No. 682,360. Patented Sept. 10, 1901.

H. R. KEITHLEY.

METHOD OF MANUFACTURING TUBULAR BODIES.

(Application filed July 1, 1901.)

(No Model.) 2 Sheets—Sheet 1.

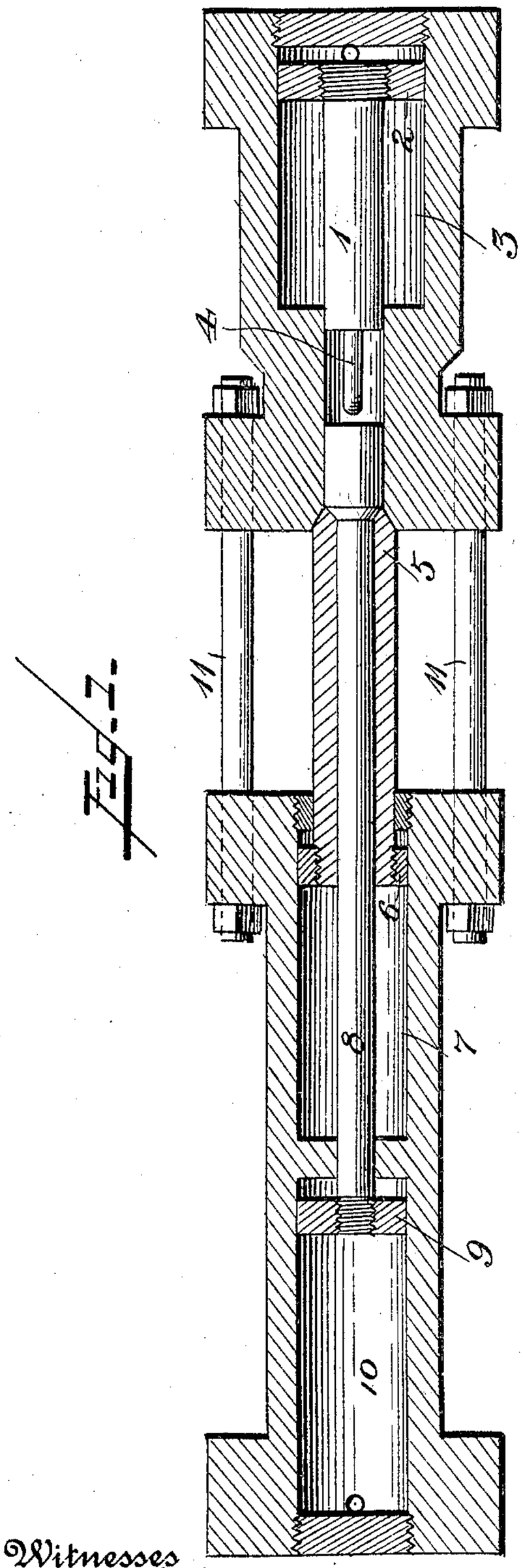

Fig. 1.

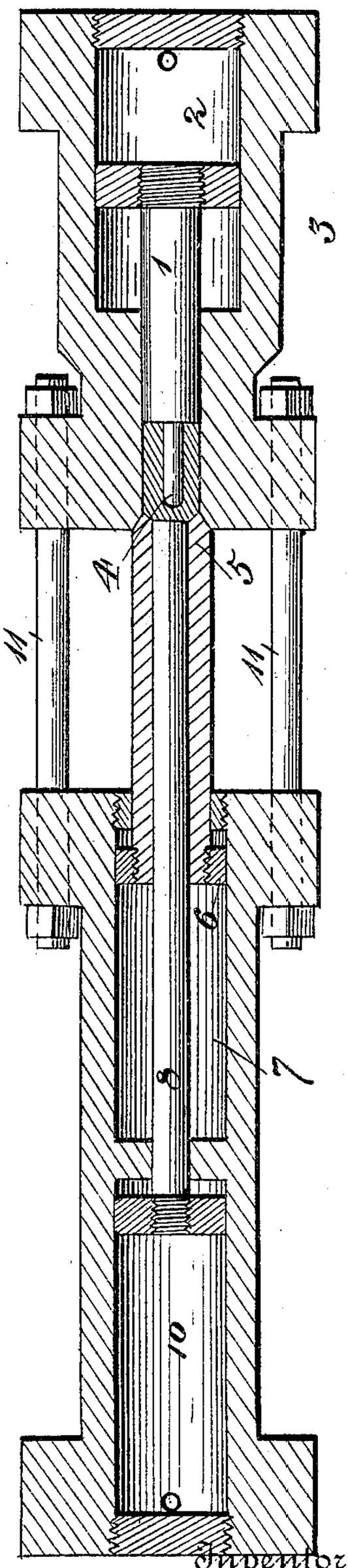

Fig. 2.

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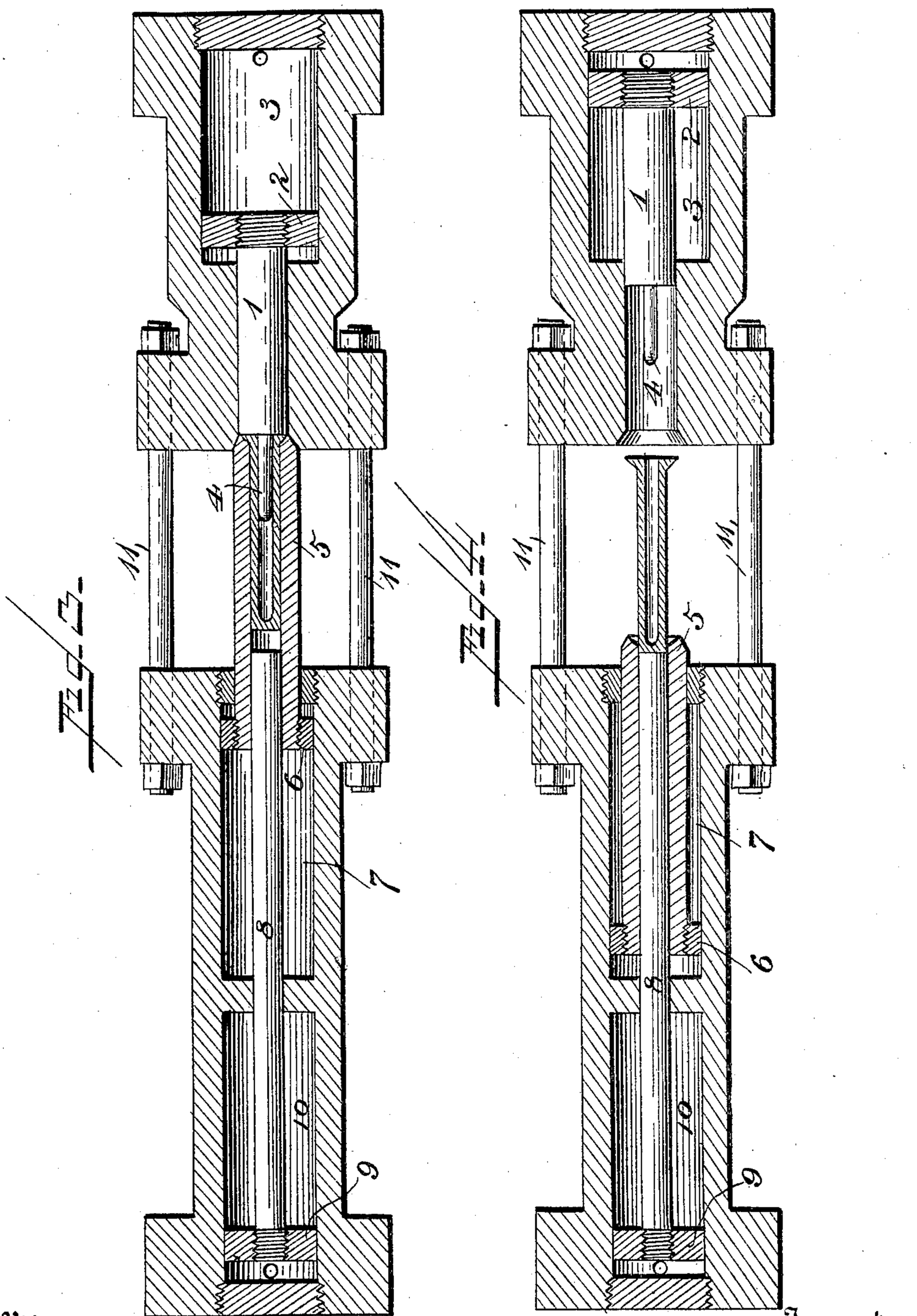

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METHOD OF MANUFACTURING TUBULAR BODIES.

SPECIFICATION forming part of Letters Patent No. 682,360, dated September 10, 1901.

Application filed July 1, 1901. Serial No. 66,667. (No model.)

To all whom it may concern:

Be it known that I, HERBERT R. KEITHLEY, of Wilson, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Methods of Manufacturing Tubular Bodies; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the manufacture of seamless tubular bodies from solid bodies of metal.

In the present state of the art there are two principal methods or processes of manufacturing seamless tubular bodies. One of these processes consists in confining a solid piece of hot metal in a suitable chamber and forcing a punch into or through the mass to form the tube. In the other process referred to the tubular blank is produced on a mandrel between rolls having differential rotation at high velocity and is called the "disk rolling or piercing" process. The principal difficulty encountered in the first-named process is to produce a tubular blank of the length required to work into the commercially-finished form, which blank shall have a perfectly-centered hole or bore, so that the walls are of uniform thickness. Commercial tubing is now made in lengths of about twenty feet, and this requires that the original seamless tubular blank be approximately three feet long. To punch a hole of the required size through a solid mass of metal of such a length (three feet) and to preserve the exact alinement of the punch under the heavy pressures required to penetrate the metal has been found to be so difficult and uncertain that this process has been superseded by the disk rolling or piercing process above referred to. This latter process requires the use of a high-grade "open-hearth" steel, which is very expensive. This is necessary because it has been found that the use of the ordinary grade of open-hearth steel or Bessemer will not produce satisfactory results. It has also been found that even when high-grade steel is employed in this process the effect of the excessive working and manipulation of the metal mass has been such that the product cannot be "machined" and prepared for various mechanical uses with satisfactory results. This disk rolling or piercing process has the disadvantage of requiring very expensive machinery which in operation requires constant and careful attention in order that the adjustments of the various parts throughout may be properly maintained; otherwise the product will be defective.

The object of my invention is to produce from the ordinary grades of steel a seamless tubular blank which will not be open to the objections above pointed out and to accomplish this result by a means and process efficient, economical, and reliable.

In the the accompanying drawings I have shown one form of machine by which my process may be practiced.

The first step in my process comprises heating a solid body of metal; second, punching said body by a punch or mandrel while it is held in a suitable chamber to thereby form a short heavy tubular body, and, finally, by pressure applied direct to the short heavy tubular body it is forced through a tubular pass of less diameter than said tubular body and contracted diametrically, so that the metal being displaced is caused to flow longitudinally and forward beyond the point of the punch or mandrel, thus forming a tubular body of greater length than said punch or mandrel. During the process a superior longitudinal fibrous structure is imparted to the tube.

In the drawings, Figure 1 is a longitudinal sectional view of a machine by the use of which my process may be practiced. Figs. 2, 3, and 4 are similar views, the parts being shown in different positions for the purpose of illustrating the successive steps of the process.

1 is a plunger or rod carried by preference by a piston 2, movable in a cylinder 3.

4 is a punch or mandrel.

In the forward end of the cylinder 3 there is a passage of a size corresponding to the size of the plunger or piston 1. This passage will hereinafter be termed the "blank-chamber." 5 is a tubular abutment, the passage

through which is of less diameter than said blank-chamber but of larger diameter than said punch. This tubular abutment is movable by means of a piston 6, in turn movable within a cylinder 7.

8 is a piston-rod of a size corresponding to the bore of the tubular abutment 5 and movable therein. This piston 8 may be moved by a piston 9, in turn movable in a cylinder 10.

The casing or casings forming the piston-cylinders are connected in any desirable way—for example, by rods or bolts 11 11. The pistons may be operated hydraulically or by any other suitable mechanical means.

The preferred form and means by which the plunger 1, the punch 4, the tubular abutment 5, and the piston 8 are operated is shown in the drawings, although it is obvious the same may be modified in form and arrangement.

In operation the first step of the process comprises heating a solid blank and then inserting said blank into the blank-chamber, so that it will occupy the position, for example, substantially as shown in Fig. 1. The piston 8 and the tubular abutment 5 are so positioned that they close the otherwise open end of the said blank-chamber—for example, as shown in Fig. 1. The punch 4 is then advanced from the position shown in Fig. 1 to the position shown in Fig. 2, thereby punching said solid blank and forming the short heavy tubular body shown in Fig. 2. The piston 8 is then retracted, say, to the position shown in Fig. 8, and the next step in the process comprises forcing the plunger from the position shown in Fig. 2 to the position shown in Fig. 3, during which operation the metal is displaced and caused to flow through the contracted passage between the wall of the tubular abutment and the punch, which together form what may be termed a "tubular" die. This movement of the metal causes it by displacement to move longitudinally and forwardly beyond the point of the punch, thereby forming an elongated tubular body substantially of the completed form shown in Figs. 3 and 4. The plunger 1 and punch 4 may then be retracted. The tube may then be removed by retracting the tubular abutment 5. In Fig. 4 the abutment 5 is retracted; but the tube is shown as being slightly in engagement therewith. It may be entirely freed therefrom, however, by slightly advancing the piston 8 or retracting the tubular abutment still further.

From the foregoing it will be seen that by this process and by the employment of a suitable means a perfectly-centered hole will be formed in a metal blank, so that the walls around the same will be of uniform thickness. This is possible by reason of the fact that the punch or mandrel employed in this process is substantially shorter than the length of the tubular body finally produced. By the use of the short punch or mandrel the said device when performing the function of a punch will successfully resist deflection from true alinement notwithstanding the great pressure required to penetrate the solid mass of heated metal. When the point of the punch has entered the pass of reduced diameter, it then begins to perform the function of a mandrel coacting with the wall of said pass, so that said parts act upon the metal as a die. Under these conditions the pressure of the metal against the punch, which now acts as a mandrel, will not deflect the same from true alinement since the resistance against the end of said member ceases, due to the fact that the metal by displacement is caused to move or flow longitudinally and forwardly beyond the point of the punch.

What I claim is—

A process for manufacturing a seamless tubular iron or steel body from a solid body in a continuous operation, said process comprising heating a solid iron or steel blank, then punching said blank while the same is confined at its sides, thereby forming a short, tubular body, then forcing said tubular body through a tubular die of less diameter than the said short, tubular body, thereby contracting said body diametrically so that the metal is caused by displacement to flow longitudinally and forwardly beyond the point of the punch or mandrel, thereby elongating said body and forming in the finished product longitudinal fiber.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HERBERT R. KEITHLEY.

Witnesses:
R. C. MITCHELL,
E. F. CAVERLY.