

No. 619,747.

Patented Feb. 21, 1899.

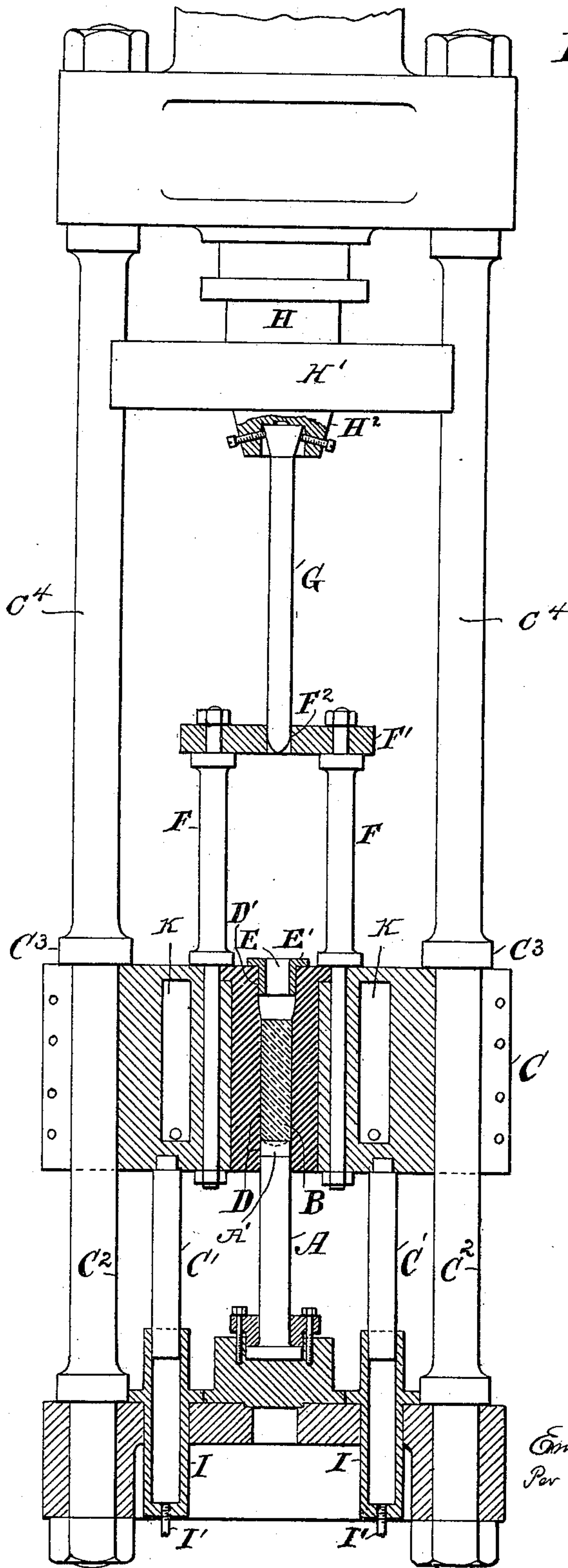
E. F. HOLINGER.
TUBE FORMING APPARATUS

(Application filed Feb. 7, 1898.)

(No Model.)

5 Sheets—Sheet 1.

Fig. 1



Witnesses.
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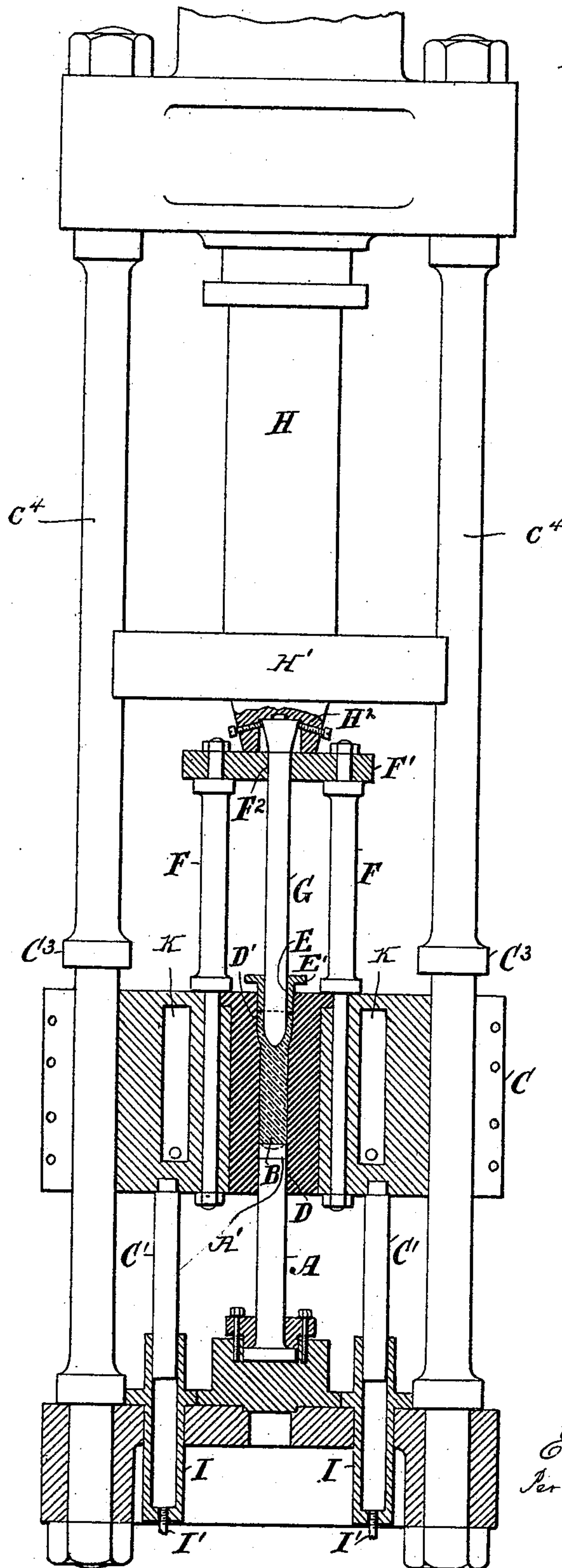
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Fig. 2



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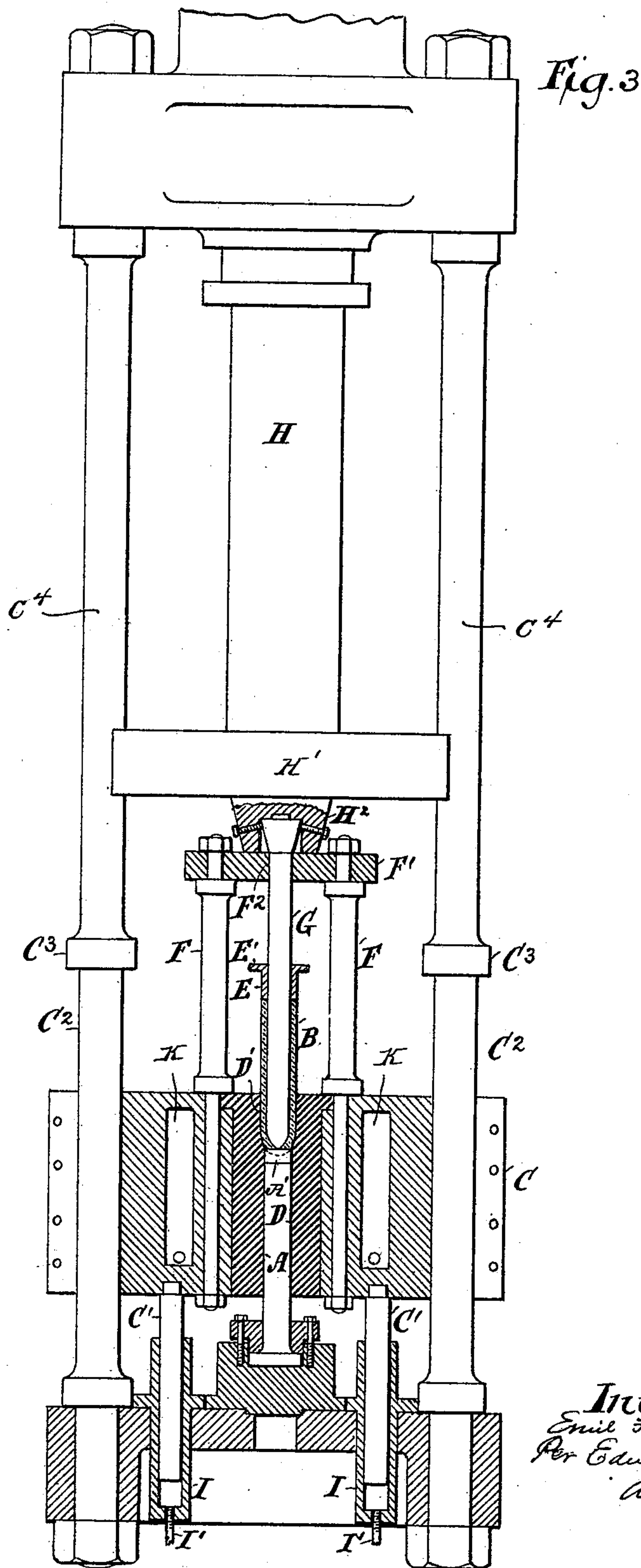
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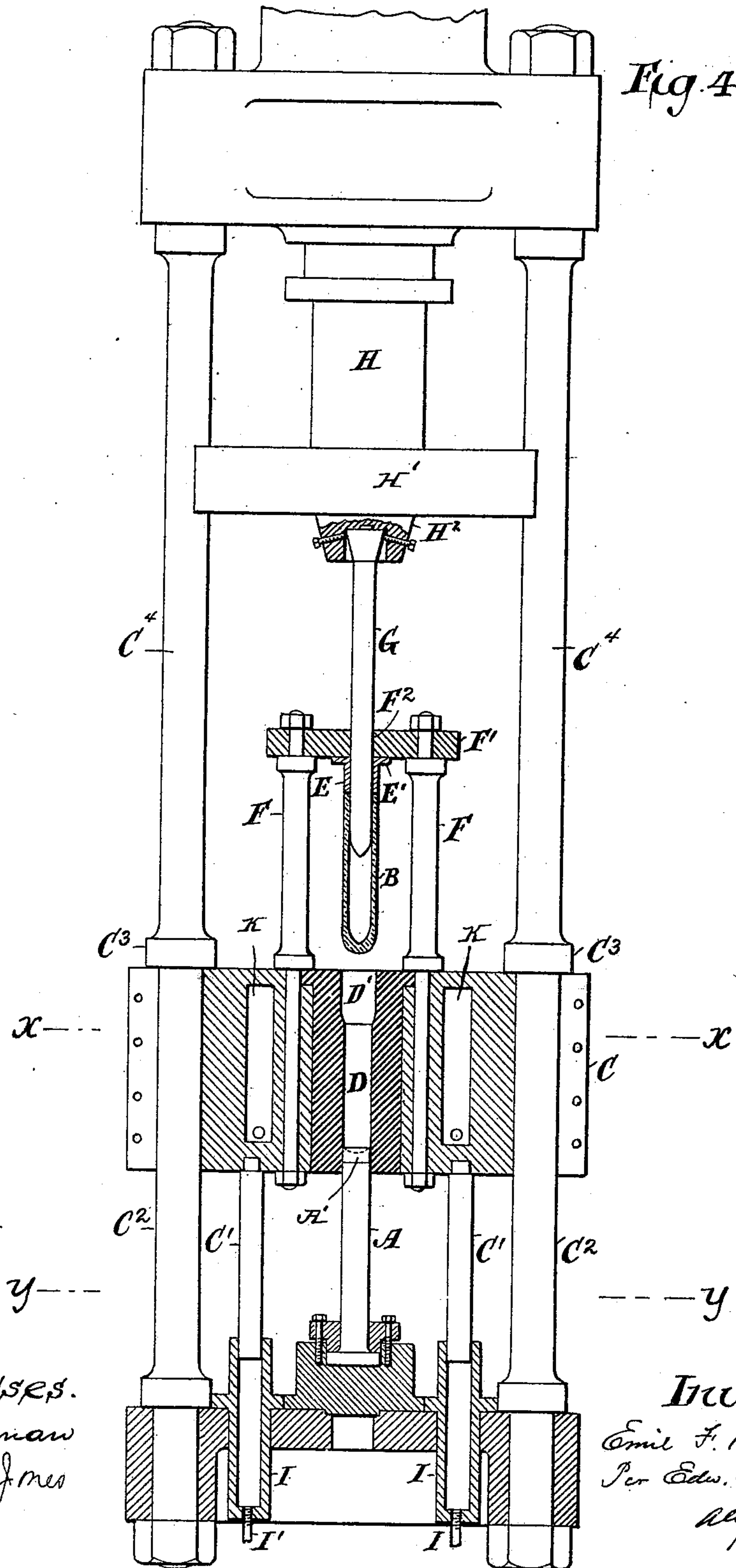
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5 Sheets—Sheet 4.



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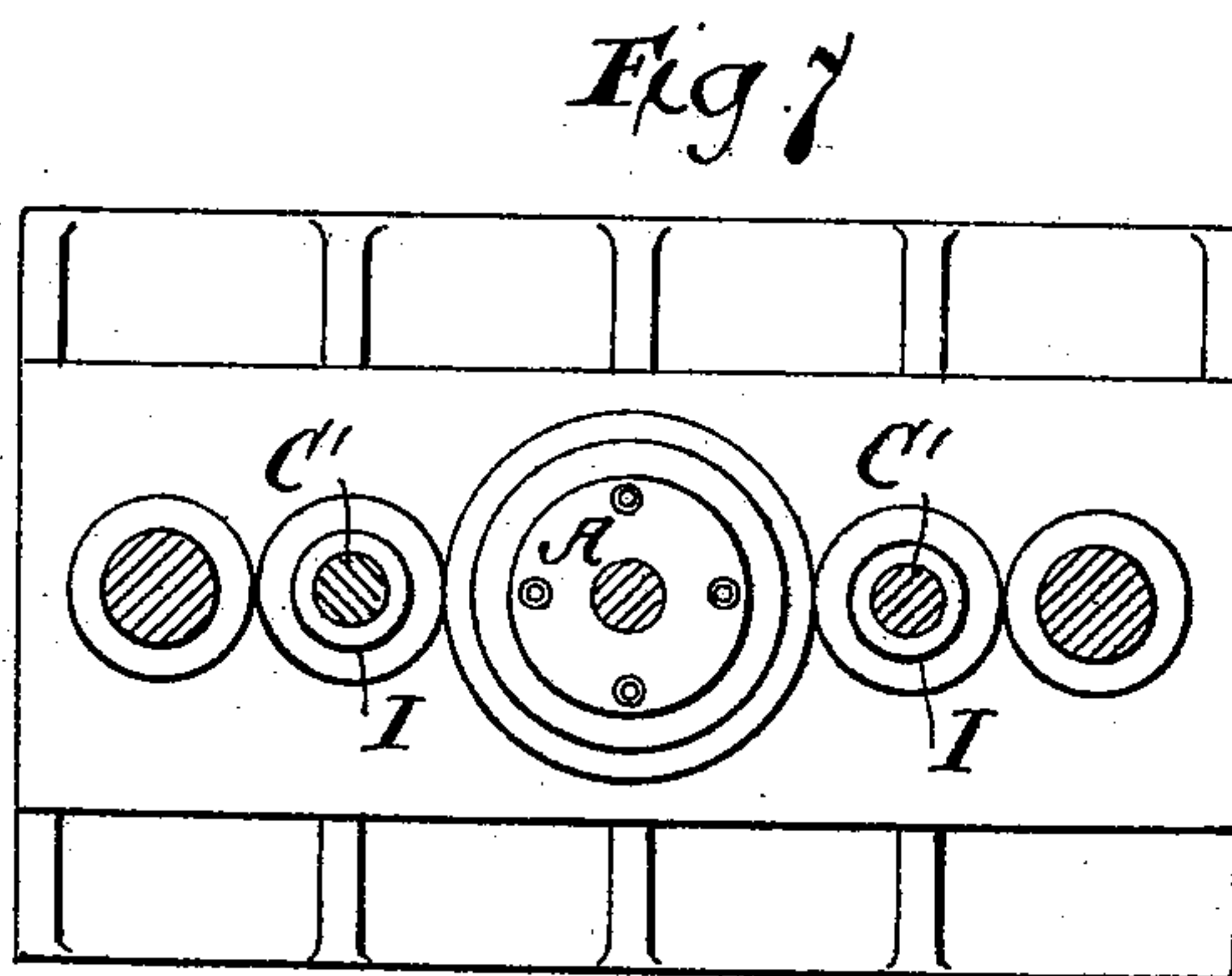
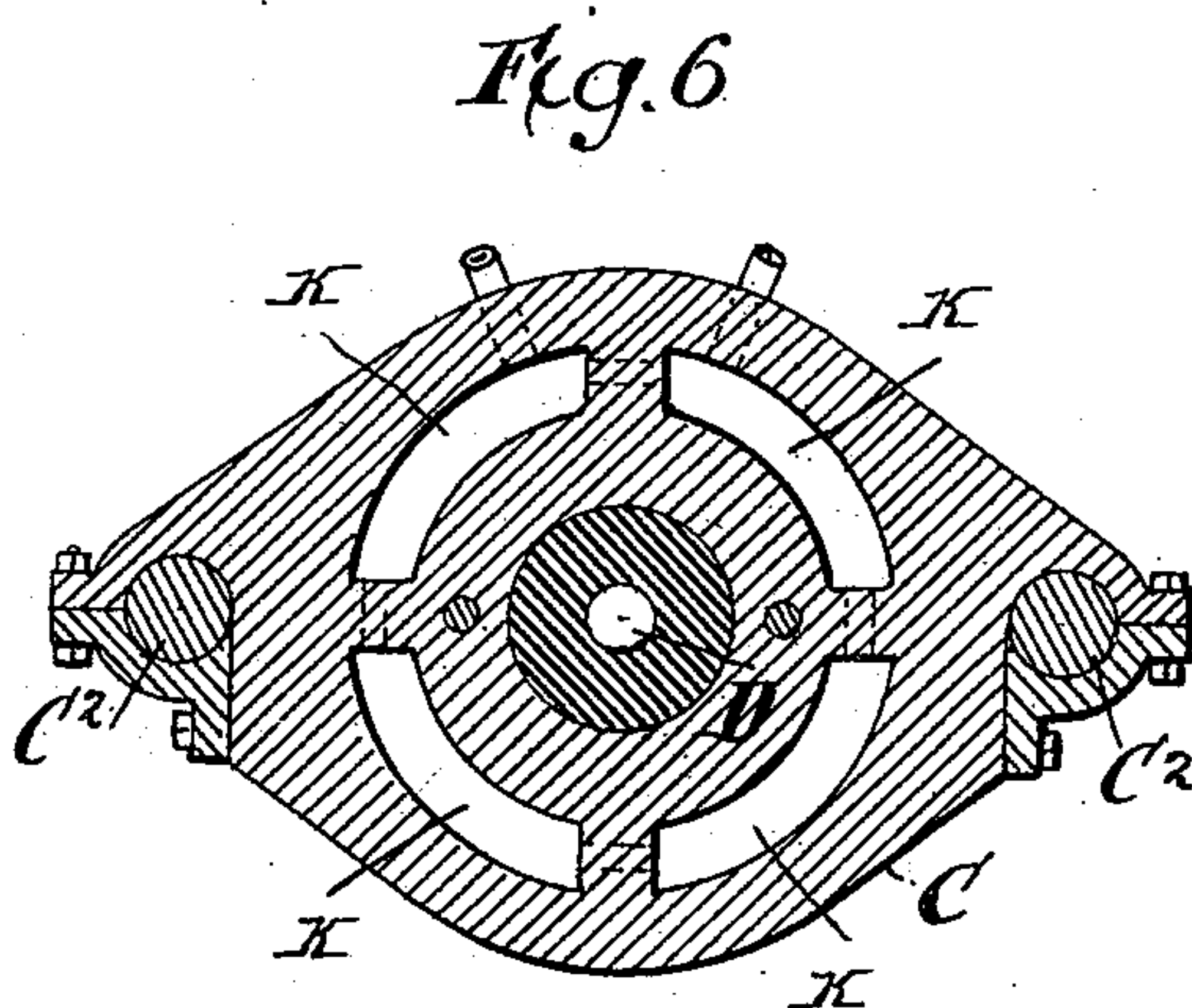
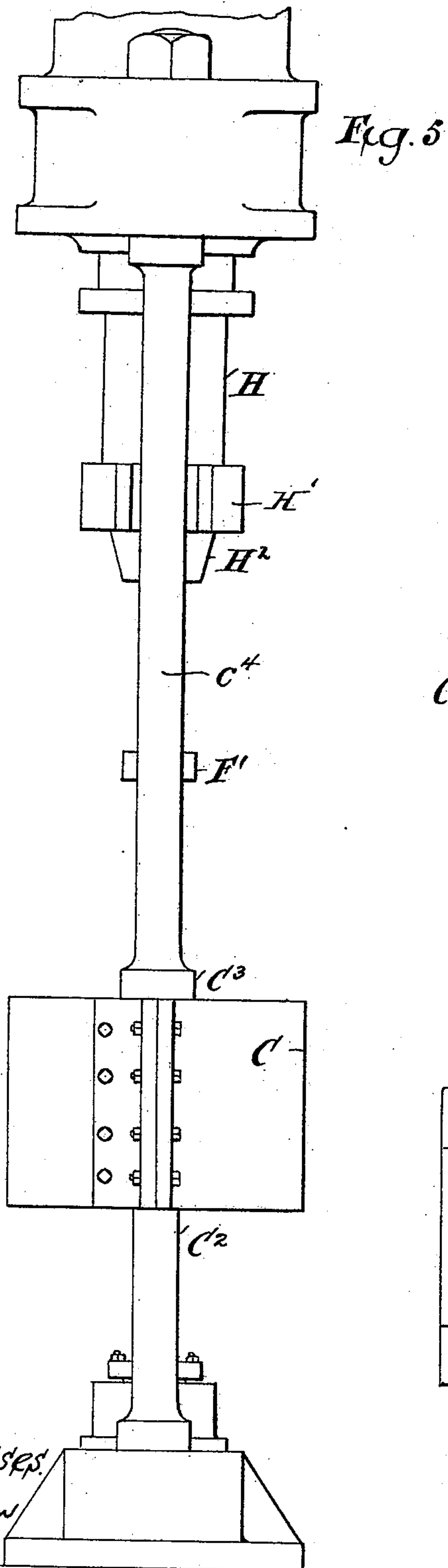
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5 Sheets—Sheet 5.



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UNITED STATES PATENT OFFICE.

EMIL F. HOLINGER, OF MCKEESPORT, PENNSYLVANIA, ASSIGNOR TO THE
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TUBE-FORMING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 619,747, dated February 21, 1899.

Application filed February 7, 1898. Serial No. 669,346. (No model.)

To all whom it may concern:

Be it known that I, EMIL F. HOLINGER, of McKeesport, Pennsylvania, have invented certain Improvements in Tube-Forming Apparatus, of which the following is a specification.

These improvements relate to the transformation of a hot metallic billet into a hollow object by causing the billet to be longitudinally pierced by a pointed mandrel while the billet is supported upon a stationary object in a centralizing holder and die which move with the mandrel.

Mechanism embodying an illustration of the invention is shown in the accompanying drawings, which are as follows, to wit:

Figure 1 is an elevation, partly in section, with the upper portion of the hydraulic cylinder for driving the mandrel represented as broken away, the parts being shown in the positions they occupy at the commencement of the working stroke of the mandrel, the billet being represented as deposited within the holder. Fig. 2 is a similar elevation, partly in section, but representing the stage in the working stroke of the mandrel at which its pointed end has penetrated the upper end of the billet and the carriage carrying the holder has commenced its descent with the mandrel. Fig. 3 is a similar elevation, partly in section, showing the parts in the positions which they occupy at the conclusion of the working stroke of the mandrel. Fig. 4 is a similar elevation, partly in section, representing the positions of the parts at the stage in the upward or return stroke of the mandrel at which the work has been withdrawn from the holder and partly stripped from the mandrel. Fig. 5 is a side elevation of the apparatus. Fig. 6 is a transverse section taken through the horizontal plane indicated by the dotted line $x x$ on Fig. 4. Fig. 7 is a transverse section taken through the horizontal plane indicated by the dotted line $y y$ on Fig. 4.

The main features of the mechanism shown in the drawings comprise a stationary upright post A for affording support for the lower end of the billet B; a vertically-reciprocating carriage C; hydraulic pistons $C' C'$ for lifting the carriage C; vertical guides $C^2 C^2$ for said carriage, provided with collars $C^3 C^3$ for lim-

iting the range of upward movement of the carriage C; a tubular billet-holder D, secured in the carriage C, into which holder the post A extends and which serves to hold the billet B in vertical alinement with the post A; a cylindrical chamber D' at the upper end of said holder concentric with the central vertical axis of the post A; a centralizing-ring E, seated with a snug sliding fit in the upper end of the cylindrical chamber D' and provided with the circumferential flange E' , adapted to rest upon the wall of the chamber D' ; two vertical standards $F F$, affixed to and rising upward from the carriage C and carrying at their upper ends the cross-head F' , provided with the vertical aperture F^2 in axial vertical alinement with the cylindrical chamber D' ; a vertically-reciprocable pointed mandrel G, having its central vertical axis in alinement with the central vertical axis of the cylindrical chamber D' and adapted to slide through the aperture F^2 and through the centralizing-ring E; a hydraulic ram H, having at its lower end a cross-head H' , constructed to slide on the vertical guides $C^4 C^4$ and employed for driving the mandrel G downward and thereby causing its pointed lower end to penetrate the upper end of the billet B; and, finally, the vertical cylinders I I, in which the hydraulic pistons $C' C'$ reciprocate, the said cylinders being provided with pipes $I' I'$ for the admission of liquid under pressure for the purpose of driving upward the pistons $C' C'$ and the carriage C and also for permitting the said liquid to be expelled from the cylinders I I when the carriage C is forced downward.

The vertical dimensions of the standards $F F$ and the mandrel G are so proportioned that when the pointed lower end of the mandrel has penetrated nearly through the part of the billet which projects into the cylindrical chamber D' , the under end H^2 of the ram H will acquire contact with the cross-head F' , so that thereafter during the continuance of the descending stroke of the mandrel G the carriage C will be forced downward with the mandrel. As the mandrel and carriage descend the centralizing-ring E will be unseated by impact with the metal enveloping the lower part of the mandrel. During

the upward stroke of the mandrel the cross-head F' acts as a stripper by detaining the centralizing-ring and the work during the concluding portion of the upward stroke of the mandrel. Preferably it is intended that the quantity of displaced metal shall be more than sufficient to fill the annular space between the exterior of the mandrel and the wall of the cylindrical chamber D', so that the chamber D' will act as a die, whereby the tubular formation will in part be due to some upward exudation of the displaced metal from said annular space, as well as in part to the piercing of the billet by the mandrel as mandrel and carriage descend. The work will thus be more or less elongated, and the hollow object produced by the complete descent of the mandrel will be to some extent longer than the original billet.

The holder D performs the function of a centralizing instrumentality for the billet in all cases, whether the cylindrical chamber D' at the upper end of the holder be employed as a die for giving shape to the exterior of the work and determining its outside diameter or otherwise. For, as will be perceived, the diameters of the mandrel and the cylindrical chamber D' may be relatively so proportioned that the metal displaced by the descent of the mandrel will not completely fill the cylindrical chamber D', in which case there will not be the described elongation of the work.

It will be understood that the aperture of the holder D is intended to conform in the size and shape of its cross-section to the size and shape in cross-section of the billet, whether the billet be cylindrical or prismoidal, with sufficient nearness to insure the appropriate centralization of the billet with relation to the descending mandrel.

Instead of employing the upper end of the post A directly as the abutment for supporting the billet it is preferred to protect the post from contact with the hot billet by surmounting it with the removable swage-block A'. The upper side of said swage-block is spheroidally recessed to enable it to oppose the tendency to lateral flow of the compressed hot metal at the lower end of the billet.

The carriage C is provided with the usual communicating chambers K K K K, through which there is maintained a continuous circulation of cold water for cooling the holder D and die D'.

The movable parts of the apparatus are herein for convenience described as "vertical." It will of course be understood that the invention would equally be present if the apparatus were placed in some other position, so that its reciprocable members would move in paths other than vertical.

What is claimed as the invention is—

1. In apparatus for transforming a metallic billet into a hollow object the combination, as herein set forth, of a vertically-reciprocable mandrel pointed at its lower end, a stationary

post in vertical alinement with said mandrel for supporting the lower end of the billet during the transforming operation; a carriage provided with a vertical aperture for holding the billet stationary and centralizing it with relation to the central longitudinal axis of said mandrel; a chamber in said carriage at the upper end of said aperture for serving as a die to give the outside shape to the metal of the billet displaced by the penetration of the mandrel; means for preventing said carriage from yielding in a downward direction until the descending stroke of the mandrel has carried its pointed end a prescribed distance into said chamber, and means for forcing the said carriage to move downward with the mandrel during the remaining part of the descending stroke of said mandrel.

2. In apparatus for transforming a metallic billet into a hollow object, a holder conforming in the shape and size of its cross-section to the shape and size in cross-section of the billet to be operated upon; a stationary post entering the lower end of said holder and serving to support the lower end of a billet partially contained therein; a vertically-reciprocable mandrel pointed at its lower end for longitudinally piercing a billet deposited in said holder; a hollow cylindrical die at the upper end of said holder so proportioned in diameter with relation to the diameter of said mandrel that the annular space between the surface of the mandrel and the concave wall of said die, is of less area in cross-section than the area in cross-section of said holder; means for preventing said holder and die from yielding downwardly during the initial part of the piercing operation and means for imparting to said holder and said die a downward movement corresponding to the downward movement of said mandrel after said mandrel has moved downward a prescribed distance into said hollow die, whereby a billet partially contained in said holder and projecting at its upper end into said die is longitudinally pierced by the descent of said mandrel and the displaced metal, after completely filling the annular space between the exterior of said mandrel and the wall of said die, is forced to exude from said space in an upward direction during the concurrent downward movement of said holder, die, and mandrel.

3. In apparatus for transforming a metallic billet into a hollow object, the combination, as herein set forth, of a vertically-reciprocable pointed mandrel; a hydraulic ram for operating said mandrel; a tubular billet-holder in appropriate alinement with said reciprocable mandrel; a vertically-reciprocable carriage for carrying said holder; guides for guiding said carriage in its path of reciprocation; hydraulic pistons for moving said carriage toward said mandrel; stops for limiting the range of movement of said carriage toward said mandrel; a stationary abutment for supporting a billet seated in said holder; up-

rights affixed to said carriage; a cross-head
affixed to said uprights and provided with a
perforation adapting said cross-head to bear
with a sliding fit upon the body of said man-
5 drel; said cross-head and its supports being
so constructed and arranged as to receive the
downward thrust of the hydraulic ram at a
prescribed stage in the working stroke of said
mandrel and transmit said thrust to said car-
10 riage.

4. In apparatus for transforming a metallic
billet into a hollow object, the combination,
as herein set forth, of a vertically-reciproca-
ble pointed mandrel; a hydraulic ram for op-
15 erating said mandrel; a tubular billet-holder
in appropriate alinement with said reciproca-
ble mandrel; a vertically-reciproable carriage

for carrying said holder; guides for guiding
said carriage in its path of reciprocation; hy-
draulic pistons for constantly exerting upon 20
said carriage a force tending to push it to-
ward said mandrel; stops for limiting the
range of movement of said carriage toward
said mandrel; a stationary abutment for sup-
porting a billet seated in said holder; and 25
means for compelling said carriage and said
holder to participate in the motion of said
mandrel during a prescribed part of the work-
ing stroke of said mandrel.

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Witnesses:

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