

No. 885,548.

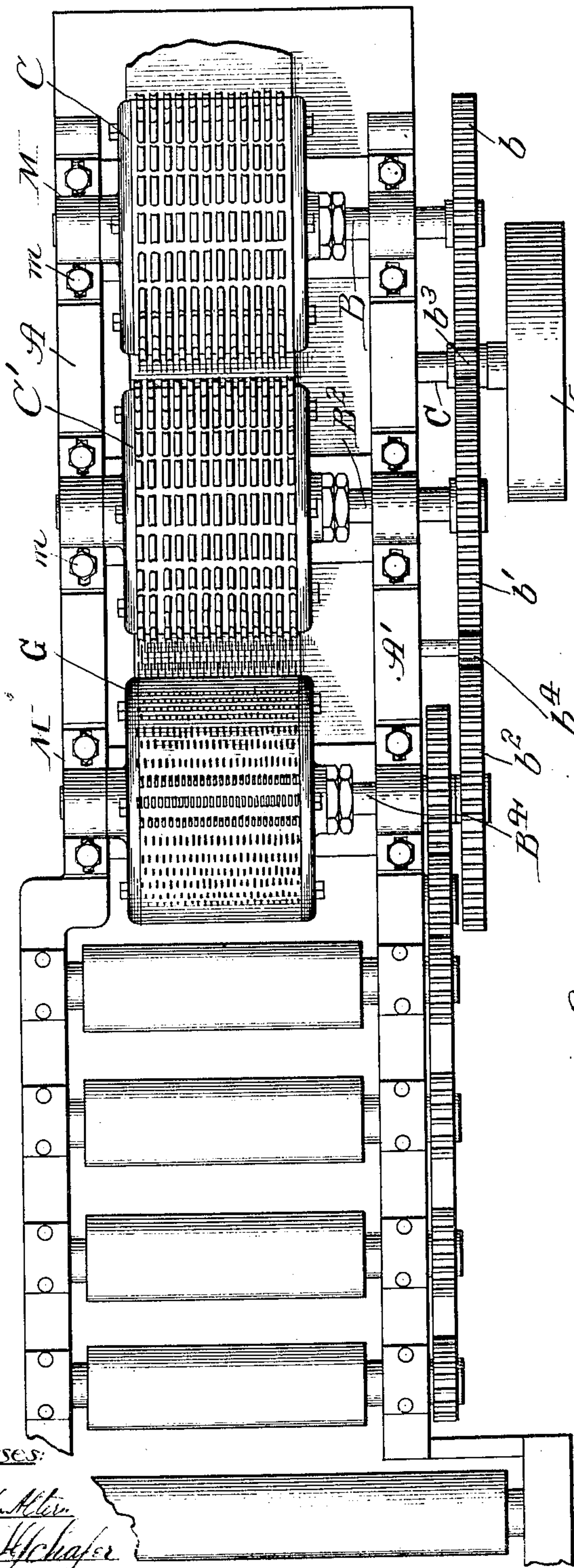
PATENTED APR. 21, 1908.

G. A. TURNBULL.  
METAL CUTTING AND FORMING MACHINE.

APPLICATION FILED SEPT. 28, 1903.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

Lute H. Allen  
Carl E. Schaefer

Fig. 1A

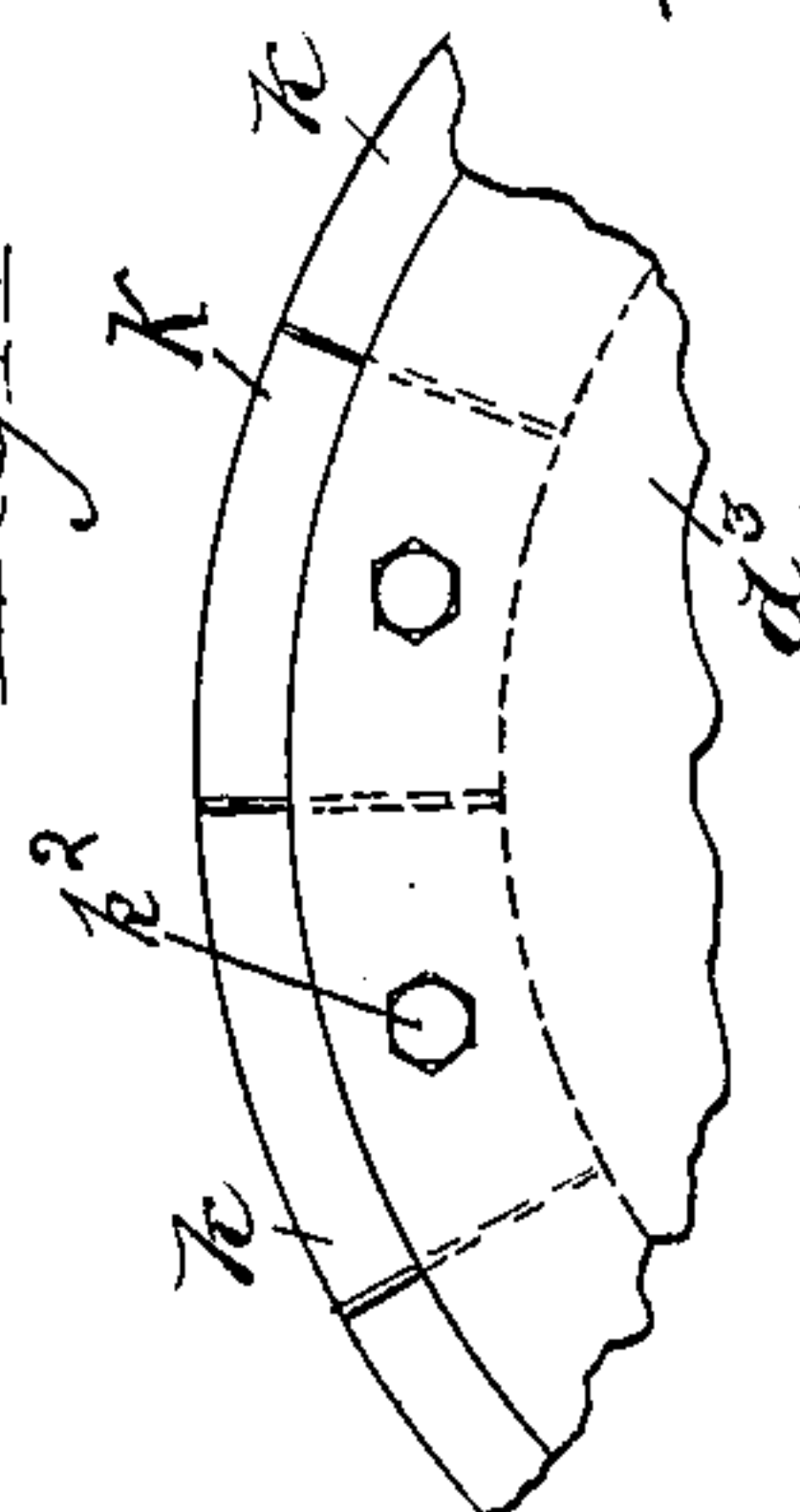
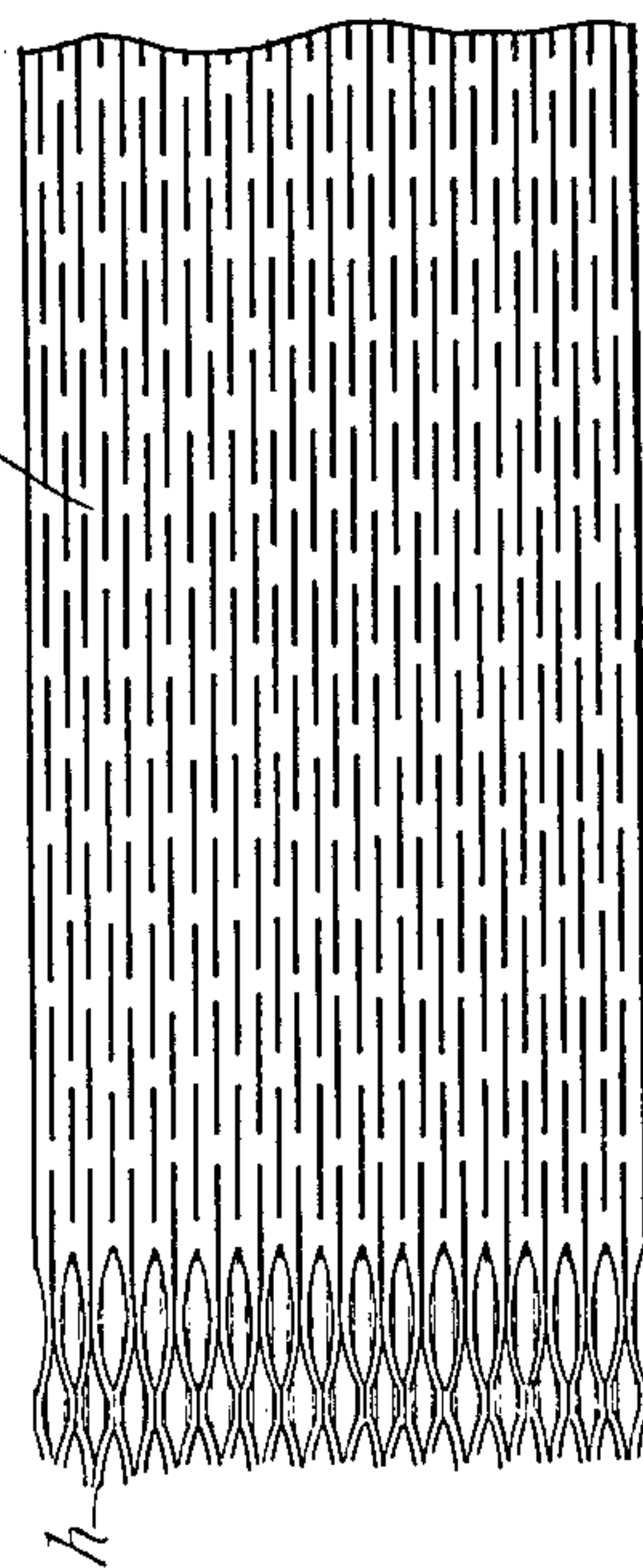


Fig. 2.



Inventor:  
George A. Turnbull  
By Charles H. Mills  
Attorney

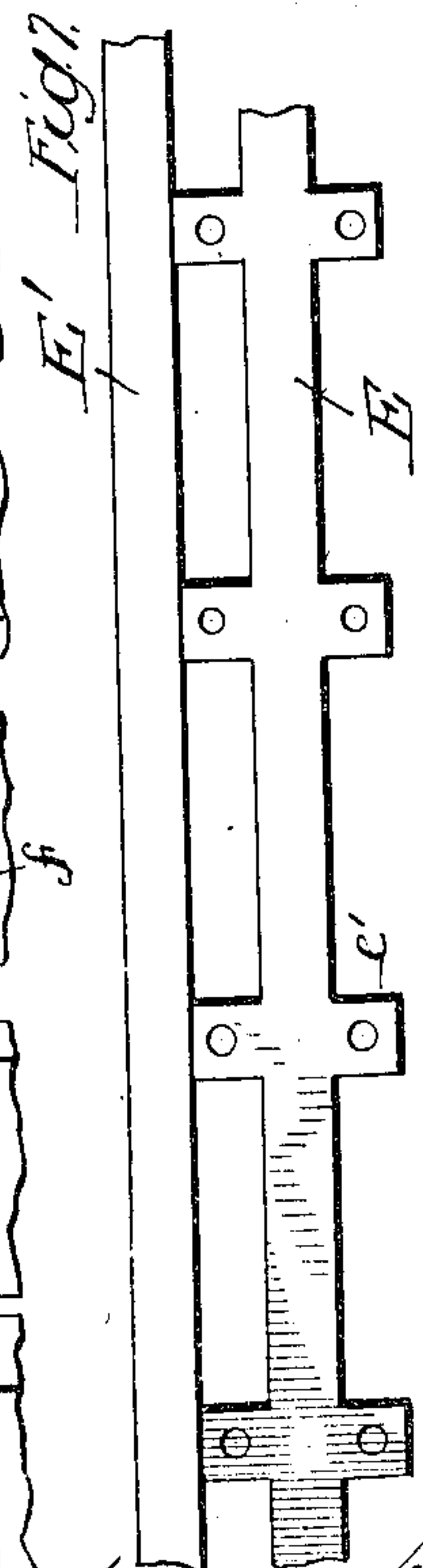
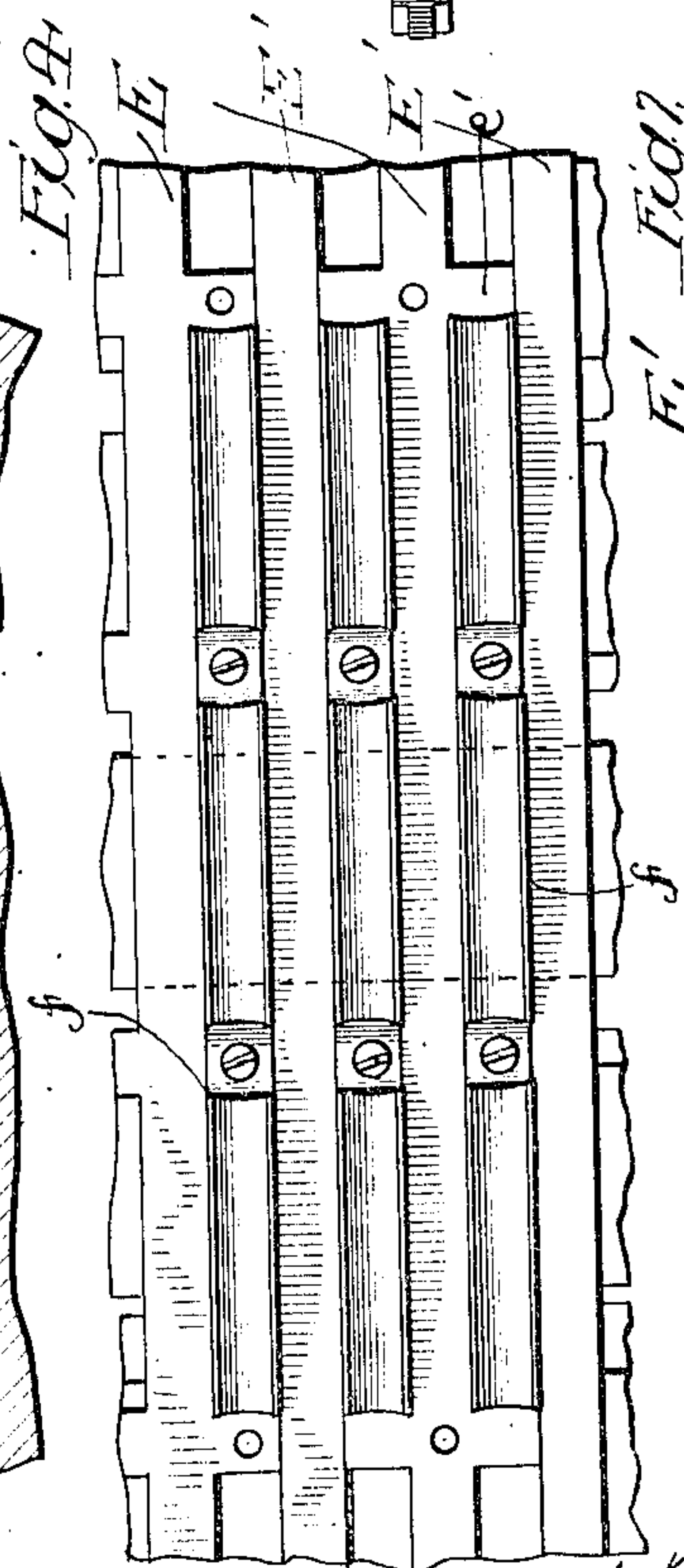
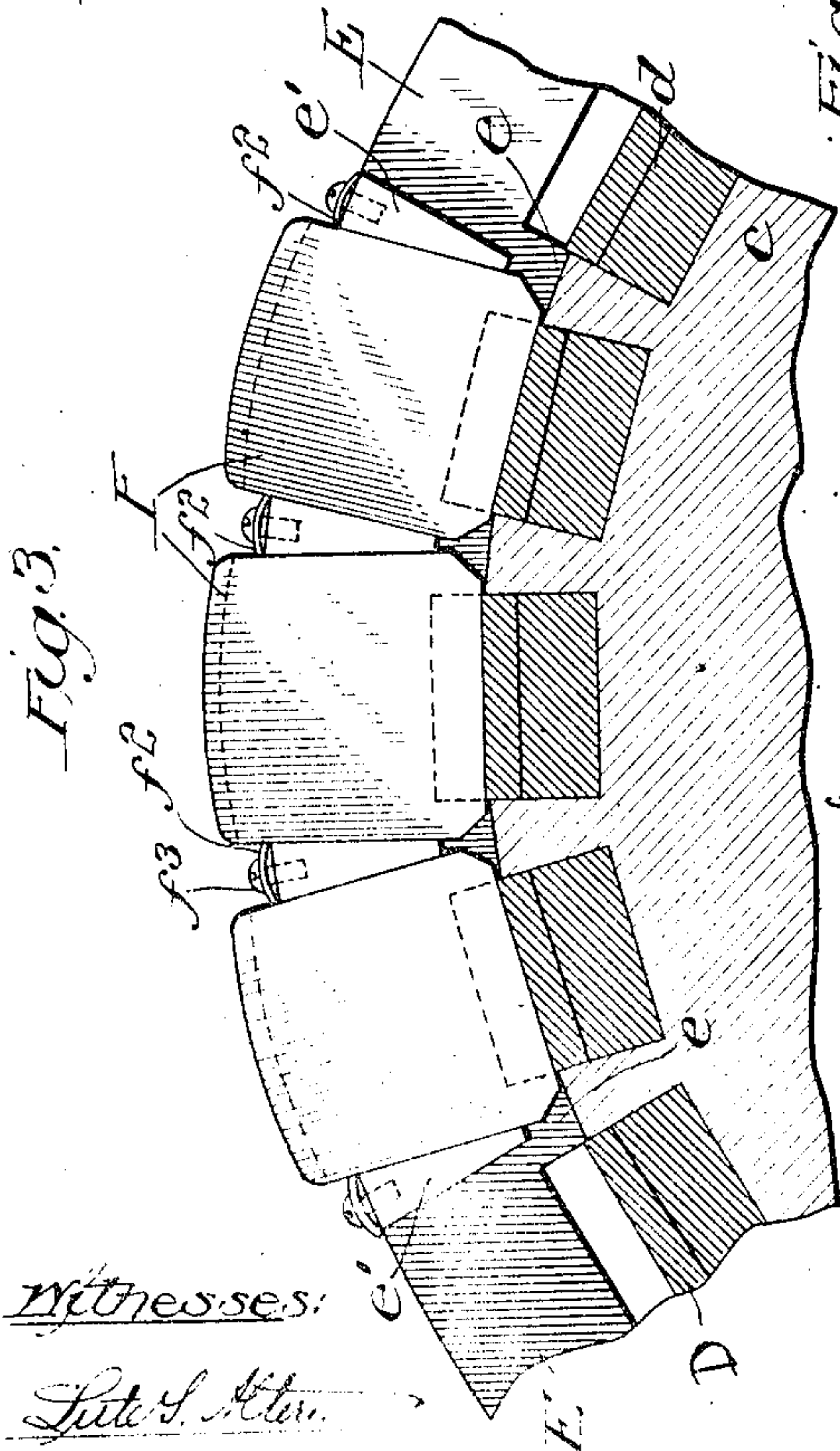
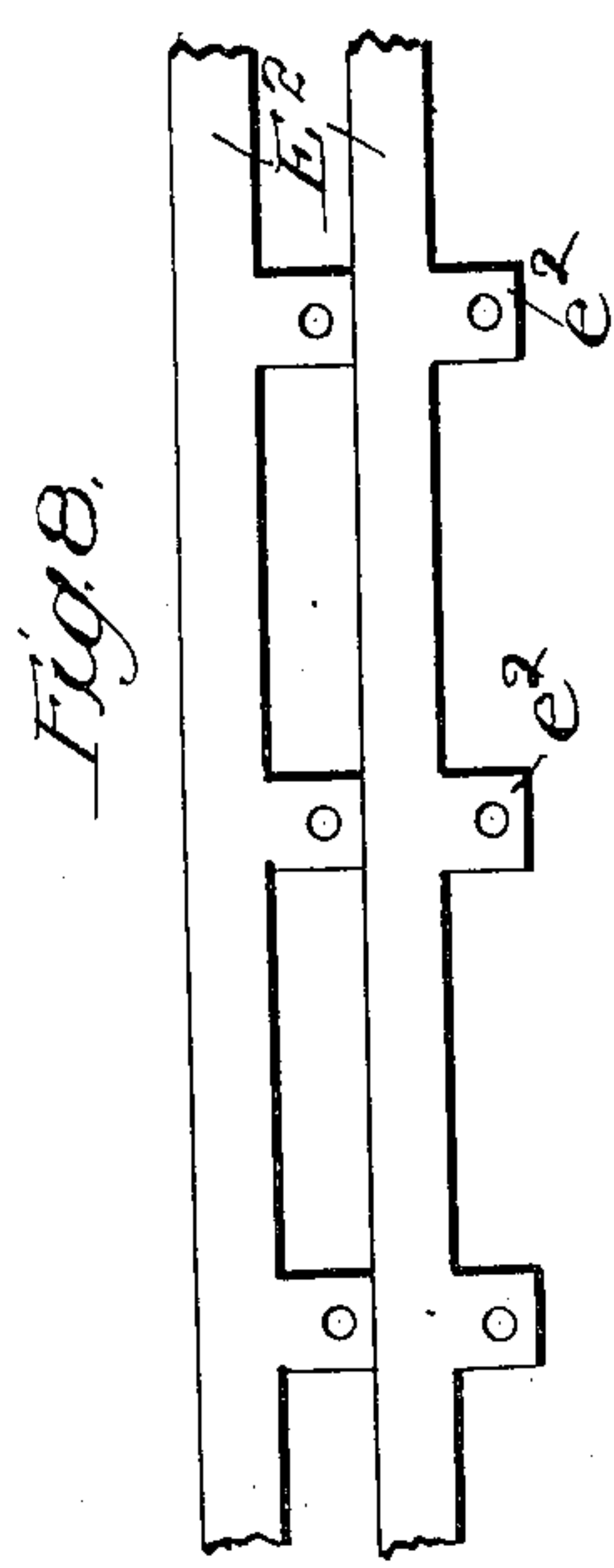
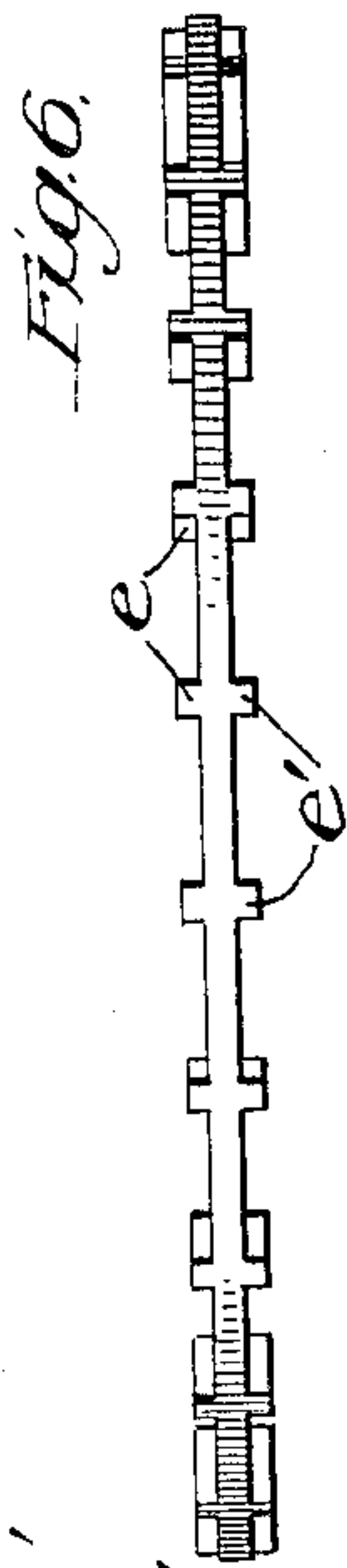
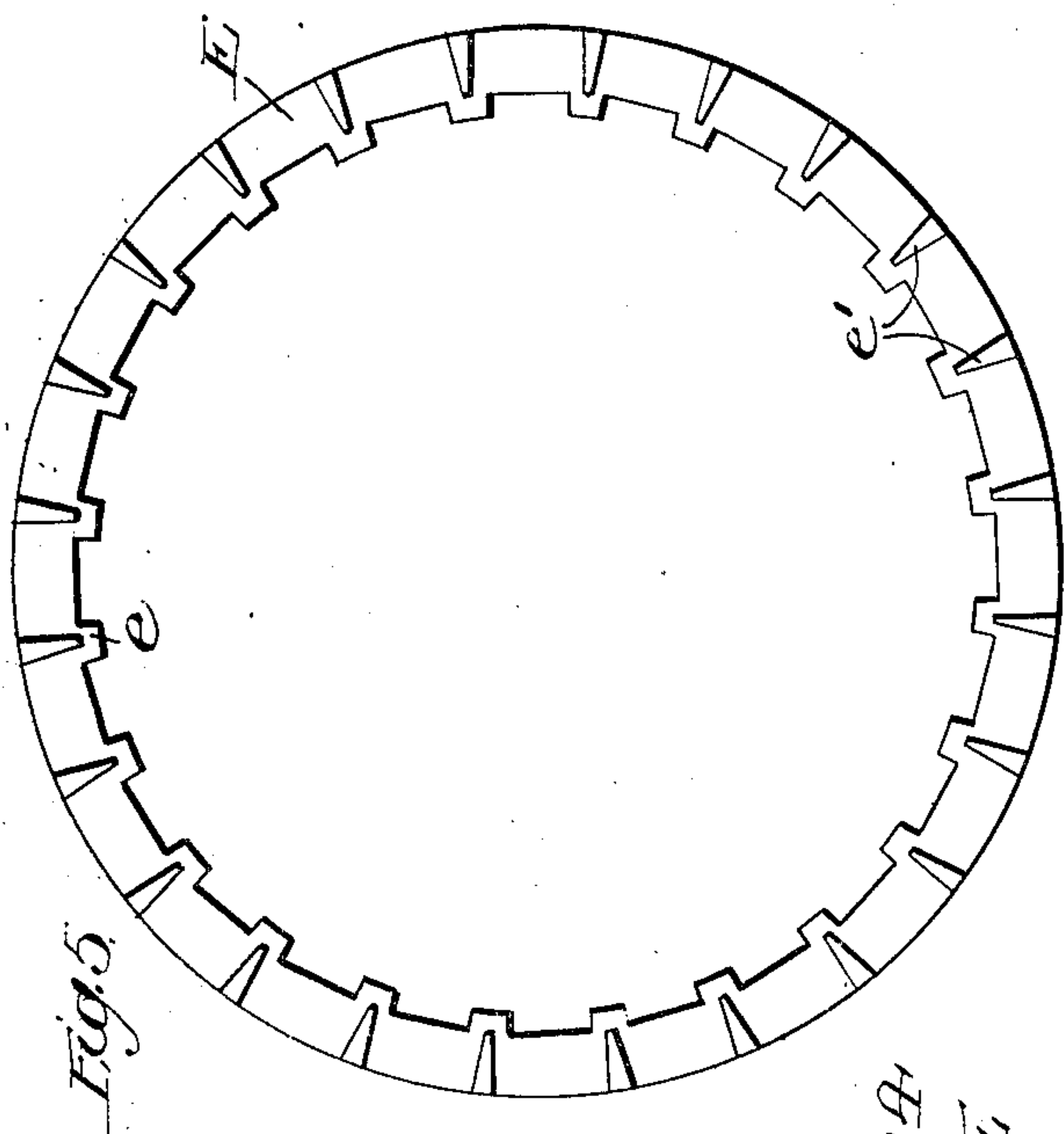
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4 SHEETS—SHEET 2.



Witnesses:

John S. Allen  
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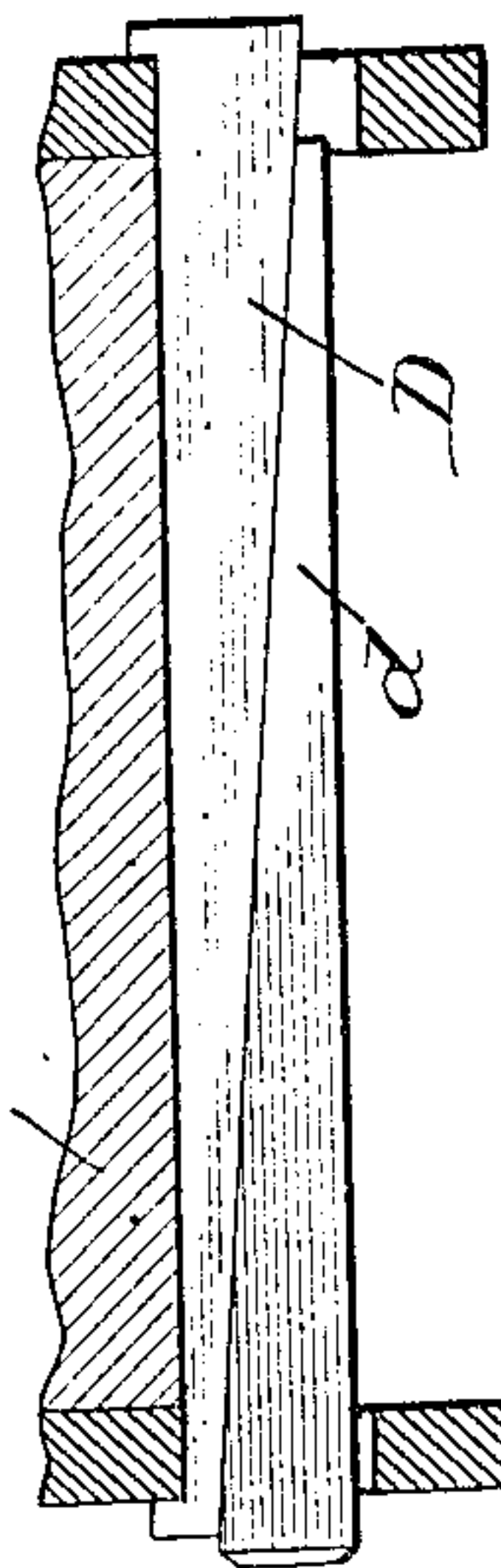
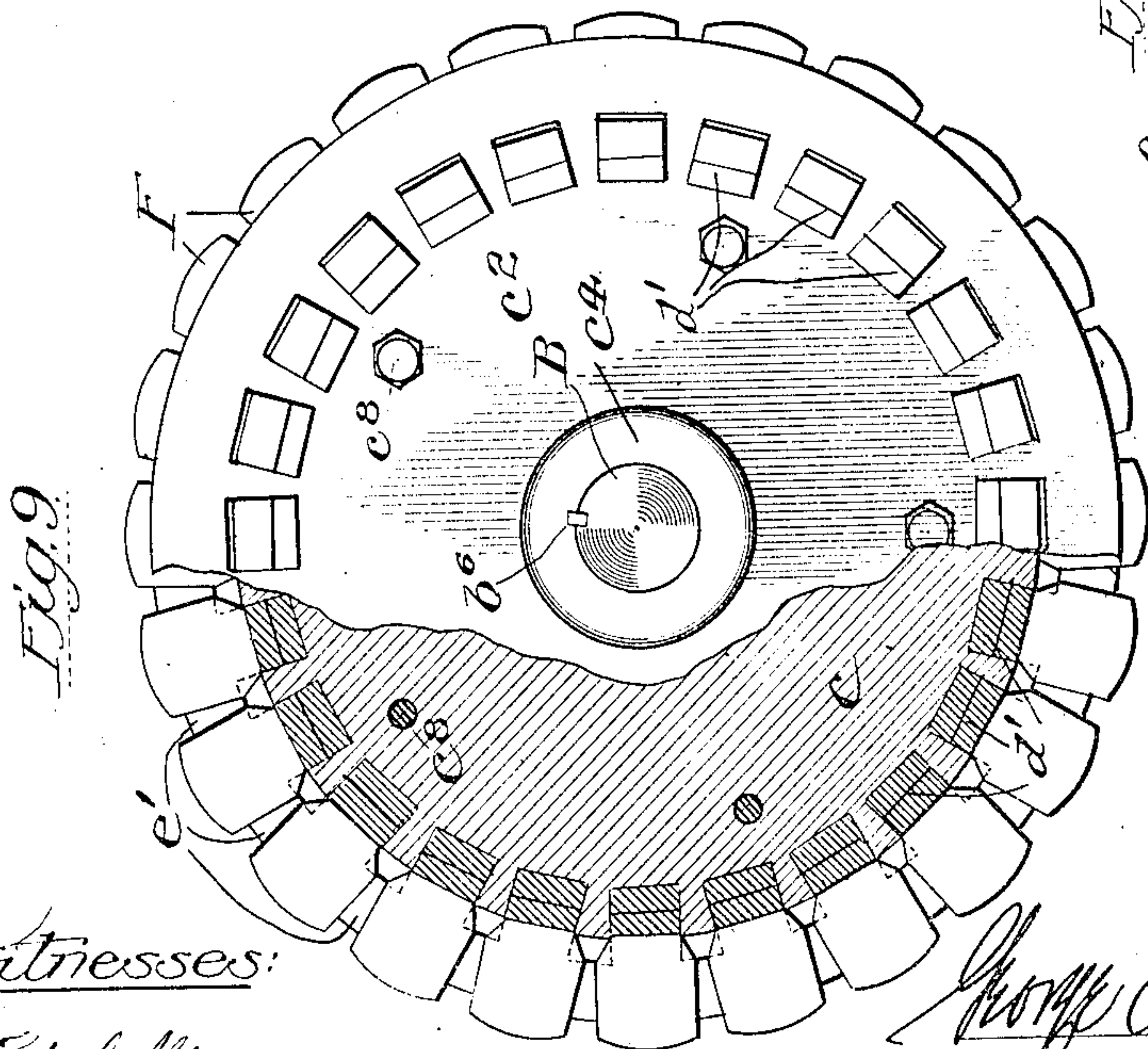
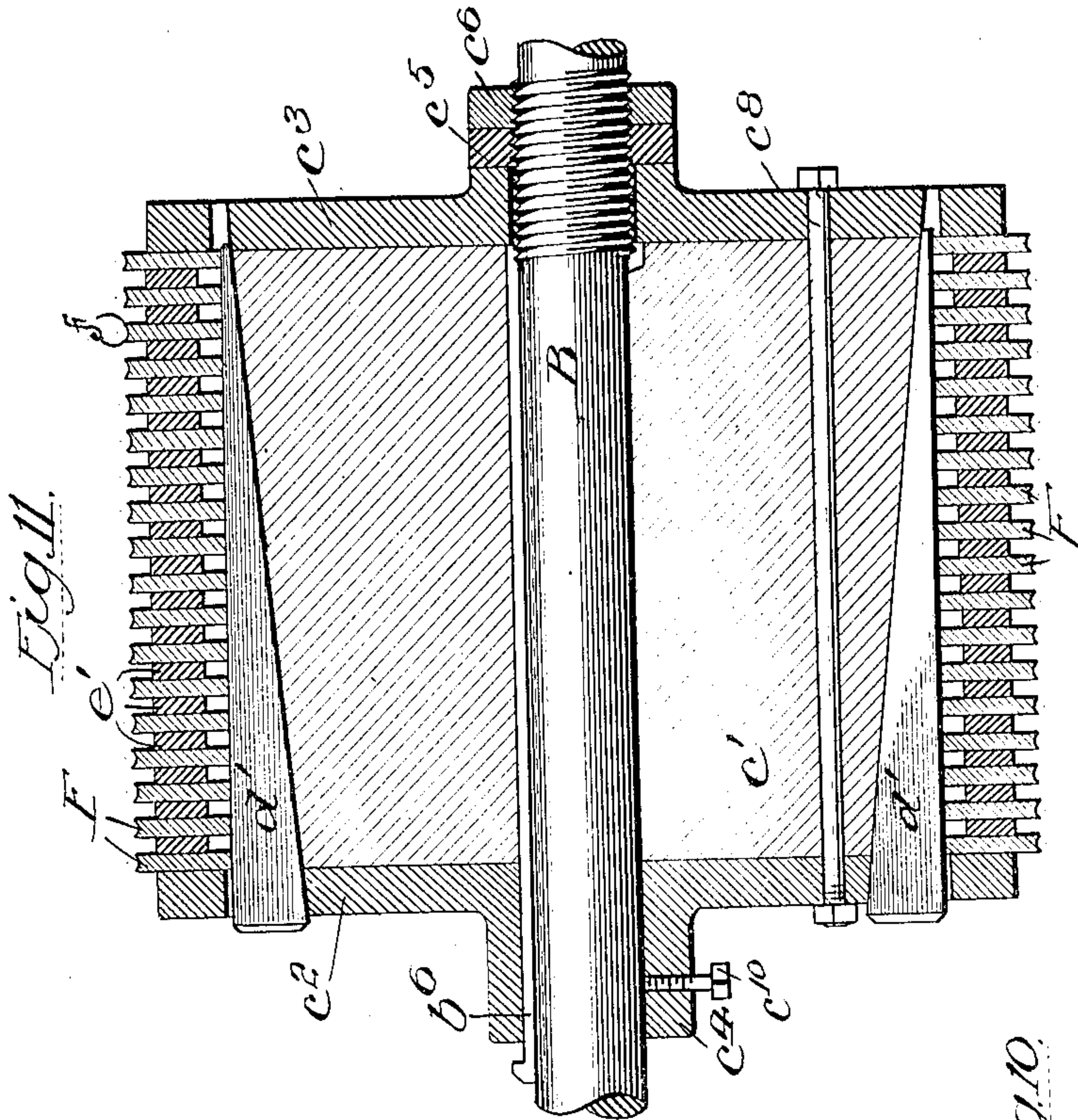
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METAL CUTTING AND FORMING MACHINE.

APPLICATION FILED SEPT. 28, 1903.

4 SHEETS—SHEET 3.



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No. 885,548.

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APPLICATION FILED SEPT. 28, 1903.

4 SHEETS—SHEET 4.

Fig. 12.

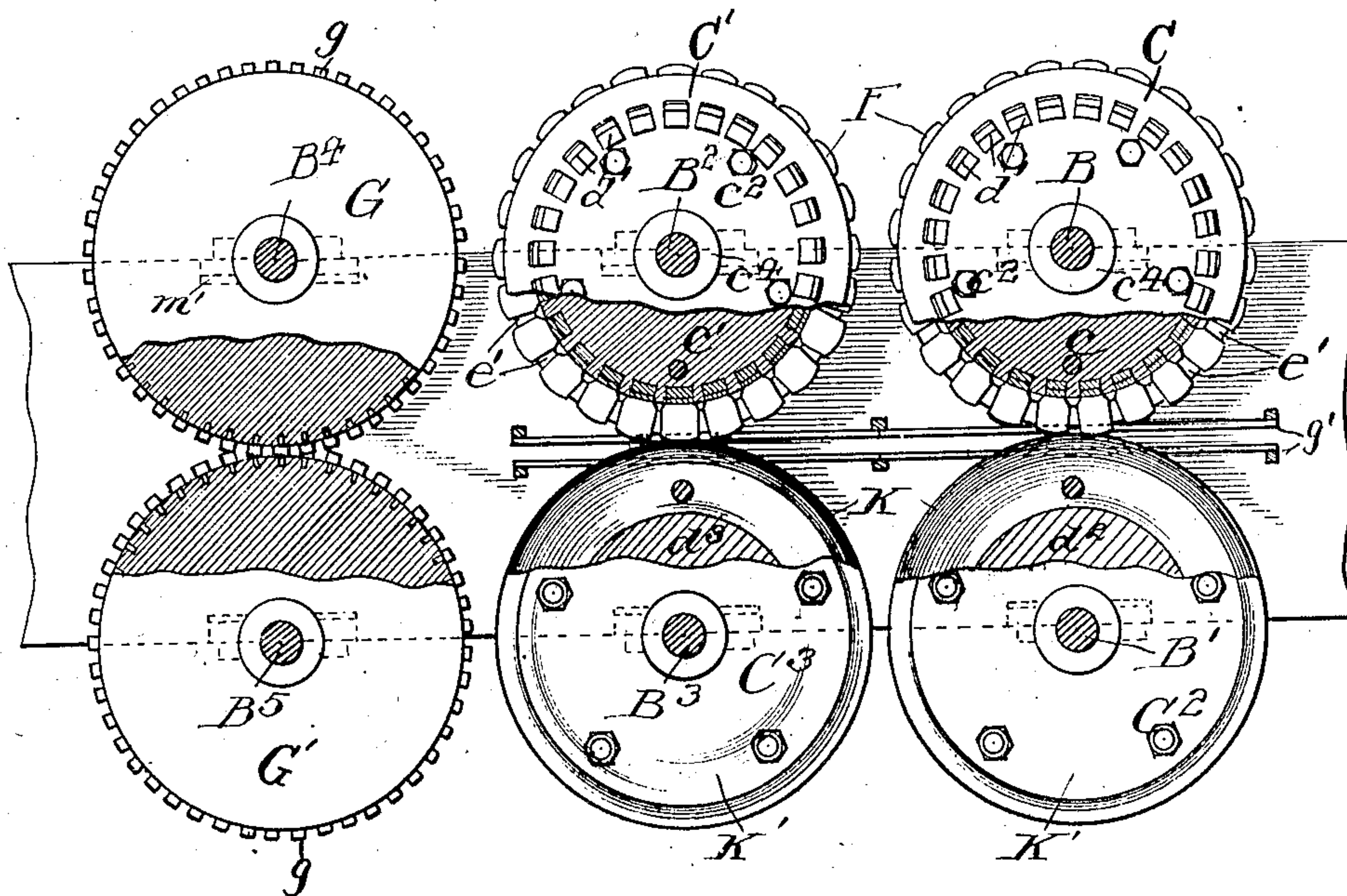
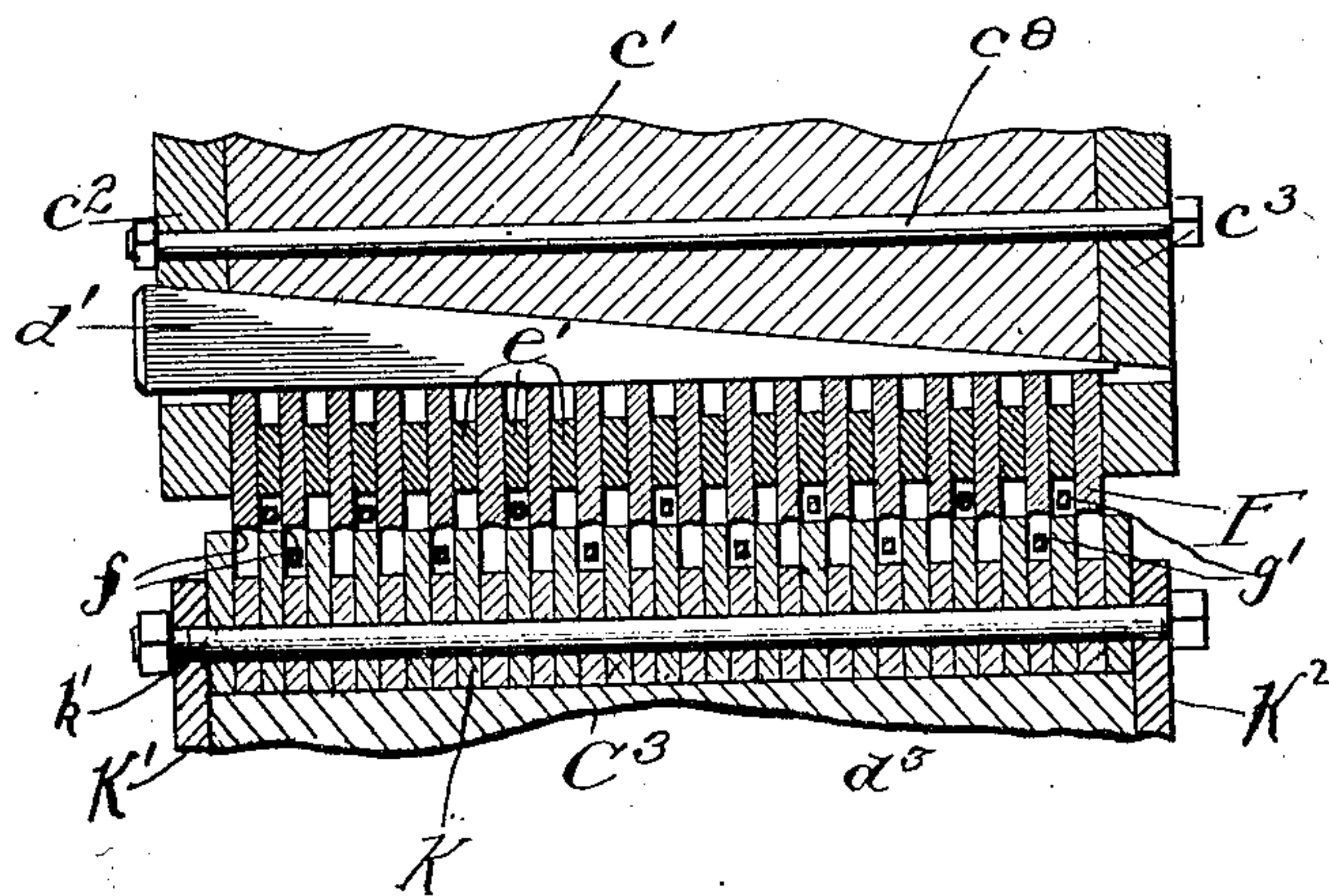


Fig. 13.



Witnesses:

L. S. Alter

W. H. Schaefer

Inventor:

George A. Turnbull

By Charles M. Hill  
Attorney



# UNITED STATES PATENT OFFICE.

GEORGE A. TURNBULL, OF CHICAGO, ILLINOIS.

## METAL CUTTING AND FORMING MACHINE.

No. 885,548.

Specification of Letters Patent.

Patented April 21, 1908.

Application filed September 28, 1903. Serial No. 174,897.

*To all whom it may concern:*

Be it known that I, GEORGE A. TURNBULL, a citizen of the United States, and a resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Metal Cutting and Forming Machines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in cutting and forming machines and is designed more particularly to cut and form metallic sheets preparatory to expanding the same in making expanded metal.

To make expanded metal it is usual to cut the sheet to provide a plurality of relatively short slits arranged staggering on the machine a distance apart equal to the desired width of the web of the metal when expanded. Ordinarily the cutting of the sheet has been done by means of a reciprocating knife bar. In my invention set forth in United States Patent No. 664,193, the cutting, forming and expanding of the sheet is done by a continuous rolling process, the cutting and forming apparatus of which is the subject of the present invention and is an improvement on the cutting and forming apparatus therein set forth.

The invention provides very powerful though simple and accurate cutting and forming means and owing to the construction and arrangement of the knives and the forming means adapted to operate at a much higher rate of speed than has been possible in constructions heretofore revised. Owing to the construction and arrangement of the operating means the cost for repairs on the machine is also greatly reduced.

The object of the invention is primarily to provide a machine adapted to cut and form the metallic sheet at a higher rate of speed than has heretofore been possible, and also with greater accuracy. And it is also an object of the invention to provide means for adjusting the knives radially on the rolls to compensate for the wear of the same through use, and to enable any of the knives to be quickly removed and others accurately adjusted in place thereof when desired.

The invention consists in the matters hereinafter described and more fully pointed out and defined in the appended claims.

In the drawings: Figure 1 is a fragmentary top plan view of a machine for expanding metal provided with cutting and forming means embodying my invention. Fig. 2 is a plan view of the sheet of metal after the same has been slitted or cut and partly formed. Fig. 3 is an enlarged fragmentary transverse section of one of the cutting rolls. Fig. 4 is a fragmentary top plan view of the same. Fig. 5 is a side elevation of one of the carrying rings. Fig. 6 is a plan or edge view of the same. Fig. 7 is an enlarged fragmentary plan view of one of the carrying rings and a spacing ring. Fig. 8 is a similar fragmentary plan view which illustrates a modified form of the carrying rings. Fig. 9 is an end elevation of one of the cutting rolls. Fig. 10 is a fragmentary longitudinal section of a cutting roll with the knives, carrying rings and spacing rings removed and illustrating one arrangement of the adjusting means. Fig. 11 is a central longitudinal section of a cutting roll showing a slightly different arrangement of the adjusting means. Fig. 12 is a fragmentary vertical section taken through the rolls. Fig. 13 is an enlarged fragmentary section of an upper and lower cutting roll. Fig. 14 is a fragmentary section of the lower cutting roll showing a modified form thereof.

As shown in said drawings:—A and A<sup>1</sup> indicate the side members of the frame of any desired material and construction. Journaled transversely of said side members are the horizontal shafts B—B'—B<sup>2</sup>—B<sup>3</sup>—B<sup>4</sup>—B<sup>5</sup> of which the shafts B—B<sup>2</sup>—B<sup>4</sup> are journaled on the upper side of the frame and the shafts B'—B<sup>3</sup>—B<sup>5</sup> are journaled on the lower side of the same, each pair comprising an upper and a lower shaft and driven oppositely by intermeshing gears as shown in Fig. 1, of which only the gears on the upper shafts are shown and indicated respectively by *b*—*b'*—*b*<sup>2</sup> and which engage the complementary gears on the lower shaft thereby causing said shaft to rotate oppositely. *b*<sup>3</sup> is a pinion secured on the main driving shaft C and intermeshes with the gears *b*—*b*<sup>1</sup>. On said driving shaft is secured a driving pulley *b*<sup>5</sup> in a familiar manner. A pinion *b*<sup>7</sup> similar to the pinion *b*<sup>3</sup> is journaled on a stud



shaft which is secured on the frame member A' in position for said pinion to be engaged by the gears  $b'-b^2$ .

Rigidly secured on the shafts B and B' and B<sup>2</sup>—B<sup>3</sup> are cutting rolls C—C'—C<sup>2</sup>—C<sup>3</sup> of which the upper rolls C—C' comprise each as shown a central roll or core  $c-c'$  secured on its shaft by means of a feather  $b^6$  as shown in Fig. 11 and on each side of which is provided the clamping collars  $c^2-c^3$  of which the collar  $c^2$  is provided with an elongated hub  $c^4$  shrunk on the shaft and provided with set screws adapted to positively engage the same upon the shaft. Each of said shafts is screw threaded at the end carrying the collar  $c^3$  and jamb nuts  $c^5-c^6$  are secured thereon in position to force said collars  $c^2-c^3$  and the central rolls  $c-c'$  into binding contact as shown in Fig. 11 and a plurality of bolts  $c^8$  extend through said collars and core and bind the same rigidly together. Each of said rolls or cores  $c-c'$  is grooved longitudinally on the periphery providing a plurality of longitudinal flat bottomed seats adapted to receive adjusting wedges D and  $d$  or  $d'$  and correspond in number with the number of longitudinal rows of slitting knives adapted to be arranged on the periphery of said cutting rolls and which, of course, will vary with the size of the roll and the length of the slit to be made thereby. Apertures are provided in said collars registering with the seats in said rolls and adapted to receive the point of said wedges, of which as shown the wedge member D is provided with flanges adapted to engage on said collar and acts to afford an inclined surface corresponding with the taper of the wedge  $d$  so that the outer bearing surface thereof is parallel with the axis of the roll. Seated on said rolls are carrying rings E, each of which as shown in Fig. 5 is notched on the inner side to engage over the wedges and intermediate said notches is provided with radial inwardly directed projections  $e$  which bear upon the rolls between the wedges as shown in Fig. 3. The carrying forms illustrated in Figs. 4, 5, 6 and 7 are also provided on each of the faces thereof with outwardly directed wedge shaped projections or stops  $e'$  of which the adjacent sides of adjacent stops are parallel and between which fit the removable and adjustable knives F. Said knives or cutters F, as shown, are of a thickness equal to the distance between the alternate slits to be formed in the sheets and are transversely concave on the face and provided on opposite sides with cutting edges  $f$  as shown in Figs. 4, 11 and 13, so that each of said knives provides simultaneously two slits in the sheet operated on thereby. Said knives are of uniform width and the front and rear edges thereof are parallel and fit between the stops or projections  $e'$  on the carrying ring and near the bottom or lower edge of said knives the edges taper inwardly to a

bottom bearing surface adapted for positive engagement on said adjusting wedges  $d$  so that when said knives are in position as shown in Fig. 3 the same fit very closely between and have positive bearing at the front and rear edges on the projections or stops  $e^1$  and at the bottom rest on said wedges.

Means are provided for rigidly clamping the knives in place comprising convexly curved spring plates  $f^2$  of a width to fit closely between the adjacent front and rear edges of adjacent knives and which are rigidly secured to the projection  $e'$  between adjacent knives by means of set screws  $f^3$  which act to spring said plates inwardly rigidly jamming or locking the knives in place. As shown in Fig. 4 a spacing ring E' equal in width to the thickness of the cutting face of the knives is secured between each of the peripheral rows of knives on each roll. Said ring is similar to the carrying ring E with the exception that it lacks the projection or stops  $e'$  and the plain sides thereof bear against said projections on the carrying ring and afford one of the side walls for the knife pockets as shown in Fig. 4.

Obviously, if preferred, the carrying rings may be constructed as indicated by E<sup>2</sup> in Fig. 8 as having projections  $e^2$  on one side only thereof. When so constructed the spacing rings may be omitted inasmuch as a plurality of said carrying rings when placed as shown in Fig. 8 with the projections of one carrying ring bearing against the plain side of the adjacent carrying ring afford knife pockets similar to those before described.

As shown, the knives F on each of the cutting rolls C and C' are staggered with each other so that each of said rolls affords half the slits in each of the sheets fed there-through, those on the second set of rolls providing the alternate slits in the sheet which are staggered with respect to those formed by the first pair. Beneath each of said rolls C and C' and journaled on the shaft B' and B<sup>3</sup> respectively are peripherally grooved rolls C<sup>2</sup>—C<sup>3</sup> in which the peripheral grooves are disposed as shown in Figs. 3, 12 and 13, to register with the cutting edges of the knives F and provide angular cutting shoulders between which and the edges of the knives the sheets are engaged as they pass between the rolls. Said rolls C<sup>2</sup> and C<sup>3</sup> may, if preferred, be cast or constructed solid, the peripheral grooves turned or otherwise constructed therein in a familiar manner, as shown, however, the same are constructed of a plurality of plates K rigidly bolted together upon the cores  $d^2-d^3$  of the lower roll by means of the bolts  $k'$  which pass therethrough and are held in place by the clamping collars K' and K<sup>2</sup>. The alternate plates in said rolls are of less diameter than the adjacent plates thus providing the shoulders before described. As shown parallel stripping bars  $g'$  extend



between the knives on said cutting rolls and act to prevent the sheet from binding to direct the sheet into the next succeeding rolls. If preferred the plates K forming the cutting shoulders of the lower rolls may be formed in sections  $k$ , as shown in Fig. 14 and rigidly bolted together by bolts  $k^2$ .

At the rear end of the machine are forming rolls G—G' rigidly secured on the shafts B<sup>4</sup> and B<sup>5</sup>. Said forming rolls are in diameter equal to the diameter of the cutting rolls and are each provided on their periphery with projections or teeth  $g$  which are V shaped or convex transversely as preferred. Said projections have each a length approximately equal to the solid portion of the sheet between the ends of longitudinally alined slits and are arranged staggering with those of the lower roll and as the rolls revolve the V shaped projections on the lower roll engages the metal between longitudinally alined slits and those of the upper roll engage centrally in the slits on each side of the same and force the cut edges downwardly between the center or uncut portions, thus supported, thereby forming the sheet as shown in Fig. 2 at H preparatory to the expansion. The forming rolls may be constructed in any desired manner and each of the projections may be formed integrally therewith or rigidly but removably secured thereon as desired.

The operation is as follows:—The sheet when fed between the first pair of cutting rolls between the strippers  $g'$  is engaged by the rolls and passed therethrough at any desired peripheral speed and the alternate slits formed therein. Said strippers acting to direct the sheet into the next pair of rolls where the alternate slits are cut which are staggered or break joints with the first cut slits and midway between the same as shown in Figs. 1 and 2. As the sheet passes outwardly the ends of the same are engaged by the forming rolls G and G' and the uncut portions between longitudinally alined slits are supported upon the projections on the lower roll while the corresponding projections of the upper roll engage in the slits on each side of said supported portion forcing the cut edges downwardly and forming a succession of V shaped or rounded keys indicated as  $h$ . Obviously any desired means may be provided for adjusting the bearings of the respective shafts either longitudinally or vertically with respect to each other. As shown, however, in Figs. 1 and 12 said bearings M are adapted to move longitudinally of the frame members, and are slotted for adjustment upon the bolts  $m$ , and beneath said bearings is inserted thin plates  $m'$  or metal or other desired material to give the proper vertical adjustment. If preferred the expanding mechanism may be attached to the rear of the present machine as shown in the drawings and the sheets successively cut, formed

and expanded as it passes through the machine, or, if preferred, a separate and distinct machine for expanding the metal may be employed after the same has been cut and formed by the expanding mechanism herein described.

Obviously the knives each being seated in a complementary recess in the roll and rigidly secured therein upon the adjusting wedges as before described are not only firmly held when in operation, but are also readily released for removal should it be desired to sharpen, repair or replace defective or injured knives for perfect ones. So too, if preferred, should any knife or knives, or the cutting edge of any knife or knives, be worn sufficiently to not entirely cut or slit the sheet, the same may be adjusted outwardly by driving the wedges  $d$ — $d'$  inwardly thus forcing the knives outwardly to the desired degree.

In the construction shown in Fig. 11 in which a single wedge  $d'$  is used in each seat in the roll  $c'$  the seat is inclined complementary to the wedge so that the outer face of said wedge is parallel with the axis of the roll. In this construction the operation is as before described, said wedge when driven inwardly acting to move the knives radially outward and if retracted, permits the same to be forced radially inward by the operation of the machine. Obviously instead of flat faces for contact faces of the wedges the outer surfaces of said wedges, if preferred, may be turned to correspond with the curvature of the roll in which instance the inner or bearing edge of the knife may be curved complementally therewith to afford a secure seat thereon.

Obviously while I have described my invention as adapted for use for expanded metal machines the same may be useful and desirable for many other purposes and I do not desire to be limited to the exact description or use or method of adjustment of the knives herein set forth as it is obvious that the means for adjusting the knives on the rolls may be varied from that herein described and many other details of construction may be varied without departing from the principles of this invention.

I claim as my invention:—

1. In a machine of the class described, a pair of cutting rolls having secured on the circumference thereof a plurality of rows of circumferentially alined independently removable knives arranged out of contact with each other and adapted to form a pair of parallel slits and locking means carried on the roll and adapted to engage a plurality of said knives.

2. In a machine of the class described, a plurality of pairs of cutting rolls and coacting, independently removable means on each pair of cutting rolls adapted to slit a sheet of



metal into a plurality of relatively short slits, the knives on each pair of said rolls forming slits alternating with those formed by the knives on the other pair.

5 3. A roll for the purpose specified having secured thereon, in circumferential rows, a plurality of knives, each comprising a plain blank of metal and having a plurality of  
10 parallel cutting edges, adjacent knives longitudinally of the roll being seated a distance apart equal to the width of said knives.

4. A roll for the purpose specified having engaged on the circumference thereof a plurality of rings separated from each by a lateral projection, a plurality of relatively short  
15 independent knives arranged between said rings, each having double cutting edges, said knives being arranged in alinement at intervals apart both circumferentially and longitudinal-  
20 tudinally of the roll.

5. In a machine of the class described, a plurality of pairs of cutting rolls, one of the rolls of each pair having removably secured thereon relatively short broad cutting knives,  
25 a plurality of cutting edges on each knife adapted to form short parallel slits at intervals apart longitudinally said knives being arranged in parallel circumferential rows and the adjacent longitudinally disposed  
30 knives of each roll being arranged a distance apart equal to the width of the knives, the knives of the second cutting roll being arranged to cut between and also out side those of the first roll.

6. In a machine of the class described the combination with adjustable rolls of a plurality of double edged knives thereon adapted to form a plurality of short parallel overlapping slits in a sheet of metal, resilient  
40 locking means engaging circumferentially adjacent knives and a pair of forming rolls adapted to engage the slit sheet and form V shaped ridges between the slits.

7. In a machine designed to slit and form  
45 a metallic sheet, a plurality of pairs of cutting rolls having radially projecting double edge knives thereon adapted to form one half the slits in the sheet resilient locking means carried on each roll intermediate said knives  
50 and engaged therewith and forming rolls adapted to engage the slit sheet and to form V shaped ridges therein between the webs.

8. The combination with a cutting roll of a plurality of removable double edged knives  
55 arranged at intervals circumferentially thereon, a spring engaged between adjacent knives and adapted to lock the same in the roll and a pair of forming rolls each having secured thereon similarly formed projections arranged staggering with each other  
60 and in alinement with the cutting edges of the cutting knives.

9. In a machine of the class described, a cutting roll formed of a plurality of annular  
65 plates rigidly secured upon a shaft, alternate

plates recessed on the periphery, knives removably secured in said recesses, a plurality of parallel cutting edges on each knife curved concentric with said roll and a coacting roll grooved complementally with the sides of  
70 the knives and adapted together therewith to form a slitted sheet.

10. In a device of the class described, a cutting roll comprising a plurality of plates rigidly secured in contact on a shaft, alternate plates being notched peripherally,  
75 knives rigidly secured in said notches, a plurality of cutting edges on each knife, a plate of smaller diameter between the knife bearing plates and a plurality of parallel connected bars extending between rolls intermediate of the knives.  
80

11. A machine of the class described comprising a roll having secured in peripheral alinement a plurality of parallel rows of  
85 knives, each of said knives being relatively broad and adapted to cut on each edge of the same, a grooved roller provided with angular shoulders to coact with the cutting edges of the knives and connected parallel bars or  
90 rods extending between the rolls and between said knives and acting to prevent the material operated upon from bending.

12. In a machine of the class described, the combination with the roll, of a plurality  
95 of notched rings thereon, removable double edged knives seated therein, adjusting wedges movably engaged beneath said knives and resilient means carried on the roll adapted to engage said knives in place.  
100

13. In a machine of the class described the combination with a plurality of pairs of cutting rolls together acting to cut a plurality of short overlapping parallel slits in a sheet of metal or the like, of forming means adapted  
105 to open the slits and to bend the portions between the slits and means for adjusting said forming means longitudinally of the machine and vertically thereof.

14. The combination with a plurality of  
110 pairs of cutting rolls, each adapted to cut a proportional part of a plurality of relatively short parallel overlapping slits longitudinally of the sheet, of means for stripping the cut sheet from the cutting rolls and vertically  
115 and longitudinally adjustable forming rolls adapted to engage the slit sheet and means thereon acting to open the slits and to bend the metal between the slits.

15. In a machine of the class described, a  
120 pair of cutting rolls, a plurality of bands thereon each provided with lateral projections adapted to abut against adjacent bands, circumferentially arranged knives engaged between said bands, a part of said knives being provided with double cutting edges and means adapted to adjust said knives radially  
125 of the roll.

16. In a machine of the class described, a pair of cutting rolls, a plurality of rings there-  
130



on provided with lateral projections adapted to space said rings equidistantly and a plurality of circumferentially alined knives carried between said rings, each comprising a plain blank of metal, concave on its upper side to provide parallel cutting edges.

17. In a machine of the class described a pair of cutting rolls each having secured thereon independently removable knives and adjusting means acting to simultaneously adjust a plurality of said knives.

18. In a machine for the purpose specified, a pair of cutting rolls, a plurality of longitudinally and circumferentially arranged knives thereon each comprising a plain blank of metal, resilient means adapted to engage the ends of said knives and engage them in place and means adapted to adjust said knives radially and in lines longitudinally of the roll.

19. In a machine of the class described, a plurality of pairs of cutting rolls and coacting independently removable knives on each pair of cutting rolls provided with parallel cutting edges and adapted to slit a sheet of metal into a plurality of relatively short slits, each pair of said rolls forming alternate slits and means movable beneath the knives adapted to adjust the knives radially.

20. In a machine of the class described, the combination with a frame, of a plurality of pairs of coacting rolls journaled thereon, a plurality of removable double edged knives arranged on said rolls equal distances apart and adapted to cut a sheet of metal into a plurality of short slits arranged staggering with each other and a uniform distance apart, wedge members seated in the periphery of the rolls adapted to engage said knives and adjust them radially and resilient locks carried on said rolls adapted to engage said knives in place.

21. A cutting roll provided on its periphery with removable radially adjustable cutters arranged in circumferential lines thereon, the cutters of each line being arranged a distance apart, resilient means adapted to engage adjacent cutters and lock them in place and means movable longitudinally of the roll adapted to adjust said cutters radially, said cutters being concave transversely and having double cutting parallel edges concentric with the roll.

22. A knife for the purpose specified, comprising a relatively short block of steel having its upper surface curved concentrically and its lower surface tapered from the end inwardly and its ends lying approximately in planes of the radius of the upper surface, said block having straight plane ends and parallel cutting edges and being transversely concave on its cutting face.

23. A roll for the purpose specified having arranged thereon a plurality of equally spaced rings, a plurality of knives interme-

diate said rings, each provided with double cutting edges and resilient means carried on said rings adapted to lock said knives in place.

24. A roll having removably secured thereon a plurality of independent knives each having a plurality of cutting edges and arranged in parallel circumferential rows, adjacent knives longitudinally of the rows being seated a distance apart equal to the width of the knives and adjacent knives circumferentially of the rolls being seated a uniform distance apart and means engaging the ends of the knives and acting to positively engage said knives to the rolls.

25. A roll having removably secured thereon a plurality of knives each having a plurality of cutting edges and arranged in parallel circumferential rows, adjacent knives longitudinally of the rows being seated a distance apart equal to the width of the knives and adjacent knives circumferentially of the rolls being seated a uniform distance apart and resilient means engaging adjacent knives and rigidly engaging the same to the roll.

26. A roll having removably secured thereon a plurality of knives each having a plurality of cutting edges and arranged in parallel circumferential rows, adjacent knives longitudinally of the rows being seated a distance apart equal to the width of the knives and adjacent knives circumferentially of the rolls being seated a uniform distance apart and resilient means engaging adjacent knives and rigidly engaging the same to the roll.

27. In a machine of the class specified cutting rolls each having transverse rows of knives arranged around the periphery thereof of said knives in each row being independently removable.

28. In a machine of the class specified cutting rolls having independently removable cutting knives extending entirely across the periphery thereof and arranged suitable distances apart transversely and longitudinally.

29. In a machine of the class described cutting rolls and a plurality of independently removable knives secured thereto and spaced suitable distances apart transversely thereof and arranged around the periphery of the rolls.

30. In a machine of the class described cutting rolls and independently removable knives secured thereto arranged in rows transversely and circumferentially of the rolls and the knives on one roll cutting alternately and staggering with the knives in an adjacent roll.

31. In a machine of the class described cutting rolls, independently removable cutting knives secured around the periphery of the rolls and means for simultaneously adjusting a plurality of knives as to the cutting position.

32. In a device of the class described cutting rolls, cutting knives thereon arranged in



transverse rows across the periphery of the rolls and independent means for simultaneously adjusting each row of knives to vary the cutting position.

5 33. In a device of the class described the combination with cutting rolls, independently removable knives secured to the periphery thereof in transverse rows, means for adjusting the knives in a row simultaneously and rolls having shoulders coacting  
10 with the knives on the cutting rolls.

34. In a device of the class described the combination with cutting rolls, independently removable knives secured to the periphery thereof in transverse rows, means  
15 for adjusting the knives in a row simultaneously, rolls having shoulders coacting with the knives on the cutting rolls and removable resilient means securing the knives in  
20 position.

35. In a device of the class described the combination with cutting rolls, independently removable knives secured to the periphery thereof in transverse rows, means  
25 for adjusting the knives in a row simultaneously, rolls having shoulders coacting with the knives on the cutting rolls, removable resilient means securing the knives in position, means extending between the teeth and means extending between the shoulders  
30 for preventing bending of the metal in cutting.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

GEORGE A. TURNBULL.

Witnesses:

A. C. ODELL,

W. W. WITHEBURY.