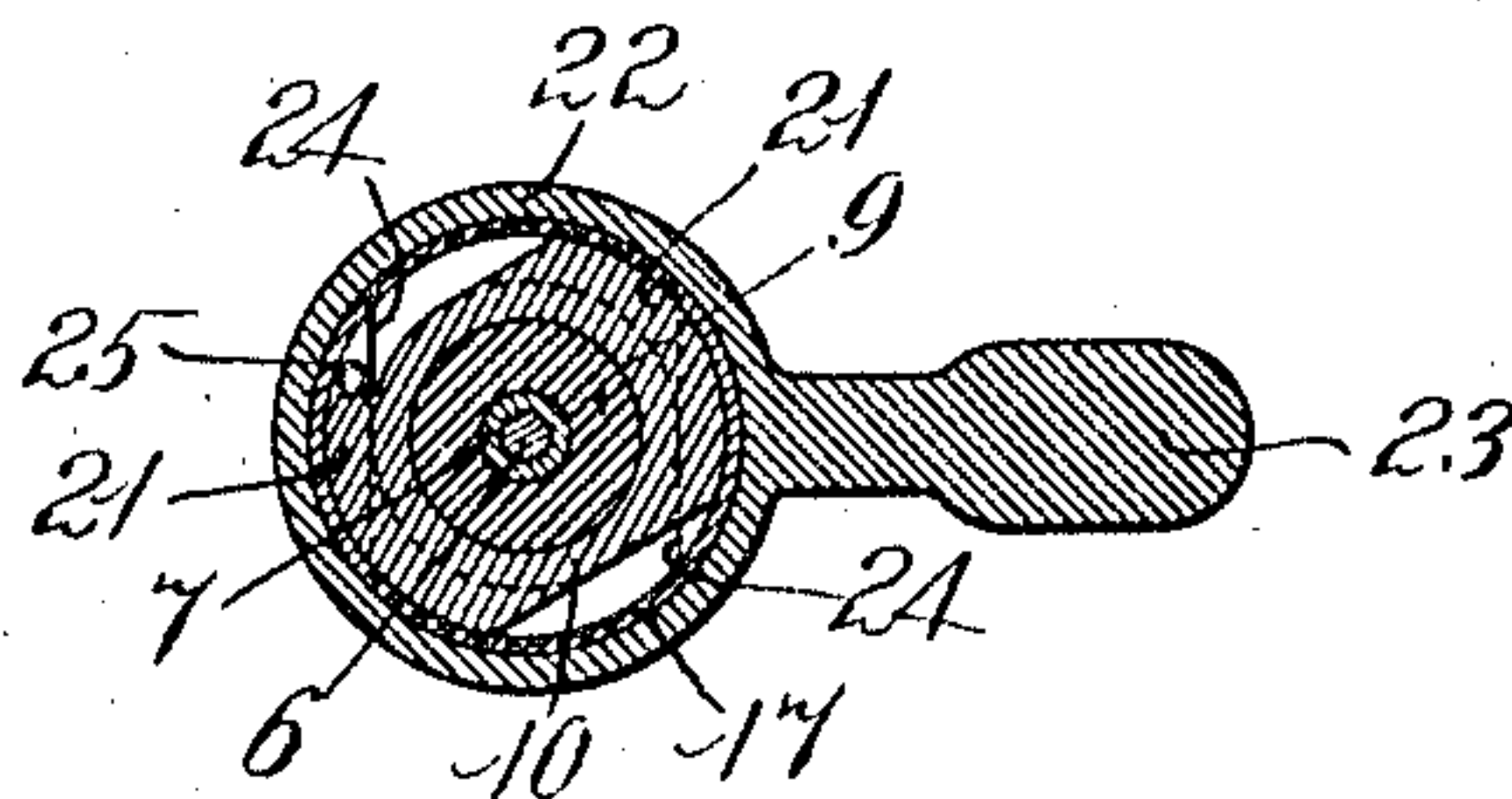
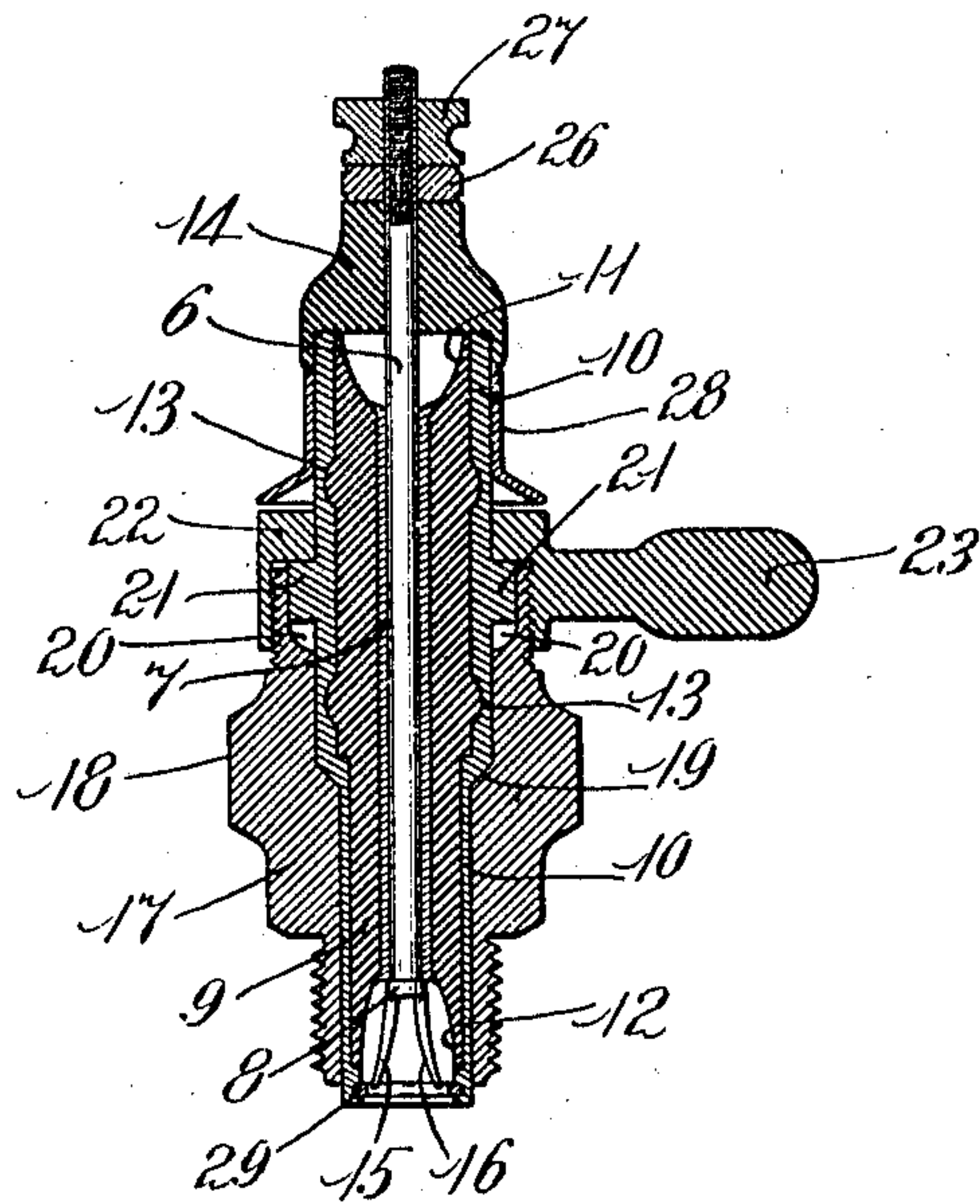
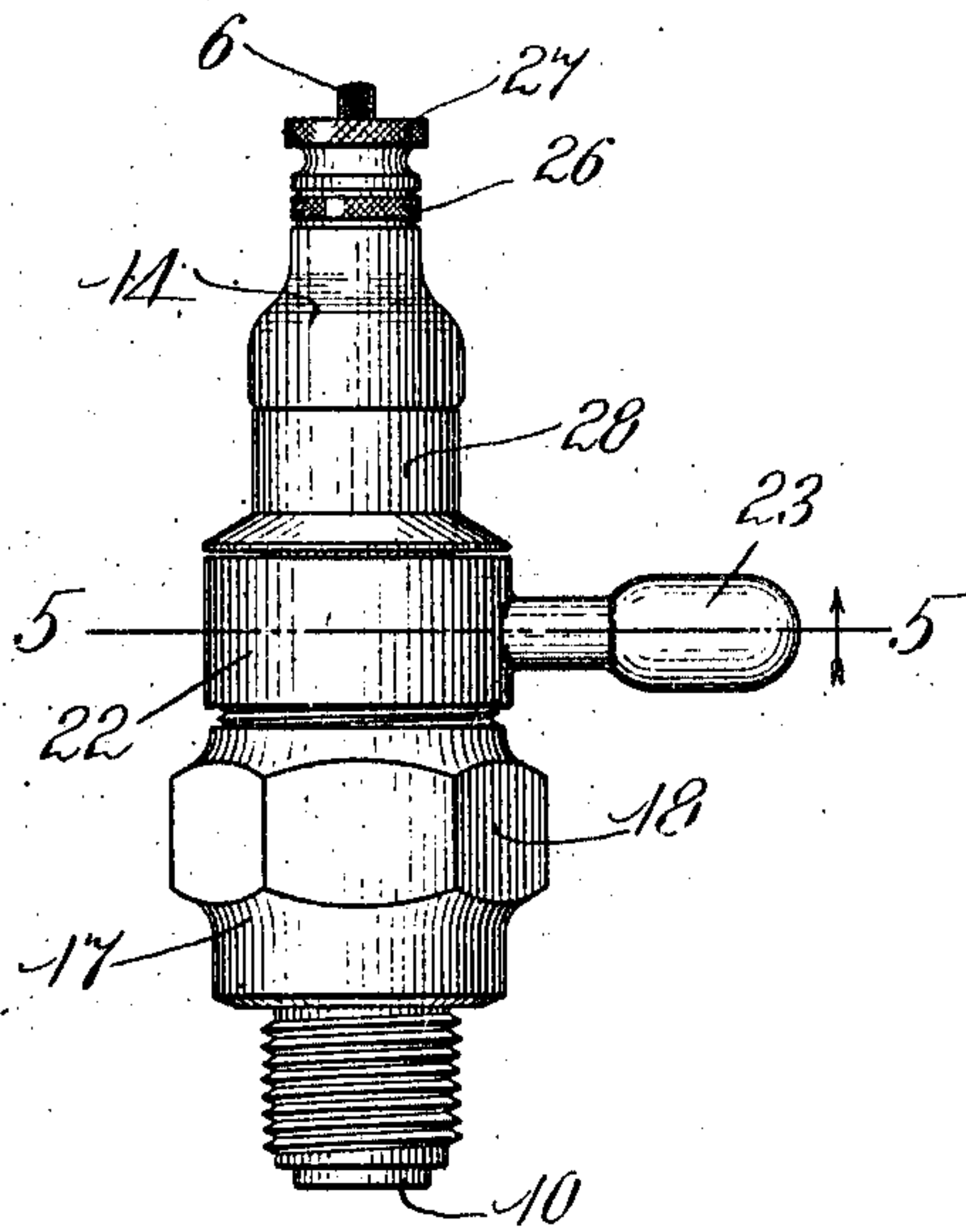
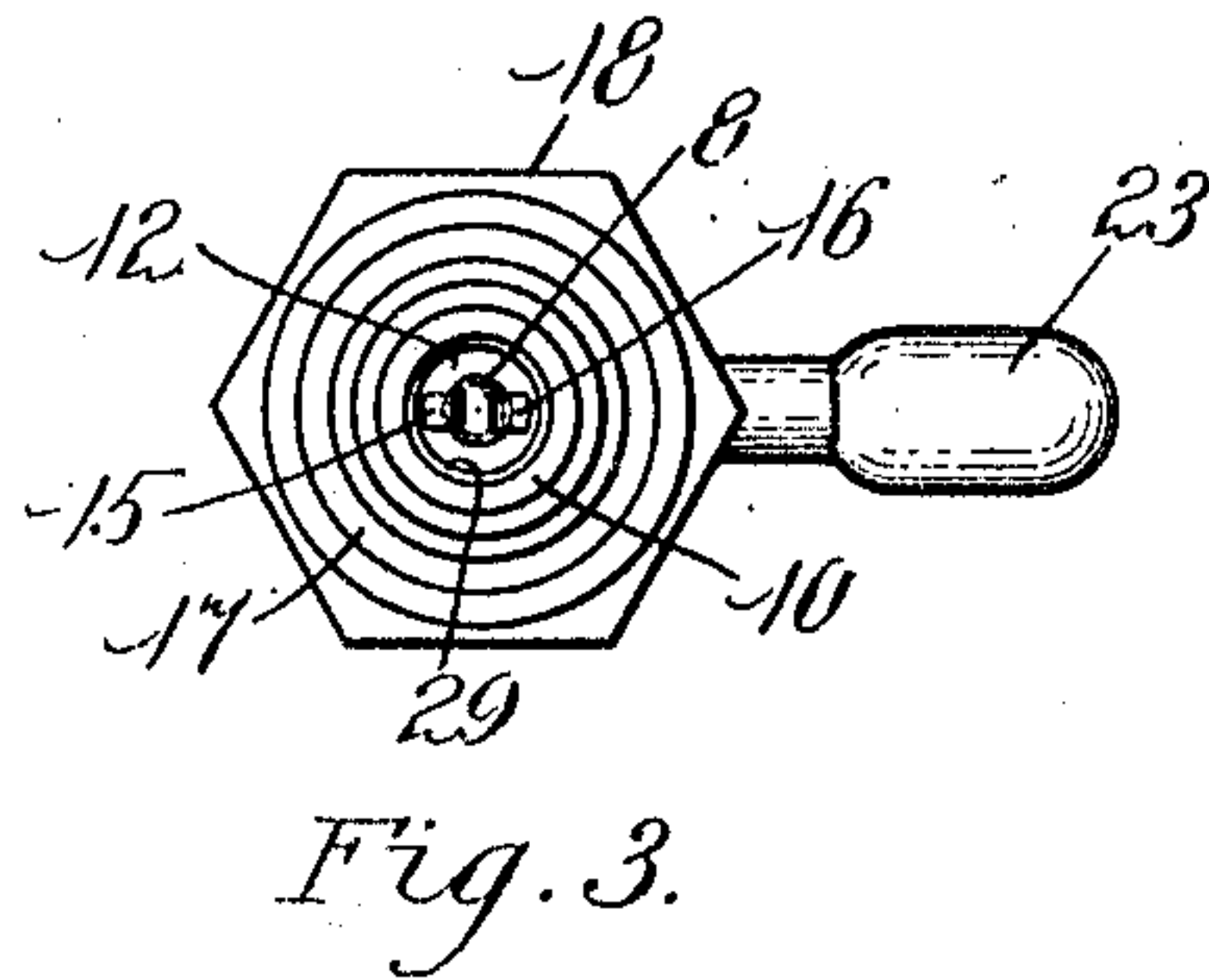
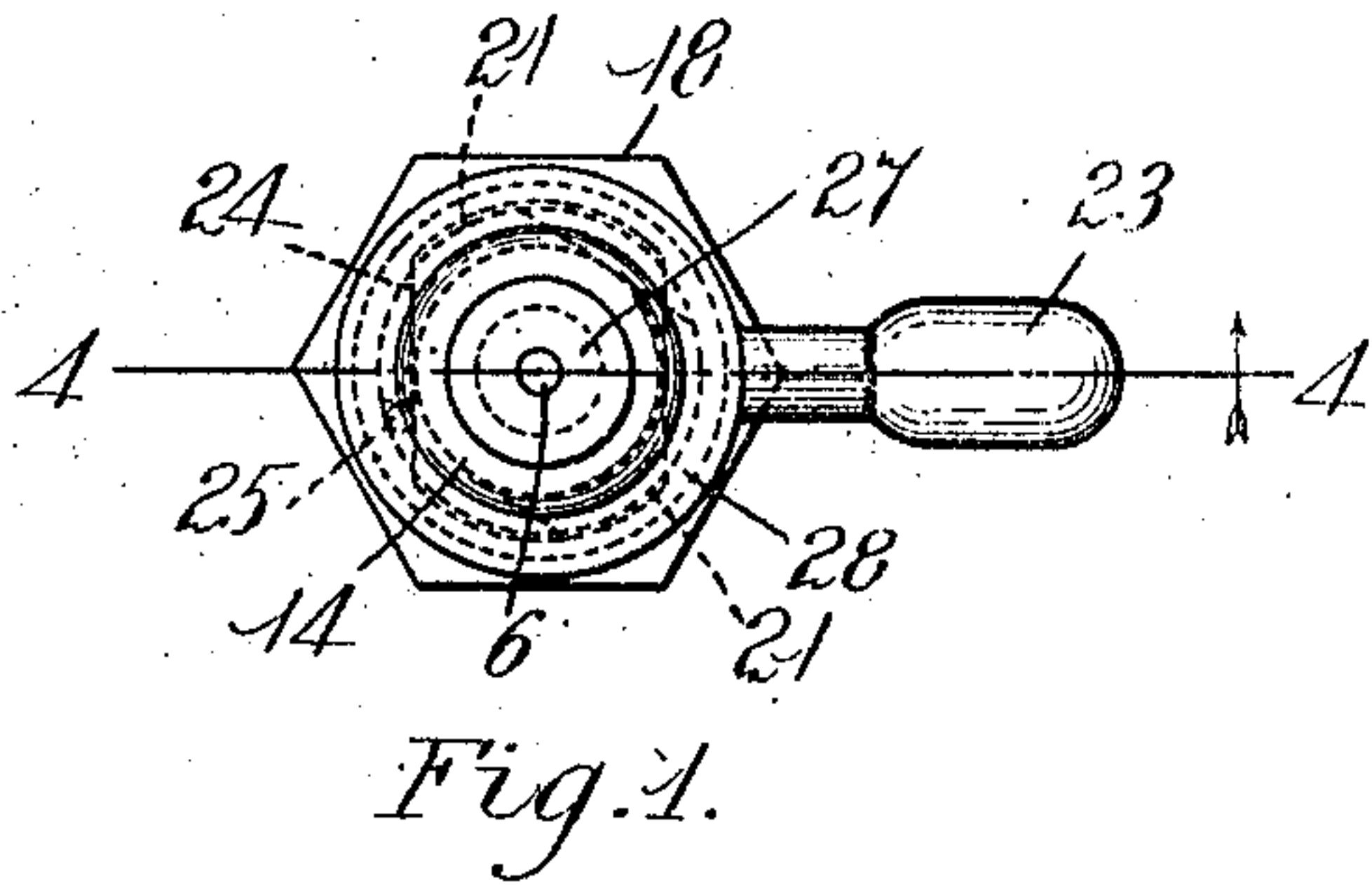


W. FALWELL.
 REMOVABLE SPARK PLUG.
 APPLICATION FILED DEC. 8, 1909.

978,280.

Patented Dec. 13, 1910.



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UNITED STATES PATENT OFFICE.

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REMOVABLE SPARK-PLUG.

978,280.

Specification of Letters Patent.

Patented Dec. 13, 1910.

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To all whom it may concern:

Be it known that I, WRAY FALWELL, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Removable Spark-Plugs, of which the following is a specification.

My invention relates to removable spark-plugs for use in internal combustion engines, and its objects are to simplify the parts thereof and render the same more accessible, to protect from injury the insulation between the electrodes, to prevent the leaking of the combustion gases and the production of short circuits in the sparking circuit, to permit the manual removal of both electrodes without removing the holder of the same, to provide a means of securely locking both electrodes to the holder when in use, and to render more effective the production and action of the igniting sparks.

It consists of a spark plug, the central electrode stem of which is incased in a thin metallic sleeve surrounded by insulating material, which material is inclosed in a protective metal case or shell forming the outer or grounded electrode and provided with a cap of wood fiber, hard rubber or other suitable material.

It further consists in constructing a holder having a thread at one end to screw into an orifice in the combustion chamber, and having a thread at the other end designed to engage with the interior thread of a hollow head, which head is adapted to secure and hold the two electrodes by means of lugs on the exterior surface of the outer electrode.

It further consists in constructing spark-ing terminal points for the central electrode stem, said points being at varying distances from the nearest contact with the outer electrode.

It further consists in other improvements more specifically illustrated in the drawing and pointed out and claimed in the following specification.

Figure 1: is a plan view of my improved spark plug and holder therefor. Fig. 2. is a side elevation of the same. Fig. 3. is a view of the lower extremity of the central electrode showing the sparking terminal

points. Fig. 4. is a vertical section on line 4—4 of Fig. 1. Fig. 5. is a horizontal section of Fig. 2. on line 5—5 looking in the direction of the arrow.

Similar numerals of designation refer to similar parts throughout the several views.

Referring to the drawing, the central electrode stem 6, composed of any metal or substance of suitable conductivity, is for the greater portion thereof inclosed by the metallic sleeve 7, the lower part of said stem normally projecting from the base of said sleeve and forming a head 8, and the upper part normally projecting above the top of said sleeve, for the purpose hereinafter described. I prefer to make the said stem 6 of but slightly smaller diameter than the sleeve 7, in order that the two may fit closely together, but at the same time to permit them to be readily disassociated when it is desired to take my invention apart. Around the said sleeve, completely inclosing the same, is a thick layer or coating 9, of insulating material which is preferably porcelain, but may be of any substance suitable for the purpose, the said layer 9 having an outside shell or jacket 10 of metal which forms the grounded electrode.

The ends of the said shell 10 extend slightly beyond each extremity of the sleeve 7, in order to permit the formation of the cup-shaped depressions 11 and 12 in the ends of said insulating material, the extremities of the sleeve 7 being at the lowest point of said depressions. By so shaping said insulating material and inclosing it as aforesaid, I am able to protect the same completely against external or internal violence, there being no exposure in such construction to injury by the use of wrenches, tools or the like, the outer and inner metallic shells affording an armored covering for the inner and outer portion of the insulating material at the parts where breakage would be likely to occur and there being none of the said material projecting from its casings, or being exposed as is common in other spark-plugs now on the market. In order to prevent any possibility of the said insulation escaping from its armored covering, I provide annular recesses 13 into which protrude portions of the said insulation. As a further

protection to the upper extremity of said insulation and as a means for conveniently handling the spark-plug when heated, I prefer to mount the cap 14, formed of wood 5 fiber or other material which is both an insulator and a poor conductor of heat, upon the stem 6, bringing said cap into close contact with the upper portion of the shell 10 and thereby preventing oil, dirt, or the like 10 from littering the same. Upon the head 8 at the lower end of the electrode stem are mounted the terminal points 15 and 16, which are composed of suitable material preferably platinum or nickel and which 15 may be of any number but are here shown as two in number, and are preferably made integral with said head 8, and located entirely within the depression 12. Preferably one of said terminal points is nearer the 20 inner edge of the grounded electrode than the other in order that where a "magneto" is used to generate the current the igniting sparks may be used to greater advantage, since I have found that when the "magneto" 25 is moving at a low rate of speed, the current furnished produces a much weaker spark than when running at a high rate of speed, and that at a low rate of speed the spark is produced from the nearest point only and 30 is of much greater size and utility than when it is divided among a plurality of points, all at the same distance from the grounded electrode. Whereas at a high rate of speed, the "magneto" furnishes a current of much 35 greater strength which produces a spark from all the points. I am thus enabled to produce a more positive ignition at all speeds than that in common use. In my invention it is obvious that the terminals are 40 arranged at such a distance from the grounded electrode that the current will only jump across on the nearer terminal on low speed, and on all the terminals on high speed,—such arrangement being easily determined 45 by actual experiment. In order that the position of said terminals may be readily changed in relation to the outer electrode, I prefer to construct them of metal sufficiently flexible to permit them to be bent into proper 50 adjustment. Upon the upper end of the said stem are mounted the binding nut 26 and the thumb screw 27 for the purpose of affording a binding post for electrical connection with the wire from the generator: 55 the circuit being completed through the steel framework of the motor car to the binding post on the circuit breaker as is well known in the art.

All the above specific description applies 60 particularly to the spark-plug as a whole, which is complete in itself and is designed to be readily removed in its entirety from the combustion chamber or installed therein in a very short space of time without the use

of wrenches or tools. For the purpose of 65 said attachment, I employ a holder 17, which is formed with a screw thread at the base thereof for the purpose of engaging with the screw-threaded orifice in the combustion 70 chamber (not shown) and to be firmly secured therein, such engagement being effected by means of a wrench applied to the nut 18 formed upon the exterior of said holder and being integral therewith. The 75 interior of said holder is made hollow for the purpose of permitting the insertion of the spark-plug above described, so that the ends of the electrodes shall be in proper position in the combustion chamber. To this end, the said spark-plug is constructed 80 with an enlargement about the central portion thereof and forming an abutment 19 which engages with a shoulder in said holder, the interior thereof being shaped to permit a close contact of all the parts of 85 both plug and holder except at the top of the holder where an annular recess 20 is formed. Into said annular recess project the lugs 21 formed upon the exterior of the spark-plug, and over the top of the holder 90 is secured the hollow head 22, the upper end of said holder being threaded to engage with the thread on the interior of said head. The releasing or tightening of said head is effected by means of the handle 23, which 95 is made integral therewith. (See Figs. 2 and 4.)

To permit the ready introduction and removal of the spark-plug, the top of the head 22 is provided with the openings 24 which 100 permit egress or ingress of the lugs 21 and the consequent removal of the said plug. The stop 25 located on the under side of the top of the head 22 and integral therewith (see Fig. 5) permits one of the lugs to be 105 turned against the same and the head may then be screwed down by means of the handle 23 and firmly secured. I prefer to locate the stop 25 flush with one side of one of the openings 24, in order that one of the 110 lugs may be turned so as to engage the same and be brought directly beneath said opening 24 when the said head 22 is loosened.

For the purpose of protecting the openings 24 and top of the casing 22, I preferably employ the collar 28, the base of which is made flaring for this purpose. I also prefer to construct the terminal of the grounded electrode with an annular recess 120 for the purpose of receiving and holding a metallic ring 29, of high resistance wire, the ring being of sufficient resilience to permit its ready introduction and removal, and serving the purpose of a sparking area or 125 sparking points.

The manner of attaching my improved spark-plug is as follows: In the first instance the holder 17 is screwed into the orifice pro-

vided in the combustion chamber and is firmly and permanently secured therein. The spark-plug is then placed in the holder and the lugs inserted through the openings 5 24. Upon turning the plug until one of the lugs abuts against the stop 25, and screwing down the head 22, the plug is secured in position and is ready for use. To remove the plug, partly unscrew the head, turn the plug 10 until the opposite lug engages the stop, and lift the plug from the holder.

So far as I am aware I am the first person to use a spark-plug the insulation of which is completely protected. In all of the 15 spark-plugs now in common use, the porcelain or other material used for insulation protrudes from the plug just above the place formed for the reception of the wrench, and I have found from experience that the ex- 20 posed position of such porcelain renders it extremely liable to injury not only from the use of removal tools but from changes of temperature and other causes. The importance of protecting the interior surface of 25 the insulation appears to have been completely overlooked in prior devices, the possibility of injury from inserting or withdrawing the electrode stem not being considered. I also believe myself to be the first to 30 construct a spark-plug which can be completely removed from the combustion chamber or installed therein without the use of wrenches and tools. I am aware that there are spark-plugs now on the market which 35 are in part removable without the use of tools, the inner electrode being detachable from the outer electrode which is left in the orifice of the combustion chamber, but I am not aware of any means for manually re- 40 moving the entire plug including both electrodes. This disassociation of parts of the plugs used in the prior art as above set forth is open to grave objection. It has been my experience that where one electrode is re- 45 moved and another inserted in its place, it is almost certain that the terminals of the two electrodes are not in proper relationship, and the only certain means of insuring adequate adjustment is by removing the ground- 50 ed electrode as well as the inner electrode,—a proceeding involving much time and difficulty. To insure good results from the practical standpoint, I have found that it is essential to preserve a constant relationship 55 between the terminals of the electrodes and that anything occasioning the disturbance of such relationship is practically certain to destroy the efficiency of the spark-plug in which they are used.

60 One great difficulty heretofore experienced with spark-plugs of the prior art is from the condensing of the combustion gases upon the insulation and parts of the plug adjacent to the electrodes, and the production of

short circuits occasioned thereby. This is 65 primarily due because of openings or crevices between the electrodes which permit gases and other matter to accumulate therein and to condense upon the electrodes and in numerous instances to cause said gases to 70 leak out through the plug. Particularly is this defect observable where parts of the plug are designed to be made removable after the plug is installed, as for instance where the electrodes are disassociated, one 75 being left in the combustion chamber. Such defect is entirely overcome by the construction and arrangement of the parts of my spark-plug, there being no openings in which said gases can collect or through which they 80 can pass to the outside air, all said parts being hermetically closed.

What I claim and desire to secure by Letters Patent is:—

1. In a spark-plug: a metallic shell electrode, a hollow metallic holder shaped to receive and hold said electrode, and having an annular recess therein, lugs located upon said electrode and formed to be inserted within said recess, combined with a head 85 for securing said electrode therein, and means for withdrawing said electrode from said holder without removing said head therefrom.

2. In a spark-plug: a metallic shell electrode, a hollow metallic holder adapted to receive and hold said electrode and having an annular recess therein, lugs located upon said electrode and formed to be inserted within said recess, combined with a head 95 threaded to engage with the top of said holder and to be turned down upon the same, and to secure said electrode, said head having openings through which said shell electrode may be inserted or withdrawn 100 when said head is loosened.

3. In a spark-plug: a metallic shell electrode, a hollow metallic holder adapted to receive and hold said electrode and having an annular recess therein, lugs located upon said electrode and formed to be inserted within said recess, combined with a head 110 threaded to engage with the top of said holder and be turned down upon the same, and to secure said electrode, said head having openings through which said shell electrode may be inserted or withdrawn when said head is loosened, and a handle secured to said head for the purpose of turning the 115 same. 120

4. In a spark-plug: a metallic shell electrode, a hollow metallic holder adapted to receive and hold said electrode and having an annular recess therein, lugs located upon said electrode and formed to be inserted within said recess, combined with a head 125 threaded to engage with the top of said holder and be turned down upon the same,

and to secure said electrode, said head having openings through which said shell electrode may be inserted or withdrawn when said head is loosened, and said head being
 5 provided with a stop situated at the side of one of the openings through which the lugs are withdrawn.

In testimony whereof I have affixed my signature, in presence of two witnesses.

WRAY FALWELL

Witnesses:

ATHERTON N. HUNT,
 WILLIAM A. WALKER.