

Sept. 16, 1947.

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2,427,630

ADJUSTABLE-PULL SOLENOID

Filed Sept. 29, 1945

Fig. 1.

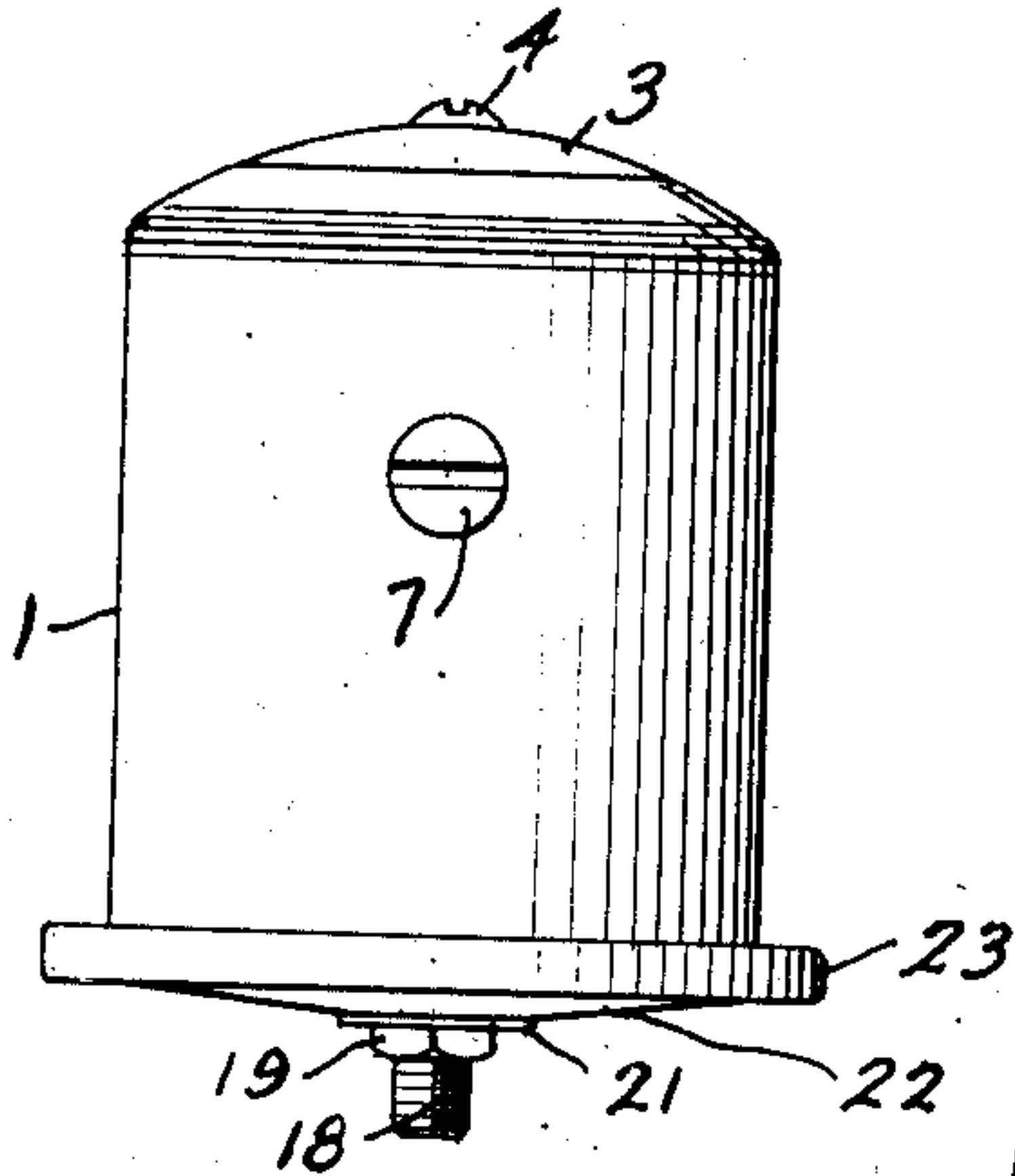


Fig. 2.

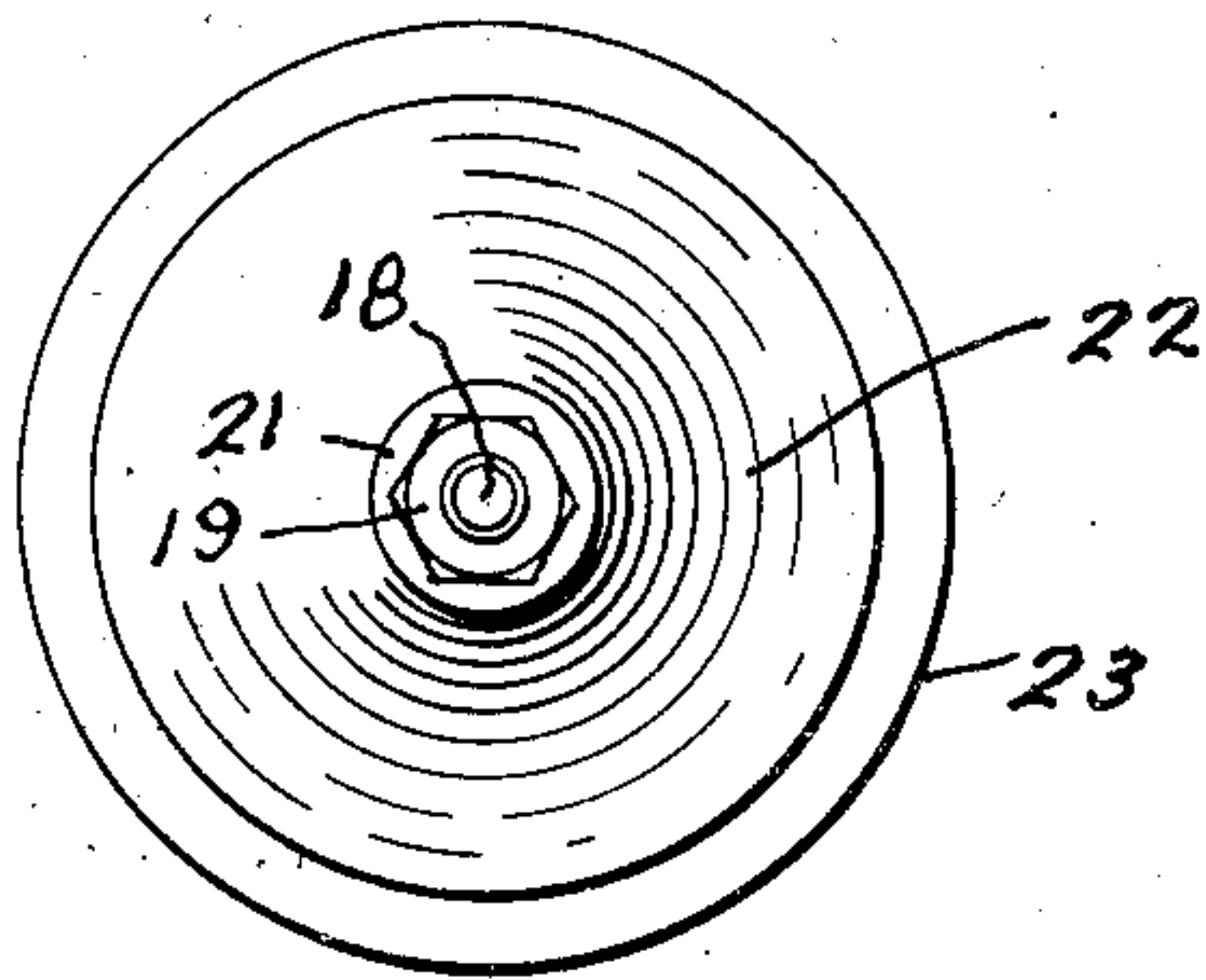


Fig. 6.

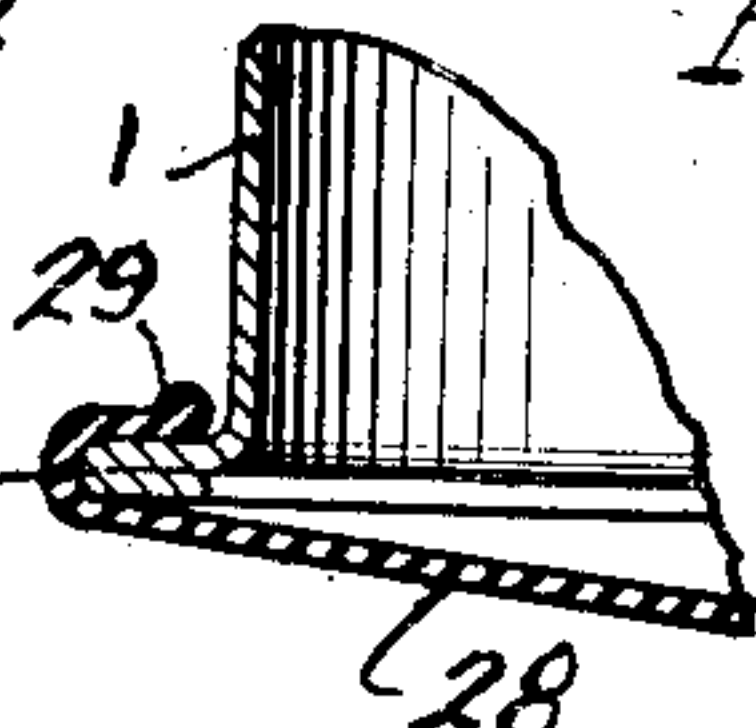


Fig. 3.

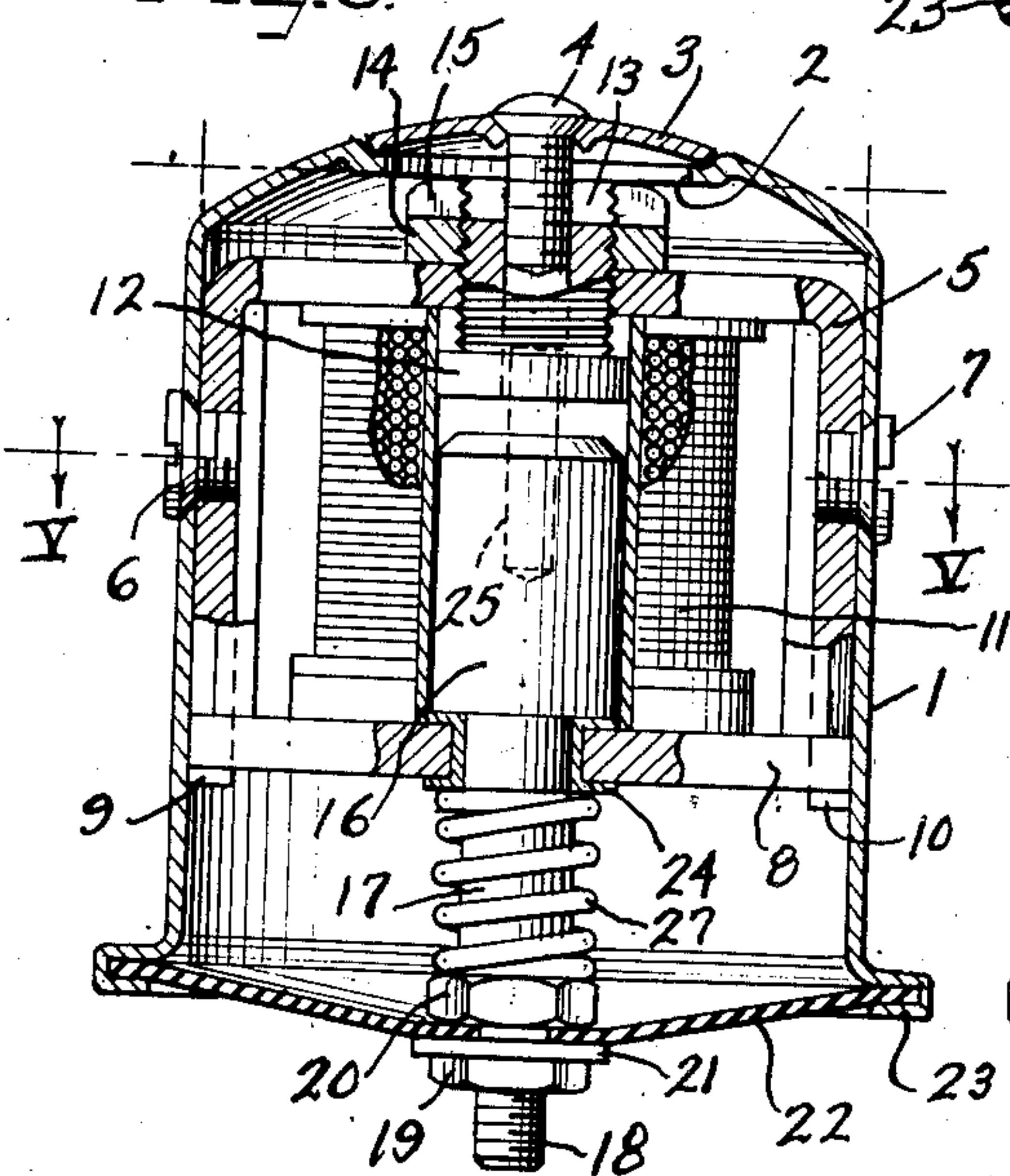


Fig. 4.

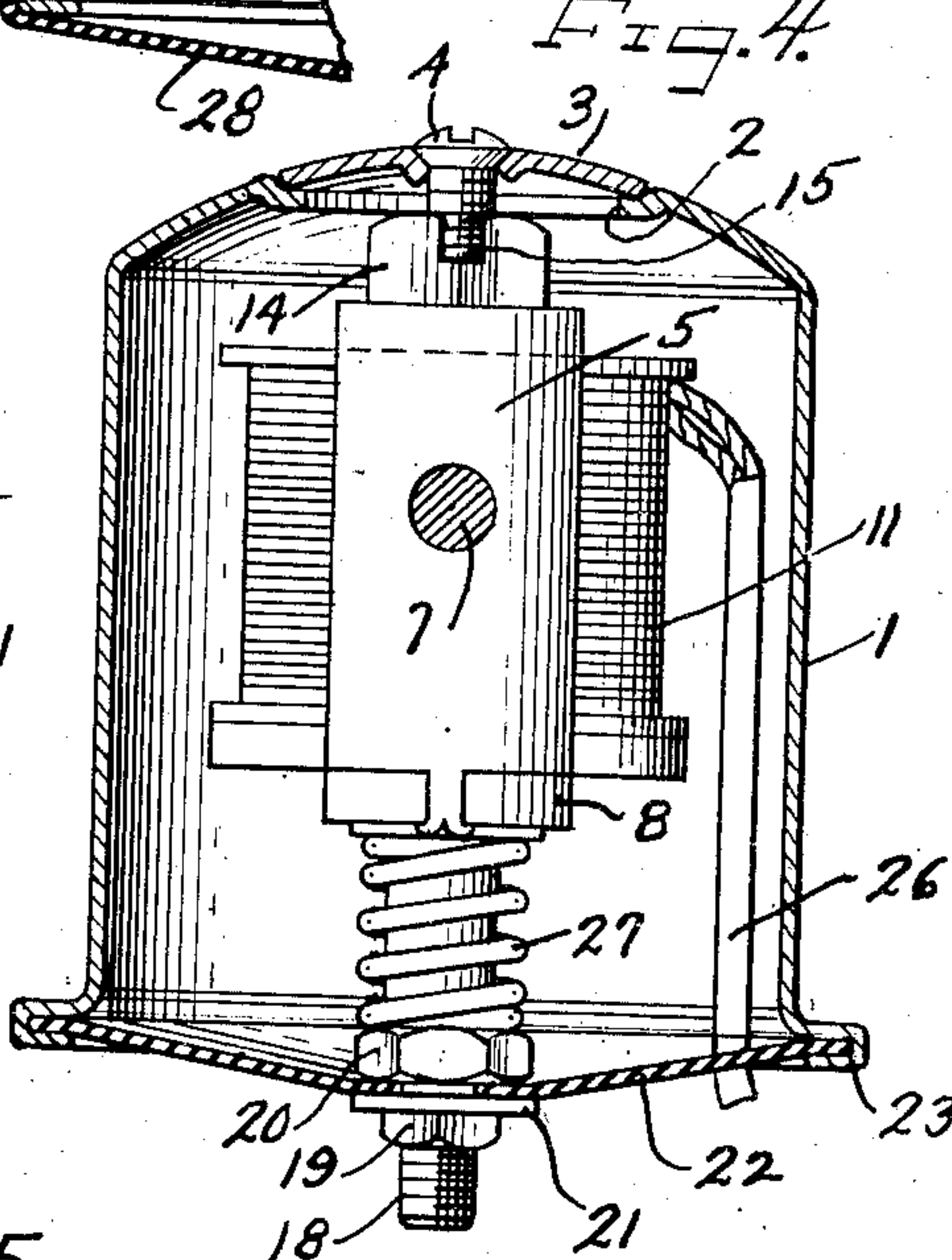
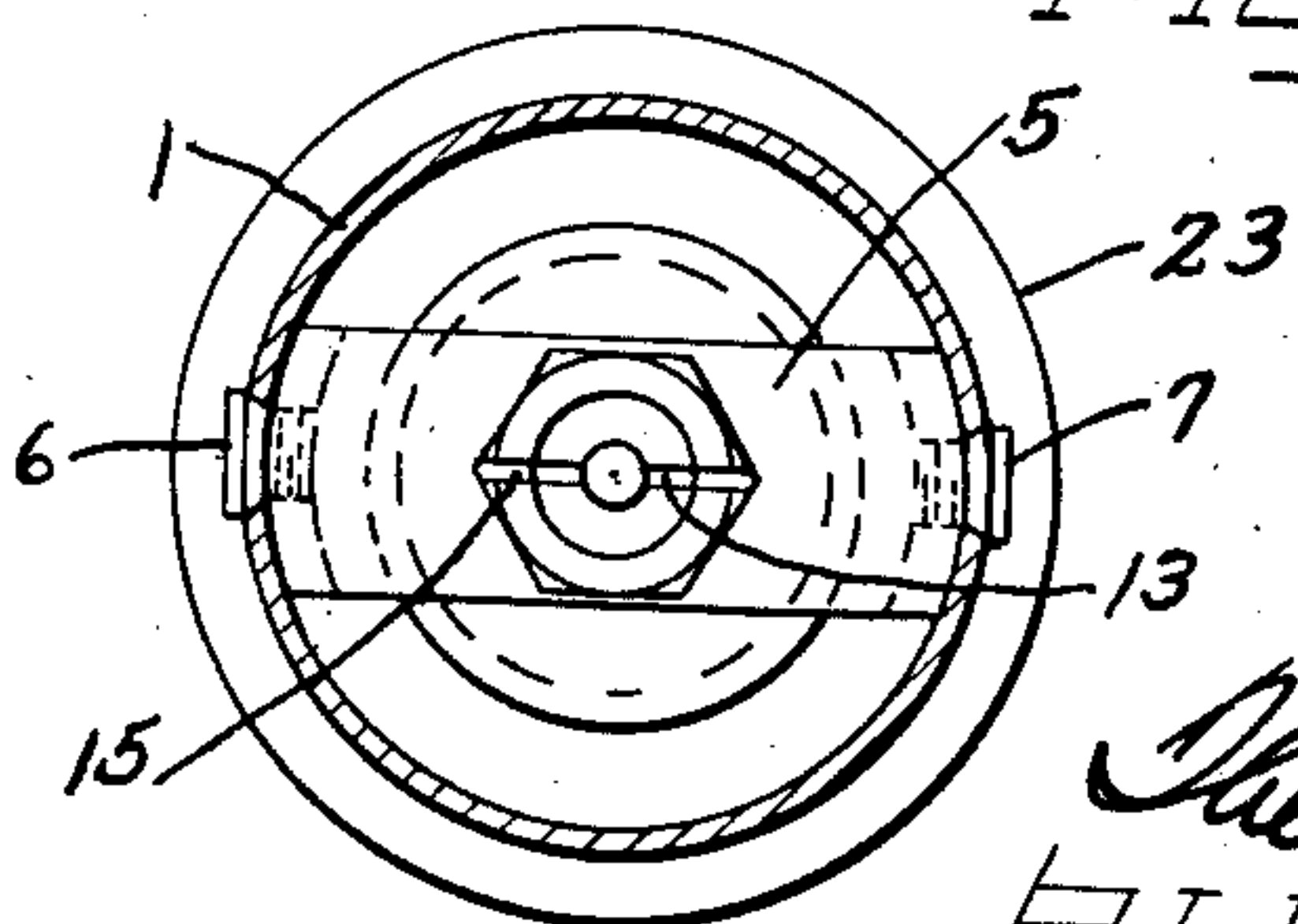


Fig. 5.



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## UNITED STATES PATENT OFFICE

2,427,630

## ADJUSTABLE-PULL SOLENOID

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Application September 29, 1945, Serial No. 619,353

6 Claims. (Cl. 175—341)

1

This invention relates to improvements in electric solenoids.

The general object of the invention is to provide an improved solenoid of rugged construction capable of adjustment to vary the intensity of the vibratory action thereof and mounted in a dust-proof case.

A particular object of the invention is to provide a solenoid which may readily be adjusted to vary the intensity of the magnetic pull therein.

Another object of the invention is to provide a solenoid which especially lends itself to mounting in a dust-proof case.

A further object of the invention is to provide a solenoid construction with a case therefor which may be readily opened to permit adjustment of the solenoid.

Other and further objects and advantages of the invention will appear from a reading of the specification and upon reference to the attached drawings wherein a preferred embodiment of the invention is shown and described.

Referring now to the drawings,

Figure 1 is a side elevation of a solenoid made in accordance with this invention.

Figure 2 is a bottom plan view of the same device.

Figure 3 is a central vertical sectional view of the device.

Figure 4 is a sectional view with portions in elevation, in a plane at 90 degrees to the sectional plane of Figure 3.

Figure 5 is a horizontal sectional view on the broken line V—V of Figure 3, and

Figure 6 is a sectional view showing a modified arrangement for attaching a diaphragm to the solenoid.

Referring further to the drawings, there is shown a casing 1 having an aperture 2 in its upper end which is ordinarily sealed by the cap 3 held in place by a screw 4.

An iron yoke 5 of U-shape is secured to the side walls of the housing by means of screws 6 and 7. An iron cross member 8 extends across the bottom of the yoke and is provided with notches into which are received the extensions 9 and 10 of the yoke. Preferably these extensions after passing through the notches will be swaged over to lock the cross member at the bottom of the yoke.

Held between the cross member and the top of the yoke is a coil 11, and threadedly engaged with the upper end of the yoke is a core 12. A kerf 13 is preferably provided in the upper end of this core by means of which the core may be

2

rotated in the yoke to adjust the air gap between it and the upper end of the plunger. A lock nut 14 having a kerf 15 is provided for locking the core in any desired adjusted position. The upper end of the core is internally threaded for engagement by the screw 4, whereby the nut cap 3 may be held in place.

The plunger of the solenoid consists of an enlarged cylindrical portion 16, and a reduced shank 17 at the lower end of which is a threaded portion 18 for engagement with lock nuts 19 and 20, which together with a washer 21 will serve as a dust proof connection with a flexible diaphragm 22, whose periphery is held crimped in the U-shaped channel 23 provided at the lower end of the housing.

Preferably the diaphragm 22 may be made of rubber, leather or any other suitable flexible material.

The cross member 8 is apertured to permit the passage of the plunger and is fitted with a brass bushing 24. Preferably a brass guide pin 25 will be secured in the upper end of the plunger and allowed to reciprocate in a suitable central aperture in the core.

The lowermost end of the plunger, being threaded, serves as a convenient means for attaching the plunger to some device to be operated by the solenoid, without interfering with the dust-proof protection afforded the solenoid, nor interfering with the established adjustment of the spring 27.

A cable for supplying alternating current to the solenoid is shown at 26 which passes to the exterior of the casing through a snugly fitting aperture in the diaphragm and hence does not adversely affect the dust-proof construction.

In Figure 6 I have shown a modified arrangement for attaching the rubber diaphragm to the solenoid housing. A diaphragm 28 is so molded as to provide an inwardly turned rim 29 which may be distended and snapped over the flange 23 on the solenoid housing 1.

The solenoid is designed to be operated by alternating current, the core attracting the plunger when the current builds up to maximum values while the spring 27 withdraws the plunger as far as is permitted by the engagement of the enlarged portion 16 of the plunger with the cross member 8 when the current passes through the zero values of its successive cycles. The compression of the spring may be varied by adjusting the nuts 19 and 20. The air gap between the plunger and core also may be adjusted even while the solenoid is



3

operating, by removing the cap 3, and adjusting the nut 14.

It will now be appreciated that I have provided a solenoid of very rugged construction together with a dust-proof housing therefor, with provision for adjustment of the spring loading of the plunger and of the air gap for varying the action of the solenoid.

Although I have shown and described one particular embodiment of my invention, I do not desire to be limited to the exact details of construction herein shown and described. It should be understood that the invention is susceptible of some variation in the details of construction within the scope of the appended claims.

I claim as my invention:

1. A solenoid comprising a U-shaped iron yoke, an iron cross member secured across the open end of said yoke, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece threaded in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired adjusted position, a plunger having a portion extending within said coil for reciprocation therein and having another portion extending through said cross member, a spring engaged with said plunger outside of said coil and bearing against said cross member for yieldably restraining movement of the plunger toward said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting access to said core piece for adjustment thereof, means providing a dust-proof closure for said aperture, means pierced by said plunger providing a dust-proof closure for the aperture at the opposite end of said housing, and means for supporting said yoke upon said housing.

2. A solenoid comprising a U-shaped iron yoke, an iron cross member secured across the open end of said yoke, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece threaded in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired adjusted position, a plunger having a portion extending within said coil for reciprocation therein and having another portion extending through said cross member, a spring engaged with said plunger outside of said coil and bearing against said cross member for yieldably restraining movement of the plunger toward said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting access to said core piece for adjustment thereof, means providing a dust-proof closure for said aperture, a flexible diaphragm pierced by said plunger and in sealed engagement with the other end of said housing providing a dust-proof closure for the second aperture, and means for supporting said yoke upon said housing.

3. A solenoid comprising a U-shaped iron yoke, an iron cross member secured across the open end of said yoke, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece threaded in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired adjusted position, a plunger having a portion extending within said coil for reciprocation therein and having another portion extending through said cross member, a spring engaged with said plunger outside of said

4

coil and bearing against said cross member for yieldably restraining movement of the plunger toward said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting access to said core piece for adjustment thereof, a cap for closing said aperture, a screw engaged with said core piece for retaining said cap, flexible means pierced by said plunger providing a dust-proof closure for the aperture at the opposite end of said housing, and means for supporting said yoke upon said housing.

4. A solenoid comprising a U-shaped iron yoke, an iron cross member secured across the open end of said yoke, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece threaded in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired adjusted position, a plunger having a portion extending within said coil for reciprocation therein and having another portion extending through said cross member, a spring engaged with said plunger outside of said coil and bearing against said cross member for yieldably restraining movement of the plunger toward said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting access to said core piece for adjustment thereof, the aperture at the other end being large enough to permit insertion of the coil and yoke assembly, removable means providing a dust-proof closure for the first aperture, a flexible diaphragm pierced by said plunger, means for retaining said diaphragm in sealed engagement with the margin of said second aperture, and means for supporting said yoke upon said housing.

5. A solenoid comprising a U-shaped iron yoke, an iron cross member secured across the open end of said yoke, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece threaded in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired adjusted position, a plunger having a portion extending within said coil for reciprocation therein and having another portion extending through said cross member, a spring engaged with said plunger outside of said coil and bearing against said cross member for yieldably restraining movement of the plunger toward said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting access to said core piece for adjustment thereof, the aperture at the other end being large enough to permit insertion of the coil and yoke assembly, removable means providing a dust-proof closure for the first aperture, a flexible diaphragm pierced by said plunger, an annular channel formed at the margin of said second aperture for retaining said diaphragm in sealed engagement therewith, and means for supporting said yoke upon said housing.

6. A solenoid comprising a U-shaped ferrous yoke, a ferrous cross member secured across the open end of said yoke to complete a magnetic circuit loop, a coil of annular cross section supported between said cross member and the opposite portion of said yoke, a core piece adjustably mounted in said yoke member and having a portion extending within said coil, adjustable means for retaining said core piece in a desired axial



5

position with respect to said coil, a plunger having a portion extending axially within said coil for reciprocation therein and having another portion extending through said cross member, resilient means urging said plunger away from said core piece, a tubular housing for said solenoid having apertures at both ends, the aperture at one end permitting insertion of said yoke therein and the aperture at the other end permitting access to said core piece for adjustment thereof, means for supporting said yoke within said housing, means pierced by said plunger providing a closure for said aperture at said one end of the housing, and means providing a re-

6

movable closure for said aperture at said other end of the housing.

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