

No. 662,815.

Patented Nov. 27, 1900.

T. H. PHILLIPS.
IMPACT TOOL.

(Application filed May 16, 1900.)

(No Model.)

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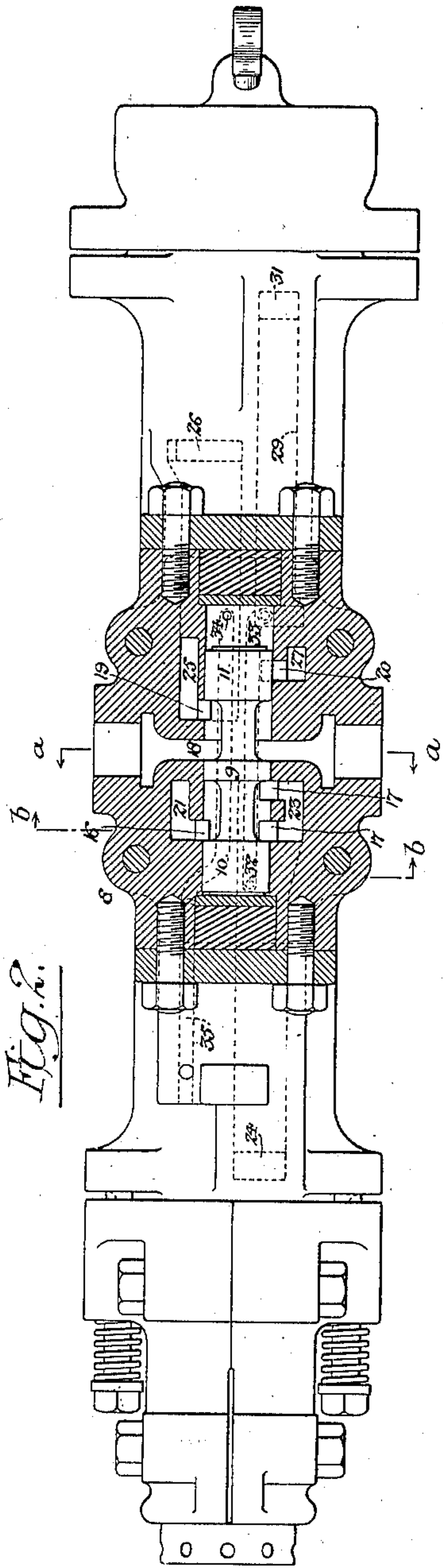


Fig. 2.

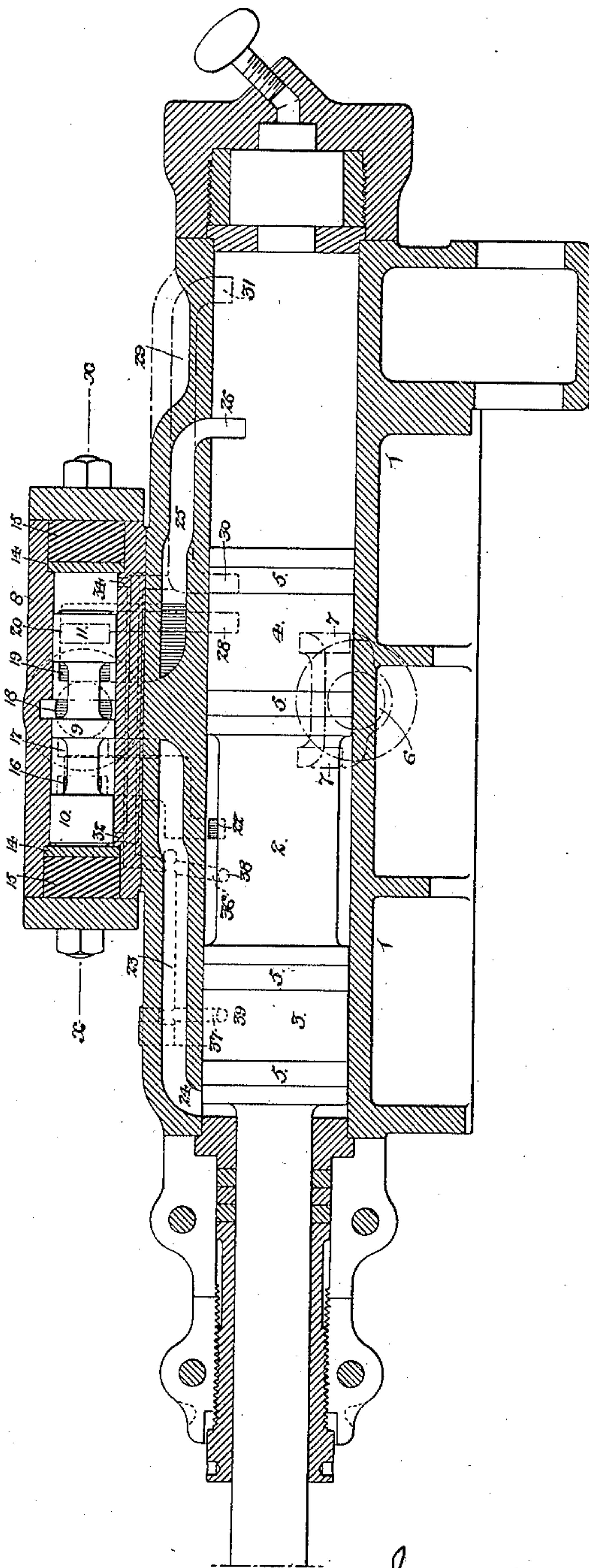


Fig. 1.

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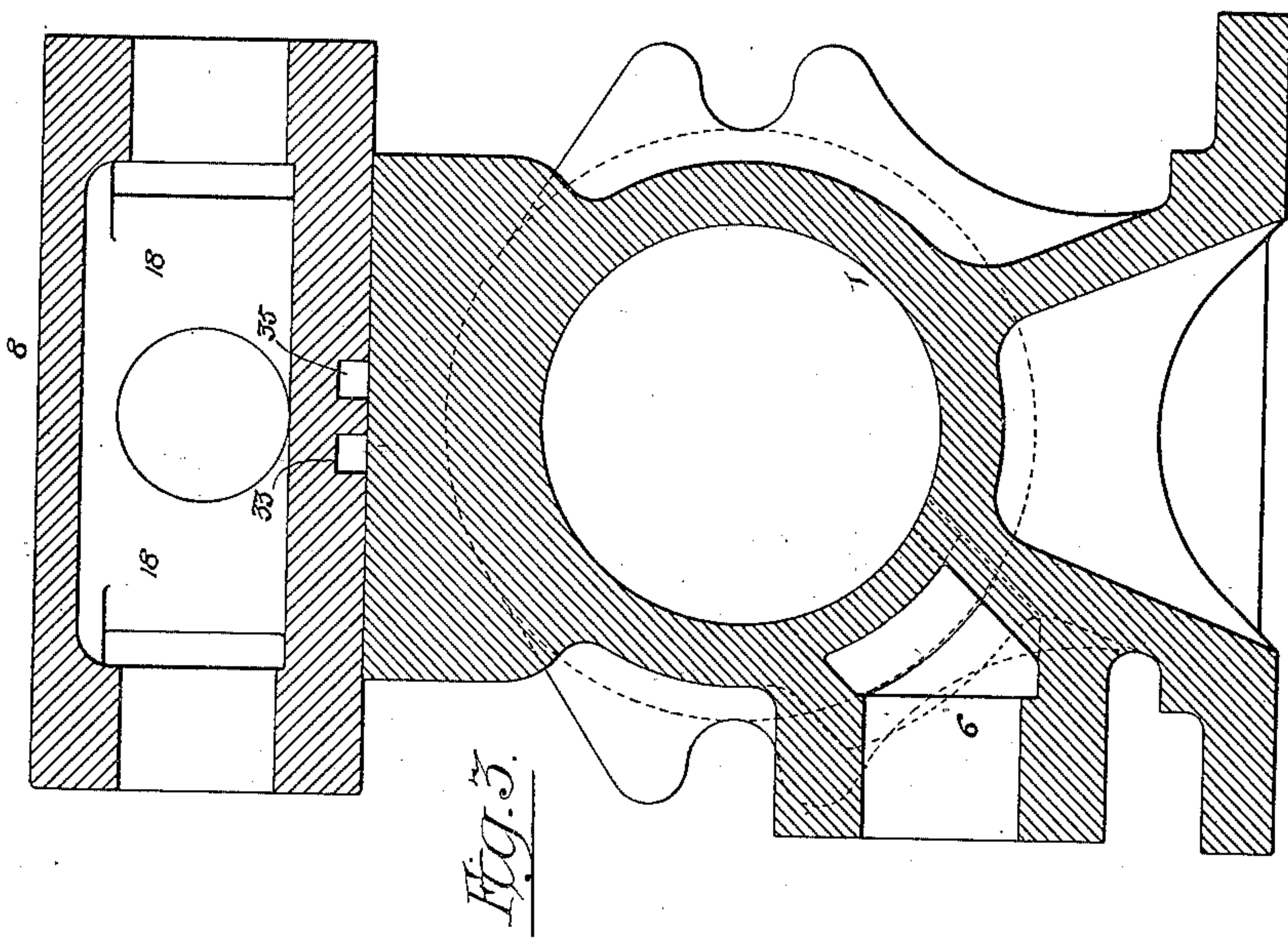
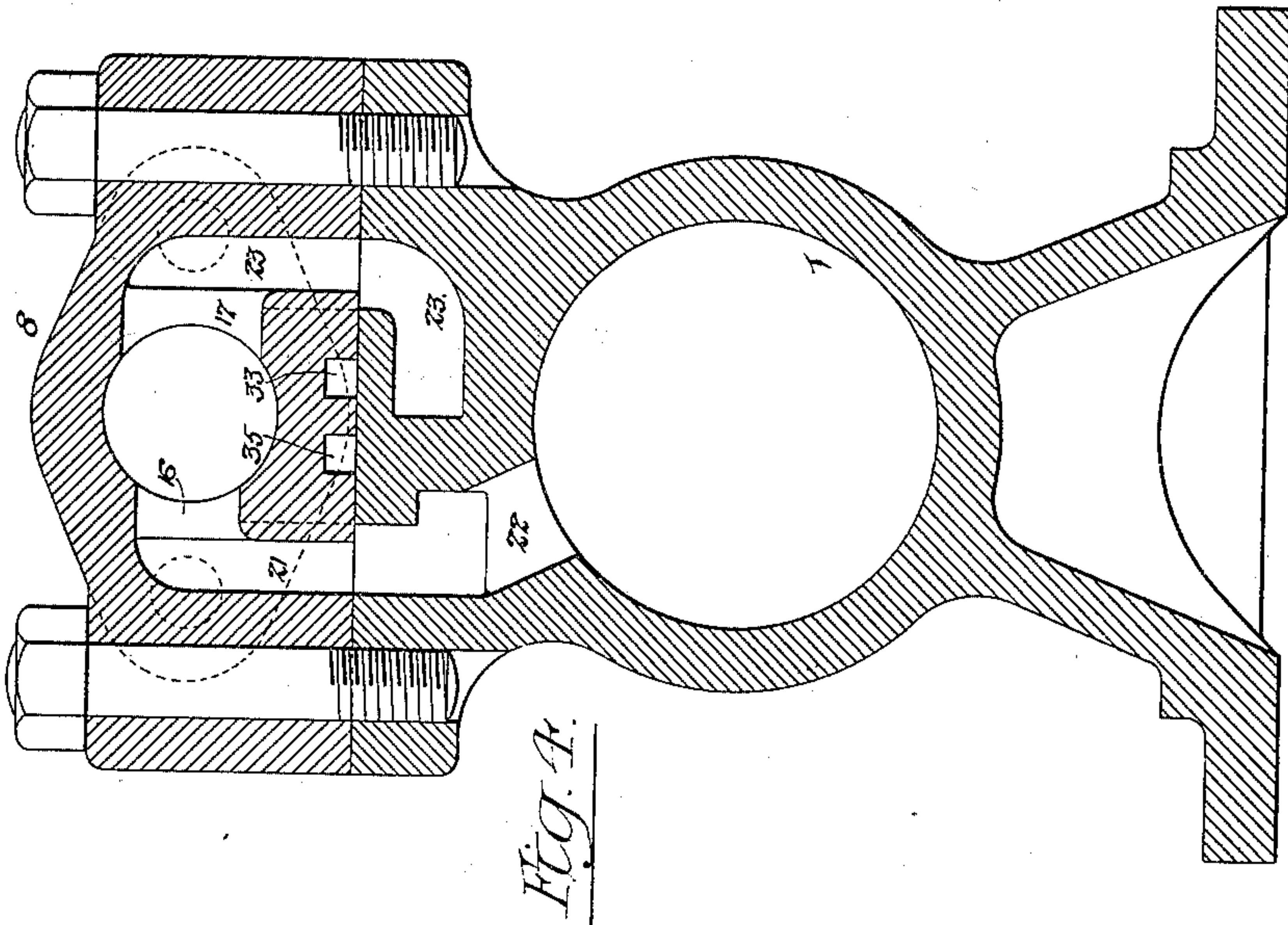
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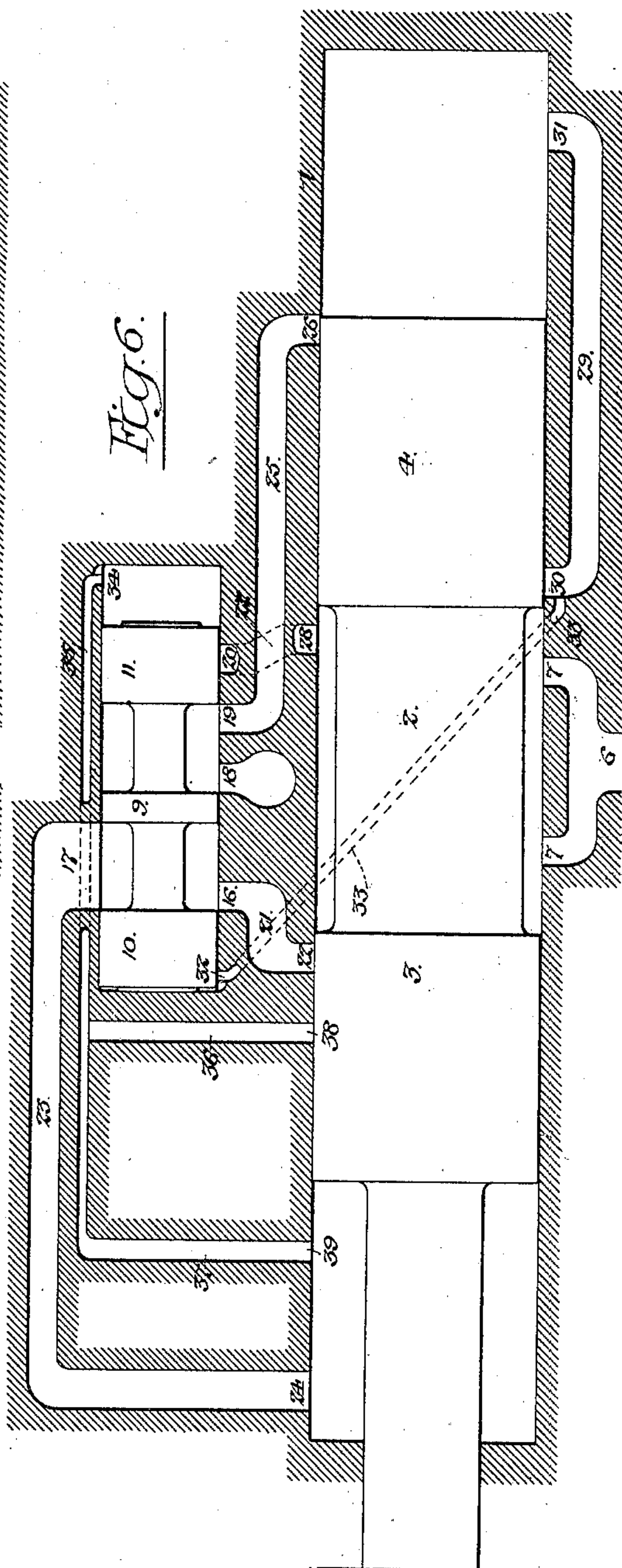
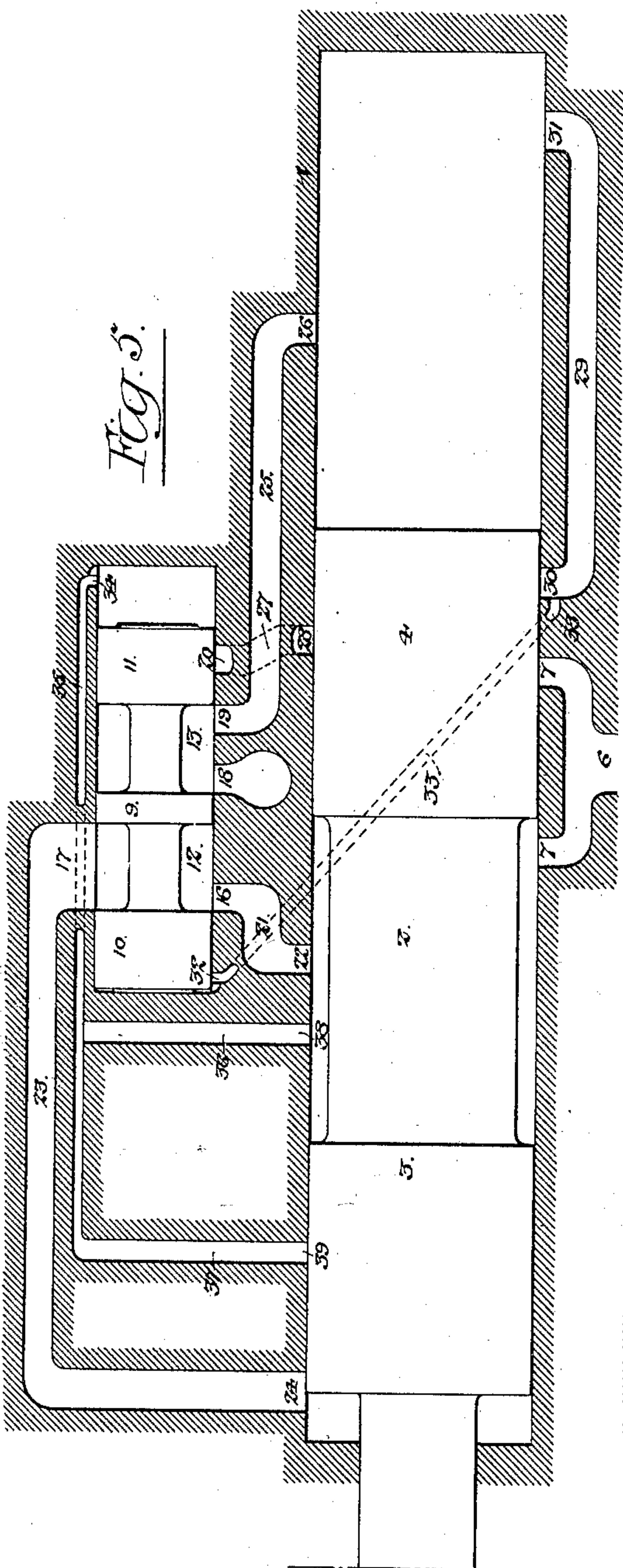
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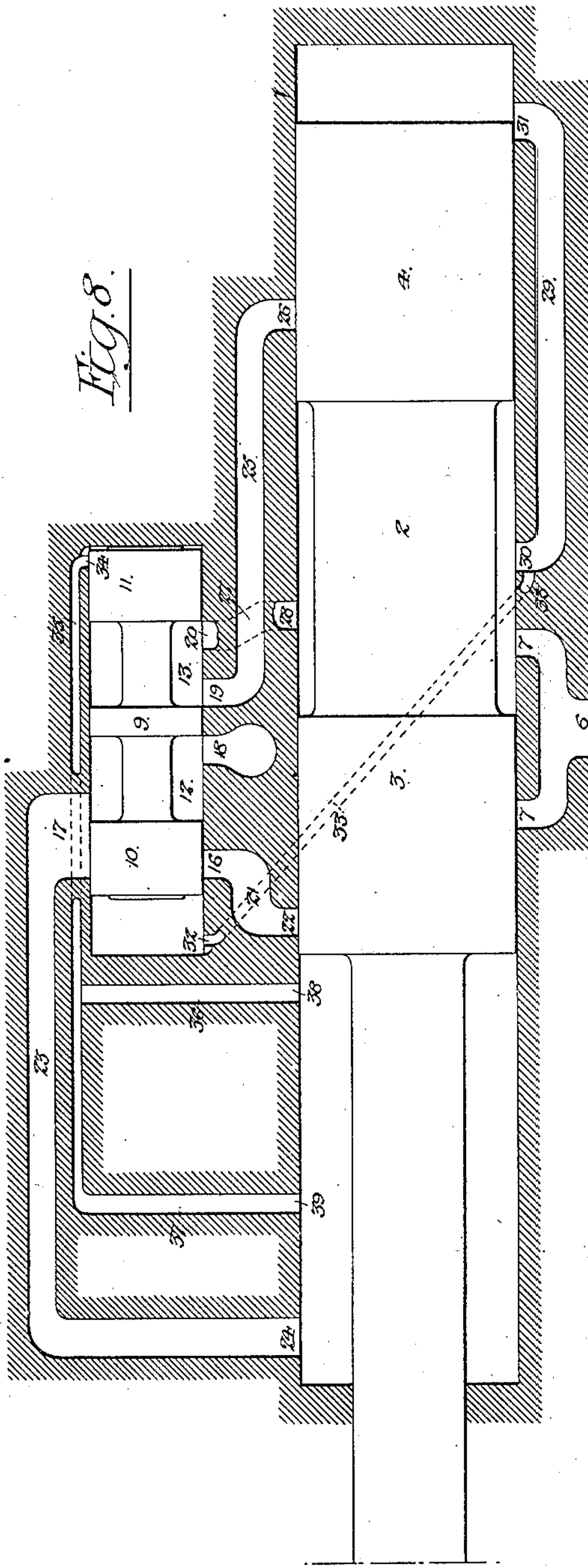
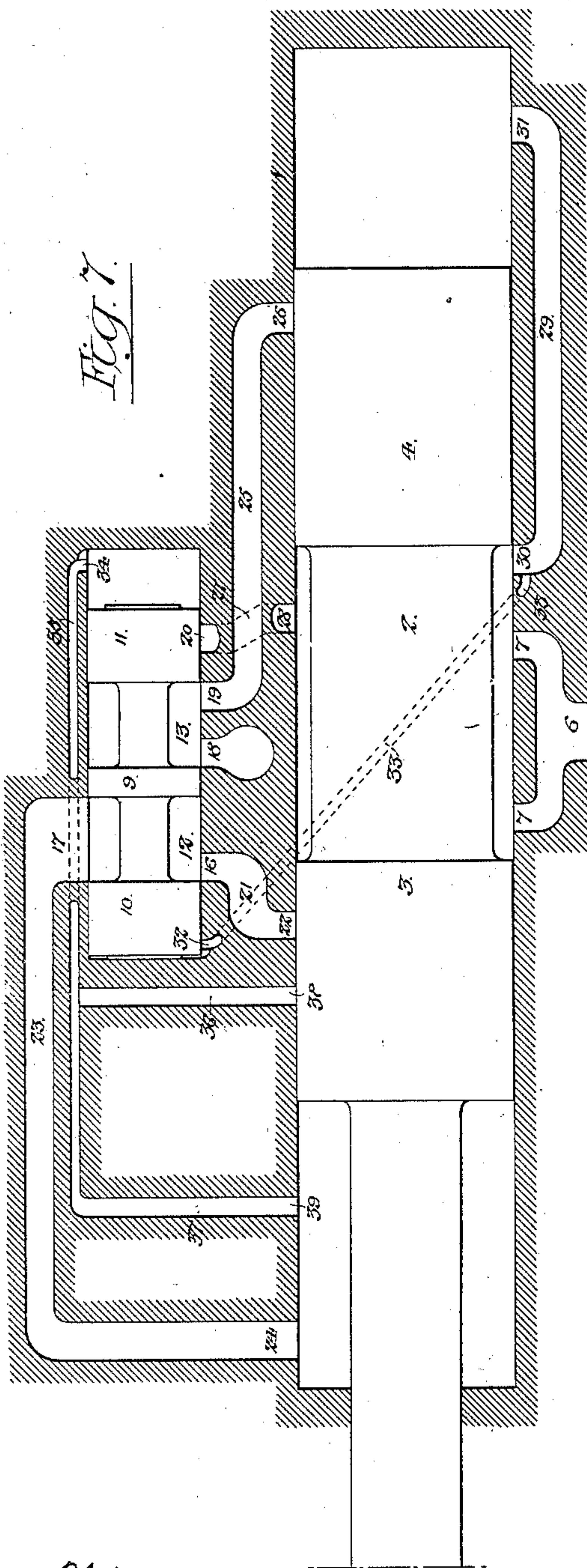
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IMPACT TOOL.

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(No Model.)

6 Sheets—Sheet 4.



Witnesses

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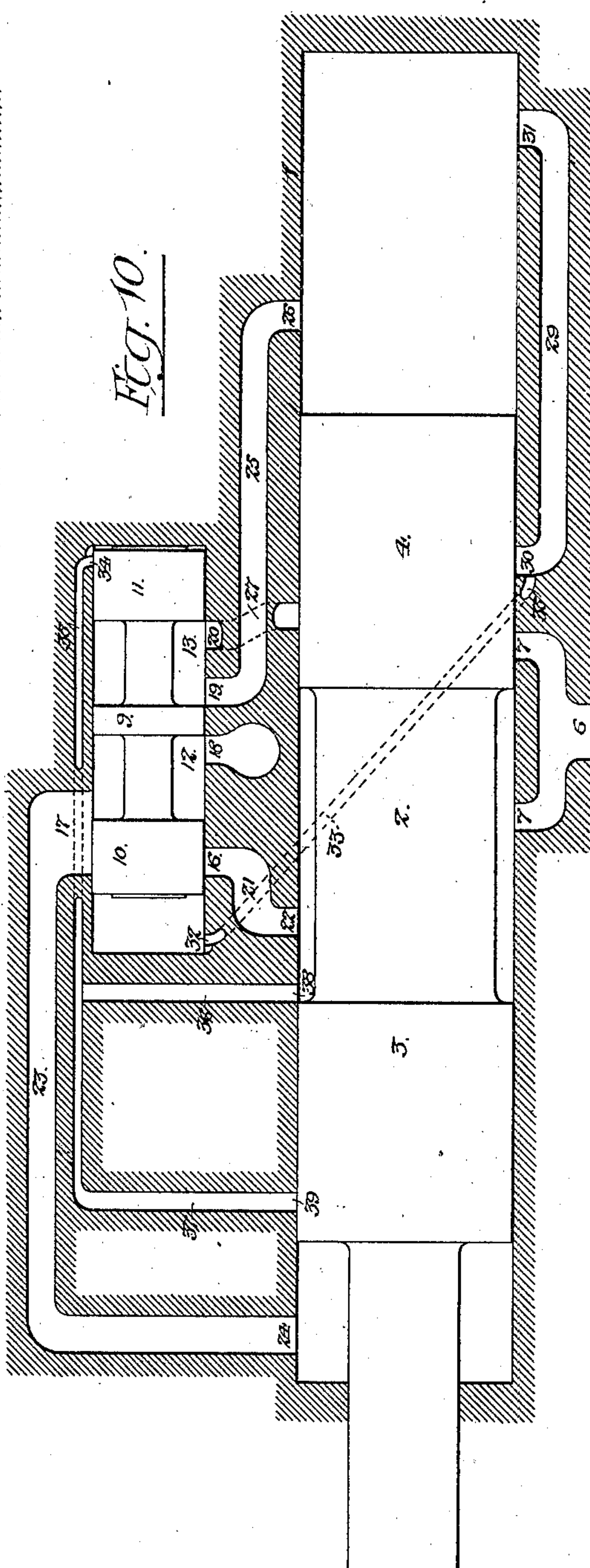
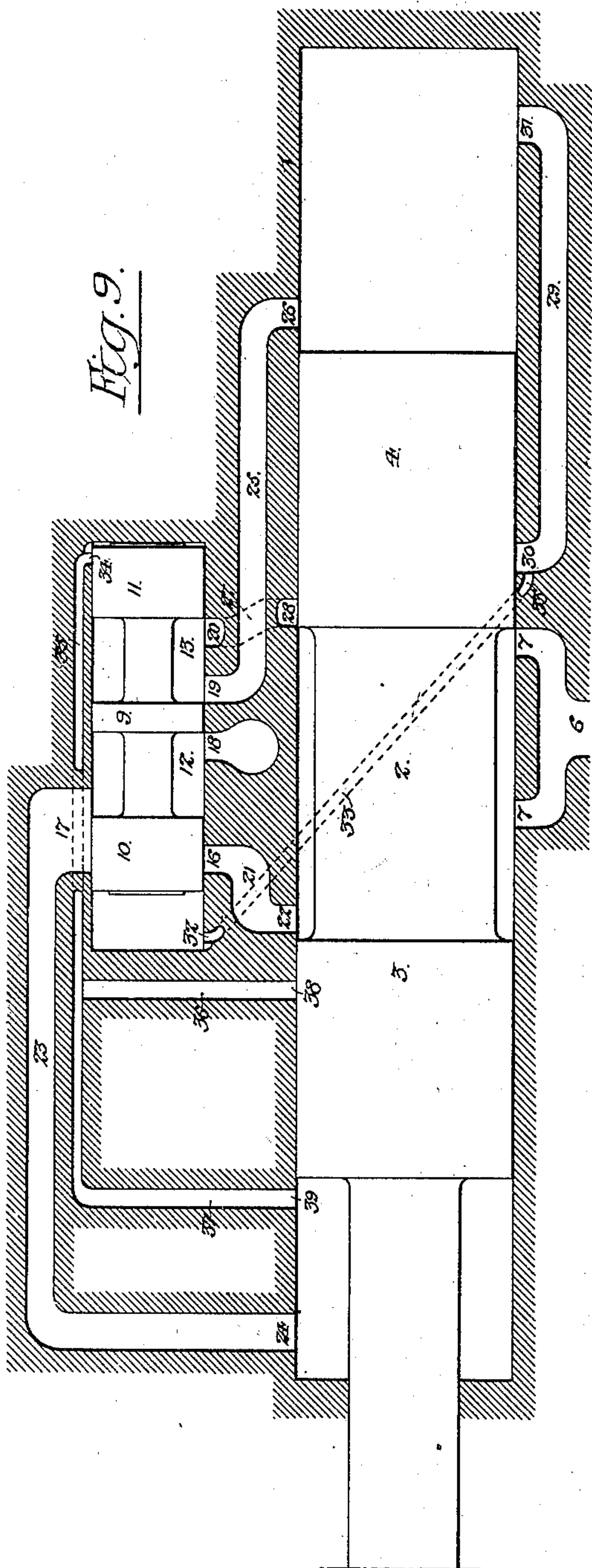
Patented Nov. 27, 1900.

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(No Model.)

6 Sheets—Sheet 5.



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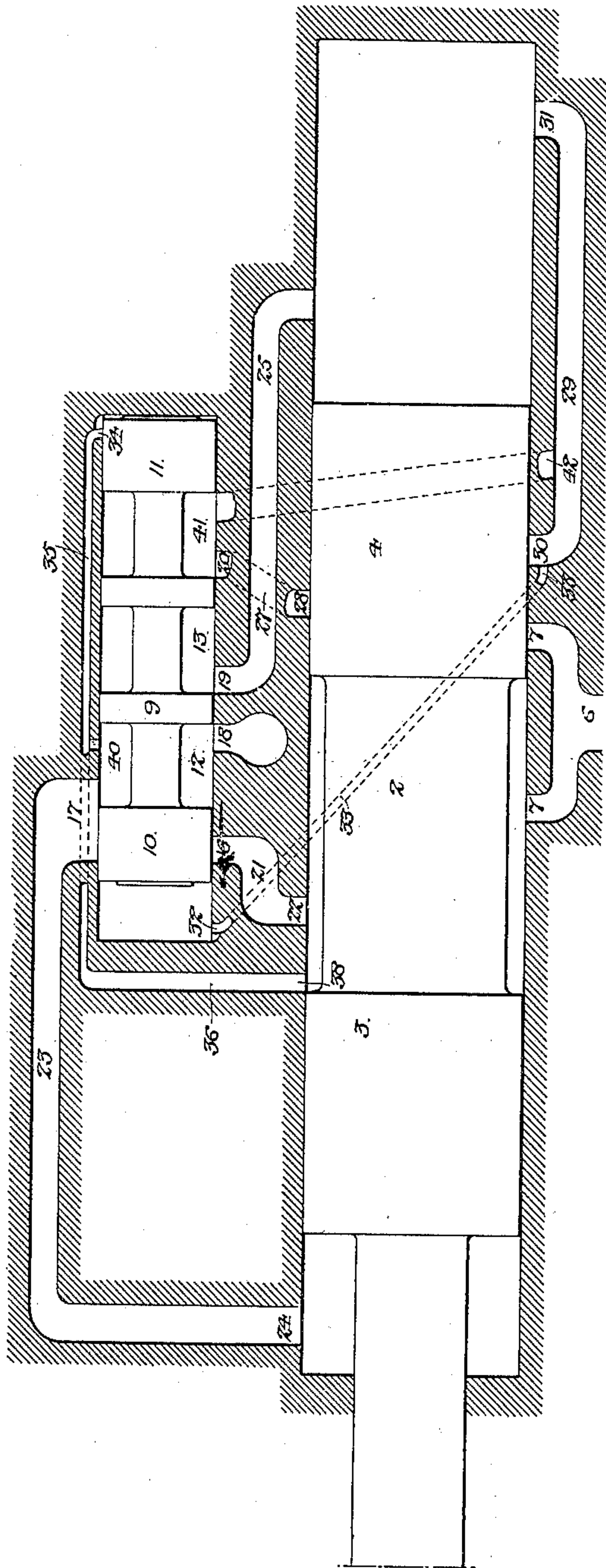
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(No Model.)

6 Sheets—Sheet 6.

Fig. 11.



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UNITED STATES PATENT OFFICE.

THOMAS H. PHILLIPS, OF ST. DAVIDS, PENNSYLVANIA.

IMPACT-TOOL.

SPECIFICATION forming part of Letters Patent No. 662,815, dated November 27, 1900.

Application filed May 16, 1900. Serial No. 16,883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS H. PHILLIPS, a citizen of the United States, and a resident of St. Davids, Pennsylvania, have invented certain Improvements in Impact-Tools, of which the following is a specification.

My invention relates to that class of impact-tools mainly intended for rock-drilling and the like and operated by steam, compressed air, or other motive fluid under pressure.

For convenience in this specification I will assume that the tool is a rock-drill and is operated by steam.

The improved drill has many of the structural and functional features of other tools for which I have previously obtained Letters Patent—that is to say, it has the inlet and exhaust ports and passages so arranged as to insure the delivery of an uncushioned blow and the cushioning of the piston on the back stroke so as to prevent injury to the rear head of the cylinder, it uses the steam expansively, it has a simple form of single supply-valve which controls the admission of steam to the forward end of the cylinder and the exhaust of steam from both ends, and it has provision for shifting this valve by admitting steam first to one end of the valve-chest and then to the other end of the same.

One object of my present invention is to so construct the ports and passages that the valve when at rest and acted upon by gravity will insure admission of steam to one end of the cylinder and free exhaust from the opposite end, thereby providing for the prompt starting of the tool under all conditions, a further object being to accomplish this result by causing the movement of the valve to follow the movement of the piston in the same direction.

Another object is to control by the piston itself and without the intervention of a valve the admission of steam to the rear end of the cylinder at a fixed point in the return stroke and to cut off the steam by the combined action of the piston and valve at a more advanced point on the forward stroke.

Another object is to effect the cushioning of the valve at each end of its stroke, and thus prevent it from striking with undue force the buffer at either end of the valve-chest.

These objects I attain in the manner here-

inafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal section of the cylinder, valve-chest, piston, and valve of an impact-tool constructed in accordance with my present invention. Fig. 2 is a section on the line *xx*, Fig. 1. Fig. 3 is a transverse section on the line *aa*, Fig. 2. Fig. 4 is a transverse section on the line *bb*, Fig. 2. Figs. 5, 6, 7, 8, 9, and 10 are diagrams prepared with the view of showing the cylinder, valve-chest, piston, valve, and all of the ports and passages in the same plane in order to clearly illustrate the operation of the tool; and Fig. 11 is a similar diagram illustrating certain modifications of the invention.

The cylinder 1 is of the usual construction and receives the reciprocating piston, which has a central groove or chamber 2 and front and rear heads 3 and 4, each of the latter having one or more packing-rings 5, whereby a steam-tight fit of the same in the cylinder is maintained.

The steam-inlet passage 6 is forked and terminates in the cylinder in two ports 7, one or other of which is always in communication with the central groove or chamber 2 of the piston, so that steam under pressure is constantly maintained in this chamber when the tool is in operation.

Above or at one side of the cylinder 1 is the valve-chest 8, to which is adapted a valve having three rings or flanges 9, 10, and 11 and two chambers 12 and 13, the opposite ends of the valve-chest having buffer-plates 14, backed by rubber or other springs 15, as usual.

Communicating with the valve-chamber are five ports 16, 17, 18, 19, and 20, the port 16 constituting one termination of a passage 21, the other termination of which is a port 22 in the bore of the cylinder. The port 17 is a wide port and in the present instance is forked or divided by a central partition-plate, although it may be a single port, if desired, and this port constitutes the upper termination of a passage 23, which extends to the front end of the cylinder and terminates therein in a port 24. The port 18 is the exhaust-port and communicates with an exhaust-passage leading to both sides of the valve-chest, so that the exhaust-pipe may be connected to

either side of the same, as may be most convenient, the opposite end of the passage being closed by a suitable plug.

The port 19 constitutes the upper termination of a passage 25, which has its other termination at a port 26 in the bore of the cylinder, and the port 20 constitutes the upper termination of a passage 27, which has its lower termination at a port 28 in the cylinder.

Formed wholly in the cylinder is a passage 29, which terminates at its forward end in a port 30 in the bore of the cylinder and at its rear end in a port 31 near the rear end of the cylinder.

Near the front end of the valve-chest is a port 32, which communicates through a passage 33 with the passage 29, and near the rear end of the valve-chest is a port 34, which communicates with a passage 35, the latter having two branches 36 and 37, which terminate, respectively, in ports 38 and 39 in the bore of the cylinder, the port 39 being some distance in advance of the port 38.

The passage 21 is an induction-passage, its purpose being to convey steam from the cylinder to the valve-chest, and the passage 23 is a combined induction and eduction passage, its purpose being to convey steam from the valve-chest to the front end of the cylinder and to exhaust steam from the front end of the cylinder back to the valve-chest. The passage 25 is likewise a combined induction and eduction passage serving under certain conditions to convey steam from the valve-chest to the cylinder and providing for the exhaust of steam from the rear end of the cylinder to the valve-chest. The passage 27 is an induction-passage serving to convey steam from the cylinder to the valve-chest, and the passage 29 is also an induction-passage which serves to convey steam from the central portion of the cylinder to the rear end of the same, this passage also serving as part of an eduction-passage for the valve-chest, as hereinafter explained.

The passage 33 is a combined induction and eduction passage which conveys steam from the passage 29 to the forward end of the valve-chest and exhausts it therefrom back to said passage 29, and the passage 35, with its branches 36 and 37, is a combined induction and eduction passage serving to convey steam from the cylinder to the rear end of the valve-chest and to exhaust it from said rear end of the valve-chest back to the cylinder.

The operation of the tool can be best understood on reference to the diagrams Figs. 5 to 10. Fig. 5 shows the piston at the forward end of its stroke in the position which it occupies after having delivered its blow.

When in this position, the valve is likewise at the forward end of its movement, owing to the fact that the rear end of the valve-chest is open to the steam from the central chamber of the piston through passages 36 and 35, while the front end of the valve-chest is open to the exhaust 18 through the pas-

sages 33 29, the rear end of the cylinder, the passage 25, and the passage 13 of the valve. When in this position, steam can enter the front end of the cylinder through the passage 21, the chamber 12 of the valve, and the passage 23, so as to move the piston rearwardly.

The first effect of this movement is to close the port 38; but this does not cut off the steam from the rear end of the valve-chest, as the port 39 is at once opened, and communication is thus established between the rear end of the valve-chest and the front end of the cylinder. The continued rearward movement of the piston next causes the front head of the piston to close the port 22, and thereby cut off the admission of steam to the front end of the cylinder, as shown in Fig. 6.

Further rearward movement of the piston under expansive action of the steam in the forward end of the cylinder causes the rear head of the piston first to close the port 26, and thereby cut off the exhaust from the rear end of the cylinder, and next to open the port 30, so as to permit a flow of steam into the rear end of the cylinder, as shown in Fig. 7, thus providing for the desired cushioning of the piston on the rear stroke to prevent damaging contact of the same with the back head of the cylinder. The port 28 is also uncovered; but as the port 20 at the valve-chest end of the passage 27 is covered by the head 11 of the valve this has no effect. As soon as steam enters the passage 29 it also enters the forward end of the valve-chest through the passage 33, and as the rear end of the valve-chest contains only the pressure of expanded steam in the front end of the cylinder as against full pressure of steam in the forward end of the valve-chest, there will consequently be a rearward movement of the valve in the chest, so as to open the front end of the cylinder to the exhaust before the piston can reach the rear end of its stroke. (See Fig. 8.)

The piston now moves forwardly, being subjected to the full pressure of steam upon its rear end and being relieved from pressure upon its front end, and the flow of steam into the rear end of the cylinder continues after the port 30 has been closed by the rear head of the piston and the port 26 is uncovered, for steam continues to flow into the rear end of the cylinder through the passage 27, the passage 13 of the valve, and the passage 25 until the rear head of the piston covers the port 28, as shown in Fig. 9, so as to continue full steam-pressure in the rear end of the cylinder for as long a time as possible in order to insure the delivery of a blow of maximum force.

When in its forward movement the front head of the piston uncovers the port 22, steam is admitted to the passage 21, but cannot enter the valve-chest, owing to the fact that the port 16 of said passage is covered by the head 10 of the valve, as shown in Fig. 9, and when the port 38 is uncovered by the front head of the piston, as shown in Fig. 10, steam enters the rear end of the valve-chest through the

passages 36 and 35, but is still opposed by the pressure in the forward end of the chest, and there is no forward movement of the valve until this pressure has been so far reduced by the expansion of steam in the rear end of the cylinder as to bring about the necessary preponderance of pressure in the rear end of the valve-chest. By this time the piston has completed its forward movement and the blow has been delivered, the valve being then moved forwardly, so as to open the rear end of the cylinder to the exhaust and the front end of the cylinder to the steam, as shown in Fig. 5. It will be observed that when the piston is at either end of its stroke the opposite end of the cylinder is open to the exhaust, so that no difficulty is experienced in starting the tool in operation, and this result is effected by the use of a valve which travels in the same direction as the piston—that is to say, when the piston is traveling forwardly the valve has a like forward movement, and when the piston is traveling rearwardly the valve likewise moves rearwardly. Hence to whichever end of the cylinder the piston may be moved by gravity when the operation of the tool is arrested there will be a like movement of the valve, and this movement is one which effects the opening of the opposite end of the cylinder to the exhaust. It will also be noted that the steam is used expansively in the cylinder and that the full steam-pressure in either end of the valve-chest is resisted by expanded pressure in the opposite end of the chest, so that the movement of the valve in either direction is cushioned and destructive hammering of the valve upon the buffers at the opposite end of the valve-chest is prevented, this result being attained, moreover, by the use of a single symmetrical, and consequently reversible, balanced piston-valve.

The forward passage 37 and port 39 can be dispensed with if other means are provided for reducing the pressure in the rear end of the valve-chest. A simple means which may be employed for this purpose is a passage 40 of small area leading from the passage 35 to the exhaust-passage 18, as shown, for instance, in Fig. 11, so as to permit leakage from the rear end of the valve-chest to the exhaust. Hence as soon as steam is cut off from said rear end of the valve-chest by the closing of the port 38 on the rearward movement of the piston the pressure will be reduced and the valve will move rearwardly when steam is admitted to the forward end of the chest on the uncovering of the port 30. This construction causes a constant leakage of steam; but this is so slight as to be unobjectionable.

The port 28 and passage 27 may also, if desired, communicate with the rear end of the cylinder independently of the passage 25—for instance, by means of the passage 29, as shown in Fig. 11. In this case the valve has an additional chamber 41, which when the valve is in the rearward position opens com-

munication between the passage 27 and a passage 42, leading to the passage 29, said passage 42 being closed by the rear head of the valve when the latter is in the forward position.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. The combination in an impact-tool, of the cylinder and its piston, having a steam-supplying groove, the valve-chest and its valve, and steam inlet and exhaust-passages whereby the piston controls the flow of steam into the valve-chest and when the piston occupies a position at that end of the cylinder which is lowermost and the valve occupies a like position in the valve-chest the under side of the piston will be open to the steam passing through the valve-chest and the upper side of the piston will be open to the exhaust, substantially as specified.

2. The combination of the cylinder and its piston having a steam-supplying groove, the valve-chest having a valve which controls the exhaust from both ends of the cylinder, a passage whereby the piston controls the admission of steam to the rear end of the cylinder at a fixed point in the rear stroke, and other passages controlled in part by the piston and in part by the valve, whereby the cutting off of the flow of steam to the rear end of the cylinder is effected at a more advanced point in the forward stroke, substantially as specified.

3. The combination of the cylinder and its piston having a steam-supplying groove, the valve-chest and its valve, a passage whereby the piston controls the admission of steam to the rear end of the cylinder at a fixed point in the rear stroke, and other passages controlled in part by the piston and in part by the valve whereby the cutting off of the flow of steam to the rear end of the cylinder is effected at a more advanced point in the forward stroke of the piston, one of said valve-controlled passages also serving as an exhaust-passage from the rear end of the cylinder, substantially as specified.

4. The combination in an impact-tool, of the cylinder and its piston having a steam-supplying groove, the valve-chest having a single valve and passages whereby full-pressure steam acting upon one end of the valve is resisted by reduced-pressure steam acting upon the opposite end of the valve, substantially as specified.

5. The combination in an impact-tool, of the cylinder and its piston having a steam-supplying groove, the valve-chest having a single valve and passages providing communication between each end of the cylinder and the opposite end of the valve-chest whereby the pressure of expanded steam upon one end of the valve is overcome by full-pressure steam acting upon the other end of the same and movement of the valve is thereby caused, substantially as specified.

6. The combination of the cylinder and its

piston having a steam-supplying groove, the valve-chest and its valve, and a passage leading from the forward end of the cylinder to the rear end of the valve-chest, and serving both
5 to convey steam to the valve-chest and to exhaust it therefrom, substantially as specified.

7. The combination of the cylinder and its piston having a steam-supplying groove, the valve-chest and its valve, and a passage leading from the rear end of the cylinder to the forward end of the valve-chest, and serving both
10 to convey steam to the valve-chest and to exhaust it therefrom, substantially as specified.

8. The combination of the cylinder and its piston having a steam-supplying groove, the valve-chest and its valve, and passages leading from each end of the cylinder to the opposite end of the valve-chest, and serving both
15 to convey steam to the valve-chest and to exhaust it therefrom, substantially as specified.

9. The combination of the cylinder and its piston having a steam-supplying groove, the valve-chest and its valve, a passage leading from the forward end of the cylinder to the rear end of the valve-chest and serving both
20 to convey steam to the valve-chest and to exhaust it therefrom, said passage having two ports located in the cylinder, one in advance of the other, substantially as specified.

30 10. The combination of the cylinder and its piston having a steam-supplying groove, a valve-chest having a valve which controls the admission of steam to and its exhaust from both ends of the cylinder, a steam-inlet pas-

sage leading from the valve-chest to the cylinder, and controlled as to its cylinder end by the piston, and as to its valve-chest end by the valve, whereby after the cylinder end of the passage has been closed by the piston, steam
35 will be used expansively in the end of the cylinder communicating with said passage until there is a movement of the valve controlling its steam-chest end, substantially as specified. 40

11. The combination of the cylinder and its piston having a steam-supplying groove, a valve-chest having a valve which controls the admission of steam to and its exhaust from both ends of the cylinder, steam-inlet passages, one for the front end of the cylinder and the other for the rear end of the cylinder, said passages leading from the cylinder to the valve-chest, and being controlled as to their cylinder ends by the piston and as to their valve-chest ends by the valve, whereby steam
45 will be used expansively in each end of the cylinder after the cylinder end of its corresponding passage has been closed by the piston and until there has been movement of the valve controlling its valve-chest end, substantially as specified. 50 60

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

THOMAS H. PHILLIPS.

Witnesses:

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JOS. H. KLEIN.