(No Model.) 8 Sheets—Sheet 1.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

FIG 1

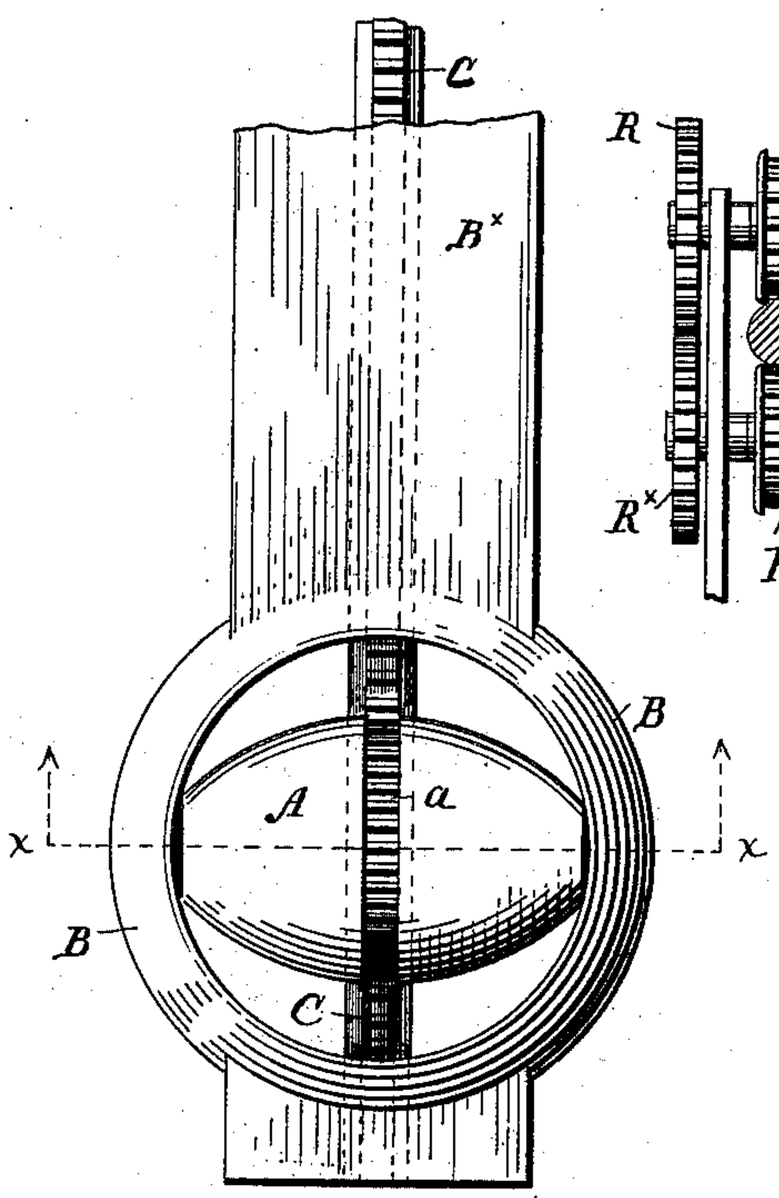


FIG 2½

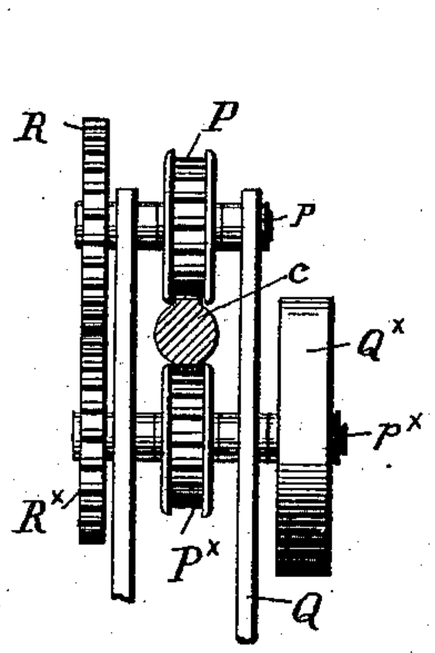


FIG 3

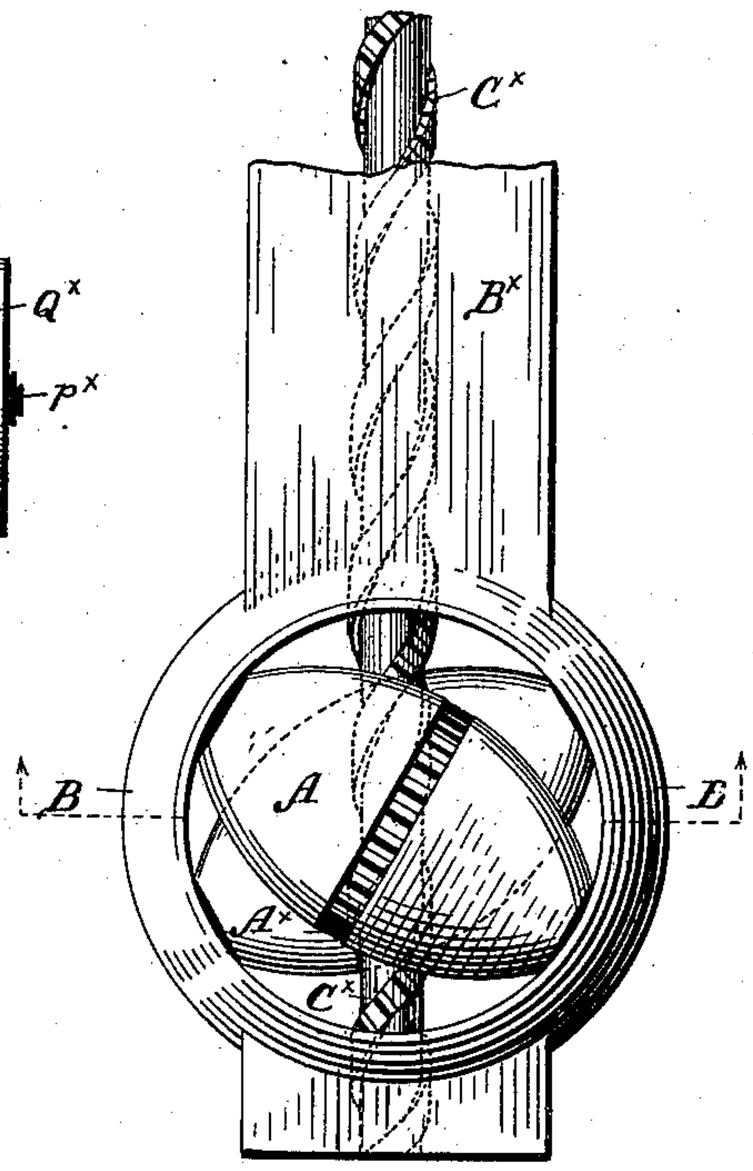


FIG 2

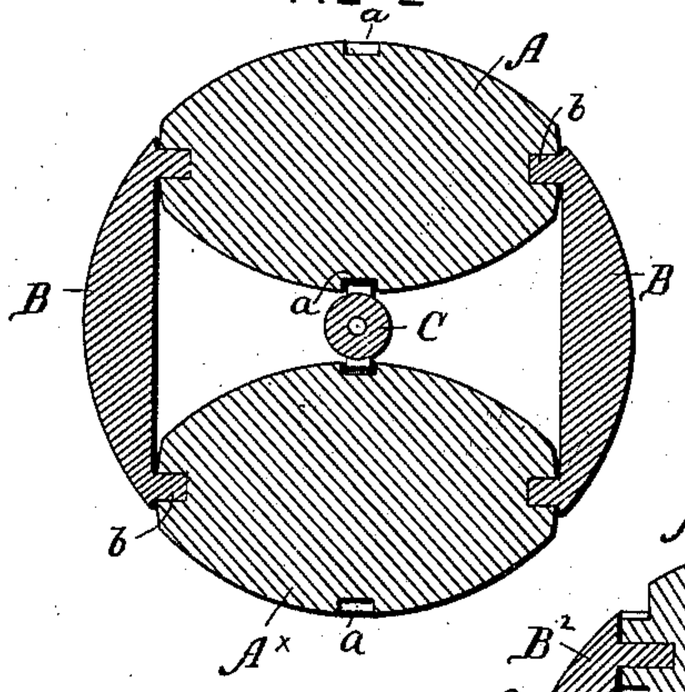


FIG 4

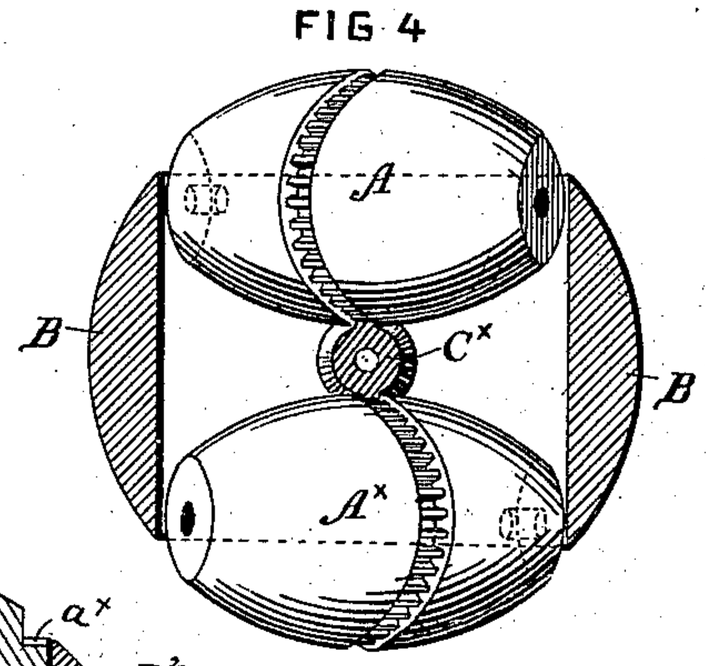
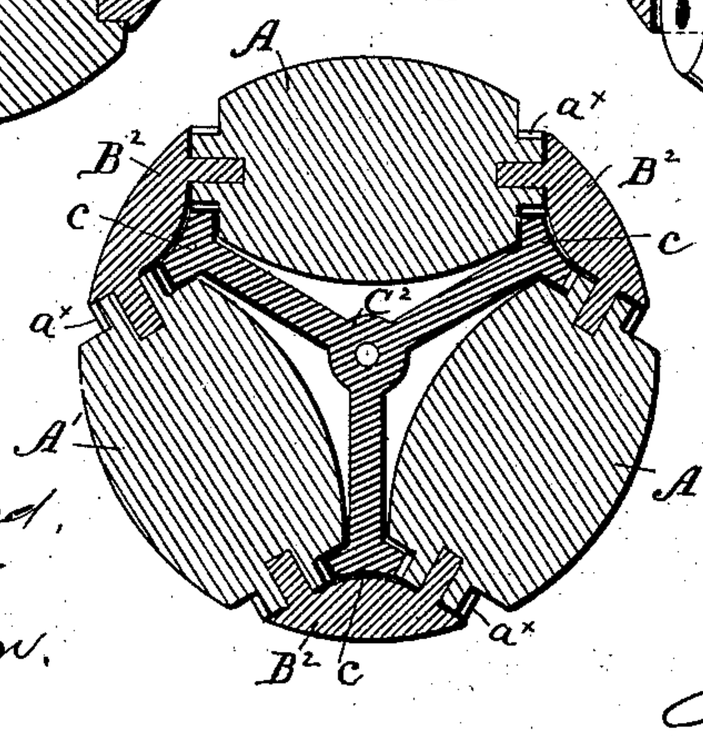


FIG 5



WITNESSES:

R. B. B. Shepherd.

F. Norman Dixon.

S. P. M. Tasker

INVENTOR

By his Attorneys

Wm. C. Strawbridge

J. Bonsall Taylor.

(No Model.)

8 Sheets—Sheet 2.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

FIG 8

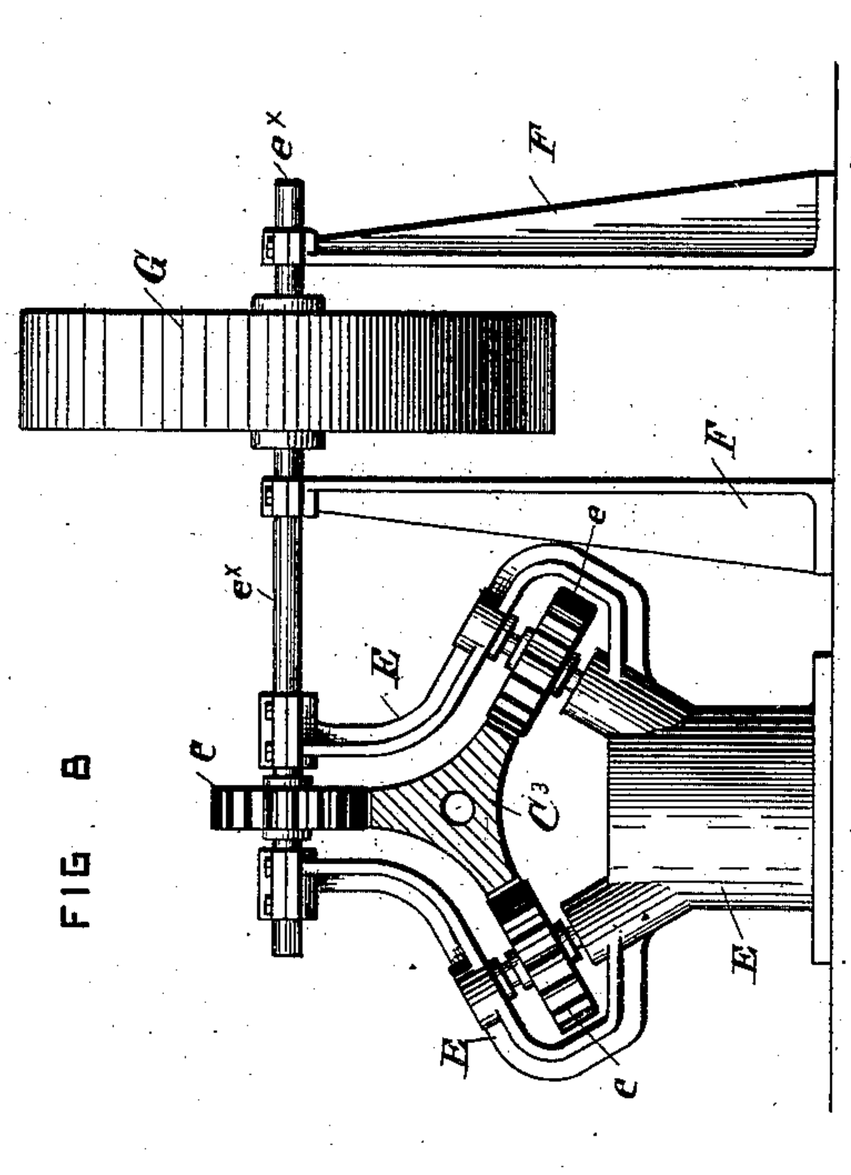


FIG 7

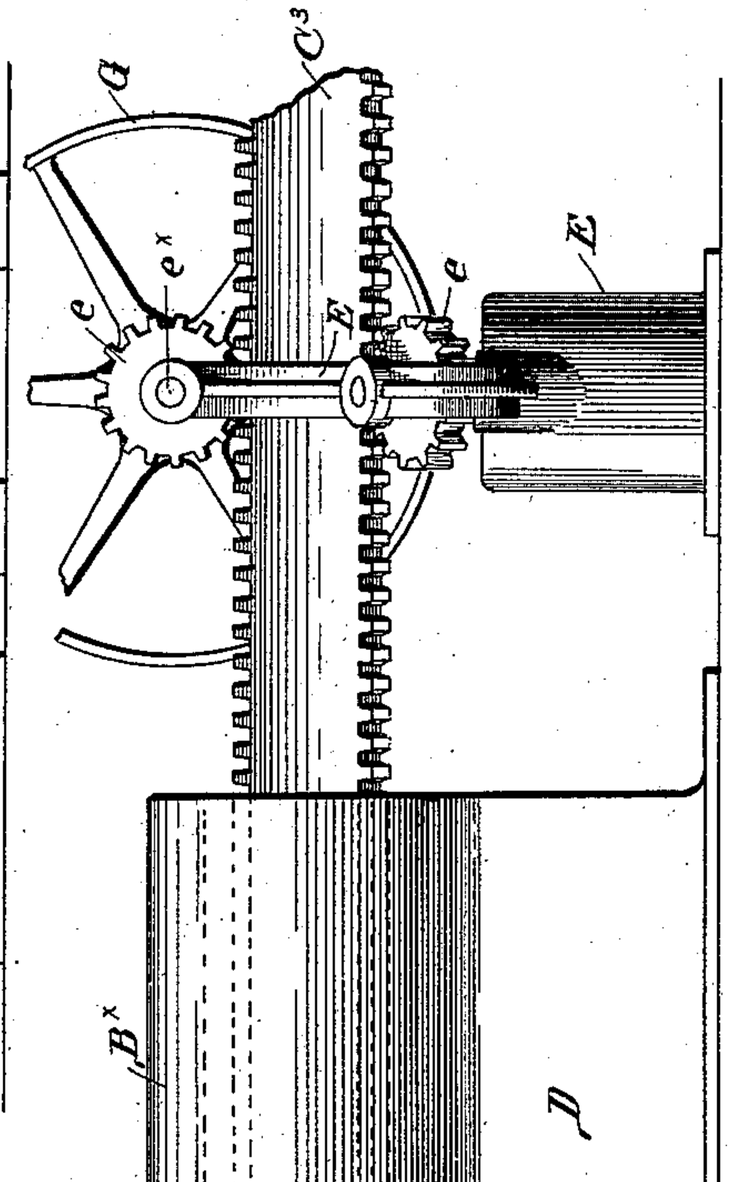
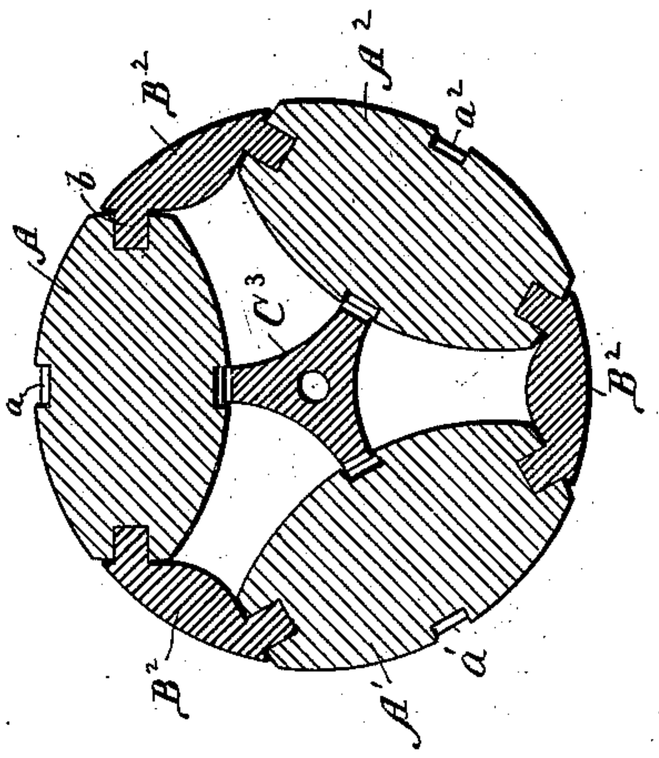


FIG 6



WITNESSES:

R. B. Shepherd.

F. Norman Dixon.

INVENTOR

S. P. M. Tasker

By his Attorneys

McCawdrick & Bonsall Taylor

(No Model.)

8 Sheets—Sheet 3.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

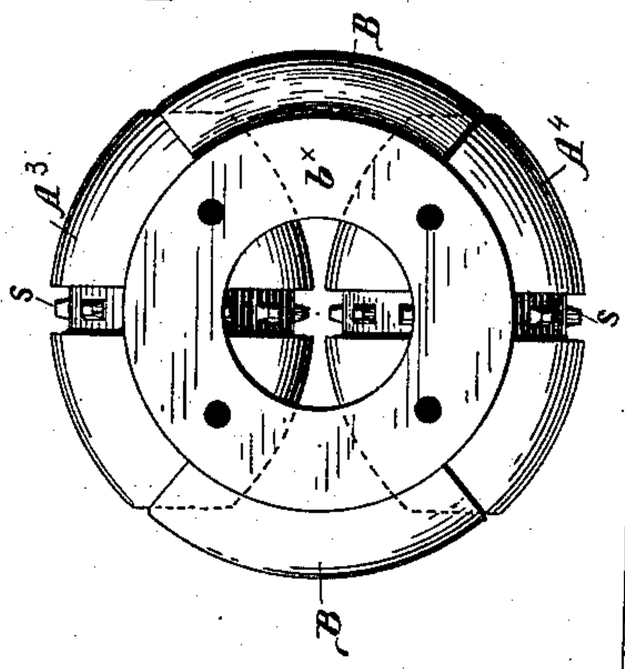


FIG 10

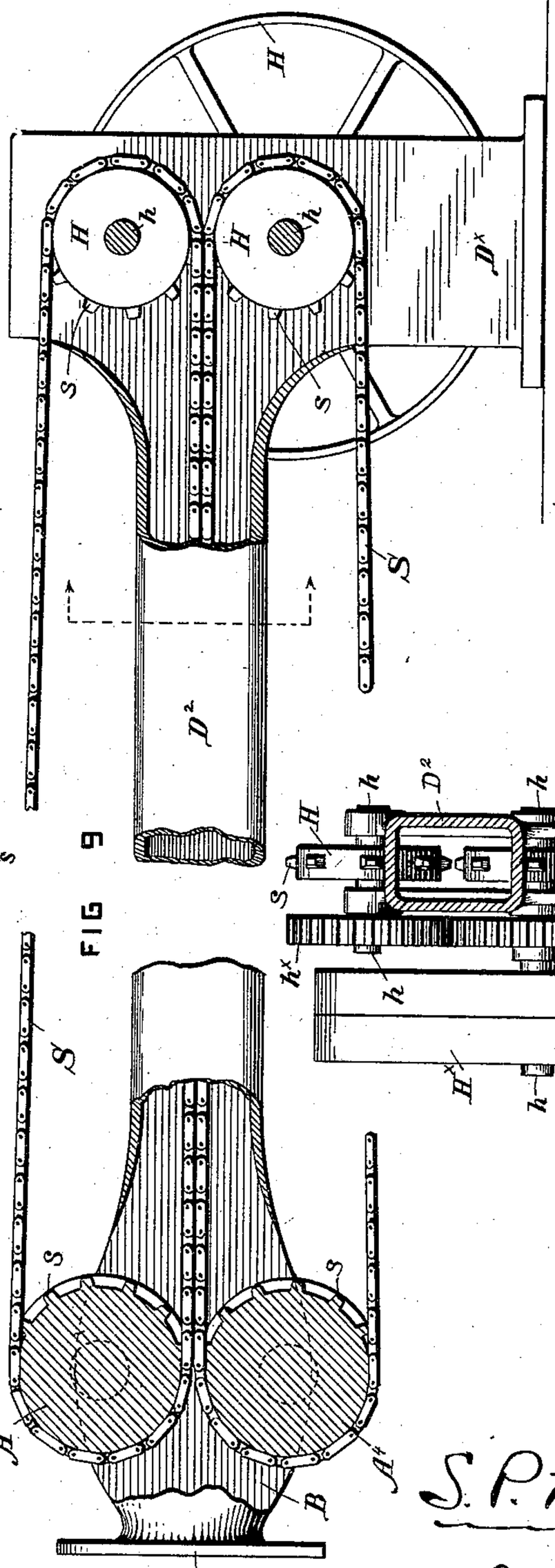


FIG 9

FIG 11

WITNESSES:

R. B. Shepherd.

F. Norman Dixon.

S. P. M. Tasker

INVENTOR

By his Attorneys

Wm. C. Strawbridge

J. Bonsall Taylor.

(No Model.)

8 Sheets—Sheet 4.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

FIG 14

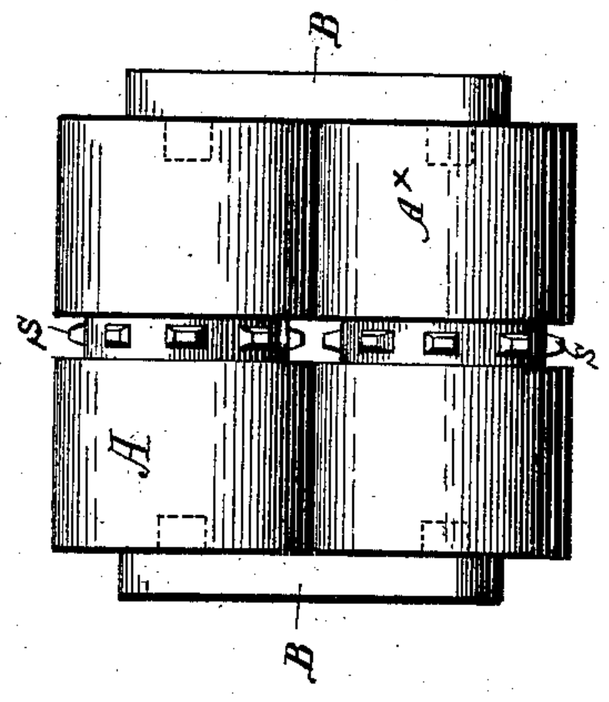


FIG 14½

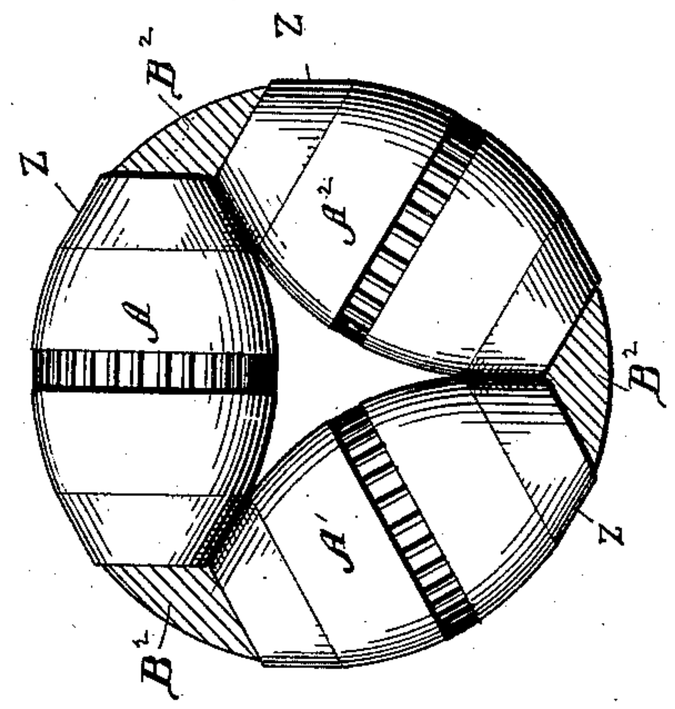


FIG 12

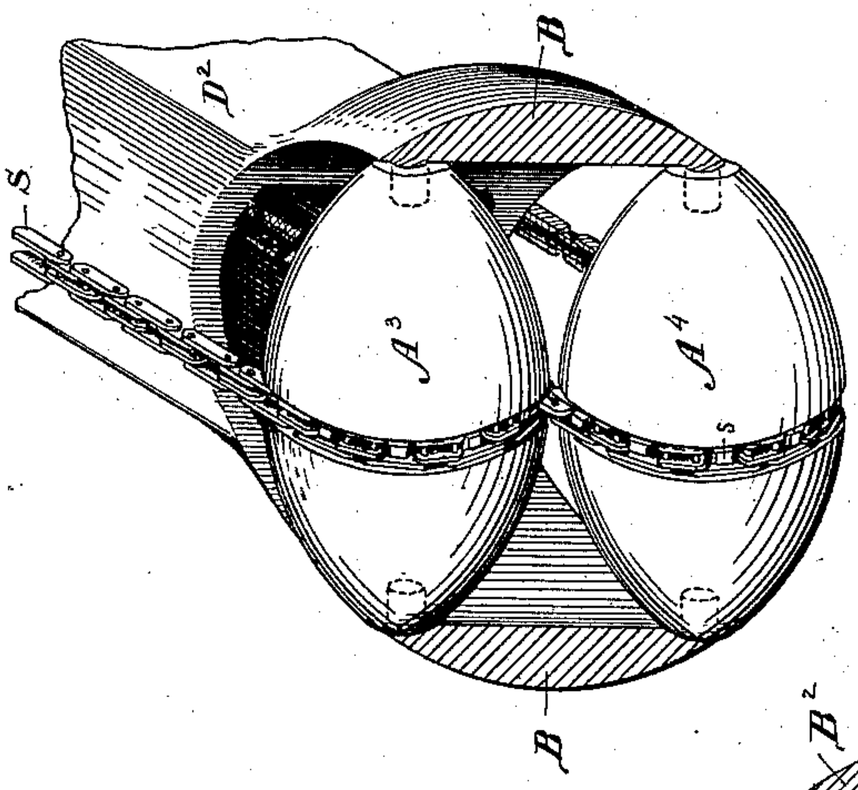


FIG 15

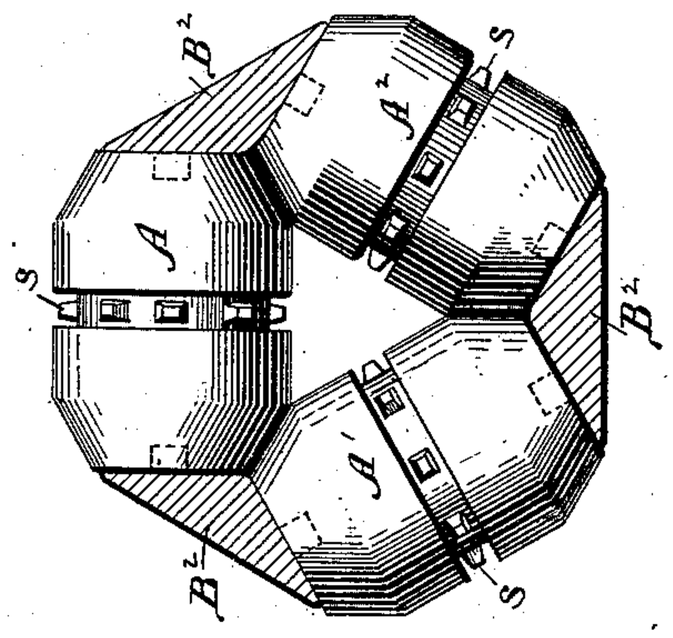
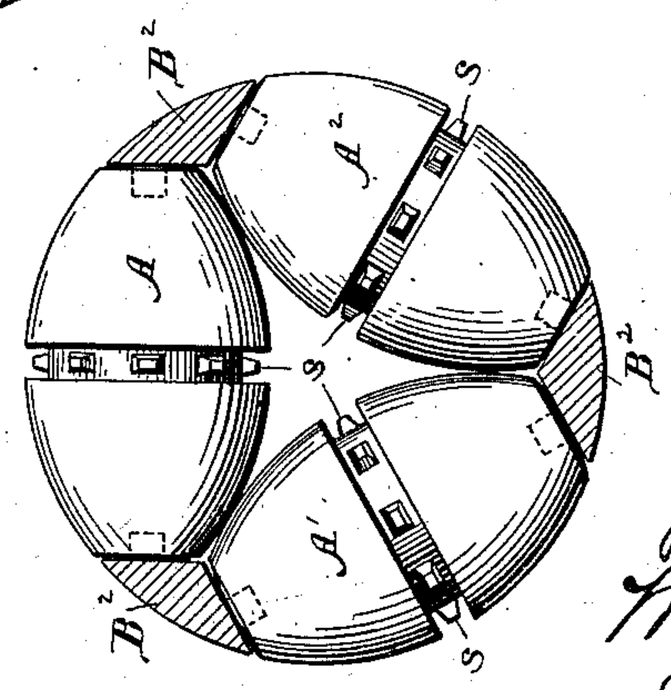


FIG 13



WITNESSES:

Wm. B. Shepherd.

F. Norman Dixon.

S. P. M. Tasker.

INVENTOR

By his Attorneys

Wm. C. Strawbridge.

J. Bonsall Taylor

(No Model.)

8 Sheets—Sheet 5.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

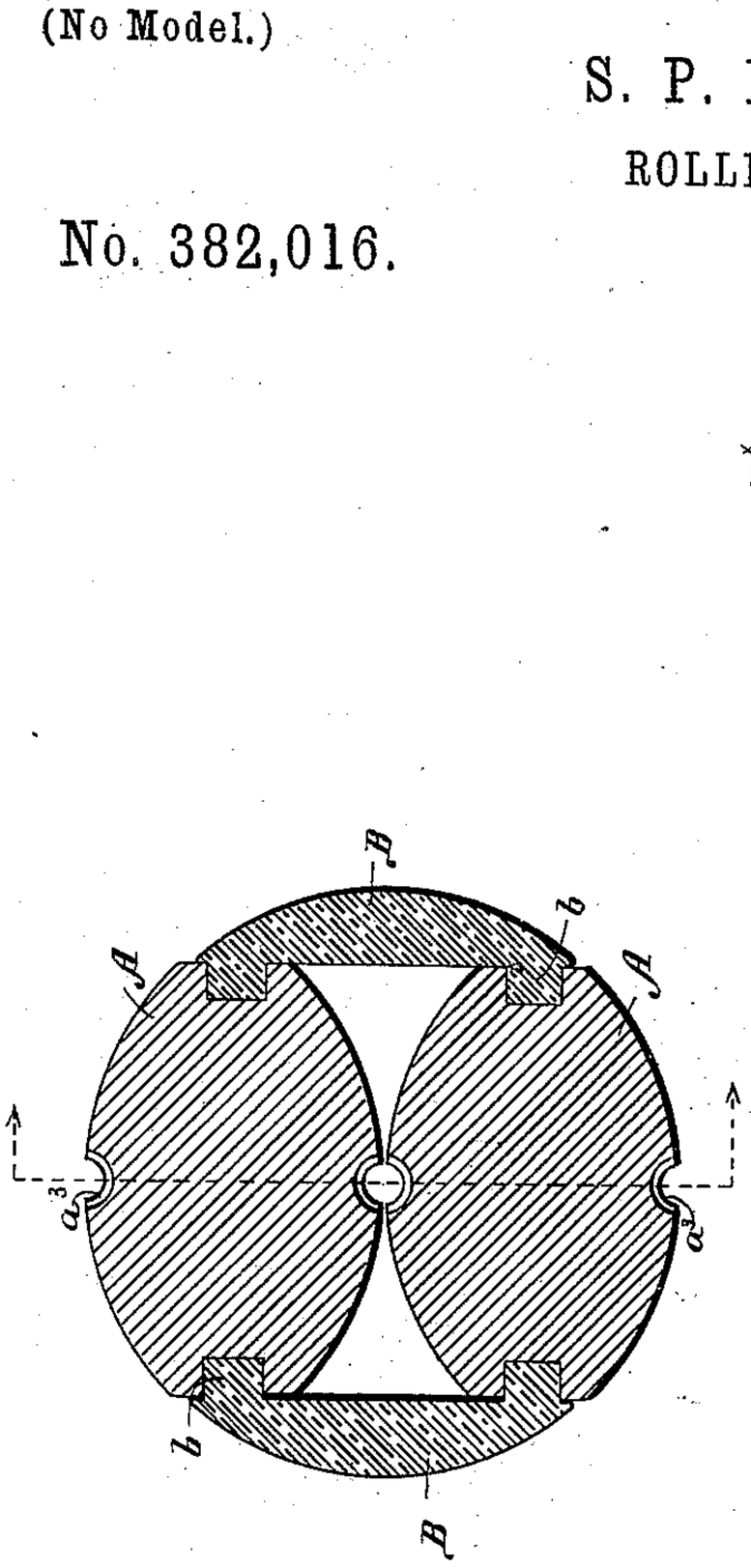


FIG 17

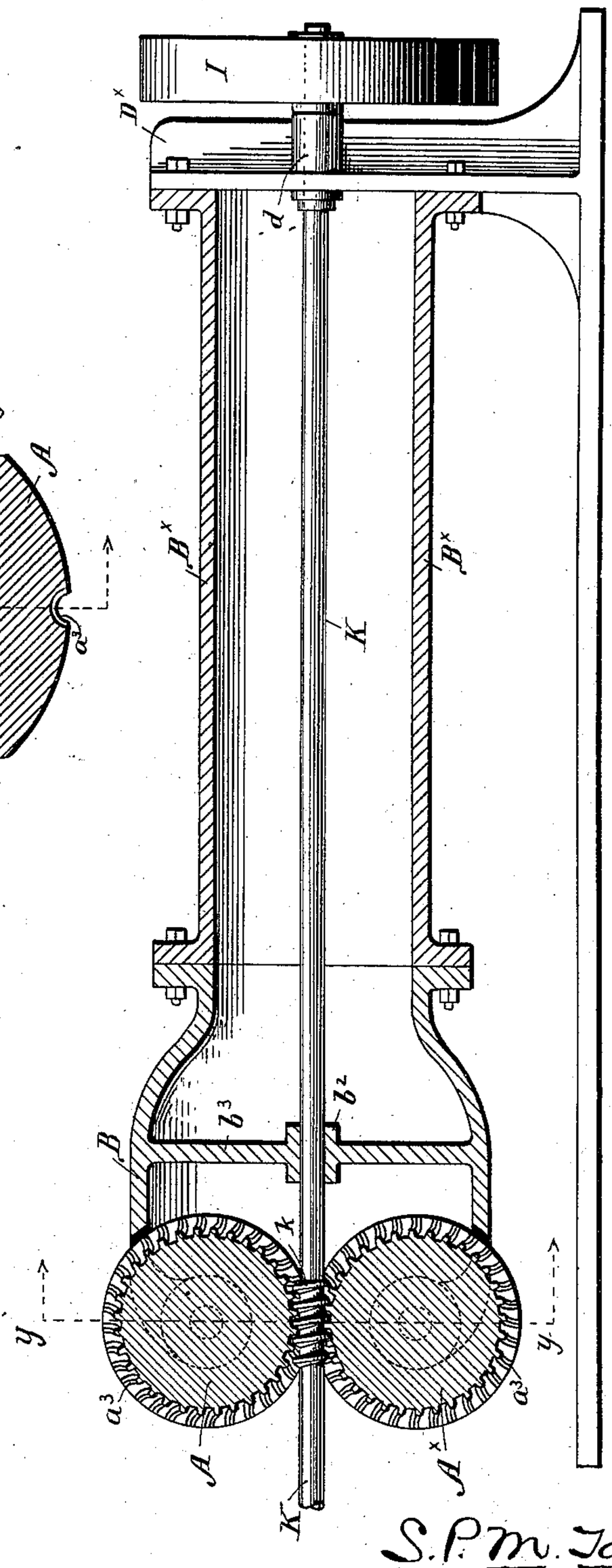


FIG 16

WITNESSES

R. B. Shepherd

F. Norman Dixon.

S. P. M. Tasker

INVENTOR.

By his Attorneys.

Wm. C. Strawbridge

Bonsall Taylor

(No Model.)

8 Sheets—Sheet 6.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016.

Patented May 1, 1888.

FIG 20

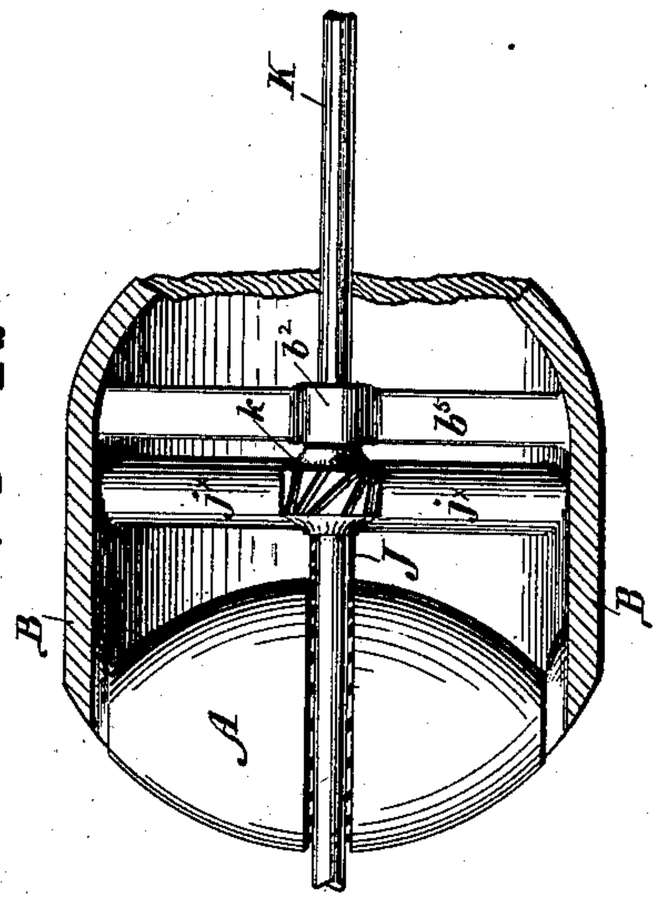


FIG 19

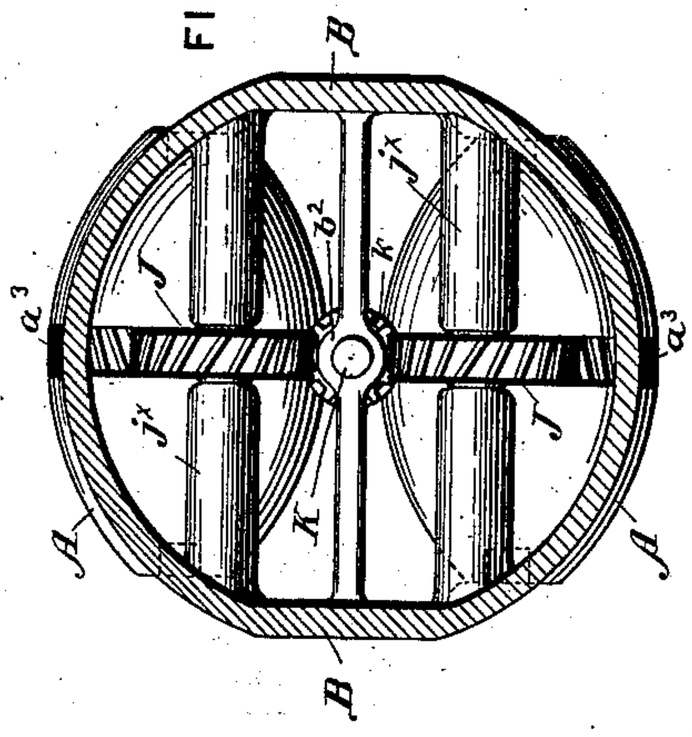
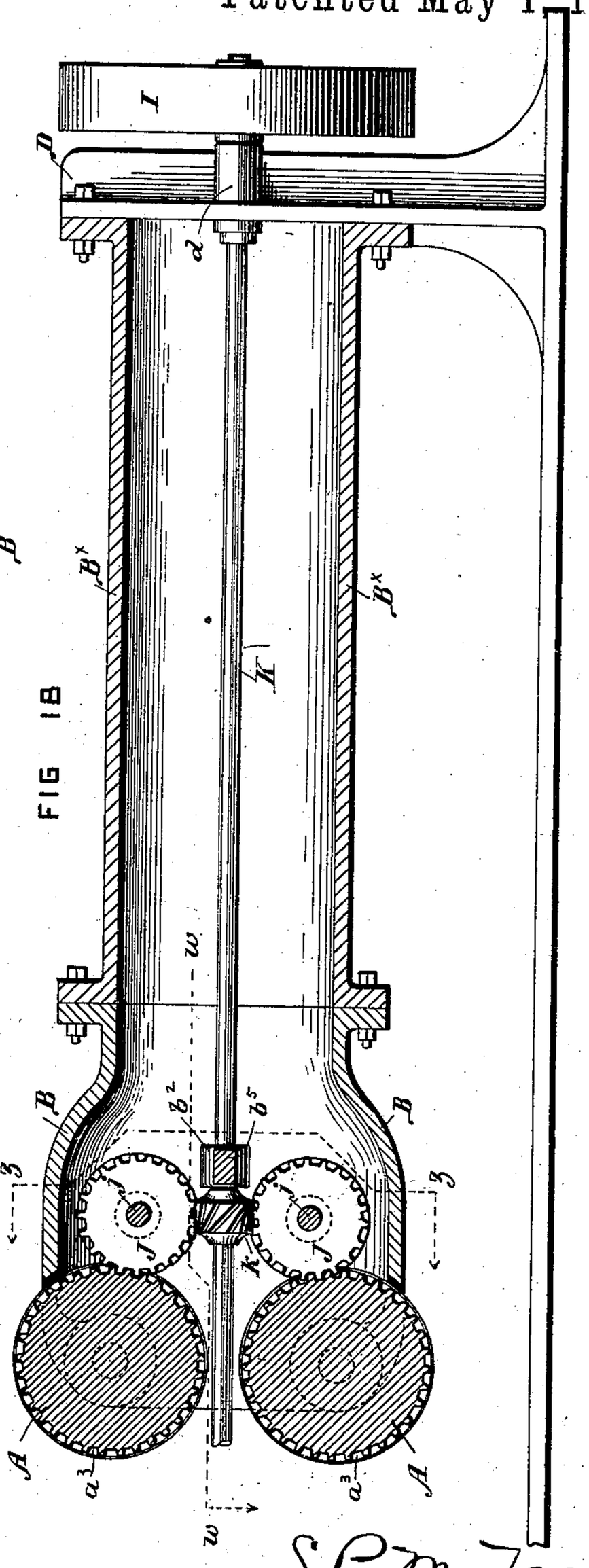


FIG 18



WITNESSES

R. B. Shepherd.

F. Norman, Dixon.

S. P. M. Tasker.

INVENTOR

By his Attorneys.

M. C. Crawford & Bonsall Taylor

(No Model.)

8 Sheets—Sheet 7.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

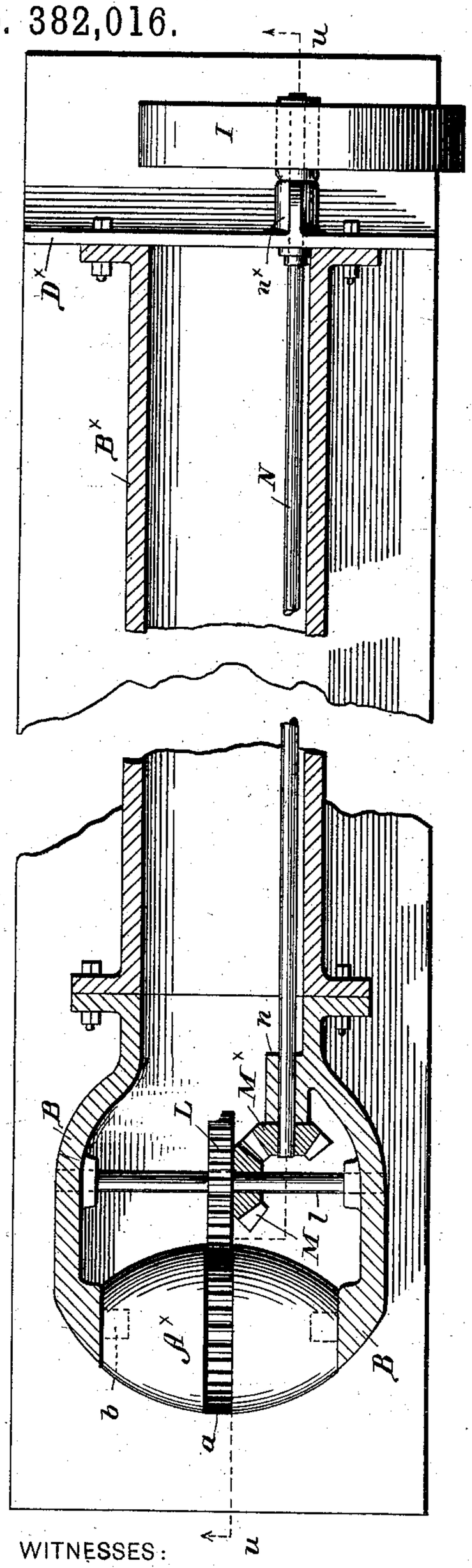


FIG. 21

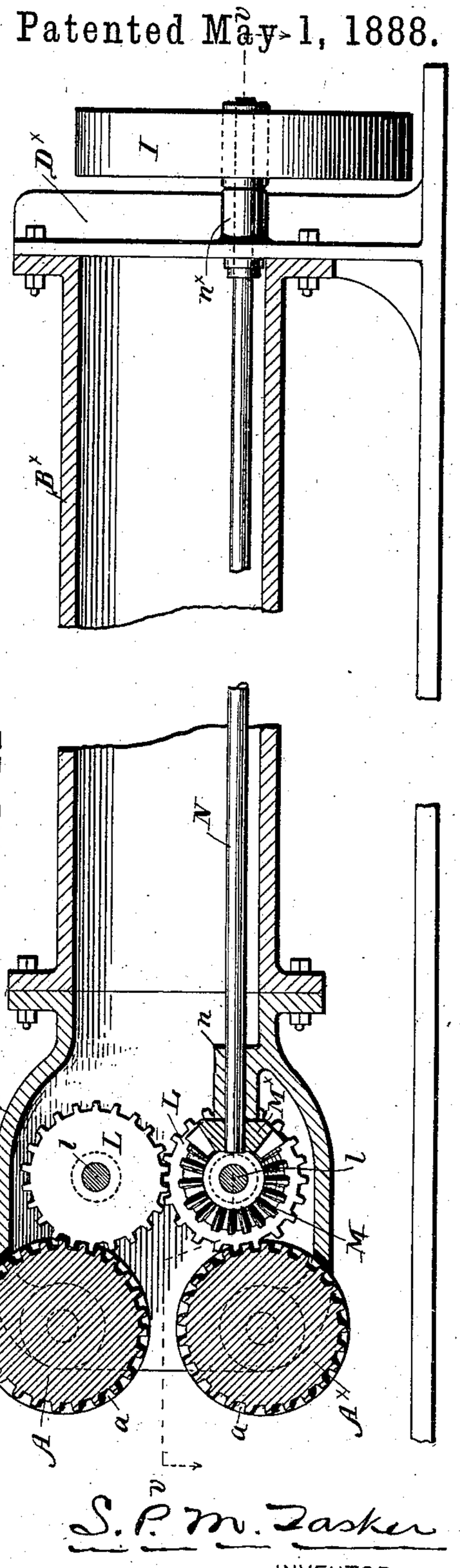


FIG. 22

WITNESSES:

W. B. Shepherd.

F. Norman Dixon.

INVENTOR

By his Attorneys

Wm. C. Strawbridge

& Bonsa & Taylor.

(No Model.)

8 Sheets—Sheet 8.

S. P. M. TASKER.

ROLLER MANDREL.

No. 382,016. Patented May 1, 1888.

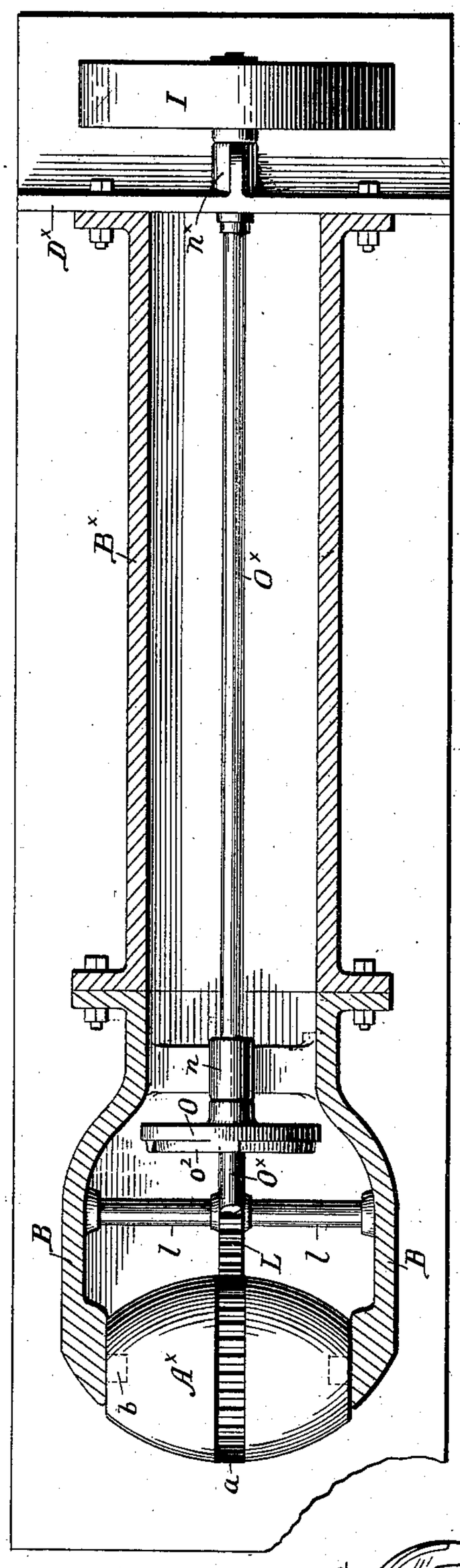


FIG 23

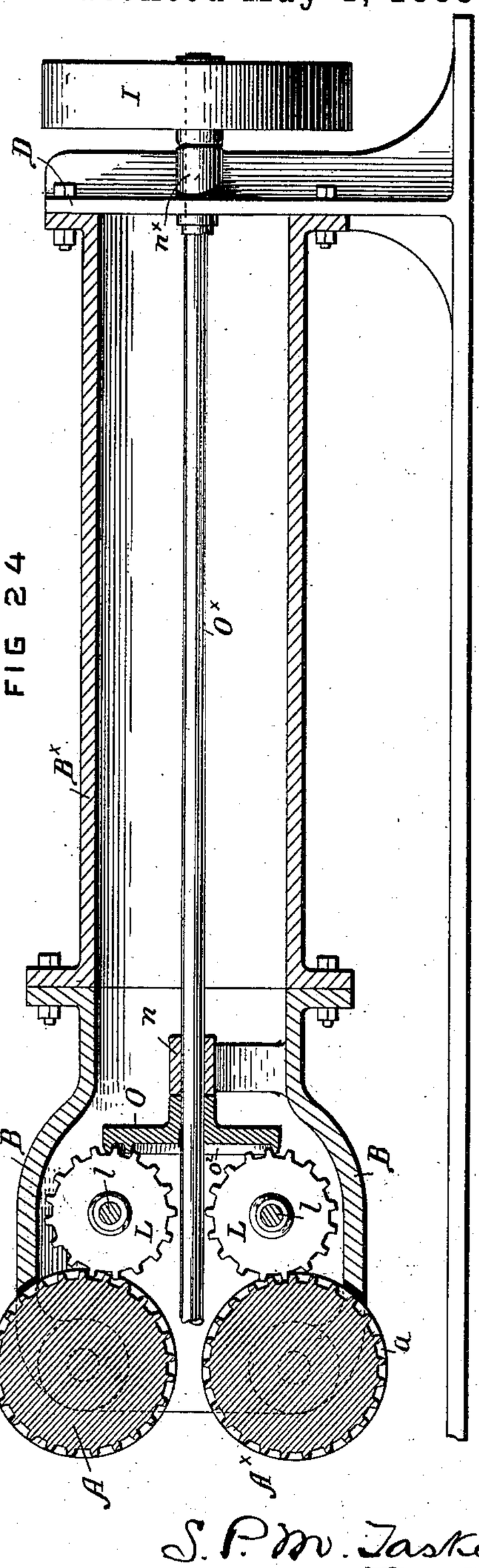


FIG 24

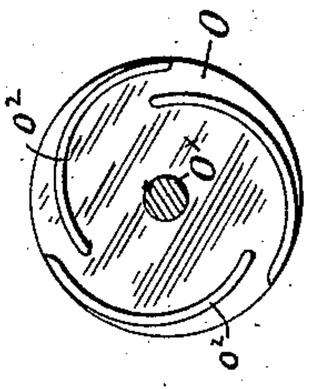


FIG 25

WITNESSES:

R. B. Shepherd

F. Norman Dixon,

S. P. M. Tasker.

INVENTOR.

By his Attorneys

Wm. C. Strawbridge

J. Bonsall Taylor

UNITED STATES PATENT OFFICE.

STEPHEN P. M. TASKER, OF PHILADELPHIA, PENNSYLVANIA.

ROLLER MANDREL.

SPECIFICATION forming part of Letters Patent No. 382,016, dated May 1, 1888.

Application filed November 9, 1887. Serial No. 254,667. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN P. M. TASKER, a citizen of the United States, residing in the city and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Roller Mandrels, of which the following is a specification.

My invention relates to a class of mandrels in which the head, ball, or mandrel proper, is provided with two, three, four, five, or more ellipsoidal friction rolls mounted in bearings in a stock or case, and adapted to be introduced within the tube to be rolled. Types of mandrels of the foregoing class, which are of my invention, are to be found in United States Letters Patent No. 151,323, dated May 26, 1874; and Nos. 331,570, 331,573, and 331,578, all dated December 1, 1885,—to which Letters Patent reference is to be made for the better understanding of my present improvements.

The intention of the employment of mandrels of the foregoing class, it may be premised, is to obviate friction between the interior surfaces of the tube and the ball of the ordinary mandrel, and to permit of the more ready passage of the tube over the mandrel and withdrawal of the mandrel from said tube.

My present invention is applicable to roller mandrels of the character set forth in the foregoing patents.

The object of my present invention is to provide means for positively driving the mandrel rolls, so as to render them no longer idler rolls the movement of which is wholly due to the movement of the tube upon them, but positively driven rolls which move under the thrust or impulse of suitable actuating devices with a positive rotative motion which is the same as, or greater, or less, than, that of the tube operated upon.

To such end my invention, broadly stated, comprehends the provision in connection with the rolls of a roller mandrel of driving gearing of any preferred character,—and substantially, for instance, of any such character as is represented in the accompanying drawings and hereinafter referred to,—which is disposed between the mandrel rolls with which it is engaged, and a prime mover of any preferred character with which it is also engaged, and which receives its movement from said prime mover and transmits it to said rolls,—the arrangement as an entirety being substantially such that the connective gearing, be its specific mechanical character what it may, operatively unites the prime mover and the mandrel rolls and imparts to said rolls a positive movement transmitted direct and derived from said prime mover.

Such being the general character of my invention, it is apparent that the form of the gearing intermediate between the prime mover and the driven rolls may structurally vary and assume the form of many well known mechanical movements, and that the prime mover may likewise vary and be a motor of any suitable character.

Such constructions as are represented in the accompanying drawings and herein described alike embody my invention, the particular subject matter of which claimed as novel is hereinafter definitely specified.

Figure 1 is a top plan view of a mandrel having two rolls, the axes of which lie in the same plane. Fig. 2 is a transverse, vertical, sectional elevation through the mandrel of Fig. 1 in the plane of the dotted line *x x* of said figure. Fig. 2½ is an end elevation of a prime mover which I find it convenient to employ to actuate the driving gearing of the mandrel rolls shown in the mandrel of Figs. 1 and 2. Fig. 3 is a top plan view of a mandrel having two rolls the axes of which, although in parallel horizontal planes, are inclined to one another. Fig. 4 is a front elevational view, partly sectional, of the rolls represented in Fig. 3. Figs. 5 and 6 are transverse, vertical, sectional elevations through mandrels having three rolls, which are adapted to be actuated by driving gearing constituted by racks of different form. Fig. 7 is a side elevational view of the mandrel represented in Fig. 6, in connection with driving gearing constituted by a convenient rack device for actuating its rolls, and with a convenient prime mover for actuating said rack. Fig. 8 is a right hand end elevational view of the prime mover represented in Fig. 7. Fig. 9 is a central, vertical, longitudinal, sectional side elevation through such a mandrel as is represented in Fig. 2, provided with driving gearing constituted by a sprocket or

chain-wheel device for actuating its rolls. Fig. 10 is a left hand end elevational view of the mandrel head of Fig. 9. Fig. 11 is a right hand end elevational view of the mandrel standard and a convenient prime mover for actuating the sprocket chain gearing shown in Fig. 9, the chains being, for clearness, omitted. Fig. 12 is a view in perspective of the mandrel head shown in Figs. 9 and 10, said head being vertically sectioned in the plane of the axes of the rolls. Fig. 13 is a face view of a mandrel composed of three elliptical rolls adapted to be driven by sprocket chains. Fig. 14 is a similar view of two cylindric rolls adapted to be similarly driven. Fig. 14½ is a similar view of such a mandrel as is shown in Fig. 13, the elliptic rolls being turned to present flat or more strictly conical peripheral surfaces which correspond and receive the thrust of the rolls against each other. Fig. 15 is a similar view of three cone-ended cylindric rolls embodying my invention and adapted to be driven by sprocket chains. Fig. 16 is a central, vertical, longitudinal, sectional side elevation through such a mandrel as is represented in Figs. 1 and 2, when the mandrel rolls are circumscribed each by a series of sunken worm teeth and are driven by gearing constituted by a longitudinally-extending worm shaft preferably housed within the mandrel rod. Fig. 17 is a transverse, vertical, sectional elevation through the mandrel head of Fig. 16 in the plane of the dotted line *y y* upon said figure. Fig. 18 is a central, vertical, longitudinal, sectional side elevation through such a mandrel as is represented in Figs. 1 and 2, when the mandrel rolls are circumscribed each by a series of sunken angle teeth, and driven by gearing constituted by a pair of angle tooth wheels mounted within the mandrel head upon shafts parallel respectively with the respective axes of the mandrel rolls, and engaged with the teeth of the mandrel rolls, the said angle tooth wheels being actuated by an angle tooth pinion mounted upon a shaft extending longitudinally and conveniently within the mandrel rod. Fig. 19 is a transverse, vertical, sectional elevation through the mandrel head of Fig. 18, in planes of the dotted line *z z* upon said figure, and sight being taken in the direction of the arrows upon said line. Fig. 20 is a fragmentary sectional plan of the mandrel head of Fig. 18, in planes of the dotted line *w w* upon said figure. Fig. 21 is a longitudinal, sectional plan in planes of the dotted line *v v* of Fig. 22, through such a mandrel as is represented in Figs. 1 and 2, when the mandrel rolls are actuated by driving gearing constituted by a pair of counter pinions which are not only engaged with each other but also, respectively, with the sunken teeth of the mandrel rolls, and which are mounted upon pinion shafts upon one of which latter is secured a beveled pinion engaged with a second beveled pinion right angular to it and mounted upon a longitudinal bevel gear shaft conveniently housed within the lower portion of the mandrel rod. Fig. 22 is a vertical, longitudinal, sectional side elevation through the mandrel represented in Fig. 21 in planes of the dotted line *u u* of said figure. Figs. 23 and 24 are, respectively, a central, longitudinal, sectional plan, and a central, vertical, longitudinal side elevation, through such a mandrel as is represented in Figs. 21 and 22, with the exception that the counter pinions of the driving gearing are not engaged with each other but are both engaged with a spiral tooth wheel mounted in a plane right angular to said pinions upon a longitudinally extending wheel shaft conveniently housed centrally within the mandrel rod. Fig. 25 is a face view of the spiral tooth wheel shown in Figs. 23 and 24.

Referring now to Figs. 1 and 2, which represent a mandrel embodying my invention and having two rolls the axes of which lie in parallel horizontal planes and in a common vertical plane,—A $A^{\times}$ are two ellipsoidal metal rolls mounted in a stock or mandrel head B, which may be of any desired construction, and which is the advance terminal portion of a hollow mandrel rod $B^{\times}$. *b* are journals or axles upon which the rolls are mounted for rotation. These axles may either be formed upon or applied to the rolls, or be formed upon or applied to the mandrel head. The rolls are spaced apart a sufficient distance to admit between them driving gearing constituted by a double-faced or double rack C, and are each provided with a series of sunken teeth *a* which circumscribe the respective rolls in a central transverse or diametric plane, and within which are respectively engaged the two series of teeth of the rack. It is obvious that the longitudinal reciprocation of the rack will, through the engagement of its teeth with the circular series of sunken teeth in the rolls, occasion the reverse or opposite rotation of the respective rolls in a direction correspondent with the direction of movement of the rack, whereof hereinafter. Any suitable means for imparting reciprocation to the rack may be employed. I find a convenient prime mover for the purpose, to be some such contrivance as is represented in Fig. 2½, in which the rack C is engaged between two toothed rack wheels P $P^{\times}$, the axles *p* $p^{\times}$ of which are supported in a housing Q, and respectively provided with sister gear wheels R $R^{\times}$ which are engaged with each other. The axle $p^{\times}$ of the lower rack wheel is also provided with a pulley $Q^{\times}$ by means of which rotation is imparted to it and consequently to its rack and gear wheels. The entire device constitutes a positively operating prime mover which according to the direction of movement of the pulley occasions the thrust or the retraction of the rack.

In Figs. 3 and 4 I have represented a mandrel provided with a pair of ellipsoidal rolls A $A^{\times}$ which cross each other at angles, that is to say have their respective longitudinal axes

so disposed as to cross or be inclined to each other, which are similarly provided with centrally circumscribing sunken teeth *a*, and which are actuated by driving gearing constituted by a double spiral rack $C^{\times}$, the pitch of which corresponds with the respective inclinations of the respective series of teeth of the rolls, and the longitudinal movement of which occasions a reverse rotation of said rolls in either direction according to its direction. Any prime mover adapted to actuate the rack may be employed.

In Figs. 5, 6, and 7, I have represented a roller mandrel having three rolls A A′ A^2 the axes of which lie in a common plane, and when projected form an equilateral triangle. In Fig. 5 I have represented pinions $a^{\times}$, formed upon the ends of all the rolls, which are engaged by driving gearing constituted by three double faced longitudinally extending racks *c* erected from a three-armed spider C^2 suitably actuated for longitudinal movement by any preferred prime mover. In Figs. 6 and 7 the three rolls are each provided with a central series of sunken teeth *a a′* a^2 which are engaged with driving gearing constituted by a triangular rack C^3, the thrust of which, acting against the teeth of the rolls, occasions their rotation.

In the forms of mandrel last above described and illustrated in Figs. 5, 6, and 7, the mandrel head has three parts or sections and is lettered B^2.

In Figs. 7 and 8 I have represented a convenient prime mover for actuating the rack. It is however, to be understood, that I do not restrict myself to the specific devices represented, but contemplate the employment as a prime mover generically considered of any suitable mechanism, such, for instance, as an hydraulic, air, or steam, rack-actuating, plunger, a crank and pitman, or kindred device.

Referring now to Figs. 7 and 8, D is a mandrel standard for supporting the mandrel rod and mandrel head, the same being hollow to admit the passage of the rack C^3 through it and through said mandrel rod and head to the mandrel rolls. E is a housing of any preferred construction, supporting three similarly angularly disposed pinions *e*, which together engage with the triangular rack C^3, in the manner represented in the drawings. Two of these pinions,—in the drawings the lower ones,—are idlers, while the upper pinion is fixedly mounted upon a shaft $e^{\times}$ which projects beyond its bearings and is journaled in boxings supported upon pulley standards F, between which latter said shaft is provided with a pulley G the motion of which when driven imparts motion to the top pinion *e*, and thence to the rack to cause its reciprocation in either direction. If desired all of the pinions may be positively driven.

Referring now to Figs. 9, 10, 11, and 12, which represent an embodiment of my invention utilizing sprocket chains as a connective gearing for transmitting from a prime mover a positive motion to the mandrel rolls the following is the construction of a prime mover which I prefer to employ: a mandrel standard $D^{\times}$ is equipped with two sprocket wheels H, mounted upon axles *h* which are parallel and both of which extend beyond the standard at one side and are equipped with gear wheels $h^{\times}$ which mesh together. One of the axles is prolonged beyond its gear wheel and equipped with driving pulleys $H^{\times}$. The mandrel rolls A^3 A^4 are each provided with a series of sunken sprocket lugs *s*, which preferably circumscribe the respective rolls in a central transverse or diametric plane, and which are adapted to be engaged with driving gearing constituted by two endless sprocket chains S which also pass over and are driven by the sprocket-wheels H in the mandrel standard. Such portions of the chains as for the time being run side by side, or come together in their passage respectively over the sprocket wheels and rolls, conveniently pass through the hollow mandrel rod D^2, while their outer or distant portions pass respectively above and below and to the outside of said mandrel rod. It is obvious that rotation imparted to the driving pulleys, occasioning a reverse rotation of the sprocket wheels, will occasion, through the opposite travel of the respective sprocket chains, the opposite rotation of the rolls. The construction of the mandrel rod, mandrel head, and standard, are substantially identical with that heretofore described. The mandrel head is, however, shown as provided with a circular flange $b^{\times}$ by which an additional head carrying additional rolls can, if desired, be secured to the mandrel head represented.

The rolls represented in Fig. 14 can be driven by chains set and geared substantially in the same manner as those above described.

The rolls of the mandrels represented in Figs. 13 and 15 are adapted to be driven by gearing constituted by three independent sprocket chains, which may be primarily actuated by three sprocket wheels mounted in the mandrel standard much after the manner of the pinions applied to the housing of Fig. 8, the shafts of such sprocket wheels being extended and provided with suitable bevel gears after a manner obvious to any mechanic. The sprocket lugs or teeth may be applied to the ends or other portions of the rolls than the central portions; and, if desired, but one of the rolls may be positively driven. The sprocket gearing is of especial application to mandrels of the construction set forth in my Patents Nos. 151,323, and 331,570. The rolls of Fig. 15 are adapted for use in rolling six-sided tubes, and are caused to act first upon three sides and then upon the remaining three. Of course by increasing the number of rolls tubes having a greater number of sides may be rolled.

The three elliptical rolls which are repre-

sented in Figs. 14½ are each turned to present flat, or, more strictly, conical peripheral surfaces Z which correspond and therefore mutually receive the internal thrust of the rolls which bear against each other in the region of such flattened surfaces. This construction is important as tending to preserve the rolls from wear and as steadying them.

Referring now to Figs. 16 and 17, which represent an embodiment of my invention utilizing a worm shaft as a driving gearing for imparting a positive motion to the mandrel rolls,—the mandrel standard $D^{\times}$ is equipped with a bearing *d* through which passes one extremity of a worm shaft K, the other extremity of which passes through a bearing b^2 formed in a diaphragm b^3 erected within the mandrel head B. In this construction the mandrel rolls A $A^{\times}$ are each circumscribed by a series of sunken worm teeth a^3 which engage with a worm *k* on the worm shaft K. The worm shaft extends through the bearing b^2 to the rear of the mandrel standard, and as to its projecting extremity is equipped with a prime mover constituted by a pulley I, by means of which rotation is imparted to it. It is obvious that the rotation imparted to the shaft will, through the action of the worm upon the sunken worm teeth of the rolls, occasion the opposite rotation of said rolls.

The construction of the mandrel rod, mandrel head, and standard, is essentially such as that of the same members of the mandrels, already described, except that, for convenience, the mandrel head is made detachable from the mandrel rod.

Referring now to Figs. 18, 19, and 20, which represent an embodiment of my invention utilizing the motive power of driving gearing constituted by a shaft equipped with an angle tooth pinion, such as is represented in Fig. 16, for driving the rolls,—J J are a pair of angle tooth wheels mounted, respectively above and below the angle tooth pinion *k* on the shaft K, upon shafts *j j* parallel respectively with the axes of the mandrel rolls and respectively conveniently journaled in shaft hubs $j^{\times}$ cast within or otherwise connected with the mandrel head. These worm angle tooth wheels respectively engage with sunken angle teeth a^3 formed on the mandrel rolls, and are both engaged with the angle tooth pinion on the shaft. The forward shaft bearing b^2 of the pinion shaft is, in this construction, conveniently supported in a cross web b^5 secured within the mandrel head. Rotation imparted to the pinion shaft by any such prime mover as the pulley shown will occasion the reverse rotation of the mandrel rolls through the intermediate rotation imparted by said shaft to the angle tooth wheels which are, as stated, engaged with both the pinion on the shaft and with the mandrel rolls.

Referring now to Figs. 21 and 22, which represent an embodiment of my invention utilizing driving gearing constituted by a pair of mutually engaged counter pinions respectively also engaged with the respective mandrel rolls and actuated by a bevel gearing applied to the shaft of one of them, the said counter pinions,—L L are a pair of counter pinions mounted upon pinion shafts *l l* supported within the mandrel head in parallelism respectively with each other and with the axes of the mandrel rolls. M is a beveled pinion mounted upon the shaft of the lower counter pinion and engaged with a bevel pinion $M^{\times}$ mounted in a plane right angular to the plane in which said pinion rotates upon the forward extremity of a bevel gear shaft N the forward extremity of which latter is supported in a bearing *n* within the mandrel head while its rear extremity is supported within a bearing $n^{\times}$ formed in the mandrel standard. Rotation is conveniently imparted to this bevel gear shaft by a prime mover being a pulley I applied to the rear of the mandrel standard. It is obvious that in this construction rotation imparted to the bevel gear shaft will, through the bevel gear, occasion the rotation of the lower pinion shaft and consequently of the lower pinion, from which latter rotation will be imparted to the upper pinion, while both of said pinions will by their common but reverse rotation occasion the reverse rotation of the mandrel rolls.

Referring now to Figs. 23, 24, and 25, which represent an embodiment of my invention utilizing driving gearing constituted by a pair of counter pinions, not, however, mutually engaged, but separately engaged with the mandrel rolls and with a spiral tooth wheel common to both,—O represents the said spiral tooth wheel which is mounted upon a wheel shaft $O^{\times}$ conveniently housed, as shown, within the mandrel rod. The teeth upon this wheel are in the form of curved or spiral ribs o^2, as shown in Fig. 25, and the wheel itself is mounted in a vertical plane in such position that its said teeth engage the teeth of both counter pinions at the same time, while the teeth of said pinions also engage the sunken teeth upon the mandrel rolls. The pulley I is the prime mover. Rotation imparted to the shaft in this instance, therefore, occasions the reverse rotation of the counter pinions and the consequent rotation of the mandrel rolls. It is obvious that this construction differs only from that represented in Figs. 21 and 22 in the means employed for actuating the counter pinions,—the spiral toothed wheel being a substitute for the bevel gear device of said figures.

It is apparent that in all of the foregoing constructions latitude may be accorded the constructor as to the details of construction and arrangement of the mandrel, mandrel head, and standard, as well as in the matter of formation, mounting and arrangement of the racks, chains, shafts, counter shafts, bearings, pinions, &c., which in the several organizations form parts of the driving gearing as such,—it being borne in mind that the invention so far as it is concerned with driving gear-

ing does not reside in any special construction of driving mechanism, but in the provision of driving gearing broadly as such for positively driving the rolls of a roll-provided mandrel head.

Such being a description of forms of roller mandrel alike embodying my invention, it is proper for me to state that the shape and configuration of the rolls, as well as the outer surfaces of the mandrel head, may be made to correspond to the interior configuration of tubes of various forms other than those illustrated.

The mandrel in connection with external rolls or dies constitutes a rolling mill, adapted for use in the manufacture of all kinds of malleable metal tubes, which forms the subject of an application for patent I am about to file.

In practice the bellied, or other intermediate, portions of the sections of the stock lie below the circle, or figure, circumscribing longitudinally the rolls; and this is important, because said sections are not intended to bear against the bore of the tube.

In the use of the mandrel it will be understood that after the tube has been rolled, it should be rotated to bring that portion of its interior surface which in the previous pass has come over the sections of the stock over the centers or rolling surfaces of the rolls, and that this operation should be repeated as often as desirable, or until the tube as to every part of its interior surface has been acted upon by the rolls.

In constructions in which racks are the driving gearing, the shape and character and location of the teeth both of the rack and of the rolls are not material, the office of the teeth as such being simply to insure the engagement between the rack as a body capable of longitudinal thrust under the influence of a prime mover, and the rolls as bodies capable of rotation and adapted to be positively rotated by said thrust. It is obvious, therefore, that instead of teeth strictly as such depressions and corresponding elevations of any suitable character, or a plain bar actuating the rolls by friction, may be employed. It is also obvious, as described in certain of the patents referred to, that the mandrel head may be, and preferably is, constructed in parts or sections, adapted to be suitably united together.

Having thus described my invention, I claim—

1. A mandrel head containing two or more positively-driven rolls, substantially as and for the purposes set forth.

2. In combination, a mandrel head containing two or more rolls, and driving mechanism, essentially such as set forth, for positively driving said rolls, substantially as and for the purposes set forth.

3. In a roller mandrel substantially such as set forth, the combination of two or more mandrel rolls, gearing for positively driving said rolls, and a prime mover for actuating said gearing.

4. In a mandrel for rolling tubes, the combination of a mandrel rod, rolls mounted rotatively therein, a prime mover mounted in connection with said mandrel rod, and gearing operatively uniting said prime mover and rolls, substantially as set forth.

5. In a mandrel for rolling tubes, the combination of mandrel rolls mounted rotatively therein, teeth identified with said rolls, propulsive gearing engaging with said teeth, and means for applying power to said propulsive gearing.

6. The combination, to form a mandrel for rolling tubes, of two or more rolls provided with teeth, a mandrel head for carrying said rolls, and a rack which is engaged with the teeth of said rolls, substantially as and for the purposes set forth.

7. The combination, to form a mandrel for rolling tubes, of two or more rolls provided with teeth, a mandrel head for carrying said rolls, a rack which is engaged with the teeth of said rolls, and means for imparting longitudinal thrust to said rack, substantially as and for the purposes set forth.

8. The combination, to form a mandrel for rolling tubes, of two or more rolls provided with teeth, a mandrel head for carrying said rolls, and a rack which passes between or among the rolls and is engaged with the teeth of said rolls, substantially as and for the purposes set forth.

9. The combination, to form a mandrel for rolling tubes, of two or more rolls provided with teeth, a mandrel head for carrying said rolls, a rack which passes between or among the rolls and is engaged with the teeth of said rolls, and means for imparting longitudinal thrust to said rack, substantially as and for the purposes set forth.

10. The combination, in a roller mandrel, of two ellipsoidal rolls the axes of which are inclined to each other and which are provided with teeth, a mandrel head carrying said rolls, and a rack which is engaged with the teeth of said rolls, substantially as and for the purposes set forth.

11. The combination, in a roller mandrel, of two ellipsoidal rolls the axes of which are inclined to each other, and which are provided with teeth, a mandrel head carrying said rolls, a rack which is engaged with the teeth of said rolls, and means for imparting longitudinal thrust to said rack, substantially as and for the purposes set forth.

12. The combination, in a roller mandrel, of two ellipsoidal rolls the axes of which are inclined to each other and which are provided with sunken teeth circumscribing their central portions, a mandrel head carrying said rolls, and a spiral rack which passes between said rolls and is engaged with the sunken teeth thereof, substantially as and for the purposes set forth.

13. The combination, in a roller mandrel, of two ellipsoidal rolls the axes of which are in-

clined to each other, and which are provided with sunken teeth circumscribing their central portions, a mandrel head carrying said rolls, a spiral rack which passes between said rolls and is engaged with the sunken teeth thereof, and means for imparting longitudinal thrust to said rack, substantially as and for the purposes set forth.

In testimony whereof I have hereunto set my hand this 8th day of November, A. D. 1887.

STEPHEN P. M. TASKER.

In presence of—
J. BONSALL TAYLOR,
F. NORMAN DIXON.