(No Model.) 2 Sheets—Sheet 1.

# W. D. FORSYTH & E. T. BELL.

## BOILER TUBE CLEANER.

No. 568,247. Patented Sept. 22, 1896.

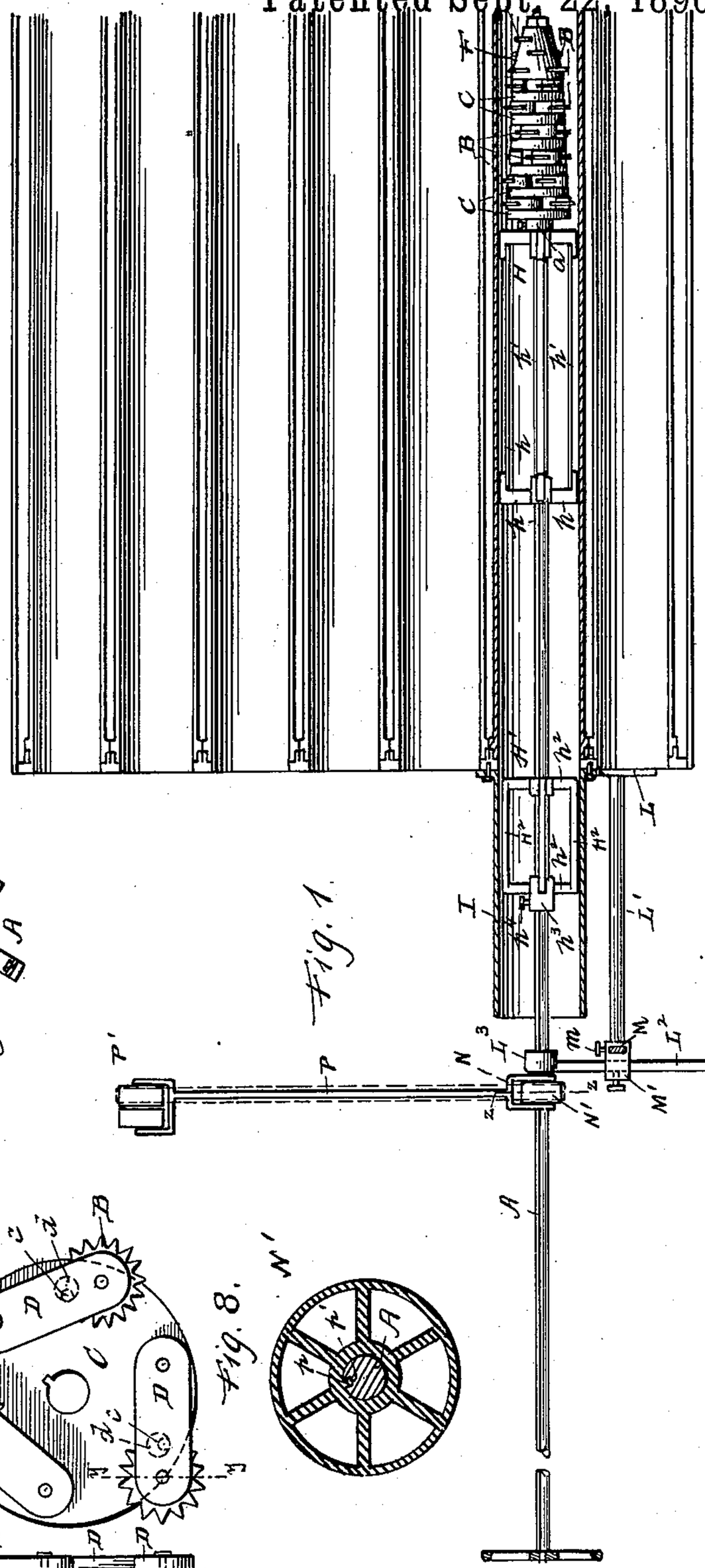


Fig. 1.

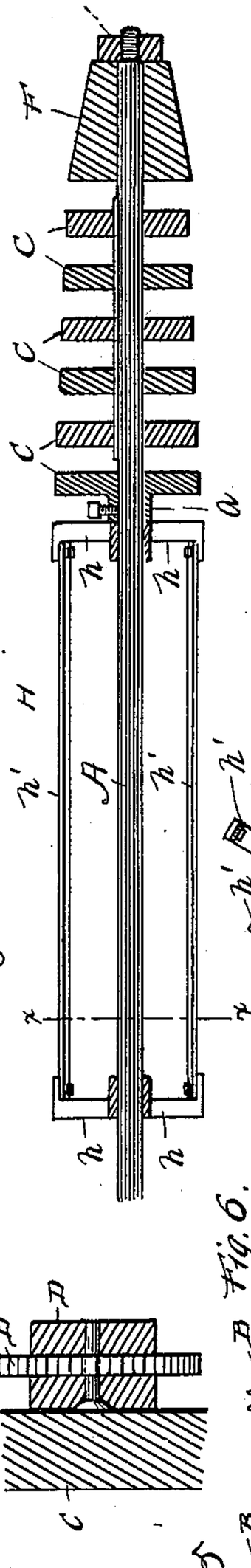


Fig. 3.

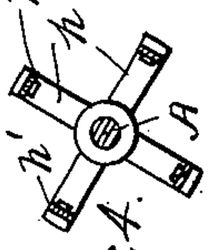


Fig. 4.

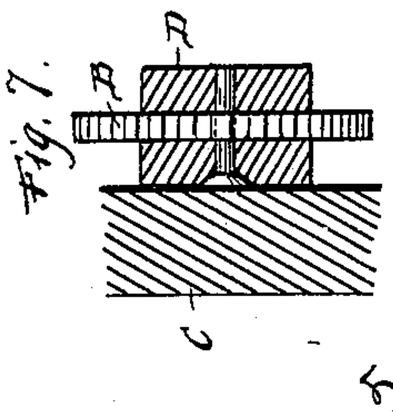


Fig. 7.

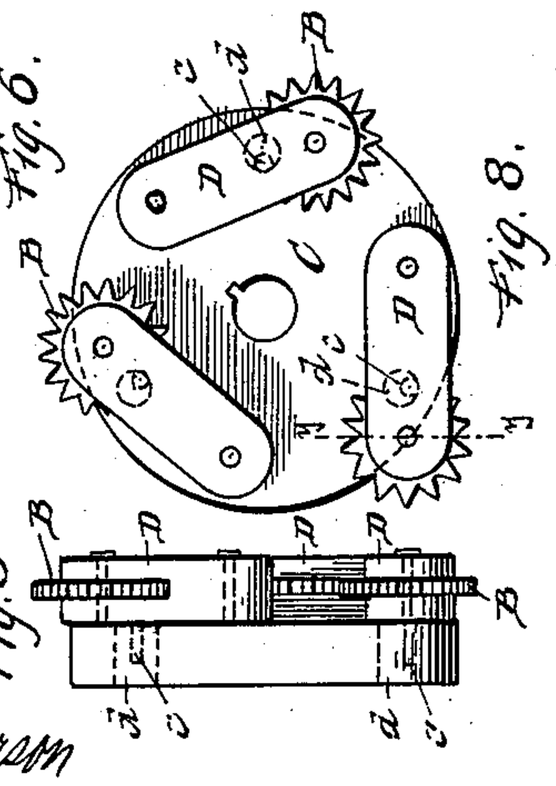


Fig. 6.




Fig. 8.

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(No Model.) 2 Sheets—Sheet 2.

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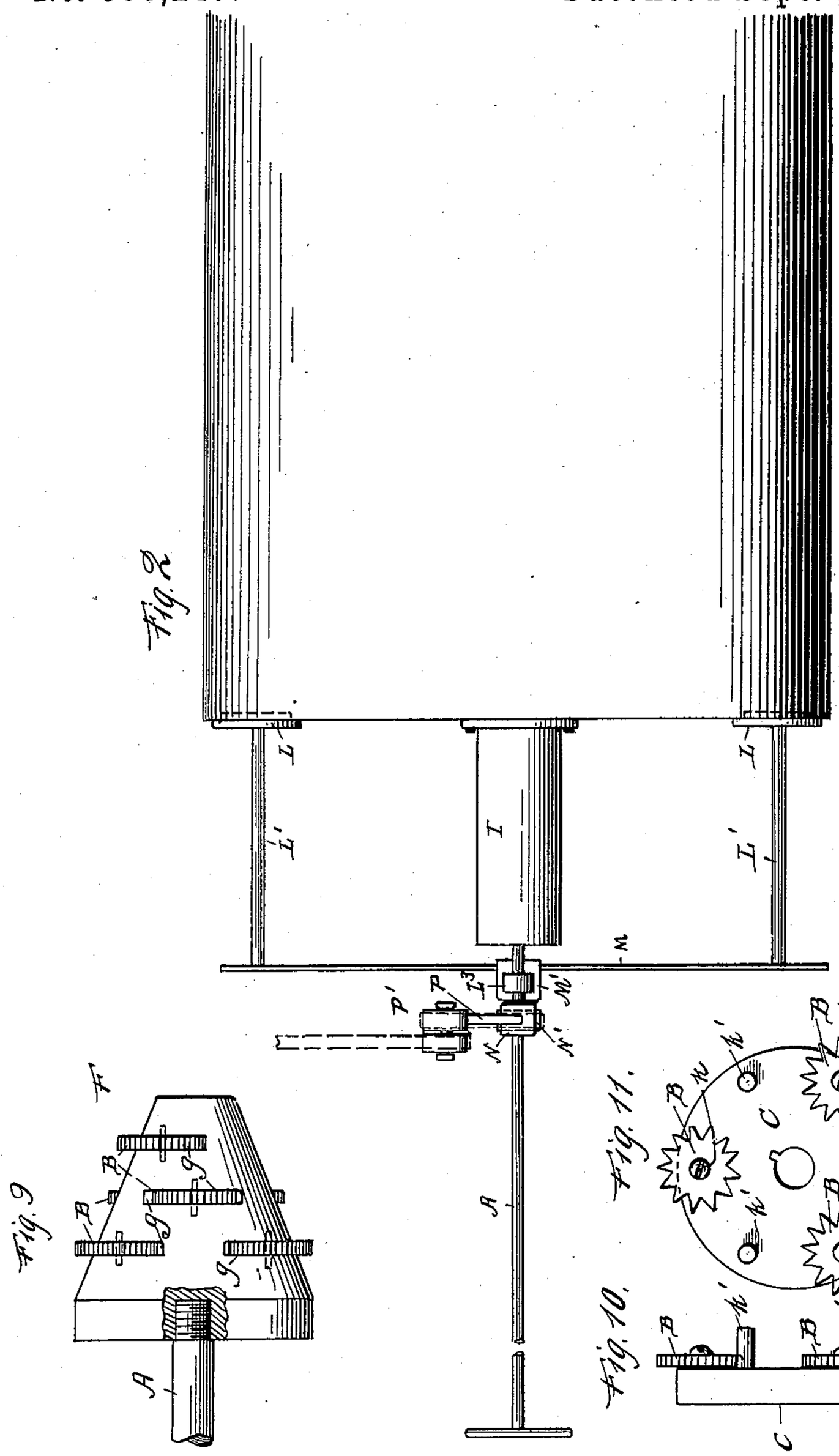
## BOILER TUBE CLEANER.

No. 568,247. Patented Sept. 22, 1896.

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# UNITED STATES PATENT OFFICE.

WILBER DAVID FORSYTH AND ENOS T. BELL, OF DUBLIN, INDIANA.

## BOILER-TUBE CLEANER.

SPECIFICATION forming part of Letters Patent No. 568,247, dated September 22, 1896.

Application filed November 17, 1894. Renewed October 3, 1895. Serial No. 564,533. (No model.)

*To all whom it may concern:*

Be it known that we, WILBER DAVID FORSYTH and ENOS T. BELL, citizens of the United States, and residents of Dublin, in the county of Wayne and State of Indiana, have invented certain new and useful Improvements in Boiler-Tube Cleaners; 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Figure 1 is a sectional view of boiler, showing the invention as in operation. Fig. 2 is a plan view of boiler, showing the invention applied with the parts in same relation as in Fig. 1. Fig. 3 is a central longitudinal section through rear guide-disks and cone, with arms D and cutters removed. Fig. 4 is a section through rear guide on link *x x*, Fig. 3. Figs. 5 and 6 are respectively side and front views of one of disks with arms and cutters. Fig. 7 is a detail showing journal for cutters. Fig. 8 is a section through pulley and shaft on line *z z*, Fig. 1. Fig. 9 is a side view of modification of cone. Figs. 10 and 11 are respectively side and front views showing another way of attaching cutters to disks.

The object of this invention is to provide means for cleaning the scale from the interior of the water-tubes of steam-boilers or other tubes needing similar cleaning, and which is designed to be more effective in its operation than other devices for the purpose, in that it will remove a greater thickness of scale, will work with greater rapidity, and is capable of being more readily repaired and kept in order.

With this object in view the invention consists in the novel construction and combination of parts, all as hereinafter described, and pointed out in the appended claims.

Referring to the accompanying drawings, the letter A designates a shaft which is designed to be rotated at a high rate of speed and which forms the carrier for the cleaner. Said cleaner consists in a plurality of rolling cutters or serrated wheels B, arranged in graduated series, whereby the foremost ones cut to as small a diameter as may be necessary, each succeeding series cutting to a larger diameter as they follow. While there are various ways of attaching these cutters to the shaft A, the arrangement which is shown in the drawings and which will now be described is that which we consider to be the best and most practical. A series of disks or sections C are provided, the rearmost one of which is usually rigidly attached to the shaft A by means of a collar *a*, while the succeeding ones are keyed to the shaft, so that they rotate therewith, but are nevertheless capable of being removed from the shaft by an endwise movement. In the drawings we have shown six of these disks or sections, but any suitable number may be employed. Pivotally secured to the forward face of each of these disks are a series of arms D, three being shown in each series, although we do not confine ourselves to such number. The pivoted points of these arms are eccentric, and their free end portions are arranged to project a short distance beyond the peripheries of the disks, the movement of said arms being limited by means of check-pins *c* on their posterior faces, which play each in a slot *d* of the disk. Each of said arms is slotted at its outer portion, and journaled in the slot of each arm is one of the rolling cutters B, which consists of a small peripherally toothed or serrated wheel.

The cutters on the first or front disk of the series are arranged to work in a circle of comparatively small diameter, each succeeding series increasing the diameter of its action. This is accomplished either by making the disks C of gradually-increasing diameters and by making corresponding changes in the length of the arms D, as indicated in the drawings, or by varying the amount of outward play which the successive series of arms shall have, this being, as before stated, controlled by the check-pins.

The arms D of the different series are preferably not attached to the respective disks at corresponding points, but the points of attachment are so disposed that the cutters are brought into spiral relation to the axis of the shaft in order to distribute the points of bearing more evenly, whereby the device runs much more steadily.

The journals for the cutters and for the arm D usually consist of pins headed at one

end, said pins being removable and held against accidental removal by the forward faces of the disk bearing against them. In front of the forward section is a cone F, which forms a guide for the device. By the removal of this cone the disks, with their cutters, may be successively removed from the shaft, and when so removed any one of the arms D or of the cutters may be quickly removed and replaced if damaged or broken.

Figs. 10 and 11 show a modified form of one of the sections, wherein the cutters B are journaled directly on the face of the disk with their teeth projecting beyond the periphery, the journals consisting of removable screws *k*. Pins *k'* are provided to keep the disks at the proper distance from each other. The graduation in this form is effected by making the disks C of different diameters.

The cone F may consist of a smooth-surfaced piece, as seen in Figs. 2 and 3, which acts not only as a guide, but also as a guard to prevent damage to the cutters in case of running into an obstruction. It also holds the forward cutters up when passing over an unusual thickness of scale in the bottom or lower side of the tube. A nut *f* secures said cone. When, however, the tubes to be cleaned are badly filled up, this cone will be provided with a series of the cutters B, (see Fig. 9,) which work in slots *g*, cut in the surface of the cone. These cutters are usually arranged in spiral form. It will be readily seen that when so equipped it will cut its way through a very small opening. The cutters are preferably somewhat heavier than those of the preceding sections. This form of cone is arranged to be screwed onto the forward portion of the shaft, the latter passing only partially through it, whereby it does not interfere with the cutters at the smaller end.

H designates a rear guide for the device. This guide comprises two spiders, through which the shaft A loosely passes, the arms *h* of such spiders being connected by longitudinal bars *h'*, the whole forming a cylindrical frame which is neatly fitted to the interior of the tube into which it is to be inserted. In operation it centers the device, preventing the weight of the cutting part from resting too heavily on the bottom of the tube. It also acts as a regulator for the feed, since if any scale is left behind the cutters the guide will strike it and stop further progress until such scale is removed, which necessitates drawing back the cutters to that point. The shaft A is usually further centered inside the tube by means of spider-bearings H', having arms $h^2$, and secured against movement upon the shaft by means of collars $h^3$ and set-screws $h^4$. The arms of the spiders have fastened thereto bars $H^2$, which lie longitudinally in the tube and guard against oscillation and vibration of the shaft.

The operation of the device is as follows: The cutting part is inserted into one end of the tube and is pushed therethrough by means of the shaft A. Said shaft during its passage through the tube is rotated at a high rate of speed, usually above fifteen hundred revolutions per minute. Under this rotation the rolling cutters expand each series to their full extent, being held in yielding, yet sufficiently rigid, contact with the work. In this manner the cutters adapt themselves to the unevenness usually found in tubes, and each series cuts its own thickness. The check-pins, in addition to limiting the outward throw of the arms D, also limit their inward movement and prevent the cutters from striking the heels of the adjacent arms.

During the operation a stream of water should be kept flowing through the tube operated upon of sufficient volume to wash away the scale as it is cut loose. Otherwise such scale forms a cushion between the cutters and lower wall of the tube and destroys to a certain extent the effectiveness of the tool. The water also prevents the tool from heating on account of its rapid rotation. A small stream is sufficient for both purposes.

To facilitate the entrance of the device to the tube, a short piece of pipe or tube I of the same diameter as the tube to be operated upon is usually provided, and is clamped to the tube proper. The cutting part and so much of the guide H as it will receive is then thrust into such short pipe or tube and the power applied. As the cutting part revolves the device is pushed gradually into the tube proper.

Inasmuch as it is necessary to be able to move the shaft A to bring its axis into alinement with the axis of any tube of a boiler, and to move said shaft endwise during its rotation, special bearings and driving mechanism must be provided. The arrangement shown in the drawings for this purpose and devised therefor is found to be an efficient and practical one, and the same will now be described.

L L designate plates which during operation are designed to be securely bolted to the cover-holes of the header of the boiler being cleaned. These plates carry heavy forwardly-projecting tubes or rods L' L', which support a transverse bar M.

M' is a clamp arranged to slide upon said bar and to be secured thereto by means of a set-screw *m*. $L^2$ is a post adjustably held in a socket of said clamp and having at its upper portion a socket part $L^3$, through which the shaft A is designed to loosely pass. This socket part has secured therein a sleeve or thimble *n* of a stirrup N, in which is journaled a driving-pulley N' for said shaft. The latter is arranged to pass loosely through the arms of this stirrup and is formed with a longitudinal groove or keyway *p*, which receives a spline or feather *p'* of said pulley. Attached to said stirrup is an arm or bar P, which at

its opposite end portion carries a twin pulley P′, one part of which is belted to the pulley N′ and the other part to a power-shaft.

By sliding the clamp M′ along the bar M and raising or lowering the post $L^2$, and occasionally moving the plates L L, the entire boiler front can be traversed, bringing the shaft A and pulley N′ in alinement with the axis of any tube.

The arrangement also permits the shaft to be moved endwise through the driving-pulley and at the same time maintain its driving connection therewith.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A tube-cleaning device, consisting essentially of a series of sets of rolling cutters adapted to be forced through the tube to be operated upon under rapid rotation, said sets being arranged one in front of another, and in a progressively-graduated series, whereby each set operates in a path of larger diameter than the preceding set, and carrying devices for said cutters, substantially as specified.

2. A tube-cleaning device, consisting essentially of a series of sets of rolling cutters designed to be forced through a tube under rapid rotation, said sets being arranged one in front of another and in a progressively-graduated series, whereby each set operates in a path of larger diameter than that in front of it, said cutters being also arranged in spiral relation to the axis of their carrying devices, substantially as specified.

3. In a tube-cleaning device, the combination with a rotatable shaft or carrier, of a series of sets of rolling cutters carried thereby and arranged in a progressively-graduated series, whereby each set cuts in a path of larger diameter than the one in front of it, and a cone-shaped guide in advance of the foremost set, substantially as specified.

4. In a tube-cleaning device, the combination with a rotatable shaft, of a series of cutter-carrying sections or disks mounted thereon, a set of rolling cutters carried by each of said sections or disks, a cone-shaped guide in advance of said sections or disks, and a guide and feed-regulating device behind said sections or disks, substantially as specified.

5. In a tube-cleaning device, the combination with a rotatable shaft, of a series of cutter-carrying sections mounted on said shaft to rotate therewith, a set of rolling cutters carried by each of the said sections, a cone-shaped guide in advance of said sections, and a series of similar cutters carried by said guide, substantially as specified.

6. The herein-described boiler-tube cleaner, comprising a rotatable shaft, a graduated series of rolling cutters carried thereby, a guide in advance of said cutters, a guide and feed-regulator back of said cutters, guide-bearings for said shaft inside the tube operated upon, and a driving-pulley for said shaft and through which the shaft is movable, substantially as specified.

7. In a device for cleaning boiler-tubes, the combination with the driving-shaft which carries the cleaners, of the rods or tubes adapted to be secured to the header of the boiler being cleaned, a transverse bar M supported thereby, a clamp M′ arranged to slide upon said bar, a post $L^2$ adjustably held in a socket of said clamp and having a socket portion at its upper end through which said shaft loosely passes, a stirrup N having a sleeve secured in said socket portion, a driving-pulley journaled in said stirrup and having a slidable spline-and-groove connection with said shaft and driving mechanism for said pulley, substantially as specified.

In testimony whereof we affix our signatures in presence of two witnesses.

WILBER DAVID FORSYTH.
ENOS T. BELL.

Witnesses:
JOHN FOUNTAIN,
JOHN A. GRIFFY.