No. 700,360. Patented May 20, 1902.

# B. F. McTEAR.

## MANUFACTURE OF STEAM GENERATOR SHELLS, CYLINDERS, &c.

(Application filed June 19, 1900.)

(No Model.) 3 Sheets—Sheet 1.

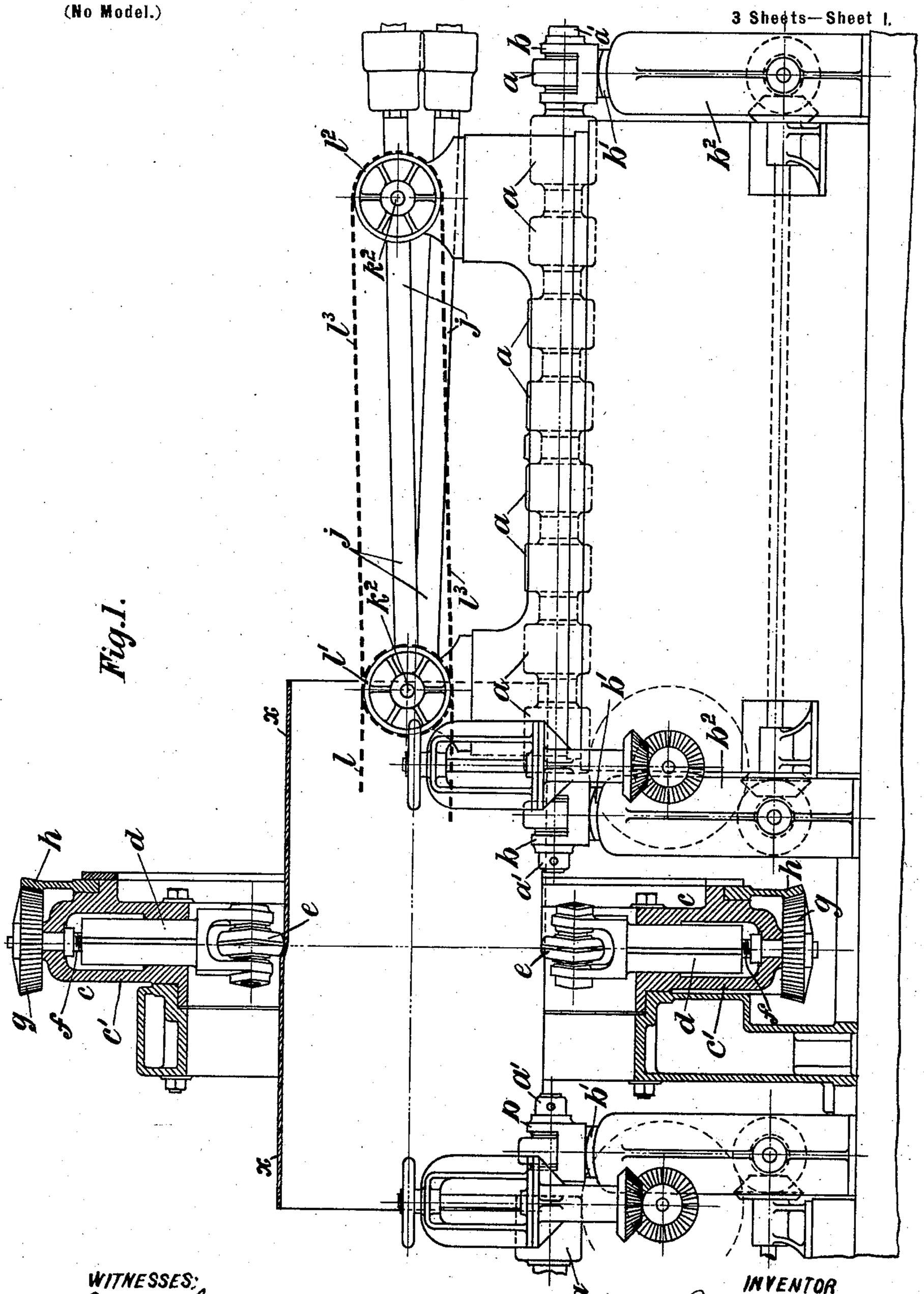


Fig. 1.

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## MANUFACTURE OF STEAM GENERATOR SHELLS, CYLINDERS, &c.

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(No Model.) 3 Sheets—Sheet 2.

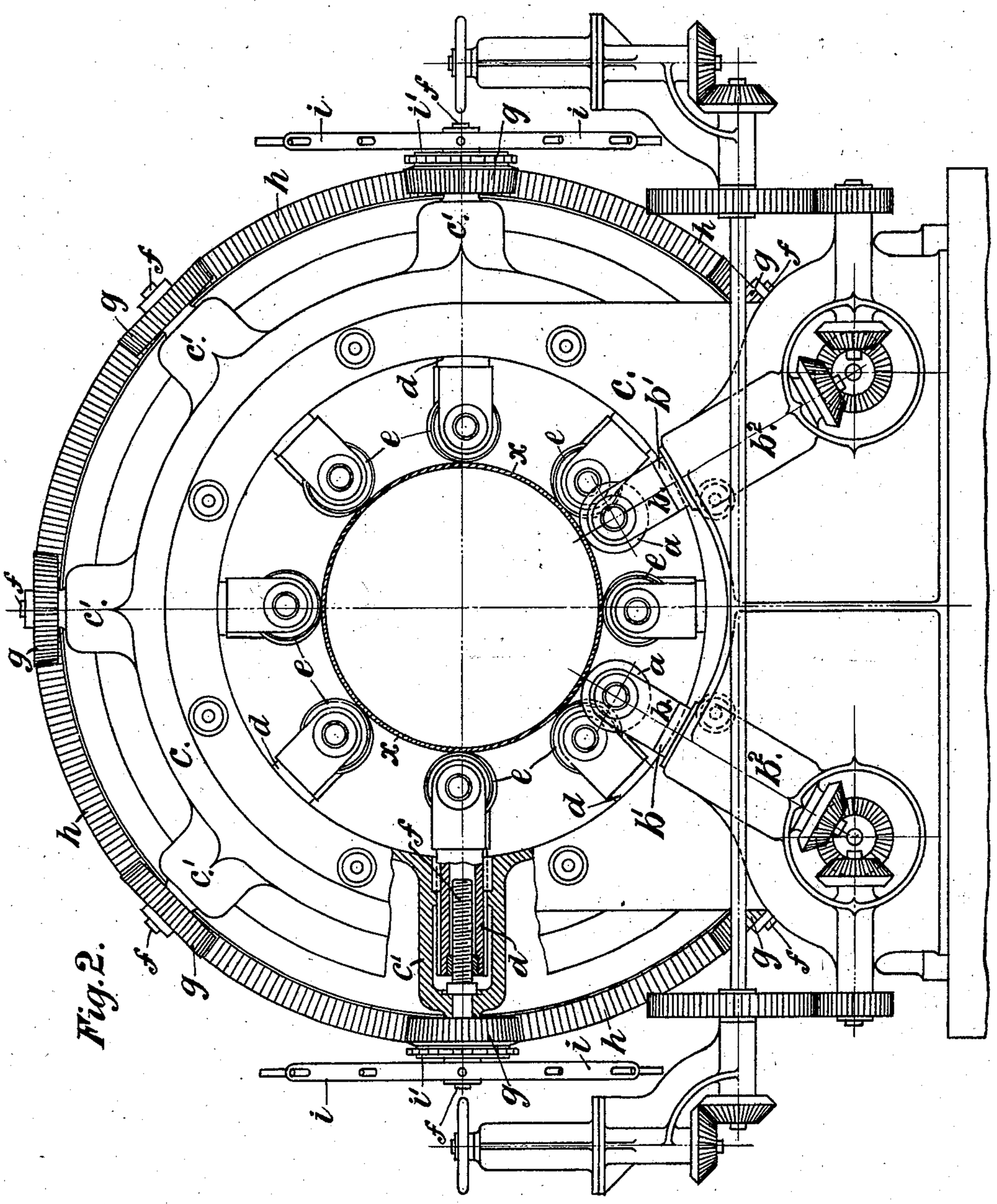


Fig. 2.

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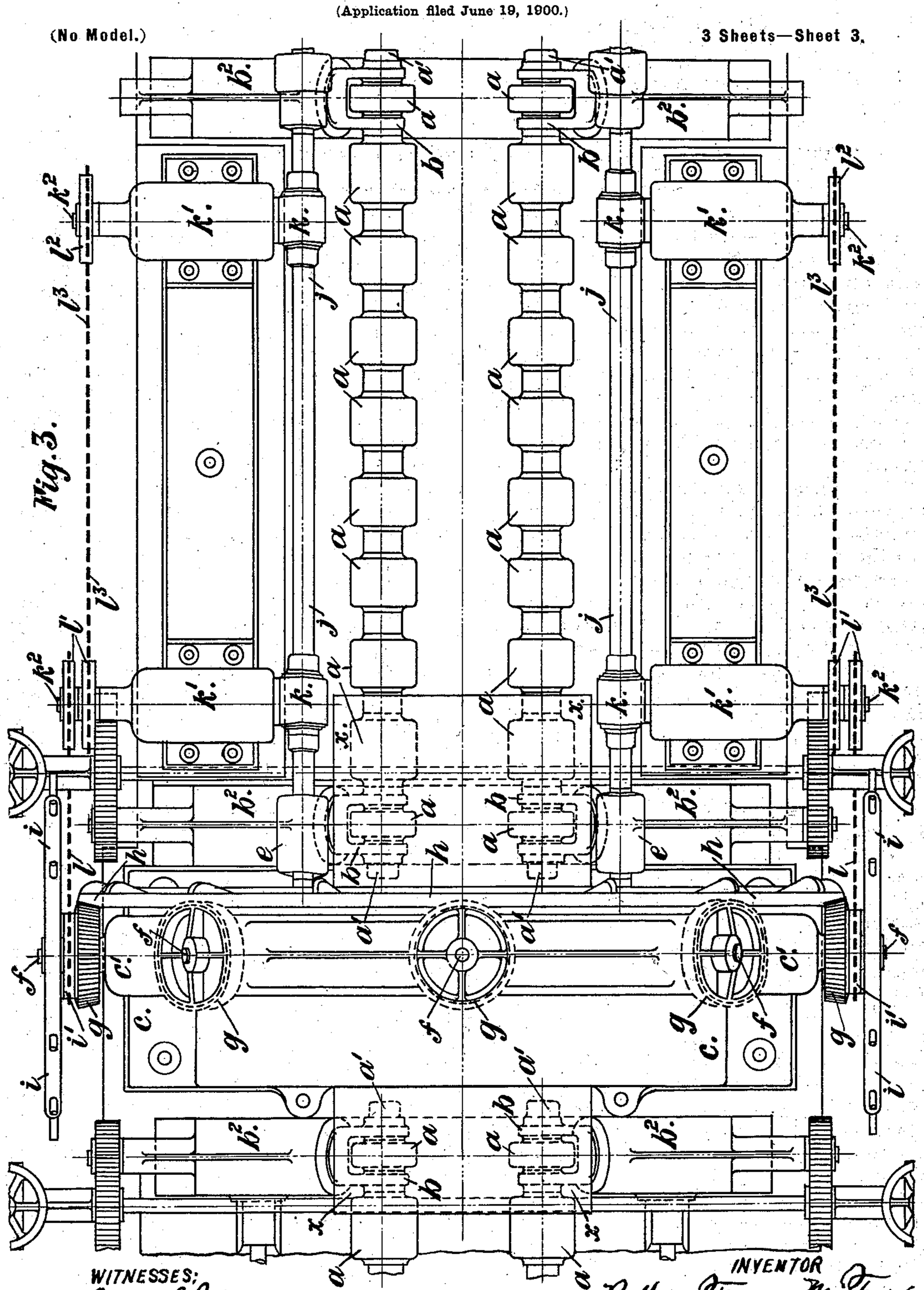
(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

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# UNITED STATES PATENT OFFICE.

BALFOUR FRASER McTEAR, OF RAINHILL, ENGLAND.

## MANUFACTURE OF STEAM-GENERATOR SHELLS, CYLINDERS, &c.

SPECIFICATION forming part of Letters Patent No. 700,360, dated May 20, 1902.

Application filed June 19, 1900. Serial No. 20,893. (No model.)

*To all whom it may concern:*

Be it known that I, BALFOUR FRASER McTEAR, a subject of the Queen of England, and a resident of Rainhill, in the county of Lancaster, England, have invented certain new and useful improvements in and connected with the manufacture of steam-generator, shells, cylinders, furnaces, and other analogous hollow articles, partly applicable to other purposes, of which the following is a specification.

My invention has reference to the manufacture of shells, flues, or cylinders of steam-generators and other analogous articles.

In the ordinary way the shells of steam-generators are formed of plates curved to the required shape and connected together by means of longitudinal and circumferential lines of rivets. It has been determined by eminent authorities that the best system of riveting weakens the plates one-fourth or even more and that if the longitudinal seams could be avoided an augmentation of pressure to the extent of about twenty-five per cent. would be permissible with the same thickness of shell-plates. Prior, however, to the present time it has been proposed to make cylinders or rings of metal without joint, seam, or weld by a rolling operation from an ingot of steel or from a bloom or mass of metal similarly as in the rolling of railway-tires. The proposed method of preparing the ingot or bloom for the rolling operation consisted in forming a hole in it by a steam-hammer and placing it on a mandrel and then hammering it in a swage. It has also been suggested to take a cast hollow cylinder ingot and forge it to the right size. For effecting the purposes of the present invention these proposals are practically useless or offer very considerable difficulties in the manufacture. To treat a block of metal of a size and weight suitable for making boiler shells or flues in the manner proposed it is hardly if at all practicable and in any event extremely difficult, and to roll, as has been proposed, a number of shells or flues direct from prepared ingots or blooms to an exact diameter and thickness, such as are required in practice, is next to impossible.

According to this invention the objections and difficulties above referred to are overcome, and the manufacture of seamless boiler shells, cylinders, or similar hollow articles in an expeditious, inexpensive, and satisfactory manner is carried out.

The following is the method or process by which the ends referred to are attained: The metal from which the shell or cylinder is to be made is in the form of an ingot or bloom hammered or cast to any desired shape in cross-section and having the requisite mass or weight to produce a shell or cylinder of the required size, and this ingot or bloom in a white-hot or glowing state is placed in a die and pierced—say by hydraulic pressure—longitudinally while held in this die, the piercing being effected by a conical or bulbous pointed mandrel or tool. The effect of this action, besides the formation of the immature hollow cylinder or shell, &c., is to compress and condense the metal and also in some cases to elongate the body to the length required. Thus the quality of the metal is improved, as the pressure caused by the piercing closes up all holes and porous places which may exist in the ingot or bloom and generally compresses the metal. The hole will be of considerable size and is effected by one pass of the mandrel of the size required or by consecutive passes of mandrels of different sizes. The immature cylinder or article after removal from the die in which it is pierced is without reheating or after being reheated rolled out by suitable inside and outside rollers to a larger diameter than that which the finished ring is to be, but of the exact thickness of ring-plate required, (this excess of size being allowed for in the ingot or bloom by employing a bloom or ingot of greater weight than the finished article,) and then this extra metal in the form of excess of diameter is reduced and converted into extra length by rolling on the outside—*i. e.*, externally—by a plurality of rolls arranged at different parts around it, the thickness of the plate remaining the same.

In order to be useful for employment in the manufacture of steam-generator shells, furnace-flues, and the like, it is necessary that the shells or cylinders of which they are comprised be quite accurate as to diameter of the cylinder and also as to the thickness of the plate, and these two conditions and

characteristics are readily accomplished by the method or process of manufacture or improvements according to my invention.

Machinery by which the manufacture of cylinders or equivalent bodies, as described, accurate both as to diameter and also thickness of plate, can be carried out advantageously is illustrated in the annexed drawings.

In the drawings, Figure 1 is a side elevation, partly in section; Fig. 2, an end view, partly in section; and Fig. 3 a plan illustrating one modification.

Like letters of reference are used to denote the same or equivalent parts wherever they occur in the drawings.

Regarding the machine illustrated in Figs. 1 to 3, this is adapted to reduce the cylinders in diameter, forcing the metal consequent upon reduction into length in such cylinders.

Referring to the drawings, $x$ represents the cylinder being operated upon. This cylinder is supported upon a roller-bed at each side of the reducing mechanism, consisting of two parallel sets of rollers $a$, the shafts $a'$, supporting these rollers, being supported at either end by bearings $b$, such bearings being mounted on the slides $b'$, supported in the guides $b^2$. The slides $b'$ are worked up and down in the guides $b^2$ by screw-gear in any suitable known way.

The mechanism which operates upon the cylinder $x$ comprises an annular frame $c$, having a plurality of guides $c'$ therein, the axes of which are arranged radially through the center in the frame. In these guides $c'$ rectangular slides $d$ fit and work, and these slides carry at their inner ends rollers $e$, arranged in skew disposition. The slides $d$ are worked up and down in the guides $c'$ by screwed shafts $f$, meshing with threads in said slides, and tooth-wheels $g$ on said shafts. All the wheels $g$ and slides $d$ are worked in and out, as required, simultaneously by a tooth-rack $h$, mounted on the frame $c$ and operated by either of the two hand-wheels $i$, each of which is mounted on one of the spindles or shafts $f$ on either side of the machine. When these hand-wheels $i$ are worked one way, the rollers $e$ are moved out, and vice versa. Two or more of the rollers $e$ are mechanically revolved and act as motor-rollers for revolving the cylinder $x$. $j$ represents the driving-shafts of these rollers, and they are adjusted laterally by moving their bearings $k$ nearer to and farther from the center of the cylinder simultaneously with the movement of the slides $d$. This is effected by mounting the bearings $k$ on the end of the slides similar to $d$, mounted in guides $k'$, the said slides being moved in and out by spindles $k^2$, which are worked from the hand-wheel $i$ by a sprocket-wheel $i'$, fixed on the spindle $f$, carrying this wheel, a sprocket-chain $l$ and sprocket-wheels $l'$ $l^2$ on the shafts $k^2$, and the sprocket-chain $l^3$ connecting said wheels $l'$ $l^2$. This gearing for the driven wheels $e$ is provided on one side of the frame $c$ only, the mechanism on the other side of the frame being merely the roller-bed for supporting the cylinder $x$.

Prior to the cylinder $x$ being operated on in this machine it is rolled to the exact thickness required, but to a larger external diameter, which of course can be done by allowing greater sectional area in the block of metal from which the cylinder is to be made than is actually required in the finished tube. Then the diameter is reduced to that actually required by setting the rollers $e$ inward at a radius less than the radius of the tube or cylinder to be operated upon—namely, to the radius of that of the finished cylinder required—which transfers the excess of diameter into length without increasing or varying the thickness. In action when the tube is started under the rollers $e$ these rollers, being on the skew and revolving, revolve the cylinder $x$ and reduce its diameter and move it longitudinally as well, and as it is revolved it traverses over one or other of the roller-beds, the rollers $a$ revolving with it. The reduction of diameter may be effected by one passing or a plurality of passings under the rollers $e$.

What is claimed in respect of the herein-described invention is—

1. The process of manufacturing seamless metal cylinders of large size, and of the diameter and also thickness required, consisting of first producing a perforate seamless blank or billet from which the cylinder is to be made, then rolling said blank or billet circumferentially and increasing its external diameter until it is of larger size than the cylinder required, and then reducing this excessive size by rolling it circumferentially at points all around simultaneously from one end to the other, while it is being revolved axially.

2. The process of manufacturing seamless metal cylinders of large size, and of the diameter and also thickness required, consisting of first producing a perforate seamless blank or billet from which the cylinder is to be made, then rolling said billet or blank until it is of larger diameter than the finished cylinders but of the required thickness, and then subsequently reducing the diameter by rolling it externally at points all around, in substantially the same transverse plane of said cylinder, from one end to the other, while it is being revolved axially whereby the excess of metal caused by the reduction is transferred into a longitudinal extension.

In witness whereof I have hereunto set my hand in presence of two witnesses.

BALFOUR FRASER McTEAR.

Witnesses:
JOHN HINDLEY WALKER,
JNO. D. BROWN.