

(No Model.)

3 Sheets—Sheet 1.

H. P. MERRIAM.
FUSE.

No. 475,786.

Patented May 31, 1892.

Fig. 2.

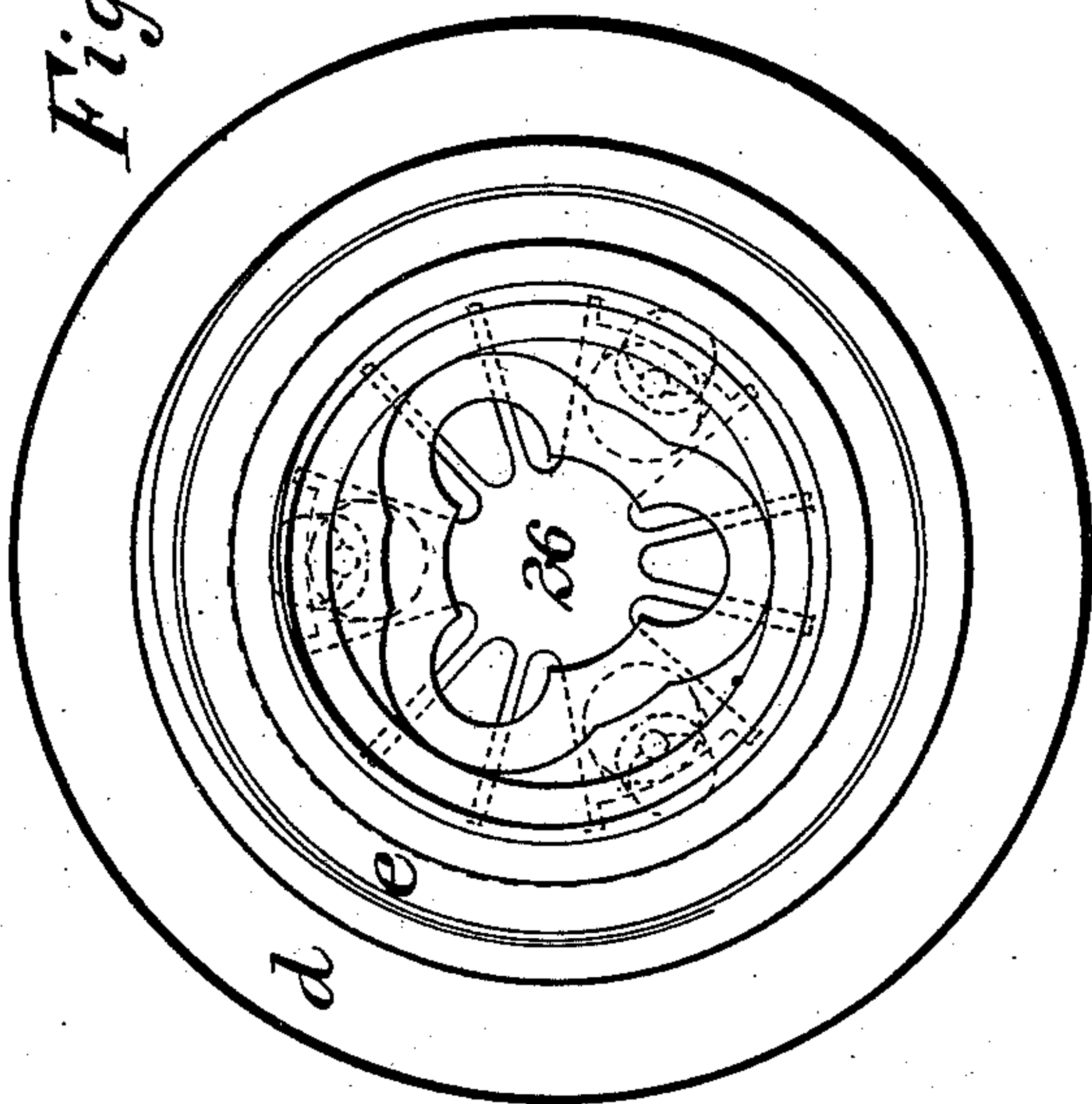


Fig. 6.

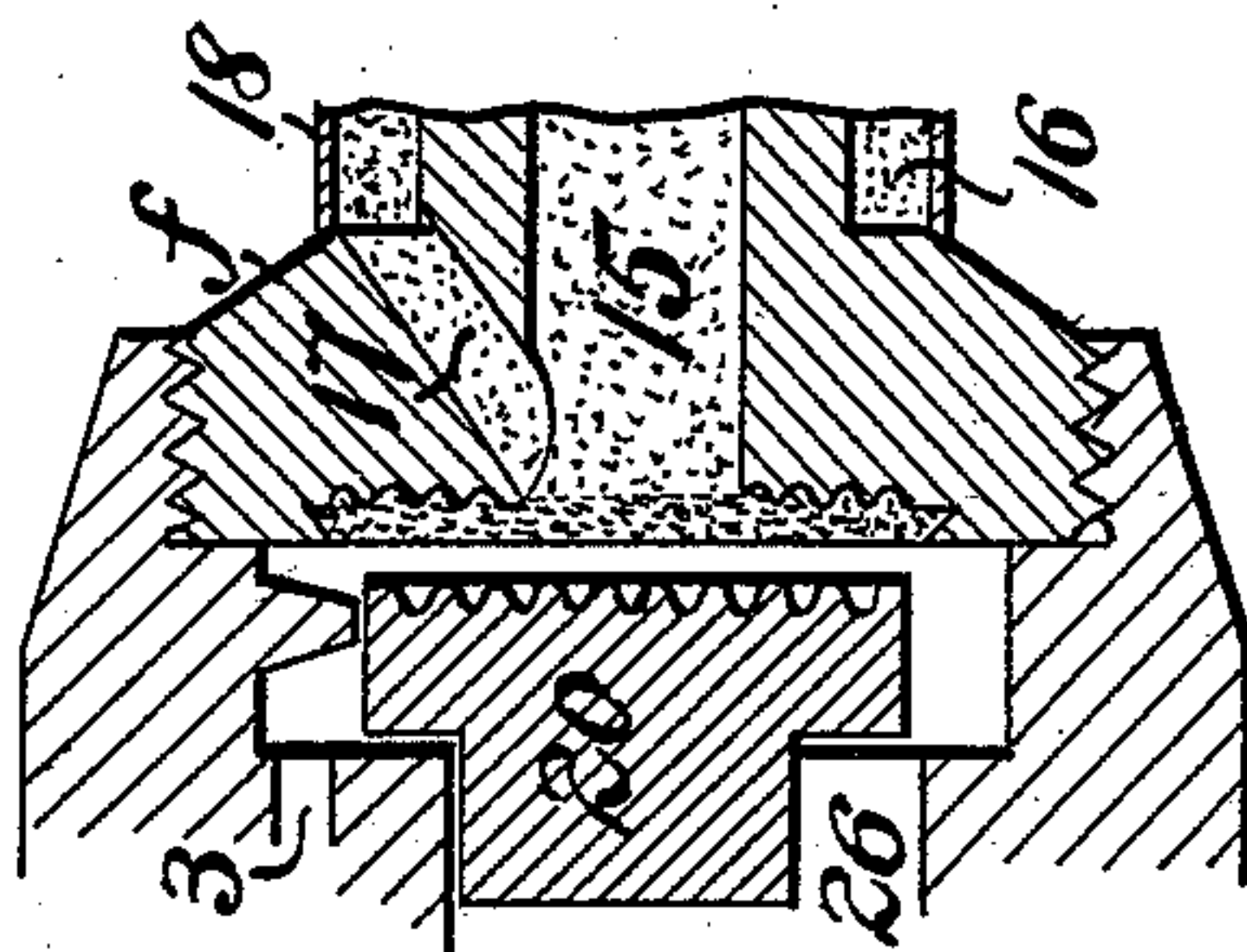


Fig. 5.

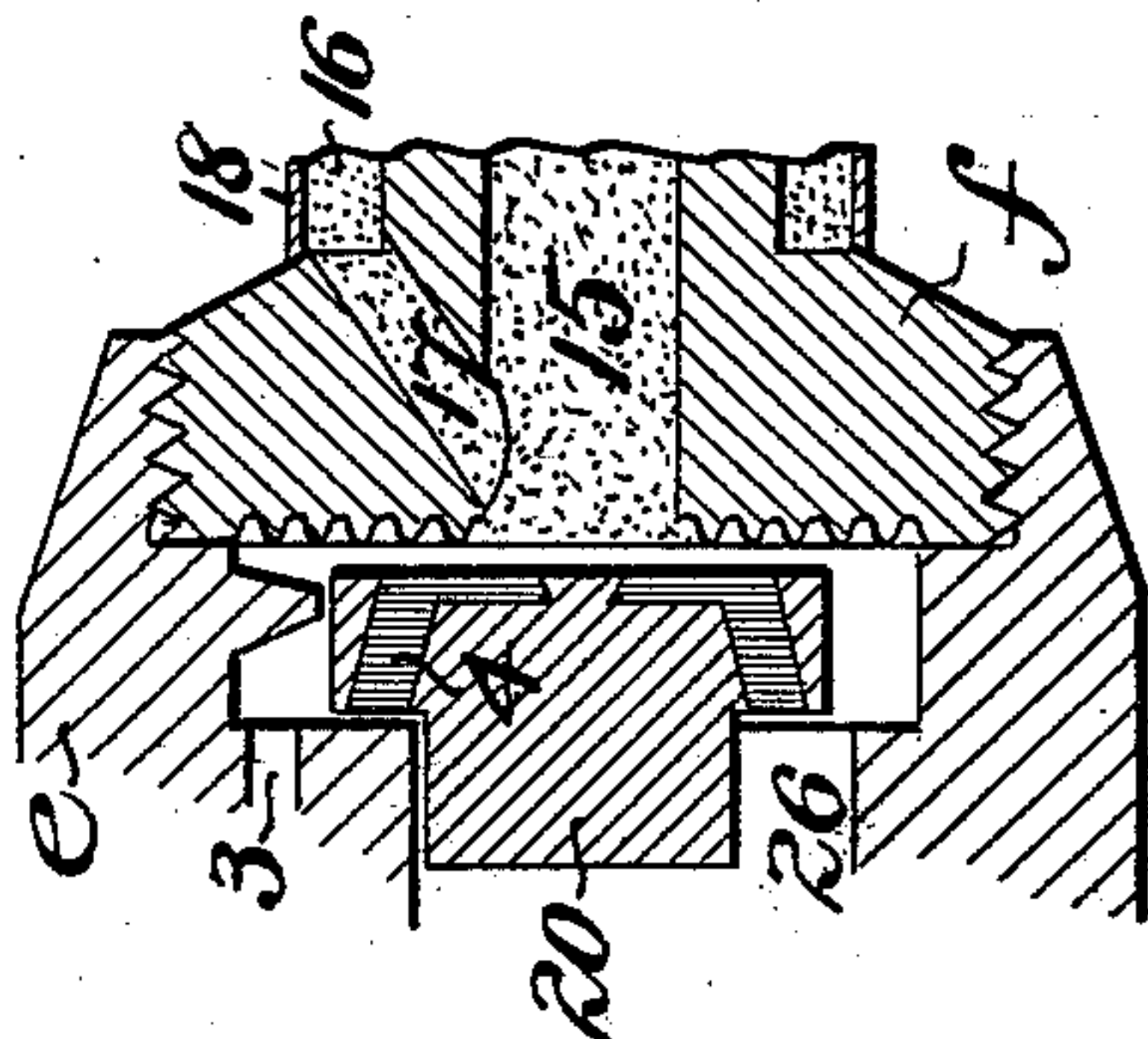


Fig. 4.

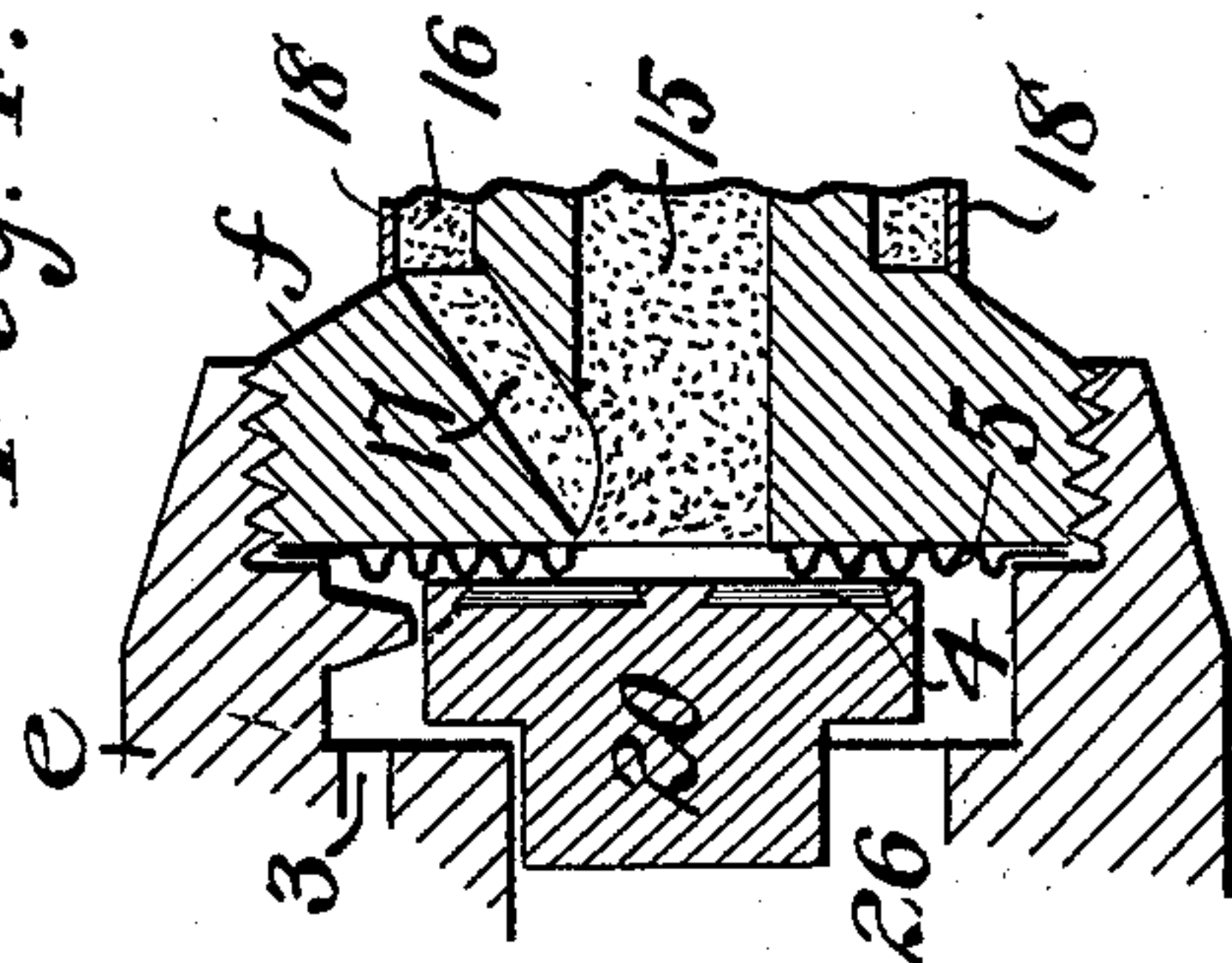


Fig. 3.

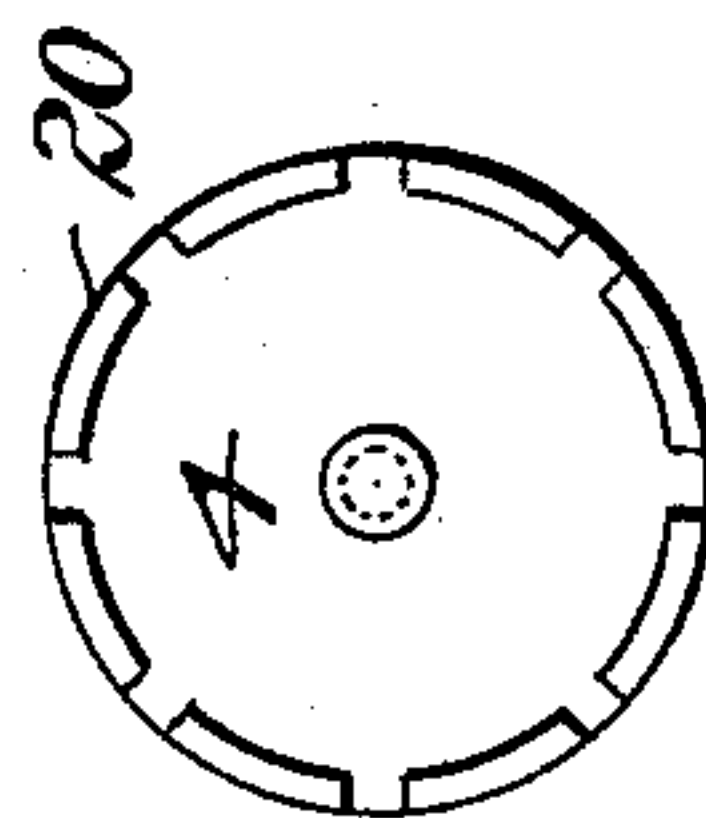
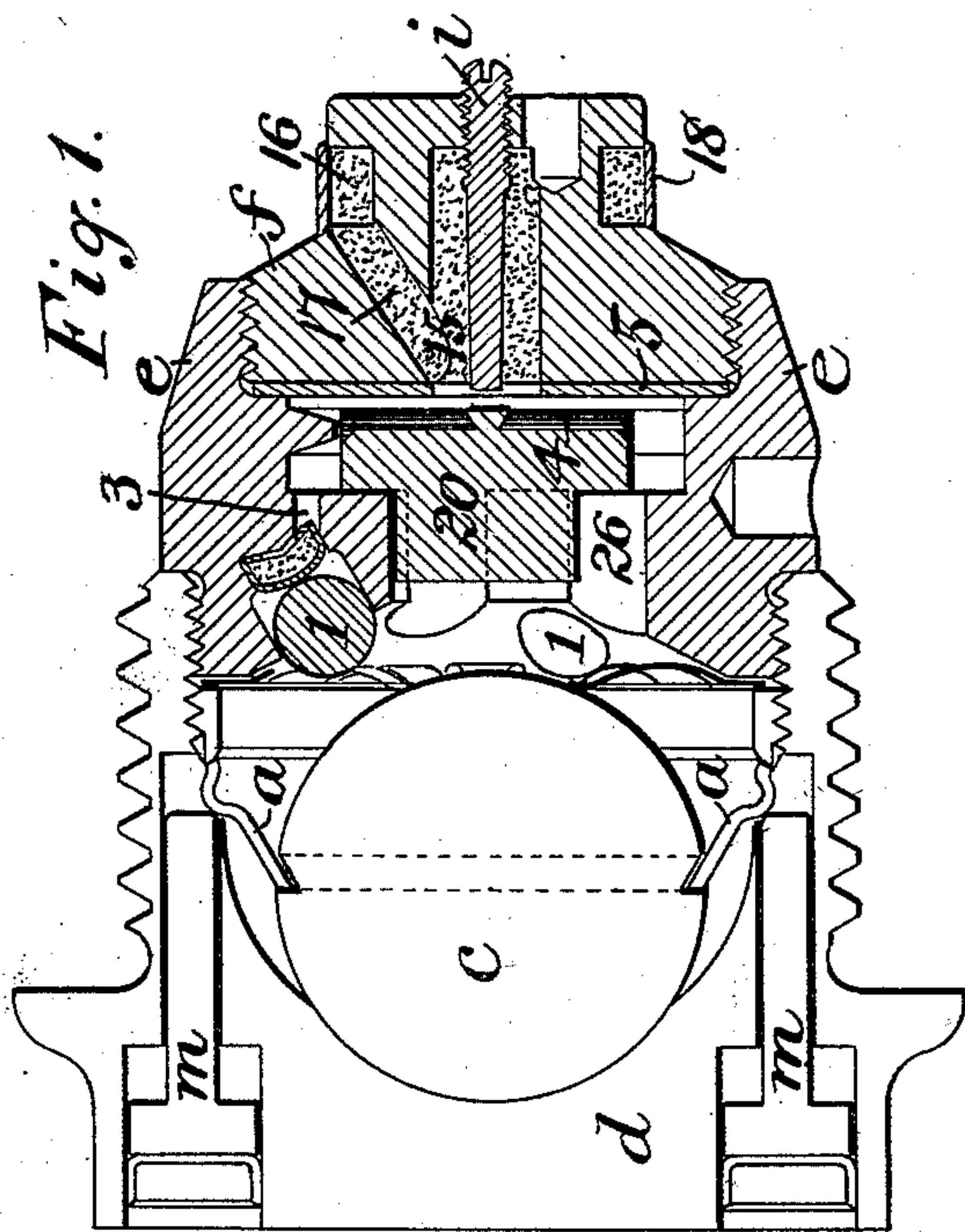


Fig. 1.



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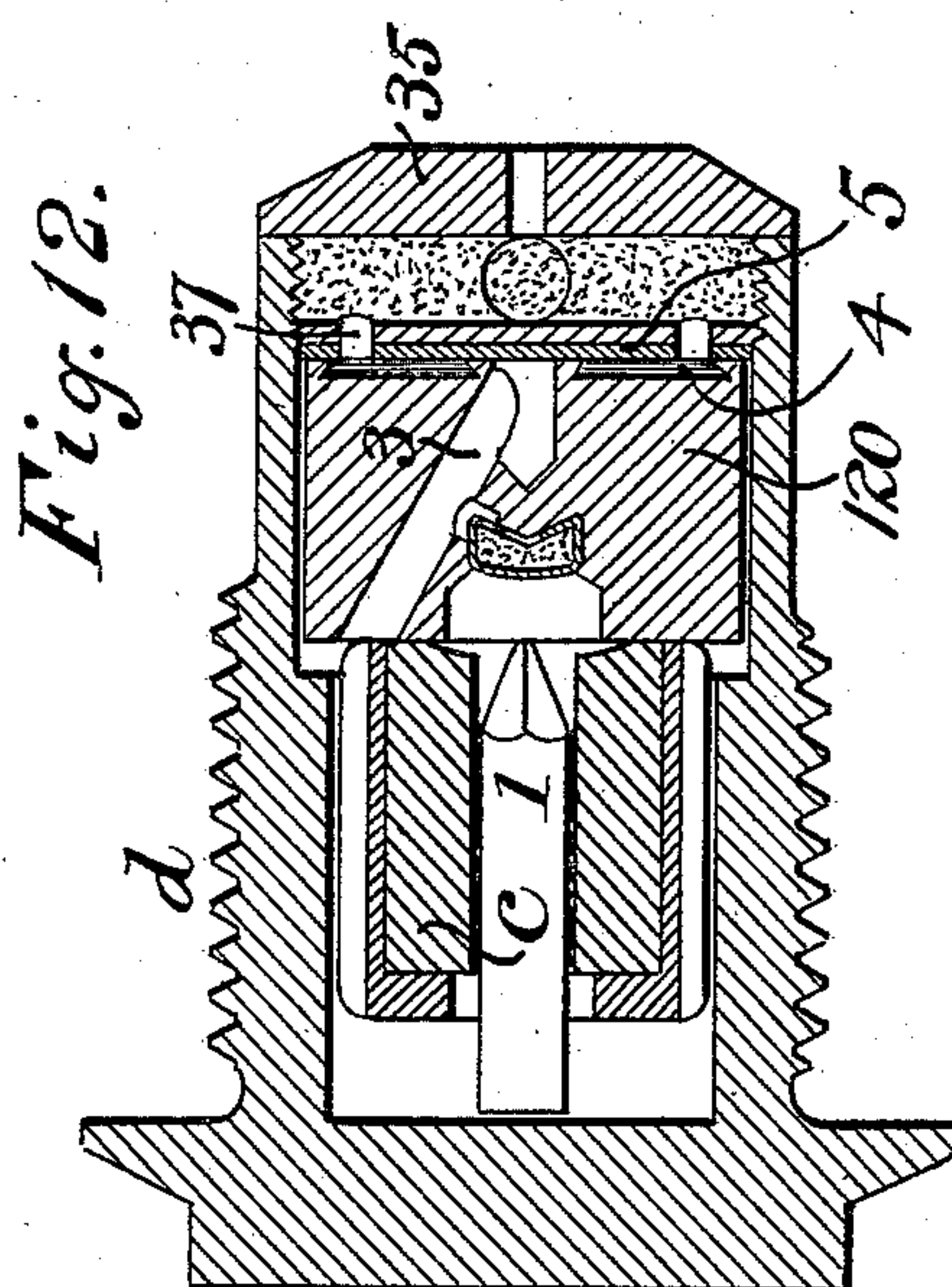
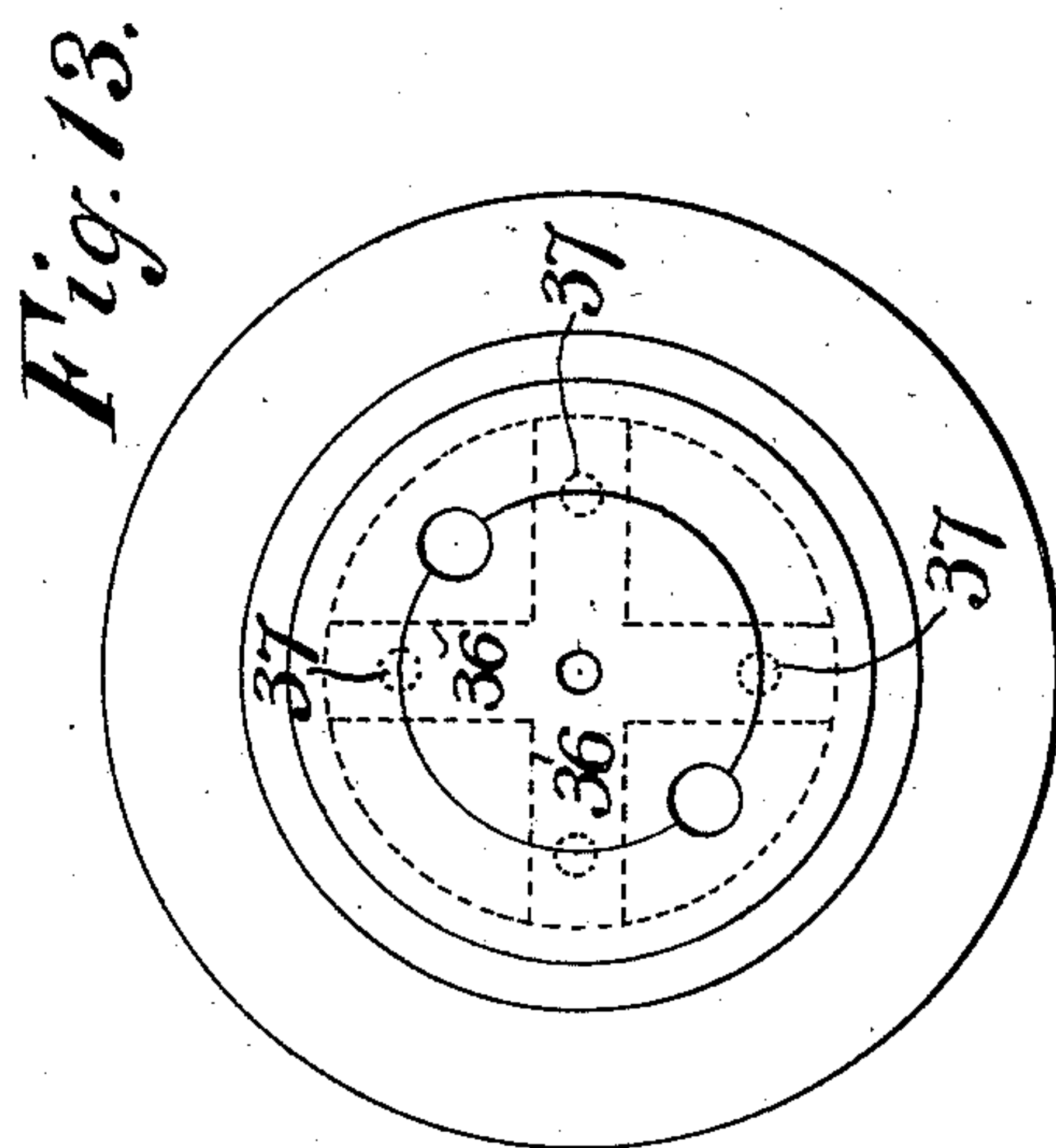
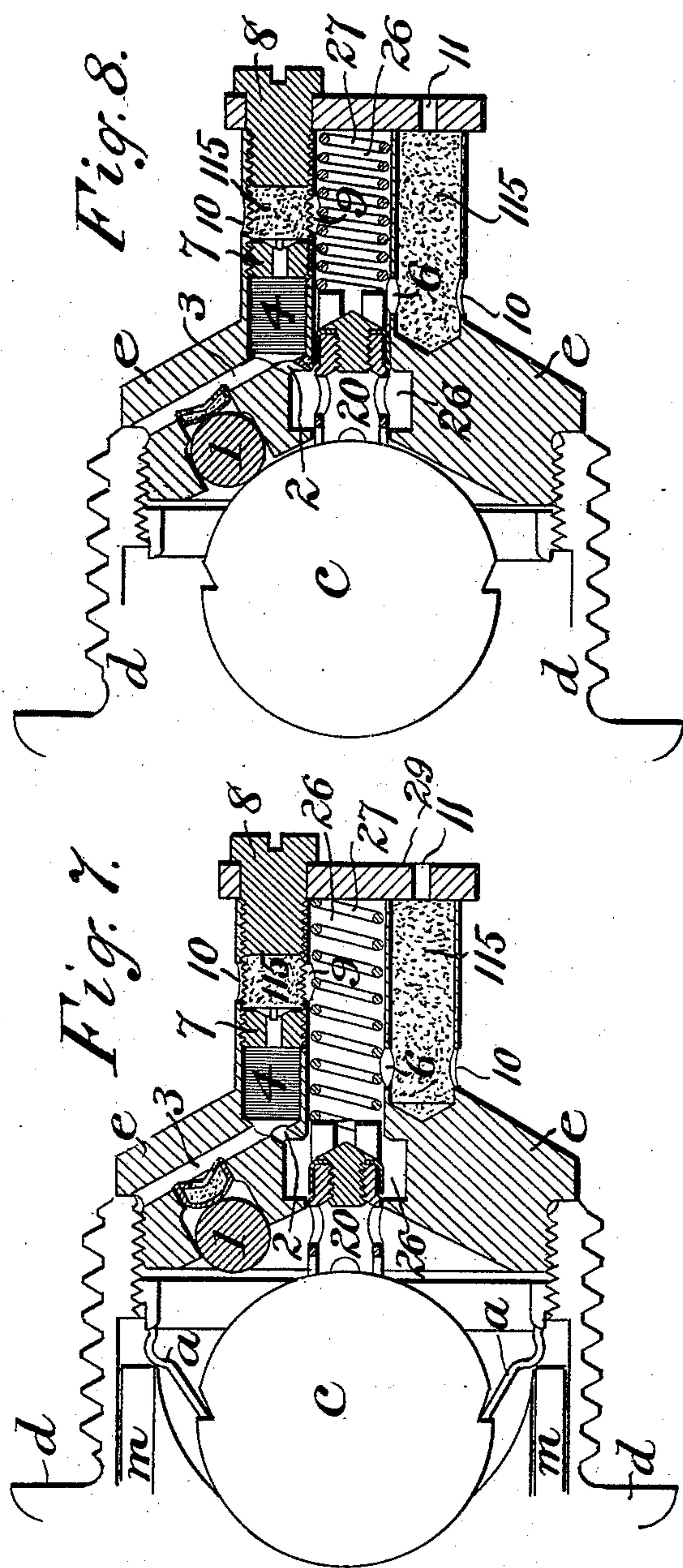
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(No Model.)

3 Sheets—Sheet 3.

H. P. MERRIAM.
FUSE.

No. 475,786.

Patented May 31, 1892.

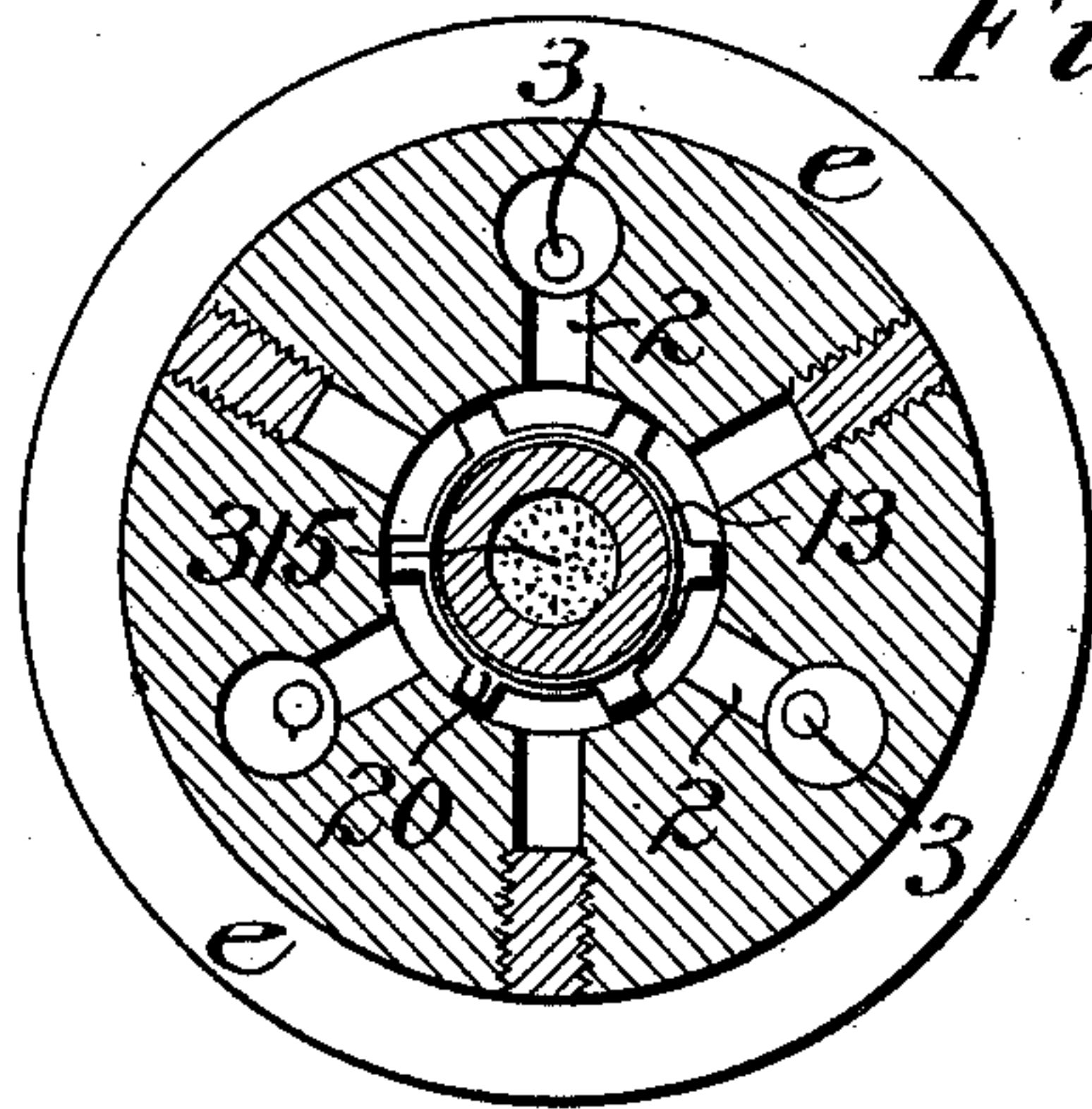


Fig. 11

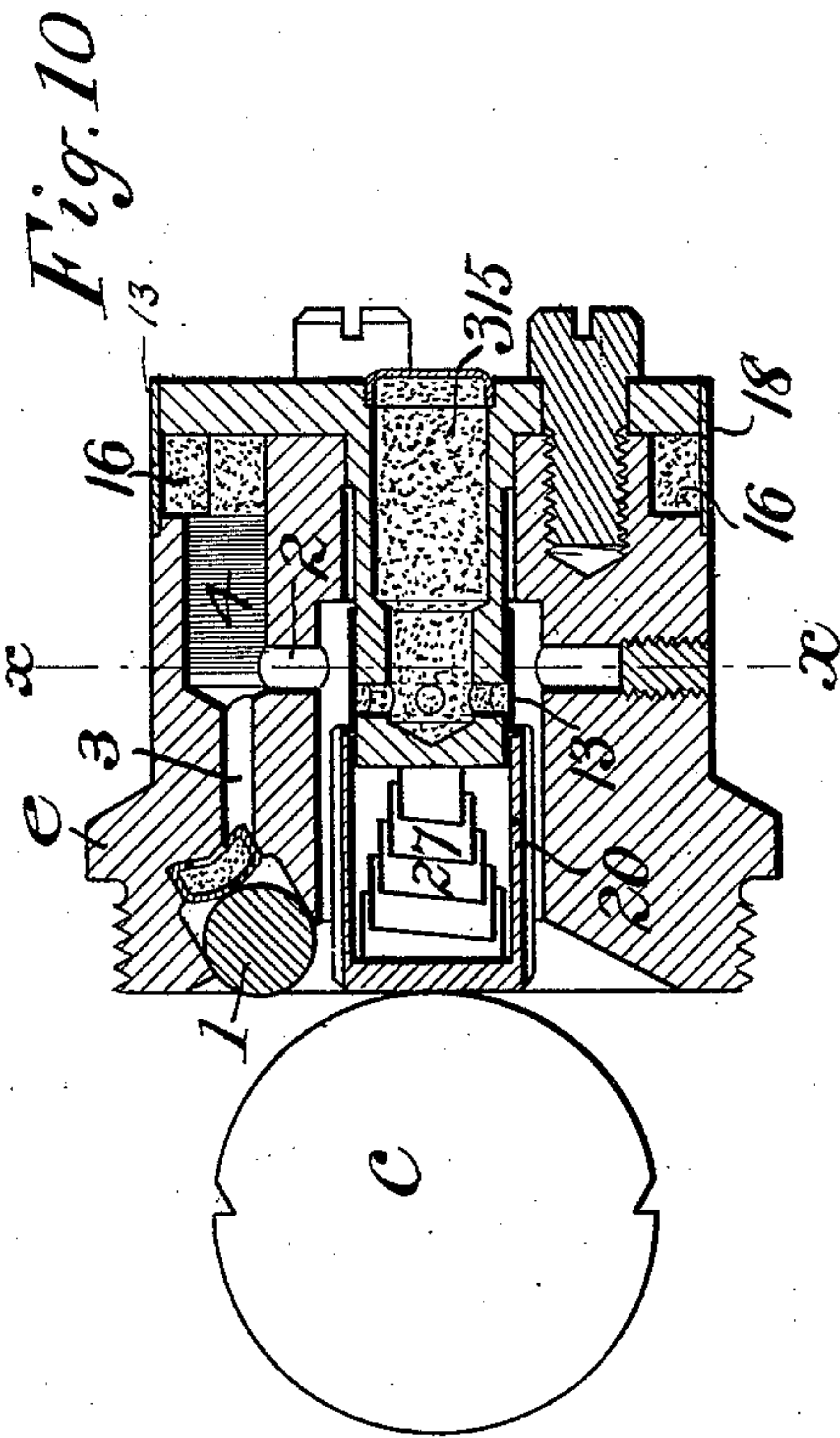


Fig. 10

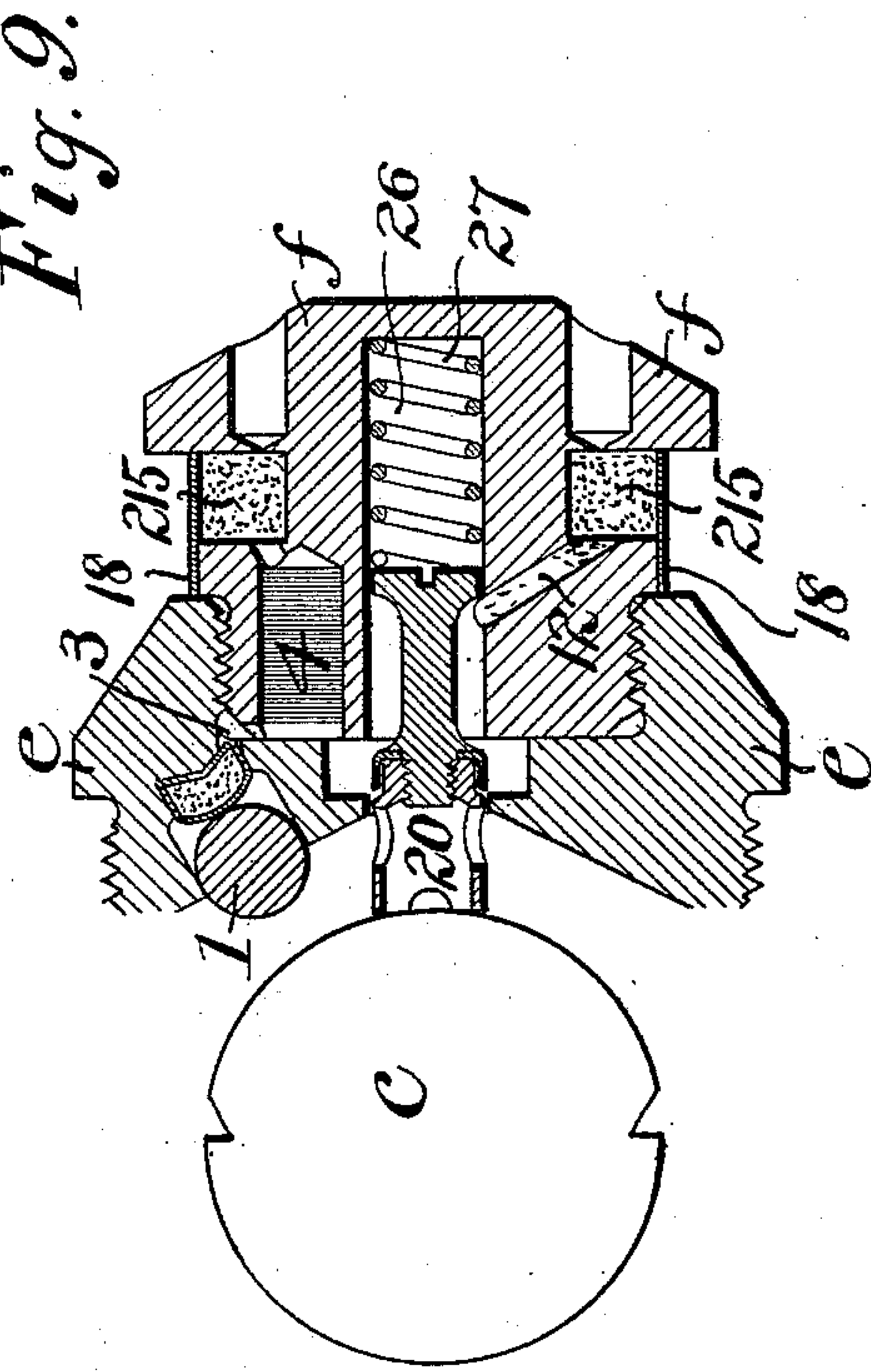


Fig. 9

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UNITED STATES PATENT OFFICE.

HENRY P. MERRIAM, OF NEW YORK, N. Y.

FUSE.

SPECIFICATION forming part of Letters Patent No. 475,786, dated May 31, 1892.

Application filed January 12, 1892. Serial No. 417,836. (No model.)

To all whom it may concern:

Be it known that I, HENRY P. MERRIAM, of the city, county, and State of New York, have invented certain new and useful Improvements in Fuses, fully set forth in the following description and represented in the accompanying drawings.

This invention relates generally to a fuse for shells, but more particularly to a means for automatically regulating the delay between the time of firing of the cap and the explosion of the bursting charge within the shell.

The object of the present invention in the main is to provide means for controlling the time at which the bursting of the shell shall take place with respect to the explosion of the cap or fulminate, or, in other words, with respect to the impact of the shell with the target, whatever its nature, whereby such a fuse may be used or the fuse be so regulated, either during manufacture or before or at the time it is combined with the shell, that the shell shall burst while in the target, while passing through it, or at different distances during or after flight, having passed through the target.

To this end the improvement embraces, broadly, a burning or igniting charge adapted to be ignited on the explosion of the cap or fulminate and a controller or valve for delaying the ignition of or retarding the free burning of said charge.

It also embraces with the burning or igniting charge and the controller or valve of a delay burning charge adapted to be ignited on the explosion of the fulminate, the rapidity of communication of the flame from which to the other burning charge being governed by the position of the controller.

It furthermore embraces other features of invention and novel constructions and combinations of parts fully hereinafter set forth, reference being had to the accompanying drawings.

In said drawings, Figure 1 is a longitudinal sectional elevation of a fuse containing the improvement in its preferred form. Fig. 2 is a front view of the same, the front or auxiliary head *f* being removed, showing the form of the interior walls of the recess holding the

controller or valve. Fig. 3 is a face view of the controller or valve. Fig. 4 is a sectional elevation of a portion of Fig. 1 with the controller in its changed or forward position and a modified form of its seat. Figs. 5 and 6 are similar views showing changes in the arrangement of the delay burning charge. Figs. 7 and 8 are similar longitudinal sections of a modified form of the controller in its two positions and a different arrangement of the burning charge. Fig. 9 is a similar sectional view of another modified structure. Fig. 10 is a like section of still another form of the controller, and Fig. 11 is a transverse vertical section of the same on the line *x x*. Fig. 12 is a sectional elevation of the improvement combined with a different form and construction of fuse, and Fig. 13 is an end elevation of the same.

The present improvements are illustrated in Figs. 1 to 11 in connection with a base-fuse of the construction set forth and described in an application filed by me in the United States Patent Office June 4, 1891, Serial No. 395,081, wherein the hammer *c* is held in place against premature movement by one or more retainers *a*, interposed between a shoulder on the hammer and a shoulder on the fuse-case, combined with which is one or more trips *m*, the heads of which are exposed to the exterior of the fuse, so that the pressure of the firing charge that propels the shell and fuse from the gun will exert its pressure against the trips to move them inwardly against a portion of the retainers, so as to trip them off the shoulder, and thus free the hammer. It is to be understood, however, that the means of exploding the fulminate may be varied from that shown.

The fuse-case in the main consists of a hollow stud-like structure or body *d*, having exterior screw-threads adapting it to be screwed into the base of the shell and with a forwardly-extending head *e*, adapted to screw into the front end of the hollow body to close the same, the whole forming when screwed together a single structure, known as a "fuse" or "fuse-case." The head *e* carries the usual caps or fulminates, which may be seated on nipples, or over which may be seated, as shown, firing-pins *l* in the form of small spheres.

The cap seat or seats are each in communication by a duct 3 with a central perforation 26, in communication with the main burning or igniting charge provided in Fig. 1 in a central longitudinal recess 15 in an auxiliary head *f*, screwed into the end of the head *e*. This charge is in communication by one or more inclined passages 17 with an exterior or circumferential chamber 16, containing a supplemental burning charge that is confined by a fragile sleeve 18. Interposed between the main burning charge and the cap or fulminate there is provided a controller or valve 20, that is adapted to retard or delay the passage of the flame from the cap to the burning charge, or to act as a means of checking the free burning of said charge.

In the construction shown in Fig. 1 the controller or valve 20 is fitted to move longitudinally with respect to the fuse-case more or less freely in the central recess 26, the walls of which provide a number of separated supports for the controller or valve, with intermediate free passages when in its normal rear position, as in Fig. 1, around it for the flame from the cap to the burning charge, but which when in its forward or moved position tends to check or partially stifles the burning of the burning charge, and thus for the time being prevents the speedy communication of the flame with the bursting charge in the shell. This movement of the controller or valve takes place at the moment of impact of the shell with the target and at the time the hammer strikes and explodes the fulminate, so that it is immediately placed in position to act as a means of delaying the ultimate communication of the flame with the bursting charge.

In the construction shown in Fig. 1 the controller, preferably free of movement, presses with considerable force against the forward face of the bursting charge, this force being due to the violent retardation in velocity of the mass of the controller and continuing so long as such change in velocity exists; and should the shell remain in the target or continue its flight after striking the target, passing through it or beyond it, according to the nature of the target, the controller, due to the pressure exerted by the gases generated in front of it, will return to its normal rearward position, permitting the burning charge to burn freely, so that the flame therefrom immediately enters the shell and fires the bursting charge in the usual way.

In the preferred construction, as shown in each of the several embodiments herein, there is provided a delay burning charge 4, which may or may not be always exposed to the flame from the fulminate, which in the moved position of the controller or valve takes the flame from the fulminate, and by reason of its different composition or harder packing, as may be preferred, burns slowly with sufficient delay to prevent the immediate ignition of the main burning charge during, for instance,

the penetration of the target by the shell, or even during its further flight beyond the target.

In the form shown in Fig. 1 the delay burning charge 4 is contained by a recess in the face of the controller, and thus moves with it. The walls of the recess are undercut, so that the charge is properly held thereby, the face of the charge being in the main exposed, so that the flame may gradually burn from the exterior edge thereof toward the center. The rim of the recess is also cut away at several places, (see Fig. 3,) so that the delay charge may fill these cut-away portions and be exposed at the circumference of the controller in the path of the flame from the fulminate, so that its ignition is insured.

Instead of allowing the face of the delay burning charge to seat against the end or contiguous surface of the auxiliary head *f*, which might be the case, there is provided a seat 5 of felt or soft metal, such as lead, or in lieu of either of these a closely-corrugated disk of copper may be used, as seen in detail, Fig. 4. The latter form presents, instead of a flat or soft surface, a broken surface, so that the burning of the delay charge is allowed to spread gradually and is not stifled too much.

In Fig. 5 the delay charge is arranged in perforations in the controller, passing from one face to the other, so that the controller must first move to its forward position to place the delay charge in position to be ignited by the flame from the fulminate.

In Fig. 6 the burning charge, whether delay or flashing charge, is arranged on the face of the auxiliary head, the controller in this case having moved up to guard its surface and thereby retard the spread of the flame and compelling its gradually burning inwardly toward the central chamber 15, as the controller bears against its surface; but when it moves away from any cause—as, for instance, by the pressure of the gases in front of it—the flame will quickly spread over the entire surface of the charge and immediately communicate with the bursting charge in the shell.

During the flight of the shell and fuse, the retainers having been tripped from the hammer by the firing pressure of the propelling charge or by any other means in other forms of fuses, the parts will remain substantially in the same position as that shown in Fig. 1, with the said one exception. As soon as the shell strikes the target the hammer moves forward against the firing-pins by its momentum and the controller or valve 20 is simultaneously moved forward, so that the delay charge is seated against the rear surface of the auxiliary head *f* or of the seat 5. In this position of the valve and delay charge, as in Fig. 4, the flame from the cap caused by the striking of the hammer is for the time being prevented from passing direct to the main burning charge, and consequently fires the delay charge only, or the flame from the fulminate ignites the edge of the burning charge, as in

Fig. 6. This burns slowly inwardly, the gases generated thereby passing upward around the valve and into the hammer-chamber, and, if the pressure be great enough, expels the trips outward and passes into the atmosphere. The flame is thus delayed in passing to the main burning charge until the delay charge or exposed portion of the main charge is nearly or wholly consumed, when it immediately fires the burning charge in the central chamber 15, and thence the supplemental charge in the exterior chamber 16, when the latter is used, and finally enters the shell to fire the bursting charge. After the first violent retardation of the shell upon striking the target and should the shell continue its flight, the controller or valve will become seated again in its rear position, so that the flame from the surface of the delay charge or the exposed portion of the main charge may then immediately communicate with the main burning charge and fire it without waiting for any further burning of the delay charge to accomplish this, when the firing of the bursting charge takes place, as before, and this may occur during the further flight of the shell or after it has again struck and its flight stopped entirely.

In the construction shown in Figs. 7 and 8 the head *e* of the fuse-case (the other parts of the fuse being of any suitable construction and being partially indicated in diagram) is formed with a number of chambers or pockets 115, one or more of which contain a burning or igniting charge and are closed in front by a removable plate 28, having a perforation 11 in line with one or more of the chambers. One or more of these chambers is in communication by the duct 3 with the cap-seat, and by a duct 2 with an enlargement of the central recess 26, and thence past the controller or valve therein through perforations 6 with the chamber or chambers 115 not in direct communication with the cap-seat. The chamber in communication with the cap-seat is preferably provided with the delay burning charge 4, which may be separated from the main burning charge in the same chamber by a perforated wad or diaphragm 7, screwed in place and holding the delay charge and the main charge held by the plate 28 or by a screw 8, which serves to secure the plate, said latter charge being in communication with the central recess 26 through a perforation 9 and with the bursting charge of the shell or the exterior of the fuse-case by a perforation 10, as is also the other chamber 115. The controller or valve in this form of the invention is in the form of a piston held to its normal rearward position by a spring 27, which also performs the function through the valve of holding the hammer *c* to its rearward position and allowing the flame from the cap to pass by the duct 2 across the front of the valve, across the recess 26, and through the perforations 6 and 9 into the chamber or chambers 115 for firing the main burning

charge. In the moved position of the valve in Fig. 8 the recess is closed, so that communication between the ducts 3 and 2 with the chamber 115 by the perforations 6 or 9 is cut off, and the flame from the cap is confined to the delay burning charge 4, the gases resulting therefrom passing by the duct 2 and perforations in the valve into the hammer-chamber. So long as the valve remains in this forward position the flame is confined to the delay charge and finally communicates through the perforation in the wad or diaphragm 7 with the main burning charge and issues out of the perforation 10 into the bursting charge of the shell. Should the shell remain in the target or continue its flight after striking the target, the momentum of the valve is overcome by the spring 27 and is forced backward to its normal position, so that the flame from the ignited delay burning charge is free to pass in front of the end of the valve and by the perforations 6 or 9, or both into the main burning charge or charges for the immediate ignition of the bursting charge, either through the perforation 10 or out through the front perforation 11.

In the construction shown in Fig. 9 the main burning charge is contained by an exterior chamber 215 in the auxiliary head, which screws into the head *e* of the fuse-case, the charge being protected by a fragile sleeve 18 and in communication with the central recess 26 by an inclined passage 12. The delay burning charge 4 is contained by a chamber in the auxiliary head, which is in communication by the duct 3 with the cap-seat, and is also open to the central recess 26. In this form the delay charge will not completely fill its chamber, so that a free passage is left in rear of the charge from the duct 3 to the recess 26, and the front of the chamber is in communication with the main burning charge chamber 215. The controller or valve 20 is similar to that described with respect to Figs. 7 and 8, except that it is provided with a sub-caliber stem, which in its normal rearward position forms sufficient space for the passage of the flame from the cap-seat or delay charge across the central recess to ignite main burning charge through the inclined passage and thence the bursting charge in the shell, as before. In the changed position of the valve it closes the entrance to the central recess or shuts off the entrance to the main burning charge, so that the flame from the cap is confined to the delay charge, the gases generated from the burning of the latter are free to pass into the hammer-chamber through the perforated head of the valve, which then registers with the central space that is in communication with the chamber containing said delay charge.

In the form of the invention shown in Figs. 10 and 11 the main burning charge is confined in a central chamber 315, formed by a rearwardly-extending nipple, the end of which has a number of radial openings, which also

contain some of the burning charge. There is provided the supplemental burning charge 16, protected by the fragile sleeve 18 but having no communication with the main burning charge. With this supplemental charge there is one or more communicating chambers containing the delay charge 4, that is open to the duct 3 with the cap-seat and by a duct 2 with the central recess around the nipple containing the main burning charge. The main burning charge through the radial openings in the nipple is protected by a fragile sleeve 13, surrounding the nipple and adapted to slide forward thereon to uncover the openings. The end of the nipple is embraced by the controller or valve 20, which is, in the form of a thimble, held extended and in its rearward normal position against the hammer *c* by the spring 27, and capable of sliding over the nipple at the moment of impact of the shell with the target to move the sleeve 13 forward to uncover the openings in the nipple and then to cover said openings to prevent the flame from igniting the main burning charge. As soon as the spring 27 can act to overcome the momentum of the valve, it moves the latter rearward and uncovers the radial openings through the nipple and permits the flame from the delay charge to ignite the main burning charge and thence the bursting charge in the usual way.

In the form shown in Figs. 12 and 13 the fulminate is carried by a longitudinally-movable block 120, which acts as the controller or valve. The forward end of the block carries the delay charge in a manner similar to the valve of Fig. 1, and the duct 3 from the cap-seat opens outward at the forward end of the head, which end is normally seated against the rearward end of the screw-cap 35 or against a felt or soft-metal seat 5. The screw-cap is formed with two diametrical channels 36, which contain the main burning charge, open to the flame from the delay charge through rear openings 37. At the moment the shell is propelled in the gun the hammer *c* moves rearward over the firing-pin 1, so as to uncover or protect its end forward beyond the hammer in a manner now well known. The block 120, carrying the fulminate, likewise moves rearward up to the shoulder of the fuse-case, and at the moment of impact the hammer and firing-pin and the block are simultaneously thrown forward until the delay charge of the block is seated against the seat 5, while the firing-pin is projected into the fulminate cavity and explodes the fulminate. The delay charge is thereupon immediately ignited from the center and burns outwardly, while the gases generated thereby escape rearward through the channel in the block and into the hammer-chamber. Should the shell remain in the target or continue its flight, the gases accumulating between the seat 5 and the delay charge will move the block 120 rearward away from the seat, so that the flame quickly spreads and thence fires the main

charge, and through the central perforation in the screw-cap fires the bursting charge of the shell.

In each of the several embodiments of the invention the controller or valve 20 of the block 120 moves at the time of impact of the shell with the target to guard or control the freedom with which the burning charges shall burn or to cut off a portion of the charge, and after the first sudden retardation of the shell, either by the pressure of the gases generated by the burning charge or by a spring, the controller or the block is caused to resume its other position, allowing the flame to spread to all parts of the charge immediately or as quickly as the nature of the charge and the manner it is packed will permit. By this means the flame from the fulminate is prevented from immediately igniting the bursting charge at the moment of impact with the target; but a short delay occurs, sufficient to allow the shell to penetrate the target, bursting while in the target or after passing through it, according as the bursting charge may have been prepared for the purpose.

It is obvious that any means of preventing the action of the controller or valve may be employed. Thus in Fig. 1 there is provided a screw-pin *i*, which when moved inward serves as a stop, preventing the movement of the controller. In the form shown in Figs. 7, 8, 9, and 10 the controller may be removed entirely and the flame from the fulminate ignite both the delay and the main burning charges.

The particular form of hammer and means for operating it is not herein claimed, as it forms the subject-matter of the said application heretofore mentioned, and such fulminate-exploding means is simply shown in connection with the present invention as one of the forms of fuses with which the invention may be practically used, and is not intended to in any way limit the scope of the invention or to be limited to such use.

While in the arrangement of the controller of valve, as shown and described, said valve moves at the time of impact into its controlling position, it is to be distinctly understood that it may be so arranged as to be normally in the controlling position and adapted to be moved automatically after impact—as, for instance, by the pressure of the accumulating gases behind it, forcing it from its controlling position, so as to open communication between the flame and the burning-charge. In fact, so many different arrangements of valves for delaying the ignition of the burning charge may obviously be made that I do not intend to limit the invention to the particular forms shown and described.

What is claimed is—

1. In a fuse, the combination, with the fulminate and means for exploding the same, and a burning charge ignited from the fulminate, of an automatically-operative controller or valve interposed between the ful-

minate and the burning charge for delaying the ignition of or retarding the free burning of said charge, substantially as described.

2. In a fuse, the combination, with the fulminate and means for exploding the same, of a delay burning charge ignited from the fulminate, a main burning charge, and a controller or valve regulating the time of ignition of said main charge, substantially as described.

3. In a fuse, the combination, with the fulminate and means for exploding the same, of a burning charge ignited from the fulminate and a longitudinally-movable controller or valve adapted to retard the burning of said burning charge, substantially as described.

4. In a fuse, the combination, with the fulminate and means for exploding the same, of a burning charge ignited from the fulminate and a movable controller or valve carrying said burning charge into contact with an opposed seat to retard its free burning, substantially as described.

5. In a fuse, the combination, with the fulminate and means for exploding the same, of a delay burning charge ignited from the fulminate, a movable controller or valve supporting said delay charge, and a main burning charge, the spread of the flame from the delay charge to the other charge being retarded by the movement of the controller, substantially as described.

6. In a fuse, the combination, with the fulminate and means for exploding the same, of a burning charge ignited from the fulminate, and a movable controller or valve for retarding the burning of said charge and adapted to move into retarding position by its mo-

mentum at the time of impact and to move from such position by the pressure of the gases generated by the burning charge, substantially as described.

7. The combination, with a fuse-case having supports for a hammer and a fulminate, and a main burning charge, of a movable controller or valve supported in said fuse-case in the path of the flame from the fulminate to the main burning charge and carrying on its forward face a delay charge for ignition from the fulminate, substantially as described.

8. In a fuse, the combination, with the fulminate and means for exploding it, of a burning charge ignited from the fulminate, a movable controller or valve for retarding the burning of said charge, and a corrugated seat for the controller or valve, substantially as described.

9. In a fuse-case, the combination of the body containing the hammer, the head containing the fulminate and the controller or valve, and the auxiliary head containing the burning charge, substantially as described.

10. In a fuse, the combination, with the fulminate and means for exploding the same, of a burning charge ignited from the fulminate, a movable controller or valve for retarding the burning of said charge, and an adjustable stop for preventing the movement of the controller, substantially as described.

In witness whereof I have signed my name, in the presence of two witnesses, this 9th day of January, A. D. 1892.

HENRY P. MERRIAM.

Witnesses:

GEO. H. GRAHAM,
N. MARLER.