F. ROCHOW.

VALVE AND OPENING FOR STEAM ENGINES.

No. 91,368. Patented June 15, 1869.

Fig. 1.

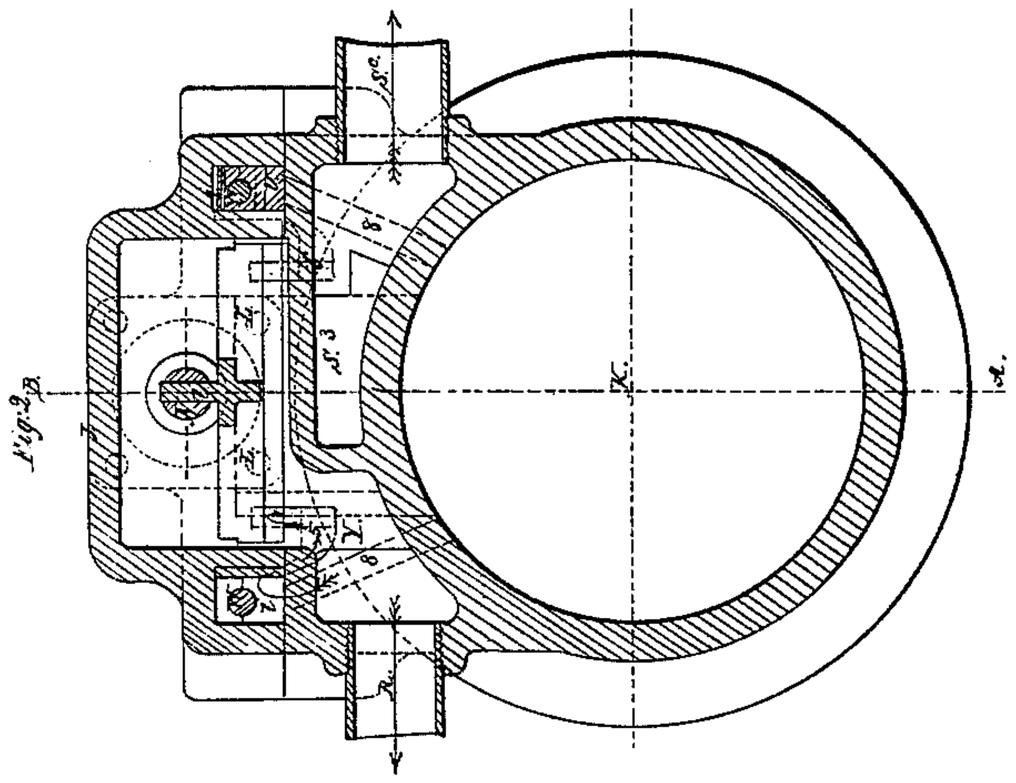

Fig. 2.

Fig. 4.

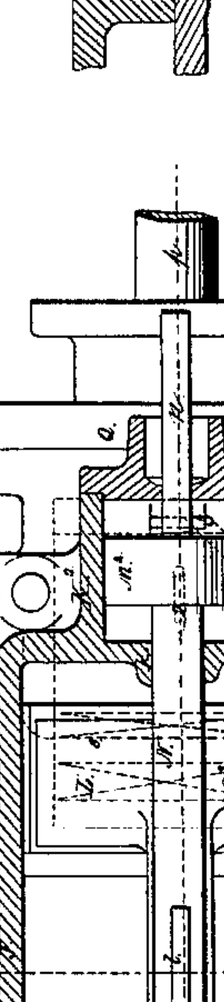

Fig. 3.

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IMPROVEMENT IN VALVES AND OPENING FOR STEAM-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, F. ROCHOW, of the city, county, and State of New York, have invented a new and improved Valve-Motion for Engines, whether worked by steam, air, water, or any other fluid; and I do hereby declare that the following is a full and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings, and the letters of reference marked thereon.

The nature of my invention consists—

First, in an improved arrangement of a slide-valve for the induction and eduction of the motive-fluid to and from the main cylinder, with two auxiliary pistons and cylinders, and passages from these to the main cylinder, which arrangement causes the slide-valve to be actuated upon at the proper times, partially by the motive-fluid derived from the main cylinder, whilst it is acting at the same time on the main piston, partially by the motive-fluid derived directly from the valve-chest, the object of this arrangement being to obtain, with certainty and simplicity of construction, the desired reciprocating motion of the main piston without the aid of any intermediate mechanical connection between the main piston or piston-rod and the induction and eduction-valves.

Second, in the arrangement of two adjustable valves, one for each half stroke, between the openings from the main cylinder and the channels to the above-named auxiliary cylinders, by which any single opening of two longitudinally-located rows of openings to the main cylinder may be brought in communication with the channel to its respective auxiliary cylinder, so that even whilst the engine is working, this valve may be adjusted so as to cause any one of these openings from the main cylinder to operate the respective auxiliary piston, by the fluid from the main cylinder being allowed to pass through it to the auxiliary cylinder. This will always take place when the main piston has passed such opening, having free communication with one of the two auxiliary cylinders.

The objects of this construction are twofold, viz:

First, to prevent the necessity of any separate arrangement for cushioning the main piston near the ends of its stroke, in direct-acting engines, without cranks, as it is obvious that the main valve may be reversed by this adjustable valve, and the motive-fluid may be caused to enter that end of the cylinder to which the piston approaches, so much before the piston has made its full stroke, as to arrest its momentum just near that point, whatever the speed may be at which the piston is allowed to move. This arrangement also arrests the motion of the piston more gradually than any mere cushion near the cylinder-heads.

The second object of this adjustable valve is to reverse any slide-valve operated by the first-named arrangement at any desired part of the stroke of the main piston.

Figure I is a longitudinal section, through A B, of the main cylinder and valve-chest.

Figure II is a cross-section, through C D, of the same.

Figure III is a top view of the same, the valve-chest being intersected at G H.

Figure IV is a section, through E F, the centre line of the valve-stem of the adjustable valve.

K is the main cylinder.

O and Q, the two cylinder-heads.

P, the main piston.

p, the piston-rod.

Cylinder K is planed straight on top, to receive the valve-chest J, which is bolted tight on to it, the double slide-valve L L travelling inside of the chest on the same surface.

There are two auxiliary cylinders, K^1 and K^2, provided on the valve-chest J, both being bored out in one line in the middle of J.

Within the cylinders K^1 and K^2 work the pistons M^1 and M^2, both being screwed or otherwise fastened on to the rod N.

These pistons and rod N are fitted as tight as possible in their respective cylinders, and move freely in them.

A slot, *l*, which is made in the centre of the piston-rod N, receives a projecting lap of the valve L L, so that by the latter, the motion of the piston-rod N is communicated to the valve L L, allowing it, as it wears, to settle freely on its seat.

The valve L L is an ordinary **D**-valve, and made double by preference, so as to shorten the passages to the main cylinder, as well as to the auxiliary cylinder, but the arrangement will be the same, whether a double or a single **D**-valve is used.

R^1 and R^2 are the main passages to the two ends of the cylinder K, opening into the valve-seat, with the respective ports R^1 and R^2; and S^1 and S^2 are the respective ports in the valve-seat, connected with the exhaust-channel S^3.

The motive-fluid is admitted into the valve-chest through the pipe R, and enters into it by means of a cavity, Y, in the centre of the valve-seat, in the manner shown in Figs. II and III.

The exhaust of the motive-fluid takes place through the pipe S, which is in direct communication with the exhaust-channel S^3. (See Figs. II and III.)

I prefer to give the valve L L some lap on each end, reaching somewhat over each port R^1 and R^2, in its central position, (as may be seen in Fig. I,) whilst the edges *e e*, Fig. I, cover the inside edges of the ports R^1 and R^2.

The object of this will be seen when I describe the operation of the valve.

There is, further, a channel, opening into each end

of each of the two auxiliary cylinders, K^1 and K^2; the channels 1 and 2 connecting their inner ends directly with the inside of the main cylinder on each side; the channels 3 and 4 connecting the outer ends of these cylinders with the valve-chest, where they terminate with the ports 3 and 4.

Figs. I and II show those behind, in dotted lines, and those in front, which are represented to be taken away, by intersection, in blue lines.

Fig. III shows them in blue lines; the main ports and channels R^1, R^2, and S^1 and S^2, being shown in red lines.

There are, further, two short channels, 5 and 6, terminating in the valve-chest with the ports 5 and 6, in such a way that the ports 3 and 5, and the ports 4 and 6, are, each pair, located in longitudinal lines. (See Fig. III.)

The valve L L operates with respect to these ports in exactly the same manner as it does with respect to the ports R^1 R^2, S^1 and S^2, as it is dished out on each wing, where it works on these ports, in line with these two pairs of ports. The outside edges *d d* of these recesses, Fig. I, nearly cover the inside edges of the ports 3 and 4.

These recesses are shown in Figs. I and II, in dotted and in blue lines, and in Fig. III in dotted lines.

Where the main valve L L travels over these ports it is made shorter on the outside, so as to have no lap, but to have the outside edges just true with the outside edges of the ports 3 and 4, in its central position. (See Fig. III.)

The channels 5 and 6 lead into the spaces *i i* dished out on the sides of the valve-chest J, (see Figs. II, III, and IV,) from which a number of holes, 8, 9, 10, 11, 12, is drilled right through into the main cylinder.

A little slide-valve, U, Fig. IV, kept on to the valve-seat by a spring, and operated by a rod, W, which extends through the valve-chest, can be adjusted easily from the outside to cover all of these holes, 8, 9, 10, 11, and 12, except the one, 8, nearest to the end of the cylinder, or by pushing in the rod W, to uncover any number or all of them; a pointed spring, *x*, holding the rod W, by means of small points being drilled into it at corresponding intervals, in the different positions where valve U has opened only the first hole from the end of the cylinder, viz, 8, or 8 and 9, or 8, 9, and 10, &c., to the last hole.

The operation of this is as follows:

Suppose the main valve L L to be thrown over to the left-hand side, Fig. I, as far as the pistons M^1 and M^2 allow, and the motive-fluid to be admitted through R, then it will pass into R^2, and move piston P to the left-hand side; the channel R^1 being at the same time in communication with the exhaust-channel S^1.

But in this position of the valve L, the channel 4 is also in communication with 6, and as this communicates with 8, 9, 10, 11, or 12, consequently also with the main cylinder.

This part of the cylinder K communicates with the exhaust as long as the main piston has not reached the first of the holes 8, 9, 10, 11, or 12, uncovered by valve U.

The outside end of cylinder K^1 is therefore in connection with the exhaust until the main piston has reached that point, while the inside of it is also in connection with it through channel 1 opening into the cylinder K.

The channel 3 is in direct communication with the valve-chest, as the valve L has uncovered port 3, admitting the motive-fluid from it into the outer end of cylinder K^2, the inside end of it being in communication with the main cylinder, and admitting the motive-fluid from it by 2.

Thus, there is a surplus pressure on the right-hand side of piston M^2, as the total pressure on piston M^1, which tends to move it, is the atmospheric pressure multiplied by the area of the rod N, acting on the left-hand side, whilst the only pressure acting to move M^2 is the pressure of the motive-fluid multiplied by the area of the rod N, so that a surplus pressure remains, acting on the right-hand side of piston M^2, which is equal to the difference of the pressure of the motive-fluid and the atmospheric pressure multiplied by the area of rod N.

This pressure tends to keep the valve L in its position to the left.

I prefer to extend a very thin prolongation of the rod N *n*, through the valve-chest, in order to enable to see the action of the valve L from the outside, which reduces the surplus pressure on this side, but I make it small enough, so that it will deduct only very immaterially from this pressure.

When the piston P, however, has passed the first of the uncovered holes 8, 9, 10, 11, or 12, inside of the cylinder K, the motive-fluid will enter such hole immediately, and pass through the channels 6 and 4, into cylinder K^1, and move the piston M^1 and valve L to the right-hand side, as the pressure against the whole surface of M^1 is a great deal larger than the surplus pressure which tends to keep it in its place.

When the valve L has reached its central position, as shown in Fig. I, it just commences to communicate the right-hand side of the main cylinder with the exhaust-channel S^2; it further commences to communicate the channel 5 with 3; and as 5 is in connection with the main cylinder on its right-hand side, by at least one of the holes 8, 9, 10, 11, or 12, therefore, both ends of cylinder K^2 are again in connection with the main cylinder, exhausting altogether at the same time, and keeping through the whole motion, (see Fig. I,) of valve L, an equilibrium of pressure in the cylinder K^2.

But the valve L further commences from its central position to open the port 4, admitting the pressure of the valve-chest into the left-hand side of cylinder K^1, whilst it closes at the same time the communication between 4 and 6, so that the full pressure is kept in this part of cylinder K^1 through the whole stroke of valve L.

When the valve has travelled so much further as it laps on each side over the ports R^1 and R^2, it commences to admit the motive-fluid into the left-hand side of cylinder K, gradually arresting the motion of piston P, and moving it again to the right-hand side, whilst it will enter through channel 1 into cylinder K^1 simultaneously, serving here also to check the rapid motion of piston M^1 and valve L.

Now it will be easily understood that the lap of valve L, over each port, R^1 and R^2, allows it to travel more than half its stroke before the motive-fluid enters through 1 in K^1 to check its motion, thus making this operation more certain, and so act quicker in opening the port R^1 than without lap.

The same surplus pressure is now acting on M^1 to keep valve L in its place on the right-hand side, as was observed to act on M^2 when we started.

This operation repeats itself at each half stroke.

It will be observed that the exactness of this motion is not diminished, even if the pistons M^1 and M, and the rod N, should wear in their respective cylinders somewhat leaky, because any fluid leaking by them would immediately exhaust and not exert any pressure on those pistons.

Further, it will be observed that the channels 1 and 2 enter the cylinders K^1 and K^2, a little distance

from their ends, (see Fig. I,) in order to cushion the pistons M^1 and M^2, as soon as they should pass over any one of them, which will not in the least interfere with the proper action of them as they are started by the fluid entering through channels 3 and 4.

The simplicity or this valve-motion—it consists only of two movable parts, viz, the valve and double piston; its exactness, which is not the least impaired by the wear of any of these parts; its perfect cushion, which prevents any jar and consequent breakage, make it very valuable for many purposes, but especially for direct-acting engines of all kinds, as rock-drilling engines, steam-pumps, steam-hammers, direct-acting pile-drivers, &c.

With reference to the adjustable valve U, it is clear how it operates. In the position as shown in Fig. IV, the valve-motion will be actuated upon as soon as the piston P has passed the opening 8 in the cylinder. Is the valve U pushed in so far as to open 9, too, then the action will commence when the piston P has passed opening 9, &c.

When the valve U is pushed in so as to open all the holes, and if the row of these should be longer than the width of piston P, then the fluid from the main cylinder would, as soon as the piston has passed the hole 12, rush through it, and out through 8 and 9, into the other side of cylinder K, and there exhaust without acting on the valve L.

To provide against this, a slide-valve, V, Fig. IV, is carried along with the stem W, after it has been pushed in some distance so as to cover the holes 8 and 9, and to prevent the fluid from escaping.

The valve V is moved by a pin fastened into it, which works in a slot in the stem W, the pin taking along the valve V, when the stem has been pushed in to the end of this slot.

Therefore, the valve L may be arrested at any part of the stroke of piston P within the length of the row of holes 8, 9, 10, 11, and 12, which may be extended along the whole stroke, by adjusting the stem W accordingly.

This arrangement may be used to great advantage on many engines:

On rock-drilling engines, either to give them any desired stroke, or adjust the cushion on the inward stroke of them, such as to have it work with its full force, whether it is pointed upward or down, without knocking against the cylinder-head, it requiring to reverse the valve earlier when pointed upward than when pointed down.

On pumping-engines, for cushioning them as gradually as possible, at any desired stroke, with whatever speed the piston may move, and whatever the pressure of the water may be in the pump.

On steam-hammers, for altering at any moment the length of the stroke and the force of the blow.

It may also be used in combination with the valve-motion, when the valve is used only as a cut-off valve to cut off the supply of fluid to the cylinder at any part of the stroke, and to allow expansion to take place.

I am aware that devices have been made to operate induction and eduction-valves as well as cut-off valves by the steam used in the main cylinder, and allowed to act for that purpose when the main piston has passed certain channels leading into the main cylinder; but

What I claim as new, and desire to secure by Letters Patent, is—

1. The arrangement of the valve L, cylinders K^1 and K^2, and channels 1, 2, 3, 4, 5, and 6, substantially in the manner set forth.

2. The induction and eduction slide-valve L, constructed and arranged as described, in connection with the passages 3 and 4, whereby to admit live steam directly from the steam-chest into either one of the auxiliary cylinders, and exhaust it from the opposite end of the auxiliary cylinder, as described.

3. The combination of a slide-valve with a row of openings in the cylinder of an engine, when this slide-valve is made adjustable, so as to uncover only one or any other desired number of these openings, substantially as set forth.

4. The combination and construction of valve U, valve V, and stem W, and openings 8, 9, 10, 11, and 12, substantially as herein set forth.

5. The valve-chest J, with its chambers *i i*, in combination with the rows of holes 8, 9, 10, 11, and 12, valves U and V, and the channels 5 and 6, substantially as described.

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Witnesses:
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