

(No Model.)

3 Sheets—Sheet 1.

H. WARDEN.
BOILER TUBE EXPANDER.

No. 488,589.

Patented Dec. 27, 1892.

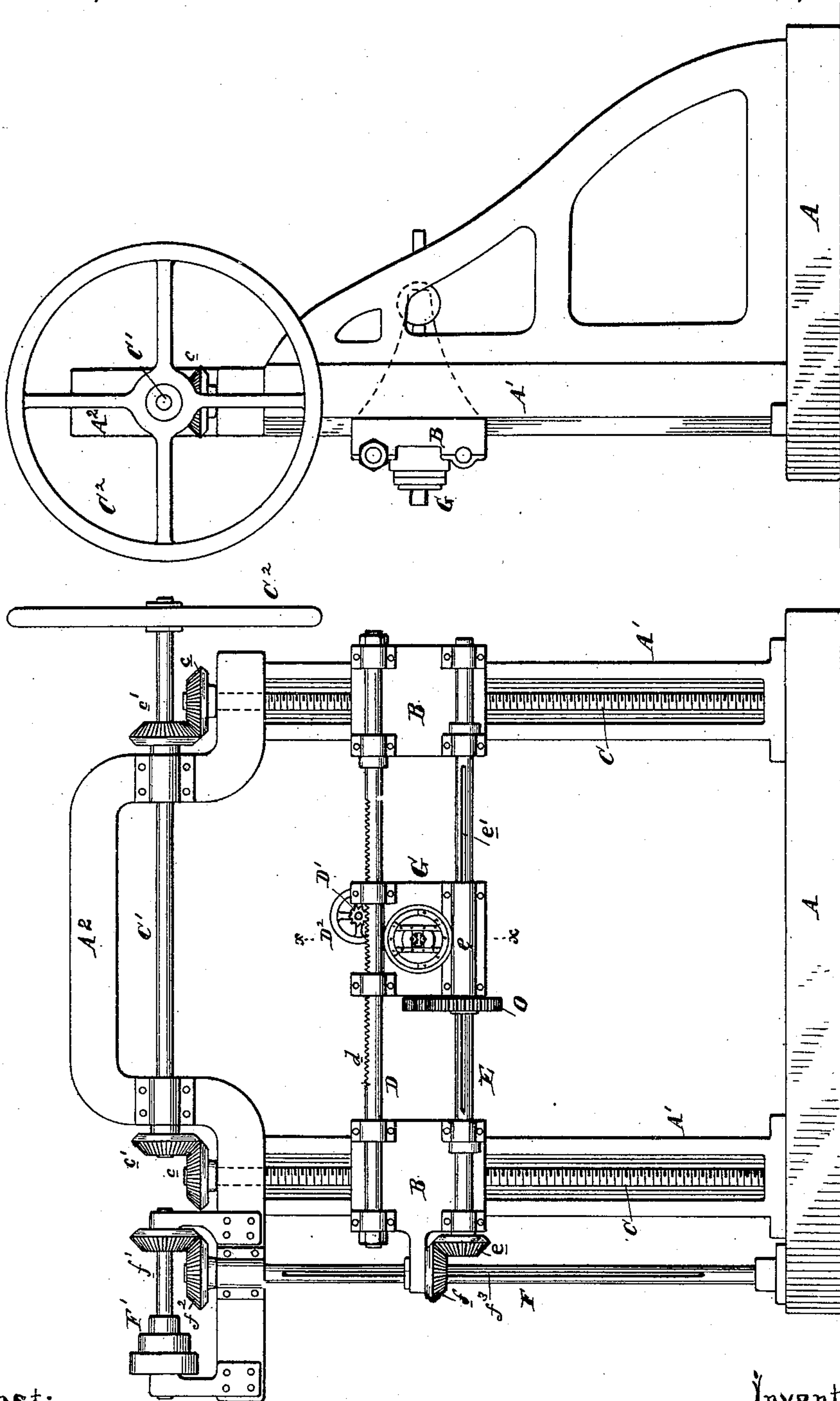


FIG. 2

FIG. 1

Witness:
Henry Drury
Joshua M. Mack, Jr.

Inventor:
Henry Warden
by his attorney
Francis T. Chambers

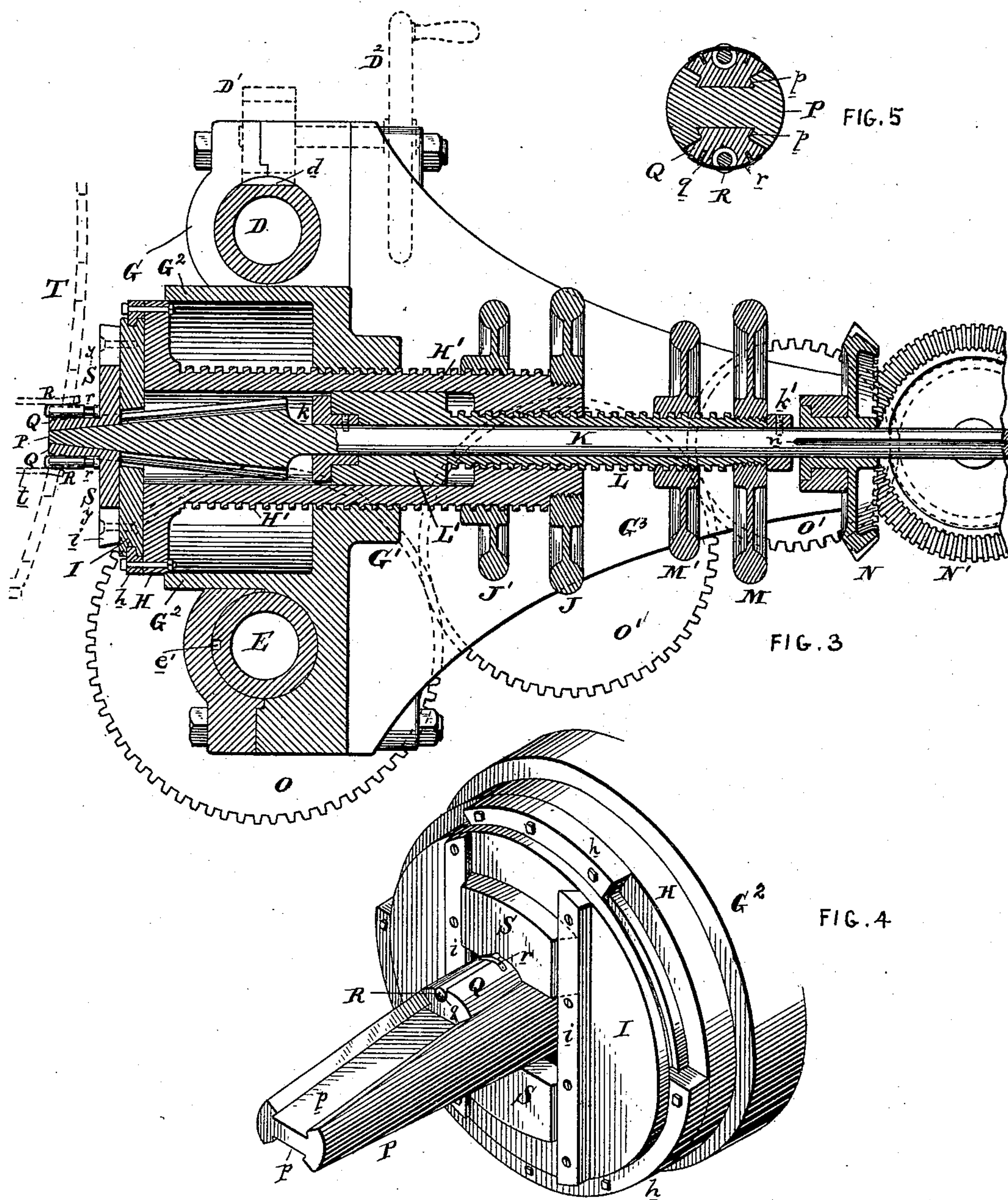
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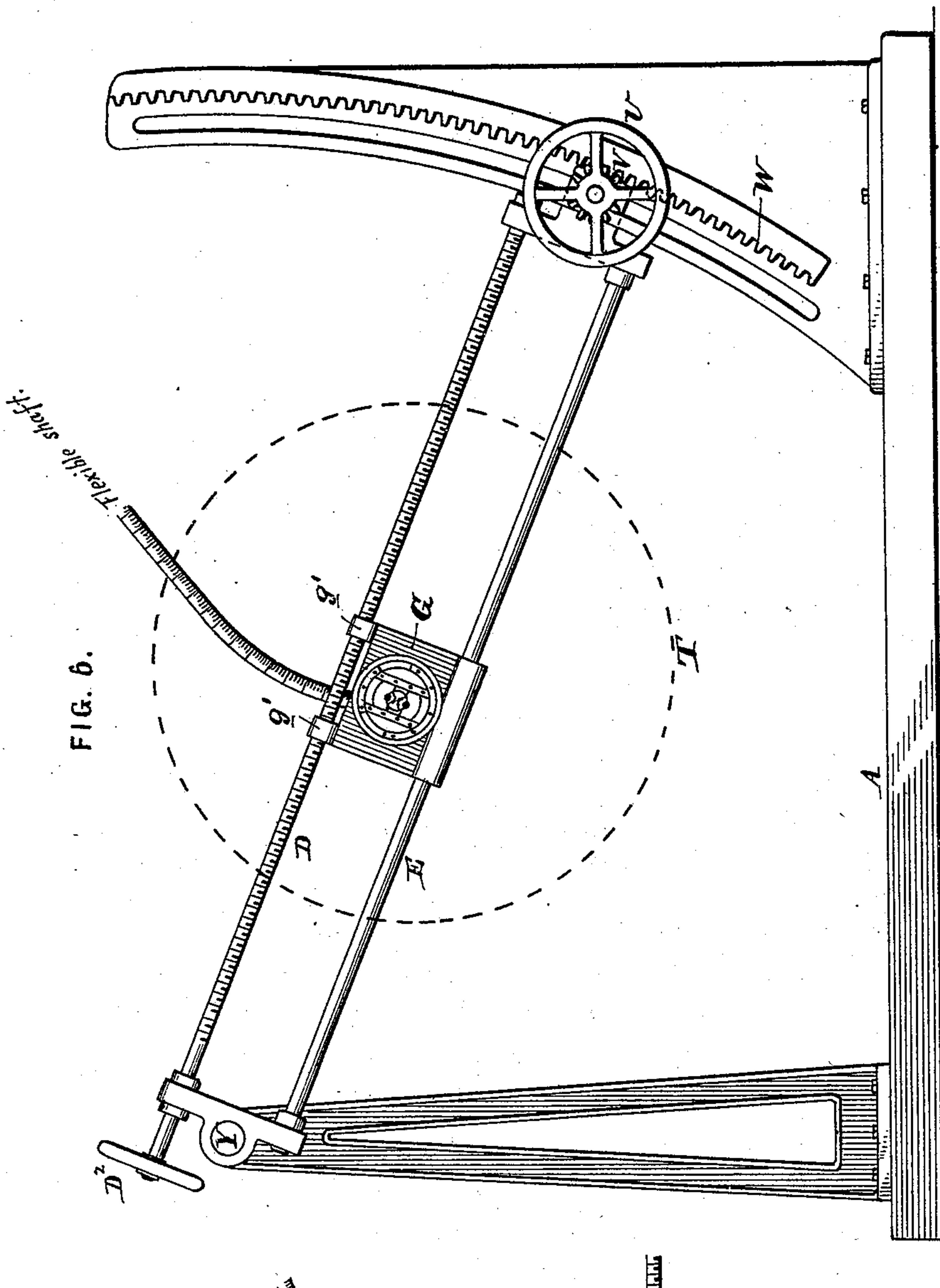
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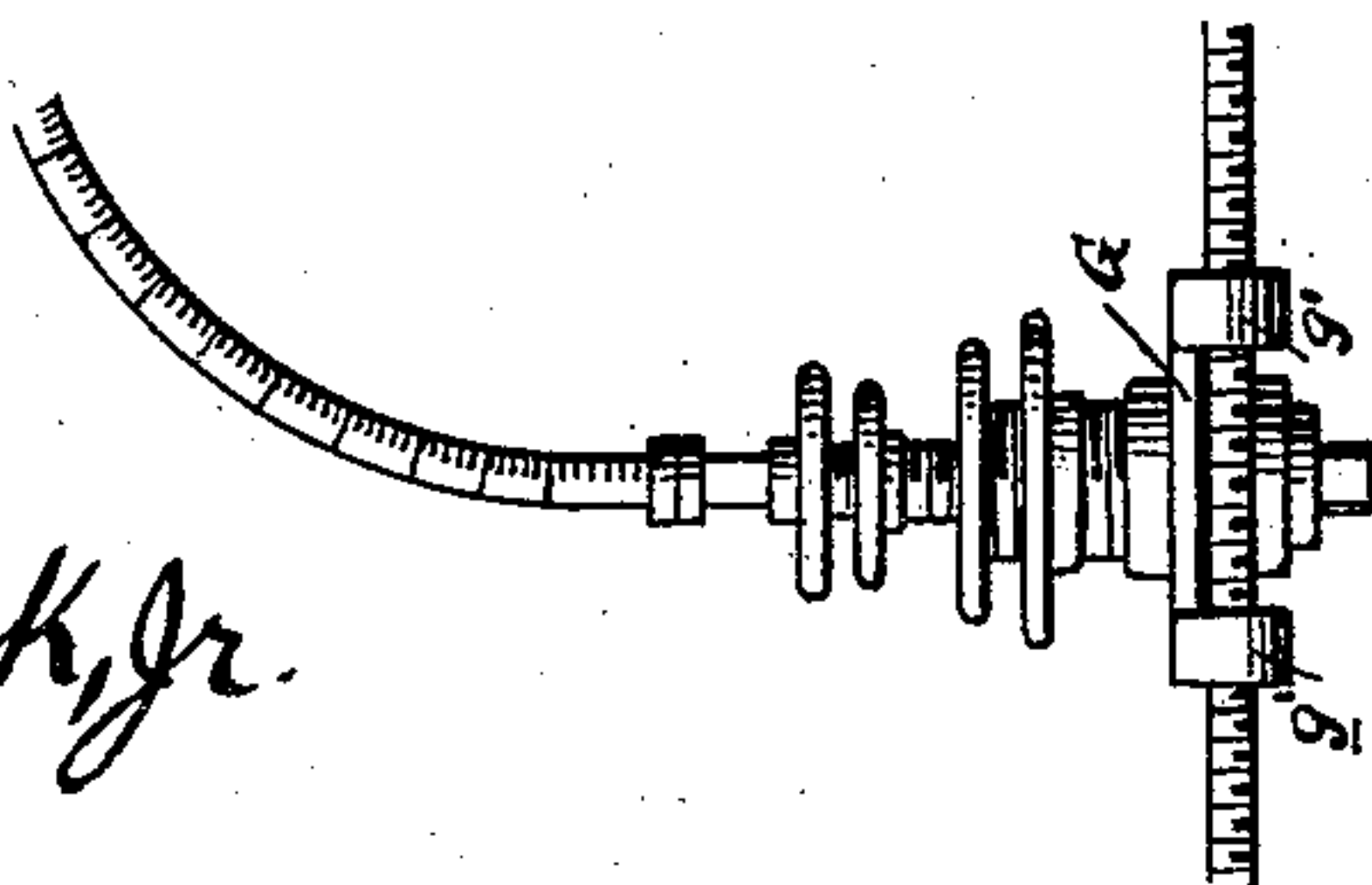
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BOILER TUBE EXPANDER.

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Attest:
Henry Drury
Joshua Matlack, Jr.



Inventor:
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UNITED STATES PATENT OFFICE.

HENRY WARDEN, OF PHILADELPHIA, PENNSYLVANIA.

BOILER-TUBE EXPANDER.

SPECIFICATION forming part of Letters Patent No. 488,589, dated December 27, 1892

Application filed December 8, 1887. Serial No. 257,261. (No model.)

To all whom it may concern:

Be it known that I, HENRY WARDEN, of the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improved Boiler-Tube Expander, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

10 The object of my invention is to provide a boiler tube expander which shall be more certain, even and reliable in its operation than those now in use and especially to fit the expander for use in securing tubes in convex
15 or concave boiler heads.

My invention consists,—first, in combining an expanding tool with adjustable bearings independent of the tube or boiler, so that the angular position of the expander may not be
20 affected as is now the case by the character of the work it is doing; second, in the combination of the expanding tool thus secured in adjustable and independent bearings with a motor by means of an adjustable connection whereby the expander is rotated in any
25 position within the range of its adjustment; and lastly, in the special appliances illustrated in the drawings and hereinafter fully described; said devices being those preferred
30 by me as embodying my invention in the best and most excellent form and connection.

Reference being now had to these drawings, Figure 1, is a front elevation of my improved apparatus. Fig. 2, a side elevation thereof.
35 Fig. 3, a central vertical section through the expander and its immediate connections and supports. Fig. 4, a perspective view of the expanding tool and the head which holds it. Fig. 5, a cross section through the expander
40 on the line *y y* of Fig. 3. Fig. 6, is a front elevation of a modified structure for supporting and adjusting the expanding tool; and Fig. 7, a side view showing the connection of the flexible shafting with the expanding
45 spindle.

A (Figs. 1, 2 and 6) is the bed plate on which the structures which support the adjustable bearings, are supported.

50 A' A' A² (Figs. 1 and 2) is the frame of the supporting device.

B B are sliding blocks which have bearings on the uprights A' A' and are engaged and

supported by the screw shafts C C; these screw shafts have bearings at top and bottom in the frame and have miter wheels *c c* secured at
5 their upper ends; these wheels are geared with similar wheels *c' c'* secured on shaft C' and when this shaft is turned by the hand wheel C², the screw shafts are rotated and the blocks B B caused to move up or down
6 as may be desired.

D and E are shafts preferably hollow; they have their bearings in the sliding blocks B and are parallel to each other; the shaft E is
65 made to rotate, while in the plan shown, the shaft D is securely clamped to the blocks B.

F is a rotating shaft journaled at top and bottom in the frame; this shaft is driven through the miter wheel *f*² by means of wheel
70 *f'* and the pulleys F'; a slot *f*³ in shaft F engages with a key on the wheel *f* which is attached to the adjoining sliding block B and moves up and down with it. This miter wheel
75 *f* is engaged with the miter wheel *e* which is attached to the end of the rotating shaft E; a slot *e'* is formed in this shaft.

G is a sliding block in which is formed the bearing for the expanding tool; it is secured at top and bottom to the parallel shafts D
80 and E and is free to move laterally along them; a toothed wheel D' actuated by a crank wheel D², being secured on block G and engaging with a rack *d* cut in the upper part of shaft D.

I prefer, especially in connection with the
85 structure I have been describing, to arrange the expander as is shown in Figs. 3, 4 and 5. In this device an annular head H is arranged to fit neatly in a hollow cylindrical projection
90 G² of the block G and on the outer rim of its face are secured guides *h*; this head is formed on the end of a tubular shaft H' having a thread cut on its outside and its other end thickened up and provided with an internal
95 thread. This shaft passes through a boss G' of the adjustable block G, which boss is made sufficiently long to afford a secure bearing for the shaft and threaded internally to engage with the thread on H'. On the end of this
100 shaft a hand wheel J is secured by means of which it is rotated and forced in or out at will. A wheeled jam nut J' is screwed on the outer end of the threaded shaft and when
screwed against the boss G', locks the shaft

H' and its head H securely in place. A round centrally perforated plate I rests against the face of the head H and is secured to it by the guides *h* before mentioned, on opposite sides of its central perforation parallel V. guides *ii* are secured. Between these guides are secured sliding plates SS having on their inner edges outwardly-projecting arms Q Q, the outer portions of which are rounded in form as shown and have recesses *q q* formed in them in which rest the expanding rollers R R which project somewhat above or beyond the surface of their supporting arms and are held in place when not being used, by bands *r r* or in any convenient way. The inner faces of the arms Q are formed as shown so as to fit against the diverging sides of the wedging plug P and under the mortised guides *p p* formed on said plug. This plug P is attached to the end of a shaft K which passes through and fits neatly in a threaded tubular shaft L, the thread of which engages with the internal thread formed in the thickened end of the shaft H'. On the end of tube L which projects into the enlarged portion of the hollow shaft H', is secured a cylindrical block L' which serves as an additional support for the shaft K, a collar *k* on which rests against the end of this cylinder L' while another collar, *k'*, secured to K at the other end of the tube L, clamps the spindle K and tube L together so that their longitudinal movement will be the same.

M is a hand wheel secured on the end of the tube or shaft L, and M' is a wheeled jam-nut by means of which, the shafts L and H' may be locked together when desired. In the outer end of the spindle K, a slot *n* is formed in which is keyed a miter wheel N which engages with a similar wheel N' journaled on a projection G³ of the adjustable block G. This wheel N' is driven by a train of gearing O' O' also journaled on G³ and these, through a gear-wheel O, which is attached to the block G so as to move with it, and driven by the shaft E by means of a key engaging with the slot *e'*.

T in Fig. 3 represents a convex boiler head in which a tube *t* is being expanded.

The operation of the above-described mechanism is easily followed: The boiler head having been placed in front of the machine, the expanding tool is brought in front of any desired tube hole by first adjusting the vertical height of the block G by means of the wheel C² turning which rotates the shafts C C, and moves the blocks B B which supports the shafts D E up or down as desired, and then adjusting its lateral position by means of wheel D² turning which rotates the toothed wheel D' which, engaging the rack *d*, moves the block G in either direction. The spindle K of the expander is drawn back by means of the threaded tubular shaft L and the guide plates S S with their arms Q Q thus drawn together on the wedge-shaped point of the plug P until the distance between the outer surfaces of rollers R R is less than the inner di-

ameter of the boiler tube. The jam-nut M' is then screwed against the end of the tubular shaft H' so as to lock it and shaft L together, and the shaft H' is then rotated by its wheel J until, by means of its screw-thread, it is thrust forward sufficiently to cause the rollers R, which are carried forward with it, to enter the end of the tube, which has been inserted in the head of the boiler. The jam nut J' is then screwed against the boss G' to hold the shaft H' and through it, the rollers R, in position and the jam nut M' then released, and the hand-wheel M turned so as to force the spindle K, and through it the wedge plug P, forward, the plug forcing the guides and arms S Q apart and the rollers R against the inside of the boiler tube. The shaft F is then set in motion by its connected gearing and through wheels *f* and *e*, rotates the shaft E which of course actuates the gear-wheel O keyed in its slot *e'*, and this wheel, through the train O' O' and N' drives the wheel N, which, being keyed in the slot *n* of shaft K, rotates it and the plug P at its end; the rollers R being thus forced to turn, and being gradually forced apart by the operator turning the hand-wheel M so as to force plug P inward. The arms Q and slides S of course turn the plug P and carry with them the plate I, to which they are attached, and which is free to turn in guides *h*.

In Figs. 6 and 7, I have represented the adjustable block G as secured to shafts D and E which, at one end, are pivoted on a center Y, and at the other, free to move in a curved guide slot, the motion being accomplished by turning a wheel V which actuates a toothed wheel *v* engaging with a curved rack W. The block G is made adjustable along the supporting rods D and E by being attached to rod D by means of internally threaded lugs *g' g'*, said rod D being threaded throughout its length and rotated at will by a crank D². By means of the two movements thus given to G, the expanding tool can be brought in front of any tube hole as in the first described apparatus. In these figures also, I have dispensed with the adjustable gearing by which the shaft K was rotated in the plan first described and accomplish the same result by attaching a flexible shaft to said shaft or spindle K.

The various devices for adjusting and managing the expanding rollers which I have described, are those which I consider best for use with a tube expander having independent adjustable bearings outside of the boiler and tube being operated on, and the devices for turning the expander when in place by power as shown, are given for the same reason. I wish it to be clearly understood however, that, save where these special devices represented in the drawings are expressly referred to in the claims, I do not mean said claims to be limited on their use. The expanding rollers R instead of resting in the arms Q of guide plates S, may be made con-

cal in shape and rest directly against a conical plug as is now usual with such tools; or rollers may be dispensed with and the wedge-like arm Q or other similar devices resting on the conical plug or wedge P, may be made to act on the end of the tube. Obviously, the plug having its spindle bearing in the adjustable block G may be pushed or pounded in by hand to force the rollers or expanders apart and rotated by power or hand as may be desired. The great advantage gained by using the outside bearing for the expander being, that no matter what the character of the work, the expanding action of the tool is always directly away from the center line of the tube being acted on, while by the older plan, the expander having its bearing only against the spots being worked on would, in case of a convex boiler head, tend to turn itself into a line at right angles to the plane of the tube hole and therefore would not do such work satisfactorily.

Another very important feature of my invention lies in the combination with the adjustable bearing for the tool of a device for rotating the spindle and its plug by power and through self-adjusting connections, as by this construction the advance of the plug is made to take place while it is being rotated and thus the expanding action is evenly exerted all around the tube, while by the old plan, the rollers were driven in at one point and then wrenched out of the depressions formed by being afterward turned.

The advantages of my preferred mechanism for supporting the adjustable bearing block G, will, I think, be obvious; but, as is made clear by Fig. 6, all that is essential is, that said block should be firmly supported by devices which allow it to have two motions so that it can be brought into any desired position with respect to the boiler head.

With reference to the various new features involved in my device for actuating and adjusting the expanding tool in the block G, I desire to note that these are capable of useful separate, as well as conjoint use; thus, the device of making the plug P a flat faced wedge instead of a cone, and of securing the rollers in the arms Q instead of making said rollers conical and allowing them to rest directly on the conical plug may be used without the system of threaded shafts &c., shown and described; and it is equally true that the arrangement of the threaded shafts H' and L and spindle K, may be advantageously used with the old conical plug and rollers or conical plug and non-rotating expanders.

The expanding device when constructed as shown in Figs. 3 and 4, is well adapted not only for expanding the tubes in place in the ordinary way, but also for turning down the projecting edges of the tube against the outside of the tube sheet. To use my device for this purpose, the face plate I with its attachments, and the plug P, should be withdrawn from the tube, and the plug then thrust for-

ward sufficiently to bring the ends of the expanding rollers opposite to the edge which it is desired to turn down. When properly adjusted, the rotating mechanism which operates the spindle K should be set in motion and then the rollers are pressed against the edges of the tube by turning the handle J so as to press the face plate H and its attachments forward. The operator, by means of the handles M and J, has complete control both of the pressure and the points on which the end of the rollers shall work and can therefore accomplish this turning down of the edge of the tube with great rapidity and neatness.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a hollow shaft externally threaded to engage in threads upon the adjustable block having at one end a face plate and at its other end an internal thread formed in a thickened portion of the tube and a handle for turning said shaft; tube expanding devices secured on the face plate aforesaid so as to be movable to and from its hollow center; a hollow shaft externally threaded to engage with the thread in the thickened end of the tube aforesaid and having a handle on its exposed end; a wedging plug adapted to move the expanding devices on the face plate as it is advanced or caused to retreat in the hole in said plate; and a spindle attached to said plug, passing through the internal hollow shaft and so connected with it as to follow its longitudinal movements while revolving freely within it, all substantially as and for the purpose specified.

2. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a hollow shaft externally threaded to engage in threads upon the adjustable block L' having at one end a face plate and at its other end an internal thread formed in a thickened portion of the tube and a handle for turning said shaft; tube expanding devices secured on the face plate aforesaid so as to be movable to and from its hollow center; a hollow shaft externally threaded to engage with the thread on the thickened end of the tube aforesaid and having a handle on its exposed end; a wedging plug adapted to move the expanding devices on the face plate as it is advanced or retracted in the hole in said plate; a spindle attached to said plug passing through the internal hollow shaft and so connected with it as to follow its longitudinal movements while revolving freely within it; a motor and adjustable mechanism connecting the motor and spindle so as to rotate said spindle in whatever position it may be placed, all substantially as and for the purpose specified.

3. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a face plate attached to said

block as described; a plate secured on the face of said plate by clamps which hold it in place while permitting it to revolve; expanding devices secured on the face of said revolving plate by guides which permit them to move to and from the center and a wedging plug passing through the centers of the plates aforesaid, so as to act on the expanders and having a spindle extending through the adjustable block, substantially as and for the purpose specified.

4. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a face plate attached to said block as described; a plate secured on the face of said plate by clamps which hold it in place while permitting it to revolve; expanding devices secured on the face of said revolving plate by guides which permit them to move to and from the center; a hollow externally-threaded shaft engaging with threads on or supported by the adjustable block and having a handle on its outer end, and a wedging plug passing through the centers of the plates aforesaid so as to act on the expanders and having a spindle passing through the hollow shaft aforesaid and so secured to it as to be governed by its longitudinal movement while free to revolve independently, all substantially as and for the purpose specified.

5. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a face plate secured on the end of an externally-threaded tube engaged with a thread on the adjustable block; a plate secured on the face of said plate by clamps which hold it in place while permitting it to revolve; expanding devices secured on the face of said revolving plate by guides which permit them to move to and from the center, a hollow externally-threaded shaft engaging with threads on or supported by the adjustable block and having a handle on its outer end, and a wedging plug passing through the centers of the plates aforesaid so as to act on the expanders and having a spindle passing through the hollow shaft aforesaid and so secured to it as to be governed by its longitudinal movement while free to revolve independently, all substantially as and for the purpose specified.

6. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a face plate secured on the end of an externally-threaded tube engaged with a thread on the adjustable block; a plate secured on the face of said plate by clamps which hold it in place while permitting it to revolve; expanding devices secured on the face of said revolving plate by guides which permit them to move to and from the center, a hollow externally-threaded shaft engaging with threads on or supported by the adjustable block and having a handle on its outer end, and a wedging plug passing through the centers of the plates aforesaid so as to act on the expanders, said plug having flanges which engage the expanding de-

vices, and having a spindle passing through the hollow shaft aforesaid and so secured to it as to be governed by its longitudinal movement while free to revolve independently, all substantially as and for the purpose specified.

7. In combination with an adjustable block adapted to support the bearings of a tube expanding tool; a face plate secured on the end of an externally-threaded tube engaged with a thread on the adjustable block; a plate secured on the face of said plate by clamps which hold it in place while permitting it to revolve; expanding devices secured on the face of said revolving plate by guides which permit them to move to and from the center, rollers seated in the faces of the sliding expanders, a hollow externally-threaded shaft engaging with threads on or supported by the adjustable block and having a handle on its outer end, and a wedging plug passing through the centers of the plates aforesaid so as to act on the expanders, said plug having flanges which engage the expanding devices, and having a spindle passing through the hollow shaft aforesaid and so secured to it as to be governed by its longitudinal movement while free to revolve independently, all substantially as and for the purpose specified.

8. In an apparatus for adjusting the bearings and rotating the spindle of a tube expander, the combination with a supporting frame of parallel screw-shafts geared to revolve simultaneously in the said frame, movable blocks each engaged with the threads of one of said screw shafts; a bar extending from one of said movable blocks to the other and secured to said blocks; a shaft having bearings in the said movable blocks and arranged parallel to the said bar; a miter wheel secured on the end of the shaft; a miter wheel secured on a projection of one of the sliding blocks so as to engage with and have its axis at right angles to the first wheel and parallel to the screw shafts before-mentioned; a shaft passing through the last-mentioned miter wheel and so engaged with it that they will revolve together while the wheel is free to move longitudinally; a block secured to the bar and shaft connecting the two sliding blocks aforesaid so as to move freely thereon longitudinally; an expanding tool having its bearings in said sliding block, and a spindle extending through the same; a gear wheel secured to said sliding block and upon the rotating shaft so as to rotate with said shaft while free to slide thereon and a train of gear wheels journaled on said sliding block, the last of which is keyed to the spindle on the expanding tool so as to rotate the same while leaving it free to move forward and backward, all substantially as and for the purpose specified.

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