

(No Model.)

3 Sheets—Sheet 1.

J. ROBERTSON.
APPARATUS FOR FORMING ELONGATED ARTICLES FROM BILLETS OF
HEATED METAL.

No. 493,045

Patented Mar. 21, 1893.

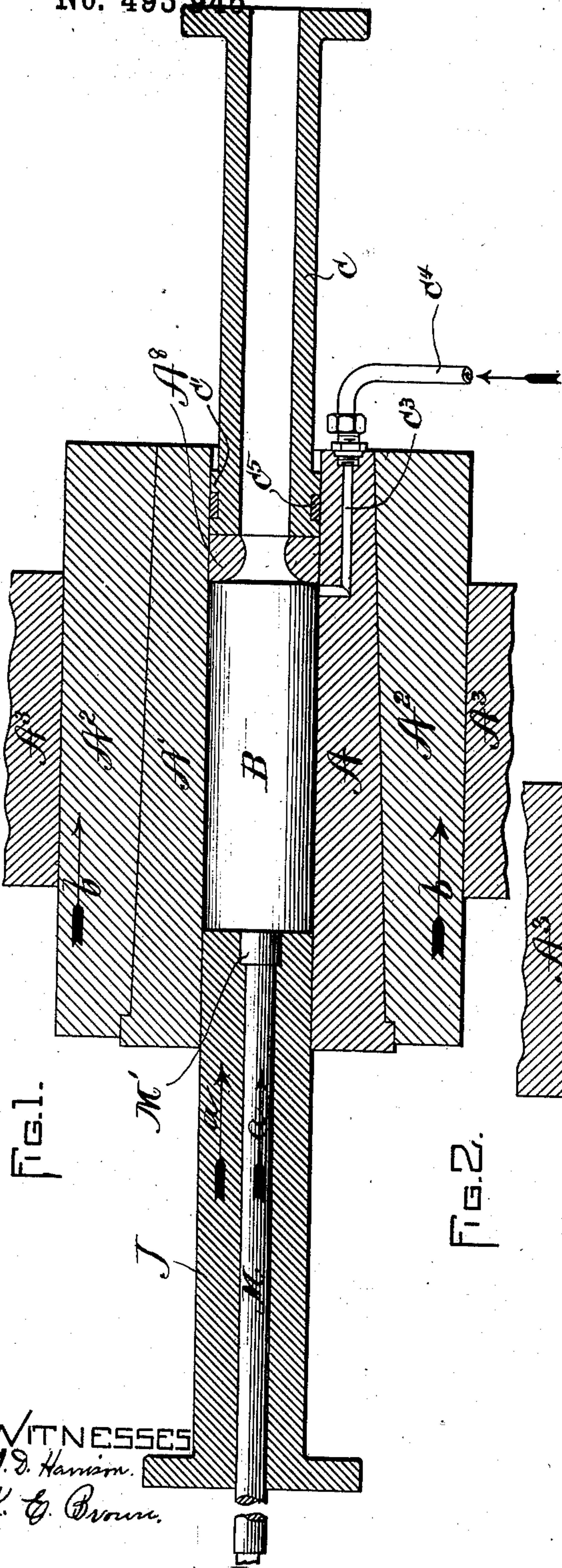


FIG. 1.

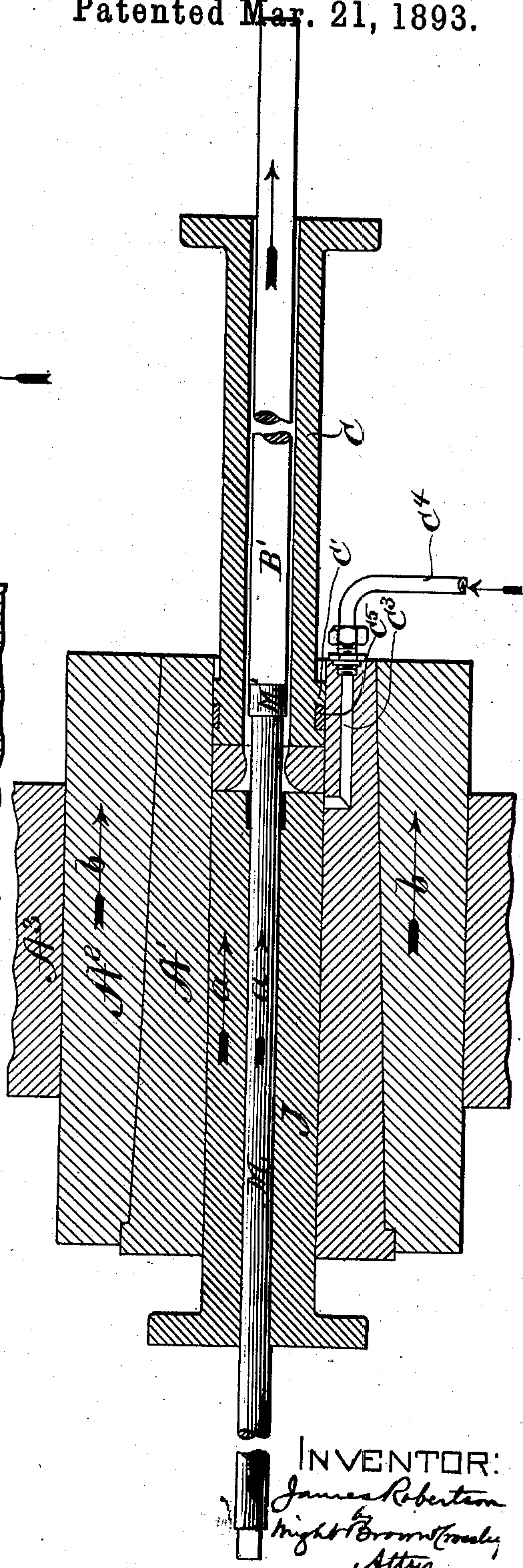


FIG. 2.

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Atty.

(No Model.)

3 Sheets—Sheet 2.

J. ROBERTSON.

APPARATUS FOR FORMING ELONGATED ARTICLES FROM BILLETS OF
HEATED METAL.

No. 493,945.

Patented Mar. 21, 1893.

FIG. 3.

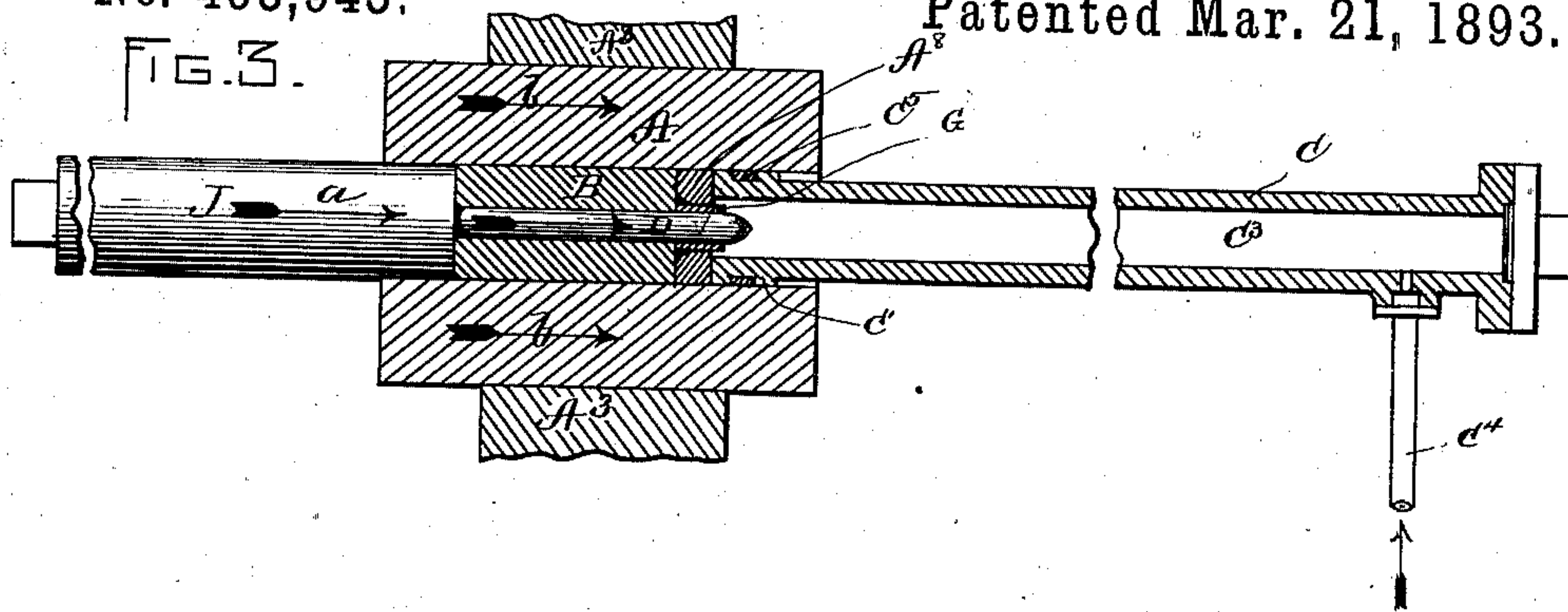


FIG. 4.

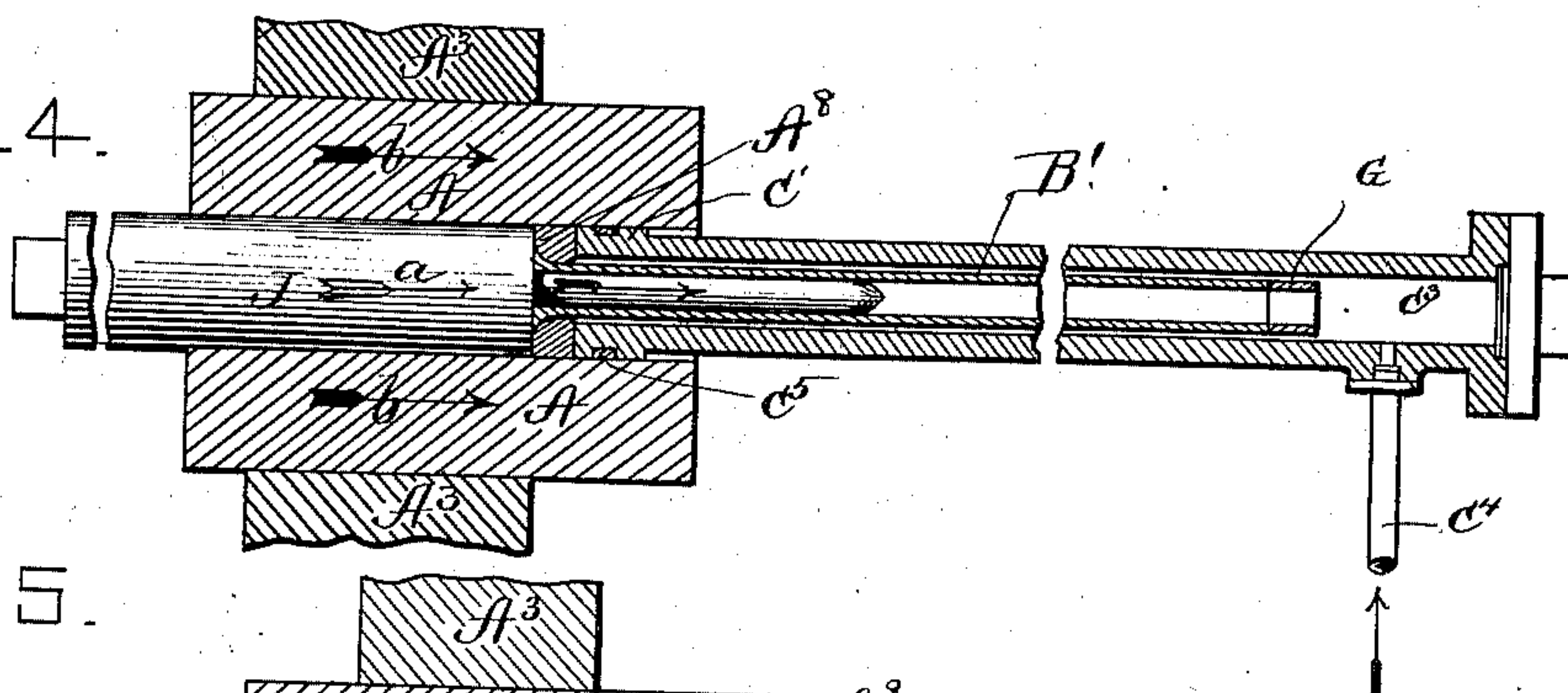


FIG. 5.

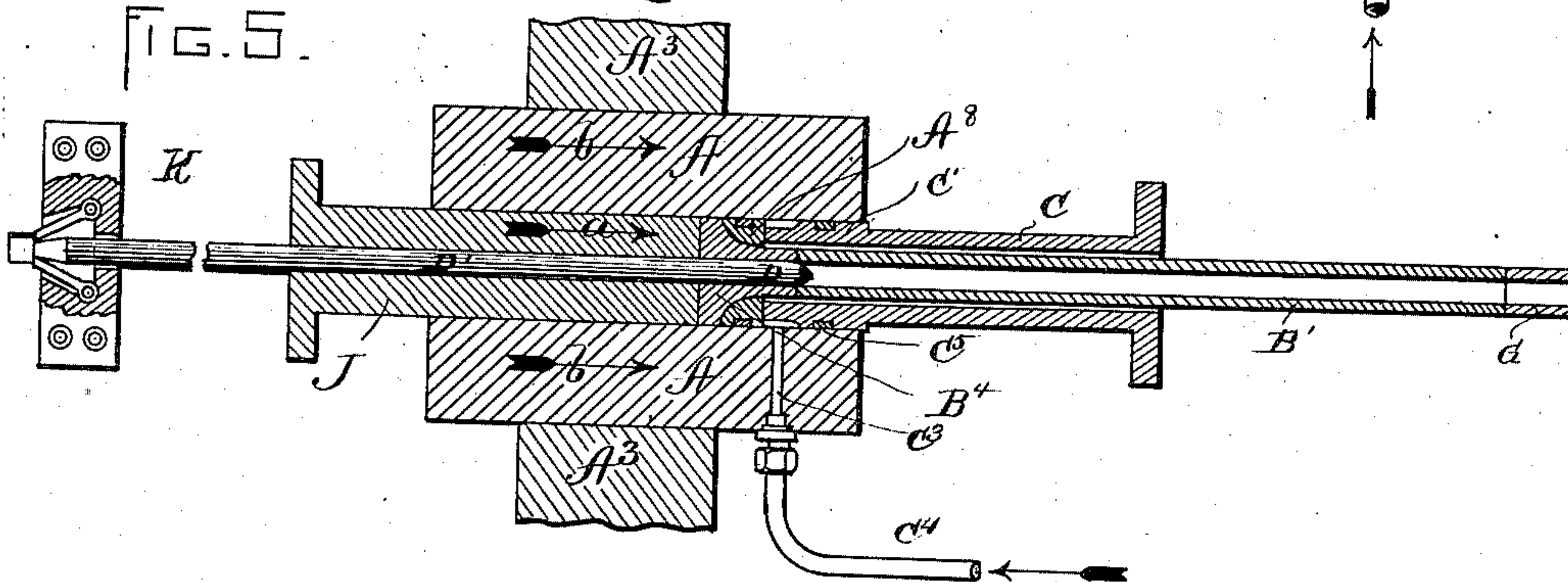
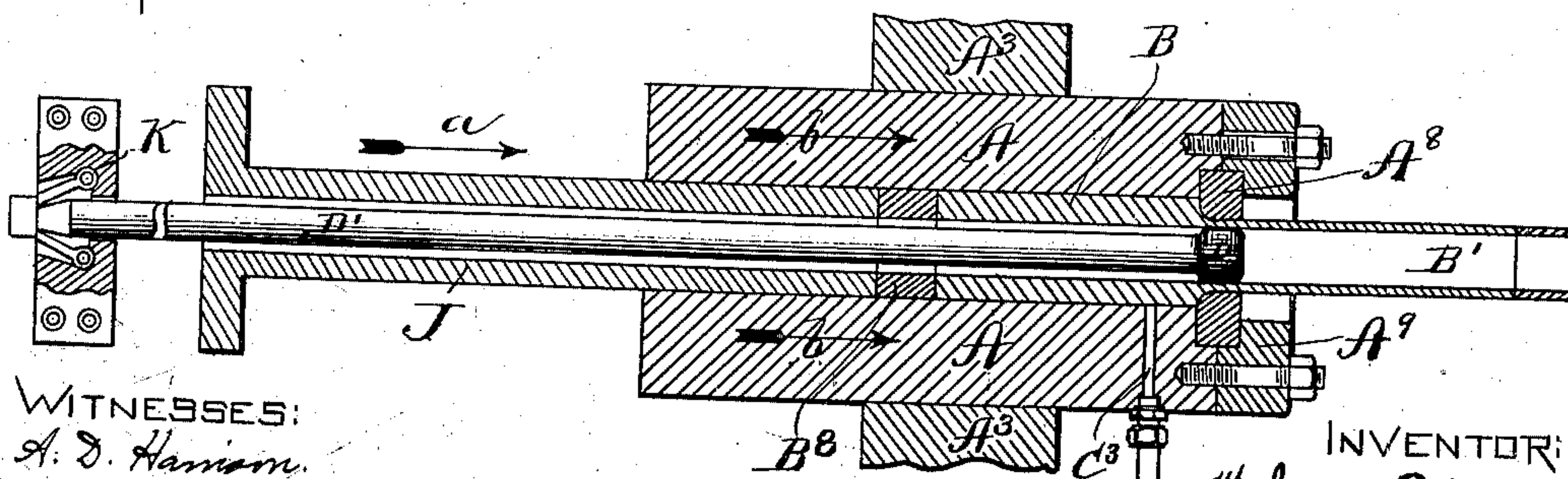


FIG. 6.



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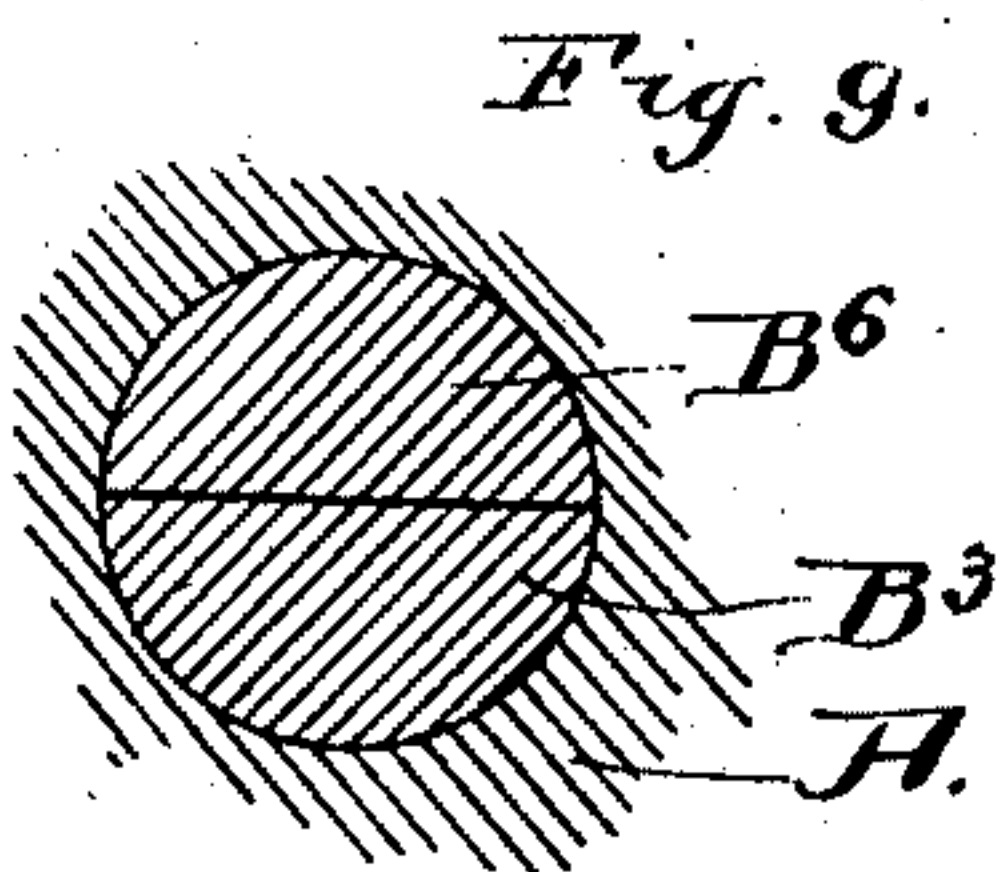
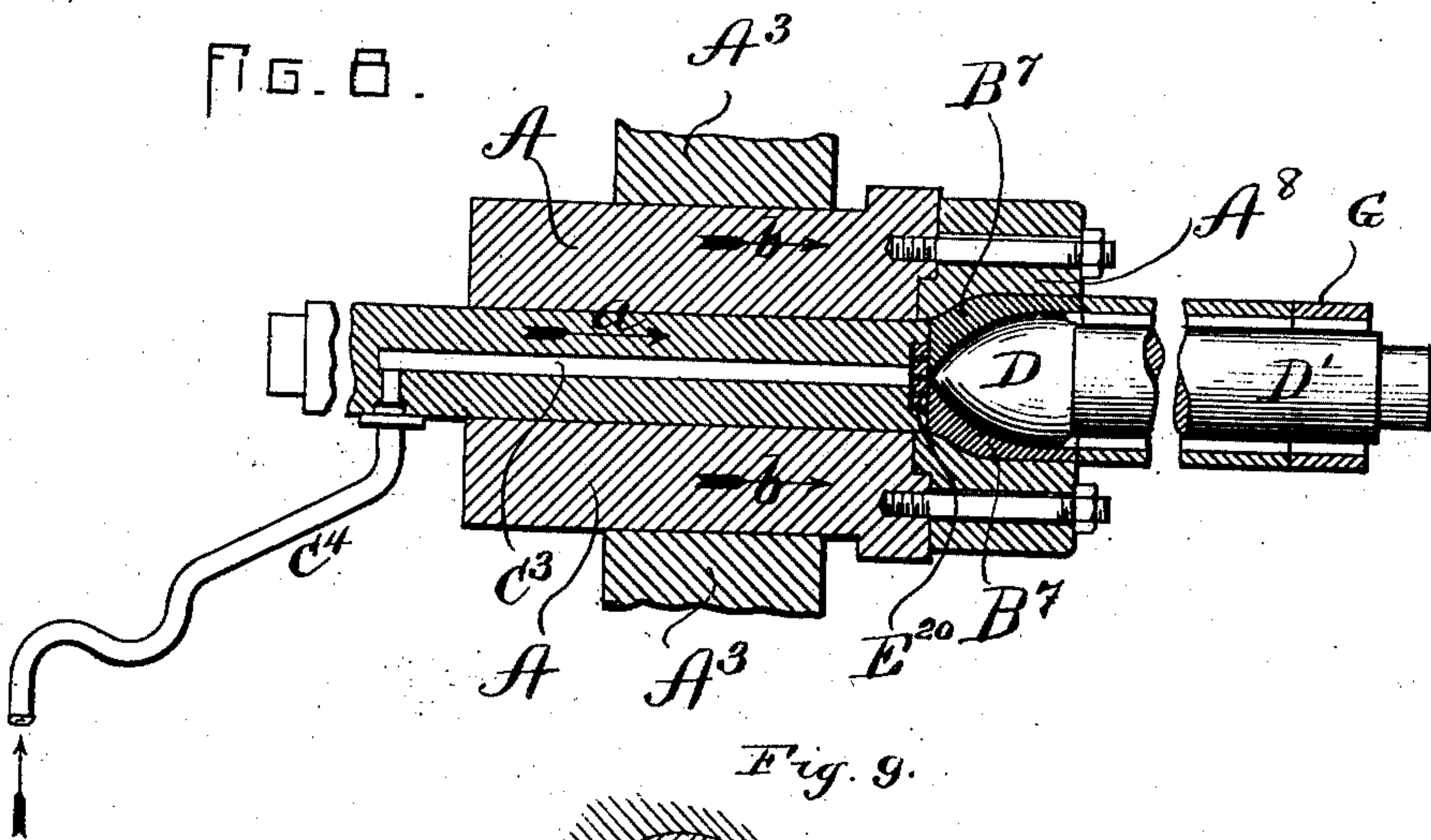
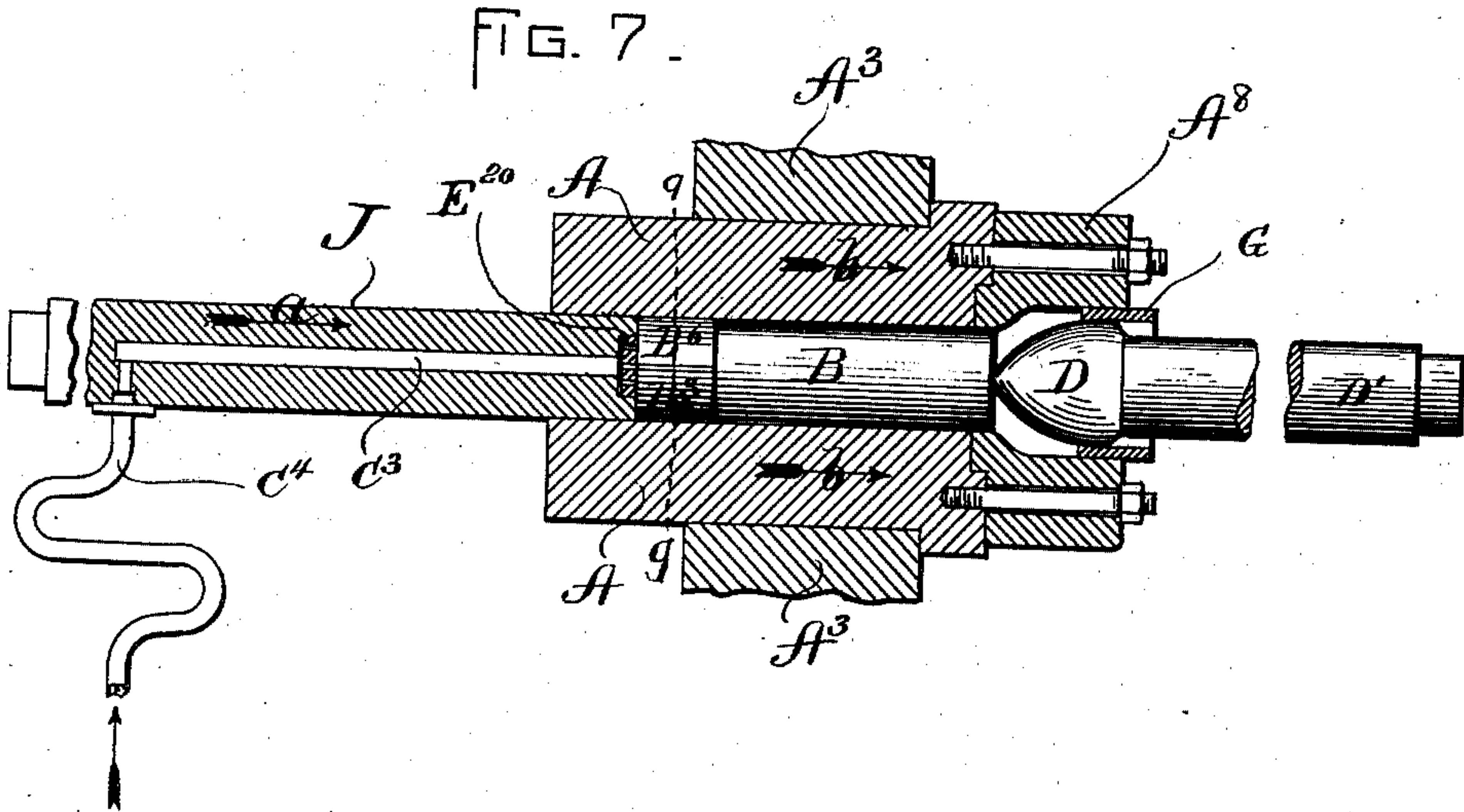
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3 Sheets—Sheet 3.

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WITNESSES:

A. S. Hanson.
K. E. Brown.

INVENTOR:

James Robertson
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UNITED STATES PATENT OFFICE.

JAMES ROBERTSON, OF MANCHESTER, ENGLAND.

APPARATUS FOR FORMING ELONGATED ARTICLES FROM BILLETS OF HEATED METAL.

SPECIFICATION forming part of Letters Patent No. 493,945, dated March 21, 1893.

Application filed July 15, 1892. Serial No. 440,151. (No model.) Patented in England July 6, 1891, No. 11,436.

To all whom it may concern:

Be it known that I, JAMES ROBERTSON, of Manchester, England, have invented certain new and useful Improvements in Apparatus for Forming Elongated Articles from Billets of Heated Metal, (for which British Letters Patent No. 11,436, dated July 6, 1891, have been granted me,) of which the following is a specification.

10 This invention has for its object to provide simple and efficient apparatus for forming elongated metal articles, of tubular and other form, from billets of metal heated to a soft state, and it consists mainly in an apparatus
15 comprising a metal holding cylinder which is longitudinally movable in both directions in a fixed holder, said die being internally formed to contain a billet of metal; a ram or plunger, fitting said die and adapted to exert
20 pressure on one end of a billet in the die, and thereby cause the metal to exude from the opposite end of the die; and a fixed reducing die or former separate from the cylinder and arranged to partially support the rear end of
25 the billet, and thus cause the compression of the billet when the ram first commences its action on the billet, the die or former being shaped and arranged so that, after the initial compression of the billet, the pressure of the
30 ram overcomes the frictional resistance of the former to the escape of the metal, so that the metal exudes in contact with the former, and is given the desired shape thereby.

The invention also consists in certain additional improvements relating mainly to the arrangement of the reducing die or former; and to a former composed of two parts, one of which is a throat at the rear end of the die and made of a different diameter from that
40 of the billet, the other being a fixed mandrel separated from said throat by a concentric space, and arranged to co-operate with the throat in forming the exuding metal into a seamless tube; all of which I will now proceed
45 to describe.

Of the accompanying drawings, forming part of this specification: Figure 1 represents a longitudinal section of an apparatus embodying one form of my invention. Fig. 2
50 represents a similar section, showing the position of the parts at a different stage of the

operation from that shown in Fig. 1. Fig. 3 represents a longitudinal section, showing the apparatus adapted to form tubular articles of smaller diameter than the billets. Fig. 4 represents a section similar to Fig. 3, showing the apparatus at a different stage of the operation. Fig. 5 represents a longitudinal section, showing a modification of the construction shown in Figs. 3 and 4. Fig. 6 represents a longitudinal section, showing another modification. Figs. 7 and 8 represent longitudinal sections, showing another modification. Fig. 9 represents a section on line 9—9 of Fig. 7.

The same letters of reference indicate the same parts in all the figures.

In the drawings: A represents a long metal holding cylinder, which is adapted to slide in a fixed holder or casing A³. The cylinder is provided with a billet-holding bore or cavity, extending through it from end to end, and is adapted to move in the direction of the length of the said cavity. In Figs. 1 and 2, I show the cylinder affixed to a sliding holder A², which is fitted to move in a way in the fixed holder A³. In the other figures, the cylinder is shown as fitted directly to the way in the holder A³.

J represents a ram, which is formed to closely fit the interior of the cylinder and to slide therein. In the operation of the apparatus, the ram J is forced into the cylinder in the direction indicated by the arrows *a a*, motion being communicated to the cylinder by any suitable means, preferably hydraulic means.

The ram J may be provided with a longitudinal hole slightly enlarged at its inner end, in which is placed a secondary ram M, adapted to slide therein, and having a head M' fitting the enlargement referred to. The said head and enlargement prevent the metal under pressure from pressing the secondary ram backward. The object of the said ram is to push the metal out of the die A³ hereinafter described, after completion of the stroke of the ram J.

At or near the rear portion of the cylinder A, is located a die or former, the office of which is to partially support the rear end of the billet against the pressure exerted by the ram, thus causing the latter to first compress

the billet longitudinally, the former being so shaped that, after the billet has been compressed to a given extent, the pressure of the ram will overcome the frictional resistance offered to the escape of the metal from the cylinder by the former, so that the metal will exude in contact with the said die, and will receive the desired shape from the former. In the construction shown in Figs. 1 and 2, which construction is adapted to produce a solid bar of metal from a billet of larger diameter, the reducing die is shown as a reduced or contracted throat A^8 , held in a fixed position within the cylinder by means of a fixed tubular stem-rod C^1 , which enters the rear end of the cylinder and supports the throat A^8 . A billet B (Fig. 1) being placed in the cylinder, with its rear end in contact with the throat or reducing die or former A^8 , and the ram being introduced into the cylinder and caused to move in the direction indicated by the arrows a , the metal of the billet will first be compressed longitudinally, the throat or former A^8 opposing the pressure of the ram. At the same time, the cylinder, being free to move endwise as described, moves with the metal in the direction of motion of the ram, as indicated by the arrow b , until the metal has been compressed to such an extent that the further pressure overcomes the frictional resistance offered by the throat or former A^8 . The metal then commences to flow through the contracted opening of the throat, in the form of a solid rod B' (Fig. 2), which emerges through a longitudinal passage in the tubular stem-rod C^1 .

C^4 represents a pipe for the admission of water or other fluid under high pressure to the interior of the cylinder, for the purpose of cooling the cylinder and ejecting the ram and the formed article or rod, as described in my Letters Patent of the United States, dated August 16, 1892, No. 481,060. It will be seen that the introduction of water in a cold state into the die containing a formed article of hot metal, exerts a quick cooling action, slightly contracting the article, and releasing the hold of the die upon it; also affording a steady force for the removal of the article, with the mandrel or pressure device, from the die or cylinder.

In the construction shown in Figs. 3, 4, 5, 6, 7 and 8, of the drawings, the reducing die or former is composed of a throat A^8 , of a diameter differing from that of the billet and the billet-containing portion of the cylinder, and a mandrel which is separated from the forming surface of the throat by an annular space, said mandrel co-operating with the throat in converting the exuding stream of metal into a seamless tube, instead of into a solid bar as formed by the apparatus constructed as shown in Figs. 1 and 2.

Referring to Figs. 3 and 4, the throat A^8 is supported by the tubular stem-rod C , as in the construction already described, and the mandrel D is affixed to the ram J . The bil-

let B , before being placed in the cylinder, is longitudinally perforated to receive the mandrel, as shown in Fig. 3. The advancing movement of the ram causes it to first compress the billet longitudinally, and then to cause the metal of the billet to exude in the form of a tube through the annular space between the mandrel D and throat A^8 , the tube B' emerging into the hollow stem-rod, as shown in Fig. 4. In this case the pipe C^4 , which admits the fluid under pressure to the cylinder, is connected to the rear end of the hollow stem-rod C , so that the tube, mandrel and ram are ejected in the same direction.

The construction shown in Fig. 5 is substantially the same as that shown in Figs. 3 and 4, excepting that the mandrel D is affixed to a stem-rod D' , which is engaged at its rear end with a fixed mandrel-holder K , so that the mandrel does not partake of the movement of the ram, the mandrel being of sufficient length to remain in operative relation to the throat A^8 during all the changes of position of the cylinder. The pipe C^4 , in this instance, enters the rear portion of the cylinder, substantially as in Figs. 1 and 2.

In Fig. 6, the construction is the same as in Fig. 5, excepting that the stem-rod C is omitted, and the throat A^8 affixed to the die A by means of a ring-shaped frame A^9 , bolted to the rear end of the cylinder. The mandrel is in this case shown as of a slightly greater diameter than its stem-rod D' .

The tubes formed by the apparatus organized as shown in Figs. 3, 4, 5 and 6 are of smaller diameter than the billet, and in each case are made from a billet which has been previously perforated longitudinally to receive the mandrel.

In the construction shown in Figs. 7 and 8, I show means for making a tube of a diameter exceeding that of the billet, and from a solid billet, or one which has not been previously perforated.

Referring to Figs. 7 and 8, the die or throat A^8 is of larger internal diameter than the billet-receiving portion of the cylinder, and is bolted directly to the cylinder. The mandrel D is rigidly supported at a point at the rear of the cylinder, by means not here shown, and its pointed end faces the ram and is located within the die A^8 , so that the mandrel first resists the pressure exerted on the billet by the ram, and then co-operates with the die in converting the exuding metal into a tube of larger diameter than the billet, the tube passing out over the mandrel stem-rod D' . In this case, the fluid-admitting pipe C^4 is made flexible, and communicates with a longitudinal passage C^2 in the ram, so that the fluid is admitted through the ram into the cylinder, and acts to expel the ram by its reaction against the mandrel or against a landing piece composed preferably of two short billets or sections $B^3 B^6$ (Fig. 7), placed in the cylinder in contact with the billet B before the operation, said landing piece serving to impart motion

to the billet B and tube B', and permit the entire metal of the billet B to pass over the mandrel in the form of a tube without sticking to the mandrel, the latter being received by the landing piece at the close of the operation. These short billets or sections B³, B⁶ may be semi-circular in cross section as indicated in Fig. 9, but I do not limit myself to this specific shape in cross section. A short landing piece B⁸, of tubular form and composed of one part is shown in Fig. 6, said billet being converted into a cap B⁴, as shown in Fig. 5. The object of the cap B⁴ is the same in the construction shown in Fig. 5 as that of the cap B⁷ shown in Fig. 8. The landing piece is particularly for detaching the formed tube from the mandrel. If said landing piece were not employed, the mandrel at the end of the operation would necessarily be enveloped in a cap piece integral with the tube, and this, piece would have to be cut away to release the tube and the mandrel. The landing piece being separate from the billet permits the ready separation of the tube from the mandrel, and prevents injurious heating of the mandrel. The sectional construction of the landing piece allows the cooling water to get more directly to the mandrel D and also allows the enveloping cap to be removed freely from the mandrel.

The invention involved in the employment of the landing piece is claimed in another application filed by me concurrently with this application and given Serial No. 440,152.

I claim—

1. The improved apparatus for forming elongated articles from billets of heated metal,

the same comprising a cylinder which is longitudinally movable in both directions, a movable ram or plunger fitting said cylinder and adapted to exert pressure on one end of a billet therein, and thereby cause the metal to exude from the opposite end of the cylinder, the cylinder being of uniform diameter from its forward end nearly to its rear end and having a delivering or forming throat separate from the cylinder and of different diameter, therefrom and a mandrel arranged to co-operate with said throat in forming the exuding metal into a seamless tube, as set forth.

2. The improved apparatus for forming elongated articles from billets of heated metal, the same comprising a cylinder which is longitudinally movable in both directions, a movable ram or plunger fitting said cylinder and adapted to exert pressure on one end of a billet therein and thereby cause the metal to exude from the opposite end of the cylinder, the cylinder being of uniform diameter from its forward end nearly to its rear end and there provided with a contracted throat separate from the cylinder to reduce the diameter of the exuding stream of metal, and a mandrel arranged to co-operate with said contracted throat in forming a tube of less diameter than the billet, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of June, A. D. 1892.

JAMES ROBERTSON.

Witnesses:

ARTHUR C. HALL,
ARTHUR H. POPE.