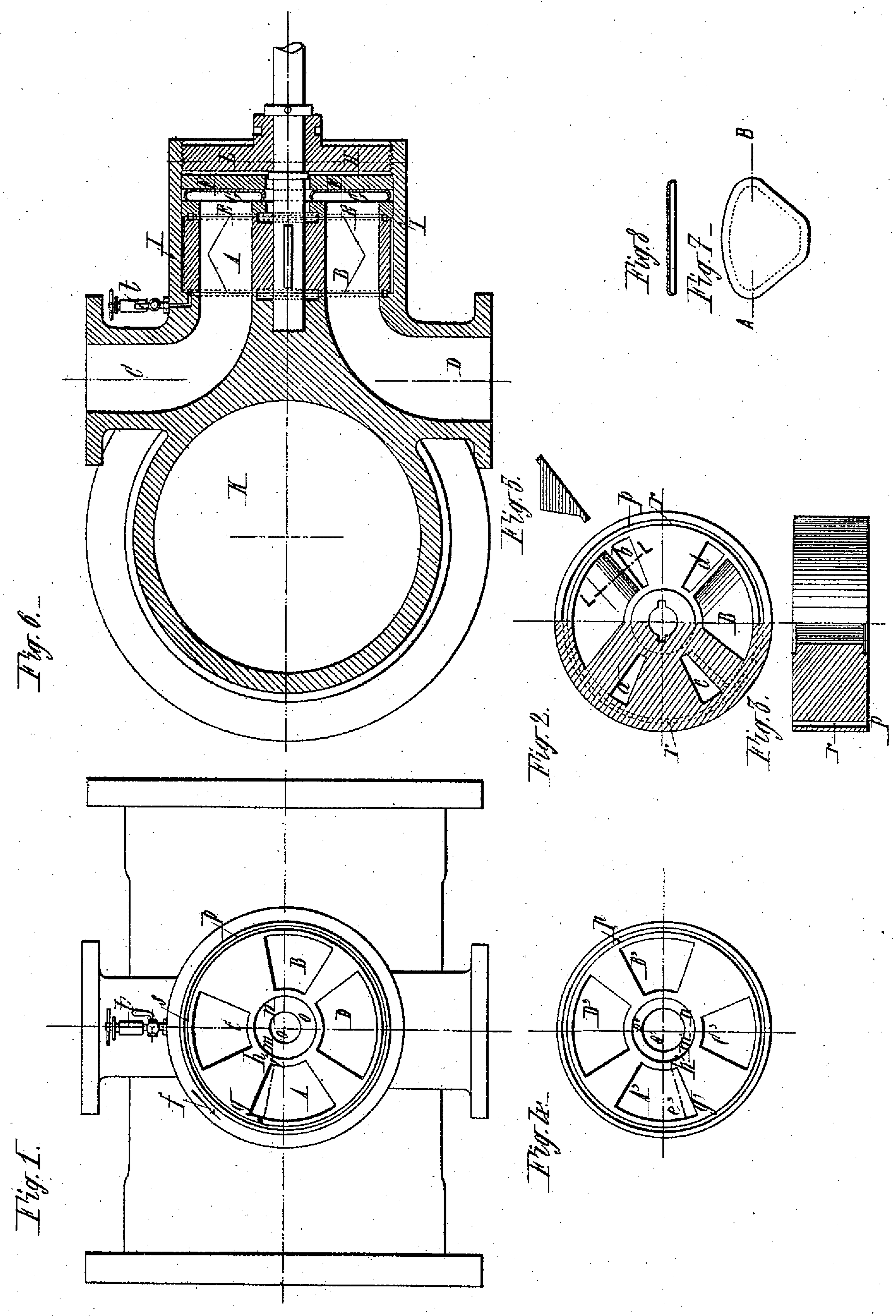
(No Model.) 2 Sheets—Sheet 1.

S. PSAROUDAKI.

STEAM ENGINE VALVE.

No. 470,443. Patented Mar. 8, 1892.



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(No Model.)

2 Sheets—Sheet 2.

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FIG. 11.

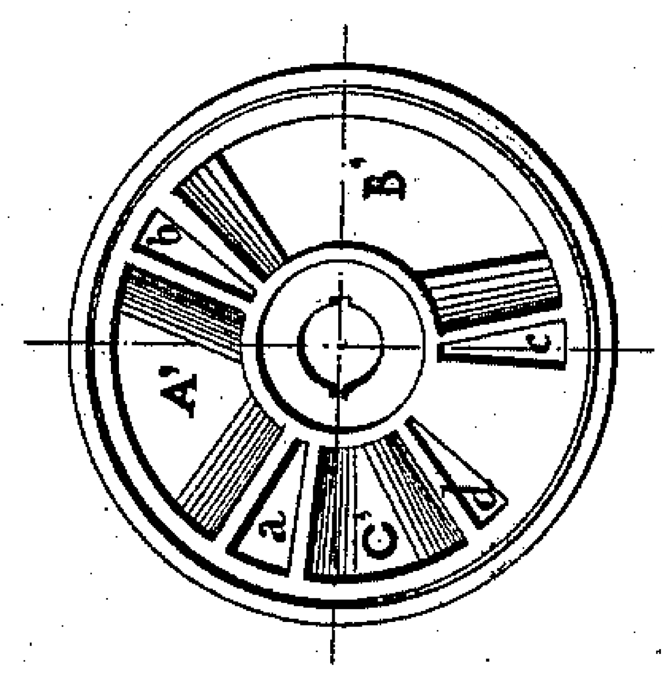


FIG. 13.

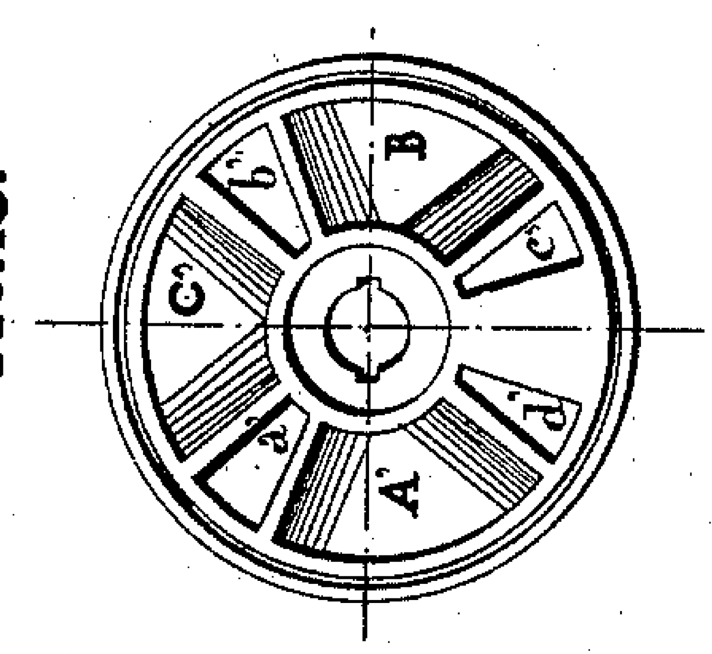


FIG. 10.

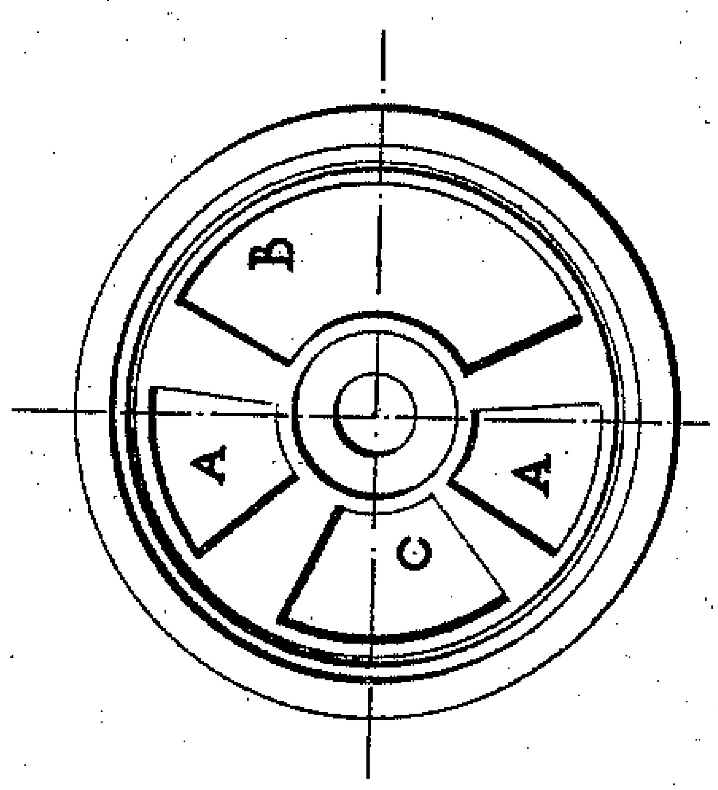


FIG. 12.

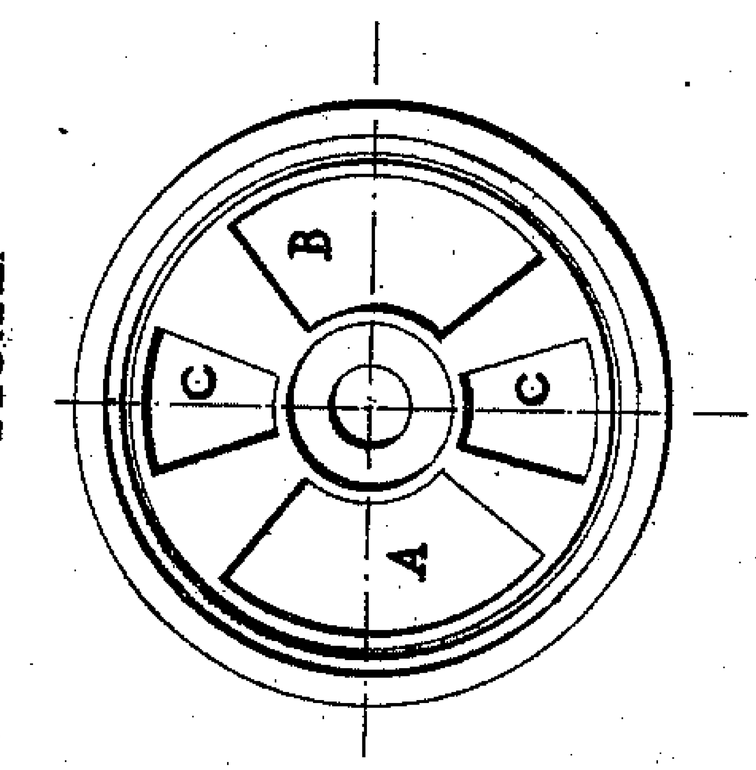
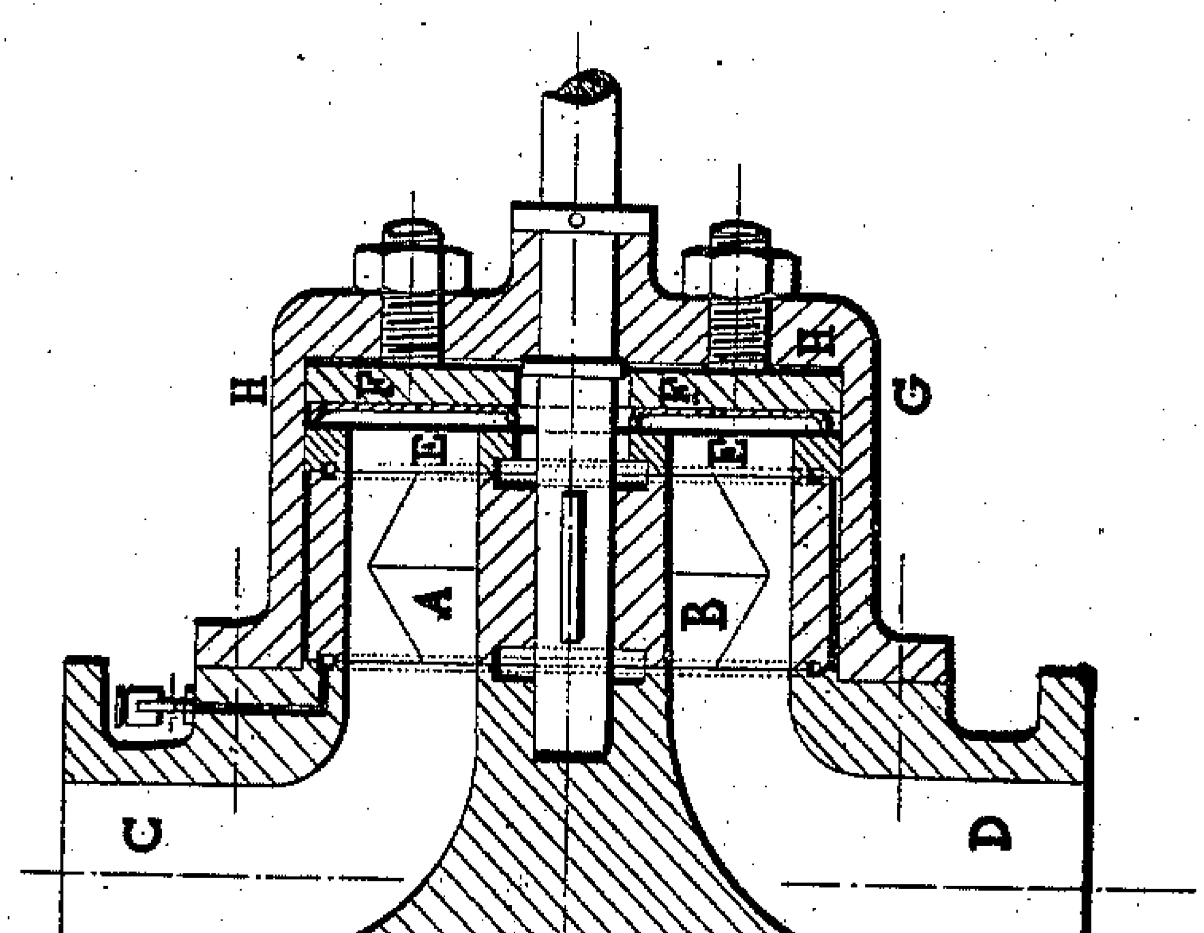


FIG. 9.



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UNITED STATES PATENT OFFICE.

SPIRIDION PSAROUDAKI, OF PARIS, FRANCE.

STEAM-ENGINE VALVE.

SPECIFICATION forming part of Letters Patent No. 470,443, dated March 8, 1892.

Application filed April 4, 1891. Serial No. 387,708. (No model.) Patented in France October 9, 1888, No. 193,396.

To all whom it may concern:

Be it known that I, SPIRIDION PSAROUDAKI, a subject of the Sultan of Turkey, residing at Paris, France, have invented certain new and useful Improvements in Steam-Engine Valves, (for which I have obtained a patent in France, dated October 9, 1888, No. 193,396,) of which the following is a full, clear, and exact description.

This invention relates to valves for the distribution of steam to engine-cylinders.

The superiority of high-pressure steam-engines has long been recognized; but plain or slide valves have proven unsatisfactory in connection therewith, especially in engines of large dimensions, and endeavor has been made to substitute other distributers with little success, as, besides being inconvenient and complicated and having other objections more or less important, difficulty was experienced in keeping them steam-tight.

Attempts have been made to render the arrangement of transmitting movement to the distributers more practical, especially in the engines capable of reversal, either to improve the conditions of supply and exhaust or to diminish the shocks produced by the reciprocation of the valves or to avoid the use of slide-valves, or finally to lessen the number of eccentrics or to completely avoid their use.

The valve forming the subject of the present specification is designed to remedy all the defects heretofore existing and presents, besides, the following advantages:

First. The space occupied by the valve and its adjuncts is reduced almost one-half, which advantage is of great importance in connection with marine engines and locomotives with interior cylinders.

Second. The expense of construction and of keeping in repair is reduced in the same proportions.

Third. The joint between the valve and its seat is more perfect and less liable to wear than in the ordinary sliding valve.

Fourth. Despite the reduction of the weight and size the ports for the passage of steam are larger.

Fifth. The force developed by the machine is modified by the lead of the admission-exhaust, which results in modifying the expansion and compression in a large degree. The lead is timed so that the admission always commences before the tension of the counter-pressure be equal to that of the boiler to avoid the shocks.

Sixth. The exhaust-pipe can be put beside the top valve-bearing, and thus avoid the constant cooling of the sides of the cylinder through the contact of these products with the said sides.

Seventh. Owing to the arrangement of the valve-passages the speed of the valve may be two or three times less than that of the main shaft. A very regular running can constantly be obtained. The speed of the machine can be changed with remarkable facility and rapidity. The commanding-lever can be held in any position without feeling any opposed force, facilitating to the highest degree the construction, the mounting, and keeping in repair, avoid frequent repairs and disorders, which characterize the present systems, and render the overlooking of the machine very easy without the use of expert mechanics.

Figure 1 is a plan view of an engine-cylinder to which any improved valve has been adapted, the top of the valve-casing being removed. Fig. 2 is a view, partly in plan and partly in horizontal section, of the drum or valve. Fig. 3 is a view of the same, partly in side elevation and partly in vertical section. Fig. 4 is an inverted plan of an apertured plate arranged above the valve. Fig. 5 is a section in the line L L of Fig. 2. Fig. 6 is a transverse section through the cylinder and valve. Figs. 7 and 8 illustrate by plan and section one of the covers for the apertures through the plate shown in Fig. 4. Fig. 9 is a sectional view illustrating a modified form of box or cover for the valve-chamber. Figs. 10 and 11 illustrate a modified arrangement of the parts of the passages of the valves. Figs. 12 and 13 illustrate other modifications of these parts.

The passage of steam to and from the cylinders is governed by one or more drum-shaped valves traversed by a number of passages and turning or oscillating between two plane circular surfaces, and in one, which I shall call the "tables," are formed the cylinder-ports, the other being provided with cavities, which act in connection with the openings in the valve to afford passages to and from the cylinder-ports. Where there is but one valve for each cylinder, the valve-seat is provided with four openings or ports, two of which A and B, Fig. 1, communicate with the ends of the cylinder K, as is usual, while port C communicates with the steam-pipe and Q with the exhaust. A circular socket O, formed in the center of this table 1, receives the end of a shaft or spindle 2, upon which is mounted the rotary valve 3. An annular recess *m n o* is formed about the socket to relieve friction between the table 1 and valve 3, which is seated on it. The valve 3, seated on this table 1, is traversed in the instance shown by two large openings $A^\times$ and $B^\times$, Fig. 2, and four small ones *a b c d*, arranged close to the large ones. This valve rotates at one-half the speed of the main shaft. Above the drum is mounted a plate E, having four cavities A′ B′ C′ D′, Fig. 4, placed exactly opposite to the four openings of the table 1, and the edge of each of these cavities is symmetrical to the edge of the corresponding port in the table. This superposed plate E is also provided at the center with an opening O to receive the spindle of the valve and an annular recess *m n o* to relieve friction between the valve and plate. The two large passages A B of the valve afford during its rotation communication between the different ports of the table and the corresponding cavities of the superposed plate in the same manner as the ports of the ordinary valve. These passages can be much narrower in the center of the valve and the walls separating the large and the small openings must have some strength, as is indicated in Fig. 5, which gives a section of this edge on line L L of Fig. 2. The four small passages of the valve afford communication between the ports and the cavities of the superposed table, which is opposite; but no direct communication should exist by way of the small passages between the cylinder-ports. Therefore these openings should have a breadth a little less than the partitions between the parts of the cylinder. The four small passages of the valve and the four cavities of the superposed plate E increase the area given to the passage of the steam. To illustrate, suppose the valve moves in the direction indicated by the arm *f*, Fig. 1, and that one of its two large passages—say $A^\times$—had uncovered at a given moment part or section *e g h l*, port A. Although the port C at this moment is almost entirely uncovered by the same large passage $A^\times$ of the valve, which has already started to uncover the port A, it is evident that the passage of steam will be confined to the area of section *e g h l*; but this same large passage $A^\times$ of the valve has at the same time also uncovered on its other side and to the same extent section *e′ g′ h′ l′*, Fig. 4, of the cavity A′ of the plate E, which is opposite, and as this cavity is at this moment in direct communication with the port A of the table by the little passage *a* of the valve, which precedes the large, it follows that space for the admission of steam to port A will be represented by the section *e g h l*, plus the passage *a* of the valve. In this manner the section given to the passage of the steam will be doubled. When communication between ports C and A through passage *a* of the valve is closed by the rotation of the valve, the passage of the valve will be brought above port C, thus maintaining the same area for the passage of steam to port A. Communication is at the same time and in the same manner established between port B and the exhaust D by way of passages $B^\times$, *d*, and *c* of the valve. This construction admits of the passage of a large volume of steam without increasing the size or weight of the valve, as is the case with multiple-passage slide-valves, or increasing the size of the bearing in which the slide moves.

The superposed table can be arranged in several ways, of which the most advantageous would be the one indicated by Fig. 6, which is a transverse section of the cylinder K, the valve, and adjacent parts. According to this arrangement the superposed table is composed of the following parts: first, a circular cast plate E E, Fig. 6, traversed by four openings symmetrical to the openings of the table and shown separately by Fig. 4; second, another plate F F, having only one opening in the middle for the passage of the valve-spindle; third, four metal cup-shaped springs *g* and *g′*, Figs. 7 and 8, arranged between the plates E and F and attached to the plate F in a manner to surround the four openings of the plate E, and thus prevent any steam from passing between these two plates, either all around or from one opening to another, at the same time tending to hold the plates apart with a certain elasticity, Fig. 7 showing separately one of these four springs in plan view, and Fig. 8 a section on line A B of Fig. 7, said springs being formed of a plate of tempered steel, copper, or any other elastic metal, whose edges are turned in, so as to make a spring and at the same time be applicable on the edges of the openings of the cast plate E by the pressure of the steam to completely prevent all escape of steam; fourth, a plate H H, Fig. 6, covers and secures the table formed by the preceding parts. This plate H H is threaded on the edge and is screwed into the upper part of bore I I, which surrounds the valve, pressing it more or less and holding it in the desired place. The degree of pressure exerted by the plate on the four springs G can be regulated at will. However, these springs must not be strained but very lightly, or the pressure necessary to establish a tight joint between the surfaces in contact with the valve and its two tables will be exerted by the steam pressure, and this pressure is applied on both sides of the plate equally, as steam occupying or passing through the spring-cups G above the plate will counterbalance the pressure of steam beneath the plate. As, moreover, the speed of rotation of the valve is but one-half of the motor-shaft, the force required to actuate the valve and also the wear become insignificant.

The arrangement which has just been described can be modified, as in Fig. 9, as follows: The valve and the superposed table are covered by a box H′ H′ H′, inclosing the parts. A certain number of screws I′ I′ traverse the upper part of the box and press on the full plate F F to regulate the tension of the springs. To oil the surfaces of the valve and its bearings, grooves or circular channels *p*, Figs. 1, 2, and 4, are formed on the friction-surfaces all around the roller-valve and its two tables, and are made in such a manner as to catch by the contact with these pieces the oil as well as the steam which tries to flow all around to escape into the box of the roller-valve. Two or more ducts 2 2, Figs. 2 and 3, are formed near the periphery of the valve to establish communication between the grooves *p* on opposite sides of the valve. Another channel *s*, Fig. 1, connects the groove *p* with an oil-cup *t*, placed outside the valve-case. The interior of the valve-chamber must be in constant communication with the escape, and it becomes very easy to lead the escape-pipe above this box and thus exhaust on the side of the superposed table. It suffices, therefore, to construct this box according to the arrangement indicated in Fig. 9 and to have a full plate F F traversed by an opening, while if the same is to be done for the admission-pipe all should be arranged so that the pressure of the steam is not exercised on the springs or on the full plate F F. The distribution by rotary valve is far superior. Use can, however, be made of the oscillating valve—that is to say, actuated by an alternative movement back and forth in many cases—and notably so when it is desirable to distribute the steam to a single cylinder by two valves serving, one for the admission of steam, the other for the escape, or mounted on the two ends of one cylinder to diminish the dead-space and serving each as supply and exhaust for one of the cylinder ends.

Fig. 10 shows the table and Fig. 11 the valve in the case, where it is desirable to distribute separately in each end of the cylinder, while Fig. 12 shows the table and Fig. 13 the valve in case one distributer is wanted for the supply and another for the escape. As is seen in these two arrangements, the table presents four openings and the roller-valve three large and four small openings, the difference consisting only in the proportion between the divers openings of the table, as well as of the valve itself, and this proportion must be maintained in each case in accordance with the scale established for the drawings accompanying this specification.

Of the four ports of the table shown by Fig. 1, the two A and A lead directly to the same end of the cylinder. The part C connects with the admission-pipe for the steam and the opening B with the escape-pipe. The valve, Fig. 11, which coacts with this table, presents three large passages A^2 B^2 C^2 and four small ones *a b c d*. The passage C^2 always serves for the admission and the passage B^2 always for the escape, while the passage A^2 serves alternately for the admission and for the escape. The four small passages *a b c d* serve to double the sections of the steam-passage, acting together for this purpose with the cavities which must always exist opposite the parts, as has been described above in the description of the rotary valve.

Fig. 11 shows the valve in the middle position in regard to the common axle. Supposing it to oscillate above the table, Fig. 10, it is easily seen that for a certain move of this valve a section about four times larger is presented for the passage of the steam than that which would be presented by a simple passage. The ends of the cylinder must not present but a small thickness and the escape-pipe must always have quite a large section. It would be preferable to have this pipe end in the superposed table. There would be then three ports in the table—A, A, and C—and a cavity B, while the escape-pipe would end opposite this cavity. A relatively slight thickness could be given the cover, at the same time avoiding the cooling off of this cove by the escaping steam.

In the table shown by Fig. 12 steam, being supplied through port A, is conducted through ports C C to one end of the cylinder and through port B into the other end. If the valve serves for the escape, the openings C and C′ will lead to the escape-pipe and will be much larger. They can even be replaced by cavities and the escape-pipe can be made to end opposite these cavities—that is to say, on the superposed table.

In case of distribution by oscillating valves, these valves must be secured to their axle with very little play and then mounted more carefully, so that they are not hindered in their movement in pressing unevenly on the glass of the cylinder, while in case of distribution by rotary valves the central opening through which the axle of these valves passes can be made a little larger, and thus have more play, without, however, changing the conditions of the distribution.

The form of the valve can be preserved. It can be made to traverse large and small openings and turn or oscillate between two glasses with the following changes: First, make one or both of the tables more or less conic-shaped and not flat, and then give the full surfaces of the valve the same form; second, give the superposed table a diameter less than that of the principal table and then make the exterior surface of the valve conic also, and not cylindrical; third, make the smallest panel of the superposed table a little larger than the corresponding panel of the glass and increase the section of the small openings of the valve on the side of the superposed table. All these variations have the result that the two bearings of the valve will not be entirely symmetrical, and they apparently present some advantages; but in reality none of these variations, as also the roller, which would distribute by its cylindrical surface, are as good as the valve turning or oscillating between the two flat surfaces with entirely symmetrical edges, for all the advantages of the other variations are insignificant, their defects more or less serious, and they cannot be kept so tight.

The springs can be mounted on the side of the table of the cylinder. There will then be on this side, first, a table presenting the necessary ports for the circulation of the steam, (the openings will be a little rounded and will present a section a little larger than the table illustrated in the drawings;) second, the springs placed on this table and having concavities of a size at least equal to that of the ports; third, a plate similar to the one shown in E E in Fig. 6, placed on springs and presenting on top the edges given by the drawings to form the table of the cylinder. On the side of the superposed table there will be but one plate presenting cavities opposite the openings of the table, and it is on top of this plate that the screws will apply (arrangement of Fig. 9) of the threaded plate (arrangement of Fig. 6) for the regulation of the pressure exercised in the valve.

As I have said before, the superposed table can be arranged in several ways—as, for example, according to the following arrangements:

First. All the springs can be made solid one with another, so as to form a single plate presenting its cavities on the side where the steam tends to escape.

Second. The sides of these same springs can be made inclined, so that the transverse section presents a sinuous line, so as to have thus a greater elasticity; but they must be placed in the cavities formed in one or the other plate in such a manner that the said sinuous sides press against the sides of the cavities, and that thus the pressure of the steam cannot deform them.

Third. The plate F F of Fig. 6 can be suppressed and the springs can be pressed directly by plate H H; but then the springs should be secured in plate F F in some manner.

Fourth. The metal springs can be replaced by rubber plate or asbestus or other analogous matter having the form of two concentric circles of different diameters united by a number of radial ribs equal to that of the partitions of the table. To hold this plate tight in its place between the two plates, grooves must be formed in one of these plates of the same form, in which the elastic plate would enter to a great extent.

Fifth. The entire superposed table could be made of one single plate and held tight in its right place without any elasticity by taking another precaution to diminish the escapes or to prevent them at least all around, although these ways are the least advantageous.

Sixth. The interior of the box or casing of the valve, instead of being in constant communication with the exhaust, which is much more preferable, can also be tight and full of steam or oil. The pressure is much greater or even equal to that of the admission and the steam will try much more to enter in the openings than to escape, as that one would be obliged to turn the concavity of the springs g and g, Figs. 6 and 9, to the side from where the steam comes, which tries to escape or even make the springs double, presenting concavities on the outside as well as on the inside. The full plate F F should not exercise but a feeble pressure on the springs, and it would therefore be necessary to retain this plate stationary in its right place.

The distributing-drum, which I have explained above, is formed of a single piece. It can, however, be constructed of several pieces, so that the size of the passages can vary and thus change the conditions of the distribution.

The manner of construction of this sectional valve varies with the form and mode of the movement of this distributer. Thus in the case of distribution by a rotary valve with two large openings this distributer may be formed of two pieces placed in the form of a cross surrounded by a circle and mounted on two axles, of which the one is full and the other is hollow or the sections may be secured together exteriorly. In changing the relative positions of these two pieces the size of the two large passages will evidently be changed, and one could thus change the end as well of the admission as of the emission, while still maintaining the proper lead.

The manner of change of working effected by the machine is much inferior to that of the changing of the angle of the level of the entire valve by the helicoidal handle, of which I will speak farther on. One can distribute by one, two, or four distributing-valves, independent one from another, in one single cylinder or by two superposed valves. In the last case these distributers will then be separated by a special table bearing on its two sides the openings and the cavities necessary to serve at the same time as superposed table for the lower drum and as table for the upper valve or expansion-valve. The admission-pipe will end above the expansion-valve, while the escape-pipe will end on the table of the cylinder. On the other hand, the distribution can be made in two cylinders placed in tandem or compound with one single valve having three large equal and six small openings, equal also, and actuated at a speed one-third that of the main shaft. The two cylinders can be side by side, end to end, or in any other position. The distributer can be placed between the two cylinders or on one, or in preference on the large one. In all these cases the table will present six lights or openings. They are, first, an opening serving for the admission of steam; second, two openings placed on the two sides of the admission-opening and conducting to the true bottoms of the admitting-cylinders; third, two openings placed beside the opening of the admitting-cylinder and leading to the two ends of the expansion-cylinder; fourth, an opening placed between the two openings of the expansion-cylinder and leading to the escape. Opposite each of these openings there will be a corresponding cavity in the superposed table. Two special pipes will conduct the steam from the openings destined to conduct the steam to the admitting-cylinder to the two ends of the cylinder. These pipes constitute dead-spaces and the counter-pressure must be regulated so that there will be no loss.

The distributing-valve can be made with three large and six small openings, and it can be given a speed one-third that of the main shaft, at the same time distributing in a single cylinder and on one table with four openings by making larger either the admission-opening or that of the escape and diminishing the other three. A distributing-valve can be had with a speed one-fourth that of the main shaft by making this distributer with four large and eight small openings, increasing at the same time the admission-opening and that of the escape and in diminishing the two openings for the admission in the two ends of the cylinder or in changing the proportion between the diverse openings of the table.

The distributing-valves can as well be placed on the ends of the cylinders as in the lateral side and in plans or positions differing greatly, according to the conditions of the application.

The movement of the drum being rotatory and uniform and the different modes of the transmission of this movement presenting nothing new, there is hardly anything special to be indicated, if it is not the reversing of the machine and the change of the expansion by helicoidal handle. I will, however, say that the rotatory movement can be transmitted to all the distributers by means of a single transmission from the main shaft to the said drums.

I claim as my invention—

1. In an apparatus for distributing steam or motor fluids in machines, the combination, with the cylinder, of two flat circular symmetrical tables, and a distributing-valve placed between the tables, provided on the side next the cylinder with suitable ports for the circulation of steam and having on the other side a cavity with symmetrical edges opposite each port, said valve being provided with passages which, in connection with the cavities, give direct and indirect communication of the sections for the passage of steam, substantially as described.

2. In the herein-described apparatus, the table comprising the cast plate E and full plate F, and the metallic springs formed of plates of spring metal arranged between said plates E and F, said springs being dished and adapted when subjected to steam-pressure to bear against the upper surface of the cast plate E, said cast plate being provided with suitable openings and the springs being arranged to surround said openings from above, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

SPIRIDION PSAROUDAKI.

Witnesses:
ROBT. M. HOOPER,
JOSEPH COWENIER.