-pressure. The present invention includes means for preventing this.

On the sides of the valve the rims *h h* are cut in, leaving flat outer surfaces, Z Z, on the valve. In co-operation with these surfaces Z Z are longitudinal back-pressure bars L L. These bars extend lengthwise the whole length of the steam-chest, and are nominally held out of contact with the surfaces *z z* by springs M M, seated in cupped projections N N in the corners of the steam-chest. The back-pressure bars are brought within proper distance of the valve by means of set-screws O O, passing through the cover of the steam-chest. By this arrangement none of the weight of the back-pressure bars is borne by the valve; but the back-pressure bars may be brought so close to the valve that while they do not interfere with the free movement of the valve they will effectually prevent the valve being lifted from its seat.

In order that the valve may be easily connected or disconnected with the valve-rod E when the cover C of the steam-chest is removed, the flange K is formed with a perpendicular projecting lip, P, having an open slot, Q, which fits over the valve-rod E. The valve-rod has a T-head, R, which is held between the lip P and the body of the valve.

The valve, as thus far described, is applicable to any steam-engine, whether vertical or horizontal. When used in upright engines, it is also contemplated to balance the weight of the valve and its connections. To this end there is provided on the upper end of the steam-chest a balancing-cylinder, S, which has communication with the steam-chest by steam-ports *a' a'*. In this cylinder is a piston, T, which is connected to the valve by the piston-rod U. This rod is preferably connected to the valve by means of a lip, P, and a slot, Q, on the valve, and T-head R on the rod, the same as the valve-rod E. The steam-pressure in the steam-chest, acting against the under surface of the piston, exerts a force to lift the piston, and with it the valve, which counteracts the weight of the valve and its connections. The area of the piston will be determined by the weight of the valve and its connections and the steam-pressure to be used in the steam-chest. When the pressure falls below the normal, the valve, unless otherwise provided, would not be balanced, and when the pressure rises above the normal the valve would be overbalanced. To equalize the balancing effect of the piston under varying steam-pressure, the upper outer end of the cylinder is open and covered with a movable and removable cap, V. This cap has a circular guide-flange, W, which embraces the exterior surface of the cylinder. Each half of this flange is provided with one open inclined slot, X, and two vertical slots, Y Z, of different heights. Near the juncture of the flange and cap the flange is provided with a series of perforations or apertures, *e' e'*. The several slots X Y Z co-operate with pins or lugs A' A' on the exterior of the cylinder. When the lugs are held in the inclined slots X, the cap is held immovable on the cylinder, with the apertures *e' e'* constantly closed. When the lugs are held in the short slots *y*, the cap will be raised and the apertures will be constantly open to the interior of the cylinder above the piston; and when the lugs are held in the long slots then the cap can move up and down, unclosing the apertures. When the pressure is normal in the steam-chest, the cap is so arranged that the apertures will be always open. When, now, the pressure falls below the normal, the cap is turned, so that the lugs enter the long slots, and the cap can move up and down, acting as a valve. The movement of the piston will soon pump out the air in the upper part of the cylinder, leaving a partial vacuum, which is equivalent to raising the boiler-pressure. If, however, the boiler-pressure is too light, the lugs are caused to enter the inclined slots, and the cap is held down with the apertures

closed. The inclosed air in the upper part of the cylinder thus offers resistance against the piston and partially counterbalances the steam-pressure.

The balancing cylinder need not be a separate piece, as shown, but may be formed directly on the end of the steam-chest, with its whole area directly open to the steam-chest. It is only essential that a chamber be formed in which the piston may work. This cylinder S need not be in connection with the steam of the steam-chest, but may be worked entirely by atmospheric pressure. In that case a permanent vacuum would be formed above the piston, and the cylinder below the piston would be open to the atmosphere, as by apertures a^2 a^2, as indicated in dotted line in Fig. 1. The piston in this case would be larger than if acted upon by the steam-pressure.

In Fig. 8 is shown an ordinary D-valve provided with the present improvements so far as they are applicable thereto. This valve, as it is usually formed, has a face, D′, larger in area than the body D″. Surrounding the body D″ and resting on the upper side of the projecting face D′ is the yoke E′ of the valve-rod, which can be lifted off the valve. The necessity of separating the valve from the yoke prevents the employment of the flanges K K. Accordingly, to make the balance-plate H large enough, the flange *j* on the balance-plate embraces the body D″ of the valve. The inner face of the flange *j* carries the bevel *i*, and the packing-strips I are inserted with their small ends upward instead of downward. The packing-strips will be held upward ordinarily by the steam-pressure; but in case the latter is cut off the retaining-springs *l l* are used. The holding-sockets *m m* for these springs are in this case drilled in the yoke E′. Since the back-pressure bars cannot be used with this valve, the area of the balance-plate is made less than that of the valve, so that the valve cannot be lifted from its seat by ordinary back-pressure. So, also, in lubricating the balance-plates, the plate H moves farther beyond the edge *w* than the valve moves beyond the ledge *y*. On one end the rim *j* is shown cut away on its inner face, at *g′*, to indicate how it may be babbitted to take up wear between the rim and the strips I, and to save dressing down. This figure illustrates how many of the foregoing improvements can be applied directly to the ordinary valves in common use.

I claim as my invention—

1. A slide-valve and a sliding plate carried thereby, a rim on said slide-valve, and a rim on said sliding balance-plate, one of said rims extending beyond and inclosing the other, in combination with packing-strips between the two rims, substantially as set forth.

2. Projecting rims on a slide-valve and a sliding balance plate, respectively, one of said rims having a beveled face, in combination with packing-strips located between said rims, each strip having a beveled face in contact with the beveled face on the rim, substantially as set forth.

3. A slide-valve and a sliding balance-plate carried thereby and projecting inclosing-rims on said valve and balance plate, in combination with packing-strips between said rims and springs for holding said strips against their seats.

4. Rims on a slide-valve and sliding balance-plate, respectively, one of said rims having a beveled face, in combination with sheet-metal auxiliary packing-strips next said beveled face and packing-strips having a beveled face located between said rims and seated against said auxiliary packing-strips, substantially as set forth.

5. The combination of a slide-valve and a stationary balance-plate, with a sliding balance-plate carried by the valve and in contact with said stationary plate, said sliding plate having lubricating-grooves on its face next the stationary balance-plate, said sliding balance-plate being carried by the travel of the valve on both the steam and exhaust sides beyond the edges of the stationary plate, substantially as set forth, whereby the lubricating-grooves are opened to the steam.

6. A stationary balance-plate and a sliding balance-plate carried by a slide-valve, said sliding plate having lubricating-grooves on its face next the stationary plate, said grooves being carried by the travel of the valve beyond the edges of the stationary plate, in combination with the slide-valve and its seat, said valve being carried beyond its seat simultaneously with and to the same extent as the sliding balance-plate is carried beyond the stationary plate, substantially as set forth.

7. A slide-valve having main exhaust-passage *e*, outer exhaust-passages, *r s*, in constant communication with said exhaust *e*, and induction-passages *p q* between said main exhaust *e* and outer exhausts, *r s*, said passages *p q* branching on either side of said exhausts *r s*, and each having double openings *t t* on the end of the valve, substantially as set forth.

8. A balanced slide-valve, in combination with spring-supported back-pressure bars, which are held in close proximity to the back surface of the valve, substantially as set forth.

9. A balanced slide-valve, in combination with back-pressure bars L, springs M M, and set-screws O, substantially as set forth.

10. In a vertical engine, a steam-chest and a slide-valve therein moving vertically against a vertical seat, which valve admits steam to the cylinder at both sides of the valve, in combination with a vertical balancing-cylinder located above said valve and a vertically-moving piston working in said balancing-cylinder and connected to the upper end of said slide-valve, substantially as set forth, whereby the steam-pressure on the under side of said piston balances the weight of the valve and the valve-gear.

11. In a vertical engine, a valve, a balanc-

ing-cylinder, and a piston in said cylinder connected to said valve, in combination with a valve-cap on the outer end of said cylinder, said cap having a series of apertures, which establish communication between the upper end of said cylinder and the outer air, said cap being arranged to be held with the said apertures constantly closed or constantly opened, or free to open and close said apertures, substantially as set forth.

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

HENRY T. GILES.

Witnesses:

JOS. H. BLACKWOOD,

ANDREW PARKER.