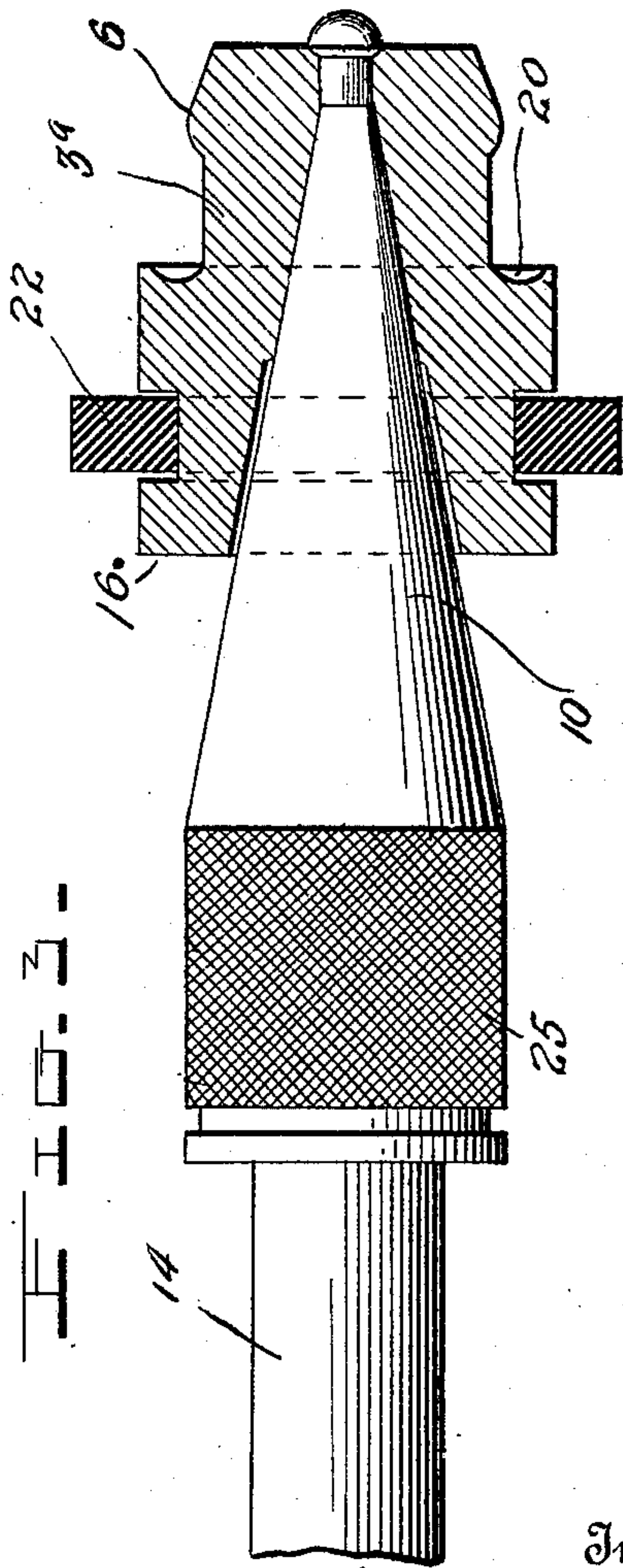
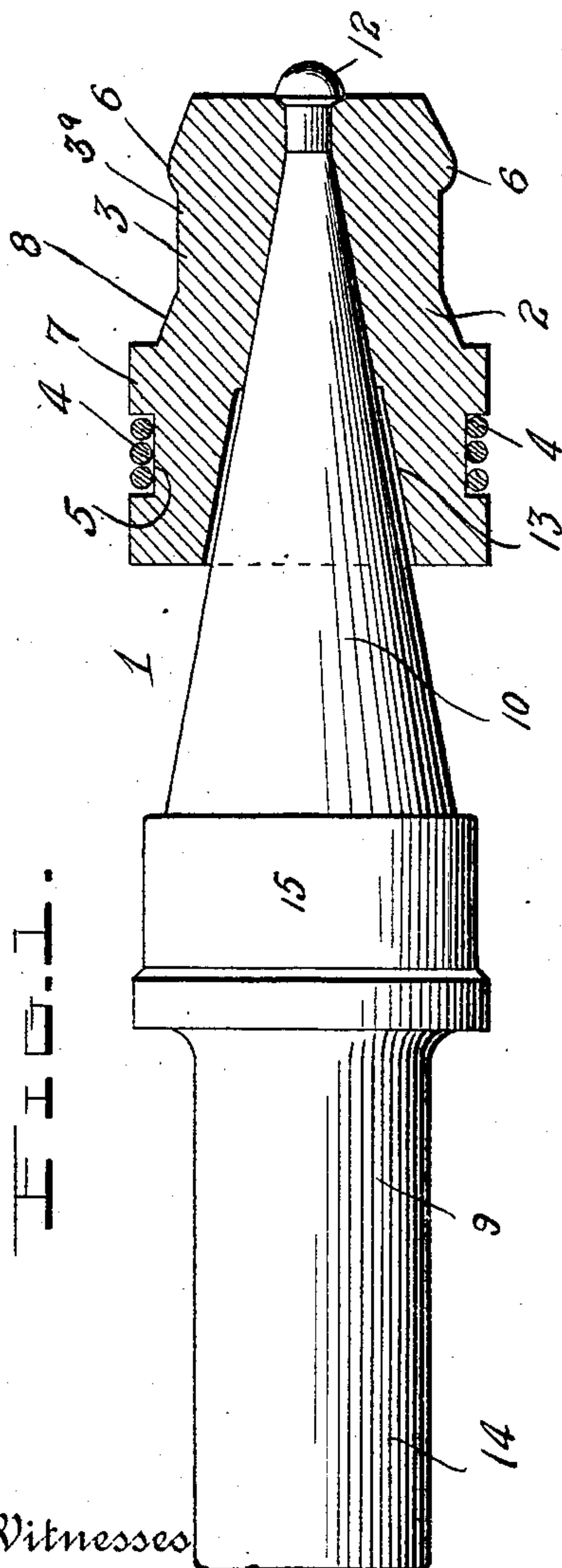
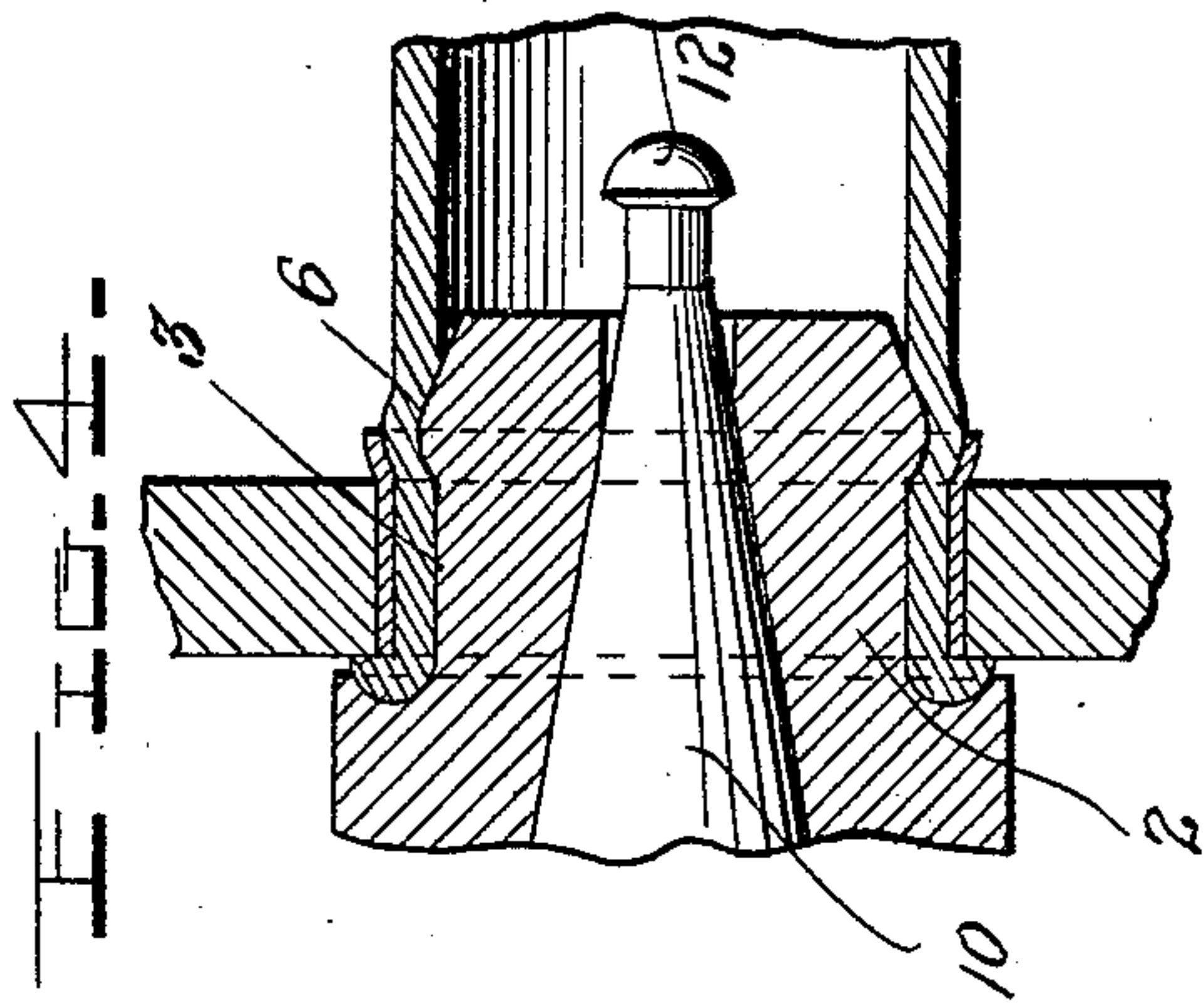


## BOILER FLUE EXPANDER.

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Patented Dec. 14, 1909.



Witnesses

Chas. L. Griesbauer.  
C. H. Griesbauer.

by

H. B. Wilson & Co.

Attorneys

 Inventors  
D. A. Lucas, G. D. DeLong  
and A. N. Lucas -



# UNITED STATES PATENT OFFICE.

DANIEL A. LUCAS AND GEORGE D. DE LONG, OF HAVELOCK, NEBRASKA, AND ABRAM N. LUCAS, OF MILWAUKEE, WISCONSIN.

## BOILER-FLUE EXPANDER.

943,117.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Application filed October 17, 1907. Serial No. 397,932.

*To all whom it may concern:*

Be it known that we, DANIEL A. LUCAS and GEORGE D. DE LONG, citizens of the United States, residing at Havelock, county of Lancaster, State of Nebraska, and ABRAM N. LUCAS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Boiler-Flue Expanders; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in boiler flue expanders. Heretofore it has been customary in the construction of boiler flue expanders to provide an expansible head made in sections for expanding and beading the tube, combined with a tapering mandrel which is driven into the head so as to expand it, but in all such constructions, where there was a tapering mandrel employed for expanding the head radially about the mandrel, the taper of the mandrel or pin and the hole in the head which it fits was so gradual that great frictional contact was created between the head and the mandrel or tapered pin, with the result that the mandrel was invariably caused to stick tightly in the head when in its expanded condition and caused great loss of time in loosening it for the purpose of turning the head into a new circumferential adjustment within the flue prior to again driving in the mandrel. The capacity of the expanding tool was in this way greatly restricted and the work to be accomplished was imperfectly done, because of the impossibility of circumferentially adjusting the head freely during the expanding operation.

The object of our invention is to provide a construction of flue expander which may expand the flue and upset or bead the end thereof and accomplish the result in a rapid and efficient manner by permitting the mandrel or tapered pin to be driven with rapid blows from a pneumatic or other hammer without sticking and the expander head free to turn in the tube under hand guidance at times between the successive blows upon the mandrel, this result being accomplished by so constructing the taper of the mandrel and the hole in the head which receives the

mandrel that the said mandrel cannot stick within the head by frictional contact under any condition due to the hammering operation.

The essential part of our invention resides in the embodiment in an expander having an expander head made up of sections and a mandrel for expanding the head, of a tapered hole or aperture in the head and a taper for the mandrel which fits it, in which the taper is so great that the mandrel cannot stick by frictional contact when driven into the head by a pneumatic hammer or other means, the said parts cooperating so that the mandrel may be rapidly reciprocated within the expander head to expand it in all directions without liability of sticking and the expander head may be freely turned within the tube during the expanding operation and at times between the blows upon the mandrel, as more fully described hereinafter and particularly defined in the claims forming a part of this specification.

Our invention will be better understood by reference to the drawings, in which:—

Figure 1 is a side elevation partly in section of an expander constructed in accordance with this invention; Fig. 2 is an end elevation thereof; Fig. 3 is a view similar to that shown in Fig. 1 of a modified form of expander adapted especially for use in repair work; Fig. 4 is a longitudinal sectional view with the tool shown in Fig. 3 applied to a boiler flue.

In the form shown in Figs. 1 and 2 which is designed for use on new work, the expander 1 consists of a head 2 adapted for insertion in the end of a boiler flue. This head 2 is formed of a plurality of segmental sections 3 of which there may be any desired number. The inner walls or faces of the sections 3 are tapered from their inner ends toward their outer ends to form a cone-shaped passage or bore within the sections. The sections are held yieldably together by means of an elastic fastening device shown in Fig. 1 in the form of a coiled spring 4, seated in an annular groove or recess 5, formed in the outer faces of the sections 3, preferably adjacent their inner ends, and in Fig. 3 in the form of an elastic band 22. The outer faces of the sections in both forms are provided intermediately of their ends with an expanding portion 3<sup>a</sup> termi-



nating at one end in an annular beading member 6, which is preferably formed on the outer or front ends of said sections. In the form shown in Fig. 1, an annular shoulder 8, is formed at the other end of the expanding portion 3<sup>a</sup> and is inclined upwardly and outwardly terminating in a right angularly projecting annular shoulder 7. This inclined shoulder 8 is designed to engage the outer end of the flue when the tool is applied to up-set said end against the outer side of the flue sheet.

Adapted to be inserted in the conical bore of the head formed by the inclined inner walls of the sections 3, is an expanding pin 9, which is provided with a tapering or cone-shaped operating end 10 adapted to engage the inner inclined walls of the sections 3, and when forced through the head will expand said sections radially to the desired extent whereby the flue is expanded and at the same time beads are formed at the inner and outer sides of the flue sheet, said sheet being clenched steam-tight between the beads.

A retaining knob 12 is formed on the outer or front end of the tapered head 10 of the pin which when the sections 3 are in contracted or normal position, will engage the outer ends thereof and prevent the expanding head from slipping from the pin. The bore formed by the inner walls of the sections 3 has an annular enlargement 13 which extends inwardly a short distance from the inner or rear ends of the sections forming an annular space between the inner face of the head and the outer wall of the pin head 10 to prevent sticking of the pin in the bore. The expanding pin 9 is provided with a shank 14 for engagement by a pneumatic operating damper, (not shown). Between the shank 14, and the tapered head 10 of the pin is formed an annular enlargement 15 which is preferably milled or roughened, as shown at 25, in Fig. 3 to form a hand-grip for turning the pin or otherwise handling it.

The form shown in Figs. 3 and 4 is designed especially for use in connection with repair work and the general construction thereof is similar to the form shown in Figs. 1 and 2. This expander 16 is made somewhat shorter than that of the head 2 to adapt it for use in repairing old flues, as will be hereinafter described. The expanding portion 3<sup>a</sup> of this head 16 is of a length corresponding to the thickness of the flue sheet to be operated on and is provided at its rear end with an annular groove 20 adapted to engage the turned or beaded end of the boiler flue to clench the same more firmly into engagement with the outer side of the flue sheet simultaneously with the expanding of the flue.

The tapered end 10 of the mandrel or pin

9 is preferably round in cross section so as to permit the expander head to be freely turned with each withdrawal of the tapered pin or mandrel, but it may be made polygonal, if so desired, because the mandrel or pin releases the expander head with each reciprocation and thereby relieves the friction of the expander head with the flue and permits both the mandrel or pin and expander head to be rotated together on or with the pneumatic hammer for adjustment. The essential feature of construction is the shape of the taper of the mandrel or pin and the taper of the hole in the expander head and which consists in having the inner surface of the hole of the expander head formed with an incline to the axis of the hole in excess of the angle of repose, and in also having the angle of the outer tapered surface of the mandrel or pin to the axis of the mandrel or pin also greater than the angle of repose, the said parts so co-acting that the mandrel or pin may be rapidly reciprocated within the expander to expand it in all directions without liability of sticking within the said expander head by frictional contact. By the term "angle of repose," we mean that angle with respect to the axis of the hole or mandrel which is formed by the surface of the tapered parts when the frictional contact is such that the mandrel would stick in the hole by friction when driven into it, the said "angle of repose" being the dividing line between those angles at which the tapered mandrel will not stick in the tapered hole and those angles for the taper of the mandrel when it will stick in the hole. This part of our invention is restricted and confined to the construction having the angle greater than the angle of repose, so that at no time can the tapered mandrel or pin stick in the tapered hole of the expanding head, no matter how hard the mandrel may be driven into the head.

From the foregoing description taken in connection with the accompanying drawings, the construction and operation of the invention will be readily understood without requiring a more extended explanation.

Various changes in the form, proportion and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of the invention, as defined in the appended claims.

Having thus described our invention, what we claim as new is:—

1. A flue expander comprising a head consisting of a series of separable segmental sections disposed about a common central axis and normally abutting against each other in annular arrangement and said sections being shaped upon their outer periphery to form an annular groove and having their inner surface shaped to conjointly



form a tapered aperture of symmetrical cross section whose interior wall all the way around inclines to the axis in excess of the angle of repose, combined with a reciprocable mandrel having its end symmetrically tapered all the way around to fit the taper of the expander head and having the angle formed between the outer tapered surface and the axis of the mandrel also greater than the angle of repose, throughout its entire circumference, the said parts co-acting so that the mandrel may be rapidly reciprocated within the expander head to expand it simultaneously in all directions without liability of sticking within the said expander head by frictional contact and whereby the expander may be freely turned about its axis at times between the blows upon the mandrel during the expanding operation.

2. A flue expander comprising a head composed of a plurality of segmental sections abutting against each other to form an annular head and connected to yield radially in a plurality of planes and provided with a tapered bore of symmetrical cross section and the inner face of which all the way around is inclined to the axis thereof at a greater angle than the angle of repose and said head having an outer face provided with means to simultaneously expand the entire circumference of the flue and upset the end thereof, combined with a reciprocable mandrel having its end symmetrically tapered all the way around to fit the taper of the expander head and in which the angle formed between the tapered surface and the axis of the mandrel is also greater than the angle of repose throughout its entire circumference, the said parts co-acting so that the mandrel may be rapidly reciprocated within the expander head to expand it simultaneously in all directions without liability of sticking within the said expander head by frictional contact, and whereby the expander head may be freely turned about its axis at times between the blows upon the mandrel during the expanding operation.

3. A flue expander comprising a head consisting of a plurality of segmental sections abutting against each other to form an annular head and radially yieldable in a plurality of planes and shaped on their outer parts to expand a flue simultaneously in all directions and formed upon their inner parts with tapered surfaces which con-

jointly form a tapered bore symmetrical all the way around, the angle formed by the inner surface of which with the axis of the bore being greater than the angle of repose throughout its entire circumference, and spring devices for normally holding the plurality of segmental sections compactly together on their radial faces while allowing of them to expand, combined with a reciprocating mandrel symmetrically tapered upon its end all the way around to fit the bore of the expander head and in which the inclination of the surface of the taper to the axis of the mandrel is greater than the angle of repose, throughout its entire circumference, the said parts coöperating so that the mandrel may be rapidly reciprocated within the expander head to expand it simultaneously in all directions without liability of sticking within the said expander head by frictional contact, and whereby the expander head may be turned about its axis at times between the blows upon the mandrel during the expanding operation.

4. A boiler flue expander comprising an expanding head formed of a plurality of normally abutting segmental sections, an annular expanding projection formed on the outer end of said head and with inclined walls formed on the inner side of the said sections to provide a tapered bore through said head, a spring adapted to hold said sections together, and an expanding pin having a tapered expanding end formed on said pin to engage the tapered bore of said head and a knob formed integral with the end of said pin to hold said head in place snugly upon the pin when the pin is withdrawn just sufficiently to allow the segmental sections to abut, whereby a continuation of the movement of the pin will carry the expanding head with it and at no time will the head be free to reciprocate loosely upon the pin.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

DANIEL A. LUCAS.  
GEORGE D. DE LONG.  
ABRAM N. LUCAS.

Witnesses to signatures of D. A. Lucas and G. D. De Long:

GEO. W. ANDERSON,  
W. H. MITCHELL.

Witnesses to signature of A. N. Lucas:

PHILIP G. HINNERS,  
K. M. HINNERS.