(No Model.) 4 Sheets—Sheet 1.

W. C. FARNUM.

APPARATUS FOR CASTING CYLINDRICAL BODIES.

No. 482,405. Patented Sept. 13, 1892.

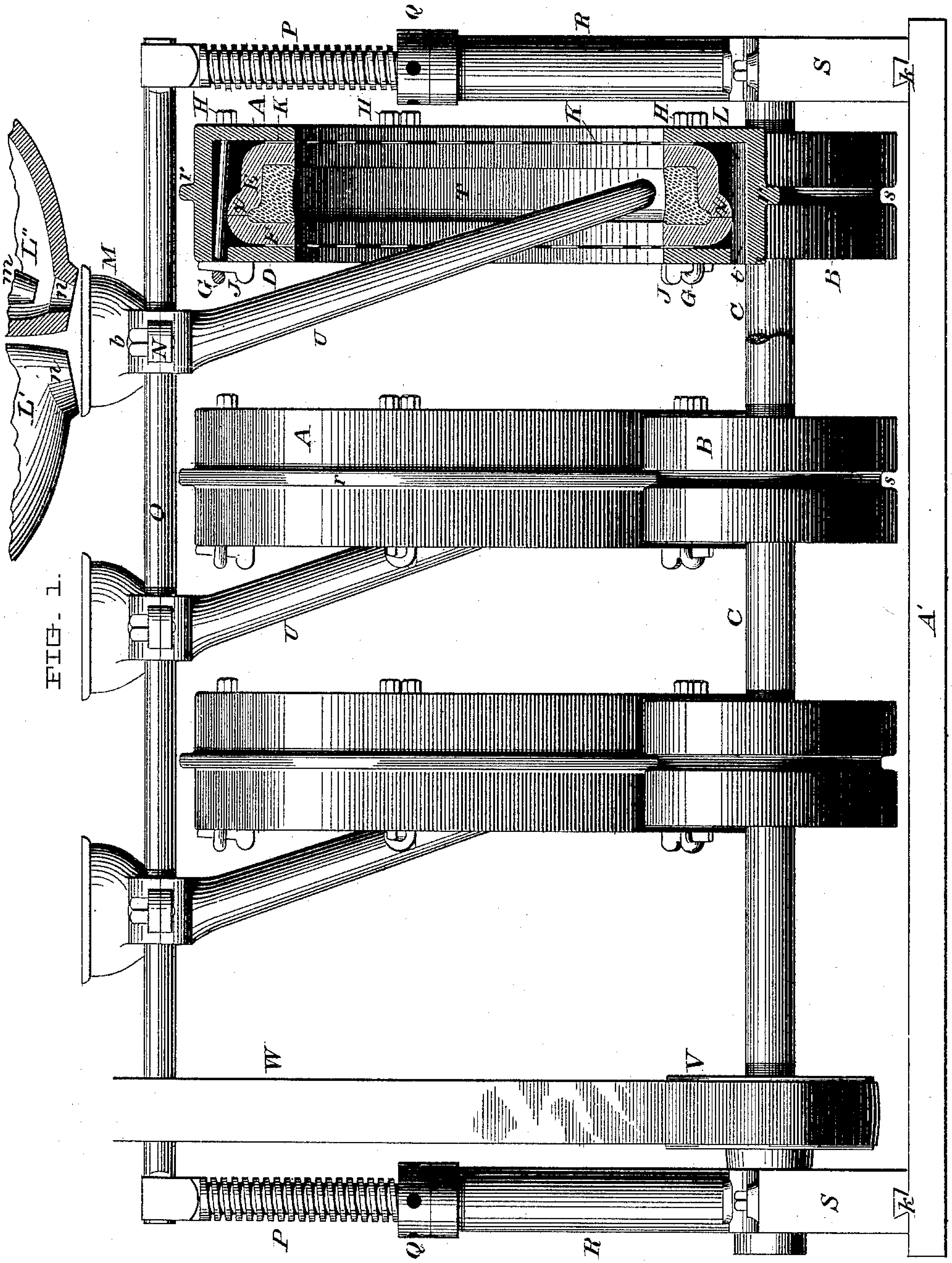


FIG. 1.

WITNESSES:

C. Ernest Canfield.
Edw. N. Worthington

INVENTOR:

WM. C. FARNUM.
By Franklin Scott, atty.

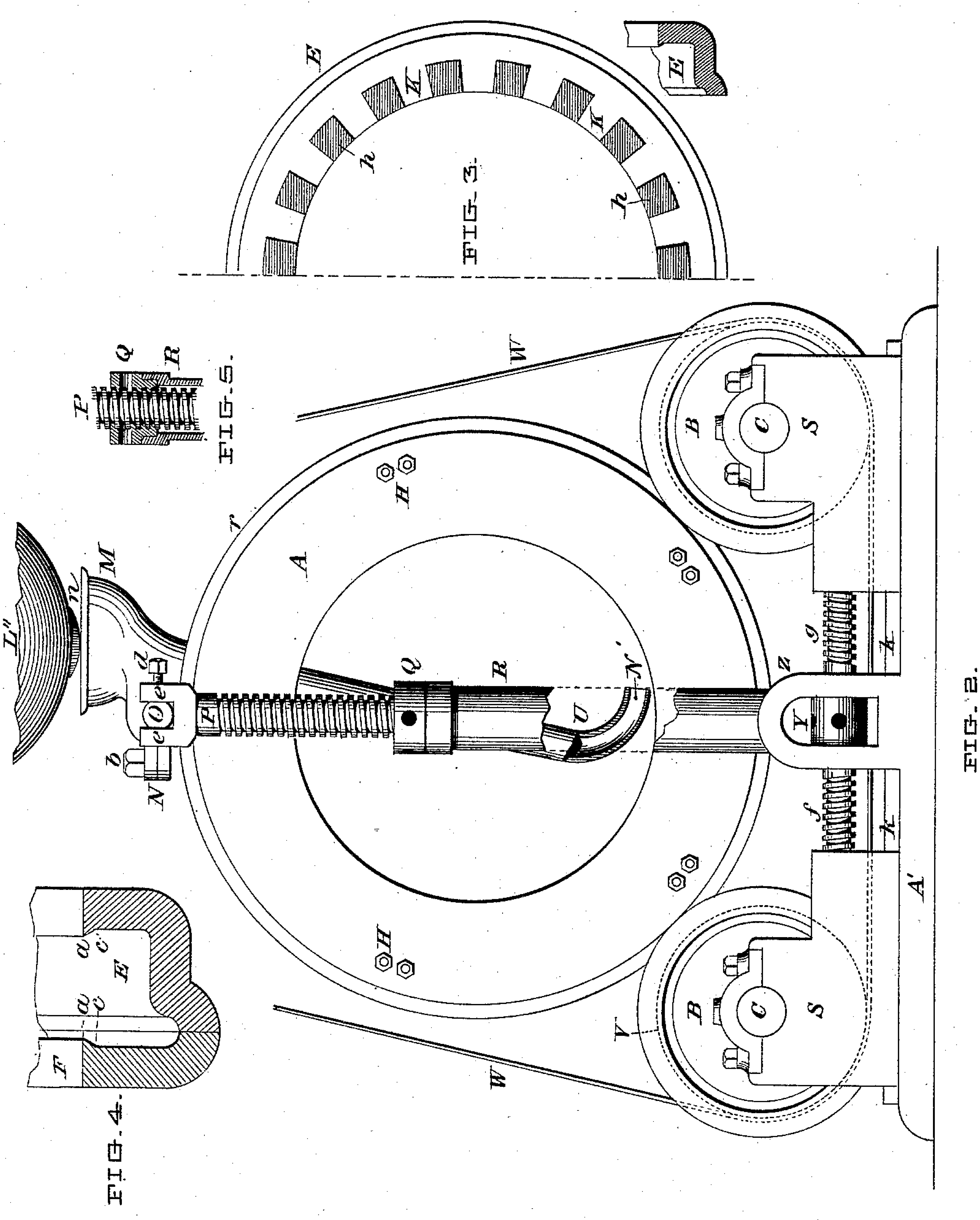
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 2.

W. C. FARNUM.

APPARATUS FOR CASTING CYLINDRICAL BODIES.

No. 482,405. Patented Sept. 13, 1892.



WITNESSES:

C. Ernest Canfield.

Edw. N. Worthington

INVENTOR:

WM. C. FARNUM.

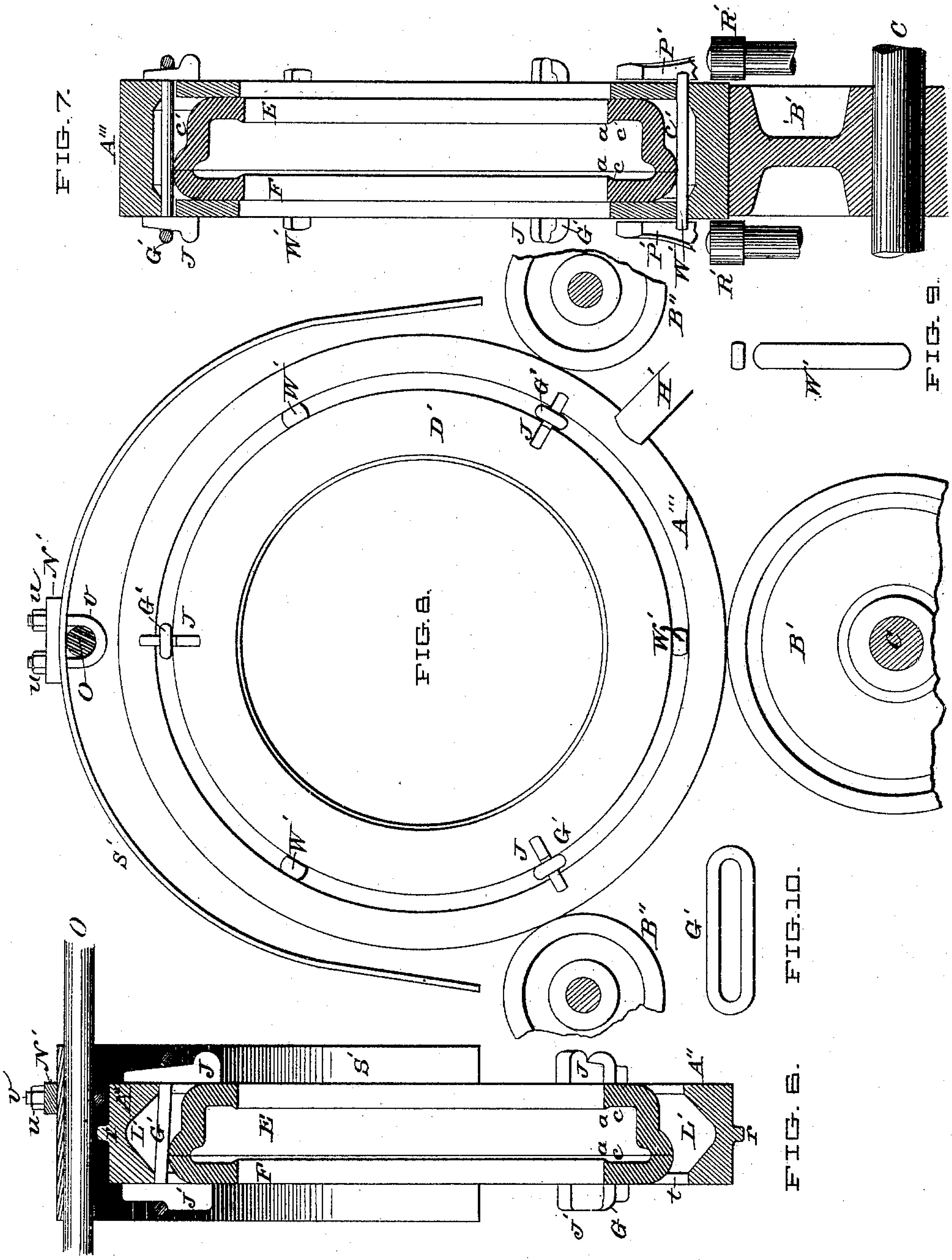
By Franklin Scott Atty

(No Model.) 4 Sheets—Sheet 3.

W. C. FARNUM.

APPARATUS FOR CASTING CYLINDRICAL BODIES.

No. 482,405. Patented Sept. 13, 1892.



WITNESSES:

C. Ernest Canfield.

Edw. H. Worthington

INVENTOR:

WM. C. FARNUM,

By Franklin Scott, Atty.

(No Model.) 4 Sheets—Sheet 4.

W. C. FARNUM.

APPARATUS FOR CASTING CYLINDRICAL BODIES.

No. 482,405. Patented Sept. 13, 1892.

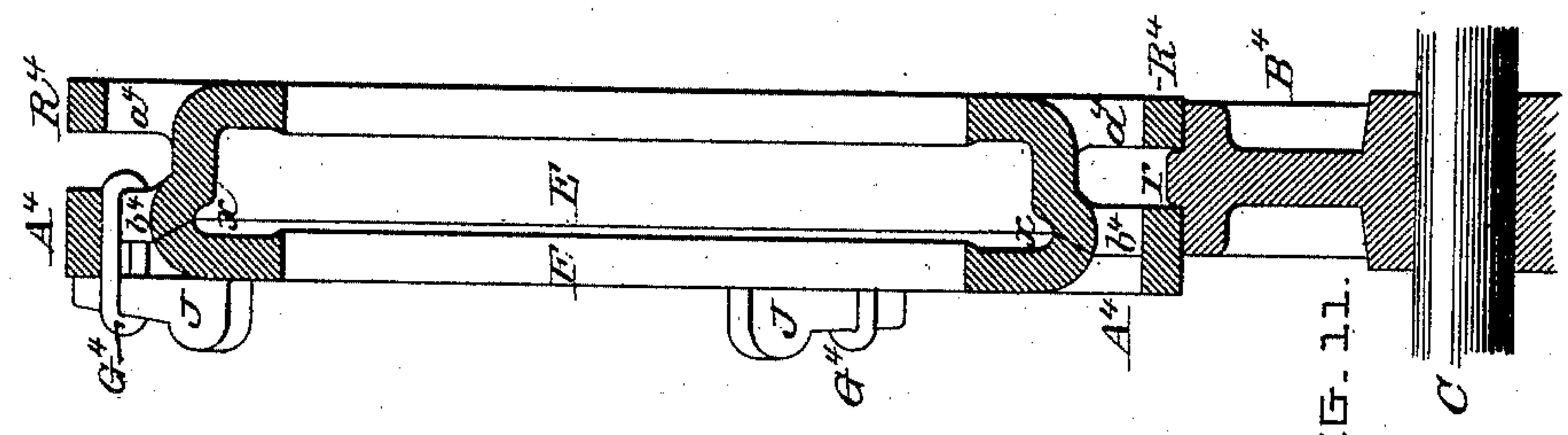


FIG. 11.

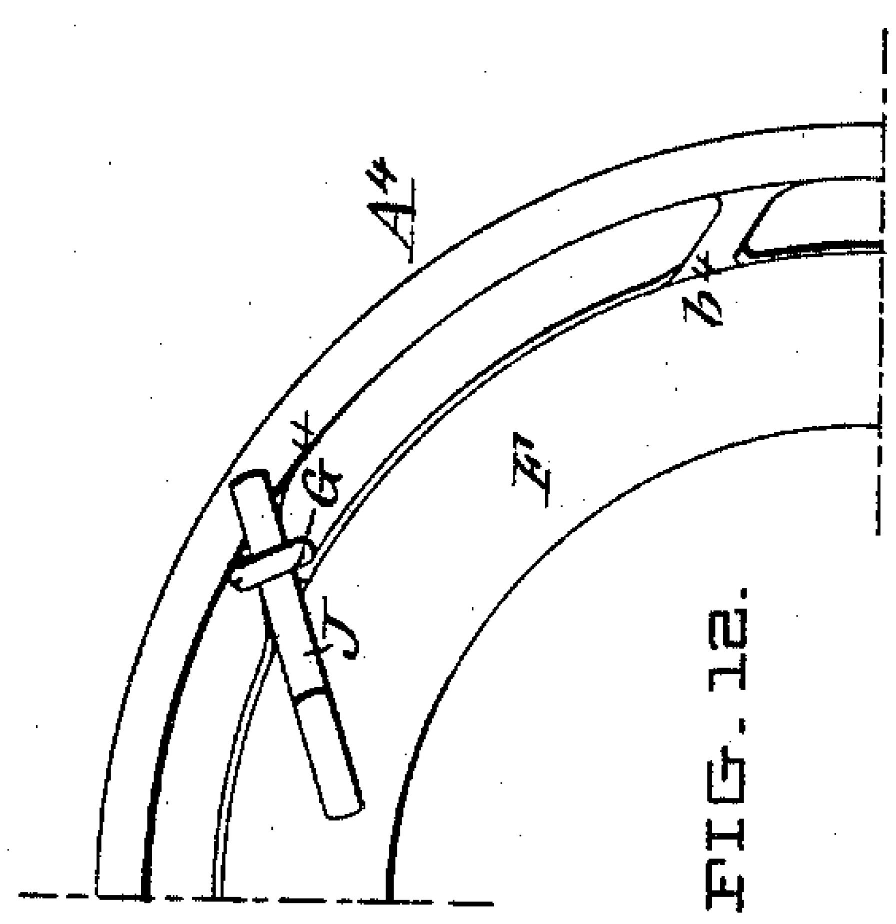


FIG. 12.

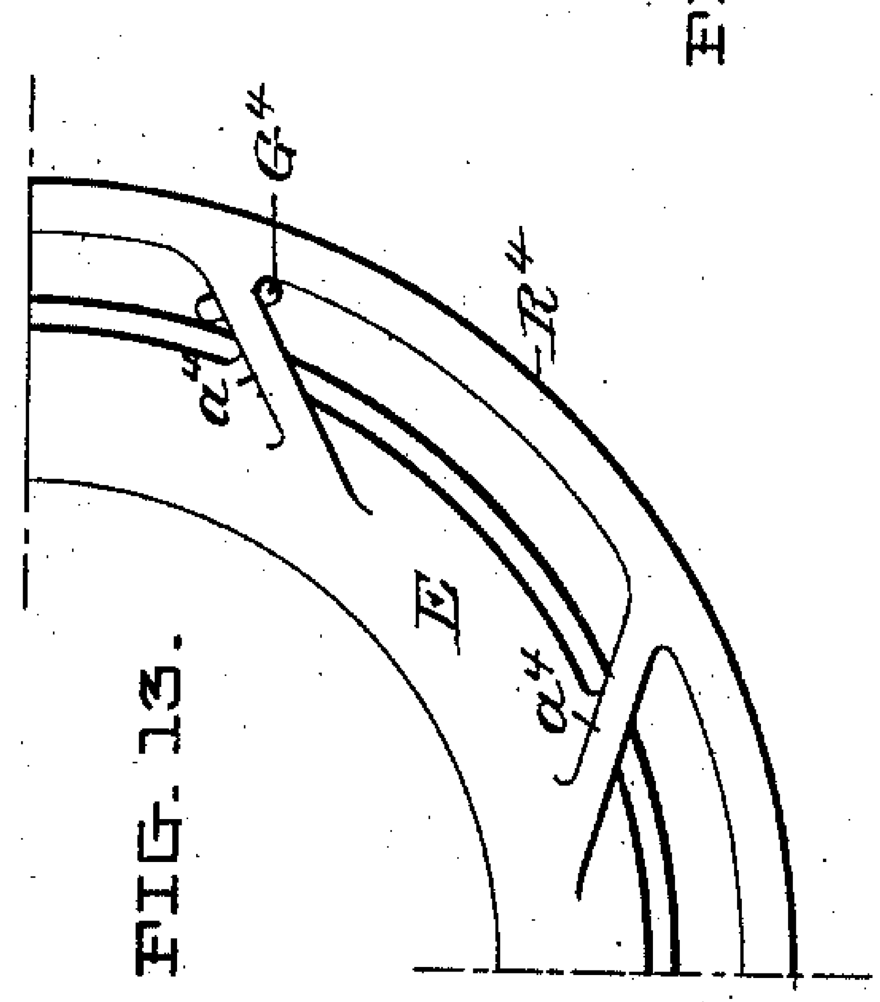


FIG. 13.

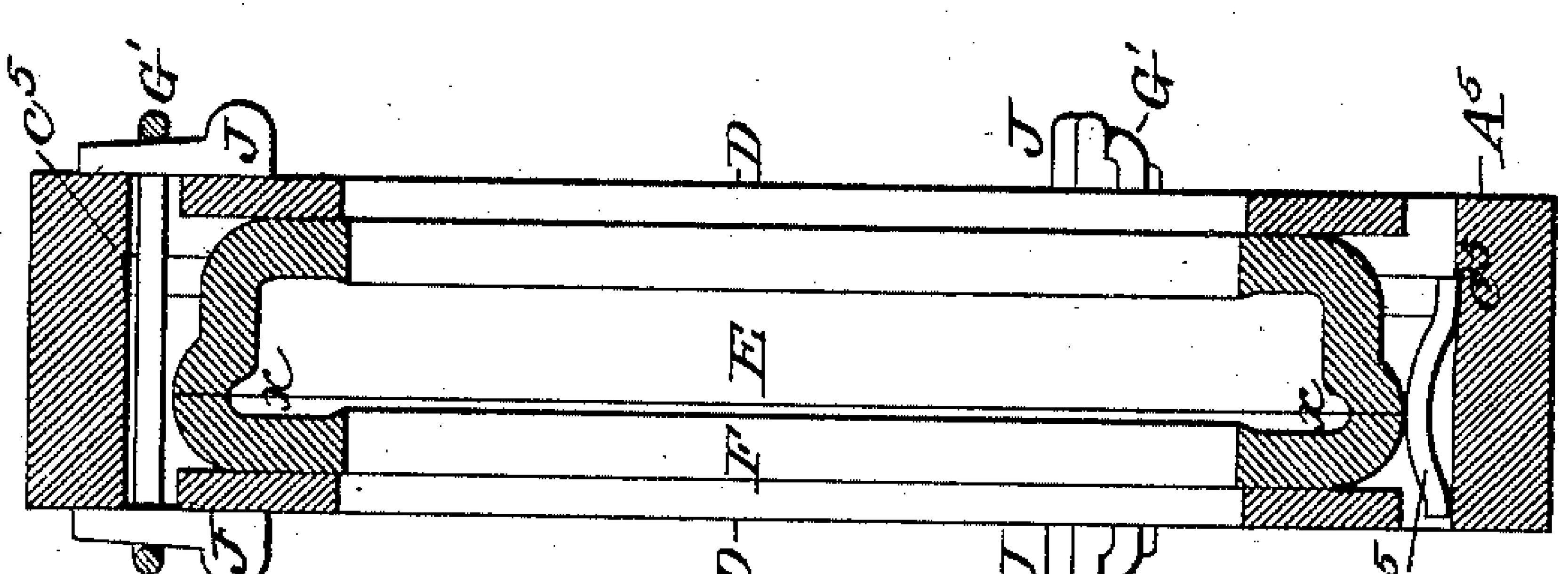


FIG. 14.

WITNESSES:

C. Ernest Canfield.

Edw. H. Worthington

INVENTOR:

WM. C. FARNUM.

By Franklin Scott, atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM C. FARNUM, OF CHICAGO, ILLINOIS.

APPARATUS FOR CASTING CYLINDRICAL BODIES.

SPECIFICATION forming part of Letters Patent No. 482,405, dated September 13, 1892.

Application filed February 9, 1888. Serial No. 263,438. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. FARNUM, of the city of Chicago, in the county of Cook and State of Illinois, have invented certain Improvements in Apparatus for Casting Cylindrical Bodies, of which the following description, in connection with the accompanying two sheets of drawings, constitutes a specification.

This invention relates to improvements in the art of making castings in rotating molds, wherein the molten metal is distributed to the peripheral parts of the mold when in rotation by centrifugal force, and also to special construction of the apparatus, whereby the process of making such castings is carried out.

The art of making castings in rotating molds under centrifugal force is not new; but in the various processes and apparatus heretofore devised for use in making cylindrical castings, wherein rotation and centrifugal force have been employed to equalize and condense the molten metal in its distribution to the periphery of the molds, failure has resulted from various causes. One difficulty has consisted in the fact that each mold has generally been built so as to require its own independent driving apparatus, from which it could not readily be detached, and such apparatus duplicated for each mold was necessarily very expensive. Another difficulty to contend against is the fact that in using steel it is essential when the charge is in the right condition to pour off the whole charge must be poured off at once, and if a large number of castings of moderate weight are to be made an extensive duplication of costly machinery to rotate the several molds is essential to dispose of a heavy charge of metal, and heavy charges are most desirable because most economical.

In some of the existing machines the construction of the molds and their attachment to or connection with the driving apparatus has been such that great difficulties existed in removing the mold from the machine and in detaching the casting from the mold after or before such removal. These defects and objections have prevented the introduction of this method of making cylindrical castings, and it is to overcome these objections and eliminate such defects of construction that the present apparatus has been devised.

The main advantages secured by this invention are simplicity and cheapness of the apparatus employed. The flasks containing the molds are themselves cylindrical and are mounted upon and driven by friction-rollers by rolling contact alone, and the flask, having no fast connection with any part of the driving apparatus, can be rolled out of position in the machine in a moment at any time by stopping the machine. A number of sets of driving rollers can be arranged on a single pair of driving-shafts, and thus a large number of molds can be rotated at once and with a small outlay of driving-power. In pouring the metal the direction and force of the current are in the same direction as the rotation of the molds, and as a result the metal is laid, as it were, in the mold evenly and uniformly about its periphery with the least possible agitation and by a continuous stream. This, coupled with the centrifugal force, tends to solidify the metal throughout the whole mold, and thereby expels gases and entirely obviates blow-holes. It also facilitates uniform shrinkage by producing in the pouring a uniform temperature. Another result attributable to the influence of the centrifugal force upon the metal as it is received in the mold is that it will not flow in the mold, being confined to the point of impact as it enters the mold by such force. This result is secured by adjusting the velocity of the current of metal as it leaves the mouth of the runner to correspond with the velocity of rotation of the mold at the point of impact. Compound castings made of two or more varieties of metal may be made by successively pouring the several kinds of metal in the same mold, and under the influence of the centrifugal force exerted thereon the resultant product will be a casting made up of concentric rings of different metals, each ring or layer being united to its next contiguous layer by concentric fusion.

The construction and operation of my apparatus may be deduced from the accompanying drawings, wherein—

Figure 1 shows a side elevation of a gang of flasks and molds, one of the flasks and molds being shown in diametrical section. Fig. 2

shows an end elevation of the same. Fig. 3 shows a semicircular side view of one-half of an annular mold. Fig. 4 shows a transverse section, on an enlarged scale, taken across one side of the annular mold. Fig. 5 is a sectional view of the column nut and screw whereby the height of the runners is adjusted. Fig. 6 shows a modification of the flask and of the means for centering and confining the mold therein. Fig. 7 shows another modification of the flask and of provisions for preventing the flask from leaving the driving-rolls when in motion. Fig. 8 is a side elevation of the apparatus shown in Fig. 7, and also exhibits a system of driving and supporting rollers different from those shown in Fig. 2. Fig. 9 is a side and end elevation of one of the chucking-blocks used between the inside of the flask and the edge of the mold, as seen in Fig. 8. Fig. 10 is a side view of one of the links employed in structures like Figs. 6 and 7. Fig. 11 shows a mold provided with a driving-rim cast integrally therewith. Figs. 12 and 13 exhibit partial views of opposite sides of the same mold. In this case the mold and flask are virtually consolidated. Fig. 14 shows another syle of yielding and centering device to be placed between the edge of the mold and the interior of the flask.

In the several modifications or varieties of flasks shown in Figs. 1, 6, 7, and 11 no specific construction of either is preferred to the exclusion of the others.

My invention may be divided into two branches for purposes of elucidation and description, the first of which relates to the mold and flask and provisions for centering and holding the former within the latter. The second relates to the mechanism for supporting, guiding, and rotating the flask in use. The apparatus shown is designed for casting tires for car and locomotive wheels, but by a substitution of molds and flasks may be employed for making a great variety of annular or cylindrical castings.

In this specification I shall confine myself to such a style of apparatus embodying my invention as is adapted to making steel tires for car-wheels. The mold in which I cast the tire is seen in transverse section and half-plan in Figs. 1 and 3. It consists of two annular sections F and E, which meet at the joint *xx*, which is at the periphery of the flange of the wheel. This mold has only sufficient depth radially to receive and retain sufficient amount of material to cast a tire and afford enough internal surplus to provide for turning and truing up the inside of the tire to fit the rim of the car-wheel. Each section of the mold has cast on its exterior raised radial ribs or ledges *h h*, which when the mold is chucked in the flask bear against the wall of the flask on one side and against the cover-plate on the other. The intervals K K between ribs *h h* constitute an air space, through which a circulation of air passes when the flask is rapidly revolved. Such circulation, generated by centrifugal force exerted on the air between the edge of the mold and the walls of the flask, contributes to the cooling of the mold and flask after the mold is charged. The ribs *h h* may as well be on the interior of the flask as on the exterior of the mold, and it is immaterial on which they are constructed, and any other kind of air passage or flue communicating from the open interior of the mold to the inclosed annular chamber L between the mold and the flask A and then out to the open air would be a substitute for the device shown. In the construction shown the air passes out from the flask through the annular space *t*. (Shown in Fig. 1.) The ribs *h h* do not appear in the mold shown in Fig. 6, because the internal flange of flask A and the annular ring or plate D are dispensed with. The interior annular corners of the mold are beveled, as seen at *a c*, Fig. 4. The office of these annular bevels is to hold the casting concentrically in the mold while it is cooling and shrinking, and also to prevent the shrinkage from leaving the casting loose in the mold. In this case the effect of shrinkage is to cause the casting to contract and draw down upon and hug the bevels *a c*.

The designs A, A″, A‴, A^4, and A^5 are five modifications of practically the same flask. Each consists of an annulus, within which the mold is either permanently or removably, but concentrically, fixed, but differs somewhat as to the means for holding the mold, as will hereinafter appear.

The flask shown in Fig. 1 consists of an annular shell A of L shape in cross-section, the central portion of the head or disk being removed to coincide with the internal diameter of the mold. This part of the flask is provided with an annular cover-plate D, the external diameter of which is something less than the internal diameter of the flask, thus leaving an annular space *t* between the edge of the cover and the flask. A series of links G G are fitted to the head of the flask, as at H H, and extend through the same between the edge of the mold and the inside of the wall of the flask and are so arranged that when the mold is placed in position in the flask its periphery will bear against these links G G, so as to incline their outer or free ends out against the inner surface of the flask, as shown in Fig. 1. By these means the mold is centrally adjusted in the flask. The cover D being laid over the mold inside of the links, the keys J J are then passed through the links and rest on the cover and on the edge of the rim of the flask, and, being tightly driven home, securely bind together the mold and the several parts of the flask. When the mold and links G G are in position as seen in Fig. 1, the round edge of the mold is tangent to each link and bears against it. When the mold is charged and expands with the heat, these links spring or yield slightly to accommodate themselves to such expansion, and when the parts are cool they return to their proper shape again. The exterior of the flask has a raised rib *r* extending around its circumference, which is provided to co-operate with the groove or grooves in the guiding or driving rolls to prevent the flask from displacement sidewise when in motion.

The means provided for rotating the flask consists of a series of driving-rolls B B, mounted on shafts C C, which rotate in journal-boxes S S. These journal-boxes are made adjustable with reference to each other by means of a screw Y, provided with right and left threads *f g*, which work in nuts in the blocks S S. The boxes S S slide on ways *k k*. The extensible adjustment secured by the screw Y is necessary to accommodate flasks of different diameters in cases where two supporting and driving rolls to each flask are used, as in Figs. 1 and 2. The shafts C C are each provided with a driving-pulley V V and are driven from a motor by the belt W, which passes around both of them, as seen in Fig. 2. As many driving-rolls B B may be arranged in a gang on one shaft as can be profitably operated.

Each of the molds is provided with a runner for conveying the molten metal from the ladle to the mold. This consists of funnel M, having a clamping attachment N for fastening the same to a bar O, and a tubular spout U, terminating in a curved nozzle N′, for delivering the metal to the mold. This clamping attachment, as shown, is merely an enlargement on the casting of the funnel M, which is bored out to take in the bar O, and the part which is to form the ears is sawed through parallel with the axis of the bore and then fitted with the clamping-screw, whereby the ears N of the clamp may be pinched together upon the bar *o*. This clamping device may be of any other form of construction. This curve N′ points in the direction of the rotation of the mold and is so constructed that it may deliver the metal to the revolving mold at a velocity corresponding with or approximating as nearly as may be to the velocity of the rotation of the mold, so that the metal shall be deposited in the mold with as little agitation as possible and in a way that its tendency to flow in the mold will be obviated.

The gang of molds is provided with a corresponding gang of runners, which are arranged on the bar O in substantially the manner shown, each runner being attached by a clamp N and set-screw *b*. By means of this clamp the runner can be turned and adjusted on the bar O to any desired inclination or may be slid along the bar for lateral adjustment. The bar O extends over the whole gang of molds and is supported at each end in the forks *e e* of the vertically-adjustable supports P P. These supports may be constructed in any suitable way to secure vertical adjustment, and in this case I have shown them as consisting of a stationary screw P, which works in the rotary nut Q. This nut is seated in a suitable bearing (see Fig. 5) provided therefor in the top of standard R. The bar O when in position is secured to the tops of its adjustable supports P P by means of set-screw *d*. After the pouring of a set of tires the set-screws *d* are loosened and the bar O, with its appendages, may be picked up by a crane or otherwise and swung around out of the way.

In connection with the apparatus hereinbefore described I employ one or more crucibles or ladles to handle the metal, partial views of which are seen in Figs. 1 and 2. These are very similar in design to those used in steel-foundries and are each provided with a discharge spout or nozzle *n* at the bottom, which is closed by a stopper *m*, which is attached to a handle and is made of the usual refractory material. These ladles are mounted on trucks running on tracks above the runners (not shown in the drawings) and are so constructed by placing the spouts to one side of the ladle that two of them can be brought into position over a runner-funnel, and their contents may be either successively or simultaneously discharged into the runner.

By means of this apparatus it becomes feasible to make compound castings of two or more different metals. By filling one ladle with steel and the other one with iron a compound casting may be made by partially filling the mold from one ladle and then cutting off this supply, introducing the other metal to complete the casting. In doing this care is taken not to allow the runner to become empty of one metal before the other is introduced, and thus a perfect union of the two metals in the casting is secured.

In cases where protection would be necessary or desirable I have provided a shield S′, Figs. 6 and 8, for each of the molds, which is secured to the bar O by the yoke or clamp N′ *v*. This guards against accidents resulting from matter thrown from the mold or flask by centrifugal force. These shields are removed with the bar O and the runners whenever the same are displaced for the purpose of emptying the flasks.

I have shown in Figs. 7 and 8 two methods of guiding the flask to preserve its proper working position in connection with the supporting or driving roll or rolls. These are substitutes for the rib *r* and grooves *s* of Fig. 1. In Fig. 7 I have shown two opposite guides or studs P′ P′, one of which is seen in Fig. 8. When these are employed, they can be used in such numbers and at such points on either side of the flask as experience may dictate. Another device is also shown in Fig. 7, which consists of two fixed studs arranged one on each side of the flask, upon each of which a friction-roll R R is pivoted. These run in close proximity to the sides of the flask and prevent lateral displacement from the driving-roll.

The flask may be driven by one or more driving-rolls. In Fig. 8 I have shown a single driving-roll, upon which the flask rests, and two guiding-rolls B'' B'', placed fore and aft the driver. In this modification of my apparatus the surfaces of the flask and of all the rolls are smooth, the flask being kept in position by the stud-guides P'.

The modification of flask seen in Fig. 7 differs from that of Fig. 1 in having two similar annular loose heads or covers in place of one loose and one solid cover and in the further particular that the flask mold and covers are held together exclusively by links and keys.

In order to assemble the several parts concentrically, the several blocks W' (shown in detail in Fig. 9) are inserted between the periphery of the mold and the inner edge of the flask. The links G', being thinner, are readily pushed through the annular space between the mold and flask and are held in position by means of keys or wedges J J, inserted through their protruding ends, as shown. These keys bear against the surface of the covers D' and the edge of the flask A''', and, being tightly driven up, securely bind the whole combination together.

In the modification shown in Fig. 6 the flask consists simply of a ring or hoop of the same thickness as the thickness of the mold provided with the circular rib r, as in Fig. 1, but having no side covers, as in Figs. 1, 2, and 7. The flask and mold are held together by links and keys similar to those shown in Fig. 7. For greater convenience in setting up a flask and mold one set of keys is preferably made like J' in Fig. 6, having a shoulder which sets up close to the link and aids in preventing displacement. The other key is inserted through the other end of the link and rests on the mold and edge of the flask. In this variety I have shown the interior of the flask-rim heavily chambered, as at L', which is done for the purpose of making the flask tighter and of creating a cooling-chamber around the wheel-mold.

Fig. 11 shows a style of combined flask and mold. The mold consists of the two sections E and F, parting at the joint x x. Section E is surrounded by the rims A^4 R^4, with which it is connected by the spokes or webs a^4 and b^4. These webs are of such thickness that they can yield under the expansion by heat of the interior mold, and by reason of their diagonal position will do so whenever the mold and rim are unequally heated. Thus these webs constitute a yielding connection between the mold and external rims and hold the mold in a central position, as well as yield to its calorific expansion in the casting process.

Figs. 12 and 13 show the edge view of the webs. The two halves of the mold are held together by means of links G^4 and keys J, the links passing around webs b^4 and projecting above the surface of the mold sufficiently to admit of the insertion of key J, as shown in Fig. 11.

In Fig. 14 the provisions for centering the mold consist of a series of curved flat springs S^5, which are inserted at intervals between the flask and the mold, so that the edge of the mold shall bear against the high part of the spring.

For convenience in setting up the mold and as a means of bringing the springs S^5 to a uniform adjustment an annular shoulder or groove c^5 is cut in the interior of the annulus A^5, within which one end of said springs find lodgment, the other end being free to come and go with the expansion of the mold.

My method of making tires or other similar cylindrical castings with this apparatus consists in first properly setting up each flask and mold and mounting it in its proper position on its driving-rollers. The mold then is preferably heated and smoked slightly, the mold meanwhile revolving slowly. This done, the molds are then speeded up to a speed of from three to six hundred revolutions per minute, or at a rate sufficiently rapid that the centrifugal force exerted on the metal in the molds will firmly and soundly condense it, so that all blow-holes and like imperfections will be obliterated. The metal is then rapidly poured into the funnel M of the runner, and as the mold revolves it is rapidly delivered through the nozzle N' as nearly as may be at a tangent to the circle of revolution of the mold. In this way the metal is delivered in the mold in fused spiral layers, whereby the casting is rendered nearly, if not entirely, homogeneous.

I therefore claim as my invention—

1. The combination of the annular flask inclosing annular cover-plates and inclosed annular mold, with space between said mold and flask, and yielding links and keys for uniting said side plate, mold, and flask and binding the parts of the combination together, substantially as specified.

2. The combination, with the revolving annular flask and inclosed mold, of a tubular runner having a funnel-shaped top attached to a removable bar supported by suitable standards, substantially as specified.

3. The combination, with a gang of revolving molds, of a corresponding gang of runners, each being attached by an adjusting-clamp to a common moveable bar, and standards for supporting the same, said bar being removable from said standards, substantially as set forth.

4. The described annular flask, having circumferential guiding groove or rib and carrying a concentric annular mold, in combination with a single pair of supporting-rollers, each ribbed or grooved to co-operate with the corresponding devices on the flask, by the revolution of one or both of which the flask is rotated independently of the other driving connections, substantially as described, and for the purposes set forth.

5. The combination, with a rotating annu-

lar flask carrying a mold, of two supporting-rolls, one or both of which may be drivers, and a suitable device connected with the bearings of said rolls, whereby they may be distended or brought together to accommodate flasks of different diameters, substantially as specified.

6. A gang of runners mounted on a single horizontal bar and vertically-adjustable supports for carrying said bar, in combination with a like gang of revolving molds and flasks mounted on a corresponding series of supporting and driving rolls, substantially in the manner described, and for the purposes set forth.

In testimony whereof I have hereto subscribed my name this 24th day of January, A. D. 1887.

WILLIAM C. FARNUM.

In presence of—
FRANKLIN SCOTT,
C. ERNEST CANFIELD.