No. 635,092. Patented Oct. 17, 1899.

C. C. EGBERT.

SLIDE VALVE.

(Application filed Dec. 2, 1898.)

(No Model.) 2 Sheets—Sheet 1.

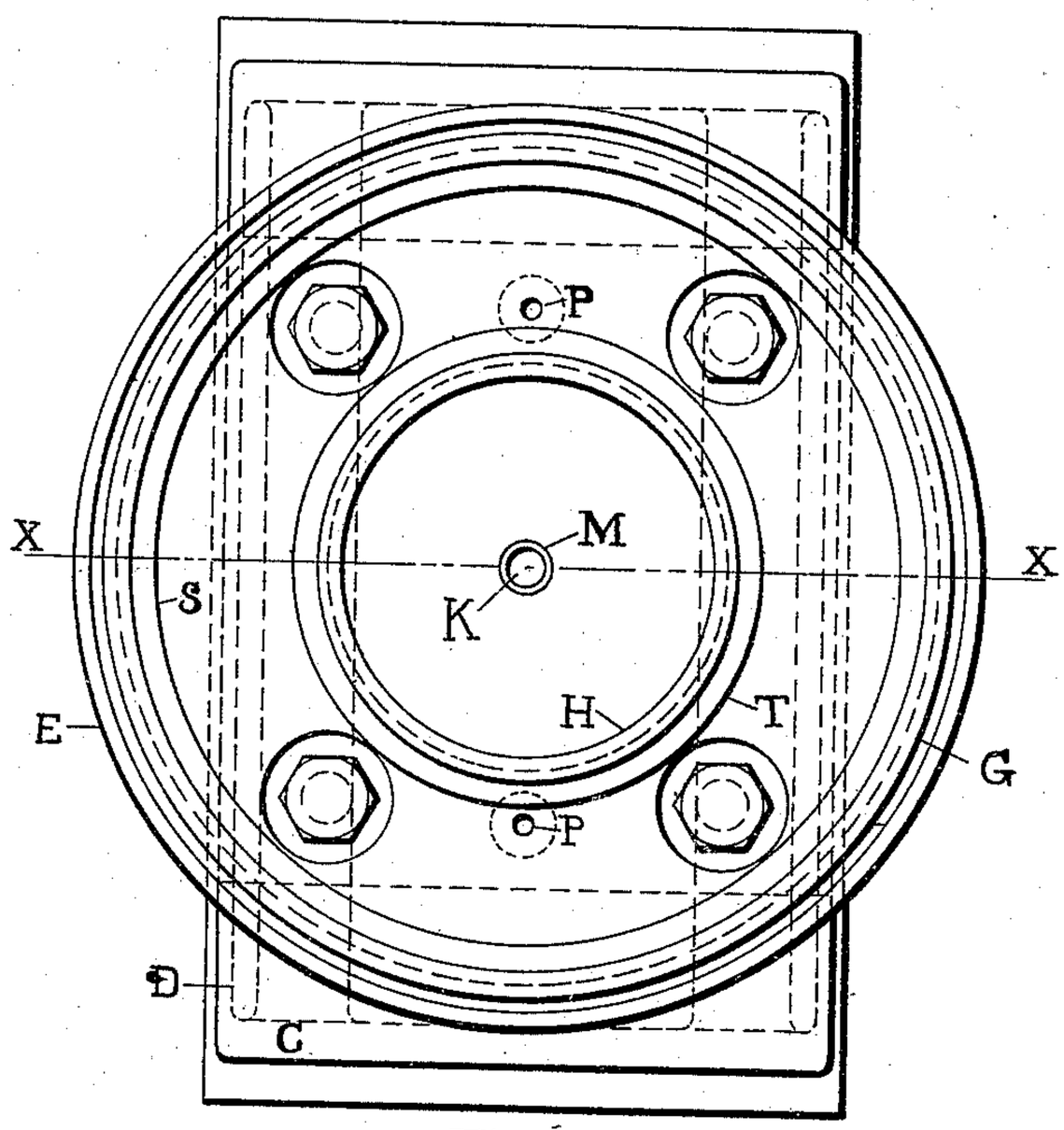


Fig. 1

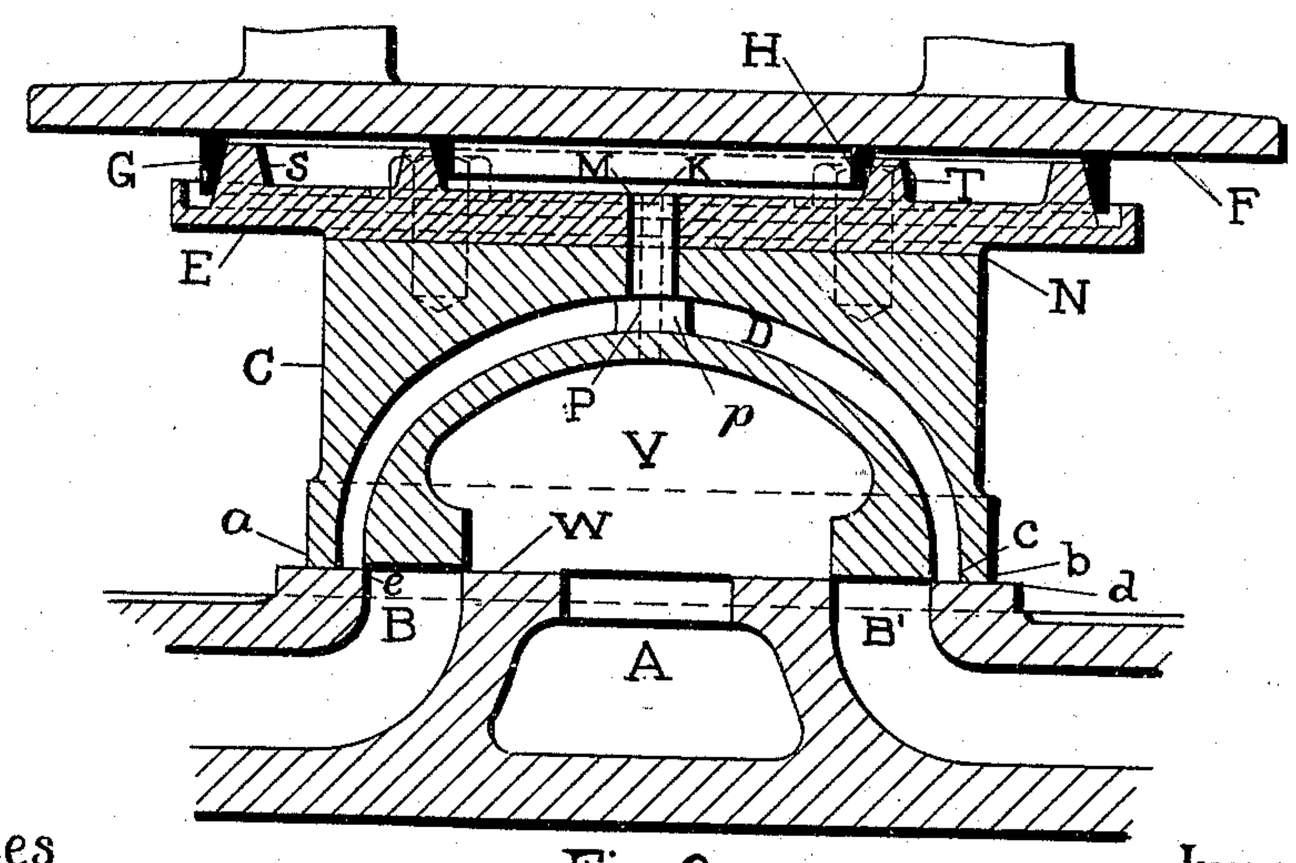


Fig. 2

Witnesses

F. B. Durand

W. H. Dew.

Inventor

Charles C. Egbert

by Rich. N. Dyer

Attorney

No. 635,092. Patented Oct. 17, 1899.

C. C. EGBERT.

SLIDE VALVE.

(Application filed Dec. 2, 1898.)

(No Model.) 2 Sheets—Sheet 2.

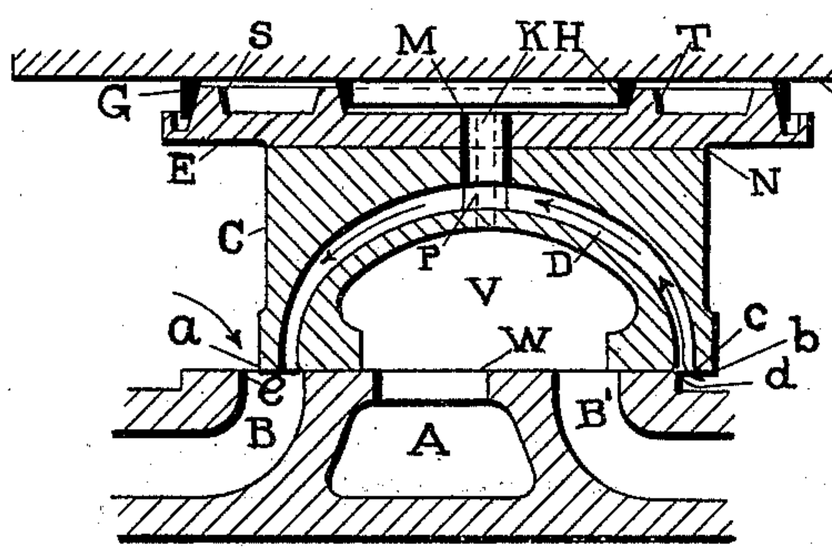
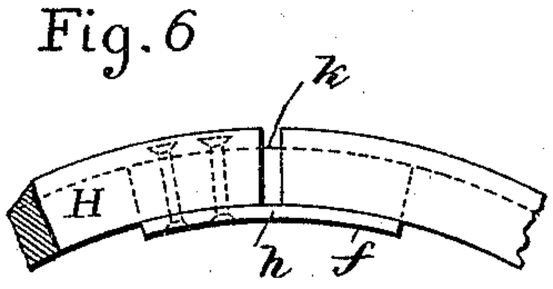


Fig. 3

Fig. 6



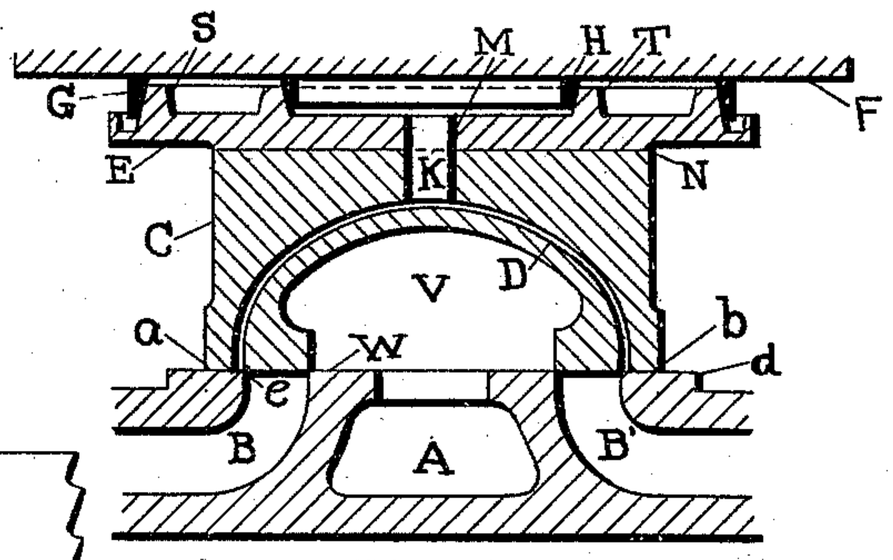


Fig. 4

Fig. 7

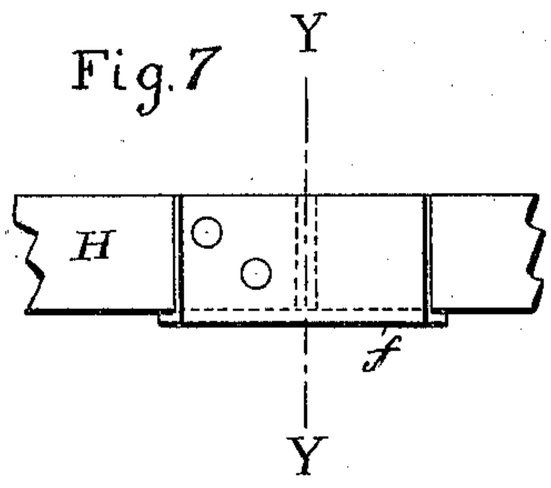
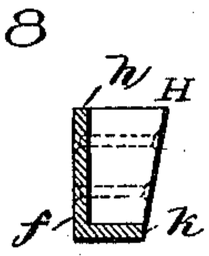


Fig. 8



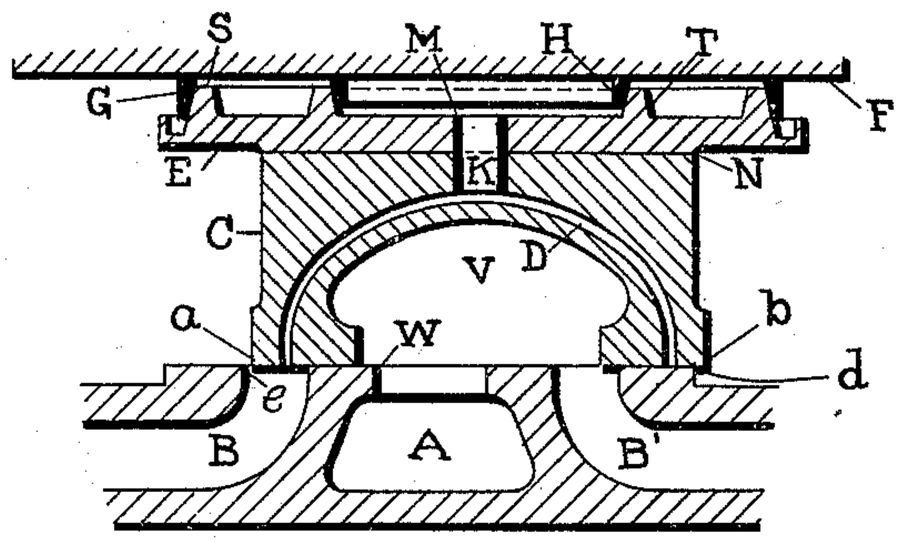


Fig. 5

Witnesses

E. B. Durand

W. H. Jew.

Inventor

Charles C. Egbert.

by Rich. W. Byron

Attorney.

UNITED STATES PATENT OFFICE.

CHARLES C. EGBERT, OF DUNKIRK, NEW YORK.

SLIDE-VALVE.

SPECIFICATION forming part of Letters Patent No. 635,092, dated October 17, 1899.

Application filed December 2, 1898. Serial No. 698,040. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. EGBERT, a citizen of the United States, residing at Dunkirk, in the county of Chautauqua and State of New York, have invented a certain new and useful Improvement in Slide-Valves, of which the following is a specification.

My invention relates to various new and useful improvements in slide-valves adapted when operated by a suitable valve mechanism to admit and release in proper rotation a fluid under pressure to and from the ends of a cylinder or cylinders of a motor, compressor, or pump, whereby the latter will perform its work in the desired manner.

My improved slide-valve is especially adapted for use in connection with steam-engines and will be so described in the following description, it being of course obvious that the valve may be suitably changed or modified, according to the use to which it will be applied.

The object of my invention is to provide a slide-valve that bears upon its seat with a pressure which may be made as light as desired and which remains practically constant throughout the travel of the valve. In effecting this object in the manner to be explained I obtain a slide-valve which will be perfectly and accurately balanced.

Prior to my invention slide-valves have been made wherein the balancing thereof has been attempted by excluding the steam-pressure from a portion of their backs, so that they will bear upon the valve-seats with a less pressure than if entirely covered by steam. It is evident that the pressure with which these so-called "balanced" slide-valves bear upon their seats varies in proportion to the steam-pressures in the steam-chest and in the ports and to the area of the portions of the valve-face exposed to such pressures. In consequence it follows from these conditions that the pressure necessary to maintain one of these valves on its seat while the force tending to lift it is at its maximum will be excessive when the said lifting force is at its minimum value.

In carrying out my invention and in addition to excluding the steam-pressure in the steam-chest from a portion of the back of the valve I provide a separate area on the back of the valve which is proportional to the area of those portions of the valve-face exposed to steam-pressure and which by means of a suitable passage or passages in the valve is put into communication with the steam which presses on such exposed portions of the valve-face.

In carrying my invention further into effect I so proportion the length of the valve-seat relative to that of the valve that the sum of the areas of those portions of the valve-face exposed to steam-pressure remains practically constant throughout the travel of the valve. In this way I am enabled to introduce onto the back of the valve a varying pressure which is proportional and synchronous with the varying pressure on the face of the valve.

In order that my invention may be better understood, I have illustrated in the accompanying drawings the improvements applied to a slide-valve of a well-known type.

In the drawings, Figure 1 is a plan of a slide-valve at present in use, known as the "American balanced valve," illustrating my present improvements applied thereto; Fig. 2, a cross-section on the line X X of Fig. 1, illustrating the balance-plate, valve, and valve-seat, and showing the valve in its middle position; Fig. 3, a section similar to Fig. 2, on a similar scale, illustrating the valve advanced on its seat; Fig. 4, a sectional view similar to Fig. 2, illustrating a slightly-different arrangement with the valve in its middle position; Fig. 5, a section corresponding to Fig. 4 with the valve advanced on its seat; Fig. 6, a plan, on an enlarged scale, of one of the packing-rings, showing a convenient arrangement of steam-tight joint therefor; Fig. 7, an elevation of the same, and Fig. 8, a cross-section on the line Y Y of Fig. 7.

In all of the above views corresponding parts are represented by the same letters of reference.

While I have illustrated my invention as being employed in connection with a valve of a special type, it will be, of course, obvious that the improvements may be used with many other varieties of valves wherein the balancing thereof is necessary or desirable.

The valve will work in any position; but

in the drawings and in the explanation that follows the valve-seat is assumed to be in a horizontal plane.

A represents the exhaust-port, and B and B′ the steam-ports, of an engine.

C is the valve, with a passage-way D connecting the ends of its face. Upon the back of the valve C the plate E is suitably secured. This plate is provided with a shoulder S, making a steam-tight joint with a ring G, and also with a shoulder T, making a steam-tight joint with the ring H. The rings G and H bear against the balance-plate F, maintained within the valve-chest in any suitable manner, parallel, or nearly so, to the valve-seat W. The areas on the back of the valve which are used to balance it may be subdivided in any other way than by the employment of packing-rings G and H, as described. These packing-rings are made of any desired material and in any convenient manner, and in Figs. 6, 7, and 8 I illustrate a construction of steam-tight joint for the ring H which may be employed, if desired, but to which I do not wish to be limited. As shown, the ring H is beveled on its outside circumference and split, in order that it may expand or contract and thereby adjust itself against the shoulder T and the plate F. The shoulder T is beveled on its inside circumference to accommodate the ring H, whereby the pressure in the space inclosed by the ring tends to expand it and maintain it always in tight engagement with the plate F. In order to prevent leakage through the split *g* in the ring, a rectangular plate *f* may be employed, fitting tightly against the shoulder T, ring H, and plate F. This rectangular plate is secured in any suitable way to one end of the ring G, the other end of said ring being allowed to slide freely with respect to said angular plate, whereby the latter does not interfere with the expansion and contraction of the ring, while at the same time it maintains the desired steam-tight character of the joint.

K is a passage connecting the passage-way D with the space inclosed by the ring H. Preferably the passage K is fitted with a bushing M to prevent the leakage of steam into the space inclosed by the ring H by way of the joint N, formed between the valve C and plate E. Passages P P connect the exhaust-cavity V in the valve-seat with the space inclosed by the ring G outside of the ring H. These passages P are formed in bosses *p*, where they pass through the passage-way D. The passages P conduct to the exhaust-cavity any steam which may leak past the rings G and H.

In the proportions of the device illustrated in the drawings the plate E is substantially circular, as shown, while the valve C is essentially rectangular. Those portions of the valve outside of the plate E are therefore pressed downward by the steam-pressure in the valve-chest, and this pressure is counteracted to the desired extent by the upward pressure of the steam in the steam-chest on the under side of those portions of the plate E which overlap the valve. These areas are so proportioned as to maintain the valve upon its seat with the desired pressure, which, with my present improvements, may be made relatively slight at all times, since the varying pressures to which the valve is subjected and which tend to elevate it from the seat are counteracted and counterbalanced by correspondingly-varying pressures in opposition thereto, as will be explained.

In explaining the operation of the device the valve shown in Figs. 4 and 5 will be first considered. With this valve the valve-seat is so proportioned in relation to the length of the valve that at the instant steam is admitted to one of the ports by one end of the valve the other end of the valve begins to overlap the end of the seat. Thus when the end *a* of the valve is at the edge *e* of the port B the other end *b* of the valve is at the end *d* of the valve-seat. It therefore follows from these proportions that the area of the portion of the valve over a steam-port plus the area of the portion of the valve overlapping the valve-seat is proportional to the area of one steam-port. During that part of the valve-travel that the valve overlaps the valve-seat the steam in the steam-port on the steam end of the cylinder is necessarily at steam-chest pressure; but after cut-off, when the steam-pressure in that port commences to diminish on account of the expansion of the steam in the cylinder, the valve ceases to overlap the valve-seat. The passage-way D is so arranged that it remains in communication with one steam-port until the steam exhausts from that port, when it comes into communication with the other port. This is clearly shown in Fig. 4, wherein the passage-way D is just cut off from the port B, and any further movement of the valve C will allow exhaust from the port B and will place the passage-way D in communication with the port B′.

It is evident that if the valve-seat be proportioned as in Figs. 4 and 5 the variable force tending to lift the valve from its seat is proportional to the area of one port plus the area of the passage-way D and to the steam-pressure in the port with which the passage-way D is in communication. In other words, the pressure tending to elevate the valve from its seat in Fig. 5 is that due to the steam-pressure on the valve-face over the port B and to the overlapping portion of the valve-face beyond the edge *d* of the seat. As the valve is moved to further uncover the port B its area subjected to the steam-pressure in the port will be diminished; but the area of the portion overlapping the valve-seat will be correspondingly increased, so that the changing surfaces which are thus subjected to the

full steam-pressure will be of constant area. During cut-off the only portion of the valve-face subjected to pressure which tends to elevate the valve will be that covering the port at the steam end of the cylinder, and during this period of the operation the passage-way D will be in communication with that port. Owing to the expansion of the steam in the steam end after cut-off, the force tending to elevate the valve will be gradually diminished; but since the passage-way D is in communication with this gradually-diminishing steam-pressure, the counterbalancing force on the valve will be correspondingly and proportionately decreased, as will be explained.

Since the space over the valve which is encompassed by the ring H is in communication with the passages K and D, it follows that the steam-pressure within the said space will be equal to the steam-pressure in the port with which the passage-way D is in communication. If now the said area of the space encompassed by the ring H is proportional to the area of one steam-port plus the area of one end of the passage-way D, then a downward force will be exerted on the back of the valve which is proportional to and synchronous with the upward force exerted on the valve by steam-pressure on the valve-face. In other words, since the pressure during the operation of the valve, other than during the cut-off period, which tends to elevate the valve is that due to the full steam-pressure acting on an area equal to the area of one port plus the area of the passage-way D, and since the space on the back of the valve inclosed by the ring H is proportional to that area and is in communication with the full steam-pressure, the forces tending to elevate the valve from its seat and toward its seat will be counterbalanced. During the cut-off period the force which tends to elevate the valve from its seat will be that due to the steam-pressure on the valve-face covering the steam-port, which pressure will gradually drop during the expansion. Since, however, the passage-ways D and K communicate with the port the steam-pressure in the space inclosed by the ring H will be correspondingly and proportionately diminished. In this way it will therefore be seen that I have obtained a valve wherein a perfect balance is at all times secured, whether the pressure which tends to elevate the valve is constant or varying.

Referring now to the valve shown particularly in Figs. 2 and 3, it will be observed that the length of the seat is so proportioned in relation to the length of the valve that the passage-way D will fulfil the functions of an auxiliary port, as is the case in the well-known Allen valve—that is to say, at the instant that the end *a* of the valve passes the edge *e* of the steam-port B the edge *c* of the passage-way D passes the end *d* of the valve-seat. Steam therefore enters the port B directly and also indirectly through the passage-way D, as illustrated by the arrows in Fig. 3. In a like manner admission to the opposite end of the cylinder takes place. It is to be observed that with a valve-seat arranged for an Allen valve, as explained, a portion of the valve-face equal at either end to the area between the edge *b* of the valve and the edge *c* of the passage-way D will overlap the valve-seat before admission takes place. The upward force due to the steam-pressure under this overlap may be compensated for in proportioning the area excluded from the steam-pressure by the ring G. In other respects, however, the upward force due to the steam-pressure in the steam-port and in the passage-way D will be compensated for in the same manner as I have already explained in connection with Figs. 4 and 5—namely, by making the area of the space inclosed by the ring H proportional to the area of one port plus the area of one end of the passage-way D, whereby the steam-pressure, whether constant or varying, which tends to elevate the valve will within said space exert a counteracting effect, tending to keep the valve upon its seat.

The advantages arising from the employment of my improvements are manifest. Steam-pressure may be excluded from a larger portion of the back of the valve than has been heretofore possible, resulting in a perfect counterbalance, in easier working of the valve, in less wear on the valve, the valve-seat, and the mechanism operating the valve, and, if the engine be of the reversible type, enabling it to be handled more easily.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. The combination with a valve-seat, of a slide-valve coöperating therewith and having pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage-way conducting pressure to the space over said area, substantially as set forth.

2. The combination with a valve-seat, of a valve coöperating therewith having pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage-way connecting the space over said inclosed area with the ports in the valve-seat, substantially as set forth.

3. The combination with a valve-seat, of a valve coöperating therewith having the pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage-way connecting the space over said inclosed area with the ports in the valve-seat and with the space beyond the valve-seat, substantially as set forth.

4. The combination with a valve-seat having steam-ports therein, of a valve coöperating with said valve-seat and having the pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage-way connecting the space above said area with those portions of the valve-face working over said ports, whereby the pressure within the ports will correspond to the

pressure within the inclosed area, substantially as set forth.

5. The combination with a slide-valve having the pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage-way connecting the ends of the valve-face with the space over said area, of a valve-seat with which said valve coöperates, said valve-seat being so proportioned that at the instant pressure is admitted to a port by one end of the valve, the other end of the valve begins to overlap the valve-seat, substantially as set forth.

6. The combination with the valve-seat of a cut-off engine, of a valve coöperating therewith and having pressure excluded from a portion of its back, an inclosed area on the back of said valve, and a passage connecting the space above said area with the ports in the valve-seat, whereby when the admission-port is cut off to allow for expansion the passage will conduct the decreasing pressure to the inclosed space, substantially as set forth.

7. An improved slide-valve, having a ring on its back and a passage-way connecting the valve-face with the space inclosed within said ring, and a balance-plate with which said ring coöperates, substantially as set forth.

8. An improved slide-valve, having an exhaust-pocket, two concentric rings on its back, a passage-way connecting the ends of the valve-face with the interior ring, and a passage connecting the space formed between the two rings with the exhaust-pocket, substantially as set forth.

This specification signed and witnessed this 28th day of November, 1898.

CHARLES C. EGBERT.

Witnesses:
S. B. DURAND,
W. H. TEW.