

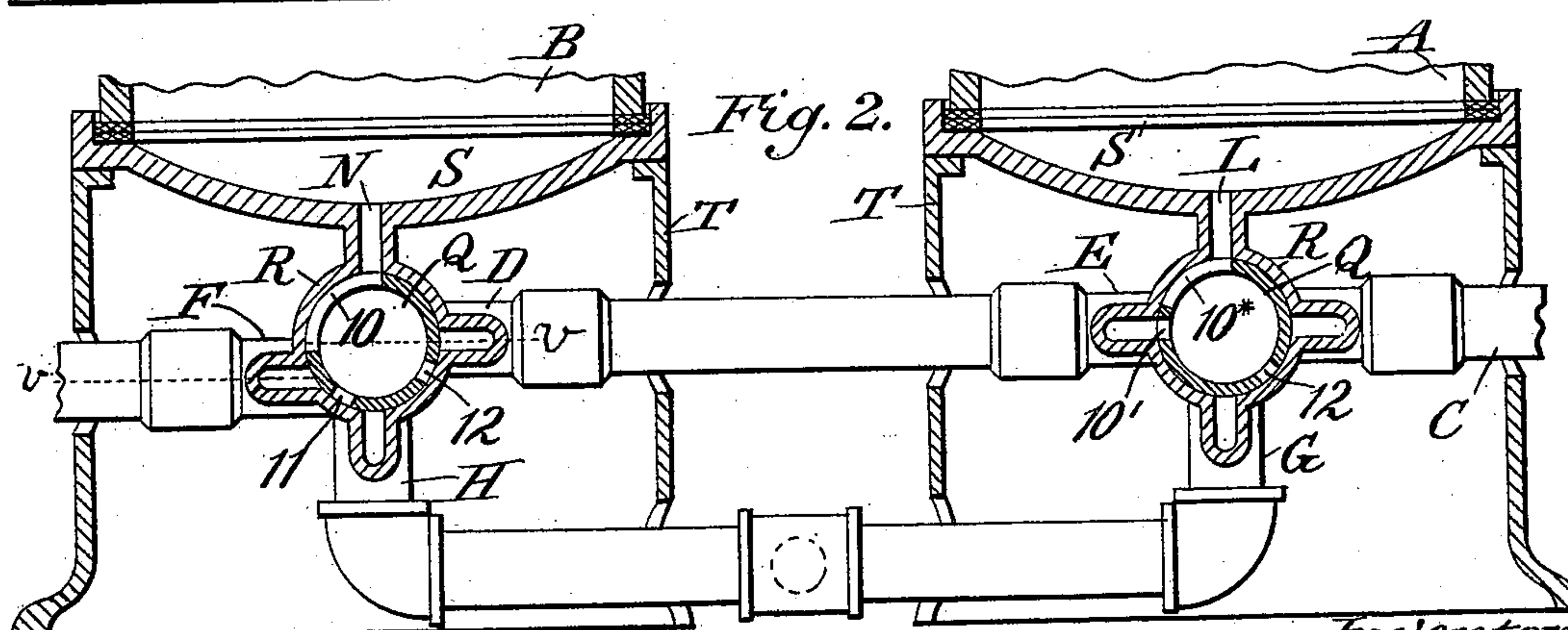
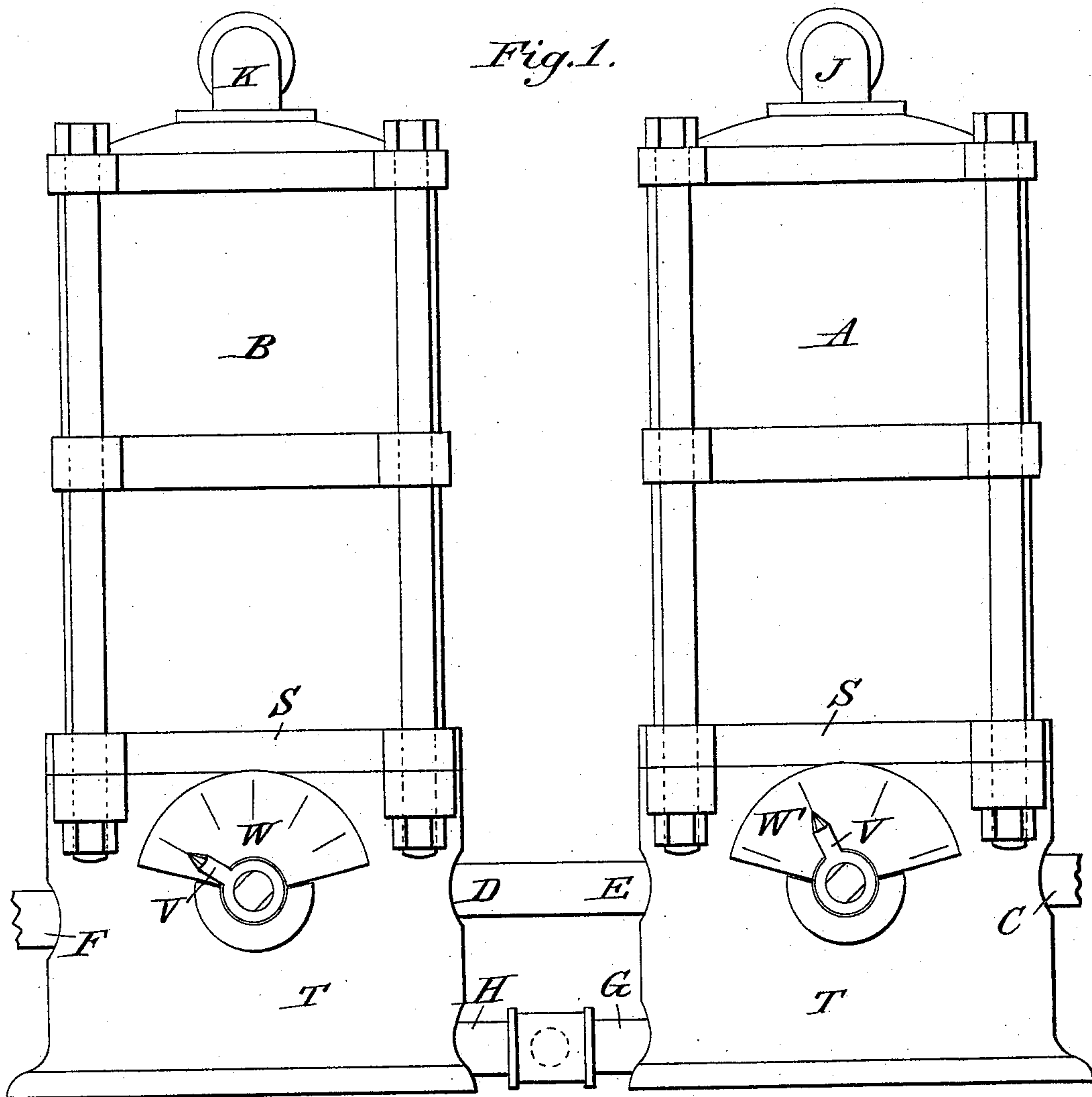
(No Model.)

4 Sheets—Sheet 1.

J. T. MANNING.
VALVE APPARATUS FOR FILTERS.

No. 594,639.

Patented Nov. 30, 1897.



Attest:
H. B. Schott
Walter W. Johnson

Inventor
Joseph T. Manning
by Chas. J. Hedrick
his attorney

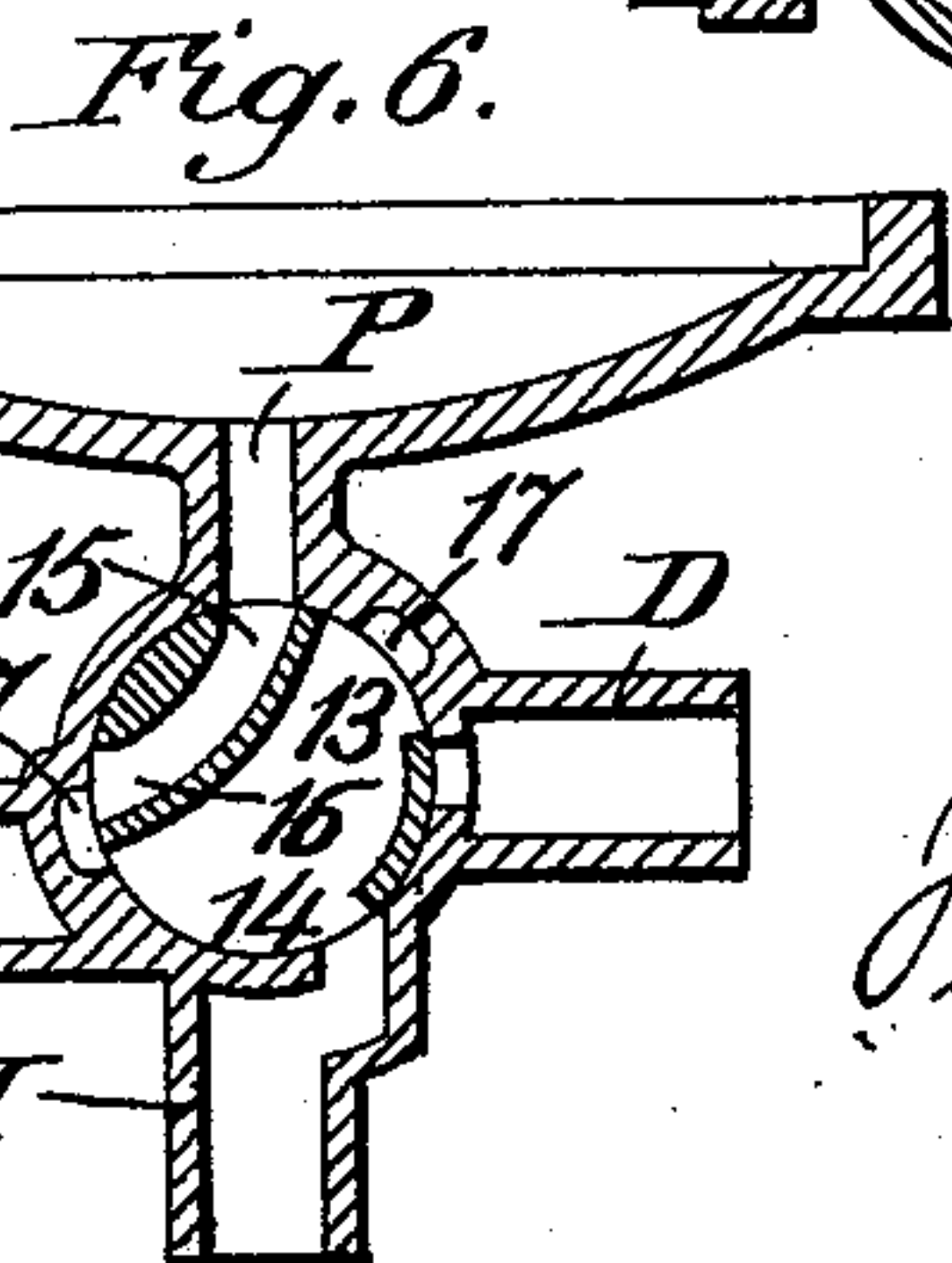
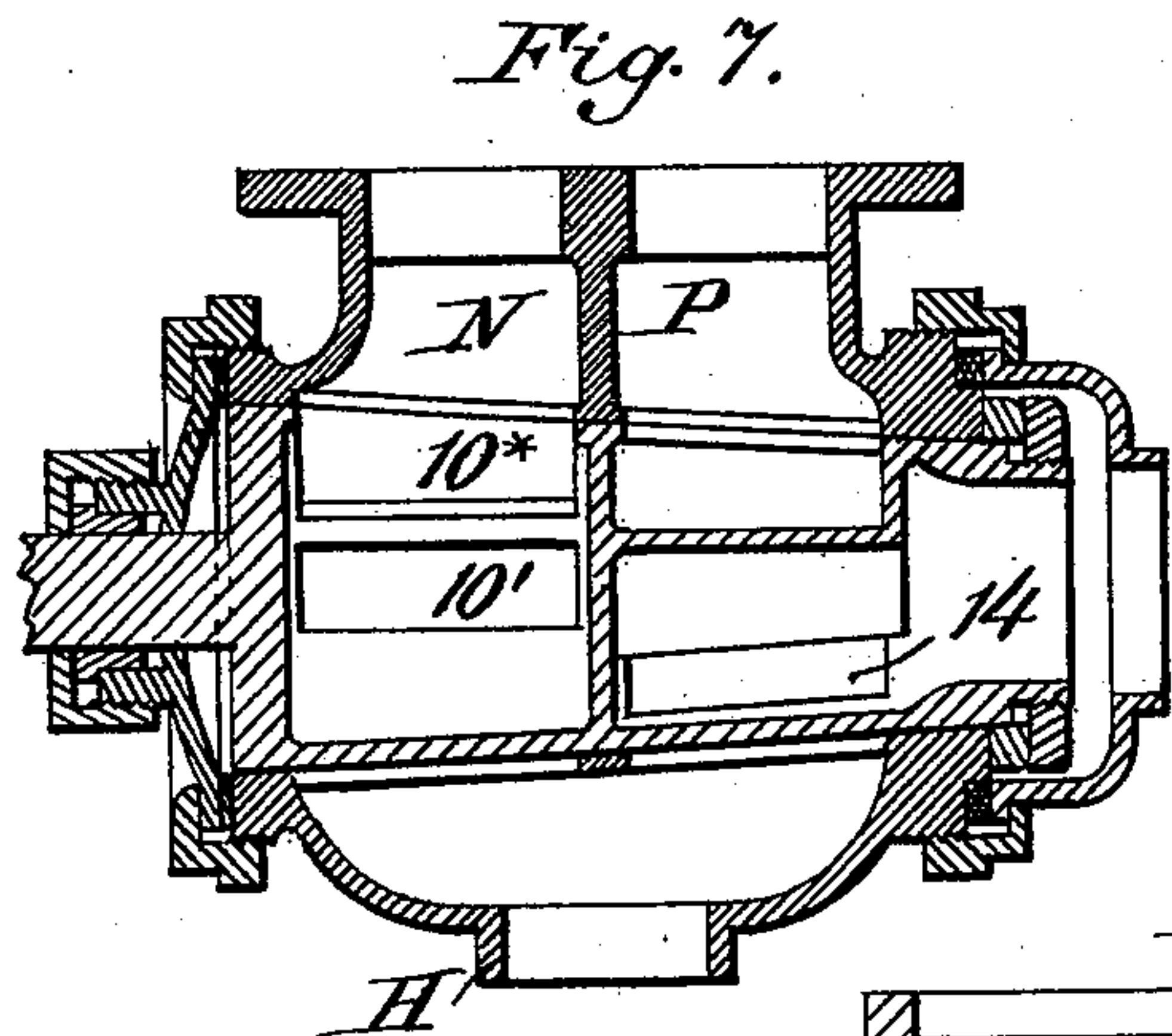
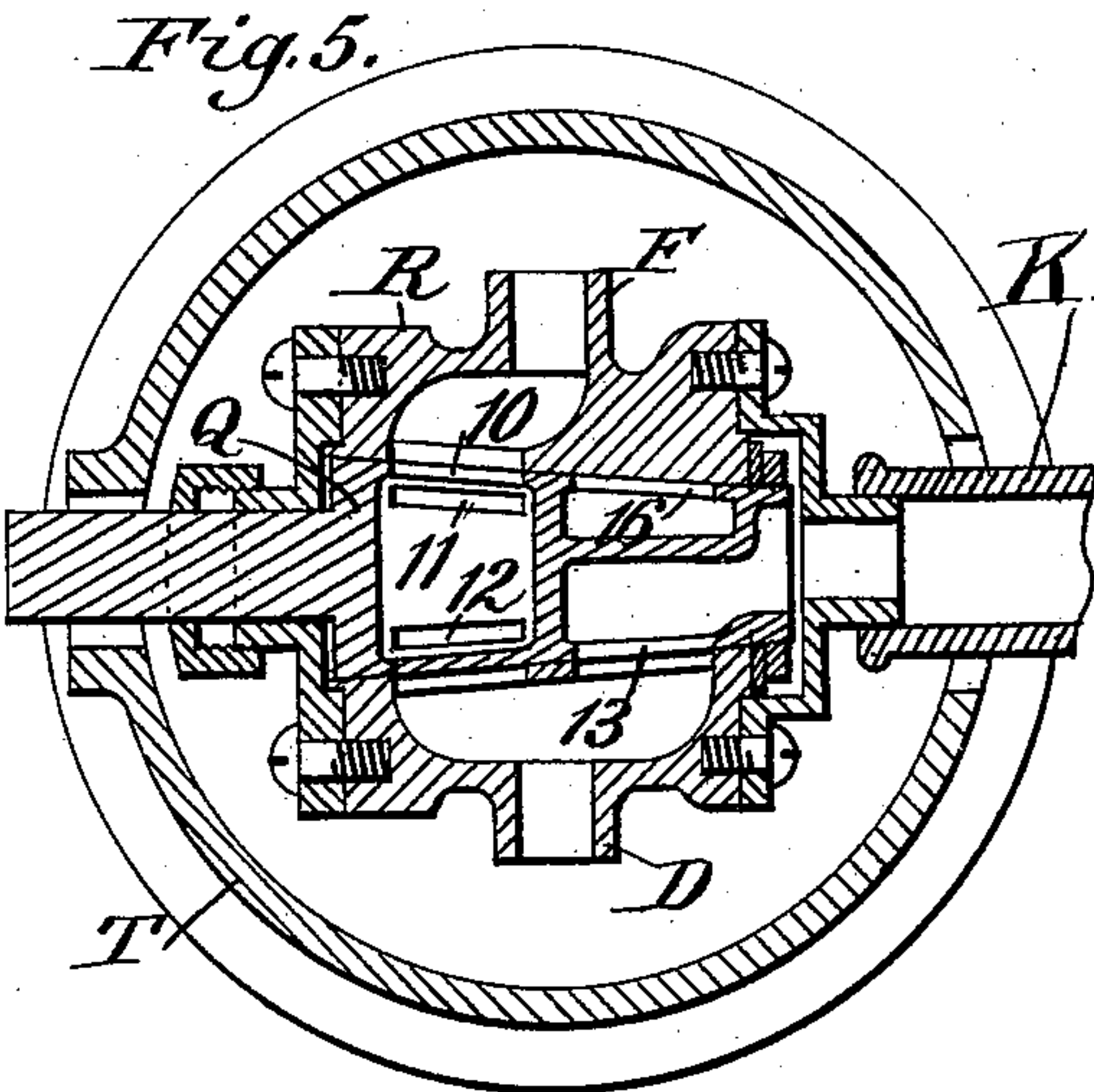
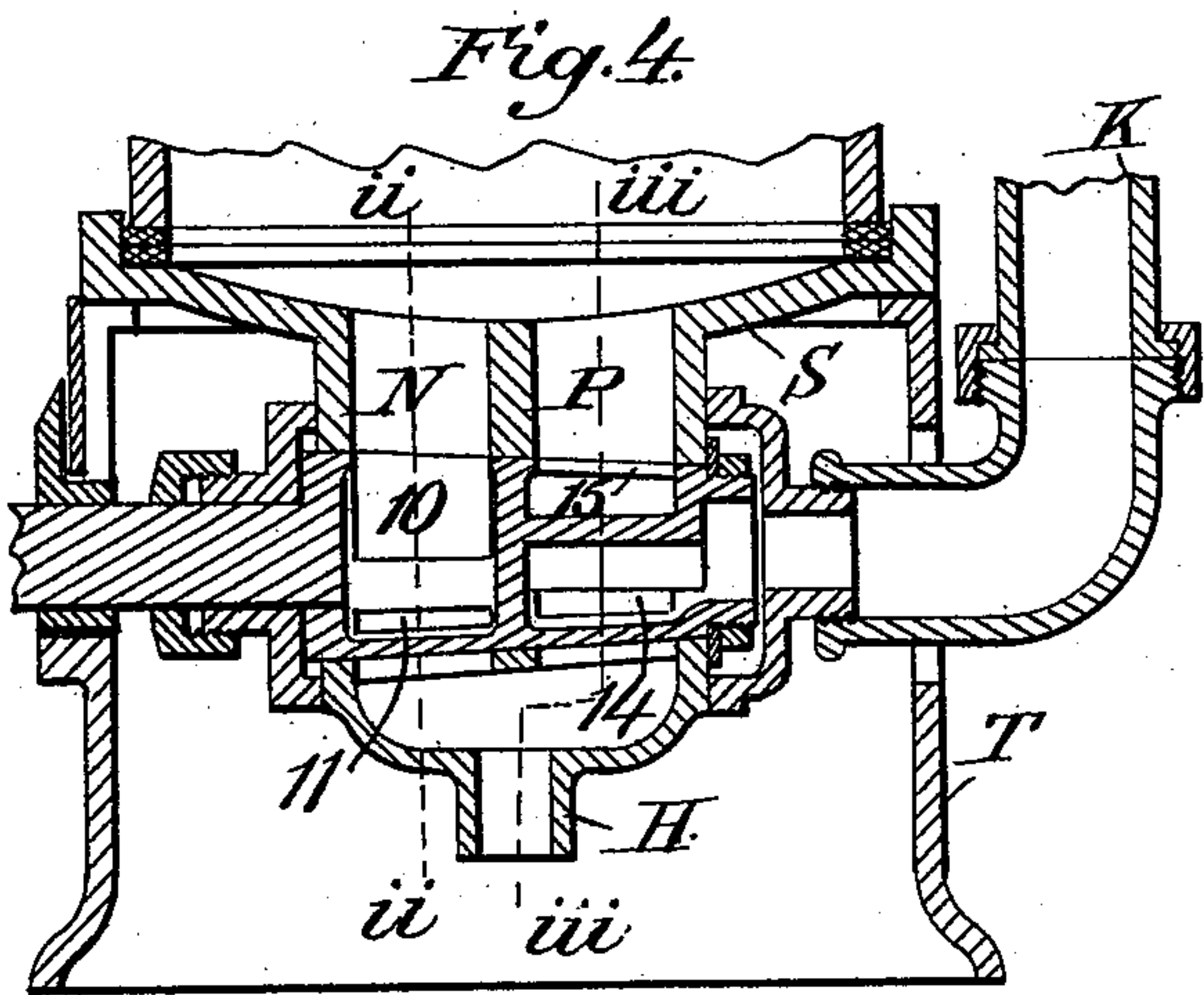
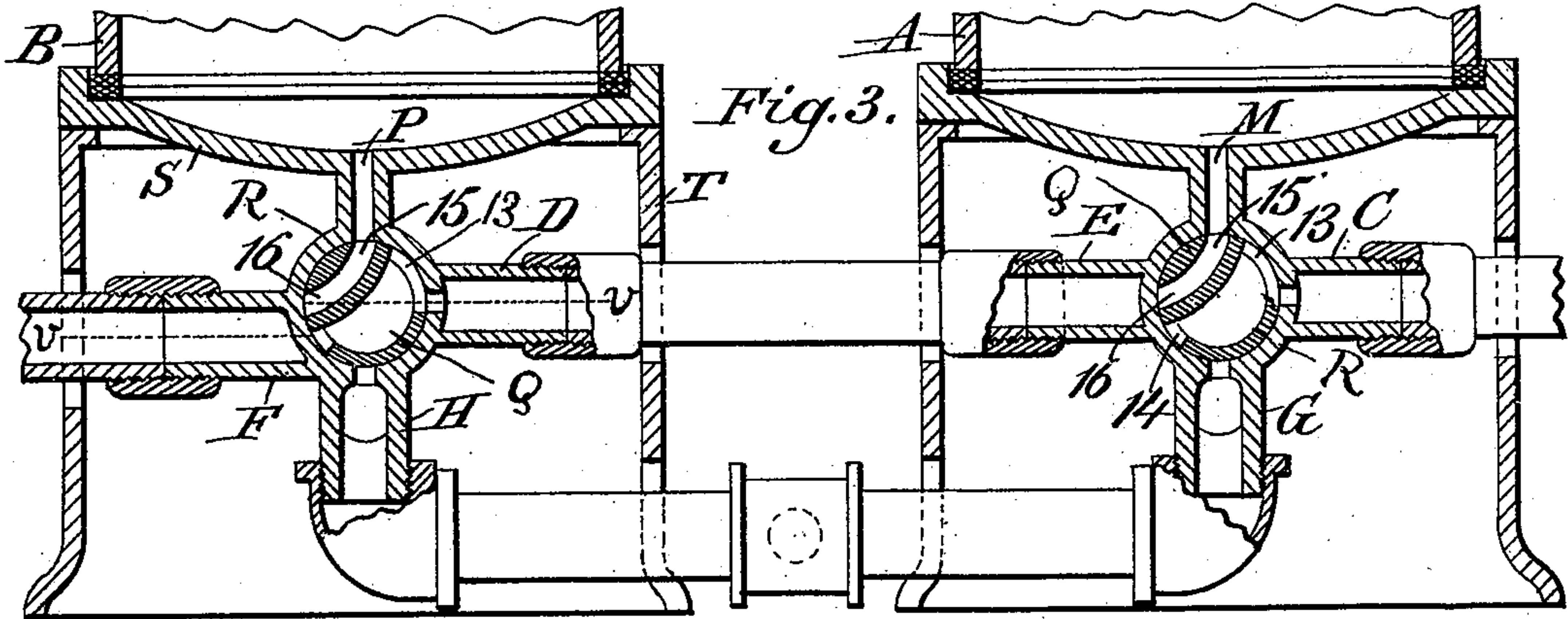
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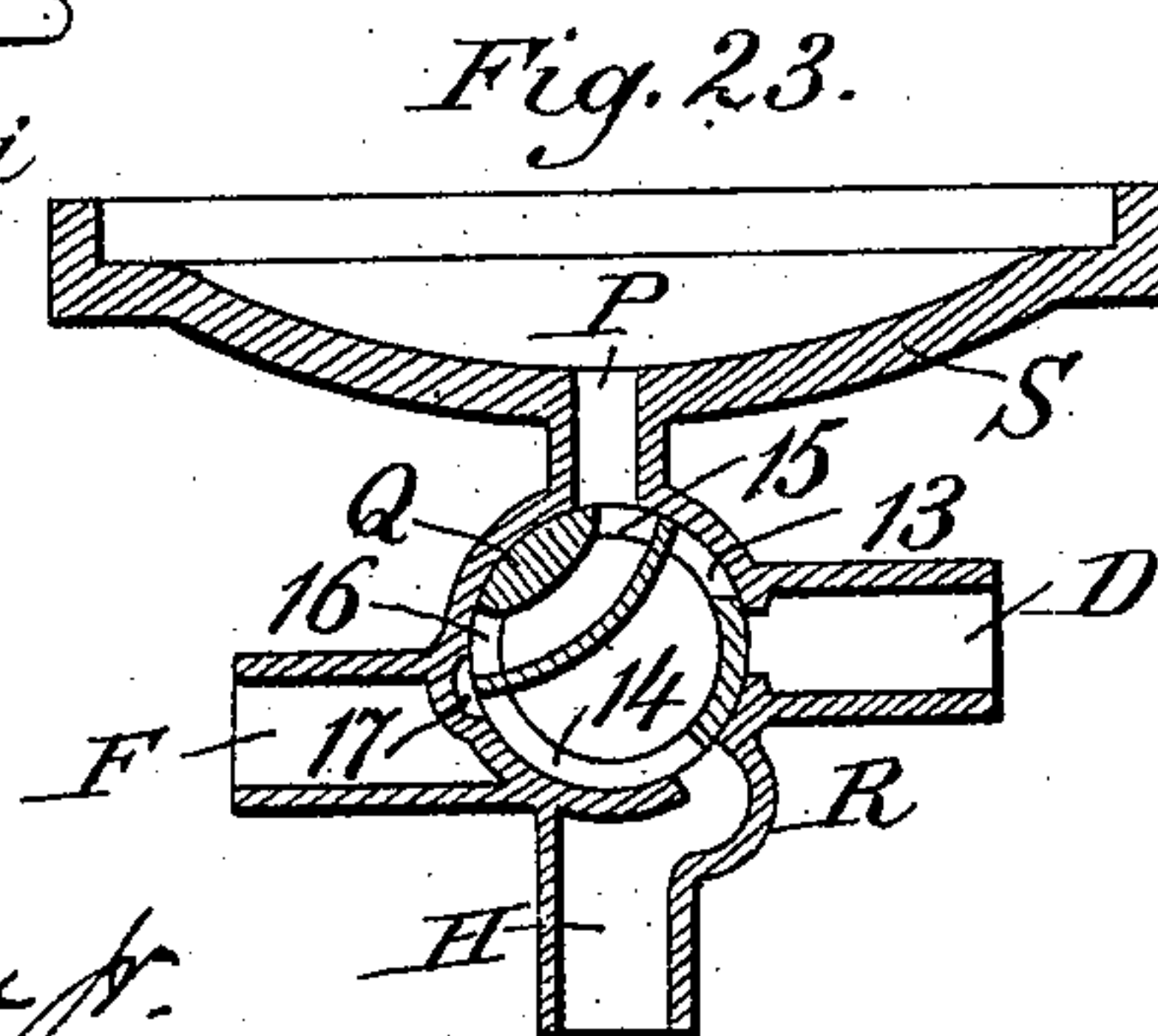
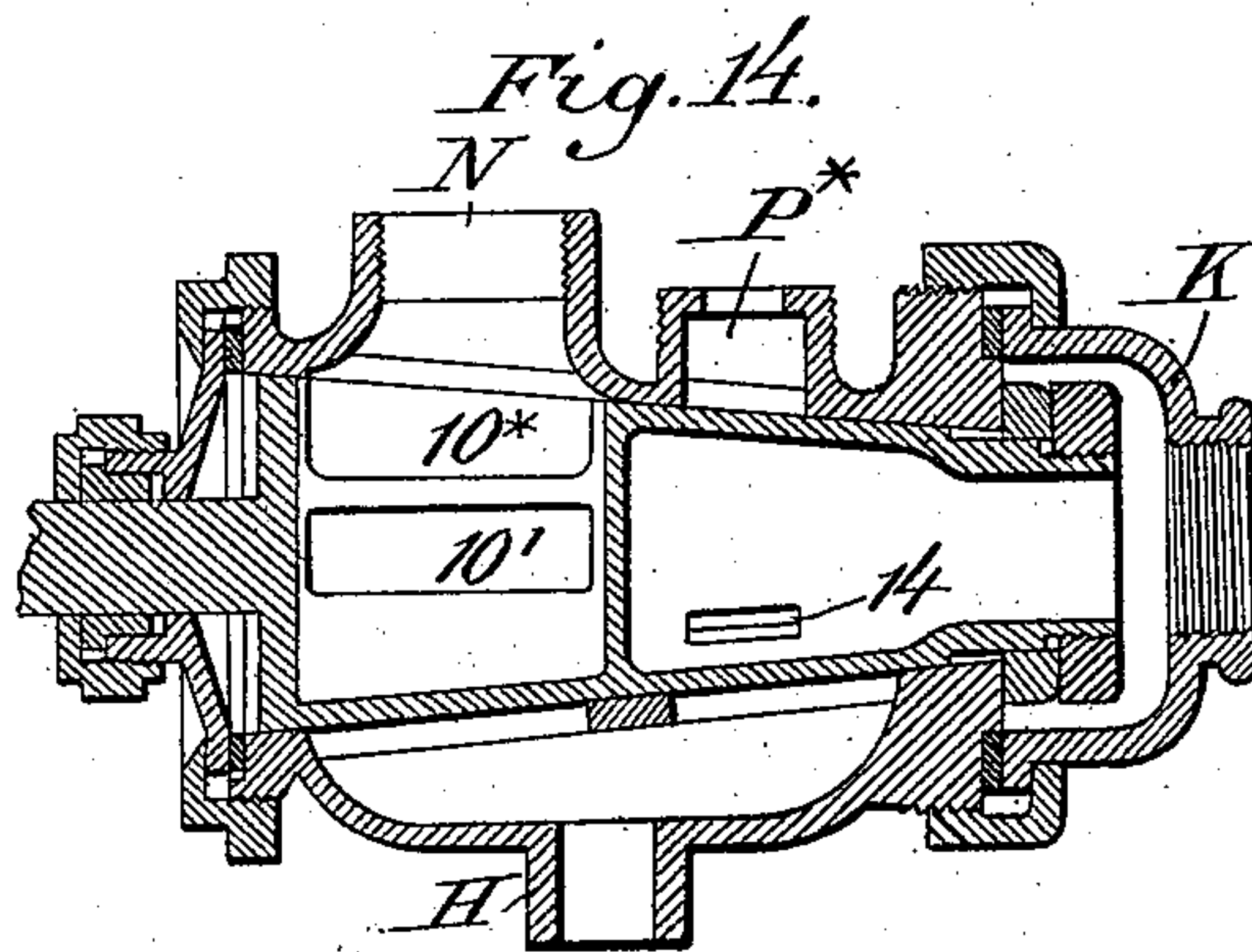
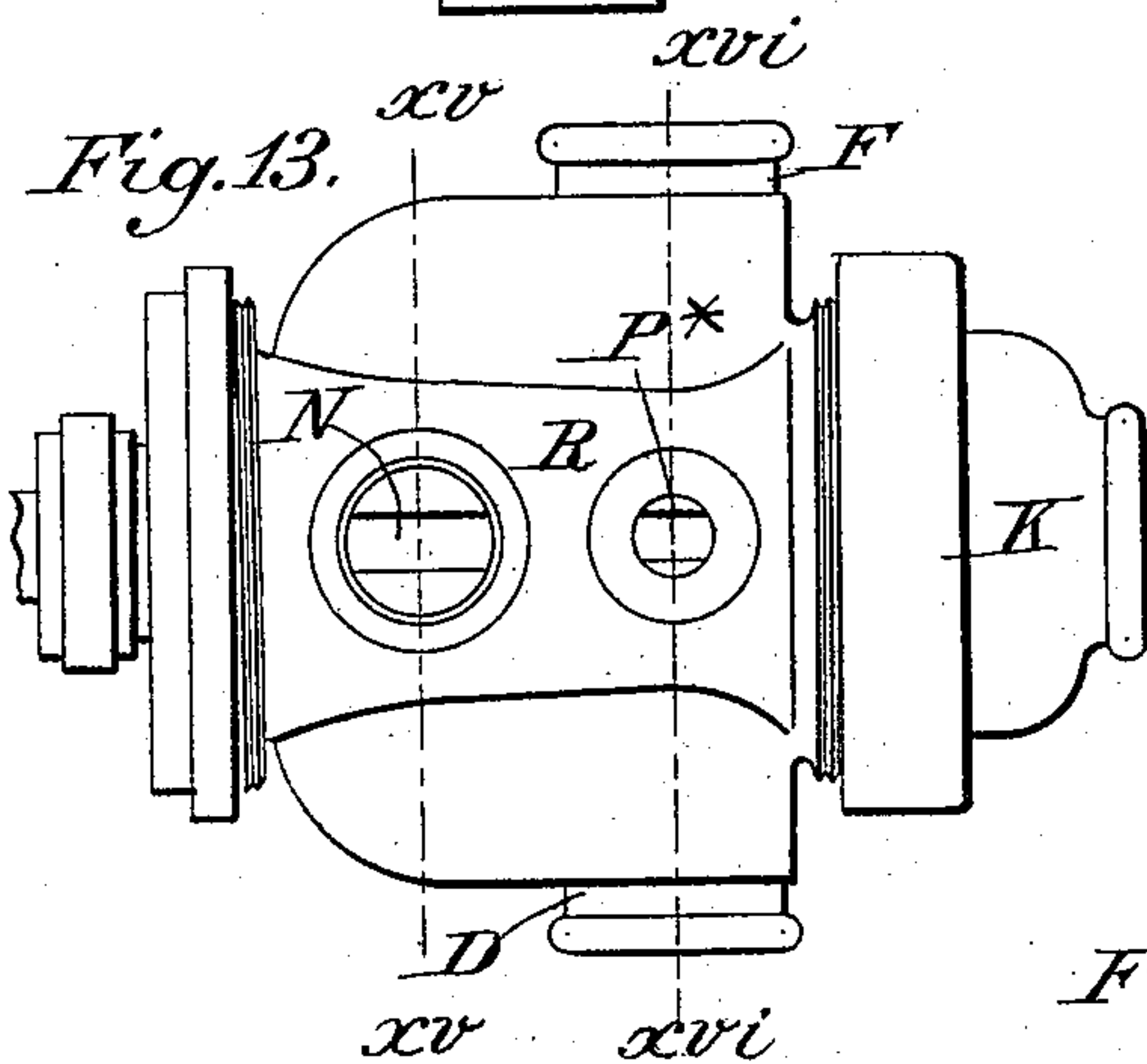
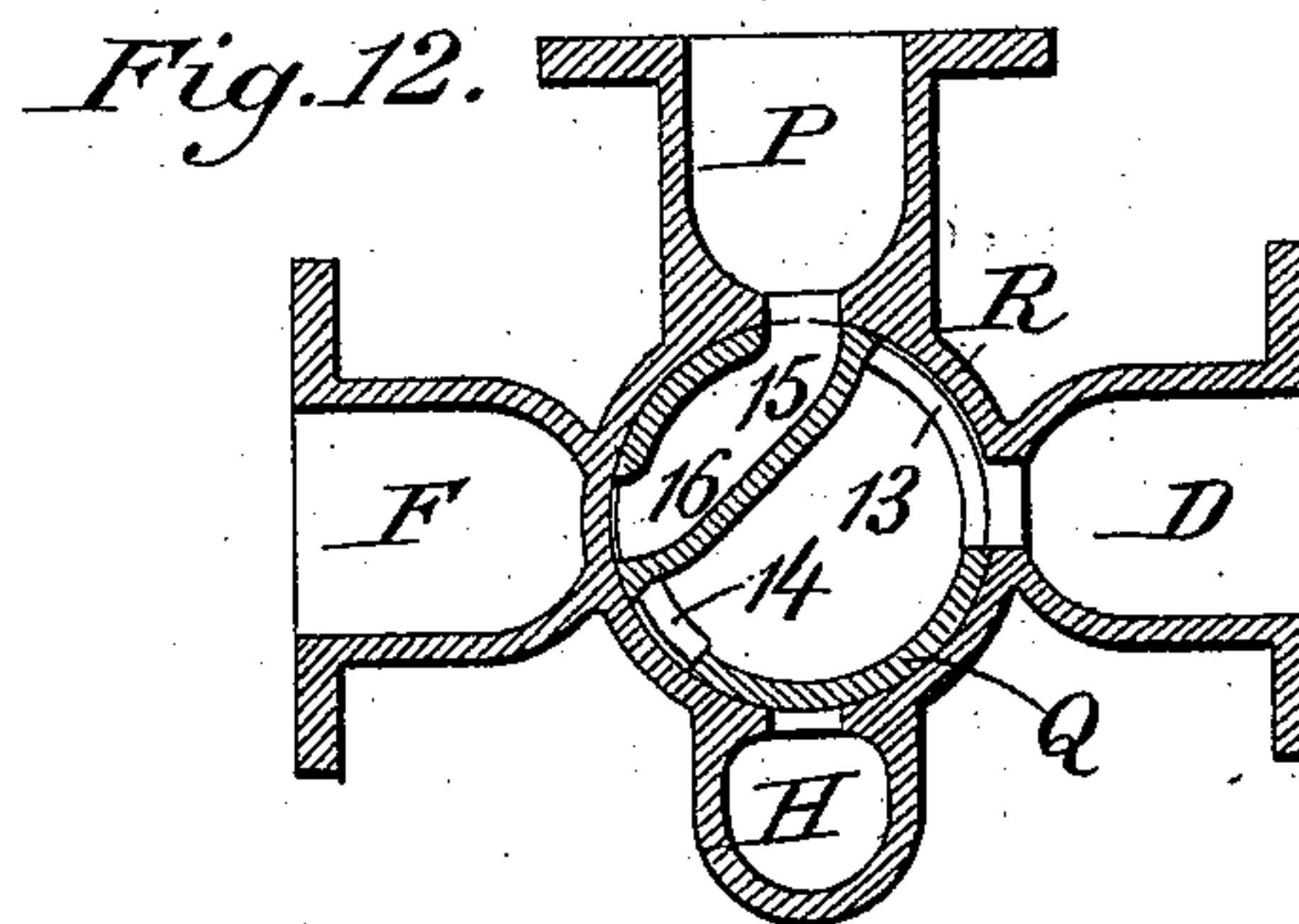
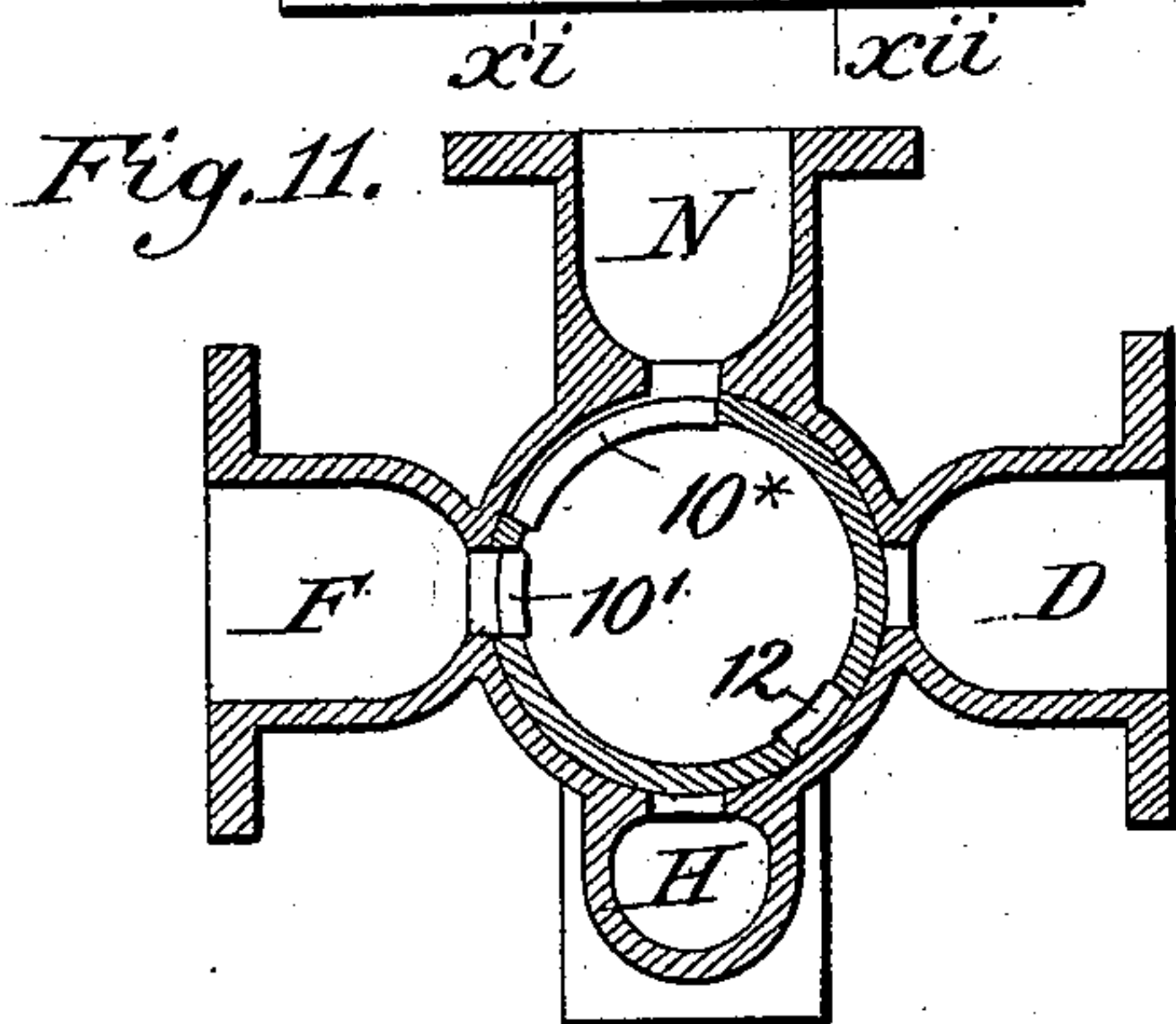
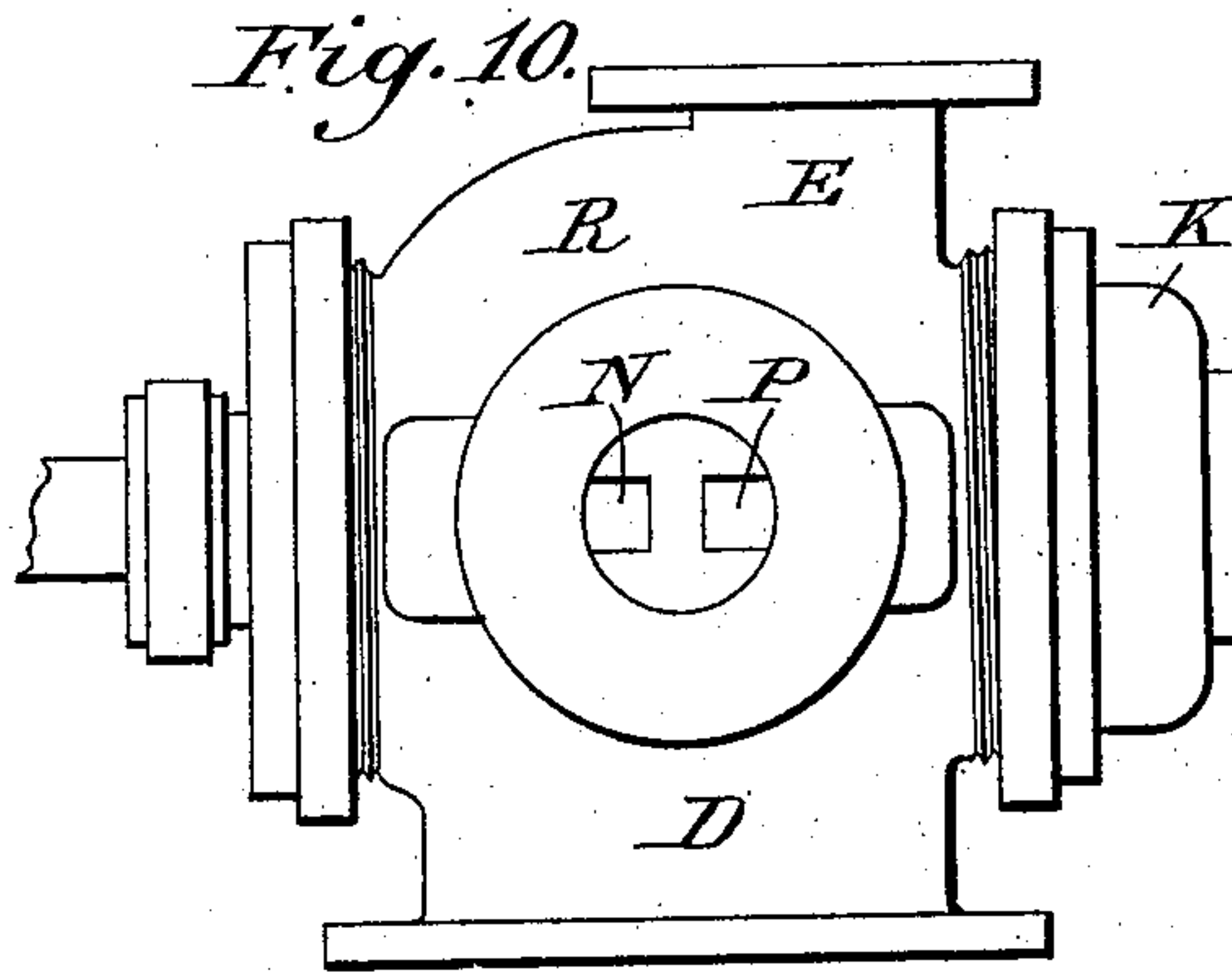
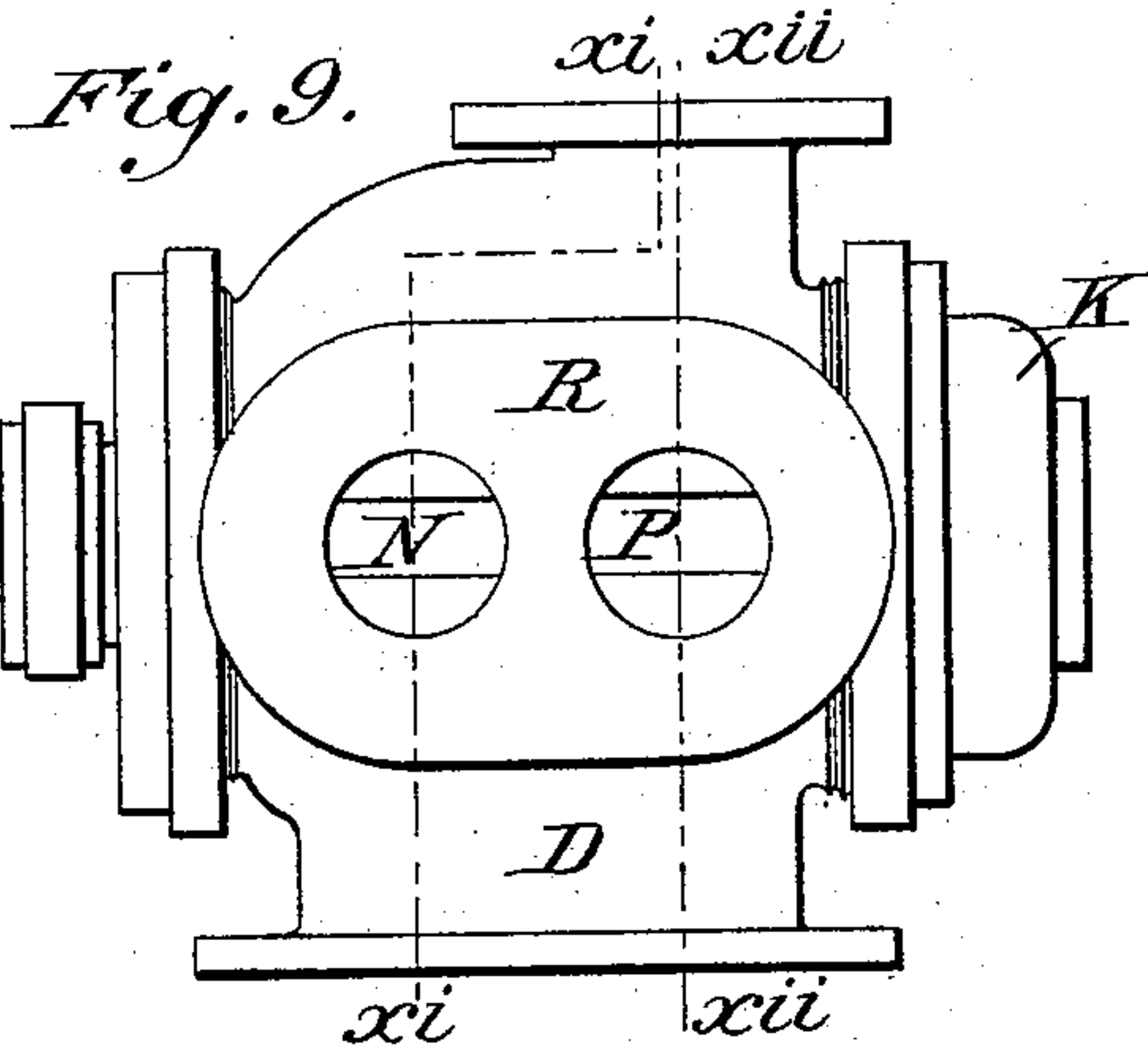
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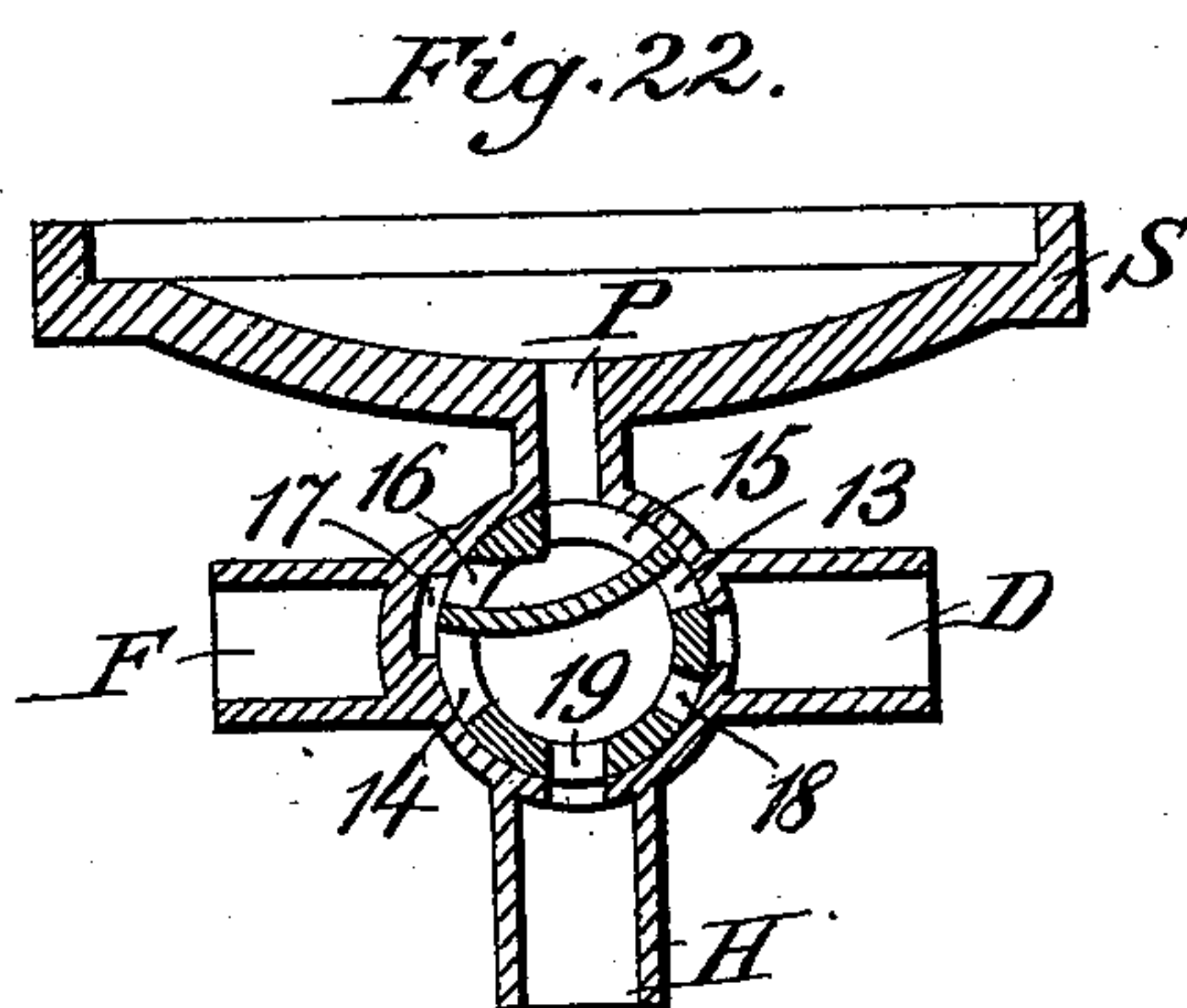
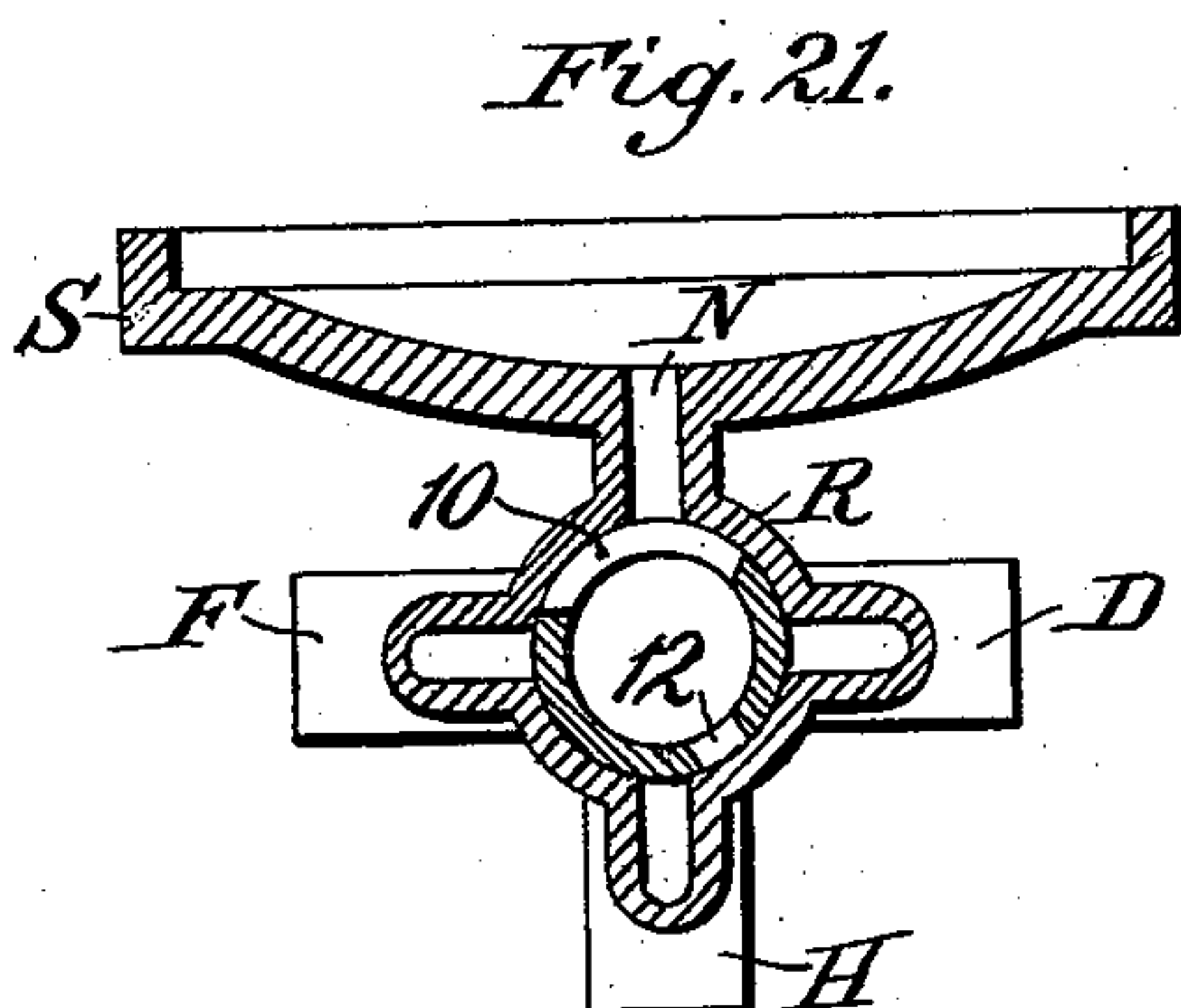
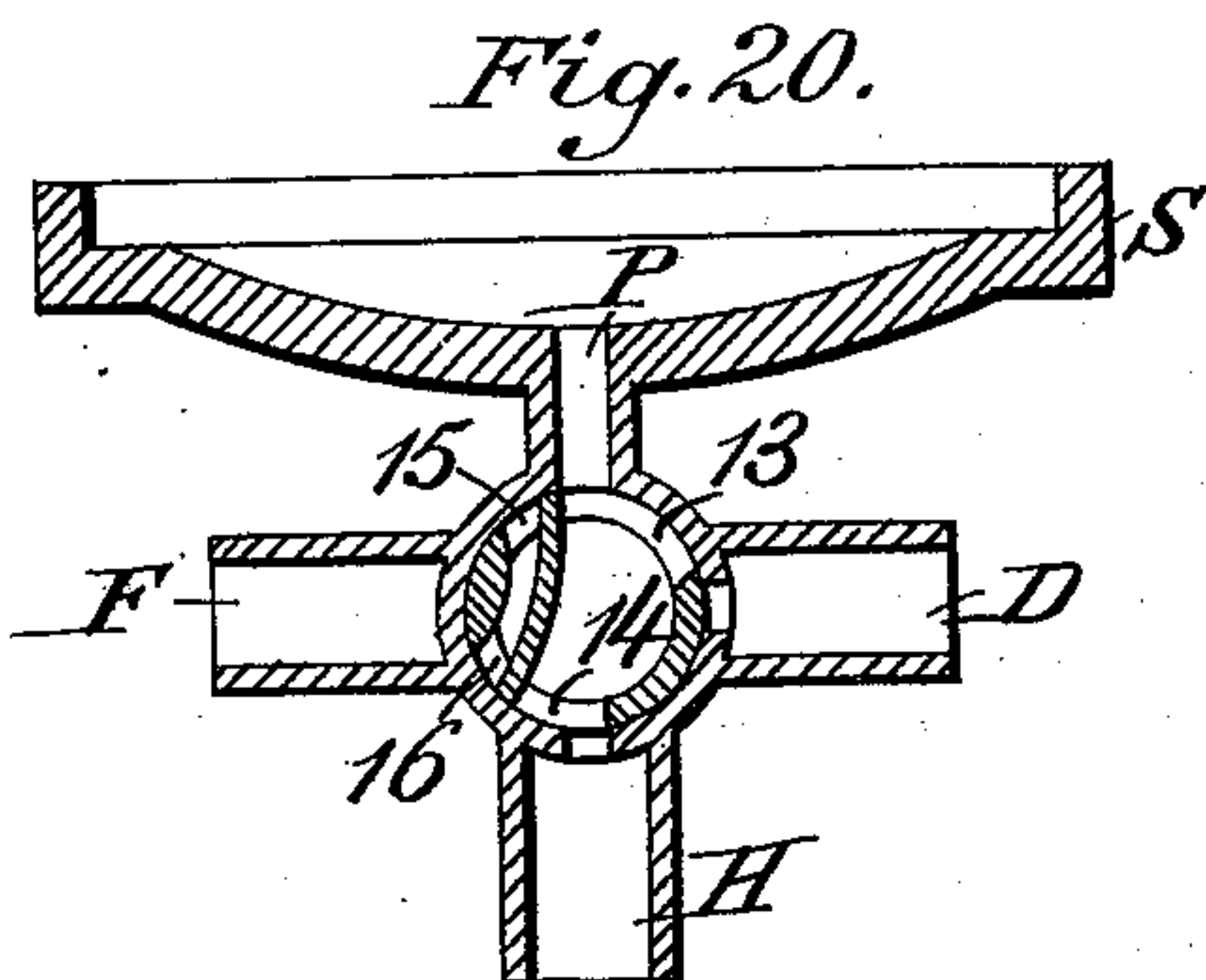
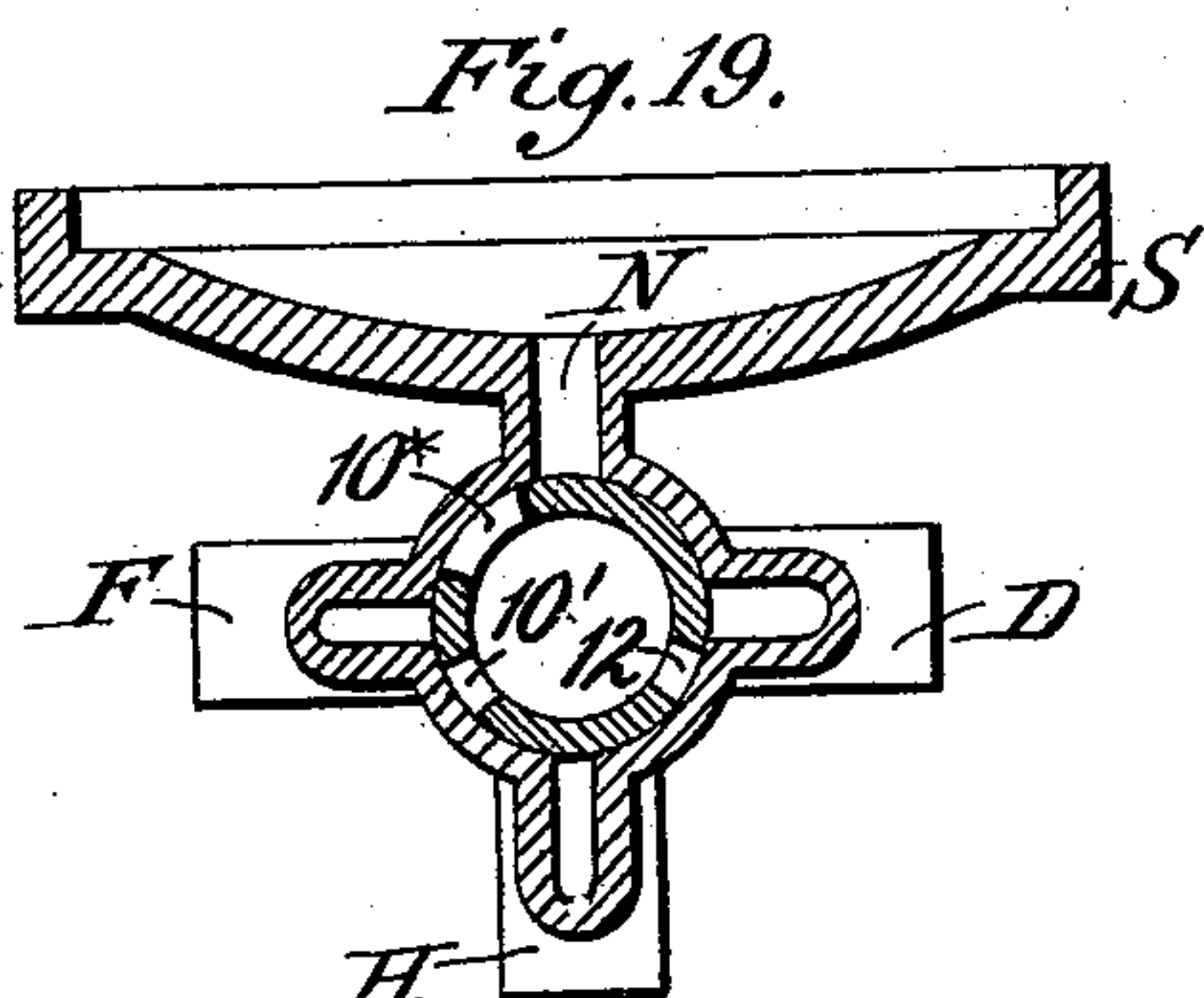
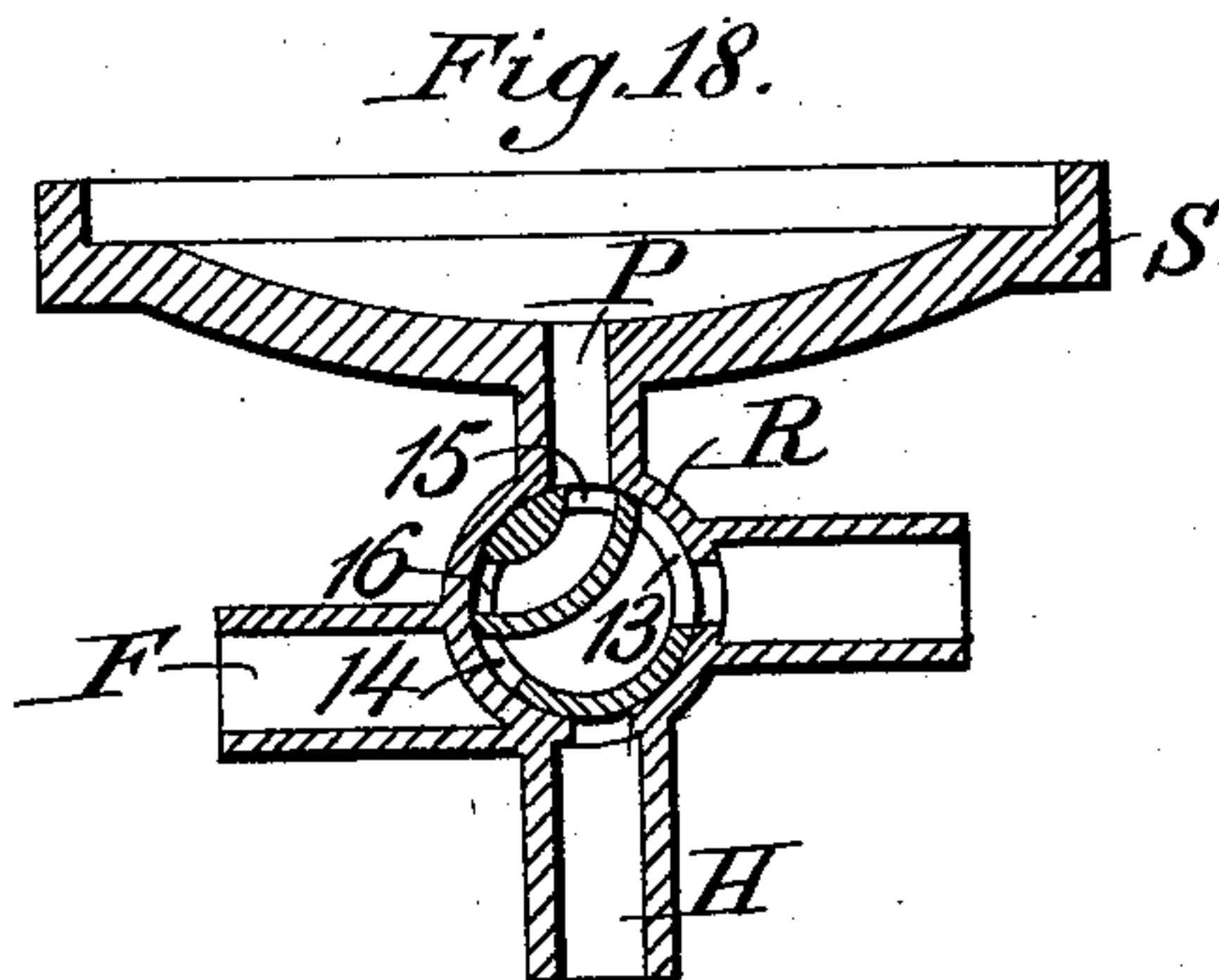
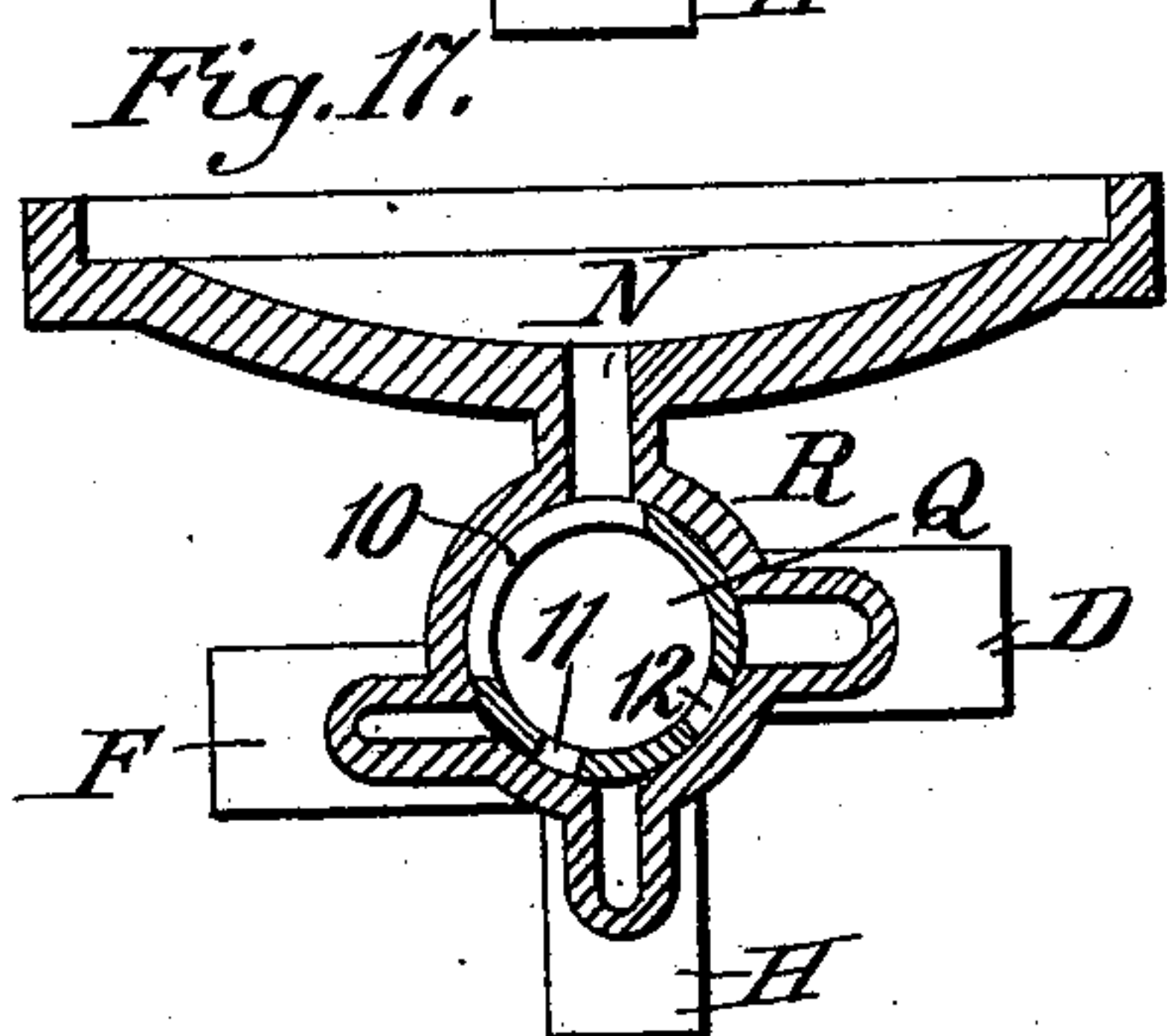
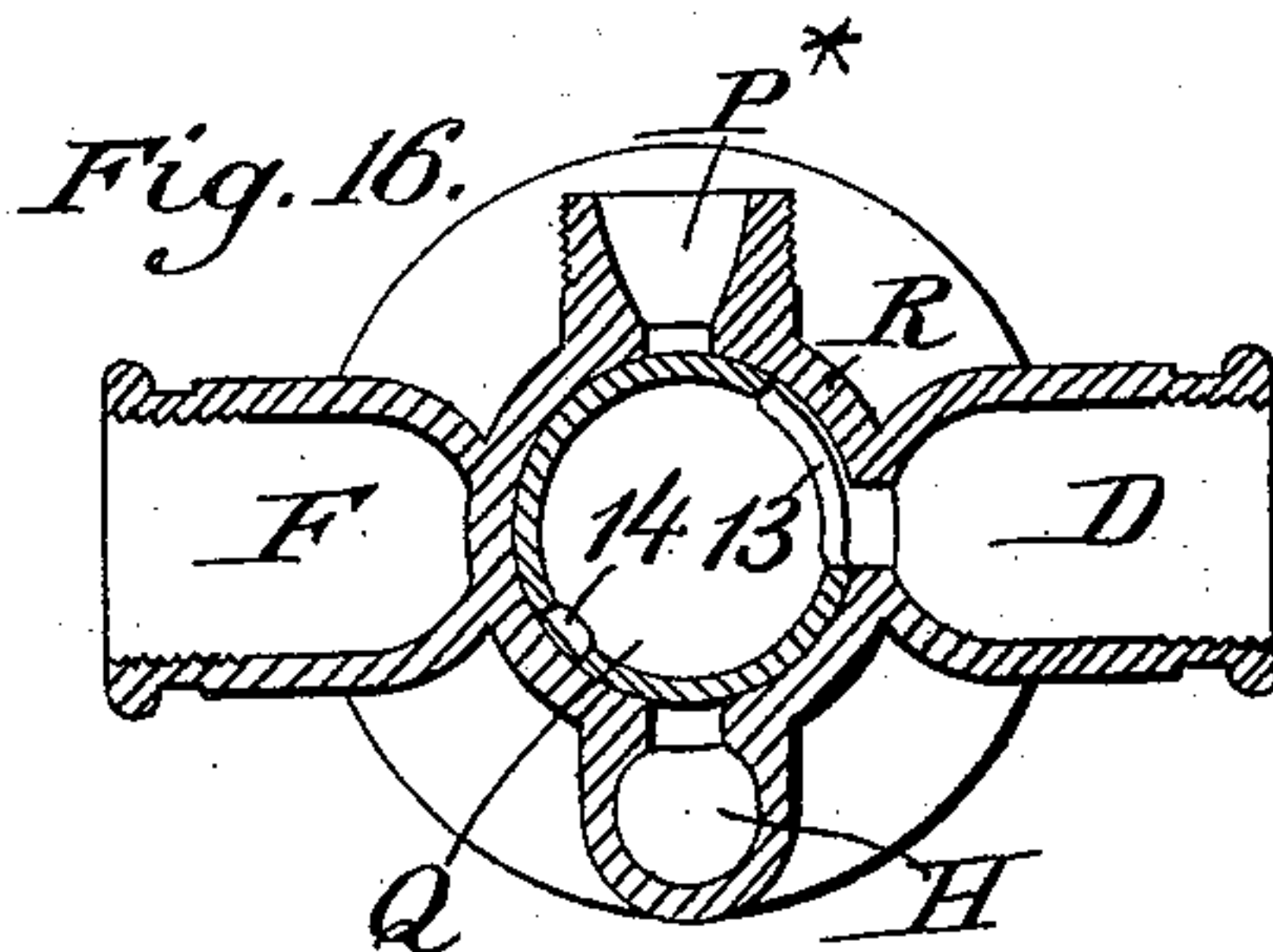
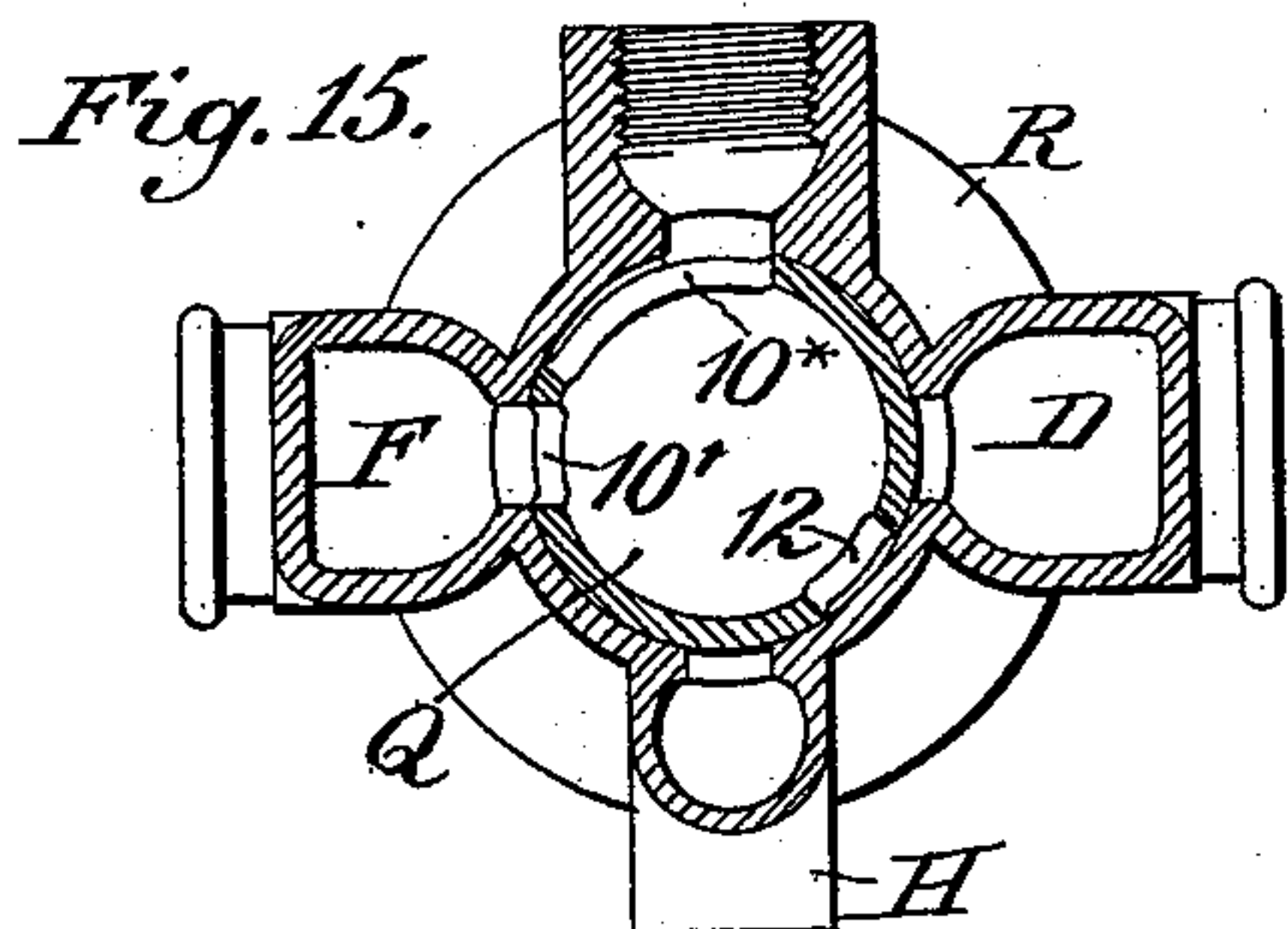
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UNITED STATES PATENT OFFICE.

JOSEPH T. MANNING, OF PHILADELPHIA, PENNSYLVANIA.

VALVE APPARATUS FOR FILTERS.

SPECIFICATION forming part of Letters Patent No. 594,639, dated November 30, 1897.

Application filed October 21, 1896. Serial No. 609,466. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH T. MANNING, a citizen of the United States of America, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Valve Apparatus for Filters; and I do hereby declare the following to be a full, clear, and exact description of the invention.

10 This invention relates more particularly to valve apparatus for filters in which the filter-bed is cleansed by reversing the current of water; but each of the improvements constituting the invention is intended to be secured
15 for all the uses to which it may be adapted.

In accordance with the first part of the present invention a valve apparatus placed below the filter is so arranged as that it may by a system of connected valves or ports not only
20 send the current through the filter in the filtering direction to a house-pipe or in the washing direction to a waste-pipe, according to its position, but that it can also be placed in a third position, in which it cuts off the current from
25 the filter and at the same time connects both the bottom of the filter-chamber and the upright pipe leading to the top of the filter with the waste-pipe, so that the water therein may drain off and leave the filter-chamber and the
30 said upright pipe empty. The emptying of the filter-chamber or of said chamber and upright pipe would be useful in order to make repairs and to prevent freezing and may be resorted to for other purposes.

35 In filters which are cleansed by reversal of current the portions of water which first pass in the filtering direction, after a reversal for washing, are apt to be dirty, and it is desirable, therefore, to send into the waste-pipe not
40 only the wash-water, as before mentioned, but also those portions of the water which have passed through the filter in the filtering direction under such conditions that they are impure. This can be effected by a suitable
45 adaptation of the above-specified valve apparatus, and the so-constructed apparatus constitutes a special improvement.

In accordance with the second part of the invention a valve apparatus placed below the
50 filter and arranged when in proper position to drain the water from the filter-chamber with or without draining it also from the up-

right pipe is further adapted to establish at the same time a direct (or, in other words, a by-pass) connection between the supply and
55 the house pipes for sending a current to house without passing through the filter and to establish in other positions connections through the filter between the supply-pipe and the house and waste pipes, respectively, for send-
60 ing a current through the filter in the filtering direction to house, in the filtering direction to waste, and in the washing direction to waste.

In accordance with the third part of the in-
65 vention a current-reversing-valve apparatus is provided with means for letting a larger stream pass through the filter for washing than for filtering. For washing a large flow is desirable for its great cleansing effect, and
70 it is obviously possible to get any desired stream by a corresponding increase in the size of the valve; but it is generally desirable to use as small a size of valve as practicable. By an arrangement of differential openings
75 a larger flow for washing can be obtained without increasing the size of the valve to a corresponding extent, if at all. The differential openings can be constituted by ports
80 of different diameters placed in the same circle, or wash-water ports can be formed in different circles, so as that two or more wash-water ports serve together, and thus make together an effective opening of enlarged section. The section of each wash-water port by
85 itself may be the same as the filtered-water port, or one or more of such duplicate wash-water ports may be when taken singly of larger or of smaller diameter than the filtered-water ports. This portion of the invention
90 extends to a current-reversing-valve apparatus with enlarged wash-water supply whether arranged or not to deliver the wash-water and the filtered water to a waste-pipe and a house-
95 pipe, respectively, but it specially covers such apparatus with a waste-pipe for the wash-water separate from the house-pipe. The apparatus may be with or without provision for delivering portions of the filtered water to waste or for forming a by-pass or for draining
100 the filter-chamber or filter-chamber and upright pipe, or for accomplishing two or more of these functions. The introduction of the means for increasing the wash-water supply

into such an apparatus need not necessarily increase the size which an otherwise similar valve apparatus would have without said means.

5 In accordance with the fourth part of the invention a valve apparatus placed below the filter and adapted to send the current through the filter in the filtering direction to the house-pipe and in the washing direction to
10 the waste-pipe and to drain the filter-chamber and an additional upright pipe when in a third position is also adapted to shut off the current from passing to the house-pipe, while at the same time it is shut off from passing
15 through the filter. This dead position may or may not be one in which the valve apparatus cuts off the supply-pipe altogether from the filter. It also may or may not be one in which it cuts off the supply from the filter
20 while establishing a waste-pipe connection whereby the filter-chamber or the filter-chamber and its upright pipe can be emptied. It is not considered essential to the usefulness or the novelty of this part of the invention
25 that there should be a by-pass valve in the apparatus, (although there may be,) nor that there should be a drainage of the filter-chamber and upright pipe in any position other than that in which the supply is cut off from
30 the house-pipe and the filter, nor that there should be the said drainage in this position if this is provided for in another position, nor that there should be provision for changing delivery of filtered water from house-pipe
35 to waste-pipe or the reverse; but these features may be used (one or more of them when desired) advantageously, and the combinations wherein one or more of them are employed in addition to the said current-reversing, filter and pipe draining, and cut-off valves
40 constitute special improvements.

The invention also consists in such other new parts, improvements, and combinations as may be hereinafter set forth.

45 In the accompanying drawings, which form part of this specification, Figure 1 is a front elevation of two connected filters, each with its own valve apparatus. Figs. 2 and 3 are vertical sections of said valve apparatus and
50 a part of the said filters, the sections corresponding, respectively, with lines *ii* and *iii* on Fig. 4. Fig. 4 is a vertical longitudinal section of the valve apparatus at the left of Figs. 1, 2, and 3. Fig. 5 is a horizontal section on line *v*, Figs. 2 and 3, of the same valve
55 apparatus. Fig. 6 is a section corresponding with Fig. 3, showing a somewhat different arrangement of the rear ports. Figs. 7 and 8 are vertical longitudinal sections of somewhat
60 different forms of valve apparatus. Figs. 9 and 10 are plan views of the valve apparatus of Figs. 7 and 8, respectively. Figs. 11 and 12 are vertical cross-sections on lines *xi* and *xii* of the valve apparatus of Figs. 7 and 9.
65 Figs. 13 and 14 are respectively a plan and a vertical longitudinal section of another form of valve apparatus. Figs. 15 and 16 are cross-

sections of this last form of valve on lines *xv* and *xvi*, respectively. Figs. 17 and 18, 19 and 20, and 21 and 22 are cross-sections similar
70 to those of Figs. 2 and 3 of still other forms of valve apparatus; and Fig. 23 is a cross-section similar to Fig. 18, showing another arrangement of rear ports.

The connection of filters, as shown, and all
75 the valve apparatus shown are in accordance with the invention or with parts thereof.

A and B are the filter-chambers, which each contain a filter-bed adapted to filter a downward current of water and to be cleansed by
80 an upward current and are each provided with a valve apparatus. The water enters the respective valve apparatus by the supply-pipe C or D and is directed to the top or bottom of the filter or otherwise according to the
85 position of said valve apparatus. It escapes by the house-pipe E or F or by the waste-pipe G or H. The upright pipe J or K is interposed between the top of the corresponding filter-chamber and the valve apparatus which
90 is placed below the filter-chamber, so that this may be emptied through the valve. The passages L M and N P connect with the bottom of the filter-chamber.

Referring first to the valve apparatus shown
95 at the left of Figs. 1, 2, and 3, the key Q turns in the casing R, which is provided with an end port, Figs. 4 and 5, and two circles of stationary ports, the front circle being shown in Fig. 2 and the rear circle in Fig. 3. The
100 supply-pipe D terminates (see Fig. 5) in a stationary port in each circle. The upright pipe opens in the rear end of the casing. The passages N P, which open into the bottom of the filter-chamber, (see Fig. 4,) terminate in a stationary port in each circle.
105 The house-pipe F terminates in a stationary port in the front circle, and the waste-pipe H terminates in a port in each circle. (See Fig. 4.) In the key Q, as shown, there
110 are in the front circle in the wall of the central chamber a quadruple port 10 and two single ports 11 and 12, and in the rear circle in the wall of the central chamber there are a triple port 13 and a single port 14. The
115 two central chambers are cut off from each other, as shown in Fig. 4. At the rear of the key there is a side passage which is cut off from the rear chamber and which terminates in the single ports 15 and 16. On turning the
120 key to the right from the position shown, so that the front key-port 11 registers with the end of house-pipe F, the water from the pipe D will pass through the rear key-port 13 and upright pipe K to the top of the filter-chamber B, will descend through the filter-bed, and will pass by the passage N and the key-ports
125 10 and 11 into the house-pipe F. To reverse the circuit for washing, the key Q is turned farther to the right, so as to put the supply-pipe D into communication with the passage N through the key-port 10 and the upright pipe K into communication with the waste-pipe H through the key-port 13. At the same time

the supply-pipe is also put into communication with the bottom of the filter through the key-ports 15 and 16 and the passage P. Thus the water from the pipe D passes into the bottom of the filter-chamber, ascends through the filter-bed, descends through the upright pipe K, and passes to waste by the rear key-port 13 and pipe H. If the passage P and the key-ports 15 and 16 were closed, the wash-water would still enter the filter-chamber by the passage N, and when the passage P and the key-ports 15 and 16 are used the wash-water would enter by them, although there might be no communication through the key between the supply-pipe D and the passage N. If, then, it is simply desired by a system of connected valves or ports to send the current through the filter B in the filtering direction to the house-pipe F, or in the washing direction to the waste-pipe H, the key Q and the casing R might be provided with a simpler arrangement of ports than is represented. In order to drain the filter-chamber, the key Q is turned still farther to the right, so that the rear key-port 14 is brought opposite the end of the passage P, the port 13 continuing to register with the end of the waste-pipe H. In this position the supply-pipe D is cut off from the passages N P and from the upright pipe K, and no water can enter the filter-chamber, but what was already therein can run to waste through the passage P and ports 14 and 13. With the arrangement shown the water can also drain off from the upright pipe K through the key-port 13, thus leaving both empty. Further, the front key-port 12 registers with the end of the house-pipe F in this filter-draining position, and thereby a by-pass is established from the supply-pipe D through the key-ports 10 and 12 to the house-pipe, while the passage N and front end of the waste-pipe H are stopped. By restoring the key Q, so that the key-port 11 registers with the end of the house-pipe F, the delivering of filtered water into the house-pipe will be resumed. The key Q could be so restored immediately after the filter-bed has been washed by the reversed current, but in that case the first portions of water which would be delivered into the house-pipe would be apt to be dirty. To avoid sending such portions into the house-pipe, the front part of key Q is provided with the port 12, which is so arranged that it registers with the front end of the waste-pipe H at a time when the port 10 opens the passage N, but not the supply-pipe D. In this position the supply-pipe D is in communication with the upright pipe K through the port 13, but the front end of the supply-pipe D, the rear end of the waste-pipe H, the house-pipe F, and the filter-passage P are stopped.

The side passage in the rear portion of the key Q between the ports 15 and 16 is provided in addition to the opening through the port 10 for the purpose of letting a large stream of wash-water into the filter. As

shown, the openings in the casing and in the key for the escape of the filtered water are of the same dimensions as are the openings by which the wash-water enters the filter through the passage N, and the side passage forms another way of like dimensions through which and the passage P the wash-water may enter the filter. Taken together, therefore, the two wash-water ways are double the filtered-water way, and as the key-ports 15 and 16 of the side passage are in the same circle as a portion of the current-reversing ports no larger key is required by reason of the wash-water way. Of course either or both the wash-water-inlet passages could be smaller than the filtered-water-outlet passages and still constitute the larger effective way when taken together. The filtered-water way may, however, be smaller than the wash-water way at the same end of the valve apparatus. Such a difference is shown in the arrangement of Fig. 17. In this the general arrangement is the same as in Fig. 2, and the ports are similarly lettered and numbered, but the single ports 11 and 12 and the terminal openings of the house-pipe F and of the front branch of the waste-pipe H are of less angular measurement than the terminal openings of the passage N and the front branch of the supply-pipe D, and are also less than the corresponding portions of the port 10. Thus even if the side passage with its ports 15 and 16 at the rear of the key Q were suppressed the wash-water way would be larger than the filtered-water way. By diminishing the angular measurement of the filtered-water ports the other ports in the same circle can be made larger angularly than they could be with all the ports of the same dimensions.

As shown at the left of Figs. 1, 2, and 3 and in Figs. 4 and 5, as also in Figs. 17 and 18, the ports in casing R and key Q are so arranged that the current-reversing and filter-draining valve apparatus can shut off the current, and thus prevent it from flowing either to house or through the filter. This dead position is the one which the keys Q occupy in the drawings. The supply-pipe is shown as opening into the filter through the port 13 and the upright pipe K. The valve apparatus of these figures—namely, Figs. 1 to 5 and 17 and 18—will also cut off the water from both the filter and the house and at the same time establish a filter-draining connection. To effect this, turn the key Q to the left of the position of the figures until the port 10 is opposite the end of the house-pipe F and all the other ways in the front part of the casing are at the same time closed by the key, while at the same time the rear key-ports 14 and 13 register, respectively, with the ends of the passage P and waste-pipe H. Both ends of the supply-pipe D are thus stopped, as also the end of the passage N; but the passage P is open to the waste-pipe H through the ports 14 and 13, and the upright pipe K is also open to the waste-pipe H

through the port 13. Thus the valve apparatus will be dead, with the filter-chamber B and its upright pipe K emptied. By turning the key Q still farther to the left the house-pipe F may be connected, through the port 10, with the waste-pipe H, while the supply-pipe is cut off both from the house-pipe and the filter. Thus the house-pipe above the valve may be drained, and the house-pipe F, the filter-chamber B, and the upright pipe K may be empty, with the supply-pipe closed. This would be useful to prevent freezing and might, of course, be resorted to for other purposes, (as repairing, for example.) By turning the key Q farther to the left the supply-pipe can be opened to allow water to run to waste to prevent freezing.

Instead of having the supply-pipe D in communication with the upright pipe K through the port 13 when the key Q is in the position which it occupies in Figs. 1 to 5 and 17 and 18 the port 13 could be smaller, so that the shell of the key would close the rear end of the supply-pipe, as shown in Figs. 6 and 23. In this case the rear end of the waste-pipe is brought nearer to the rear end of the supply-pipe, so that when the key is turned to the right sufficiently to make the port 10 register with the front end of the supply-pipe D and the port 15 with the rear end of said supply-pipe the port 13 will register with the rear end of the waste-pipe. In these figures—namely, Figs. 6 and 23—the port 14 is enlarged, so, as in the position represented, it registers with the rear end of the waste-pipe, and recesses 17 are formed in the casing, so that water may drain from the filter-chamber when the port 16 partly overlaps said recesses. The arrangement of rear ports in Fig. 6 is for a valve apparatus having the arrangement of even-sized front ports and ways of the left-hand valve apparatus of Fig. 2, and the arrangement of rear ports in Fig. 23 is for a valve apparatus having the differential front ports and ways, Fig. 17.

In the valve apparatus as thus far described the ways in the casing are not symmetrically disposed, the terminal openings of the house-pipe F at the left of Figs. 2 and 3 and those of the house-pipe F and the waste-pipe H in Figs. 6, 17, 18, and 21 being arranged at oblique angles from the ends of the passages N P and the supply-pipe D. In Figs. 2 and 3 the ends of the waste-pipe H are ninety degrees distant from the ends of the supply-pipe D. A symmetrical arrangement with differential front ports and ways is shown in Figs. 19 and 20. Except for a variation in the sizes of the key-ports and of the terminal openings of the ways in the casing the same arrangement could be used, with the terminal openings of the casing-ways and the key-ports all of the same size, and so generally any arrangement shown for differential ports and ways could be used for those of even size, and conversely.

In Figs. 19 and 20 a double port 10* and a sin-

gle port 10' are used in place of the quadruple port 10 of the preceding figures, and the intermediate portion of the shell is of sufficient width to stop the end of the house-pipe F when the key Q is in the position represented. In this position the house-pipe and both ends of the supply-pipe are closed, but the bottom of the filter is in communication with the waste-pipe H through the rear ports 13 and 14. On turning the key Q to the right this waste-pipe connection is interrupted, and the water from the supply-pipe D enters by the port 13, passes by the upright pipe to the top of the filter, descends through the latter in the filtering direction, and escapes into the house-pipe through the front ports 10* and 10'. On a further movement to the right the water continues to enter by the rear port 13 and flows through the filter in the filtering direction, but it passes to waste through the front port 12, which has by the movement been brought opposite the front end of the waste-pipe H. A third movement to the right brings the solid shell of the key Q opposite all the ends of all the casing-ways except the rear end of the supply-pipe, which remains open to the top end of the filter. The flow is therefore in this position cut off both from flowing to the house-pipe or through the filter. A further movement to the right puts the valve apparatus in the washing position, in which water from the supply-pipe D enters the bottom of the filter through the front ports 10* and 10' and also through rear ports 15 and 16, while the wash-water escapes through the port 13, which in the washing position registers with the rear end of the waste-pipe H. A fifth movement to the right establishes a by-pass across the front end of the key Q through the ports 10* and 12, while the filter-chamber and its upright pipe are emptied through the rear end of said key. A sixth movement to the right would establish the filter-draining and dead position as in the figures, only with the ports diametrically opposite the places shown.

By turning the key Q to the left from the position represented in Figs. 19 and 20 a by-pass (through front ports 12 and 10*) and a filter-draining connection (through ports 13 and 14) would be formed, and a still further movement to the left would allow the water in the house-pipe F above the valve apparatus to run to waste through the ports 10* and 10', with both ends of the supply-pipe stopped. Another symmetrical arrangement is shown in Figs. 21 and 22, all the ports being shown of even size. In the front of the key Q there is a triple port 10 and a single port 12, while at the rear in addition to the ports 13 14 15 16 and recess 17 there are two single ports 18 and 19. In the position represented the valve apparatus is dead, with a draining connection for the filter-chamber and its upright pipe. In this arrangement the filtering to house is effected by a turn to the left, the water entering by the rear port

18 and escaping by the front port 10. A second movement to the left establishes a by-pass through the front ports 12 and 10, while establishing a filter and upright-pipe draining connection through the rear ports 13 and 14. By moving the key to the right from its dead position represented the water entering by the rear port 13 can pass through the filter in the filtering direction and escape to waste by the front ports 10 and 12. A second movement to the right establishes the washing position, in which the wash-water enters the bottom of the filter by both the front and rear portions of the key Q and escapes by the rear port 18. A third movement to the right leaves the apparatus dead. The results of other movements can be easily perceived.

Referring to Fig. 21, if the port 12 were enlarged at the left, so as to uncover the end of the waste-pipe without shifting the key Q, it will be seen that the filter-chamber would drain through the front part of the casing. In this case the recess 17 and the enlargement of the port 15, as shown in Fig. 22, would be superfluous, and the third movement to the right would establish a by-pass.

In the valve apparatus shown at the right of Figs. 1, 2, and 3 the solid portion of the shell between the front ports 10* and 10' is too narrow to stop the ways in the casing, but is a mere brace and might be omitted. In the position represented in these figures the waste-water from the supply-pipe C enters by the rear port 13, passes through the filter in the filtering direction, escapes by the ports 10* and 10' to the house-pipe E. By moving the key to the right the filtered water is sent to waste through the port 12. By a further movement to the right the washing position is reached, in which the wash-water enters the filter-chamber A by the front ports 10* and 10' and the rear ports 15 and 16 and escapes by the rear port 13, which in this position registers with the end of the waste-pipe G. A third movement to the right establishes a by-pass through the front of the key between the ports 10* and 12, the filter-chamber A and its upright pipe J being at the same time provided with a drainage connection through the ports 14 and 13. By turning the key Q to the left from the filter-to-house position represented a by-pass and filter and upright-pipe draining connection is established. The key could of course be placed in other positions with results easily to be seen.

With the two valve apparatus of Figs. 1, 2, and 3 in the position shown water would stand in both filters but would not flow to the house, because it is stopped by the left-hand apparatus. By turning the key Q of this apparatus to the left the delivery of doubly-filtered water is commenced. The water from the pipe C enters the port 13, (right of Fig. 3,) ascends the pipe J, descends through the filter-bed in chamber A, leaves said chamber by passage L, Fig. 2, and escapes by the

ports 10* and 10' into the house-pipe E, which is in series with the supply-pipe D. Flowing through said supply-pipe D and the upright pipe K this water which has just been filtered in the chamber A descends through the filter-bed in chamber B, whereby it is filtered anew and goes to house by the pipe F. If it is desired to cut out either of the filters, the valve apparatus thereof can be turned to by-pass, whereupon the water filtered by the other will go to the house through the pipe F. To wash either filter, the valve apparatus thereof is manipulated. The filter B can be washed with water which has been filtered in the chamber A or with unfiltered water delivered through the by-pass of the right-hand valve.

The casings of the valves thus far described are shown as cast integral with the bottom plate S of the filter-chamber. This plate rests at its edges upon a hollow base T, which incloses the valve apparatus, leaving the key Q accessible by an opening. Indexes V on the stems of the keys travel over dials W W' on the bases to indicate the positions of the keys. The base T and plate S could be cast together, but it is considered easier to make them separate. The manufacture in one piece with the bottom plate of the valve-casing with its passages N P and the other ways is considered advantageous for small filters. For larger apparatus it is considered better to make the casings so that they can be secured with appropriate fittings. Figs. 7 and 9 show the passages N and P extended separately to the top of the casing, while in Figs. 8 and 10 they come together inside the casing R. In all four figures the front and rear branches of the supply-pipe are kept separate to the outside of the casing and can receive separate pipes, if desired, but they could be brought together before leaving the casing, as in Figs. 5 and 13. In the cross-sections, Figs. 11 and 12, of the apparatus of Figs. 7 and 9 the arrangements of ways in the casing and ports in the keys are as represented in the right-hand apparatus of Figs. 2 and 3, but any other of the arrangements shown could be used in the separate casings of Figs. 7 and 9 or of Figs. 8 and 10. In Figs. 13, 14, 15, and 16 the extra wash-water ports 15 and 16 of the preceding figures are omitted, all the wash-water entering by the passage N. The filter-draining passage P* and port 14 are contracted in size, for their function is simply to drain off the standing water and there would be no particular purpose in making them of the same size as the other ports, although they could be so made. The ports 15 and 16 could be closed in the other forms of valve apparatus if they are not desired to furnish an enlarged supply of wash-water.

In all the apparatus shown the valves for the various purposes described are found in a single key. This is the best arrangement, but it is evident that any form of key shown could have the front circle of ports in one key

and the rear circle in another key, which could be connected with the former key, so as to be operated simultaneously therewith. Moreover, the valves formed in the drawings by the same circle of ports could be constituted by connected keys instead of a single key. The consolidation of the valves in a smaller number of many-way valves is advantageous, as is also the union of the many-way valves in a single key. As shown in all the figures, a key Q and its casing R constitute two four-way valves. The front four-way valve has its ports and the terminal openings of its ways so arranged that one of said ways can be separately put into communication with each of the other three and that two (at least) of these can be connected with each other. The rear four-way valve has its ports and the ends of its ways so arranged that two of said ways can be connected with each other in two positions of the key and the other two in a third position. In this third position, moreover, one of the first two ways is connected with the latter two. Further, in all the apparatus illustrated except that of Figs. 13, 14, 15, and 16 the rear four-way valve has a side passage with its own ports in addition to the ports mentioned just above. When this side passage is used, it is not so important to have a separate communication between a way in the front four-way valve and more than two of the other three, since the rear side passage may be utilized for the like purpose as one of these connections.

In the front end of the apparatus of the left of Figs. 1, 2, and 3 there is a port 10, which could be divided into a number of single ports, that extends through the arc covered by three movements of the key and is sufficient to connect two adjacent ways in the casing, and also in conjunction therewith there are ports 11 and 12 opposite said port 10, and, further, one of the front ways—to wit, the house-pipe F—is arranged to be stopped by the solid portion of the key outside of and next adjacent to said port 10. This has a certain advantage over stopping said house-pipe on other parts of the key, since then the changes of the valve may proceed consecutively from a dead position through the filtering-to-house, washing, and other positions. The apparatus of Figs. 17 and 18 is of the like character. This feature would not be affected by the substitution of the rear arrangements of Figs. 6 and 23 for those of the left of Figs. 3 and 18, respectively.

Reference has been made above to the use of differential key-ports and terminal openings in the casing and to the unsymmetrical disposition of said terminal openings. Each of these arrangements has a special value in securing a maximum size of the wash-water openings generally with a given style and size of key.

I claim as my invention or discovery—

1. In combination with a filter, a current-reversing and drainage valve apparatus

therefor placed below the filter-chamber and connected with the top and bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby in one position of said apparatus the current flows in the filtering direction through the filter to the house-pipe, and in another position in a reverse direction to the waste-pipe, and in a third position the filter is cut off from the supply and house pipes and a communication opened to the waste-pipe from the bottom of the filter-chamber and from the upright pipe which leads to the top of said chamber, substantially as described.

2. In combination with a filter, a current-reversing and drainage valve apparatus therefor placed below the filter-chamber and connected with the top and bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby in one position of said apparatus the current flows in the filtering direction through the filter to the house-pipe, in another position in the same direction to the waste-pipe, in a third position in the reverse direction to the waste-pipe, and in a fourth position the filter is cut off from the supply and house pipes and a communication opened to the waste-pipe from the bottom of the filter-chamber and from the upright pipe which leads to the top of said chamber, substantially as described.

3. In combination with a filter, a by-pass and drainage valve apparatus placed below the filter-chamber and connected with the top and bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby the supply can be cut off from the filter and be connected with the house-pipe while at the same time the house connection with the filter is stopped and the bottom of the filter-chamber and the upright pipe leading to the top of said chamber are put in communication with the waste-pipe, substantially as described.

4. In combination with a filter, a current-reversing by-pass and filter-draining valve apparatus placed below the filter-chamber and connected with the bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby the supply can be cut off from the filter and connected with the house-pipe while at the same time the bottom of the filter-chamber is put in communication with a waste-pipe and the current can in other positions of said valve apparatus be sent through the filter-chamber in the filtering direction to the house-pipe, in the filtering direction to the waste-pipe, and in the washing direction to a waste-pipe, substantially as described.

5. In combination with a filter, a current-reversing by-pass and drainage valve apparatus placed below the filter-chamber and connected with the top and bottom thereof,

said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby the supply can be cut off from the filter and connected with the house-pipe while at the same time the bottom of the filter-chamber and the upright pipe leading from the top of said chamber are put in communication with the waste-pipe and the current can in other positions of said valve apparatus be sent through the filter-chamber in the filtering direction to the house-pipe, and in the washing direction to the waste-pipe, substantially as described.

6. In combination with a filter, a current-reversing by-pass and drainage valve apparatus placed below the filter-chamber and connected with the top and bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby the supply can be cut off from the filter and connected with the house-pipe while at the same time the bottom of the filter-chamber and the upright pipe leading from the top of said chamber are put in communication with the waste-pipe and the current can in other positions of said valve apparatus be sent through the filter-chamber in the filtering direction to the house-pipe, in the filtering direction to the waste-pipe, and in the washing direction to the waste-pipe, substantially as described.

7. In combination with a filter, a current-reversing-valve apparatus provided with means for letting a substantially larger stream pass through the filter in washing than in filtering, substantially as described.

8. In combination with a filter, a current-reversing-valve apparatus provided with openings at the ends of wash-water ways of substantially larger section than the ends of the filtered-water ways and with wash-water key-ports and filtered-water key-ports to correspond, so that a larger stream may pass through the filter in washing than in filtering, substantially as described.

9. In combination with a filter, a current-reversing-valve apparatus provided with double wash-water-inlet ways and ports approximating each other in size and a single set of ways and ports for the water in filtering, substantially as described.

10. In combination with a filter, a current-reversing-valve apparatus, having two circles of ports and a wash-water-inlet port in each circle, substantially as described.

11. In combination with a filter, a current-reversing-valve apparatus provided with a system of connected valves or ports whereby the current can be sent through the filter in the filtering direction to a house-pipe and in the washing direction to a waste-pipe and composed of substantially larger openings for the flow of the water in said washing direction, substantially as described.

12. In combination with a filter, a current-reversing-valve apparatus, composed of supply, house, filter and waste ways terminating

in two circles with key-ports to correspond, arranged to send the current through the filter in the filtering direction to the house-pipe and in the washing direction to the waste-pipe and having wash-water-inlet openings in both said circles, substantially as described.

13. In combination with a filter, a current-reversing drainage and cut-off valve apparatus placed below the filter-chamber and connected with the top and bottom thereof, said apparatus having house, waste, supply and filter ways and a system of connected valves or ports whereby the current can be sent through the filter in the filtering direction to the house-pipe, and in the washing direction to the waste-pipe, and can be cut off from the filter-chamber and its upright pipe while these are connected to waste, and can be cut off from the house-pipe while at the same time it is cut off from passing through the filter, substantially as described.

14. A valve apparatus composed of two four-way valves having their key portions connected for joint operation, one four-way valve being arranged for putting one of its four ways separately in communication with each of the other three and for connecting two of these three with each other, and the other four-way valve being arranged for connecting two of its ways with each other in two positions of the valve and for connecting the other two with each other in a third position, substantially as described.

15. A valve apparatus composed of two four-way valves having their key portions connected for joint operation, one four-way valve being arranged for putting one of its four ways separately in communication with each of the other three and for connecting two of these three with each other, and the other four-way valve being arranged for connecting two of its ways with each other in two positions of the valve and for connecting one of said two and the remaining two ways with one another when in a third position, substantially as described.

16. A valve apparatus composed of two four-way valves having their key portions connected for joint operation, one four-way valve being arranged for putting one of its four ways separately in communication with two of the other three and for connecting two of these three with each other, and the other four-way valve being arranged for connecting two of its ways with each other in two positions of the valve and for connecting the other two with each other in a third position and being provided with a side passage and ports in addition, substantially as described.

17. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute filter-draining, by-pass and current-reversing valves, substantially as described.

18. In combination with a filter, a valve apparatus placed below the filter-chamber and

composed of two four-way valves connected for joint operation and arranged to constitute filter-draining, cut-off, by-pass and current-reversing valves, substantially as described.

5 19. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute filter-draining, cut-off and current-reversing
10 valves, substantially as described.

20. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute
15 current-reversing valves with wash-water-inlet openings in each of said four-way valves, substantially as described.

21. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute
20 filter-draining, by-pass and current-reversing valves with wash-water-inlet openings in each of said four-way valves, substantially as described.
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22. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute
30 filter-draining, cut-off, and current-reversing valves with wash-water-inlet openings in each of said four-way valves, substantially as described.

23. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of two four-way valves connected for joint operation and arranged to constitute
35 filter-draining, by-pass, cut-off and current-reversing valves with wash-water-inlet openings in each of said four-way valves, substantially as described.
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24. A valve apparatus composed, in connection with another many-way valve, of a four-way valve having a key-port 10 to connect
45 two adjacent ways in the casing with each other, and provided with additional ports as 11 and 12 opening from the same space in the center of the key and located opposite said port 10, one of said four ways being arranged
50 to be stopped, in the proper position of the valve, by the shell of the key outside of and next to the said port 10, substantially as described.

25. A valve apparatus composed, in connection with another many-way valve, of a four-way valve having openings of different sizes at the ends of the casing-ways, substantially as described.

26. A valve apparatus composed, in connection with another many-way valve, of a four-way valve having the openings at the ends of the ways in the casing unsymmetrically disposed, and the key-ports arranged to put one of said casing-ways in separate communication with each of the other three, substantially as described.
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27. A valve apparatus composed, in connection with another many-way valve, of a four-way valve having the openings at the ends of the ways in the casing unsymmetrically disposed and of different sizes, substantially as described.

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28. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of valves which are connected for
75 joint operation, which have casing-ways extending from the valves directly to filter, supply, waste, and house respectively, and which have said ways and the corresponding key-ports arranged to establish a filtering to house,
80 a filtering to waste, a washing, and a filter-draining position by a succession of movements within an arc of half a circle, substantially as described.

29. In combination with a filter, a valve apparatus placed below the filter-chamber and composed of a four-way valve connected for joint operation with another many-way valve, and having its key-ports and ways arranged to establish a filtering to house, a filtering to
85 waste, a washing, a by-pass or a cut-off or both, and a filter-draining connection by a succession of movements within an arc of half a circle, substantially as described.

30. In combination with a filter, a current-reversing and filter-draining valve apparatus placed below the filter and connected with the top and bottom thereof, said apparatus having two sets of key-ports and two sets of casing-ways, the casing-ways of one set being
90 connected respectively with both ends of said chamber and with supply and waste pipes, and the corresponding key-ports being arranged in one position of the valve apparatus to connect both ends of the filter with the
95 waste-pipe while cutting off the flow of water to the filter, substantially as described.

31. In combination with a filter, a by-pass, filter-draining and current-reversing valve apparatus having two sets of key-ports and
100 casing-ways, arranged in one position of said valve apparatus to establish a by-pass through ports and ways of one set and a filter-draining connection with the bottom of the filter through ports and ways of the second set,
105 substantially as described.

32. In combination with a filter, a by-pass, filter-draining and current-reversing valve apparatus having two sets of key-ports and casing-ways, arranged in one position of said
110 valve apparatus to establish a by-pass through ports and ways of one set and a drainage connection through ways and ports of the second set for both the filter-chamber and the upright pipe leading to the top thereof, substantially
115 as described.

33. A valve having in its key a central chamber open at one end and ports, as 13 and 14, opening from said chamber at the periphery thereof, and also provided with a side
120 passage, between other ports as 15 and 16, and with an end pipe as K, and casing ways or passages as P D H, terminating in the circle of the peripheral ports, the side passage
125

being adapted to connect two of the last-mentioned casing ways or passages which are not directly opposite to the exclusion of the third way or passage, and the first-mentioned ports being located at opposite points as well as at an intermediate point, substantially as described.

34. A valve apparatus composed of two four-way valves connected for joint operation, one of which valves has a central chamber open to a pipe, as K, and provided with peripheral ports, as 13 and 14, at opposite points and also at an intermediate point for registering with the casing ways or passages, as P D H, while the other of said valves has a central chamber provided with peripheral ports at opposite points and also at intermediate points for registering with the casing ways or passages, as N D H F, substantially as described.

35. A valve apparatus composed of two four-way valves connected for joint operation, one of which valves has a side passage between ports, as 15 and 16, in addition to a central chamber open to a pipe, as K, and is provided with peripheral ports, as 13 and 14, at opposite points and also at an intermediate point for registering with the casing ways or passages, as P D H, while the other of said valves has a central chamber provided with peripheral ports at opposite points and also at intermediate points for registering with the casing ways or passages, as N D H F, substantially as described.

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

JOSEPH T. MANNING.

Witnesses:

BERTHA S. DANA,

WALTER W. H. ROBINSON, Jr.