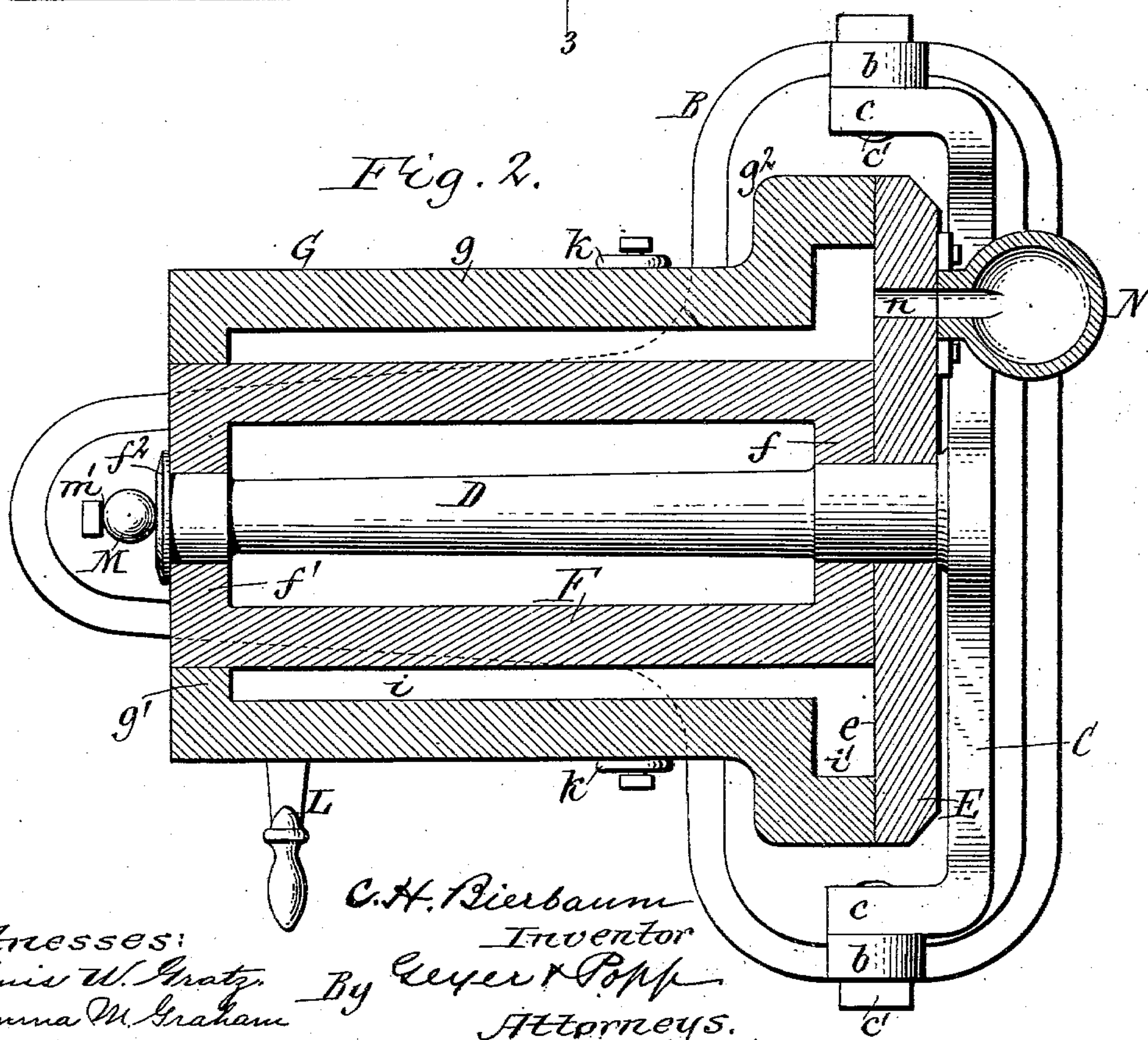
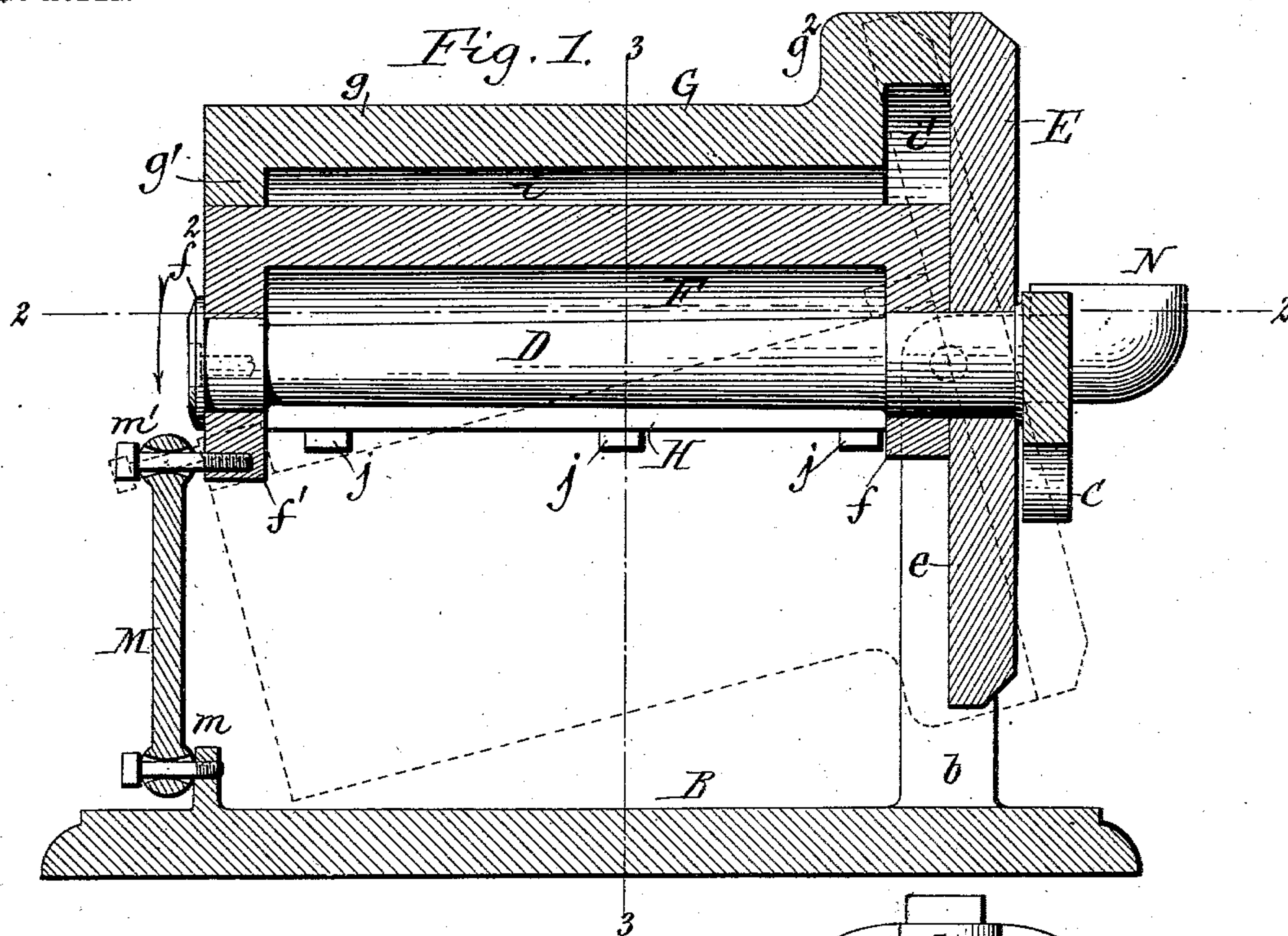


C. H. BIERBAUM.  
METHOD OF MAKING CASTINGS.

APPLICATION FILED FEB. 27, 1902.

NO MODEL.

3 SHEETS—SHEET 1.



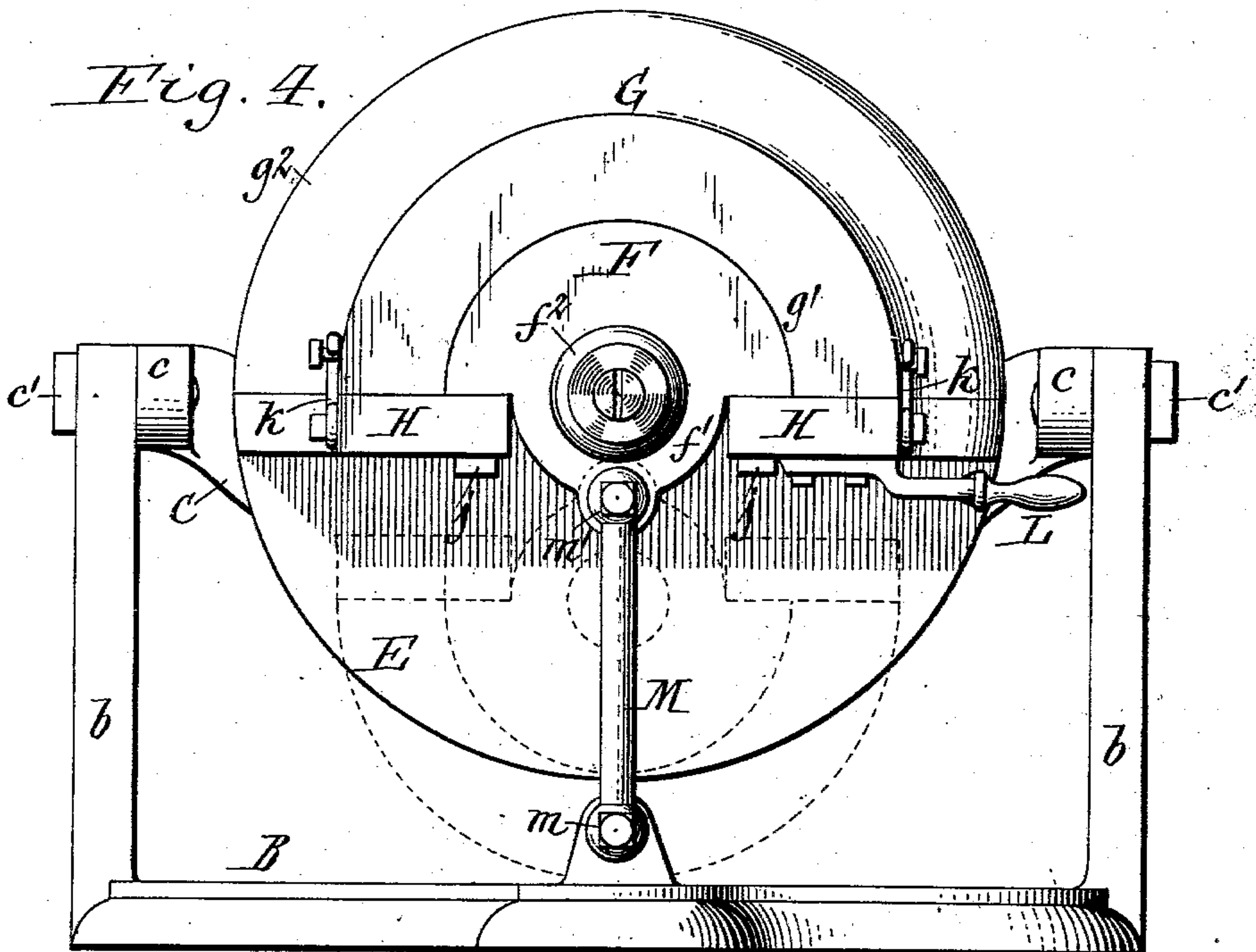
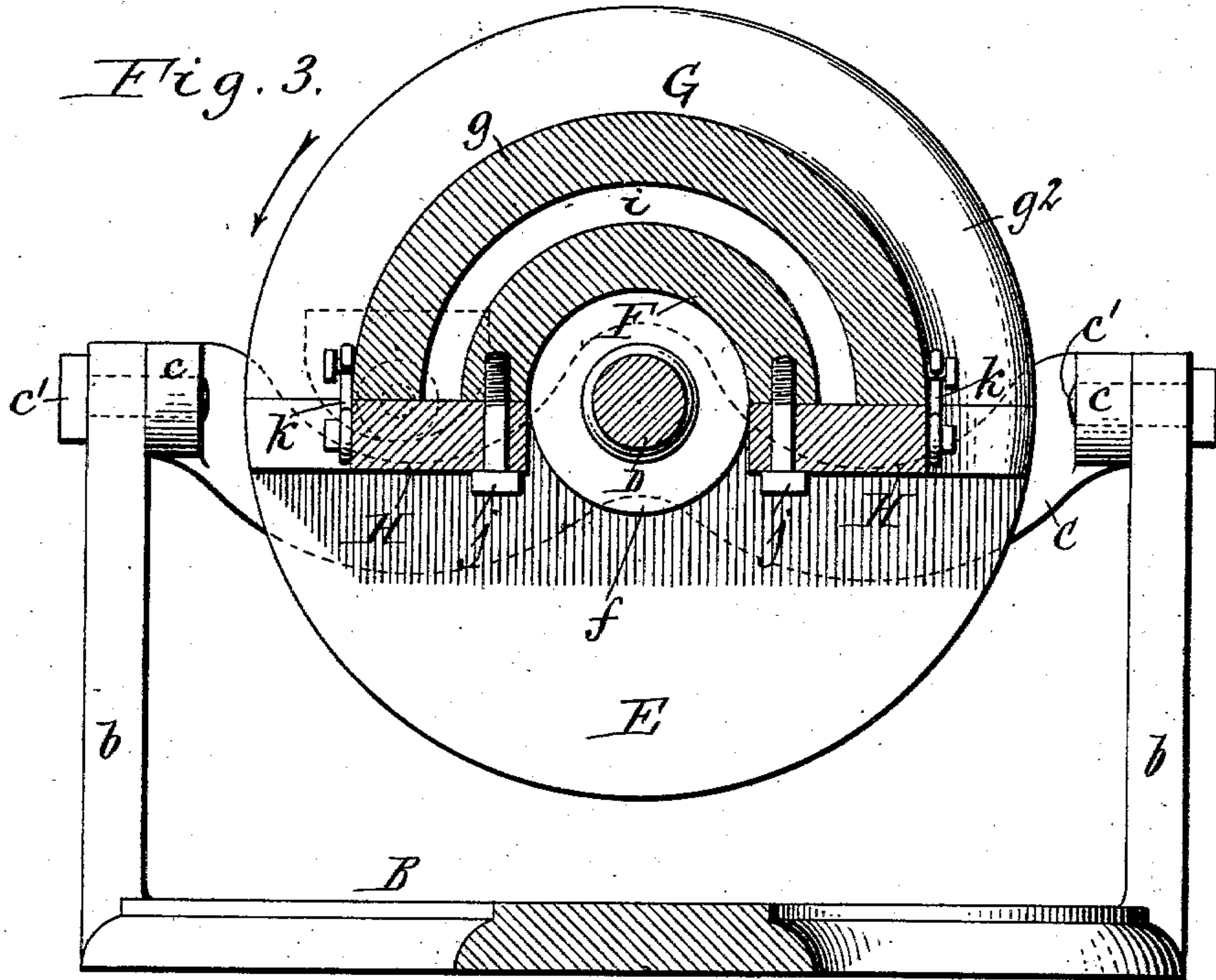


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3 SHEETS—SHEET 2.



Witnesses:  
Louis W. Gratz  
Emma M. Graham

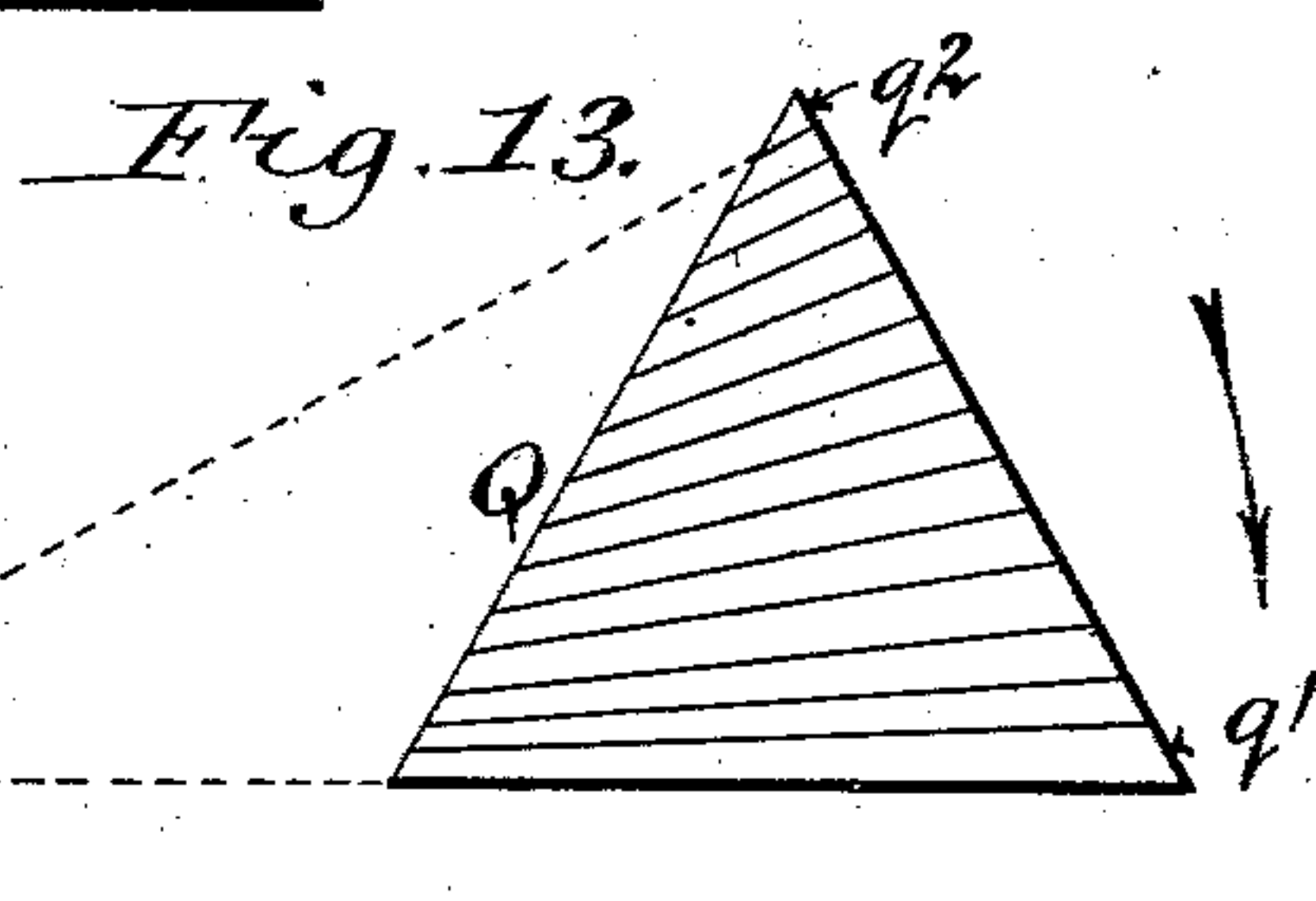
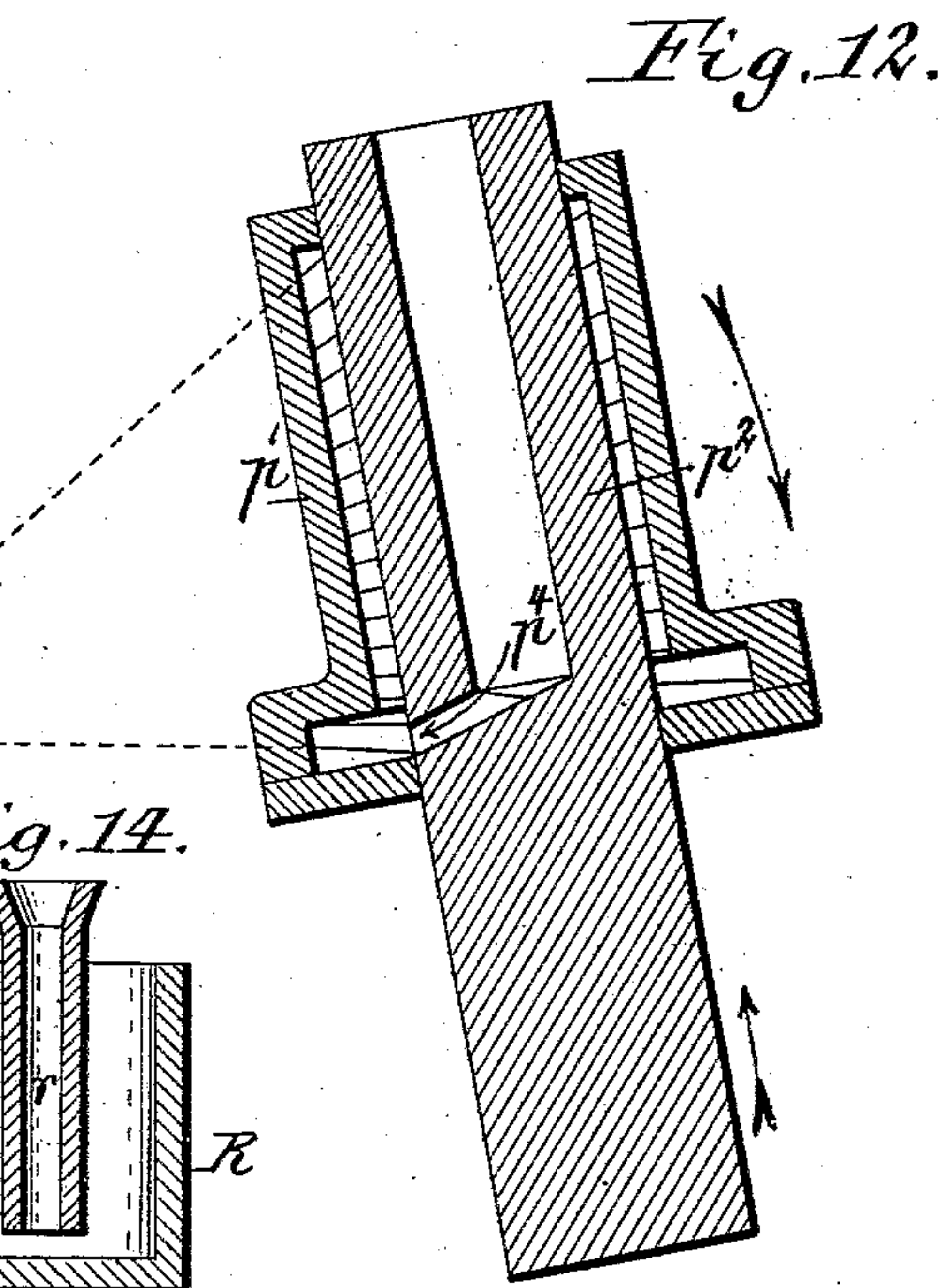
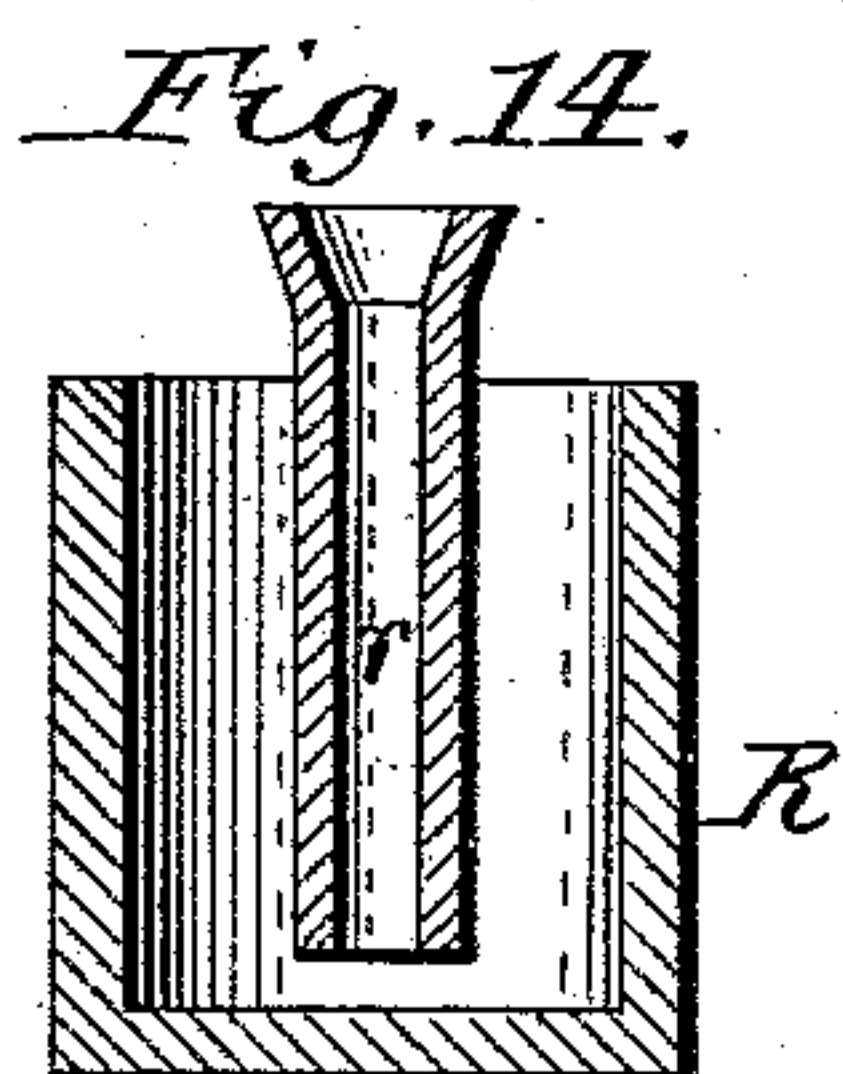
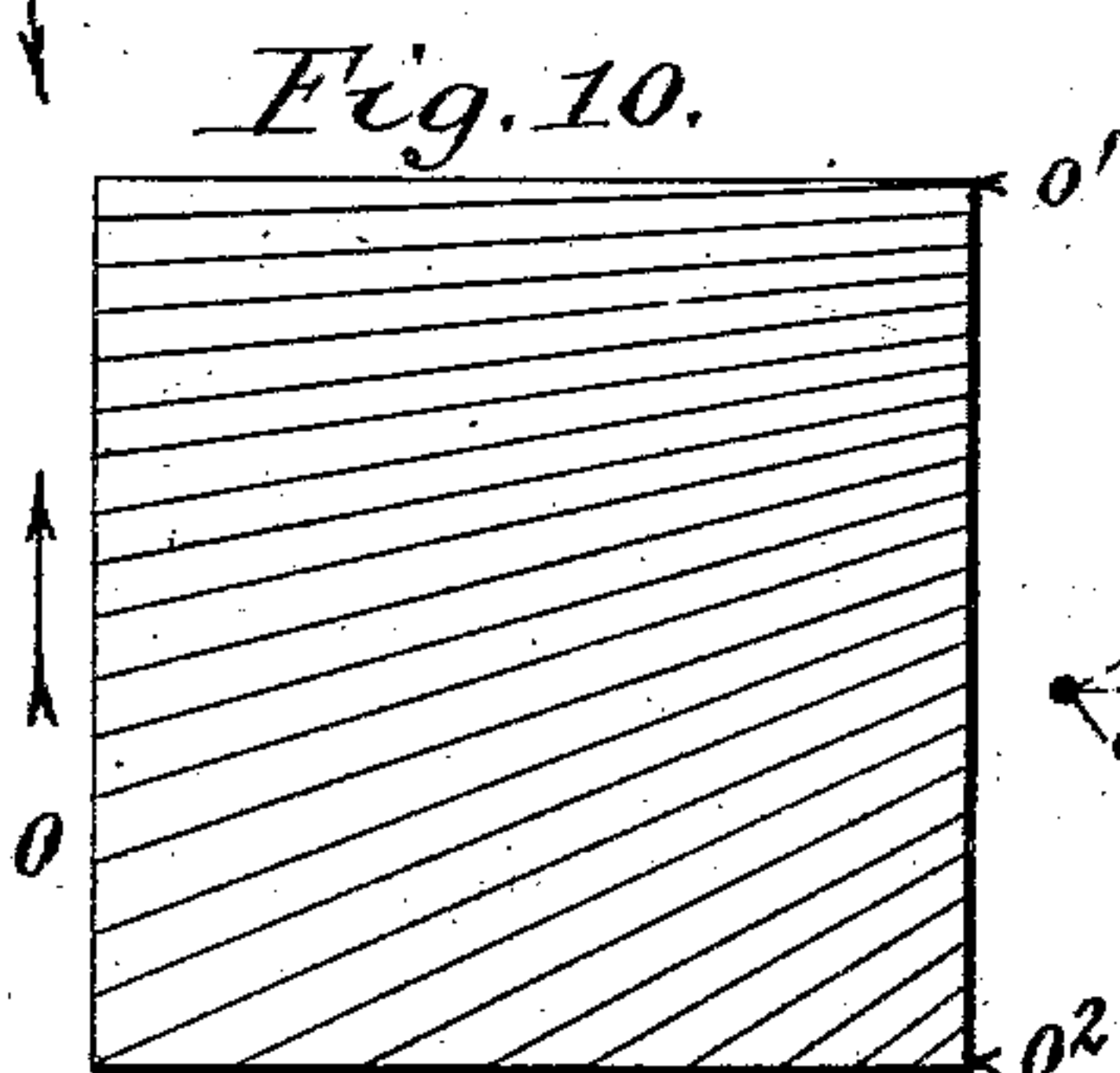
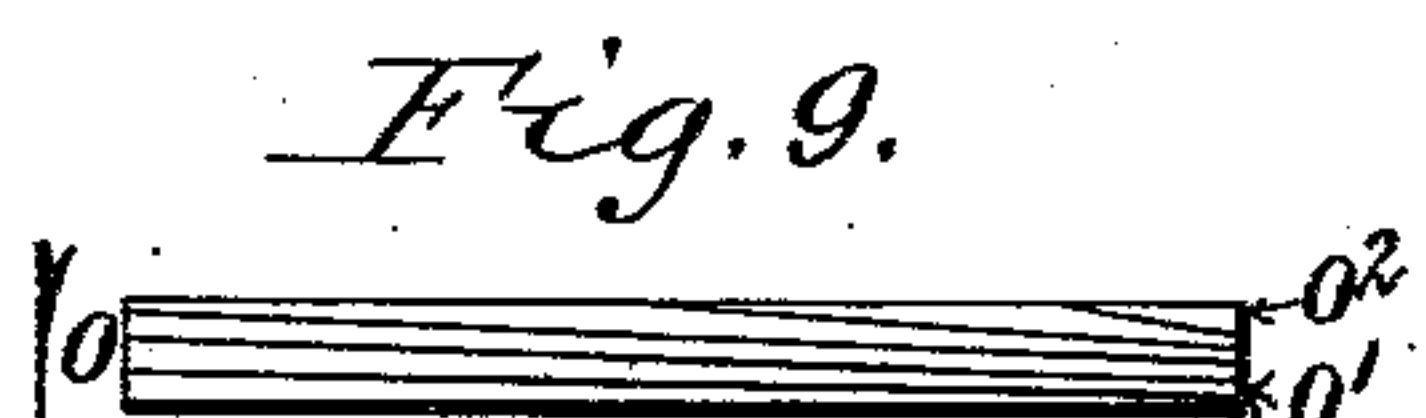
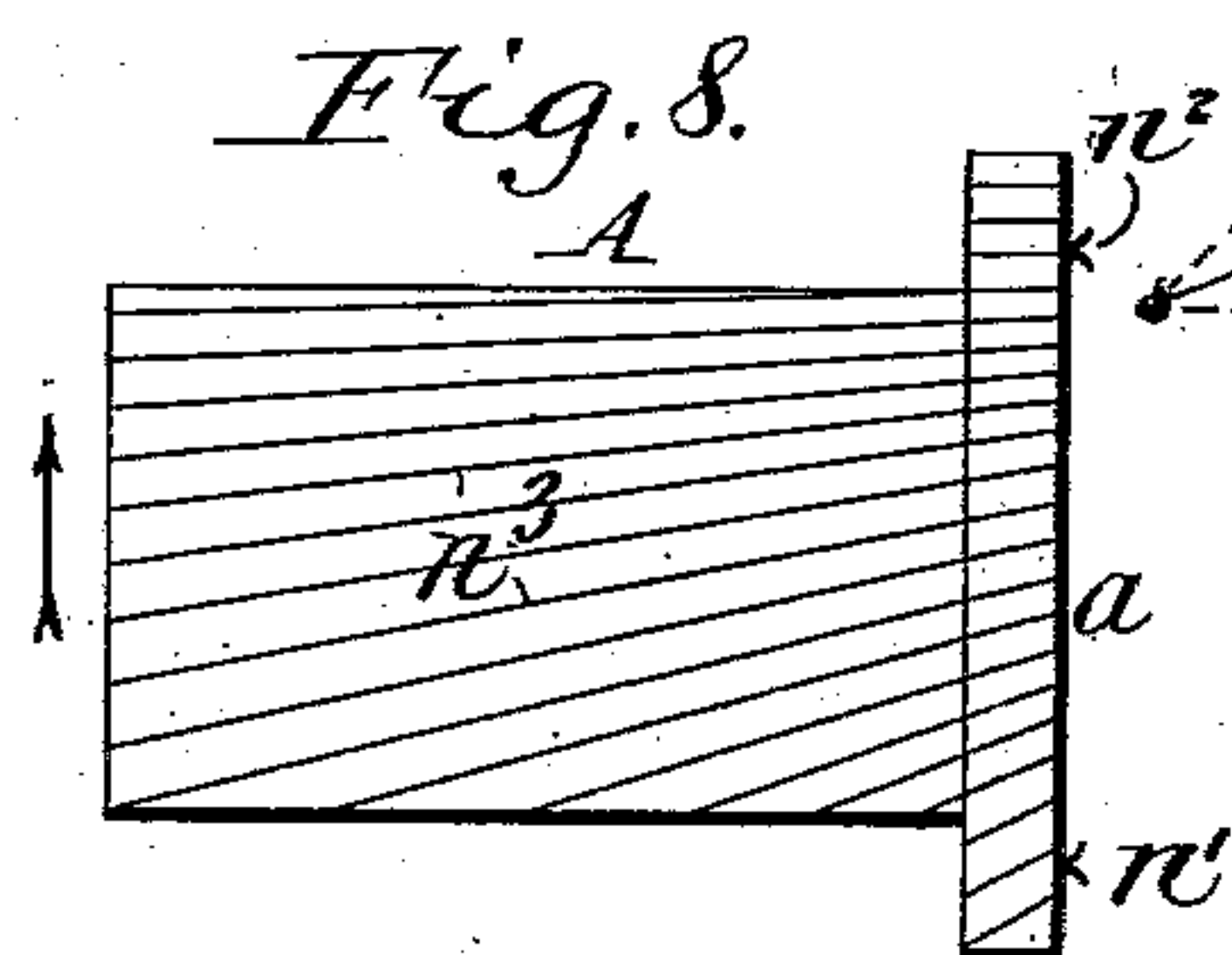
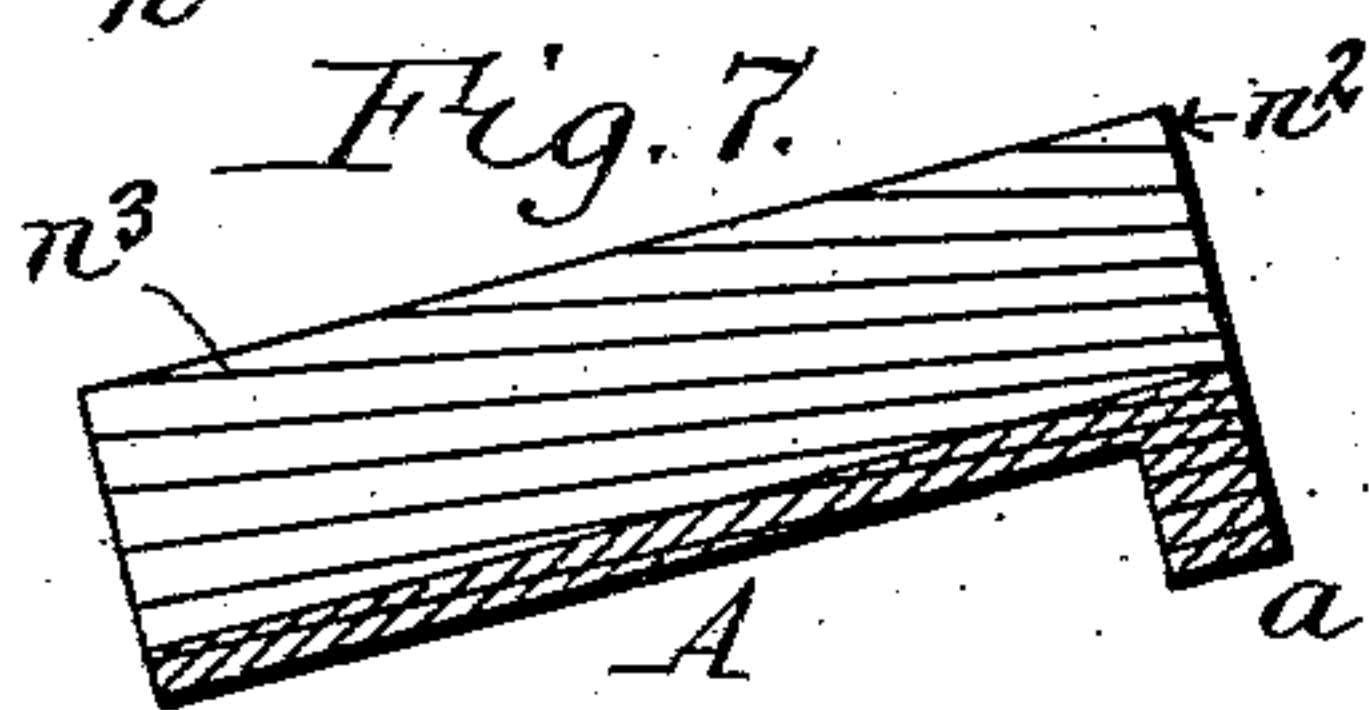
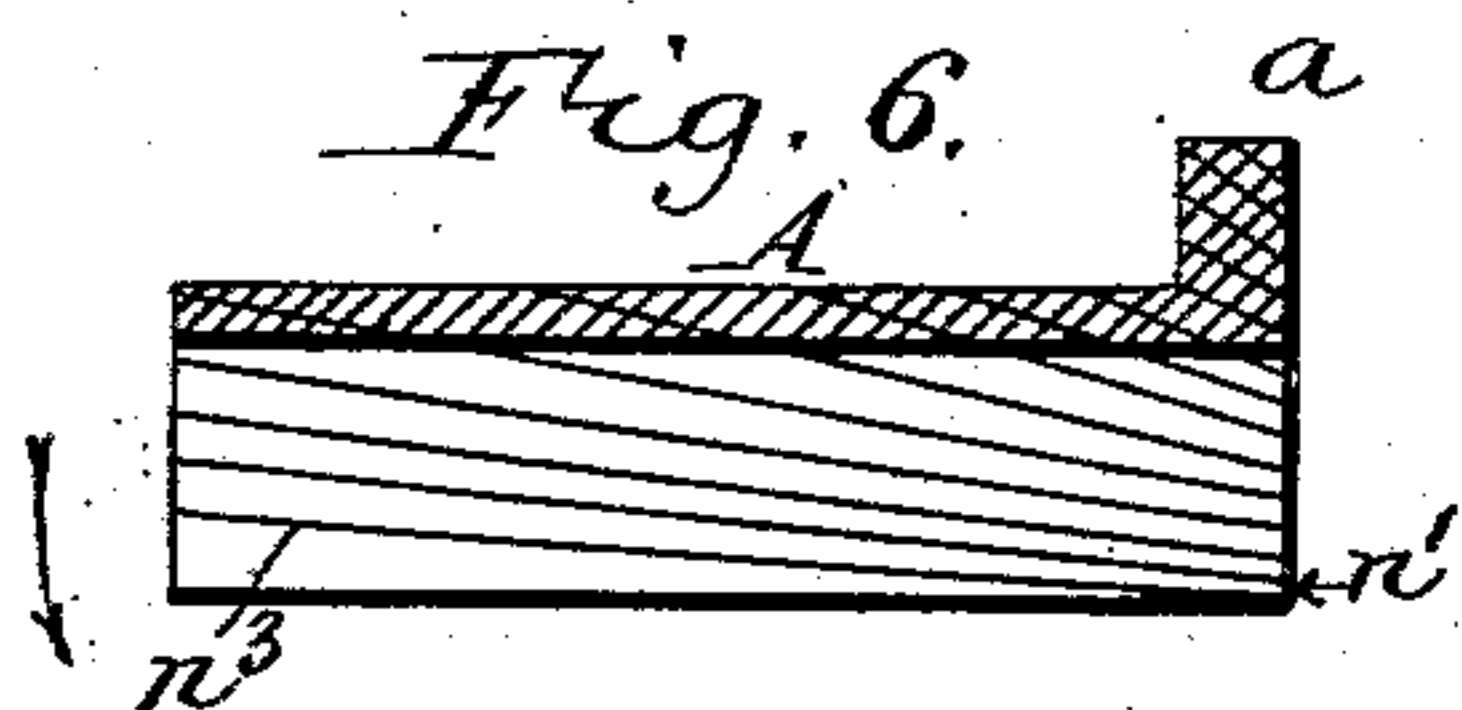
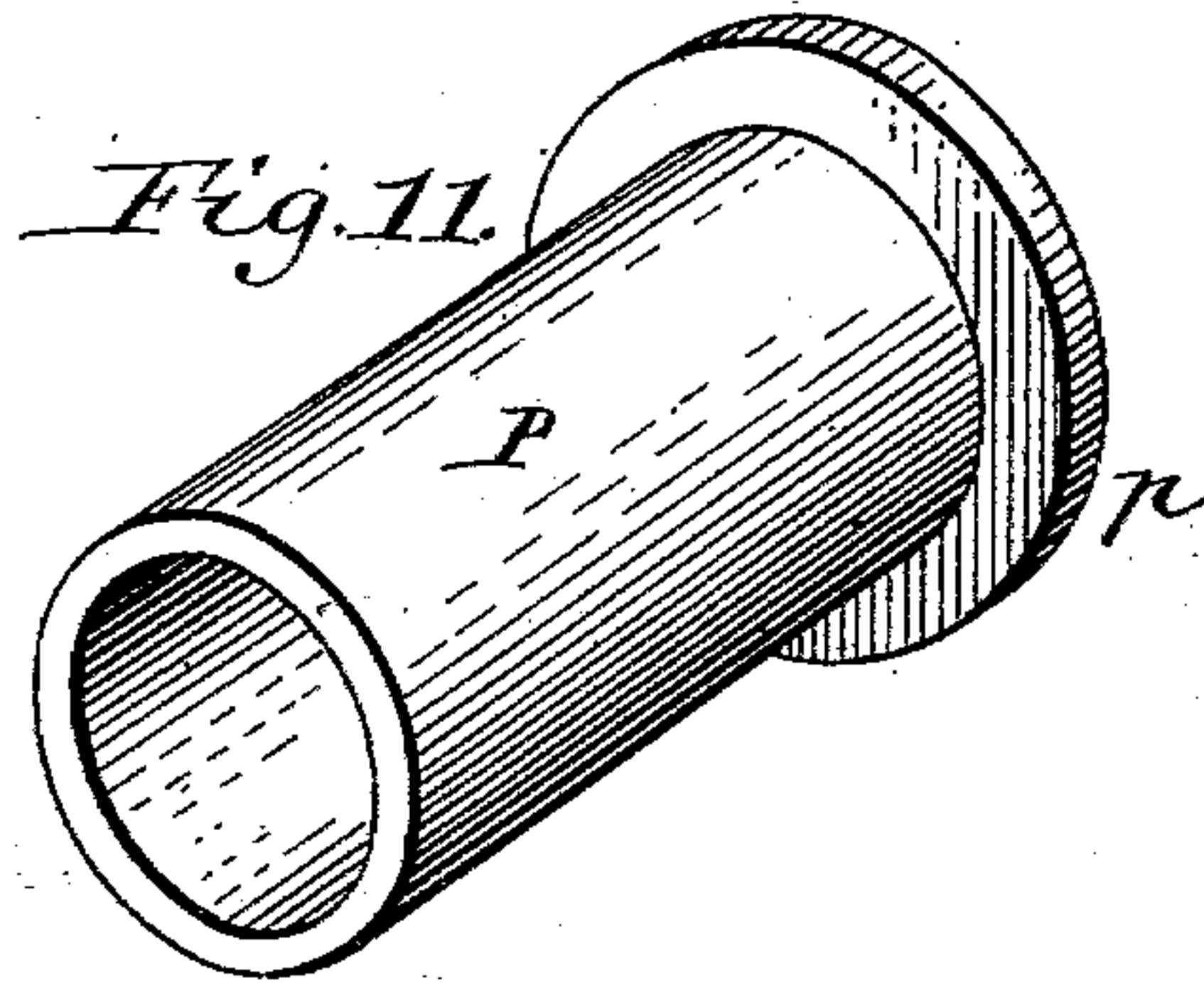
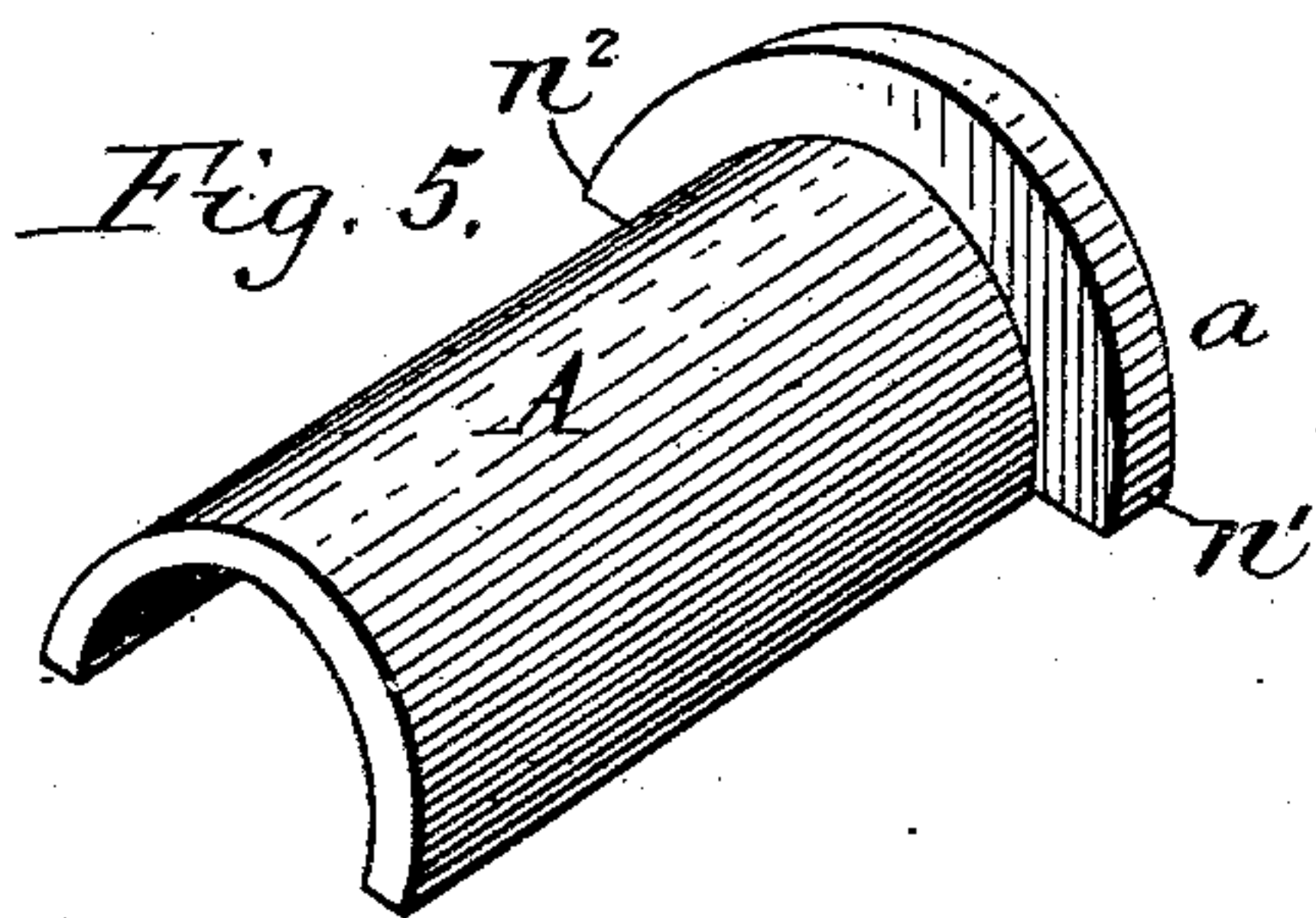
C. H. Bierbaum Inventor  
By Geyer & Popp  
Attorneys.

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NO MODEL.

3 SHEETS—SHEET 3.



Witnesses:  
Louis W. Gratz  
Emma M. Graham.

C. H. Bierbaum Inventor  
By Leyer & Popp  
Attorneys.



# UNITED STATES PATENT OFFICE.

CHRISTOPHER H. BIERBAUM, OF BUFFALO, NEW YORK.

## METHOD OF MAKING CASTINGS.

SPECIFICATION forming part of Letters Patent No. 740,733, dated October 6, 1903.

Application filed February 27, 1902. Serial No. 95,856. (No model.)

*To all whom it may concern:*

Be it known that I, CHRISTOPHER H. BIERBAUM, a citizen of the United States, residing at Buffalo, in the county of Erie, in the State of New York, have invented new and useful Improvements in Methods of Making Castings, of which the following is a specification.

This invention relates to a method of casting hardening fluids, such as molten metals and plastic substances, but is more especially desirable for casting in metal molds that class of metals and alloys in which the maximum shrinkage occurs at nearly the same temperature at which solidification takes place. Characteristic of this class are the alloys containing a relatively high percentage of zinc. Heretofore more or less perfect castings of these metals or alloys were produced by the use of sand molds. The heat of the metal upon entering these molds generated steam, due to the moisture in the sand, which caused a considerable oxidation to take place. This oxidation is especially injurious in alloys containing aluminium. The scum procured by oxidation is lighter than the metal and rises to the surface of the molten metal, leaving the lower surface of the metal comparatively free from oxid scum. This movement of the scum from the lower to the upper portion of the metal is possible in sand molds because the metal cools slowly in such molds and remains in a molten condition a sufficient time for this purpose. When sand molds are employed for casting alloy half-bearings, linings, and sleeves, the mold is usually so arranged that the inner or journal side of the bearing is lowermost, while the outer side thereof is uppermost. By this arrangement of the mold a bearing-casting is produced free from oxid scum on its journal side which otherwise would be liable to cut the shaft turning therein, while the oxid scum is gathered on the outer side of the bearing, where it can be dressed or timed off by a suitable tool, if necessary.

While serviceable bearings can be produced in sand molds, the use of such molds is objectionable because of the excessive oxidation produced in the same, which requires considerable trimming of the castings for removing the oxid scum, and also because of the ex-

pense attending the construction of an individual mold for each casting.

When metal or other permanent molds are used for producing alloy castings, oxidation is reduced to a minimum owing to the absence of moisture in the mold, the expense of constructing a new mold for each casting is avoided, and the castings can be produced more expeditiously because the molten metal cools rapidly in a metal mold.

The use of metal molds in the same manner described with reference to sand molds is impractical because the rapid cooling of the molten metal in metal molds produces undesirable shrinkage strains in the castings and prevents the oxid scum from rising to the upper surface of the castings, which scum is liable to become entrained in the body of the casting. This renders such castings unsuitable for bearings because the presence of oxid scum on the journal-surface of the bearing-castings cuts the shaft turning therein.

One of the objects of my invention is to produce in an expeditious manner castings which are full or unshrunk and have no shrinkage strains.

Another object is to avoid the entraining of oxid scum in the body of the castings.

My improved method of casting hardening fluids is as follows: After the mold has been prepared the same is so placed that that portion which is to be filled first is lowermost. The delivery gate or outlet of the receptacle, from which the molten metal is supplied, is then so placed that the metal is delivered quiescently into the mold and without falling freely from the gate to the same. As the metal flows from the gate into the mold one of these members is moved relatively to the other, so that the gate always remains in line or substantially in line with the level of the liquid in the mold. By this relative movement of the gate and mold the metal when once deposited in the mold is not disturbed, but remains at rest, and the following new metal is deposited upon the preceding metal. By thus avoiding agitation of the fluid in the mold after its deposit oxidation is reduced to a minimum and a casting is produced without entrained scum. A quiescent delivery of the metal into the mold is further-



more desirable because the process of solidification can begin immediately upon depositing the metal, enabling the new incoming metal to take up any shrinkage which takes place during solidification and producing a casting which is full and without blow-holes. The relative movement of the mold and gate and the rate of admission of the metal to the mold are so regulated that filling, shrinking, and solidifying of the metal occur continuously and simultaneously in different parts of the mold.

In addition to moving the mold and gate relatively to each other it is desirable in some forms of castings to tilt the mold gradually either by a simple or a compound movement as the filling thereof progresses for the purpose of filling the rear end of the mold first and concentrating the final or front portion of the mold space to be filled around the gate, thereby enabling the mold to be filled entirely and producing a full and perfect casting.

A machine for practicing my invention is shown in the accompanying drawings, which consist of three sheets, and in which—

Figure 1 is a longitudinal sectional elevation of a machine for producing the casting shown in Fig. 5. Fig. 2 is a horizontal section thereof in line 2 2, Fig. 1. Fig. 3 is a vertical cross-section in line 3 3, Fig. 1. Fig. 4 is an end elevation thereof. Fig. 5 is a perspective view of a flanged half-bearing or semicylindrical lining which may be cast in accordance with my invention in the machine shown in Figs. 1 to 4. Figs. 6 and 7 are diagrams in a vertical plane, showing the manner in which the metal is deposited in the mold for casting the half-bearing shown in Fig. 5. Fig. 8 is a plan view of the same. Fig. 9 is a diagram in a vertical plane, illustrating the manner of depositing metal in a mold for casting a flat rectangular plate. Fig. 10 is a top plan view of the same. Fig. 11 is a perspective view of a flanged whole bearing or cylindrical sleeve which may be cast according to my invention. Fig. 12 is a sectional elevation of a mold for producing the casting shown in Fig. 11. Fig. 13 is a diagram showing the manner of casting a flat triangular plate in accordance with my improved method.

In all of the foregoing figures the arrows show the direction of motion of the parts with which they are associated.

Like letters of reference refer to like parts in the several figures.

The casting shown in Figs. 5 to 8 and intended to be produced in the machine shown in Figs. 1 to 4 consists of a semicylindrical body or shell A, having an external flange *a* at one end.

B represents the base of the machine, which is provided on opposite sides of its front end with standards *b*.

C represents a cross-piece or yoke provided at its ends with rearwardly-projecting ears

*c c*, which are pivoted by horizontal pins *c'* to the upper ends of the standards *b*, so that the yoke can swing in a vertical plane.

D represents an axle or arbor projecting rearwardly from the yoke and arranged at right angles to the pivots *c'* and intersecting their axis.

The mold is constructed wholly of metal and consists, essentially, of a front section or disk E, an inner semicylindrical section F, an outer semicylindrical section G, and bottom plates H H. The disk E is secured to the arbor adjacent to the yoke C and forms the front end of the mold-cavity. The disk is provided with a flat rear side or face *e*, which is arranged at right angles to the arbor and intersects the axis of the yoke-pivots *c'*. The inner mold-section F bears at its front end against the rear side of the disk E and is journaled to turn transversely on the arbor D by means of two hubs *ff'*, which are mounted on the front and rear ends of the arbor. The inner mold-section is held against axial movement on the arbor by the disk E, bearing against the front end of the inner section, and a head *f<sup>2</sup>*, secured to the rear end of the arbor and engaging the rear end of the inner section. The outer mold-section G has its semicylindrical body *g* arranged concentrically with the inner section and is separated therefrom by an intervening semicylindrical space *i*, forming the mold-cavity, in which the body A of the half-bearing is cast. The rear end of the outer mold-section is provided with an internal flange *g'*, which rests on the rear end of the inner mold-section and forms the rear end of the mold-cavity. The outer mold-section is provided at its front end with an offset or enlarged portion *g<sup>2</sup>*, which bears against the rear side of the disk E and forms, with the latter, the lateral extension *i'* of the mold-cavity in which the flange *a* of the half-bearing is cast. The bottom plates H bear at their front ends against the rear side of the disk E, while their sides and rear ends bear against the longitudinal edges of the inner and outer sections and the internal flange *g'*, respectively, thereby closing the bottom of the mold-cavity. The bottom plates are secured permanently to the inner mold-section by screws *j*, and the outer mold-section is detachably held in place by catches *k*, connecting the same with the bottom plates.

In the use of this machine the inner and outer sections F G of the mold and the bottom plates H in their assembled condition are reversed or given a half-turn on the arbor, this movement causing the front ends of these parts of the mold to sweep over the disk E. One of the bottom plates H is provided with a handle L for turning the mold-sections on the arbor. While turning the mold about the arbor the same is also lowered at its rear end, so that when reversed the mold is tilted or inclined from its front toward its rear end. This tilting of the mold is effected automatically while turning the mold by means of an



upright link M, pivoted at its lower end to the rear end of the base by a swiveling connection  $m$  and having its upper end pivoted eccentrically to the rear hub  $f'$  of the inner mold-section by a swiveling connection  $m'$ . In the normal position of the mold preparatory to being filled the same occupies a horizontal or nearly horizontal position and the swiveling connection  $m'$  is below the arbor, as shown by full lines in Figs. 1 and 4. Upon reversing the mold its rear end is depressed below the swiveling connection  $m'$  owing to the eccentric connection with the link M, as shown by dotted lines in Fig. 1.

The metal from which the casting is produced is fed into the mold-cavity through a gate or inlet-passage  $n$ , which is formed in the disk E and communicates with the front end of the mold-cavity. As shown in the drawings, the metal is conducted to the gate by a funnel or filler N, which is secured to the disk E. The gate is located in the disk E on one side of the arbor D and substantially at the intersection of the axes of the pivots  $c'$  and the arbor, whereby the gate remains practically stationary relative to the mold while the latter is being reversed and tilted.

Preparatory to filling the mold the same is turned to the position shown in full lines in Figs. 1 to 4, in which position its rotary parts are located horizontally above the arbor and the bottom of one side of the semicylindrical mold-cavity is in line with the gate  $n$ . The molten metal is now poured into the mold through the gate and at the same time the mold is turned about the arbor, which causes it to be tilted rearwardly in the direction of the arrows, Figs. 1 and 3.

Although the supply of liquid to the mold is continuous, the same may be regarded as a succession of layers for the purpose of illustration. Viewed in this manner, when an alloy is cast in a metal-mold the process of cooling or solidifying is taking place in the first layer, the process of shrinking is taking place in the second layer, while the third layer is still in a molten state and in condition to supply the necessary metal for taking up the shrinkage which occurs in the second layer, thereby producing a casting which is full and free from side cavities which are usually present in castings produced by the methods heretofore employed. Each of the so-called "layers" of the casting passes successively through the steps or stages of filling, shrinking, and solidifying, these stages progressing upwardly in the same order from one layer to the next above as the mold is turned and the fluid fills the same. It will thus be seen that by this manner of using a metal mold in which the liquid hardens rapidly the initial portion of the casting may be in a completely hardened condition before the metal for the final portion of the casting has been poured into the mold.

If the mold were simply turned about the arbor without tilting it, the final portion of

the mold-cavity would consist of a long and narrow space which could not be properly filled from one end of the mold, and a perfect casting could not, therefore, be produced. Such a narrow final space in the mold-cavity is avoided by tilting the mold rearwardly at the same time that it is turned about the arbor when a casting of the form shown in Fig. 5 is made. The effect of this compound movement is shown in diagrammatic Figs. 6, 7, and 8. By thus tilting the mold rearward gradually as the filling proceeds at the gate  $n$ , the rear end of the cavity, which is remote from the gate, is filled in advance of the front part of the mold, adjacent to the gate. This causes the unfilled part of the cavity to always flare outwardly, or toward the gate, from the beginning of the filling operation at  $n'$ , while the mold is above its longitudinal axis, as shown in Fig. 6, to the completion of that operation at  $n^2$ , while the mold is reversed and below its longitudinal axis, as shown in Fig. 7. While turning the mold around the arbor at the same time that it is tilted rearwardly the so-called "layers" are laid in the mold obliquely, this formation being shown by the lines  $n^3$  in Figs. 6, 7, and 8, which represent an imaginary succession of liquid-levels. During the filling of the mold, while the same receives this compound movement, its cavity gradually contracts from all sides toward the gate, which action causes the rear end of the cavity to be filled first and concentrates the final or unfilled portion of the cavity at the gate, where the same can be filled completely, so as to produce a perfect casting.

Owing to the rapid cooling of the metal in a metal mold, the casting is completely hardened when the mold reaches the end of its rotary and tilting movement.

Upon releasing the catches  $k$  the outer mold-section G may be detached from the bottom plates H for removing the finished casting. The outer mold-section is then replaced and the mold returned to its initial position preparatory to producing the next casting.

The compound movement of the mold is also desirable for casting a flat rectangular plate O, as shown in Figs. 9 and 10. The filling of the mold for producing this casting begins at  $o'$  and terminates at  $o^2$ .

When the filling of the mold for casting the plate O begins, the mold is in a horizontal position, or nearly so, corresponding to the position of the plate in Fig. 9. As the filling proceeds the mold is moved laterally in the direction of the arrow, Fig. 10, so that the gate moves gradually from  $o'$  to  $o^2$ , and at the same time the rear end of the mold is tilted or lowered, as indicated by the arrow in Fig. 9, whereby the rear part of the mold is filled in advance of the front part and the mold cavity or space to be filled is gradually concentrated around the gate.

For the purpose of producing a casting consisting of a cylindrical body P, having an ex-



ternal annular flange  $p$  at one end, as shown in Fig. 11, the mold may be constructed as shown in Fig. 12. In this figure  $p'$  represents the outer part and  $p^2$  the inner part of the mold, both of which parts are mounted in any suitable way so that they can be tilted, for instance, by turning the mold about the center  $p^3$ . The inner mold-section is provided with a filling-gate  $p^4$  and is movable axially in the outer section. Preparatory to filling the mold is tilted to substantially the position shown in Fig. 12, and the inner section is so adjusted that the gate  $p^4$  opens into the lowermost part of the mold-cavity. The metal is now poured through the gate into the mold-cavity and at the same time the mold is tilted in the direction of the arrow, Fig. 12, and the inner mold-section raised in the inner section in the same measure as the filling of the mold progresses, whereby the liquid metal is deposited in the mold without any free fall and comes to rest immediately on entering the mold. The uppermost corner of the mold-cavity between the parts  $p'$   $p^2$  is filled during the final casting operation by the weight of the metal pressing the same into

this space and displacing any air contained in the same.

A flat triangular plate  $Q$  (shown in Fig. 13) may also be cast by moving the mold for the same about a center  $q$  in the direction of the arrow while beginning the filling at  $q'$  and terminating at  $q^2$ .

I claim as my invention—

The herein-described method of producing castings from hardening fluids, which consists in delivering the fluid from a gate into a mold, maintaining the gate substantially in line with the liquid-level in the mold as the same becomes filled by moving one of these members relatively to the other, and at the same time so tilting the mold that the end thereof remote from the gate is filled in advance of the end adjacent to the gate, substantially as set forth.

Witness my hand this 26th day of February, 1902.

CHRISTOPHER H. BIERBAUM.

Witnesses:

THEO. L. POPP,  
CARL F. GEYER.