

Sept. 29, 1953

T. J. BAY

2,653,334

EXPANDABLE CONDENSER TUBE CLEANER

Filed Sept. 30, 1947

2 Sheets-Sheet 1

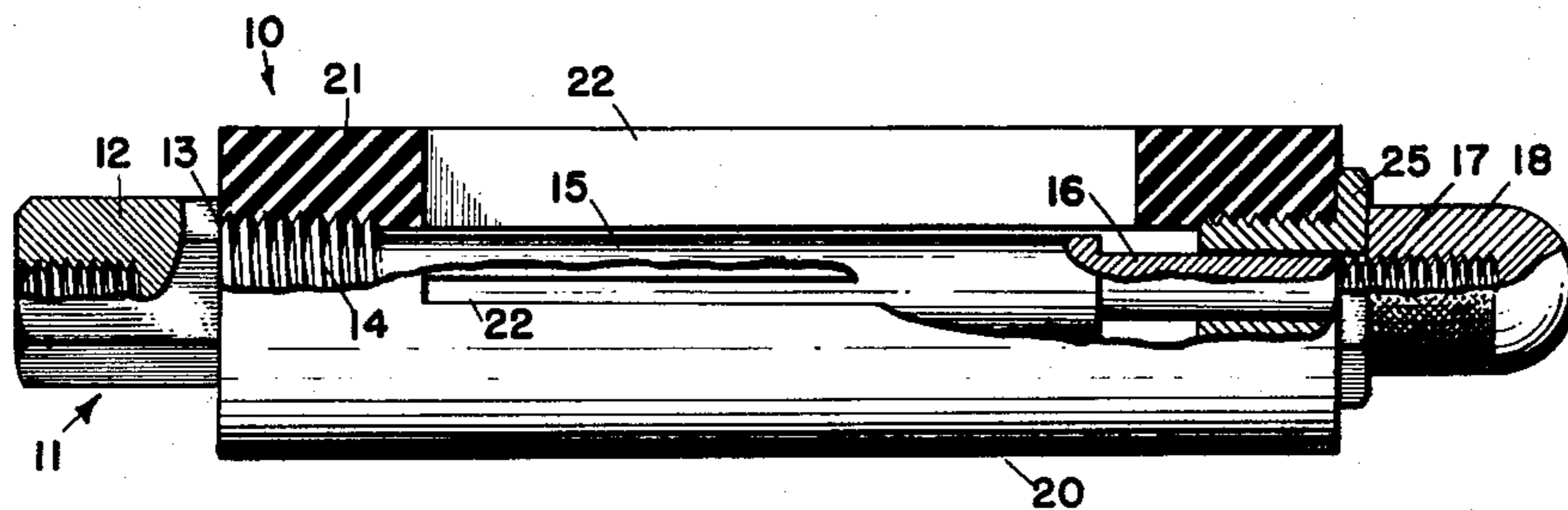


FIG. 1

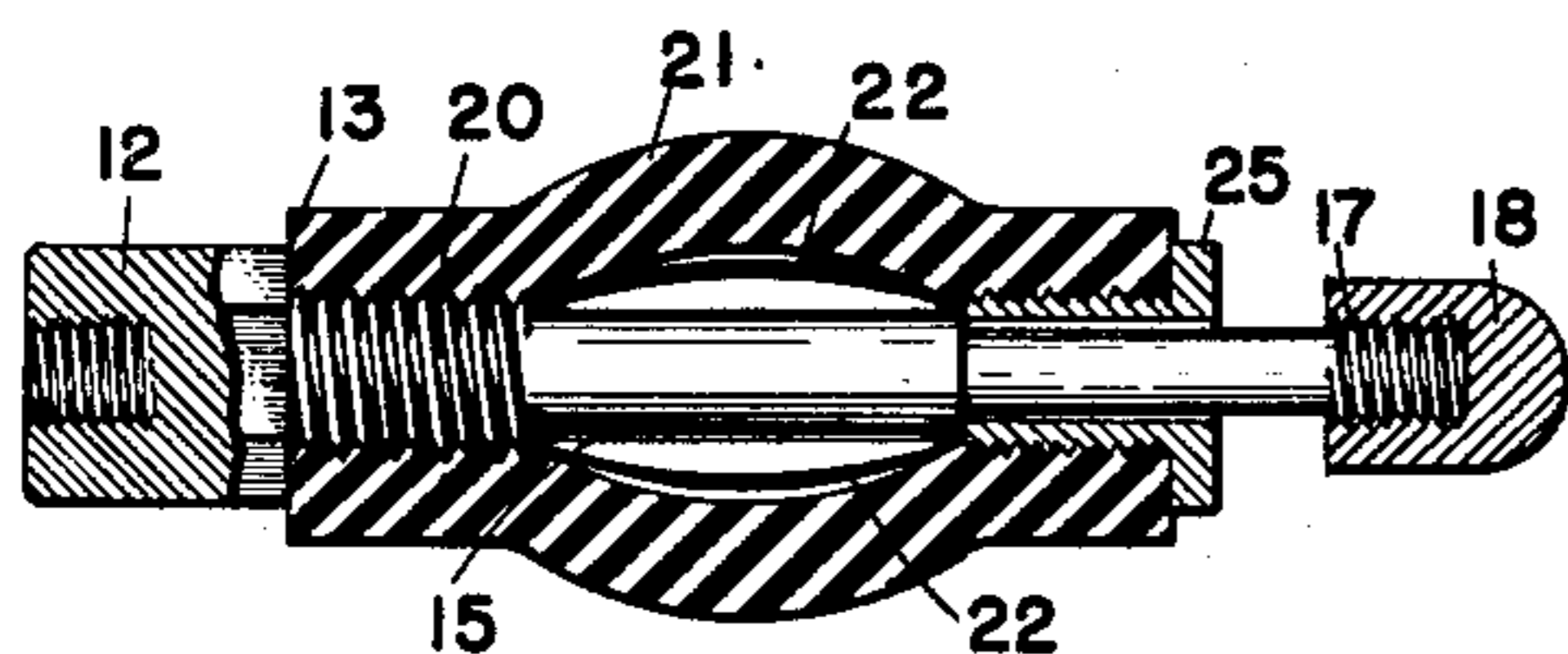


FIG. 2

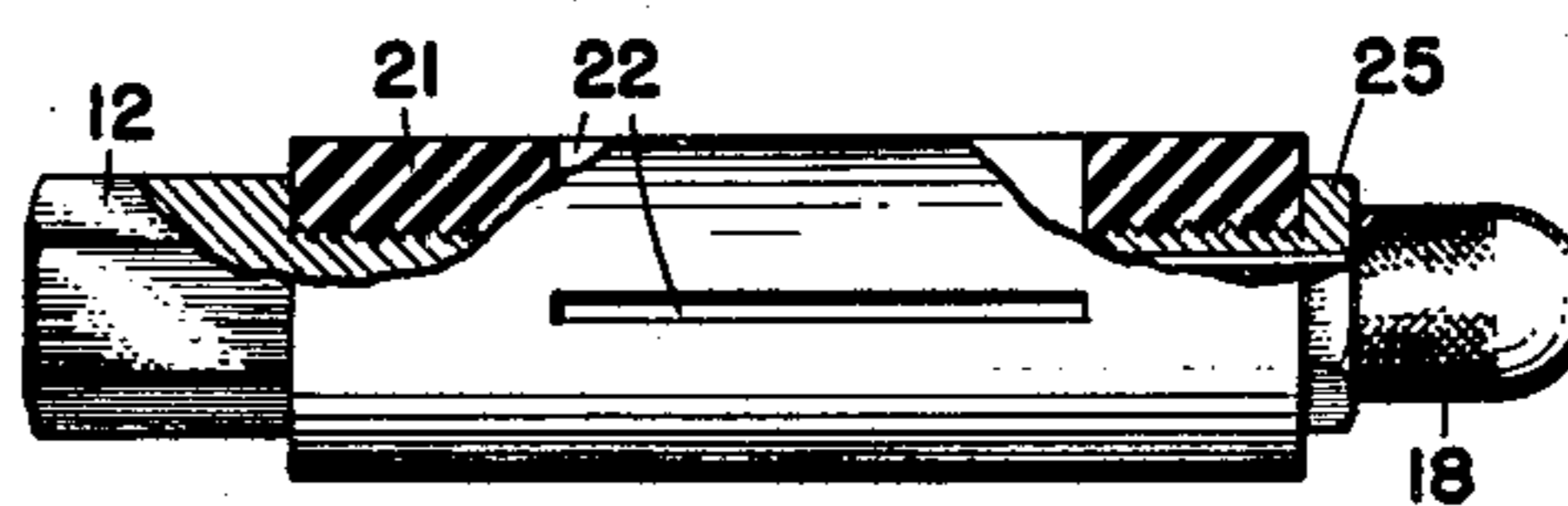


FIG. 3

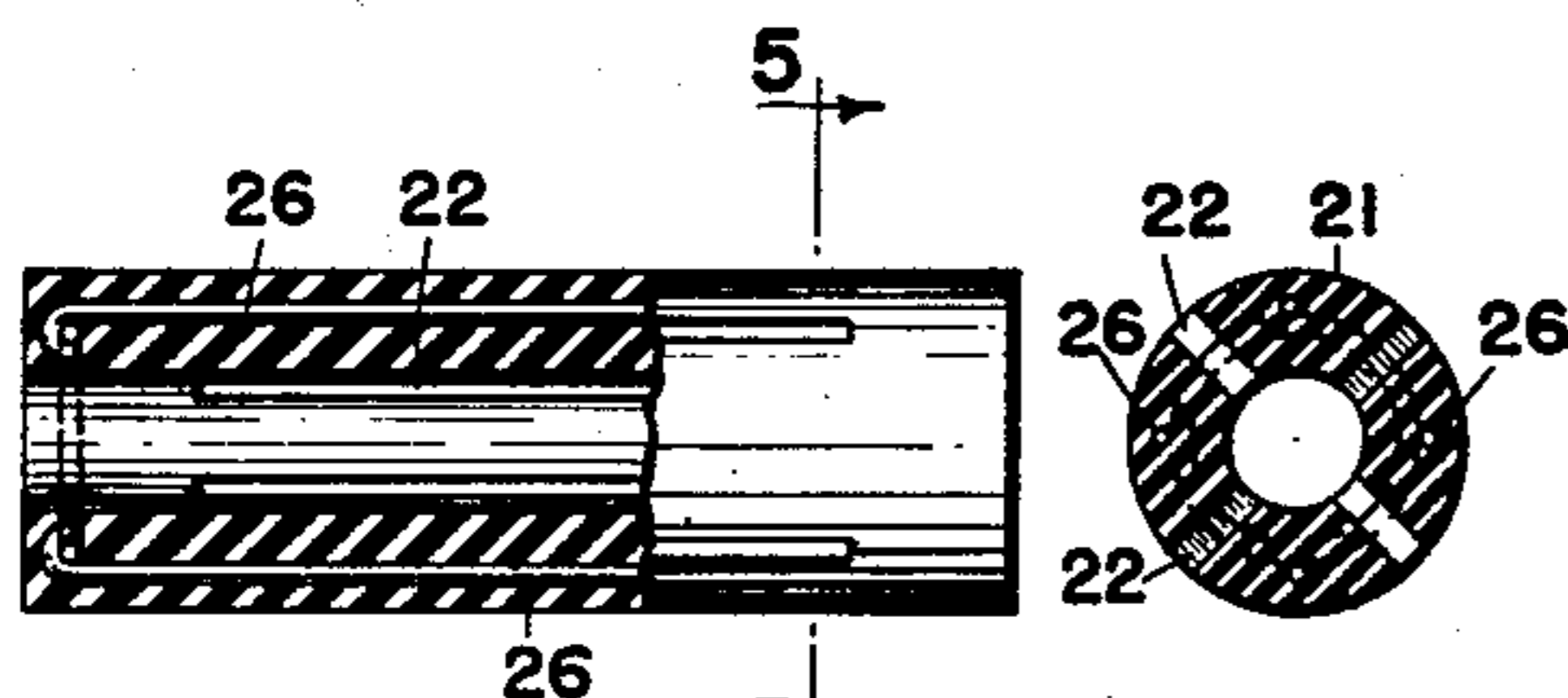


FIG. 4

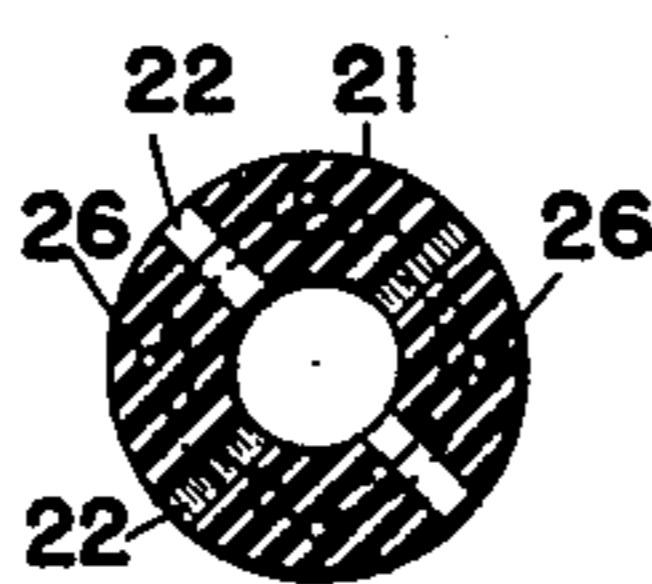


FIG. 5

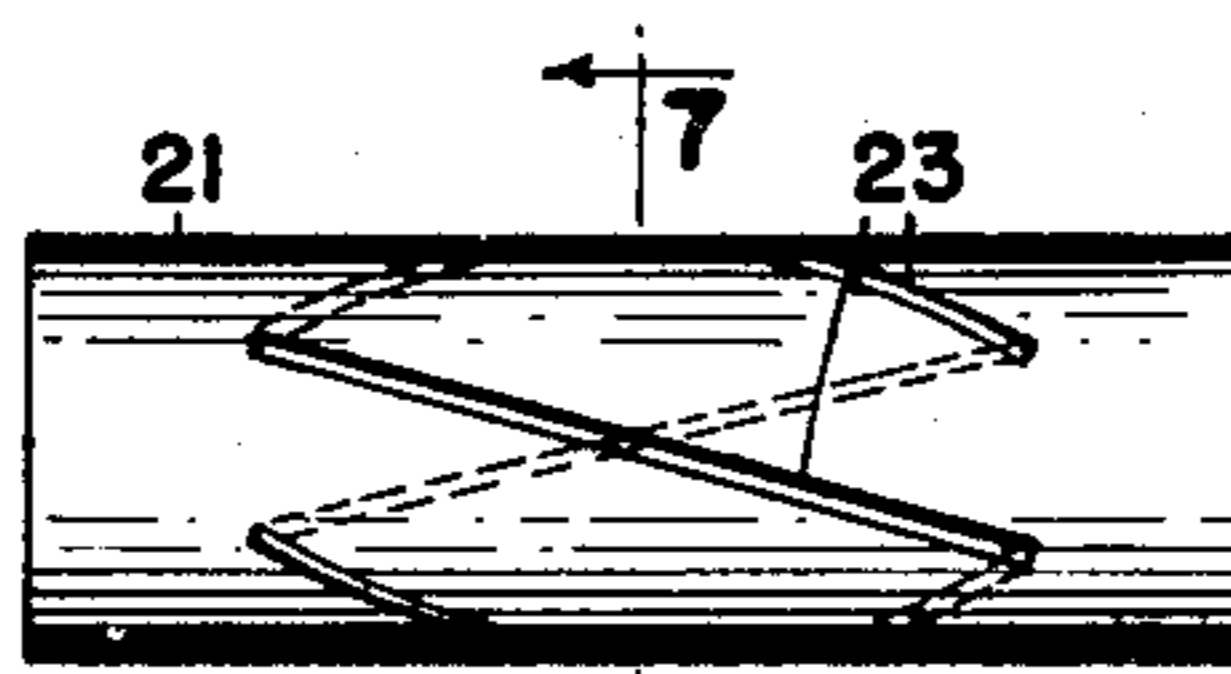


FIG. 6

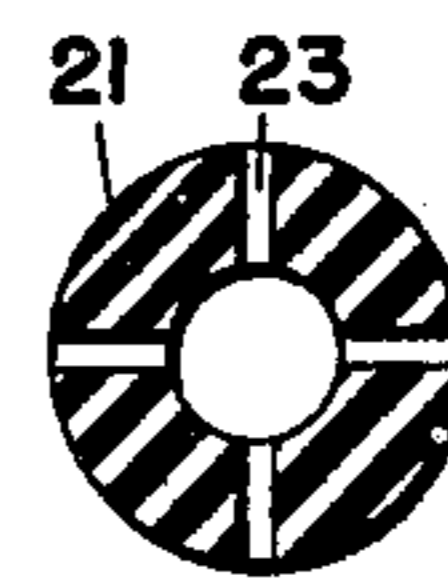


FIG. 7

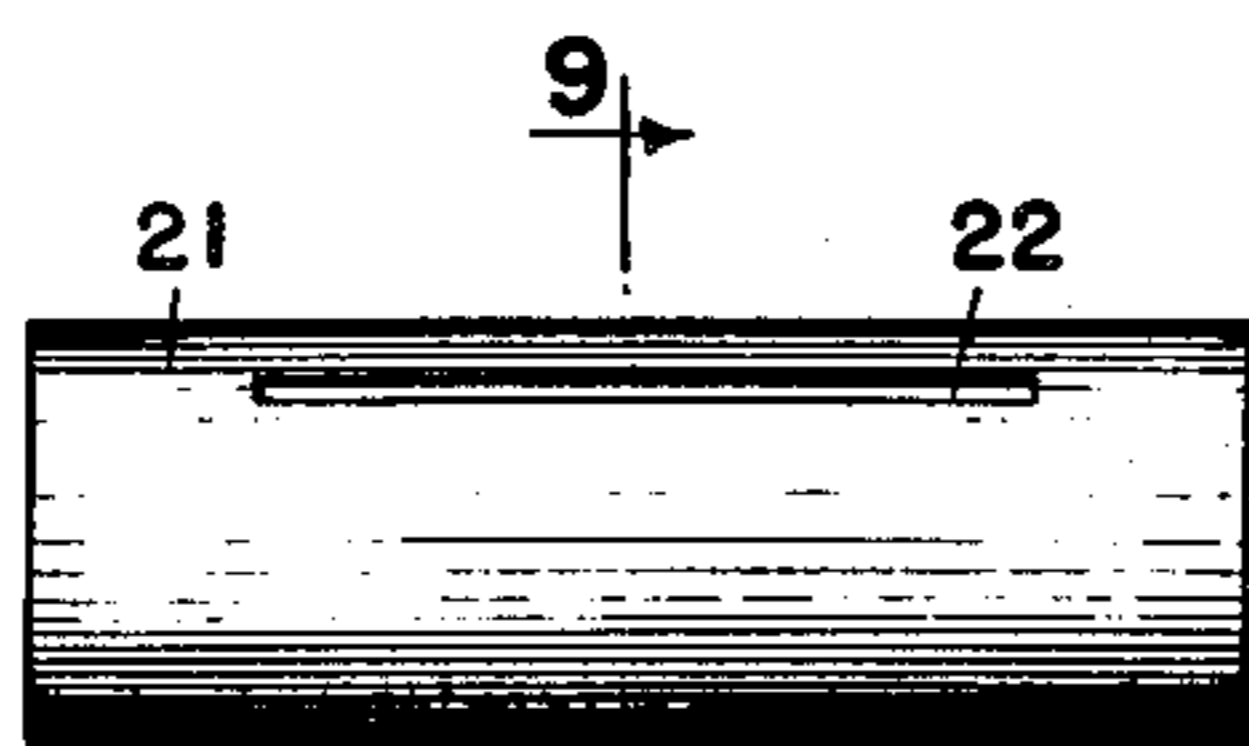


FIG. 8

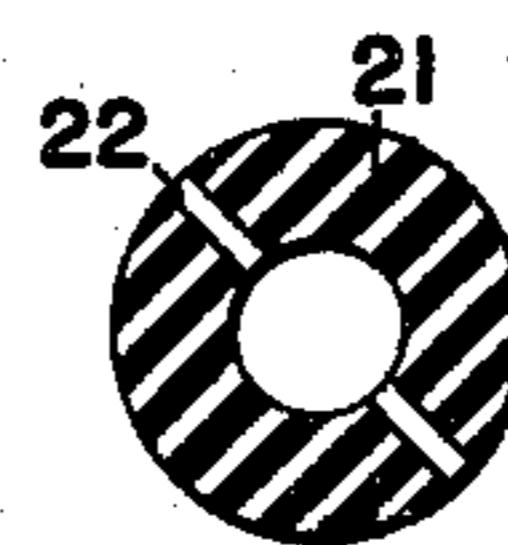


FIG. 9

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EXPANDABLE CONDENSER TUBE CLEANER

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2 Sheets-Sheet 2

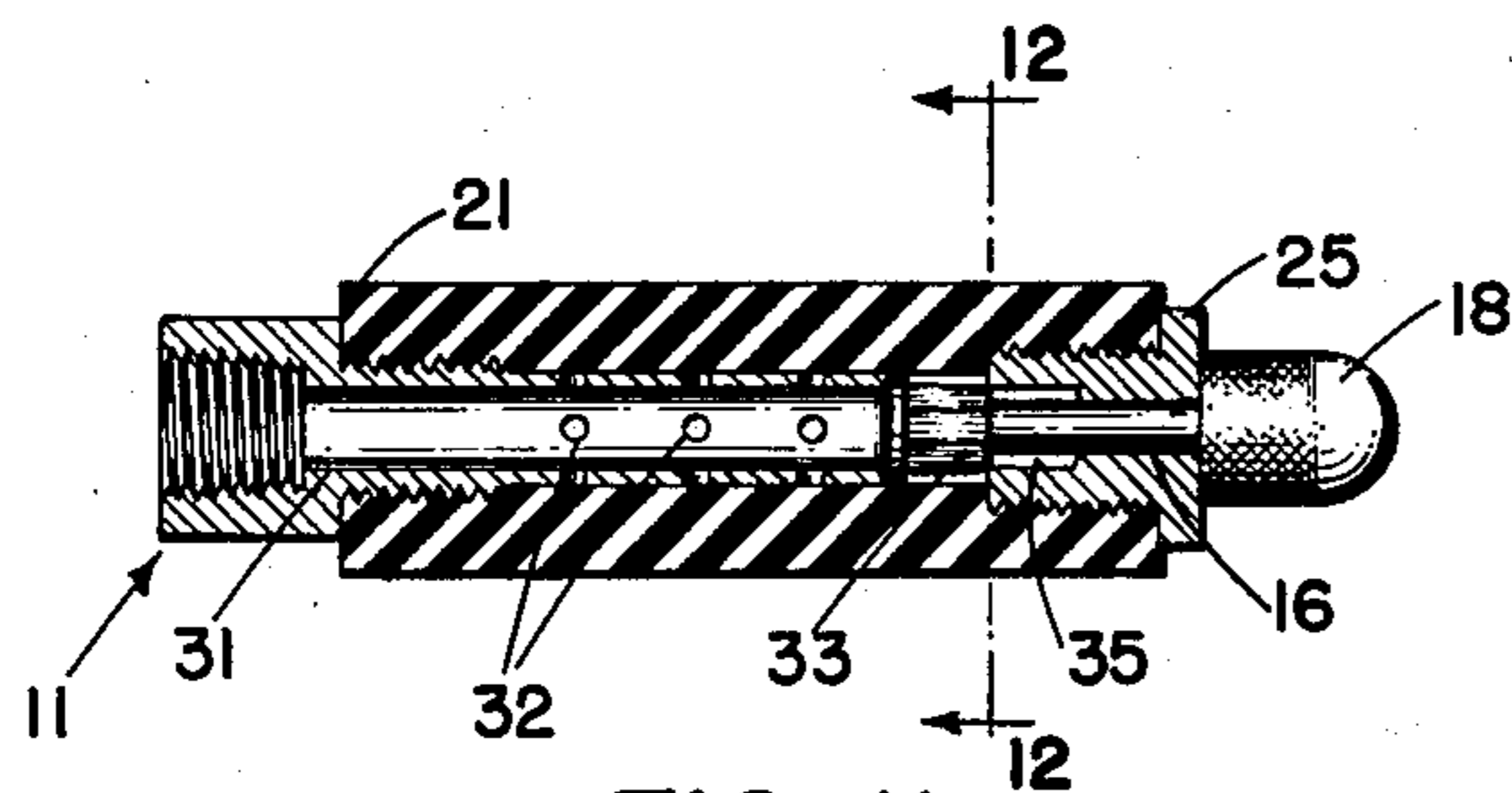


FIG. 11

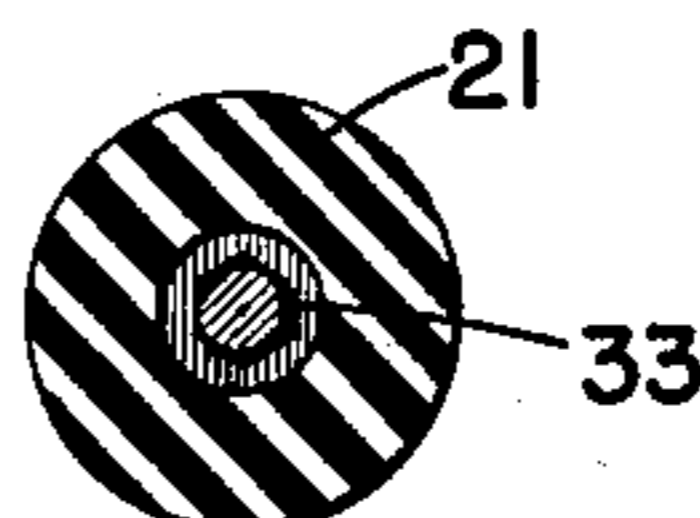


FIG. 12

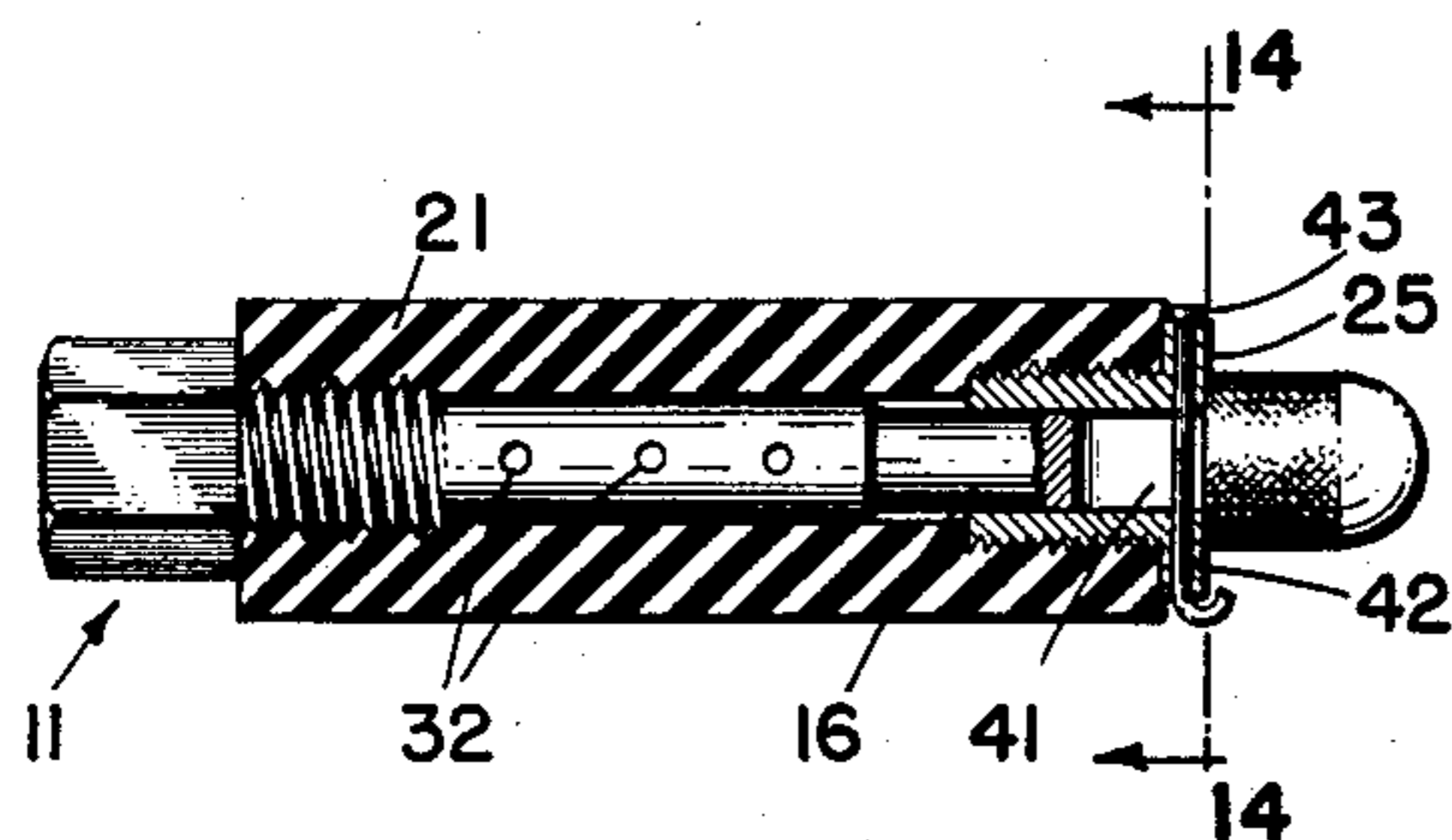


FIG. 13

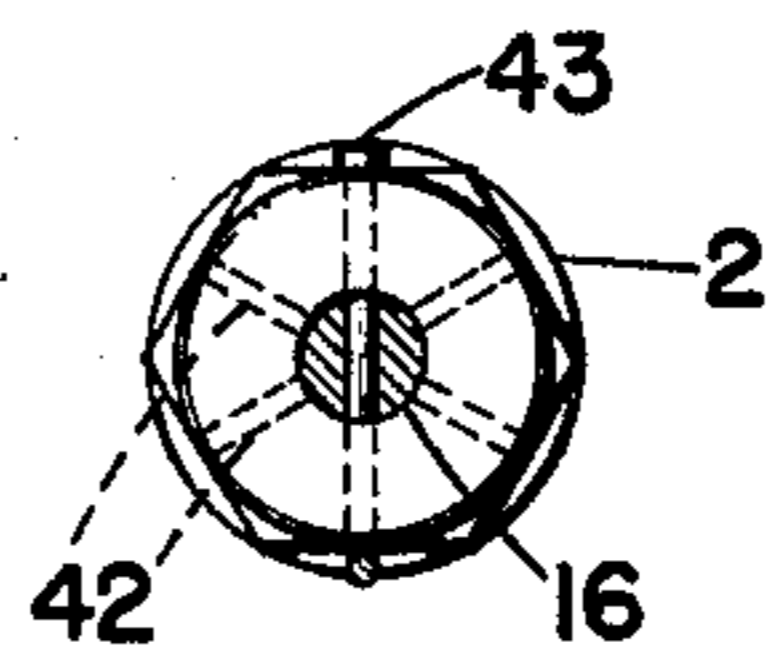


FIG. 14

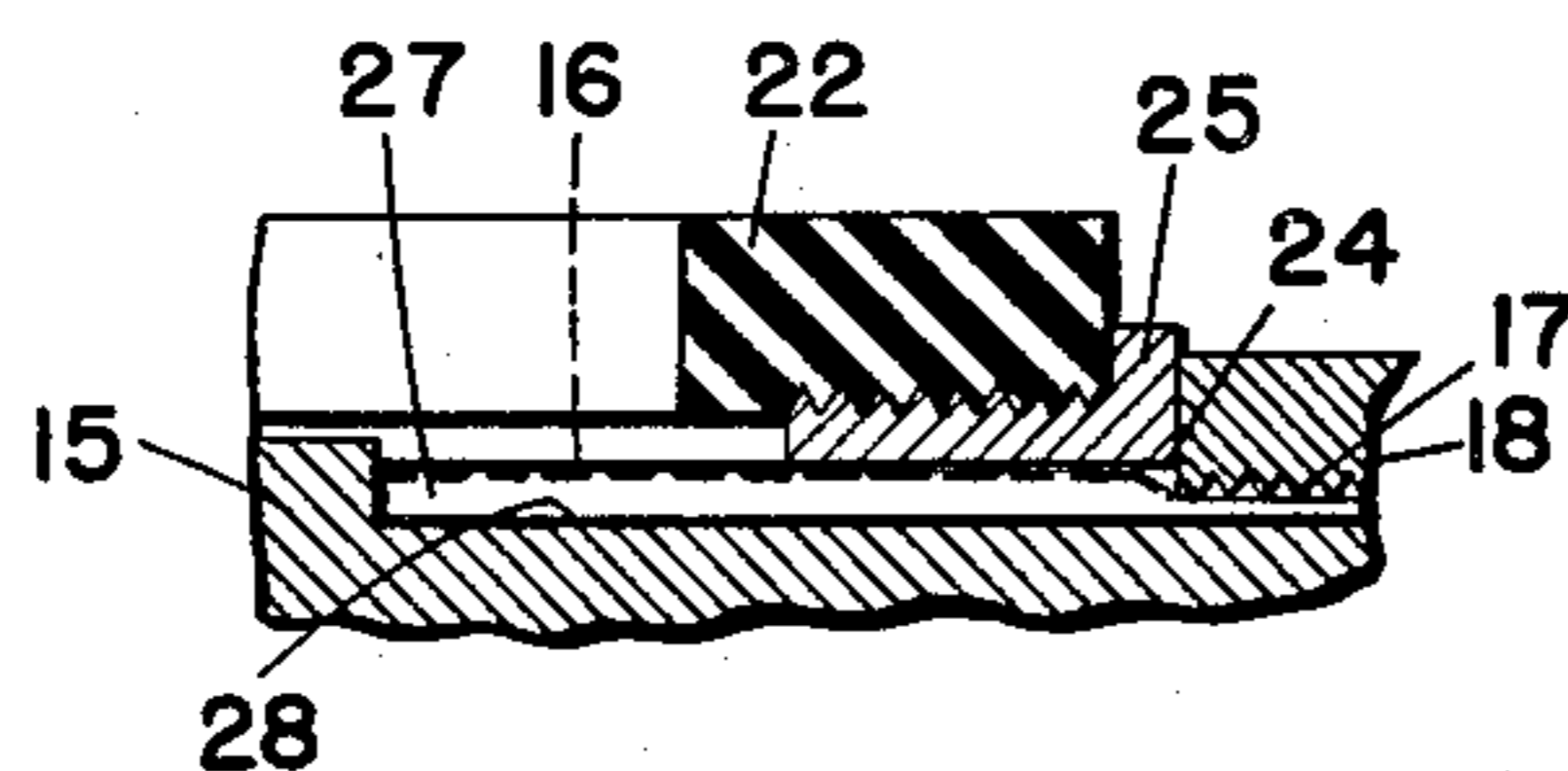


FIG. 10

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EXPANDABLE CONDENSER TUBE CLEANER

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8 Claims. (Cl. 15—104.14)

(Granted under Title 35, U. S. Code (1952),
sec. 266)

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This invention relates to a cleaner for pipes and tubes and particularly to a cleaner for water cooled tubes of steam surface condensers.

Deposits of slime and other foreign matter on the inside surfaces of steam condenser tubes tend to decrease the flow of heat from the condensing steam in contact with the outside of the tubes, through the metallic tube wall, to the cooling water flowing through the tubes. Thus the effectiveness of the condenser is gradually decreased and it becomes necessary to clean the inner surfaces of the tubes periodically in order to maintain reasonably high vacuum consistent with satisfactory and efficient operation of steam turbines and other apparatus served by the condensing equipment.

In tropical waters slime formation on condenser tube surfaces is much more rapid than in colder waters and the relatively high temperature of the circulating water has a direct effect in reduction of the condenser vacuum obtainable. High temperature circulating water combined with high power operation of propelling machinery tends to overload condensing equipment and reduce condenser vacuum below safe and economical limits unless the tube surfaces are kept free of slime coatings and other deposits of foreign matter.

Periodic removal of foreign deposits from the interior surfaces of condenser tubes has been required in the past principally as a measure for minimizing corrosion of the tubes and deposit attack or selective pitting of the metal tube surfaces underneath particles of foreign matter. The standard method of cleaning condenser tubes has been by use of an air or water "lance" to sweep out foreign deposits. In cases of extreme fouling, as often occur in the tropics, rubber plugs have been employed for cleaning the tubes. These rubber plugs are slightly larger than the inside diameter of the tubes and are forced through the tubes by use of air or water pressure to scrape off the slime and other foreign matter. The use of rotating metallic wire brushes, scrapers and other types of metallic condenser tube cleaners of various types for cleaning condenser tubes is prohibited because the metal scraping parts of these devices scratch and otherwise injure the interior surfaces of the tubes by damaging the thin, adherent protective coating and rendering the tubes subject to accelerated corrosion, pitting and early service failure.

The rubber plug cleaning method mentioned above has been found satisfactory for removing slime from condenser tube surfaces under cer-

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tain applications. One of the principal objections to the use of rubber plugs at present is associated with the wide use of condenser tube protectors which are inserted in the inlet end of the condenser tubes to prevent corrosion and impingent erosion. Such an assembly is shown in my Patent No. 2,225,615, which insert has a restricted neck portion adjacent its inlet end. This objection will be clearly observed by reference to said patent. Under these conditions it is extremely difficult to insert a rubber plug tube cleaner into the tube through the restricted neck portion of the insert unless the rubber plug is either too small or too soft to exert sufficient pressure against the tube surface beyond the insert to provide for proper cleaning of the metal tube surface.

One of the objects of the present invention is the provision of a collapsible and expansible cleaner of the rotary type which will pass freely through the restricted throat or neck portion of a condenser tube protector and which will thereafter expand into intimate contact with the wall of the tube in order to remove foreign matter therefrom.

A further object of this invention is to provide an improved cleaner of the type generally shown in my prior Patent No. 2,313,042 of March 9, 1943.

With these and other objects in view, as well as other advantages that may be incident to the use of the improvements, the invention consists in the parts and combinations thereof hereinafter set forth and claimed, with the understanding that the several necessary elements constituting the same may be varied in proportion and arrangement without departing from the nature and scope of the invention, as defined in the appended claims.

In order to make the invention more clearly understood, there are shown in the accompanying drawing, means for carrying the invention into practical use, without limiting the improvements in their useful application to the particular constructions, which, for the purpose of explanation, have been made the subject of illustration.

In the accompanying drawings:

Fig. 1 is a partly sectional plan view of the cleaner of this invention.

Fig. 2 is a section view showing the hose expanded under centrifugal force.

Fig. 3 is a partly sectional view, similar to Fig. 1.

Fig. 4 is a partly sectional view of a modified form of hose.

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Fig. 5 is a section on line 5—5 of Fig. 4.

Fig. 6 is a modified form of hose with diagonal slits.

Fig. 7 is a view on line 7—7 of Fig. 6.

Fig. 8 is a plan view of a hose, with but two slits.

Fig. 9 is a section on line 9—9 of Fig. 8.

Fig. 10 shows a modification with a spline-key added, applicable to any of the foregoing forms.

Fig. 11 is a plan view partly in section of a modified form of the device of Fig. 10.

Fig. 12 is a sectional view taken on the line 12—12 of Fig. 11.

Fig. 13 is a plan view partly in section of another modified form of the device of Fig. 10.

Fig. 14 is a sectional view taken on the line 14—14 of Fig. 13.

Referring now to the drawings in which like numerals designate like parts throughout the various figures, there is shown at 10 the complete cleaner head of this invention. This cleaner head 10 includes a spindle 11 shaped as shown, including an internally threaded and externally hexagonal end 12 connected by a shoulder 13 to a reduced threaded portion 14. This in turn is connected by a reduced spindle body 15 to a further reduced cylindrical neck 16 having a threaded end 17, the threaded end 17 having the same diameter and thread as the internal thread on the other end 12, whereby two or more spindles 11 may be connected in tandem, if desired. A knurled nut 18 is threaded to fit on the threaded end 17.

The cleaning element 20 consists of a piece of three or more ply fabricated or molded rubber hose or tubing 21, which may be molded about the reinforcing spring metal cage 26 which is designed to add strength, stiffness and rigidity to the hose or tubing. This tubing 21 is provided with a plurality of parallel slits 22 stopping short of its ends. As shown, the slits 22 are also parallel to the longitudinal axis of the hose 21, but may extend spirally instead, either clockwise, as shown at 23, Fig. 6, or counterclockwise.

A bushing 25, with a thread similar to that at 14 on the spindle, fits slidably over the cylindrical neck 16. In addition, the bushing 25 may have one or more longitudinal splineways 24 to cooperate with a spline-key 27 removably secured in a longitudinal groove 28 extending along the reduced neck 16 and threaded end 17, the spline-key being held in position by the nut 18, all as shown in Fig. 10. The use of this removable spline-key 27 permits the hose or tube 21 to be readily replaced, yet holds it against twisting while being rotated at high speed during the cleaning operation.

To assemble the cleaner head 10, the bushing 25 is threaded into one end of the hose or tubing 21, and the hose or tubing 21 is then passed over the spindle body 15 and has its other end threaded over the threaded portion 14 until it abuts the shoulder at the end. The knurled nut 18 is threaded over the threaded end 17. Should two or more cleaner heads be used in tandem, the threaded end 17 of one is threaded into the internally threaded hexagonal end 12 of the second spindle 11, and the nut 18 is placed on the threaded end 17 of the final spindle.

In operation, the cleaner head 10 is connected to a flexible power shaft, similar to that shown in the aforementioned Patent 2,313,042, by threading the end 12 of the spindle 11 to the end of the shaft. After the cleaner head has been inserted into the tube to be cleaned, it is rotated

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at high speed. Centrifugal force causes the slitted center portion of the hose or tubing 21 to move outwardly, the bushing 25 moving on the neck 16 toward the shoulder to permit such action. The edges of the slitted portions act as squeegee scrapers or wipers to clean the insides of the tubes or pipes of slime, which has collected therein. When removing the cleaner head from the tube being cleaned, the knurled nut serves to prevent the cleaner tubing or hose 21 from being broken by undue elongation and strain.

As shown in my prior patent referred to hereinabove, it is often desirable to pass flushing water through the tube cleaner and in such event, it is particularly desirable to prevent twisting of the hose or tube 21 during the cleaning operation as such twisting tends to close the slits in the hose thereby not only preventing the aforementioned squeegee action produced as the edges of the slits pass over the insides of the condenser tubes but also preventing the flow of flushing water from the slits. The arrangement of Fig. 10 will prevent such twisting of the hose which result may also be accomplished by the means illustrated in the modifications shown in Figs. 11, 12, 13 and 14.

Referring now to the structure of Figs. 11 and 12, there is disclosed a condenser tube cleaner provided with a spindle 11 having a longitudinal bore 31 therein and intersecting apertures 32 to permit the passage of flushing fluid therethrough during the cleaning operation. In order to prevent closure of the slits in the hose or tube 21 carried by the spindle 11 caused by twisting of the hose in use, the spindle 11 is provided with a reduced cylindrical neck 16 provided with a hexagonal or other non-circular section 33 which is arranged to cooperate with a close-fitting hexagonal or other non-circular bore 35 in the bushing 25 when the bushing is caused to slide on the neck 16 under the action of centrifugal force. The interengagement of section 33 with bore 35 prevents rotation of the bushing 25 with respect to the spindle 11 without in any way interfering with the rotation of bushing 25 when it is initially assembled in the hose or tube 21 by screwing therein. The operation of this modification is similar to that hereinbefore described in connection with the previous figures.

Figs. 13 and 14 illustrate an arrangement similar to that of Figs. 11 and 12, the difference residing in the provision of an entirely distinct arrangement for preventing twisting of the hose or tube 21. This is accomplished by providing the reduced neck 16 of the spindle 11 with a longitudinal slot 41 and providing the bushing 25 with a series of radial apertures 42 any one of which may be rotated into alignment with the slot 41 when the bushing 25 is assembled in the hose or tube 21. After assembly of these elements is completed, a headed pin or cotter 43 is inserted in the aligned aperture 42 and slot 41, the pin or cotter being then bent, as shown, to retain it in position. It is obvious that the pin or cotter 43 will prevent rotation of the bushing 25 with respect to the spindle 11 while permitting slidable movement of the bushing on the neck 16 as the pin 43 slides freely in the slot 41.

It will be understood that, as previously stated, the above description and accompanying drawing comprehend only the general and preferred embodiment of the invention and that various changes, in construction, proportion and arrangement of the parts may be made within the

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scope of the appended claims without sacrificing any of the advantages of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What I claim is:

1. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material fixedly secured at one end about the spindle, and means rotatable with said spindle, for slidably mounting and securing the other end of said hose to said spindle, said hose having a plurality of longitudinal slits extending radially therethrough intermediate its ends whereby the edges of said slits provide squeegee action under centrifugal force when the tube cleaner is rotated.

2. The tube cleaner of claim 1 having a hose of flexible and elastic material.

3. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material fixedly secured at one end about said spindle, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing secured within such other end of said hose, a reduced neck on said spindle, said bushing being slidably movable on said reduced neck, a nut threadedly secured on said reduced neck limiting the outward movement of said bushing, and spline key means engaging mating slots on said reduced neck and said bushing thereby preventing rotation of said bushing with respect to said spindle, said hose having a plurality of longitudinal slits extending radially therethrough intermediate its ends whereby the edges of the slits provide squeegee action under centrifugal force when the tube cleaner is rotated.

4. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material and provided with longitudinal slits intermediate its ends fixedly secured at one end about said spindle, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing inserted within such other end of said hose, a reduced neck on said spindle, said bushing being slidably movable on said reduced neck, a nut threadedly secured on said reduced neck limiting the outward movement of said bushing, and a spline-key held in a longitudinal groove in said neck by said nut and cooperating with a longitudinal groove in said bushing to prevent rotation of said bushing and hose relative to said spindle.

5. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material fixedly secured at one end about said spindle, a plurality of longitudinal slits extending radially through and intermediate the ends of said hose, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing inserted within such other end of said hose, a reduced neck on said spindle provided with a non-circular portion, said bushing being slidably movable on said neck and having a non-circular opening therein cooperating with the non-circular portion of the neck thereby to prevent rotation of said bushing and hose relative to said spindle.

6. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable

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and replaceable hose of yieldable material fixedly secured at one end about said spindle, a plurality of longitudinal slits extending radially through and intermediate the ends of said hose, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing inserted within such other end of said hose, a reduced neck on said spindle provided with a longitudinal slot therein, an aperture in said bushing substantially coincident with said slot, and a pin passing through said aperture and said slot when said bushing is mounted on said reduced neck whereby the bushing is permitted to slide upon said neck but is prevented from rotating thereon.

7. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material fixedly secured at one end about said spindle, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing inserted within such other end of said hose, a reduced neck on said spindle, said bushing being slidably movable on said reduced neck, and a threaded nut secured on said reduced neck limiting the outward movement of said bushing, said hose being provided with a plurality of longitudinal slits extending radially therethrough intermediate its ends, the edges of said slits providing squeegee action under centrifugal force when the tube cleaner is rotated.

8. A tube cleaner comprising a spindle arranged to be rotated at high speed, a removable and replaceable hose of yieldable material fixedly secured at one end about said spindle, means for slidably mounting and securing the other end of said hose to said spindle, said means including a bushing inserted within such other end of said hose, a reduced neck on said spindle, said bushing being slidably movable on said reduced neck, a nut threadedly secured on said reduced neck limiting the outward movement of said bushing, and a spline-key held in a longitudinal groove in said neck by said nut and cooperating with a longitudinal groove in said bushing to prevent rotation of said bushing and hose relative to said spindle, said hose having a plurality of longitudinal slits extending radially therethrough intermediate its ends whereby the edges of said slits provide squeegee action under centrifugal force when the tube cleaner is rotated, said hose being of flexible material.

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