(No Model.) 2 Sheets—Sheet 1.

B. F. WILSON.

PISTON VALVE.

No. 592,644. Patented Oct. 26, 1897.

Fig. 2.

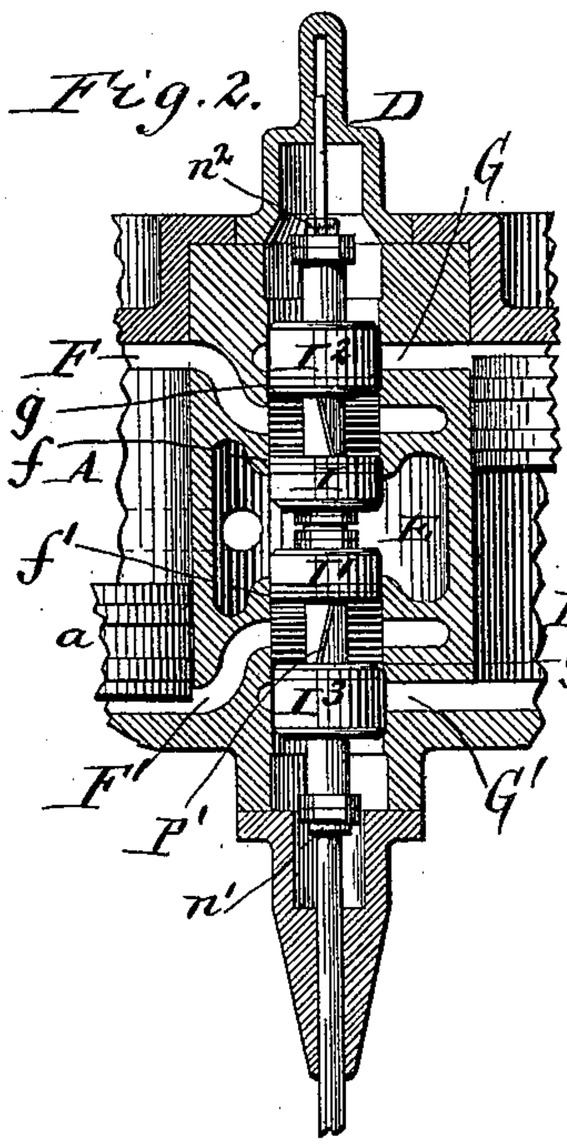


Fig. 1.

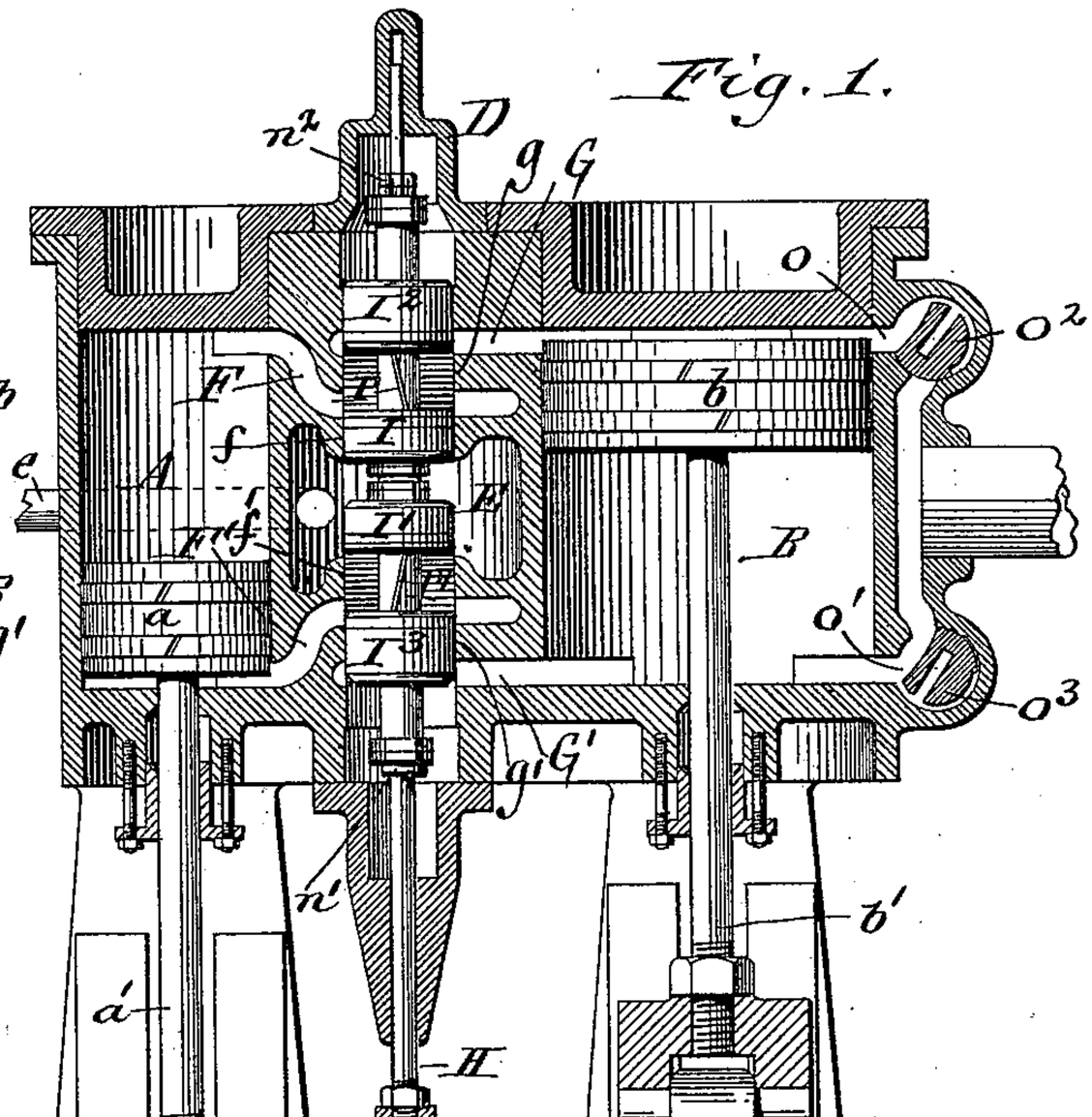
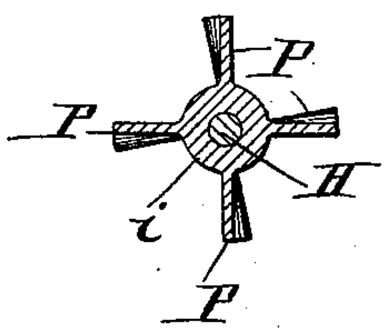
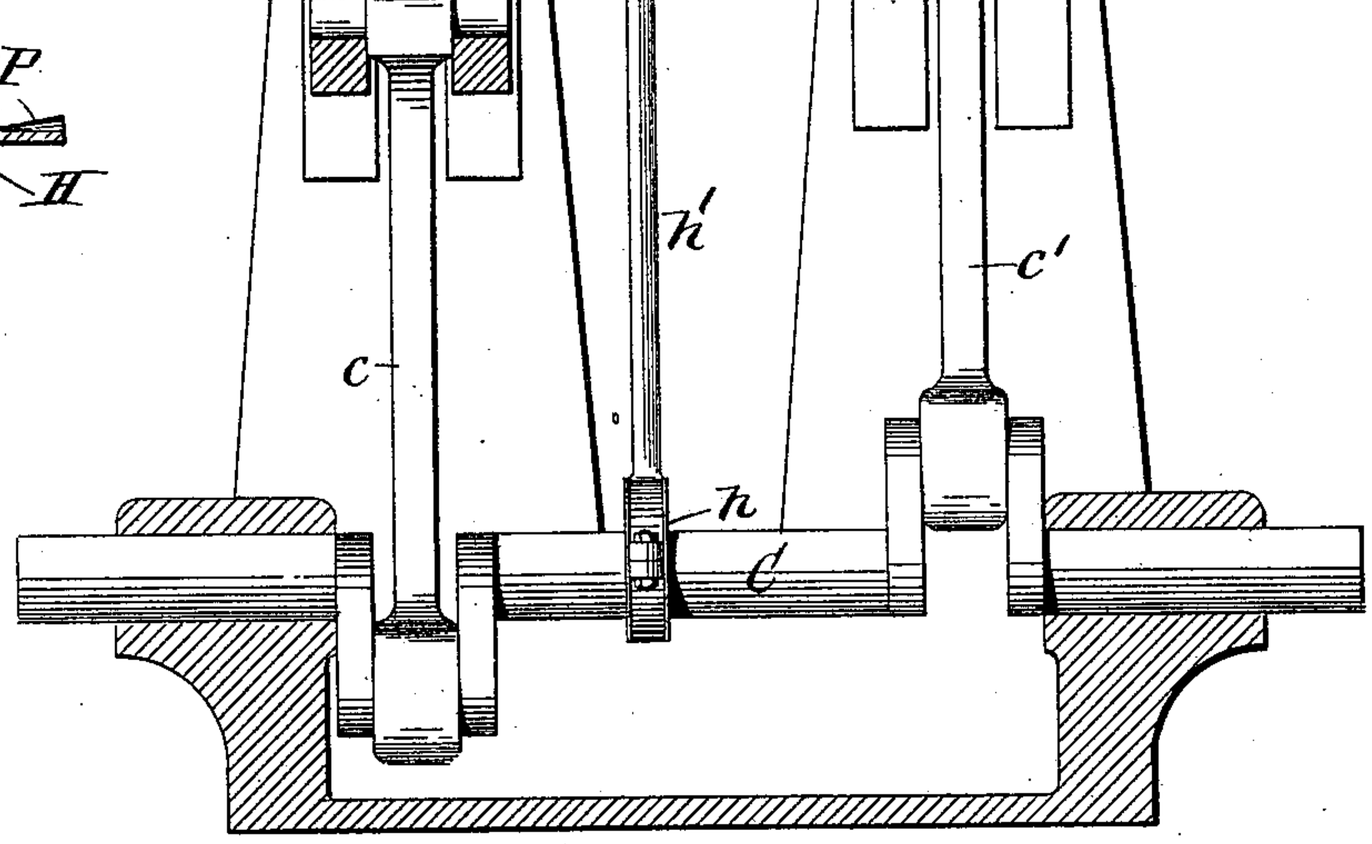


Fig. 3.





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(No Model.) 2 Sheets—Sheet 2.

B. F. WILSON.

PISTON VALVE.

No. 592,644. Patented Oct. 26, 1897.

Fig. 4.

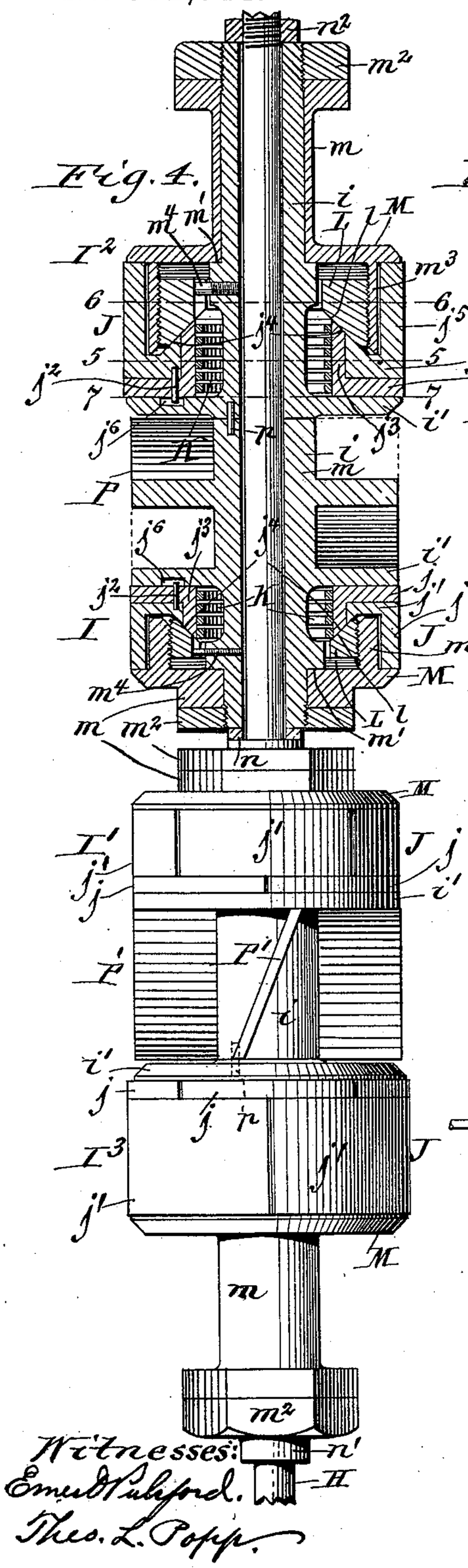


Fig. 5.

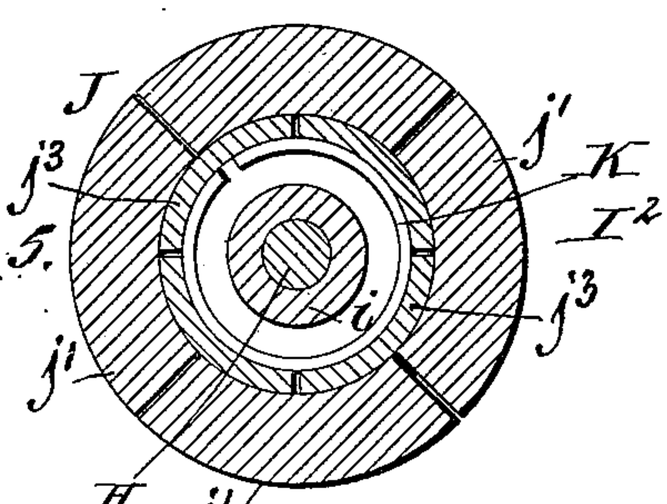


Fig. 6.

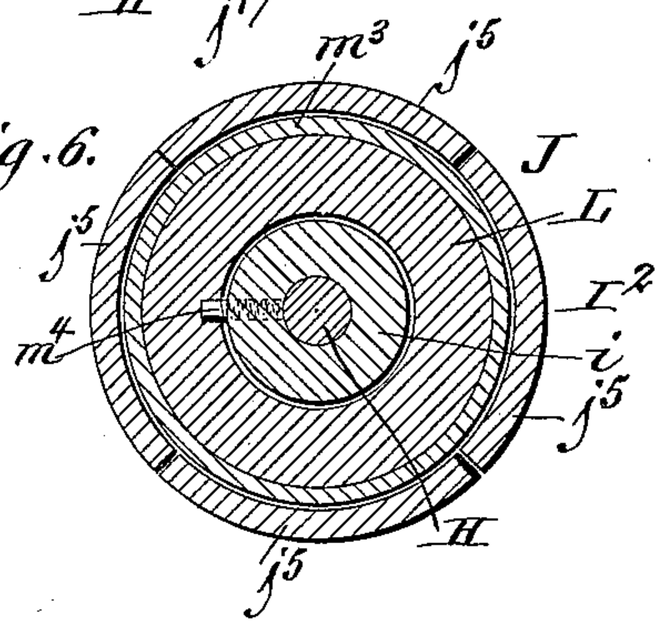


Fig. 7.

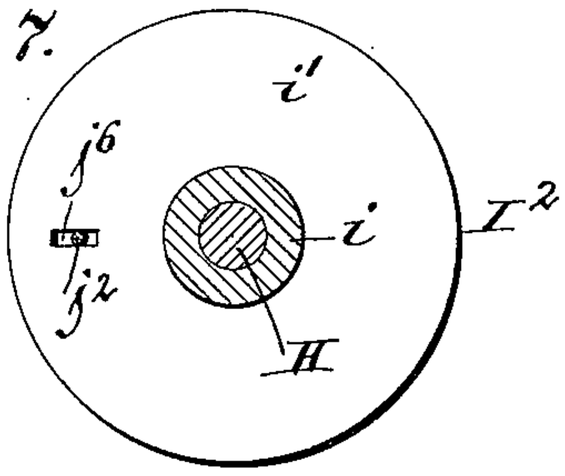
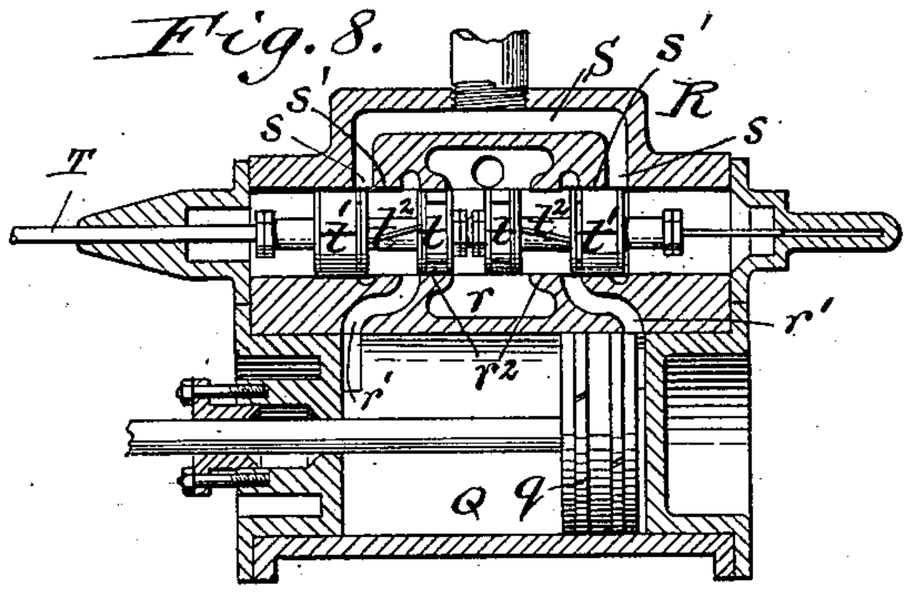


Fig. 8.



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UNITED STATES PATENT OFFICE.

BENJAMIN F. WILSON, OF NORTH TONAWANDA, NEW YORK, ASSIGNOR OF ONE-HALF TO EDWARD F. WILSON, OF SAME PLACE.

PISTON-VALVE.

SPECIFICATION forming part of Letters Patent No. 592,644, dated October 26, 1897.

Application filed January 14, 1896. Serial No. 575,454. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. WILSON, a citizen of the United States, residing at North Tonawanda, in the county of Niagara and State of New York, have invented a new and useful Improvement in Piston-Valves for Steam and other Engines, of which the following is a specification.

This invention relates to piston-valves for steam and other engines, and has for its object to provide means for automatically turning the valves, so that they will wear uniformly, to provide a simple adjusting device whereby the valves can be adjusted to fit the valve-seats, and to render the valves yielding, so as to afford relief for water or other liquid which may be caught in the cylinder and prevent injury to the engine.

In the accompanying drawings, consisting of two sheets, Figure 1 is a sectional elevation of a vertical compound steam-engine provided with my improvements and showing the steam-valves in one position. Fig. 2 is a fragmentary section of the steam-valves and connecting parts, showing the valves in another position. Fig. 3 is a cross-section, on an enlarged scale, of the spiral wings and connecting parts, whereby the steam-valves are turned. Fig. 4 is a detached sectional elevation, on an enlarged scale, of the steam-valves and connecting parts. Figs. 5, 6, and 7 are transverse sections in lines 5 5, 6 6, and 7 7, Fig. 4, respectively. Fig. 8 is a sectional elevation showing my improvements applied to a horizontal single-cylinder engine.

Like letters of reference refer to like parts in the several figures.

Referring to Figs. 1 to 7, A B represent the high and low pressure cylinders, respectively, of a vertical compound steam-engine; *a b*, the pistons arranged, respectively, in said cylinders and provided with piston-rods *a' b'*; C, the crank-shaft, and *c c'* the pitmen connecting the cranks with the piston-rods.

D represents the steam-chest, in which the valve mechanism is arranged, whereby the admission of steam into the cylinders is controlled.

E is the steam-chamber, formed in the central portion of the steam-chest and which is connected with a steam-pipe *e*.

F F' are the upper and lower steam-ports of the high-pressure cylinder, which open into the upper and lower ends of this cylinder and which are connected with the upper and lower sides of the steam-chamber, respectively, by cylindrical openings *f f'* in the valve-chest, forming inner or high-pressure valve-seats.

G G' are the upper and lower steam-ports of the low-pressure cylinder, which open into the upper and lower ends of this cylinder and which are connected with the high-pressure steam-ports F F' by cylindrical openings *g g'* in the valve-chest, forming outer or low-pressure valve-seats. The high and low pressure valve-seats are arranged axially in line.

H represents the valve-rod arranged lengthwise in the steam-chest and connected at one end to the eccentric *h* on the crank-shaft by the eccentric-rod *h'*.

The steam-valve consists of two inner or high-pressure valves or pistons I I', arranged one above the other in the central portion of the steam-chest and adapted to open and close the cylindrical seats *f f'* of the steam-chest for controlling the admission of steam into the high-pressure cylinder, and two outer or low-pressure valves or pistons I^2 I^3, arranged in the steam-chest above and below the high-pressure valves or pistons I I', respectively, and adapted to open and close the cylindrical valve-seats *g g'* of the steam-chest for controlling the passage of steam from the high-pressure cylinder to the low-pressure cylinder. Each high-pressure valve or piston is separated from the adjacent low-pressure valve or piston to form a steam-passage between these valves or pistons. Each of the valves or pistons is constructed as follows and is best shown in Figs. 4 to 7.

i represents a supporting-sleeve which is capable of turning freely on the valve-rod and which is provided on its central portion with an abutment-disk *i*, formed, preferably, integrally with the sleeve.

J represents a sectional valve-ring which is capable of expansion or contraction to fit the valve-seat. This ring is composed of two annular sets of sections or segments *j j''*, arranged one above the other, the outer sides of the sections being flush and forming a cylindrical valve-face. The spaces or di-

visions between one set of sections are arranged out of line with the spaces or divisions between the sections of the other set, as represented in Figs. 4 and 5, and the sections are retained in this relative position by a pin j^2, which secures two adjacent sections of both sets together, as represented in Fig. 4, thereby preventing steam from passing through the valve-ring. The valve-ring sections j bear with one side against the abutment-disk i' and are provided on the opposite side of their inner ends with flanges j^3, against which the inner ends of the other set of valve-sections j' abut.

K represents a number of split spring-rings which bear against the inner side of the flanges j^3 and which tend to press the sections of the valve-ring outwardly. Each of the valve-ring sections is provided on its inner side with an inclined face j^4, the inclined faces of the several sections being so arranged that together they form a cone.

L represents an adjusting-ring, whereby the valve-ring sections are adjusted. This ring surrounds the supporting-sleeve and is provided on one side with a conical face l, which engages with the inclined faces of the valve-ring sections. Upon moving the adjusting-ring axially toward the inclined faces of the valve-ring sections the latter are contracted, thereby reducing the diameter of the face of the valve-ring, and upon moving the same in the opposite direction the valve-ring sections are permitted to be expanded by the springs K, thereby increasing the diameter of the valve-ring.

M represents a rotary adjusting-disk, whereby the adjusting-ring is shifted for adjusting the valve-ring. This disk is secured to the inner end of an adjusting-sleeve m, which is mounted on the supporting-sleeve and which is held against axial movement thereon by a shoulder m', formed on the supporting-sleeve and bearing against the inner end of the adjusting-sleeve and a screw-nut m^2, arranged in a screw-threaded portion of the supporting-sleeve and bearing against the outer end of the adjusting-sleeve. The marginal portion of the adjusting-disk bears against marginal flanges j^5, formed on the valve-ring sections j', and is provided on the inner side of the flange-sections j^5 with an internally-screw-threaded adjusting-flange m^3, which engages with an external screw-thread formed on the adjusting-ring. The latter is held against turning on the supporting-sleeve by a radial pin m^4, secured to the supporting-sleeve and engaging with a longitudinal slot in the inner side of the ring.

When it is desired to adjust the valve-ring, the screw-nut m^2 is loosened, which leaves the adjusting-sleeve free to be turned in either direction, and this turning movement causes the adjusting-ring, which is held against turning, to be moved lengthwise, thereby expanding or contracting the valve-ring. After adjusting the valve-ring the screw-nut is again tightened for holding the parts in position. The adjusting-ring L, by engaging with the inner portion of the ring-sections, also serves as a stop which limits the expansion of these sections, thereby preventing the latter from being forced outwardly to an abnormal extent and injured by engagement with the shoulders formed in the bore of the valve-seat by the ports and passages. The valve-ring sections are held against turning with reference to the supporting-sleeve, but permitted to move radially while turning the adjusting-disk, by extending the pin j^2 into a radial slot j^6, formed in the adjacent side of the abutment-disk, as shown in Figs. 4 and 7. The inner ends of the supporting-sleeves of both high-pressure valves bear against opposite sides of a washer n, mounted on the valve-rod, and the inner ends of the supporting-sleeves of the low-pressure valves bear against the outer ends of the supporting-sleeves of the high-pressure valves. The steam-valves are compelled to move lengthwise with the valve-rod by stops, which are arranged on the valve-rod adjacent to the outer ends of the supporting-sleeves of the low-pressure valves. These stops consist, preferably, of a collar n', secured to the valve-rod and bearing against the outer end of the sleeve of the lower low-pressure valve, and screw-nuts n^2, engaging with screw-threaded portions of the valve-rod and bearing against the outer end of the sleeve of the upper low-pressure valve, as shown in Figs. 1, 2, and 4. It is obvious that this means of expanding or contracting a piston-valve to fit its seat is equally desirable for expanding or contracting a working piston to fit the same to its working cylinder.

During the operation of the engine one of the high-pressure valves is moved into its respective seat for shutting off the steam to the adjacent end of the high-pressure cylinder, while the other high-pressure valve is moved out of its seat and into the steam-chamber for admitting steam to the adjacent end of the high-pressure cylinder, and at the same time one of the low-pressure valves is moved into its seat to prevent the live steam from entering the respective end of the low-pressure cylinder, while the other low-pressure valve clears its seat to permit the exhaust from one end of the high-pressure to pass into the adjacent end of the low-pressure cylinder, as represented in Fig. 1.

O O′ represent the exhaust-ports of the low-pressure cylinder, which are alternately opened and closed in the usual manner by exhaust-valves O^2 O^3.

During the last portion of each stroke of the low-pressure piston the exhaust-valve closes the port and the low-pressure valve still covers the steam-port at the respective end of this cylinder, as represented in Fig. 2. In the event of water being caught in the end of the low-pressure cylinder when the parts are in this position the pressure of the water

against the side of the low-pressure valve will cause its valve-ring sections to be contracted sufficiently to allow the water to pass the valve and enter the space between the high and low pressure valves and the exhaust end of the high-pressure cylinder, thereby preventing injury to the engine, which otherwise would occur if no relief were afforded for the caught water. As soon as this low-pressure valve clears the steam-port of the low-pressure cylinder the low-pressure piston begins the next stroke and the caught water is carried back again into low-pressure cylinder by the exhaust of the high-pressure cylinder.

When the valve-rod approaches the end of its stroke in either direction, the receding side of the closing high-pressure valve and the advancing side of the closing low-pressure valve are exposed to the pressure of the live steam, as shown in Fig. 1. In order to check the movement of the valves when they approach the end of the stroke, the low-pressure steam-valves are made of slightly-larger diameter than the high-pressure steam-valves, which causes the steam-pressure against the closing low-pressure valve to preponderate over the pressure against the closing high-pressure valve, thereby cushioning the movement of the valves at the end of the stroke.

The upper high-pressure valve is of slightly-larger diameter than the lower high-pressure valve. This relative size of the upper and lower high-pressure valves causes the cushioning effect during the downward stroke of the valves to be more pronounced than during the upward stroke of the valves, owing to the greater difference in area between the opposing upper low-pressure valve and the lower high-pressure valve and the opposing lower low-pressure valve and the upper high-pressure valve, thereby compensating for the greater momentum of the valves during their downward movement, which is produced by the aid of gravity.

During the first portion of the upward stroke of the valves the receding side of the upper low-pressure valve and the advancing side of the lower high-pressure valve are exposed to the live steam, which causes the valve mechanism, owing to the greater area of the upper low-pressure valve, to be floated or lifted, thereby preventing the weight of the valve mechanism from unduly wearing the actuating mechanism. During the next portion of the upward movement of the valve mechanism the upper and lower high-pressure-valve seats are both closed by the upper and lower high-pressure valves, during which time the valve mechanism is floated by the preponderating pressure of the steam against the large upper high-pressure valve over the small lower high-pressure valve. During the last portion of the upward movement of the valve mechanism the receding side of the upper high-pressure valve and the advancing side of the lower low-pressure valve are exposed to the live steam, at which time the cushioning effect takes the place of the floating effect; but this cushioning effect is not so pronounced as at the end of the downward stroke, owing to the smaller difference in the diameter between the opposing lower low-pressure valve and the upper high-pressure valve and the opposing lower high-pressure valve and the upper low-pressure valve. During the downward movement of the valve mechanism the latter is floated by the steam engaging with the valves in the reverse order described above, the floating and cushioning of the valve mechanism both taking place at the end of the downward movement thereof. During the last portion of the stroke of the steam-valves in either direction the opening high-pressure valve has both of its sides exposed to the pressure of the live steam, as represented in Fig. 1, so that the effect of the steam-pressure against this valve is neutralized.

P P′ represent radial or spiral wings arranged in the spaces between the low and high pressure valves and preferably formed integrally with the supporting-sleeves of the high-pressure valves. These wings extend to the periphery of the abutment-disks of the high-pressure valves and fit into the high-pressure-valve seats, so as to serve as guides for supporting these valves while they are removed from their seats and for directing these valves into their seats upon closing the same. Each of the wings is slightly inclined or arranged at an angle to the axis of its valve, as shown in Figs. 1, 2, 3, 4, and 5, so that the steam in moving lengthwise of the piston in passing from one port to another strikes the inclined wings in a direction parallel with the axis of the valve and turns the same every time the steam passes the wings, thereby imparting an intermittent rotary movement to the valve, which causes the latter and its seat to wear uniformly. The intermittent rotary movement is transmitted to the adjacent low-pressure valves by longitudinal pins *p*, connecting the supporting-sleeves of the high-pressure valves with those of the low-pressure valves, as shown in Fig. 4.

My improved valve mechanism is also applicable to a horizontal and single-cylinder steam-engine, as shown in Fig. 8, and constructed as follows:

Q represents the working cylinder, and *q* the working piston.

R is the steam-chest, provided with a central steam-chamber *r*, two inner or steam ports *r′ r′*, opening into opposite ends of the cylinder and connected with the steam-chamber by two inner valve-seats r^2 r^2, an exhaust-chamber S, and two outer or exhaust-ports *s s*, opening into the exhaust-chamber and connected by outer valve-seats *s′ s′* with the inner or steam ports.

T is the valve-rod, provided with two inner

or steam valves *t t*, adapted to open and close the inner valve-seats, two outer or exhaust valves *t' t'*, adapted to open and close the outer valve-seats, and spiral wings t^2 for turning the valves.

The outer or exhaust valves are of slightly-larger diameter than the inner or steam valves, so as to cushion the movement of the valves at the end of each stroke, and each of these valves is constructed the same as the valves of the compound vertical engine heretofore described.

I claim as my invention—

1. In a piston, the combination with the body, of an annular row of radially-movable piston-sections guided on said body, and an adjustable stop mechanism connecting the body and the piston-sections, whereby the outward movement of the piston-sections may be adjusted, substantially as set forth.

2. In a piston, the combination with the body, of an annular row of radially-movable piston-sections guided on said body, a spring whereby said sections are pressed outwardly and an adjustable stop mechanism connecting the body and the piston-sections, whereby the outward movement of the piston-sections may be adjusted, substantially as set forth.

3. The combination with the ring-sections each of which is provided with an incline, of an adjusting-ring provided with a conical face engaging with the inclines of said sections, and a spring engaging with the inner sides of said sections, substantially as set forth.

4. The combination with the ring-sections each of which is provided with an incline, of an adjusting-ring provided with a conical face engaging with the inclines of said sections, a spring pressing against the inner sides of said sections, and an adjusting-disk having a screw-thread connection with the adjusting-ring, substantially as set forth.

5. The combination with a supporting-sleeve provided at one end with an abutment-disk, of a sectional ring composed of two sets of sections, one of said sets bearing against the abutment-disk, springs engaging with the inner side of said sections, an adjusting-ring provided with a conical face bearing against inclines formed on said sections and a rotary adjusting-disk bearing against the other set of sections and having a screw-thread connection with said adjusting-ring, substantially as set forth.

6. The combination with a supporting-sleeve provided with a shoulder and with an abutment-disk having a radial groove, of a sectional ring composed of two sets of sections, one of said sets bearing against the abutment-disk and the divisions between one set of sections being arranged out of line with the divisions between the other set of sections, a pin whereby one of the sections of one of said sets is connected with one of the sections in the other set and which engages with said radial groove, springs engaging with the inner side of said sections, an adjusting-ring provided with a conical face bearing against inclined faces formed on said sections, a pin secured to the supporting-sleeve and engaging with a longitudinal groove in the adjusting-ring, an adjusting-sleeve mounted on the supporting-sleeve and bearing with one end against said shoulder, an adjusting-disk arranged on one end of the adjusting-sleeve and bearing against the other set of sections, an annular flange formed on the adjusting-disk and having a screw-thread connection with said adjusting-ring and a screw-nut arranged on a screw-threaded portion of the supporting-sleeve and bearing against the other end of the adjusting-sleeve, substantially as set forth.

7. The combination with a cylinder, a piston and a steam-chest provided with a central steam-chamber, two steam-ports opening into the ends of said cylinder, two inner valve-seat openings connecting said ports with the steam-chamber and two outer valve-seat openings connected with said ports, of a valve provided with two inner pistons controlling the inner valve-seat openings and two outer pistons controlling the outer valve-seat openings and having a diameter larger than the inner pistons, substantially as set forth.

8. In a vertical steam-engine, the combination with a cylinder, a piston and a steam-chest provided with a central steam-chamber, two steam-ports opening into the ends of said cylinder, two inner valve-seat openings connecting said ports with the steam-chamber and two outer valve-seat openings connected with said ports, of a valve provided with two inner pistons controlling the inner valve-seat openings and arranged one above the other, the upper one of said inner pistons being of larger diameter than the lower one and two outer pistons controlling the outer valve-seat openings and having a diameter larger than the inner pistons, substantially as set forth.

9. The combination with a high-pressure cylinder and its piston, a low-pressure cylinder and its piston, and a steam-chest provided with a central chamber, two high-pressure steam-ports opening into the ends of the high-pressure cylinder, two inner valve-seat openings connecting said ports with the steam-chamber, two outer valve-seat openings connected with said ports and two low-pressure steam-ports connecting the outer valve-seat openings with the ends of the low-pressure cylinder, of a valve provided with two inner pistons controlling the inner valve-seat openings and two outer pistons controlling the outer valve-seat openings, substantially as set forth.

10. The combination with the cylinder and the piston, of a steam-chest provided with a cylindrical valve-seat, a steam-port leading from one end of the valve-seat to the cylinder and an exhaust-port leading from the oppo-

site end of the valve-seat, a cylindrical valve movable axially in said seat, and wings arranged spirally on said valve and adapted to be turned together with the valve by the steam striking the wings in passing from the steam-port lengthwise through the valve-seat to the exhaust-port, substantially as set forth.

Witness my hand this 2d day of December, 1895.

BENJAMIN F. WILSON.

Witnesses:
EDWARD F. WILSON,
DORA F. SMITH.