No. 770,997. PATENTED SEPT. 27, 1904.

A. E. BECK & G. TOWNSEND.

APPARATUS FOR THE PRODUCTION OF TUBES.

APPLICATION FILED NOV. 24, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

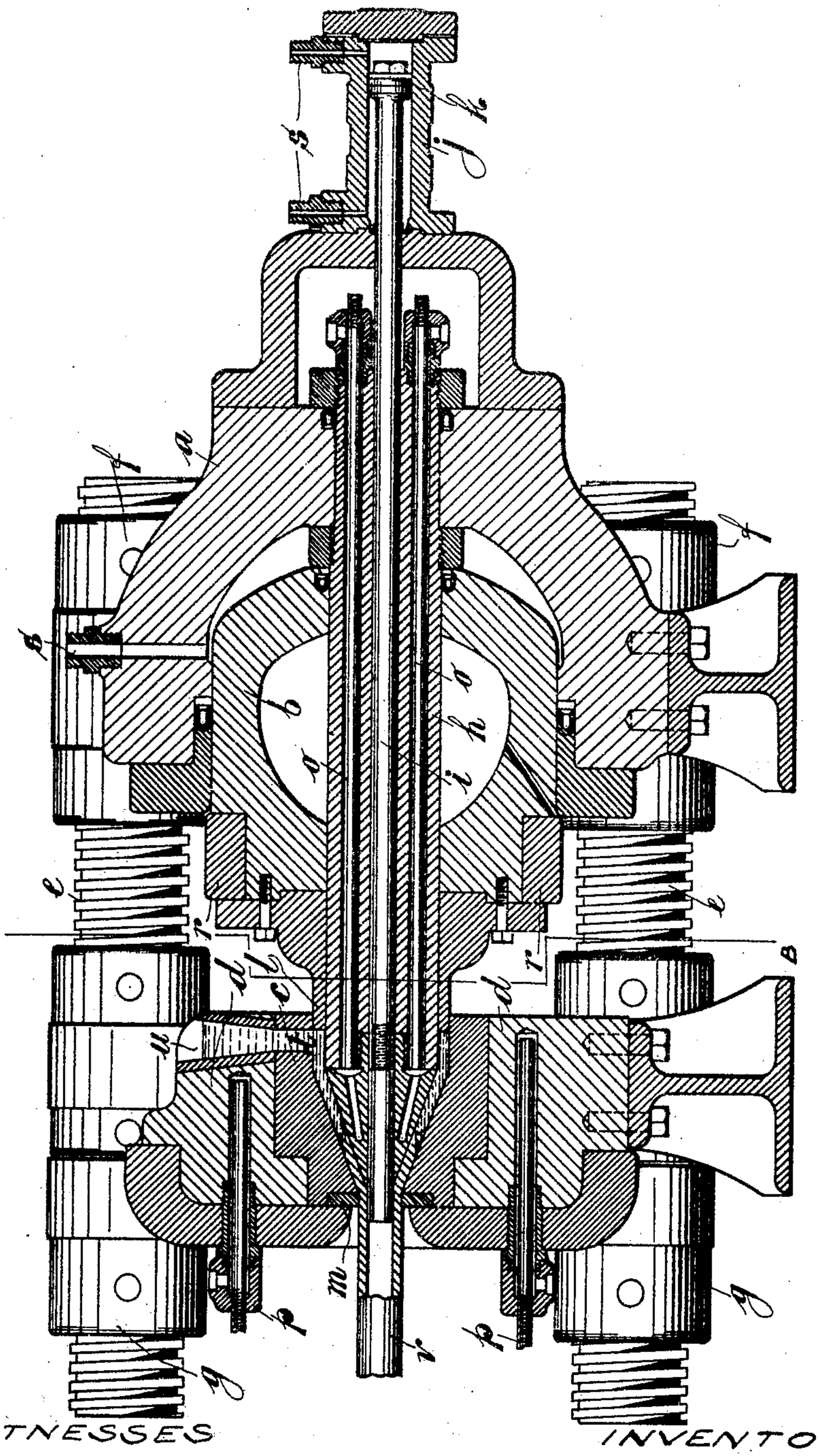

FIG. 1

WITNESSES

W. M. Kuehne

John A. Percival.

INVENTORS

Arthur Edward Beck

George Townsend

BY Richards & Geier

ATTORNEYS

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NO MODEL. 3 SHEETS—SHEET 2.

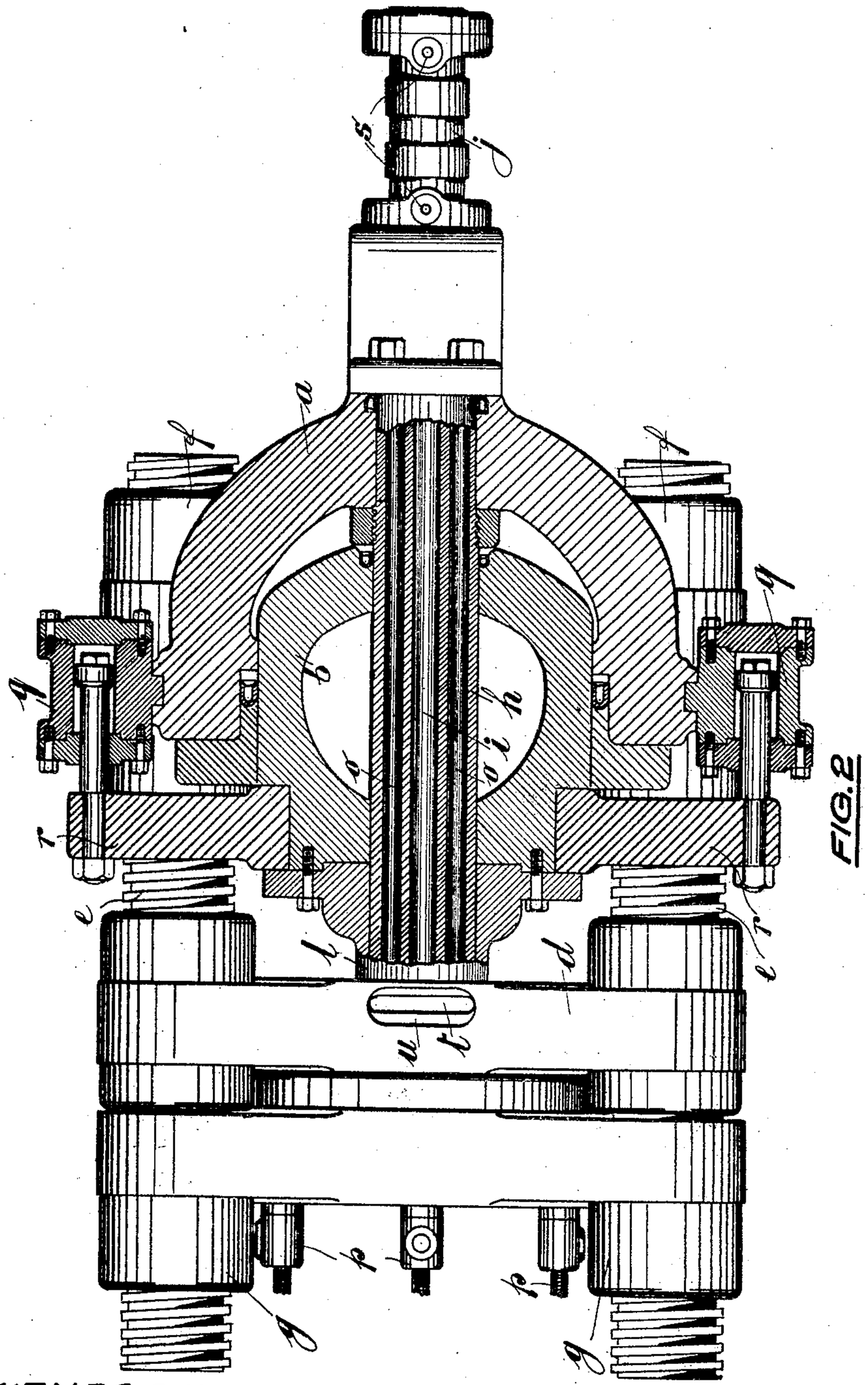

FIG. 2.

WITNESSES

Wm. Kuehne

John A. Percival

INVENTORS

Arthur Edward Beck

George Townsend

BY Richards & Co.

ATTORNEYS.

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NO MODEL. 3 SHEETS—SHEET 3.

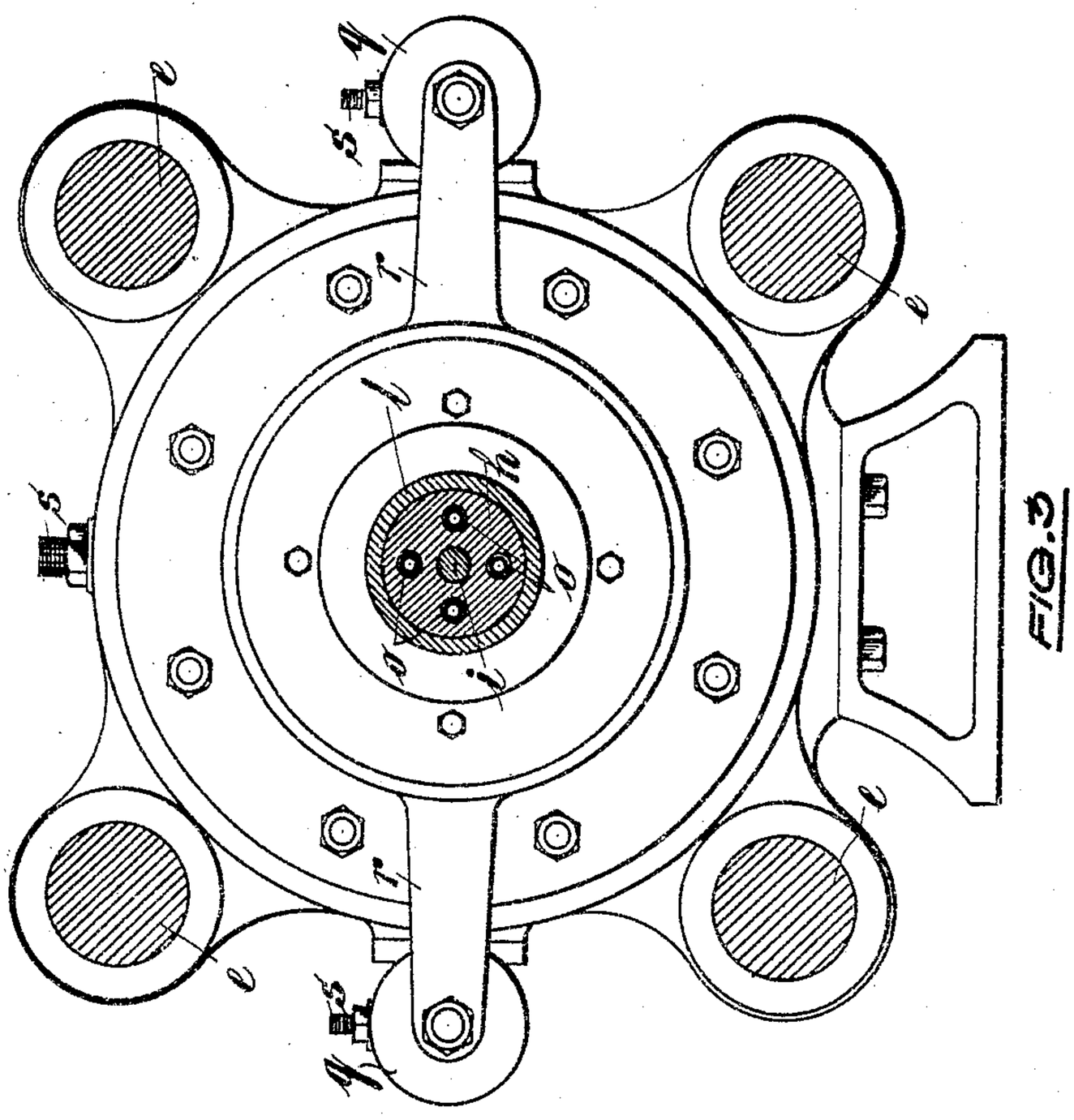

FIG. 3

WITNESSES

W. M. Kuehne

John A. Percival.

INVENTORS

Arthur Edward Beck

George Townsend

BY Richards & Co

ATTORNEYS

No. 770,997. Patented September 27, 1904.

UNITED STATES PATENT OFFICE.

ARTHUR EDWARD BECK AND GEORGE TOWNSEND, OF BIRMINGHAM, ENGLAND.

APPARATUS FOR THE PRODUCTION OF TUBES.

SPECIFICATION forming part of Letters Patent No. 770,997, dated September 27, 1904.

Application filed November 24, 1903. Serial No. 182,501. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR EDWARD BECK and GEORGE TOWNSEND, subjects of the King of Great Britain and Ireland, residing at 33 Newhall street, in the city of Birmingham, England, have invented certain new and useful Improvements Relating to the Manufacture of Metal Tubes, (for which we have filed an application in Great Britain, No. 26,637, bearing date December 3, 1902,) of which the following is a specification.

This invention comprises an improved means for the production of tubes direct from molten or plastic metal, and is particularly applicable to the production of weldless steel tubes for various purposes.

In a simple form a plant or apparatus for the production of tubes in accordance with this invention comprises a twyer-like or water-cooled central core having a diameter equal to the bore or internal diameter of the required tube and arranged within a cylinder or chamber of such an internal diameter that the annular space between the cylinder-wall and the aforesaid core serves as the die or mold for the formation of the tube. Within the space between the cylinder and the core (which may be varied in dimensions either by increasing the diameter of the cylinder or reducing the diameter of the core) an annular ram or plunger is inserted and arranged for reciprocation in any convenient manner. During such reciprocation the ram is made to pass over an aperture formed through the cylinder-wall to admit the metal to be operated upon from a container communicating with the said aperture. Thus when the plant is in operation a small quantity of the metal flows or is drawn into the cylinder on each outstroke of the ram after the latter has uncovered the admission-aperture; but during the instroke of the ram the aperture is closed or cut off, and by the continued inward movement of the ram the metal in advance of it is pressed along the aforesaid die or mold. On each double stroke or complete reciprocation of the ram the same action is repeated, so that a tube may be made of any desired length, for as the tube is gradually delivered or pushed off from the outer end of the core and out of the cylinder or chamber as increment upon increment is added to it by the pump-like action of the ram the lengths of the cylinder and the core do not limit the length of tube.

In another form of plant or apparatus suitable for the manufacture of steel tubes in accordance with this invention a reciprocating mandrel is arranged within the twyer-like or water-cooled core, and both the core and the cylinder are made of tapered form at the extrusion or delivery end. The annular space forming the mold or die is thus made to vary in area or cross-section in order that the metal shall be subjected to an action akin to that which takes place during forging and like operations. The end portion of the reciprocating mandrel aforesaid is made on its outstroke to pass beyond the front or delivery end of the core, but on its instroke to pass within the core, and is thereby cooled. Preferably the outstrokes of the annular ram and the mandrel are made to synchronize and the instroke of the latter to commence slightly in advance of that of the former. As in the previous case, the tube is formed increment by increment on each complete reciprocation of the ram and is gradually and intermittently pushed from one end of the die to the other. During its gradual movement along the tapered or conical portion of the mold the varying cross-section throughout such portion produces a molecular action throughout the metal somewhat akin to that which takes place during forging and like operations, whereby it is increased in density and improved for most services for which tubes are required. On leaving the mold the tube is still hot and may, if required, be subjected to reducing or other processes either with or without additional heating.

Referring to the three accompanying sheets of explanatory drawings, Figure 1 is a sectional elevation, and Fig. 2 a sectional plan, of an apparatus constructed for the manufacture of tubes in accordance with our invention in which the core and the cylinder are

tapered and a central mandrel is provided. Fig. 3 is a sectional end view on the line A B, Fig. 1.

The same reference-letters in the different views indicate the same or similar parts.

a is a cylinder with an annular ram or plunger *b*.

c is a chamber fitting within a housing or holder *d*.

The motor-cylinder *a* and the housing *d* of the operating-cylinder *c* are connected together by screw tie-bars *e*, provided with abutment or thrust nuts *f* and *g*. A core *h*, having one end bolted or secured to the motor-cylinder *a*, projects longitudinally through the center of the annular ram *b*, as illustrated, while in a central aperture formed longitudinally through the said core *h* itself is placed a mandrel *i*, adapted for independent reciprocation by a supplementary motor-cylinder *j*. One end of the mandrel *i* is arranged as or provided with a plunger or piston *k* for working within the said supplementary cylinder *j*. The outer or operative end of the ram *b* is preferably provided with a detachable nose-piece *l*, having its fore part adapted for entering the mouth of the operating cylinder or chamber *c*. The bore of the cylinder *c* at its mouth or admission end is parallel for a short distance corresponding with the length of the plunger-stroke. From the inner extremity of such parallel portion to the opposite or extrusion end—*i. e.*, to a die *m*, which is secured at such end by the abutment *n*—the bore of the cylinder is made to a tapered form. The nose or end portion of the core *h* which enters the cylinder *c* is also made tapered, as shown, and the said nose is preferaby made detachable by means of a screw-joint. The end of the mandrel *i* which projects beyond the nose of the core *h* and through the die *m* is also preferably made detachable by means of a screw-joint. The core *h* is cooled by the circulation of water through the same—*e. g.*, by means of pipes *o*, arranged within channels formed longitudinally through the core, the inner ends of the said channels communicating with the water-cooling apertures, as illustrated, in the tapered nose of the core *h*. Cooling-apertures, with water-circulating pipes and connections *p*, are also formed and arranged around the housing or holder *d* of the operating cylinder or chamber *c*. The return stroke of the ram *b* on its movement away from the operating-cylinder *c* is effected by means of a pair of drawback-cylinders *q*, within which are plungers connected to the opposite ends of a cross-head *r*, fixed upon the main or annular ram *b*, as shown. Suitable plugs or fittings *s* are provided upon the cylinder *a*, the supplementary cylinder *j*, and the return or drawback cylinders *q* for the connection of the hydraulic supply-pipes with suitable automatic or other valves for regulating the admission and discharge of water to or from the various cylinders. Ordinary leather or other packings are employed where necessary. The drawings show the ram *b* at the end of its inward stroke. Its nose-piece *l* is therefore at its outer position with respect to the operating-cylinder *c*.

During the inward stroke of the ram *b* with respect to its cylinder *a* the lateral port or aperture *t* in the operating cylinder or chamber *c* is opened. A quantity of molten metal from the supply in the container *u*, which may be heated, if necessary, for the purpose of keeping the metal therein at the proper consistency, is then drawn or carried through the said port into the cylinder *c*. The container *u* can be formed in the housing or holder *d* of the cylinder *c*, as illustrated. In some cases it may be found advantageous to provide more than one port *t* from the container *u*, and it is also an advantage to furnish the container and port or ports with a removable liner, as will be readily understood. On the outward stroke of the ram *b* with respect to its cylinder *a* or its inward stroke with respect to the cylinder or chamber *c* the port *t* is closed or covered by the ram-nose *l*, and the metal entrapped in the chamber is pressed toward the die *m* at the extrusion or discharge end. By the continuation of the reciprocatory action of the apparatus the molten metal is gradually withdrawn increment by increment from the container *u* to the cylinder or chamber *c*, subjected to a number of intermittent compressions in the said chamber, and finally extruded therefrom as a uniform or continuous tube, such as *v*, in a step-by-step manner. By maintaining the supply of molten metal to the container *u* at the proper temperature the tube may be produced of any desired length, or as it is extruded in a continuous form the tube may be cut into lengths, as required.

By the arrangement and combination of mold parts, as aforesaid, and the speed of reciprocation and length of stroke of the ram we provide for a gradation or regulation of temperature throughout the inclosed metal operated upon, so that as it flows from the discharge end of the die it is sufficiently rigid to retain its shape, while at the opposite end it is sufficiently molten or plastic to permit each incoming addition or increment of metal to readily unite with the preceding increment for the formation of a continuous tube. The said gradation or regulation of temperature also prevents any such solidification of the metal within the mold as to completely resist extrusion and render the apparatus liable to breakage or stoppage. At meal-times or other required stoppages of the plant the chamber *c* can be readily cleared of the metal by admitting a charge of sand, soapstone, or other

material that can be readily extruded in a cold state.

Our invention in the form illustrated by the drawings is particularly applicable to the production of tubes of steel and other hard or difficultly-fusible metals which cannot be satisfactorily extruded on a commercial scale as and by the means heretofore employed with soft metals. By the use of our invention in the form above referred to the following desiderata are achieved, viz: (*a*) The metal is cast in annular shape and forged subsequently. (*b*) The annular casting is of greater diameter than the finished tube, and so back pressure is produced which enables the ram to make the tube homogeneous. (*c*) The internal and external portions of the mold are made sufficient in cooling effect to properly reduce the temperature. (*d*) Each increment of plastic or liquid metal ejects the previous one. (*e*) The mold is so arranged that the metal is liquid at the casting end and solid at the finishing end, and (*f*) there is intermittent cessation of work, so that the mandrel and other parts are cooled.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In the manufacture of tubes direct from molten or plastic metal, the combination consisting of an operating cylinder or chamber, a central cooling-core, a mandrel within said core and reciprocating independently thereof, a mold formed by the said cylinder the core and mandrel for the reception of the molten or plastic metal, and an annular ram reciprocating in the said mold whereby the said metal is subjected to repeated compressive workings and gradually carried step by step through the mold and discharged therefrom in a continuous length, substantially as described.

2. In the manufacture of tubes direct from molten or plastic metal, the combination consisting of an operating cylinder or chamber, a central cooling-core, a reciprocating mandrel, a die, a mold formed by the said cylinder the core the mandrel and die for the reception of the molten or plastic metal, and an annular ram reciprocating in the said mold whereby the said metal is subjected to repeated workings and gradually carried step by step through the mold and discharged therefrom in a continuous length, substantially as described.

3. In the manufacture of tubes direct from molten or plastic metal, the combination consisting of an operating cylinder or chamber, a central cooling-core, a mandrel, a mold formed by the said cylinder the core and the mandrel for the reception of the molten or plastic metal, an annular ram, a motor adapted to reciprocate the said ram in the said mold whereby the metal therein is subjected to repeated compressive workings and gradually carried step by step through the mold and discharged therefrom in a continuous length, and to reciprocate also the said mandrel, substantially as described.

4. In the manufacture of tubes direct from molten or plastic metal, the combination consisting of an operating cylinder or chamber, a central cooling-core, a mandrel, a die, a mold formed by the said cylinder the core the mandrel and die for the reception of the molten or plastic metal, an annular ram, a hydraulic cylinder and connections adapted to reciprocate the said mandrel, and hydraulic cylinders and connections adapted to reciprocate the said ram in the said mold whereby the metal therein is subjected to repeated compressive workings and gradually carried step by step through the mold and discharged therefrom in a continuous length, substantially as described.

In witness whereof we have hereunto set our hands in presence of two witnesses.

ARTHUR EDWARD BECK.
GEORGE TOWNSEND.

Witnesses:
JOHN MORGAN,
HENRY WORWOOD.