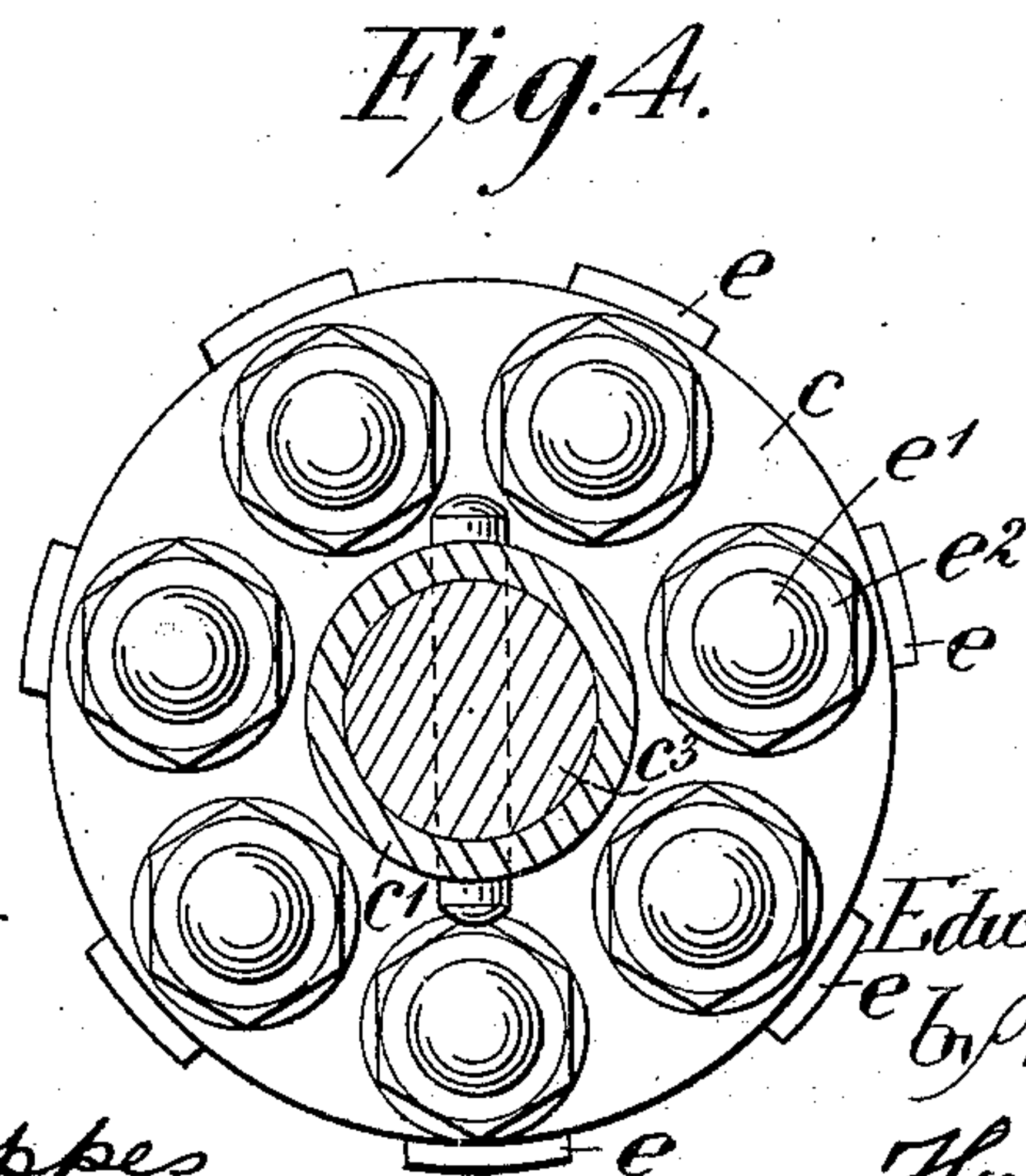
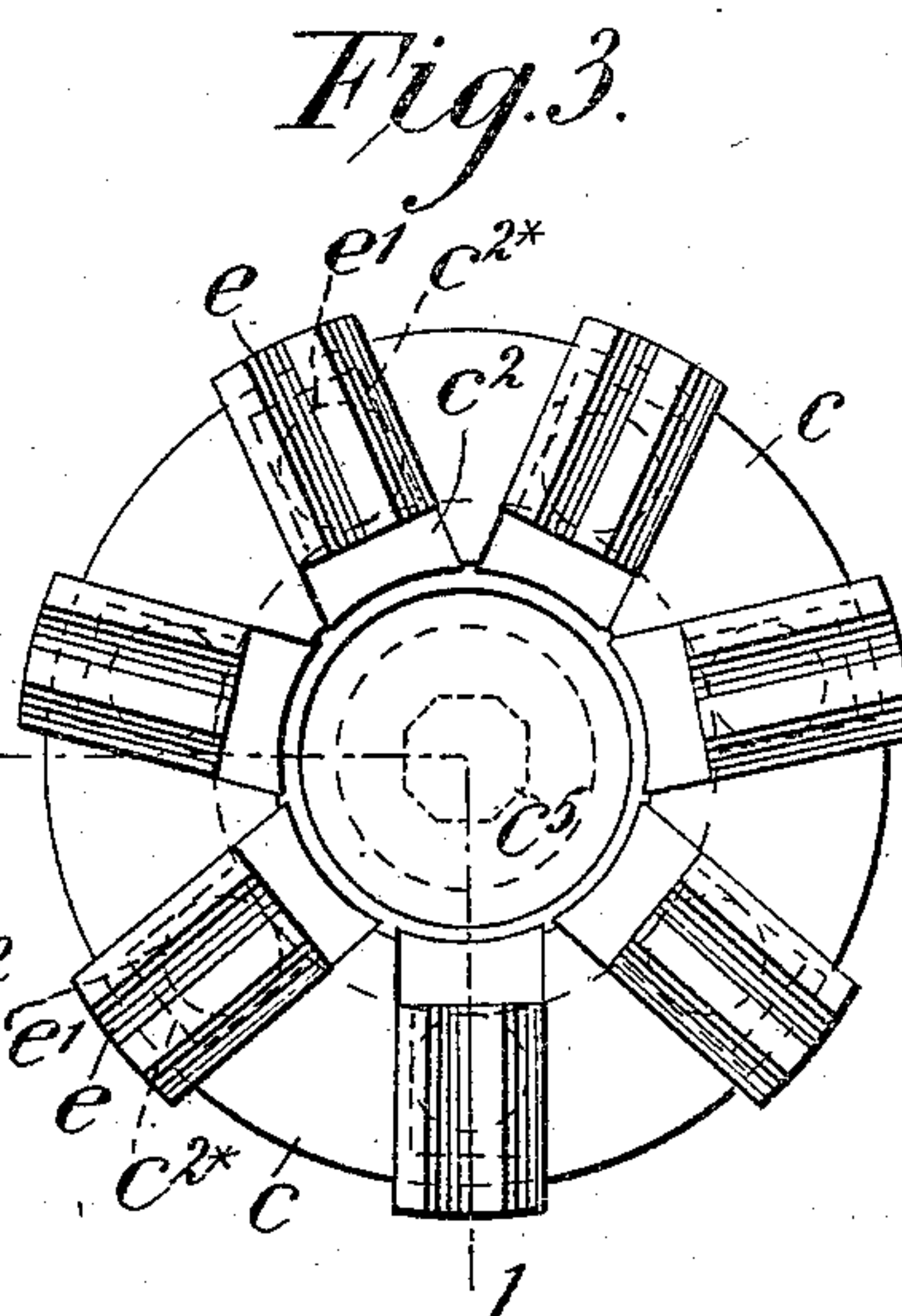
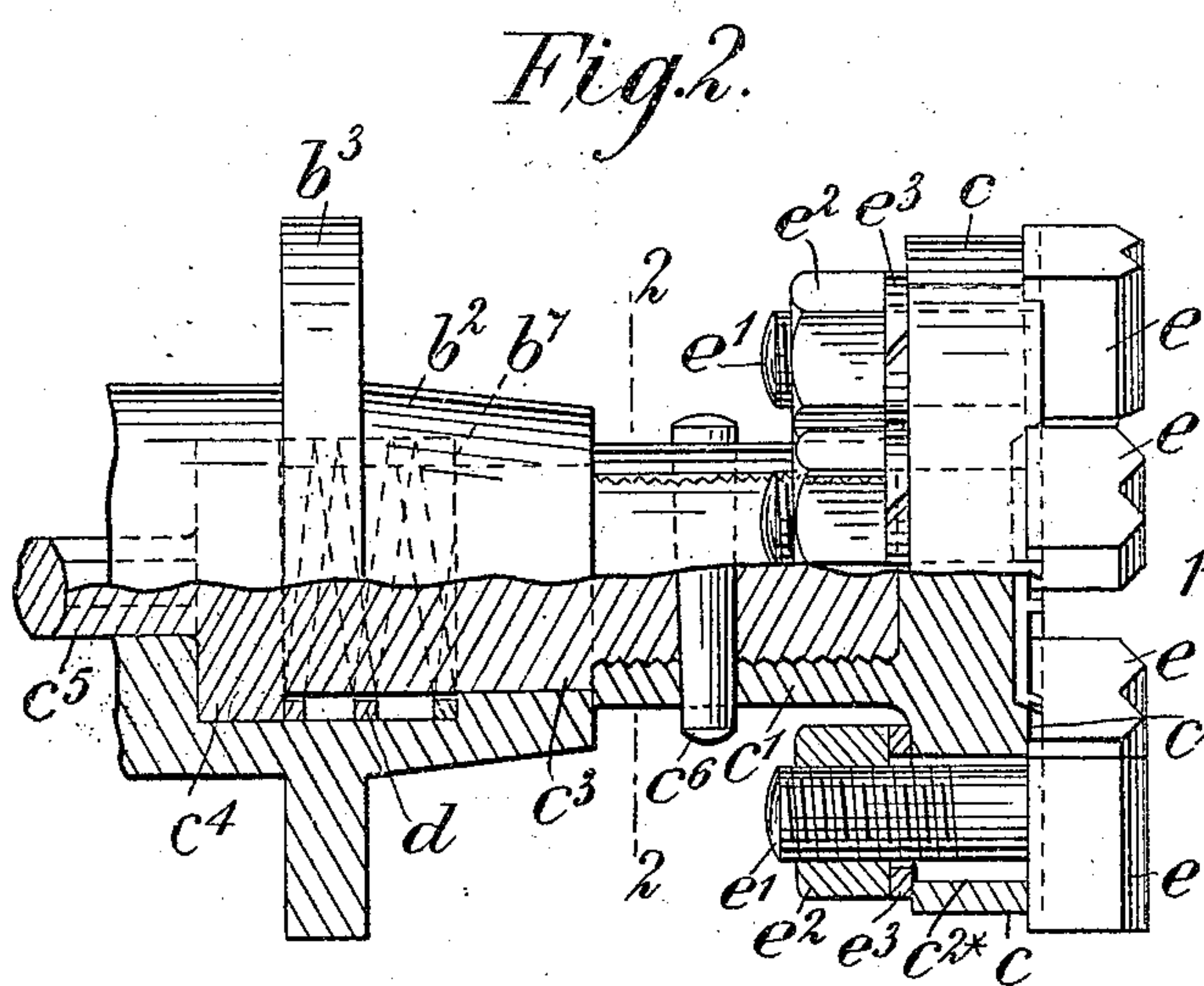
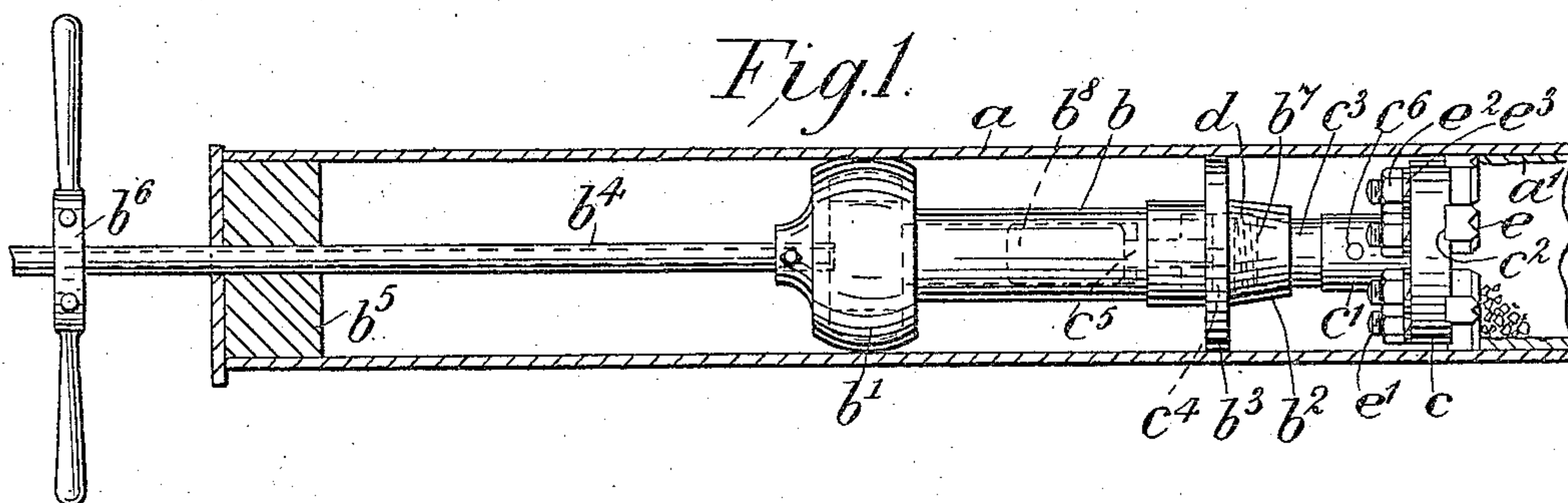


E. S. RATCLIFFE.  
BOILER FLUE CLEANER.  
APPLICATION FILED OCT. 15, 1907.

929,489.

Patented July 27, 1909.  
2 SHEETS—SHEET 1.



—Witnesses.—

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*Augustus B. Coppes*

—Inventor.—

*Edward Stanhope Ratcliffe*  
by his Attorneys,  
*Harmon & Harmon*

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Fig. 5. Fig. 6. Fig. 7. Fig. 8.

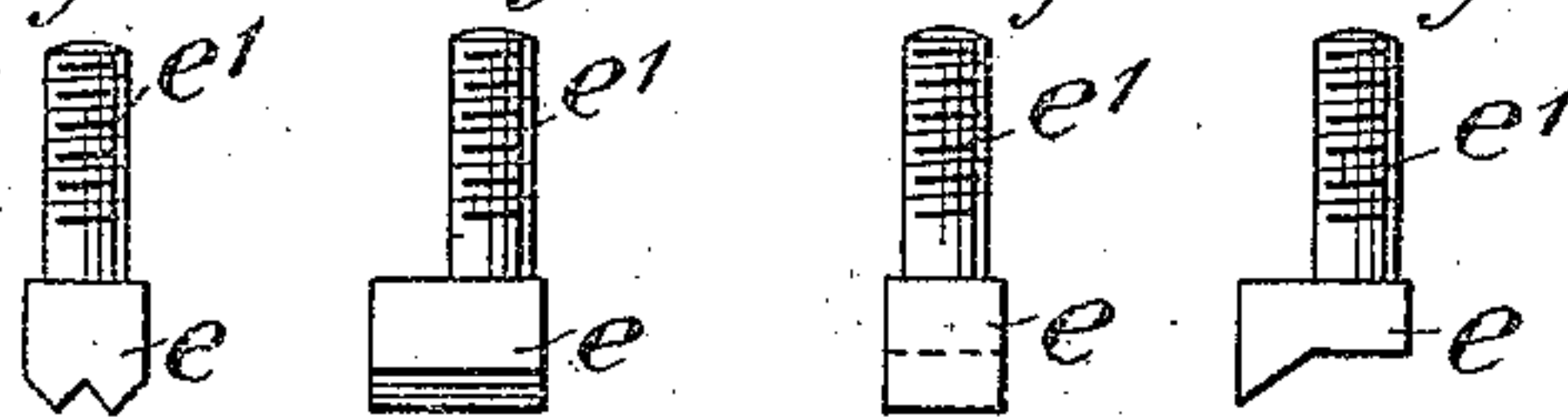


Fig. 9. Fig. 10. Fig. 11. Fig. 12.



Fig. 13.

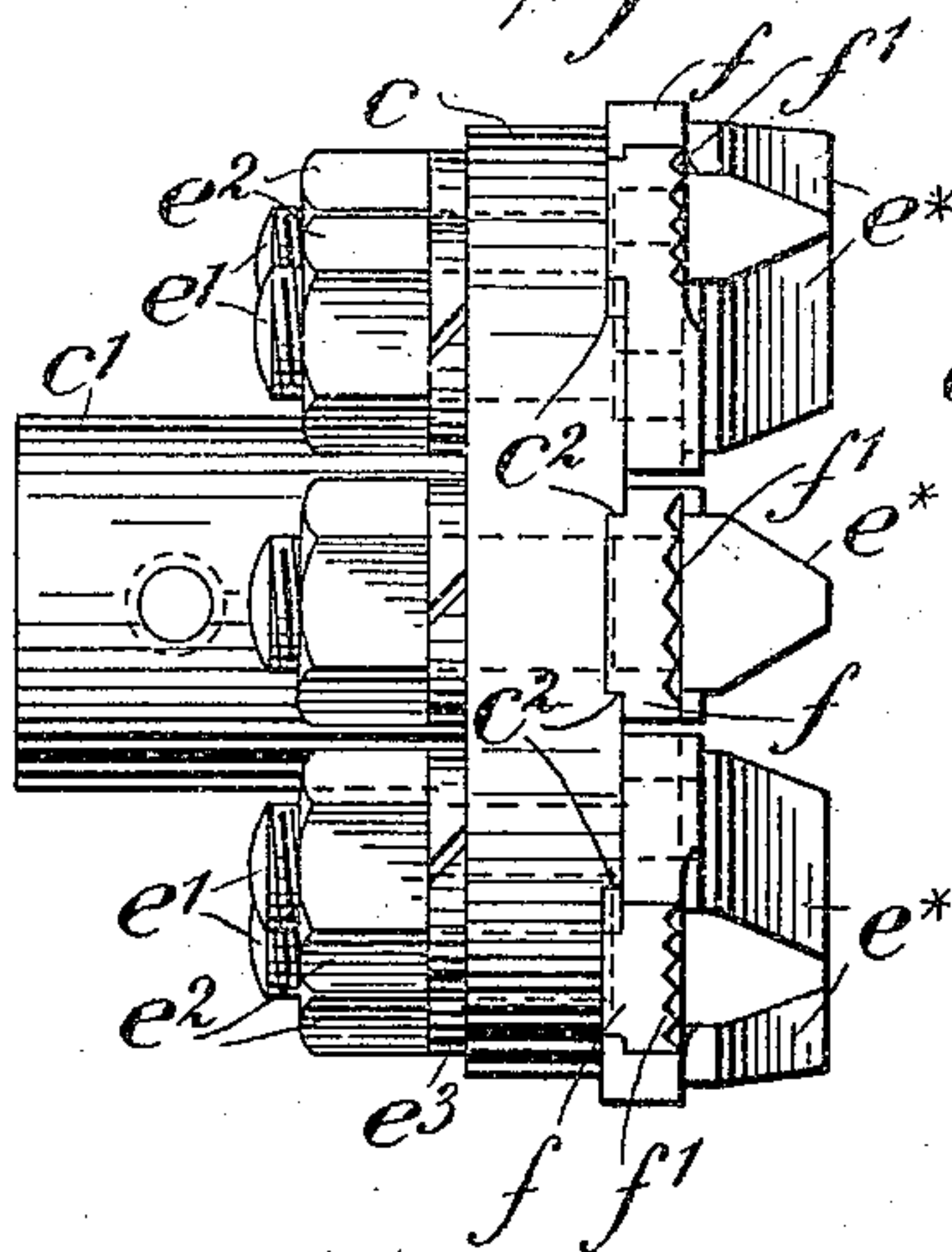
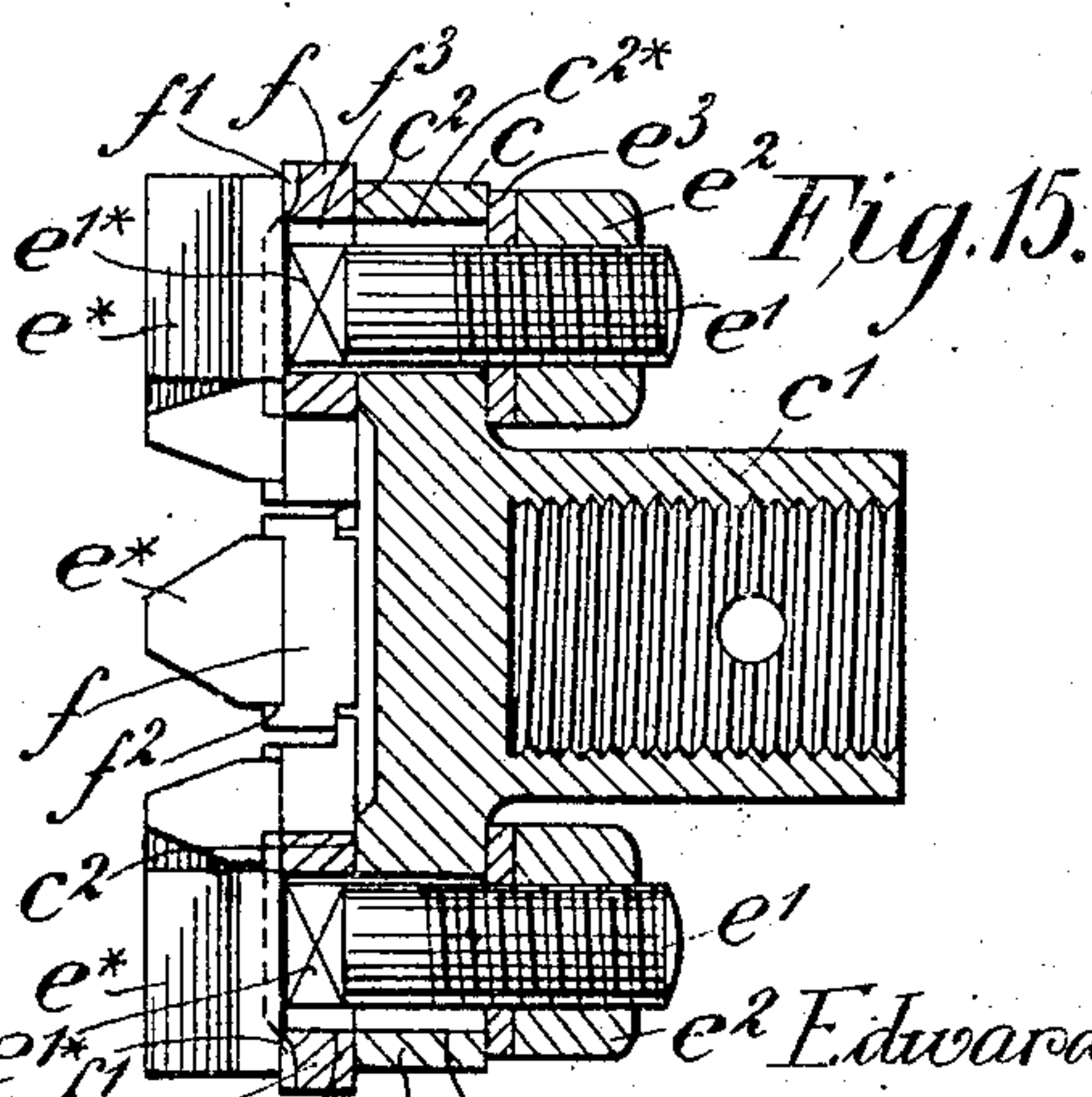
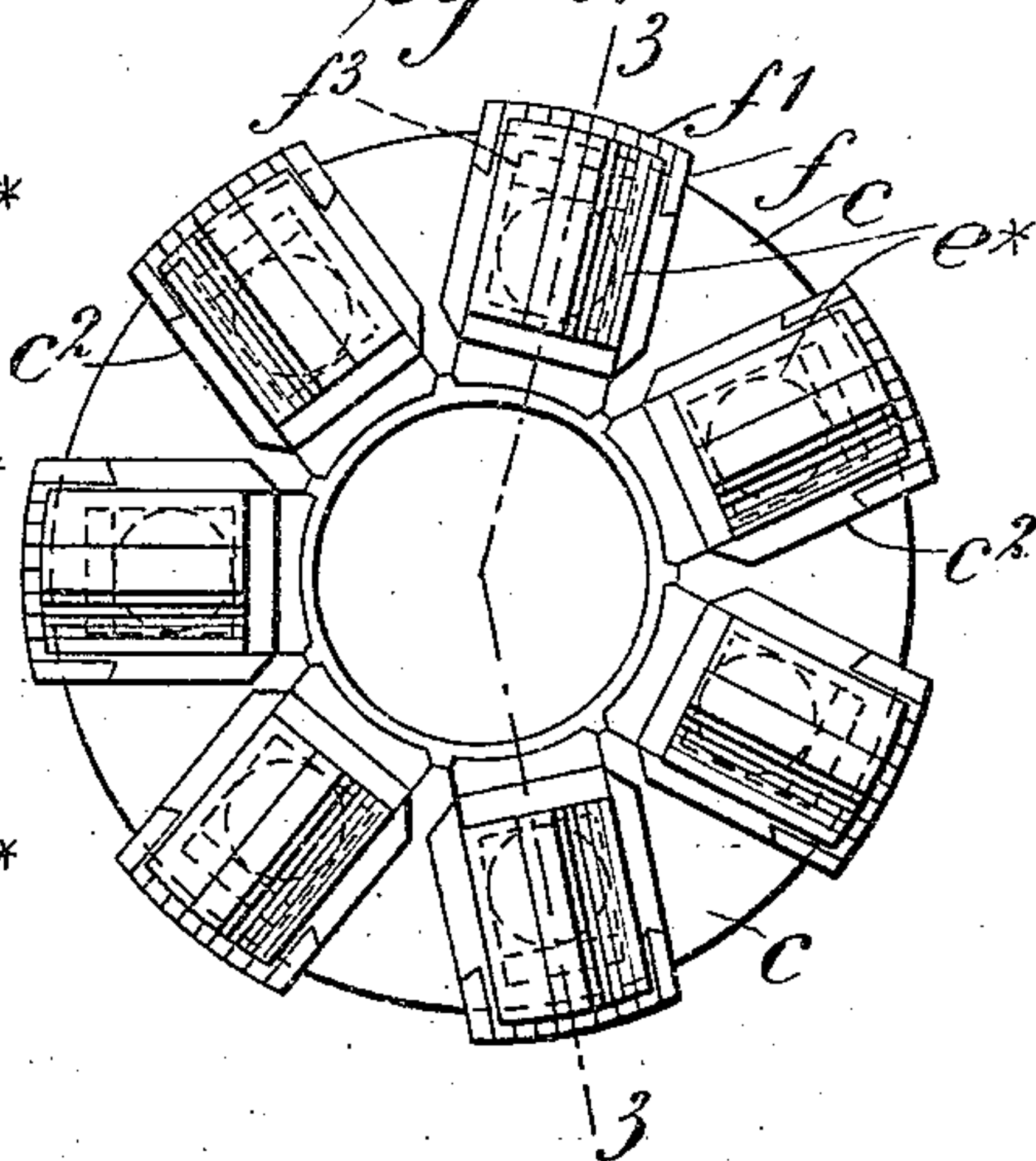


Fig. 14.



—Witnesses.—

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Edward Stanhope Ratcliffe  
By His Attorneys,  
H. M. Johnson



# UNITED STATES PATENT OFFICE.

EDWARD STANHOPE RATCLIFFE, OF TWICKENHAM, ENGLAND.

## BOILER-FLUE CLEANER.

No. 929,489.

Specification of Letters Patent.

Patented July 27, 1909.

Application filed October 15, 1907. Serial No. 397,496.

*To all whom it may concern:*

Be it known that I, EDWARD STANHOPE RATCLIFFE, engineer, a subject of the King of Great Britain, residing at No. 17 Clifden Gardens, Twickenham, in the county of Middlesex, England, have invented new and useful Improvements in or Connected with Boiler-Flue Cleaners, of which the following is a specification.

My said invention relates to that class of tools which are operated by percussive action and which are designed to chip or break off the scale or incrustation which forms upon the interior surface of boiler and other water tubes. For this purpose, the tool holder is formed with a stem which is adapted to receive a rapid succession of blows from a hammer actuated by electric or other power.

The operative parts of the tool consist of cutters fixed in and carried by the tool holder, and such cutters may consist of advanced cutters which serve to remove the outer portion of incrustation when the latter is of considerable thickness, and a series of cutters (hereinafter termed the "finishing cutters") which are also fixed in and carried by the tool holder in positions in rear of the advanced cutters. The advanced cutters are of less diameter than the tube to be scaled while the finishing cutters work close to the interior surface of the tube. The cutters, which may be formed with chisel or other suitably shaped edges, advance in lines parallel with the tube to be scaled. When the two series of cutters are employed the advanced cutters first roughly remove a portion of the scale and the rear or finishing cutters which follow them complete the operation by chipping off or removing the scale down to the metal of the tube. The rod or tube carrying the tool holder is rotated or turned about by hand or otherwise in the usual manner and by reason of the cutting edges acting in lines parallel with the inner surface of the tube and directly upon the edge of the scale, there is no liability to injure the inner surface of the tube. Furthermore, there are no pivotal joints connected with the cutters to become choked with dust neither are springs required to maintain the cutters in their acting position. And, in order that the said invention may be more clearly understood and readily carried into effect, I will pro-

ceed, aided by the accompanying drawings, more fully to describe the same.

Figure 1 is a longitudinal section of a boiler tube showing a tool constructed according to the present invention at work therein actuated by a pneumatic hammer the tool being fitted with a single set of cutters and shown in its advanced position. Fig. 2 is a sectional side view of the tool and some adjacent parts separately, showing the tool in its retracted position the section being taken on the line 1—1 of Fig. 3. Fig. 3 is an end view thereof. Fig. 4 is an opposite end view thereof the section being taken on the line 2—2 of Fig. 2. Figs. 5 and 6 are views taken at right angles to each other illustrating the cutter separately. Figs. 7 and 8, and 9 to 12, are similar views of a modified form of cutter. Fig. 13 is a side view of a tool holder or cutter head fitted with a double set of cutters. Fig. 14 is an end view thereof, and Fig. 15 is a sectional side view thereof the section being taken on the line 3—3 of Fig. 14.

In the several figures like parts are indicated by similar letters of reference, and Figs. 5 to 12 are drawn to an increased scale, and Figs. 2 to 4, and 13 to 15, are drawn to a further increased scale with respect to Fig. 1.

Referring to Figs. 1 to 12, *a* represents the boiler tube, *a'* represents a coating of incrustation upon the interior thereof, *b* represents a pneumatic percussive hammer of well known construction for acting upon the stem of the tool holder or cutter head, and *c* represents the tool holder.

The cylinder *b* of the percussive hammer is at one end formed with a guide bulb *b'* which supports it centrally of the boiler tube *a* and at the other end with a cylindrical removable cap *b<sup>2</sup>* also provided with a guide disk or support *b<sup>3</sup>*. Fastened to the bulb *b'* axially thereof and communicating with the interior of the same is a tube or stem *b<sup>4</sup>* which passes through an axial perforation in a guide disk or stopper *b<sup>5</sup>* fitting into the end of the boiler tube *a* and said tubular stem *b<sup>4</sup>* supplies the motive fluid to the cylinder *b* in the usual way while it has adjustably fixed therewith handles *b<sup>6</sup>* by the aid of which the hammer and tool may be advanced and turned in the required manner.

The tool holder or cutter head *c* is circular or disk like and is provided with a screw



threaded tubular or socket like stem  $c'$  which fits upon or receives a correspondingly threaded extension  $c^3$  carrying a piston guide  $c^4$  which works in the cap  $b^2$  and these parts, that is the extension  $c^3$  and the socket  $c'$  are secured against working loose by a cross pin  $c^6$  passing through perforations in both.

The cap  $b^2$  is interiorly formed with a shoulder  $b^7$  at its extremity and between this shoulder and the piston guide  $c^4$  is coiled around the extension  $c^3$  a spring  $d$  which takes an abutment against said shoulder and acts upon one side of the piston guide so as to normally retain the tool holder or cutter head in a retracted position.

Projecting from the other side of the piston guide  $c^4$  axially thereof is a stud  $c^5$  upon which the hammer  $b^8$  percussively acts to drive the tool holder or cutter head  $c$  forward while the return movement thereof is effected by the spring  $d$ . The stud  $c^5$  is formed octagonal in cross section or it might be of other suitable angular section and works in a corresponding perforation formed in the end of the cylinder  $b$  and serves to prevent the independent rotation of the holder or cutter head  $c$  while permitting its longitudinal movement.

The face of the tool holder or cutter head  $c$  is formed with a number of radially disposed grooves or recesses  $c^2$  therein in the bottom of each of which is provided an oblong perforation  $c^{2*}$  and in each of these grooves or recesses is seated a cutter  $e$  the base of which is shaped to nicely fit said groove but to slightly project beyond the margin of the disk  $c$  and each cutter has fixed thereto a threaded stud  $e'$  which passes through the oblong rectangular perforation  $c^{2*}$  at the bottom of the groove or recess  $c^2$  and extends beyond the disk  $c$  where a nut  $e^2$  is screwed thereon and bears against the back of said disk through an interposed spring washer  $e^3$ , thus, in conjunction with the groove  $c^2$ , firmly fixing the cutter  $e$  in position but with capability of being radially adjusted within the limits of the oblong hole  $c^{2*}$  and easily changed.

The acting face of the cutter  $e$  may be shaped in any way considered most suitable for the work to be performed; in the present example the face of the cutter  $e$  is formed in end view like the letter **W** the two lower points of which constitute the cutting edges as shown more particularly at Figs. 5 and 6, or it might be otherwise shaped for example as shown at Figs. 7 and 8, and 9 to 12.

In all cases, the cutters are formed to act in lines parallel with and to work close to the inner surface of the boiler tube  $a$  that being the direction of motion of the tool holder or cutter head  $c$ .

In operation, the hammer and the tool are advanced or fed forward and intermittently turned in the boiler tube  $a$  by means of the

handles  $b^6$  and the hammer delivers a rapid succession of blows upon the stud  $c^5$  of the piston guide  $c^4$  and thus to the tool holder or cutter head  $c$  causing the cutters  $e$  to strike directly upon the edge of the scale  $a'$  in lines parallel with the tube  $a$ , without liability to injure the inner surface of the tube  $a$ , the return movement being effected by the spring  $d$ . Furthermore, there are no pivotal joints connected with the cutters to become choked with dust neither are springs required to maintain the cutters in their acting position as is the case in other existing devices.

In the example given at Figs. 13, 14 and 15, a tool is shown fitted with two sets of cutters, which, if desired, may be formed in one piece, arranged one set in advance of the other and the first designed to more or less clear the way or prepare for the action of the second.

$e^*$  represents the advance cutters which in end view or cross section are shown to be shaped somewhat like a truncated cone although they might be of other suitable shape and their threaded studs  $e'$  are slightly prolonged and at  $e'^*$  near to the bases of the cutters  $e^*$  said studs are formed of square section for the purpose hereinafter described. In this case, the bases of the cutters  $e^*$  do not fit into the grooves  $c^2$  in the disk or cutter head  $c$  as in the former example, but a second set of plate like cutters  $f$  having serrated cutting edges  $f'$  are fitted into said grooves and said cutters  $f$  are formed with grooves  $f^2$  in the faces thereof into which are fitted the bases of the cutters  $e^*$  while the cutters  $f$  are formed with oblong rectangular perforations  $f^3$  therein which receive the square parts  $e'^*$  of the threaded studs  $e'$  and by reason of the corresponding oblong rectangular holes  $c^{2*}$  in the disk  $c$  both sets of cutters  $e^*$  and  $f$  may be readily adjusted with relation to each other and the disk  $c$ . By this arrangement, the cutters are rendered interchangeable, and the head  $c$  may be fitted with a single set of cutters as shown in Figs. 1 to 4, or with a double set as shown in the present example.

The single set (Figs. 1 to 4) is intended to be used in cases where the scale or incrustation is not unduly thick or hard and work close to the inner surface of the tube so that the single set may completely remove said scale.

The double set (Figs. 13 to 15) is intended to be employed in cases where the scale or incrustation is either of considerable thickness or hard or both thick and hard and the advance cutters  $e^*$  are set slightly within the radius of the following or finishing cutters  $f$  which latter work close to the inner surface of the tube  $a$  and the cutters  $e^*$  are designed to partially break up or remove the scale so that the following cutters  $f$  may readily complete the operation by chipping off or



removing the scale down to the metal of the tube *a* the action of both sets of cutters being in lines parallel with the inner surface of the tube *a* as hereinbefore explained.

5 Although a pneumatic hammer is herein shown and described as the means of delivering a rapid succession of blows to the stem of the tool holder or cutter head *c* it will be understood that an electrically operated or  
10 other suitable percussion hammer may be employed if desired and it will also be understood that the shape of the cutters employed may be varied according to the requirements and that more than two sets  
15 arranged in advance of one another may be employed if desired.

By the means hereinbefore described, a tool is obtained which is highly efficient in action, simple, inexpensive, and durable, and  
20 by reason of the direction of motion of the cutters being parallel with the inner surface of the tube to be scaled, injury to the latter is virtually impossible.

Having now particularly described and  
25 ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The combination in a boiler tube cleaner, of a cutter head, means for actuating the  
30 same, and a series of cutters rigidly mounted on said head so that their cutting edges project in front and inside of the edges of the head, each of said cutters having a threaded stud extending through the head and pro-  
35 vided with a nut for holding it in position.

2. The combination in a boiler tube cleaner, of a cutter head consisting of a disk provided in one face with radial grooves, cutters

mounted in said grooves, the cutting edges of said cutters lying in a plane or planes 40 radial to the tube to be cleaned and extending inwardly from the edges of the disk, and means for removably and adjustably holding said cutters.

3. The combination in a boiler tube cleaner, 45 of a cutter head having actuating means and provided with a series of radial grooves, with two sets of cutters mounted on said head, certain of the cutters fitting the grooves of the head and each cutter of one set having 50 means whereby it and a cutter of the other set are removably held in place.

4. The combination in a boiler tube cleaner, of a cutter head, means for actuating the same, and two sets of cutters mounted on 55 said head, the cutters of one of said sets being of a plate-like form and having serrated edges, there being grooves in the head for the reception of said set of cutters, and the second set of cutters having portions fitting 60 into grooves in the first set of cutters, with means for retaining said cutters in place upon the cutting head.

5. The combination in a boiler tube cleaner, of a cutter head, means for actuating the 65 same, cutters on the head mounted so as to extend radially thereof, each of said cutters having its outer end at right angles to its length and being provided with cutting edges extending toward the center line of the head, 70 said cutting edges lying in a plane or planes radial to the tube operated on.

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Witnesses:

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