No. 672,826. Patented Apr. 23, 1901.

L. & E. GATHMANN.

SAFETY FUSE FOR HIGH EXPLOSIVE SHELLS.

(Application filed Aug. 8, 1898.)

(No Model.) 7 Sheets—Sheet 1.

Fig. 1.

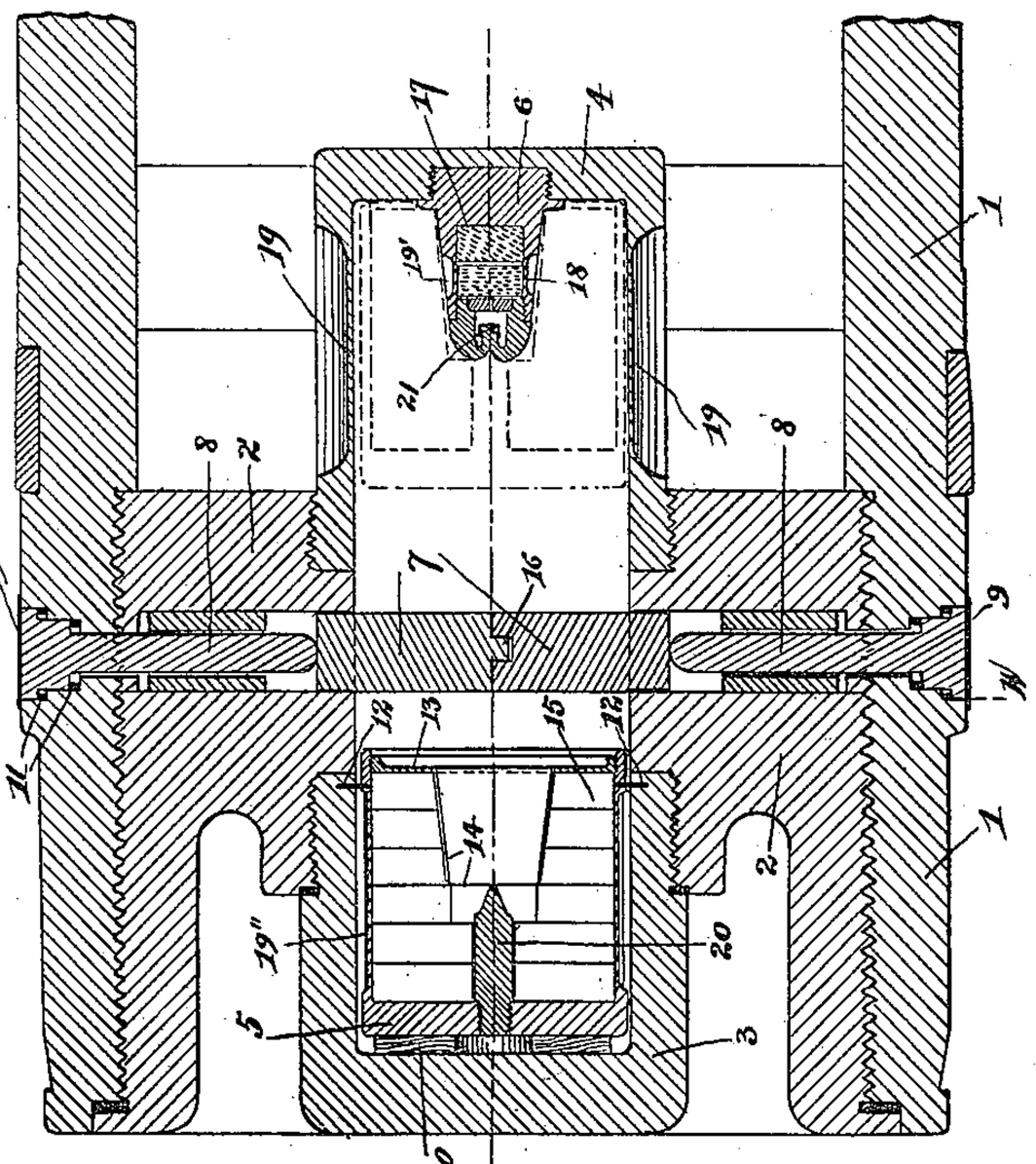

Fig. 2.

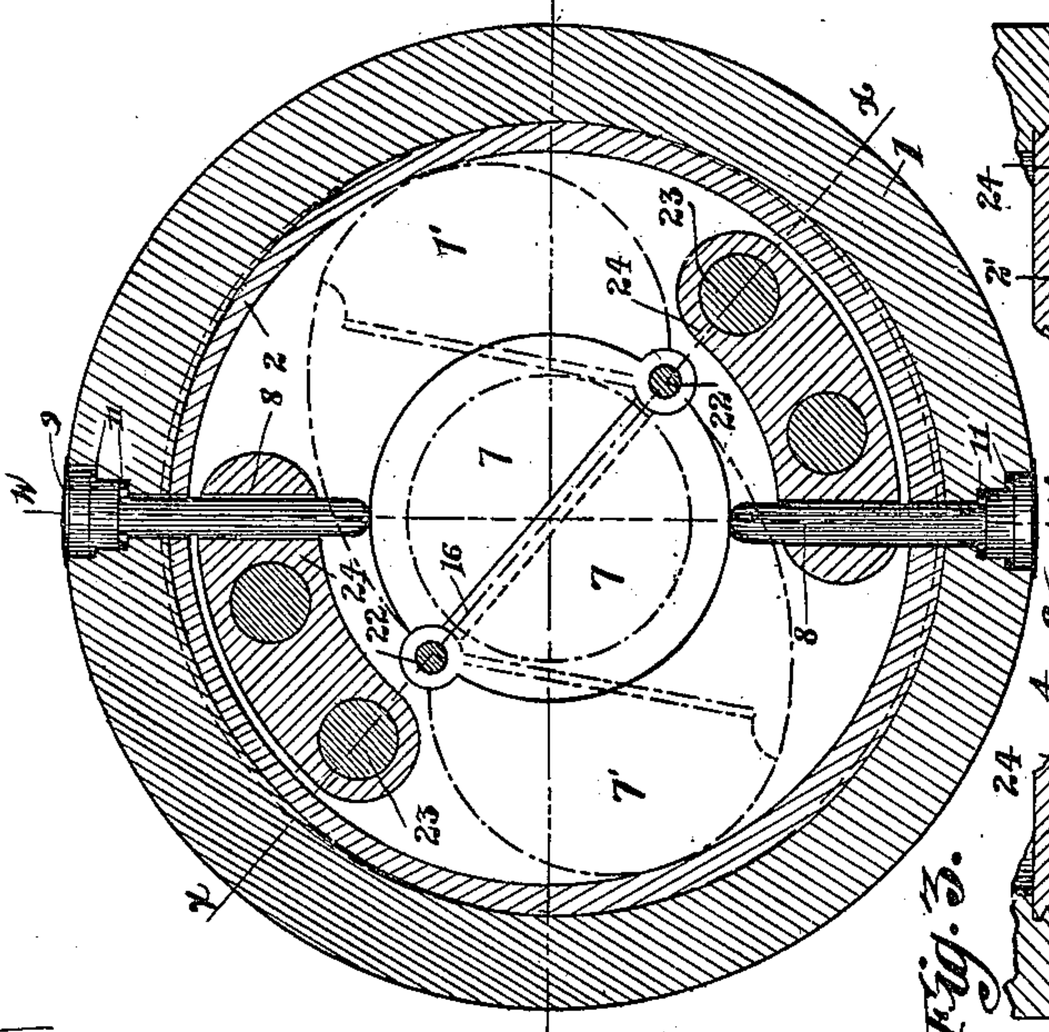

Fig. 3.

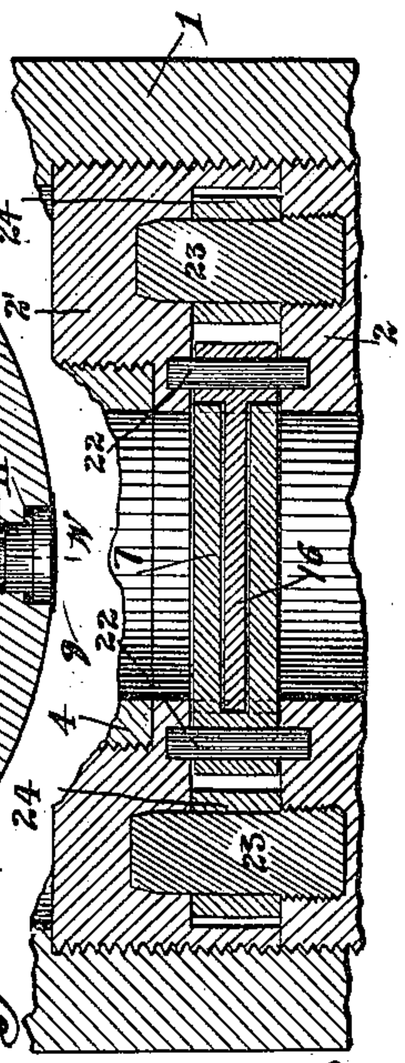

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Fig. 4.

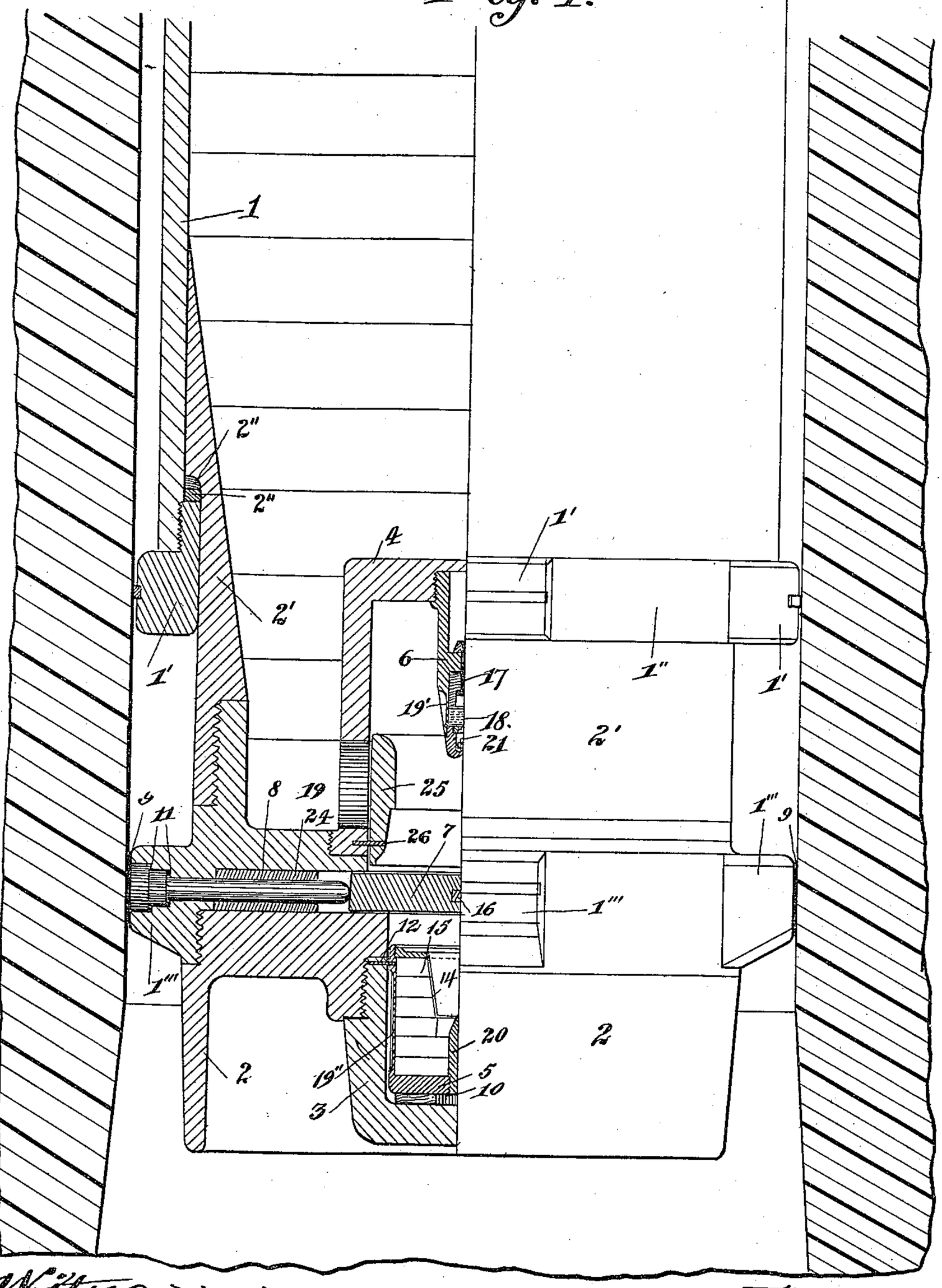

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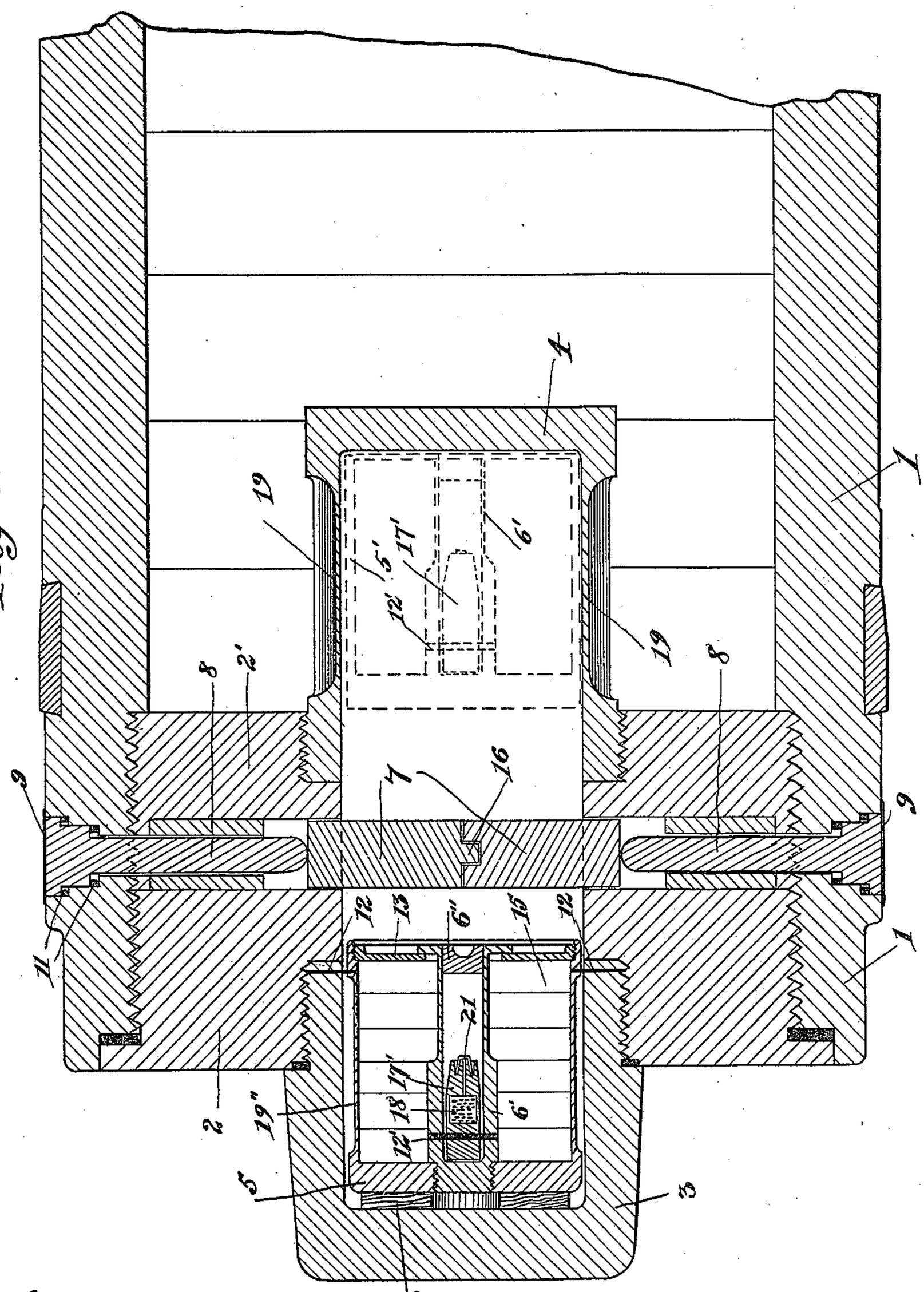
Fig. 5.



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(No Model.) 7 Sheets—Sheet 4.

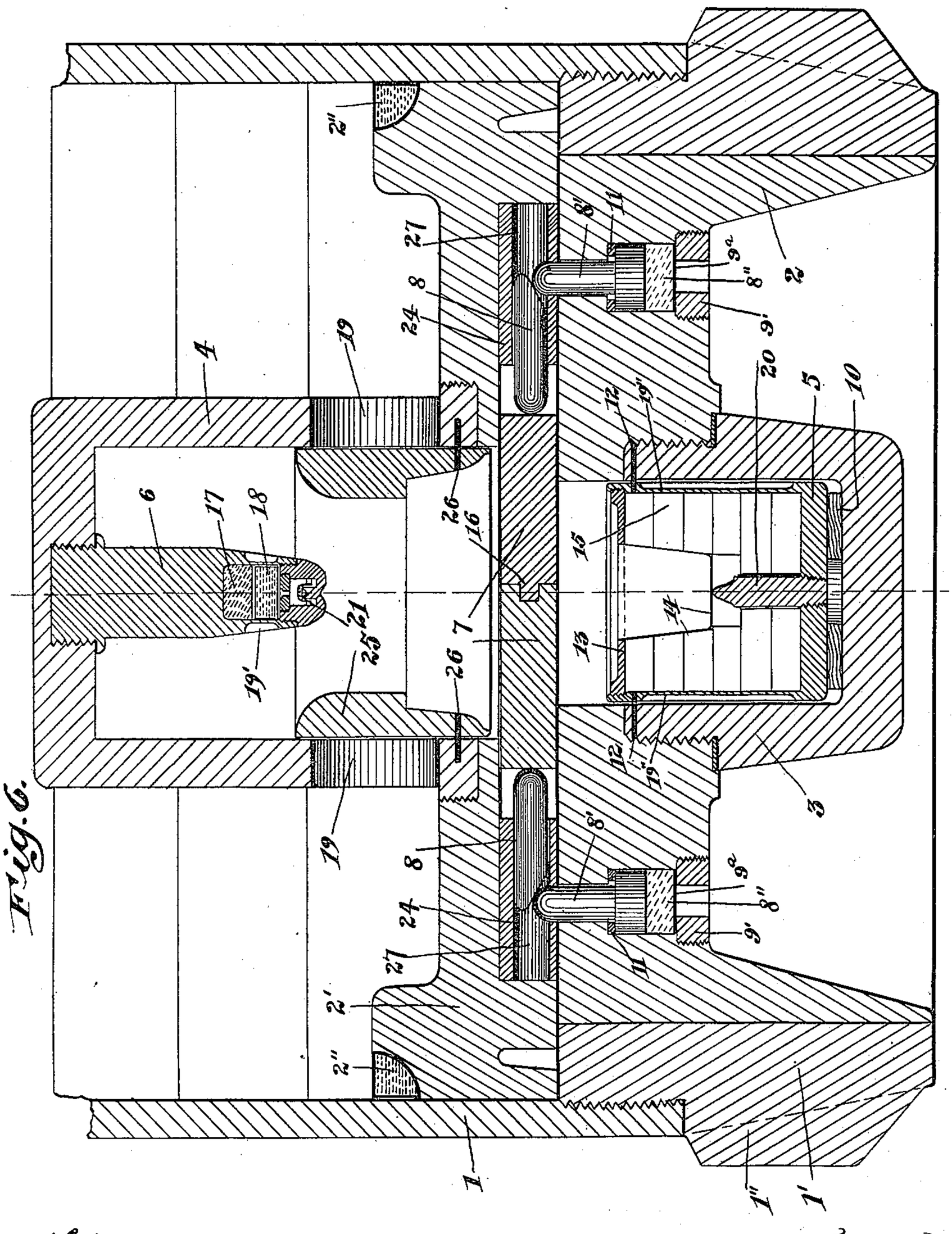

Fig. 6.

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Fig. 7.

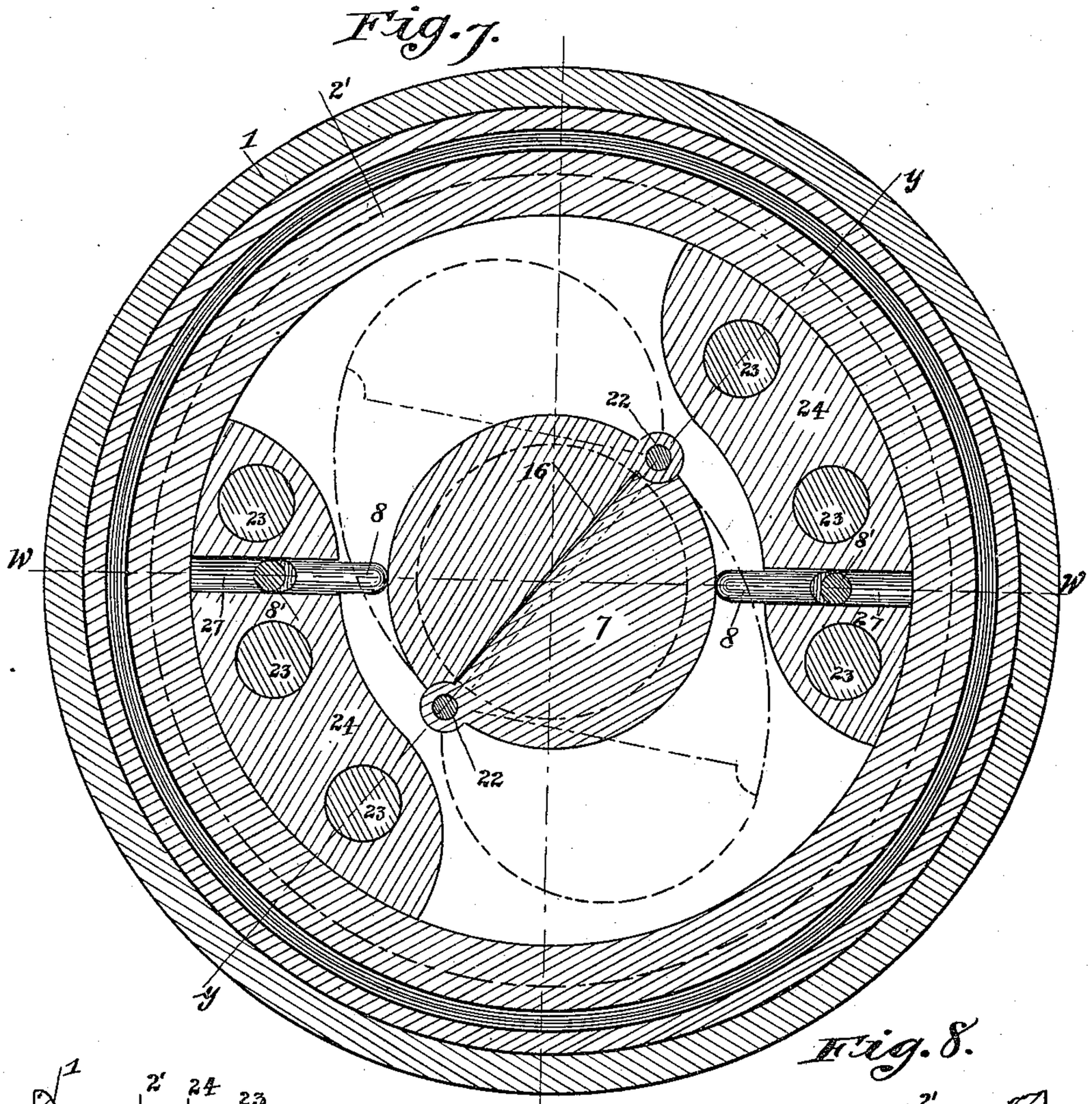
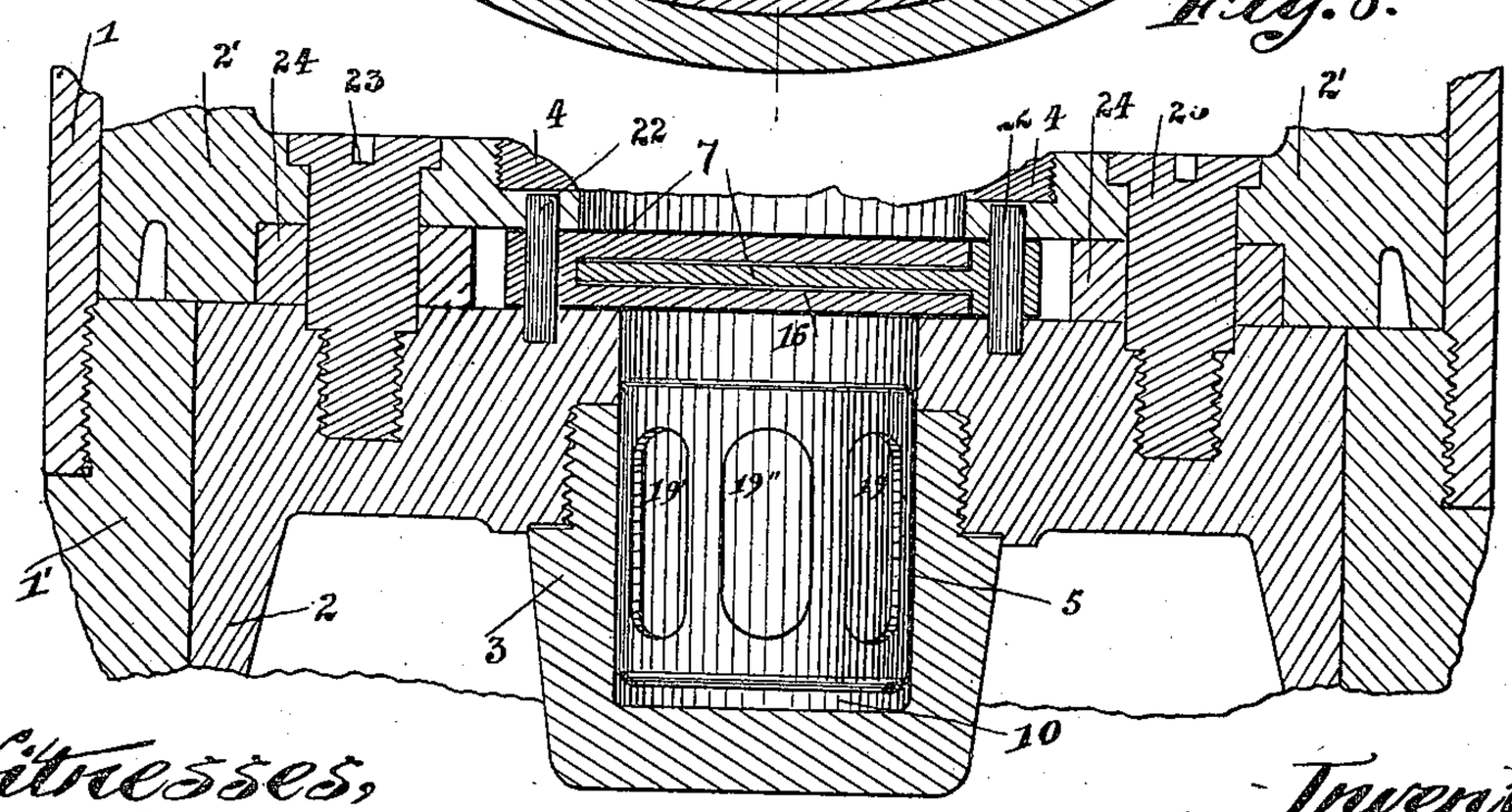


Fig. 8.



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(No Model.) 7 Sheets—Sheet 6.

Fig. 9.

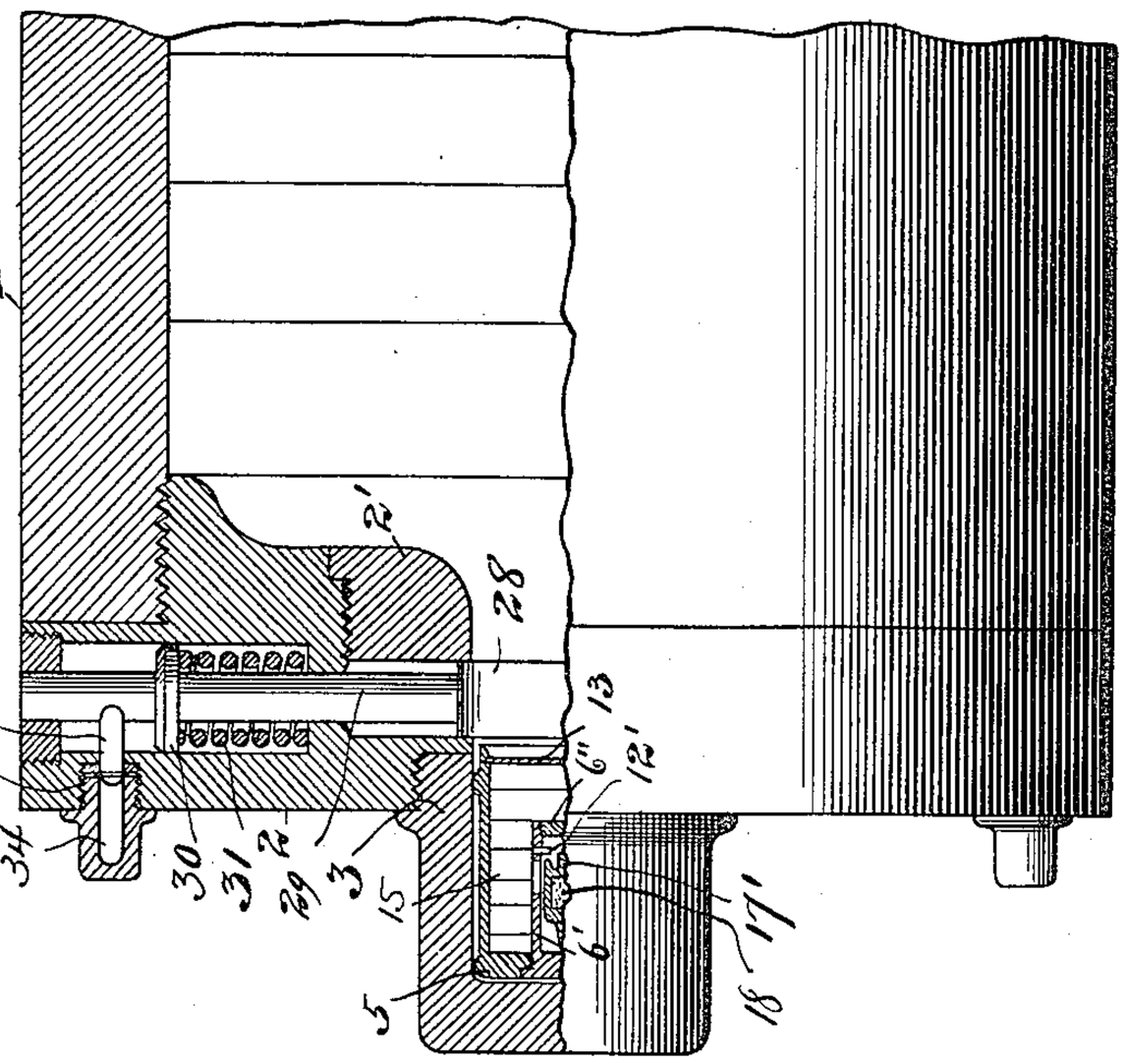

Fig. 10.

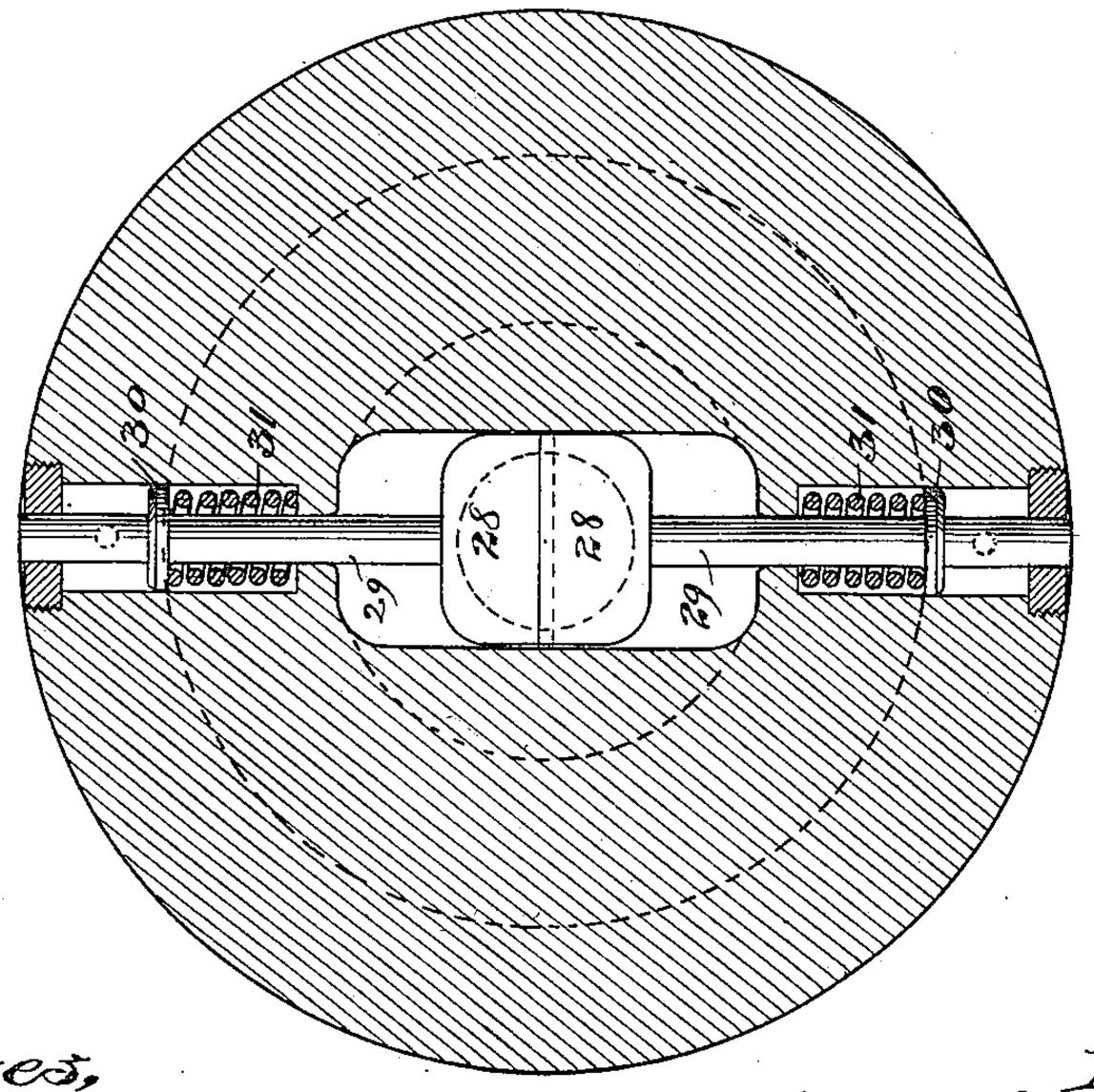

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Fig. 11.

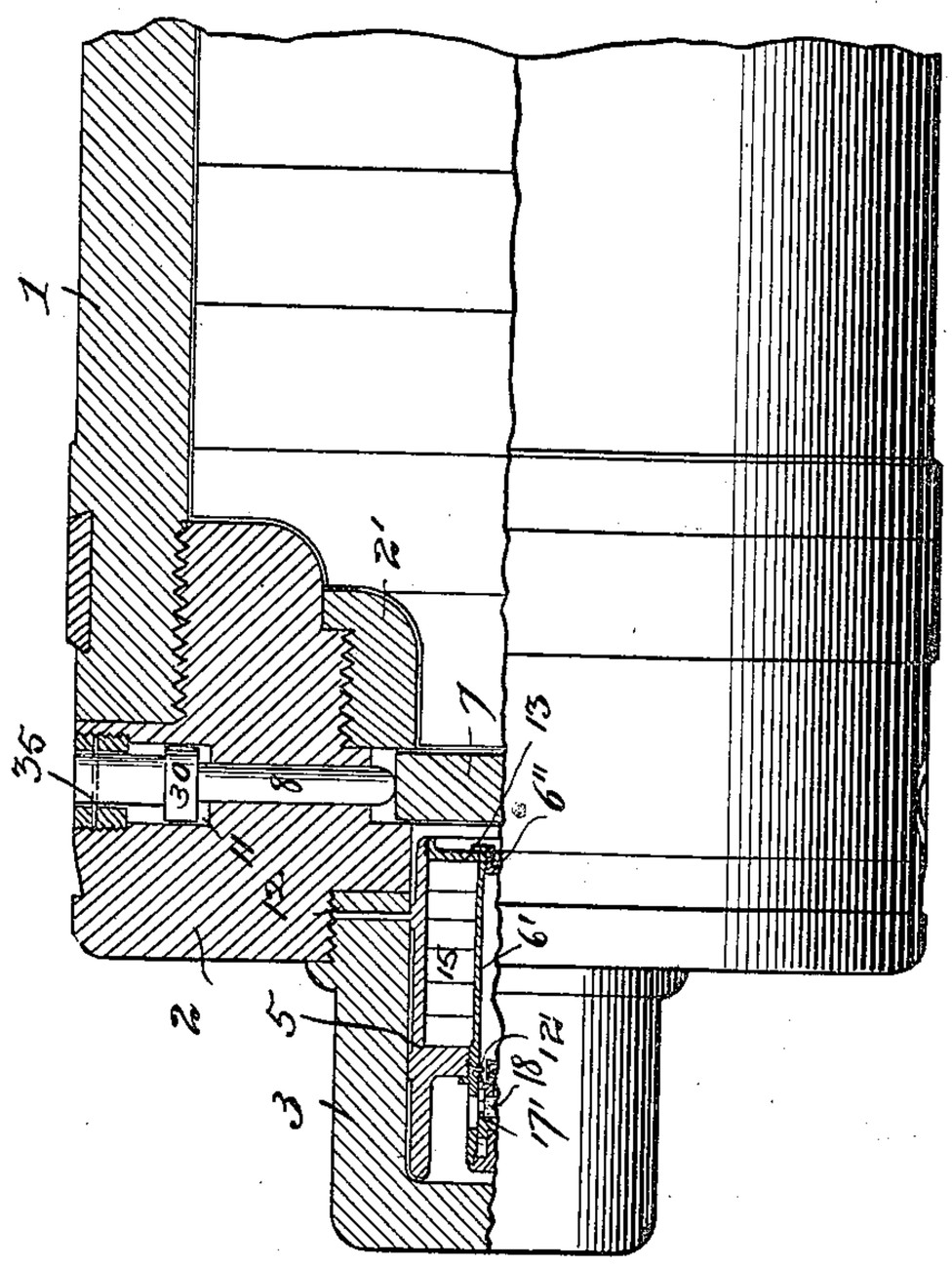
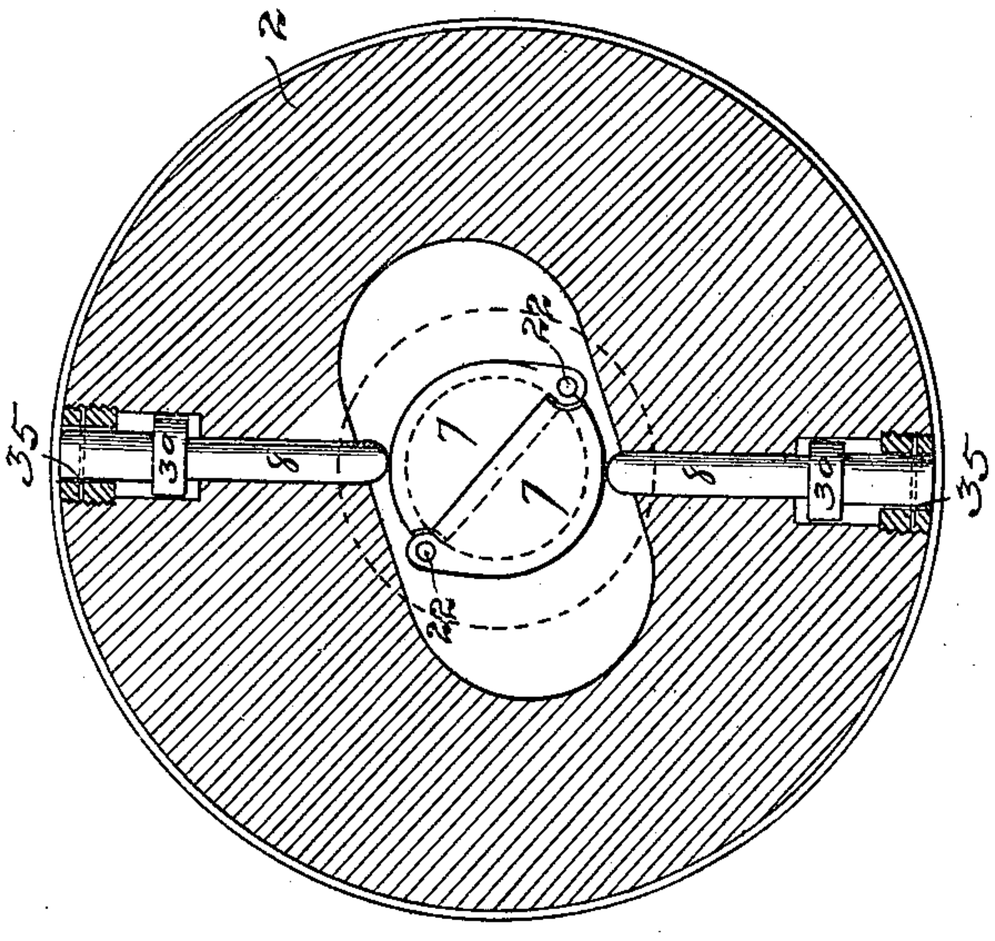


Fig. 12.



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UNITED STATES PATENT OFFICE.

LOUIS GATHMANN AND EMIL GATHMANN, OF CHICAGO, ILLINOIS, ASSIGNORS TO THE GATHMANN TORPEDO GUN COMPANY, OF SAME PLACE.

SAFETY-FUSE FOR HIGH-EXPLOSIVE SHELLS.

SPECIFICATION forming part of Letters Patent No. 672,826, dated April 23, 1901.

Application filed August 8, 1898. Serial No. 688,036. (No model.)

To all whom it may concern:

Be it known that we, LOUIS GATHMANN and EMIL GATHMANN, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Safety-Fuses for High-Explosive Shells, of which the following is a specification.

This invention relates to safety-fuses for high-explosive shells, and particularly for that class of shells in which wet guncotton is used as the explosive or bursting charge.

The object of the invention is to absolutely insure the main charge of explosive material against premature explosion during the handling or transportation of the shell or while it is in or being fired from the gun. To attain this object, we provide a projectile having a main explosive charge, such as wet guncotton, with a fuse containing the detonating charge, consisting of a suitable detonating compound or fulminate and a mass of dry guncotton, and isolate either the whole or some part of the detonator from the main charge by placing the dry guncotton and, if desired, the fulminate compound in a safety-chamber removed from the main charge, and this detonating charge we not only separate from the main charge at such distance as to render the setting off of the main charge prematurely extremely unlikely, but to further insure against such premature explosion the safety-chamber is separated from the main charge by strong plates normally in position to cut off all communication between the mass of dry guncotton and the main charge of wet guncotton, said plates being held in place to effect this separation either mechanically or by pressure should a premature explosion of the dry guncotton occur, while they are moved laterally to permit the opening of the passage between such safety-chamber and the main charge by centrifugal force caused by the whirling of the projectile when discharged from the gun. By means of our invention, therefore, the dry guncotton is completely separated and isolated from the main explosive charge, whereby premature explosion of the main charge is impossible, and the construction is also such that when the projectile meets with sufficient resistance, such as impact upon the object fired at, the detonating charge will then be in proximity to the main explosive charge, so that the explosion of the latter will be insured.

Our invention may be embodied in various forms of construction, some of which are represented in the accompanying drawings, which will now be described.

In said drawings, Figure 1 is a longitudinal section through the base of a shell, showing one form of our improved fuse. Fig. 2 is a cross-section on line W W of Fig. 1. Fig. 3 is a cross-section on line X X of Fig. 2. Fig. 4 is a longitudinal section of the rear portion of the tube or barrel of the gun, showing the front of the powder-chamber and containing a half-sectional plan of the base of the shell and our improved fuse, the latter being a modified form of that shown in Fig. 1. Fig. 5 is a longitudinal sectional view of the rear end of a shell having a closed base and showing our improved fuse mechanism in position therein. Figs. 6, 7, and 8 show in sectional plan, transverse, and longitudinal sections, respectively, a modified construction of safety-fuse embodying, however, the general principles of our invention. Figs. 9 and 10 show, in part section and part elevation and in plan section, respectively, another modification of our invention, wherein the entire body of the fuse is external to the shell and wherein also another form of movable partition is employed. Figs. 11 and 12 are similar views of a further modification, showing an external fuse and hinged partitions.

We will first describe the construction shown in Figs. 1 to 5, inclusive. In said figures let 1 represent the body of the shell, and 2 the base-plug thereof, said parts having a threaded connection with each other. To the base-plug is secured a cup-like stock 3, constituting a safety-chamber to contain the detonating charge of dry guncotton. A base-ring 2′, secured within the base of the shell, carries a second cup-like portion 4, which constitutes the detonating-chamber and may contain the detonating compound or fulminate, as hereinafter described. We designate the

space within the part 3 as a "safety-chamber" and locate therein a stock 5, held in place by the brittle screws 12 and containing a mass of dry guncotton 15, held in place by the threaded plate 13. Within the cup-like portion 4, constituting what we have denominated the "detonating-chamber," may be affixed the detonator stock or cartridge 6, containing, as shown in Figs. 1 and 4, the detonating compound 18, protected by the cushion 17, and adjacent thereto a detonating-cap 21. In the construction shown in Figs. 4 and 6 the retaining-plate 13 has a conical flange 14, thus affording a cavity which the detonating-cartridge may enter. The base-ring 2′ is secured to the base 2 by means of intermediate pieces 24 and the pins 23. The base-pieces 24 are segmental in form.

7 7 represent semicircular disks or plates, each mounted upon a pivot-pin 22, the ends of which rest within apertures in the base 2 and the base-ring 2′. These semicircular disks have an interlocking joint preferably formed by tongues 16 on one member entering grooves in the other member, and when closed together their outer edges have an abutment between the base 2 and the base-ring 2′, while their meeting edges interlock, thus forming a close partition between the safety-chamber and the detonating-chamber. These disks are held closed upon each other by the pins 8, which pass through apertures in the intermediate base-pieces 24. As shown in Figs. 1 to 5, inclusive, these pins have shouldered heads resting within similar apertures in the shell 1 and held therein by thin strips of solder or frangible metal 9. The outer surface of the head being flush with the outer surface of the shell and the inner ends of the pins contacting with the edges of the disks 7, as shown in Fig. 4, these pins bear upon the interior wall of the gun, which, as shown, is rifled, the head being sufficiently wide to bear upon the lands of the rifling. By this abutment or contact of the heads of the pins with the interior wall of the gun-barrel the pins are absolutely prevented from outward movement while the shell is in the gun, and thereby the disks are held tightly closed until the shell is fired from the gun. The frangible strips 9 will retain the pins in place during the handling or transportation of the shell, and thus at all times when premature explosion would likely prove injurious the mass of wet guncotton is protected from explosion by the complete isolation of the detonating charge therefrom. The heads of the pins 8 are packed by packing-rings 11 to prevent ingress of the gases of the expelling charge to the dry guncotton.

As shown in Fig. 5, the cartridge or stock 17′, containing the fulminate 18, and the cap 21 are placed within a stock 6′ in the safety-chamber and held therein by the break-pins 12′. The outer end of the stock is sealed by the block 6^2. Should the priming charge be detonated by concussion or from any cause while the shell is being handled or while it is in the gun, the mass of dry guncotton would not of itself generate sufficient force to explode the main charge of wet guncotton in the body of the shell, because of the protection afforded by the disks or partitions 7. Such a premature explosion, while it would probably destroy the walls of the safety-chamber, could not perforate the plates 7 and reach the interior of the body of the shell. In this construction we employ a packing or cushion 10 to prevent ordinary shocks from causing violent concussion, such as might set off the dry guncotton.

As shown in Figs. 6, 7, and 8, the disks 7 are held in place by pins 8, which are capable of outward movement in the apertures 27 of the intermediate base-pieces 24, and which pins are held in contact with the edges of the disks by means of the counter-pins 8′, said last-mentioned pins being arranged at right angles to the pins 8 and the points thereof protruding into the passages 27 and contacting with the outer beveled ends of the said pins 8. A body of rocket-powder 8″ is confined against the heads of these pins 8′ by means of the solder strips 9^a and the screw-plugs 9′, the latter being centrally apertured and open to the flame generated by the explosion of the powder constituting the expelling charge. Such explosion would ignite the rocket-powder, and thus permit the counter-pins 8′ to move backwardly during the flight of the shell, and thus allow the pins 8 to be thrown outwardly by centrifugal force, permitting the disks 7 to separate and the detonating charge to pass bodily into the forward chamber.

Describing now the operation of our safety-fuse, as shown in Figs. 1, 2, 3, and 4, the shell being inclosed within the gun, the heads of the pins 8 are in contact with the wall of the gun-barrel, thus holding the disks 7 closed and isolating the charge of dry guncotton from the mass of wet guncotton. When the shell has cleared the gun, it has attained a rapid whirling motion, due to the rifling of the barrel, and by reason of such revolving motion the frangible strips 9 will be ruptured, the pins 8 will be thrown out, and the disks 7 will separate, thus placing the two ends of the fuse-chamber in open communication with each other. The first shock of the explosion of the expelling charge will operate to cause the container 5 to set back, thus breaking the pins 12, and during the flight of the shell said container will move forward to the position shown by dotted lines in Fig. 1, thus bringing the plunger 20 into close proximity to the cap 21. When the shell strikes a solid object, the impact will cause the plunger to explode the cap and also the mass of detonating compound 18, and thereby the mass of dry guncotton 15. We have found by experience that while the detonation of the dry guncotton will readily rupture a thick-walled fuse still the detonation of the wet guncotton is

made very uncertain when such thick-walled fuse is employed. Therefore we reduce the walls of the detonating-chamber 4, as shown at 19, so as to insure perfect detonating of the wet guncotton when the detonation of the priming charge occurs. An equivalent provision is shown in Figs. 4 and 6, where the walls of the detonating-chamber 4 are provided with openings normally covered by an annular seal-ring 25, held by the break-pins 26. In the last-described construction when the shell is fired the ring 25 will set back, thus breaking pins 26, and the ring during the flight of the shell will move forward, uncovering the apertures 19, and thus placing the interior of the detonating-chamber in open communication with the main shell-chamber containing the wet guncotton. For similar reasons the walls of the cartridge-stock 6 and of the container 5 are reduced in thickness, as shown at $19'$ 19^2, thus insuring the rupture of the stock and container by the explosion of the fulminate cap and of the mass of dry guncotton, respectively.

In Fig. 4 the fuse-chamber is mounted upon the base-plug 2, as before described; but said base is capable of movement into the body of the shell 1, thereby insuring an increase of pressure upon the contents of the shell due to the pressure of the expelling charge and equivalent to the external pressure upon the walls of the shell from the gases of the same expelling charge. This movable base is provided by extending the base-ring $2'$ so as to telescope with the shell 1 and providing the same with an offset or shoulder in its outer surface, which will be engaged by the flange of the retaining-ring $1'$, suitable packing $2''$ being interposed between said shoulders. Instead of using the pins 23, as shown in other figures of the drawings, the base 2 and the base-ring $2'$ are coupled together by the threaded coupling 1^3. When the shell is fired, the pressure of the gases of the expelling charge will cause the entire base of the shell to move into the body thereof, thus compressing the contents of the shell and transmitting to the interior an increased pressure and assuring an equilibrium of pressure internally and externally.

In the construction shown in Figs. 6, 7, and 8 we have shown another form of movable base wherein the base 2 is secured to the base-ring $2'$ by the intermediate pieces 24 and pins 23, the ring $2'$ being held within the shell by the threaded ring $1'$, having the centering-lugs 1^2. The entire base is thus made capable of inward movement under the pressure of the gases of the expelling charge.

In the several forms of our invention above described it will be apparent that should any explosion of the detonating charge occur prematurely the pressure generated thereby would be expended against the disks 7, and this pressure would hold said disks in place and prevent communication of the flame to the main or bursting charge. This does not, however, provide for holding the disks in place during the handling of the shell or at any other time except during the premature explosion, and therefore we have provided positive mechanical means for holding the disks in place, consisting of the pins 8, the latter being held in place in one construction by contact of their heads with the walls of the gun-barrel and in the other construction by the counter-pins.

Obviously some of the features of construction may be modified in other respects than those hereinbefore particularly described— as, for example, we have described a fuse which is transversely divided by movable disks or partitions, so as to afford both a detonating-chamber and a safety-chamber, and we prefer in all cases to employ said detonating-chamber, as thereby the detonating charge is introduced into the body of the main bursting charge and is thereby in the best situation for securing a perfect and certain detonation of the main charge; but that portion of the fuse formed by the cup-like part 4 and which is secured to the base $2'$ may be omitted, and the detonating charge with its cap or cartridge may be placed within such safety-chamber, as shown in Fig. 5, and when the disks or plates are thrown out after the discharge of the shell from the gun the detonating charge will pass into the opening thereby provided, thus coming in contact with the main bursting charge of wet guncotton and upon the impact of the shell will be exploded.

Among the many modifications which may be made in the form of the partitions one is shown in Figs. 9 and 10, wherein the rear end of the shell is closed by a base-ring provided with ways for sliding partitions. These partitions are marked 28, and the ways within which they slide are formed by the base-ring 2 and the internal ring $2'$, the latter having a threaded engagement with the base-ring 2. The partitions 28 are secured to stems 29, having collars 30, with springs 31 abutting upon them and normally tending to thrust the partitions outwardly, so as to uncover the aperture leading from the safety-chamber, formed by the cup or shell 3, into the main explosion-chamber. In order to hold the partitions closed, the lock-pins 32 engage the stems 29, said lock-pins being held in place by a break-pin 33, which is carried in the walls of a hollow screw-cap or chamber 34. The entire body of the detonator is contained within the safety-chamber formed by the cup-shaped chamber, and all of the parts thereof may be of the same construction and arrangement substantially as shown in Fig. 5. The detonator-casing 4 is omitted in this instance and the dotonating charge simply passes through the gateway or channel into contact with the body of wet guncotton therein. Upon the firing of the shell the holding-pins 32 will set back and release the stems 29 and the springs will act positively to separate the sliding partitions, thus permitting the deto-

nating charge to move bodily forward into contact with the mass of wet guncotton.

In the construction shown in Figs. 11 and 12 the complete isolation of the detonating charge is provided for by locating said charge entirely within the safety-chamber formed by the cup 3. In this case the pivoted disks 7 are employed and the holding-pins 8 are provided with collars 30, said pins being held in place by the frangible break-pins 35, which will be broken by the thrust of the pins 8 and disks 7, due to the centrifugal force generated by the whirling motion of the shell.

It will be readily perceived that the constructions shown in Figs. 5, 9, 10, 11, and 12 may be applied to shells of usual construction with slight alterations only and that therefore our invention may be used with shells which have been constructed with reference to the employment of other forms of fuse.

We claim—

1. A safety-fuse for high-explosive shells having a chamber to contain the detonating or priming charge and a laterally-movable partition normally separating and isolating said charge from the bursting charge, and positive locking means for the partition, said locking means being adapted to be released by the discharge of the shell from the gun, whereby to permit the priming charge to pass into proximity to the main or bursting charge of the shell, substantially as described.

2. A high-explosive shell comprising a chamber for the main or bursting charge, an isolated chamber for the priming or detonating charge, a partition between said chambers adapted to close communication between them and to be opened during the flight of the shell, means for locking said partition in a closed position, and said locking means being also adapted to be freed or released by the discharge of the shell from the gun, substantially as described.

3. A shell for high explosives provided with a chamber for the main or bursting charge, a separate and isolated chamber containing the priming or detonating charge, a passage connecting said chambers, a partition normally closing said passage, locking-pins normally holding said partition in its closed position, and retaining devices for said locking-pins adapted to be released on the discharge of the shell from the gun to free said locking-pins and permit lateral movement of said partition, substantially as described.

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