J. C. HARKNESS.

SEAMLESS TUBE ROLLING MILL.

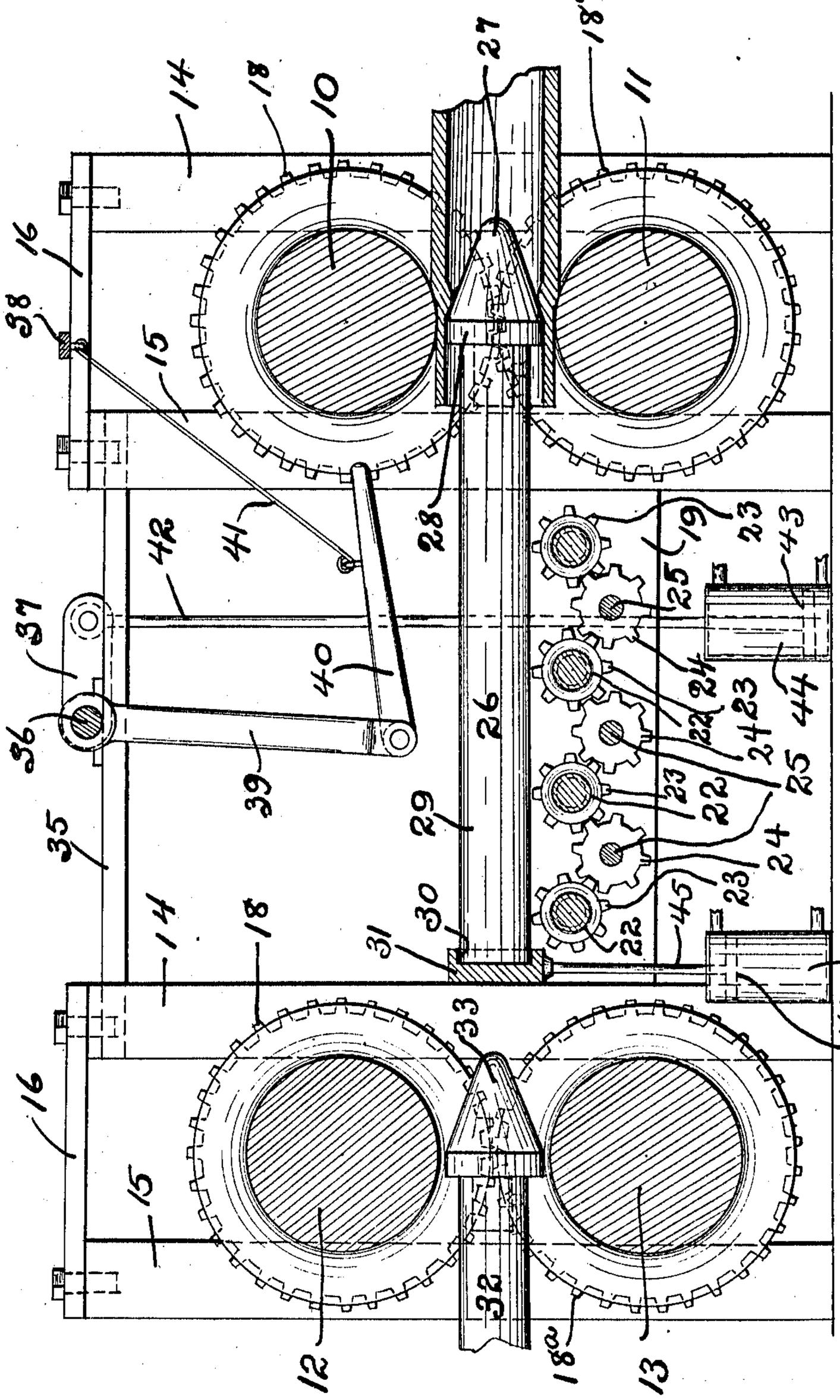
APPLICATION FILED SEPT. 28, 1908.

988,569.

Patented Apr. 4, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



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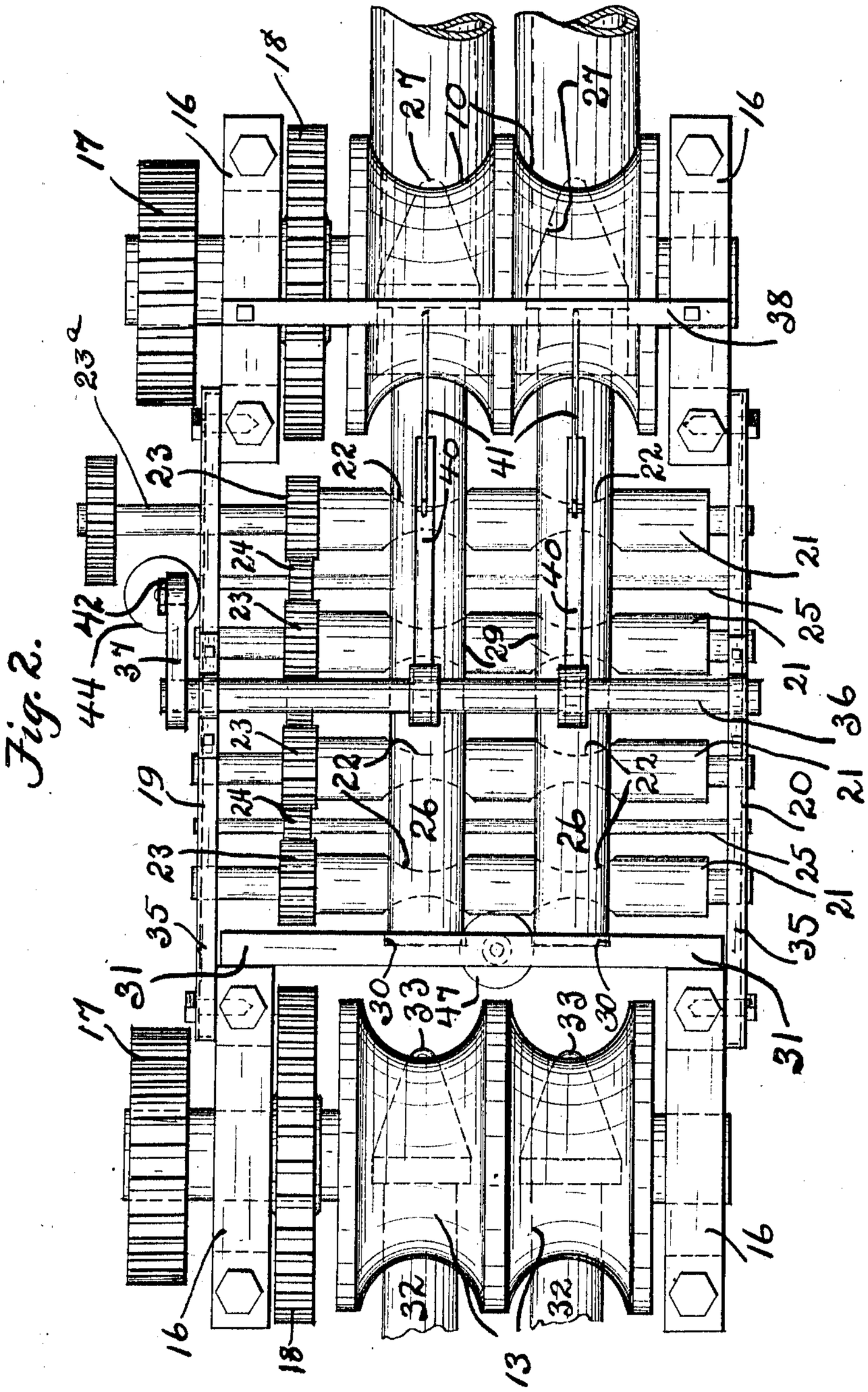
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

JOSEPH C. HARKNESS, OF LORAIN, OHIO.

SEAMLESS-TUBE-ROLLING MILL.

988,569. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed September 28, 1908. Serial No. 455,089.

To all whom it may concern:

Be it known that I, JOSEPH C. HARKNESS, a citizen of the United States of America, residing at Lorain, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Seamless-Tube-Rolling Mills; and I 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 pertains to make and use the same.

This invention relates to improvements in seamless tube rolling mills.

The object of the invention is the provision of a rolling mill by means of which seamless tubes can be more quickly, easily and cheaply produced, than with the apparatus and methods heretofore employed.

In carrying out my invention I provide a plurality of sets of rolls having shaping portions which form between the rolls openings through which the metal or stock passes, the openings between the rolls of the different sets being of successively decreasing size, and provide a plurality of mandrels which are supported in a line between the different sets of rolls so as to coöperate therewith, the whole being so arranged that the metal or stock will pass successively through the different sets of rolls and over the corresponding mandrels, the number of rolls and mandrels being such that a tube of proper shape and length is formed when the metal passes the last set of rolls. Each of the mandrels is preferably provided with a head or forming portion which coöperates with the rolls and with a shank which extends toward the next adjacent set and is supported preferably by means of a supporting yoke or bar. In order that there may be no interruption in the rolling process I provide means for shifting the supports for the several mandrels out of the path of the oncoming metal so that the tube may be formed by a continuous forward movement through the rolls.

My invention may be further briefly summarized as consisting in certain novel combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In the accompanying drawings Figure 1 is a vertical sectional-elevation of a portion of my improved rolling mill for forming seamless tubes, said figure showing two sets of forming or shaping rolls of the double or twin type and showing a partially formed tube in the process of being rolled. Fig. 2 is a plan view of the same.

In carrying out my invention, as many sets of rolls as is necessary or desired may be employed in the series but in the drawings I have shown only two sets, the rolls of one set being designated respectively 10 and 11 and the rolls of the next adjacent set being designated 12 and 13. The rolls here shown are each provided with two peripheral grooves or concave portions, the concave portions of the upper rolls forming between the rolls openings of a shape corresponding to the desired shape of the tubes which in this case will be circular. By referring to the figures of the drawings it will be seen that the shaping or rolling portions and consequently the openings between the rolls of the first set are larger than the openings between the rolls of the second set, and in my improved rolling mill or apparatus the openings between the rolls of the several sets will preferably be of successively decreasing sizes from the first set to the last set, so that the external diameter of the tube will be gradually decreased as it passes through the rolls. Each set of rolls is supported in bearings of any suitable character between uprights and standards 14 and 15, each pair of standards being connected together at the top by a cross bar 16. At least one of the shafts of each set of rolls extends beyond the corresponding set of uprights and is provided at its outer end with a suitable driving gear 17. The two rolls of each set of rolls are provided with intermeshing gears 18 and 18ª of the same size so that rotation of one will be transmitted to the other in a well known manner. The standards supporting the two adjacent sets of rolls are connected together on each side by two cross bars 19 and 20, between which is mounted a horizontal series of carrying rolls 21, each being preferably provided with concave portions 22 in line with the shaping or forming portions of the main roll, these carrying rolls serving to carry the metal or partially formed tubes from one set of shaping or forming rolls to the next adjacent set. The different carrying rolls are simultaneously driven from a shaft 23ª by means of gear wheels 23, one of which is on each of the rolls 21, and by means of idler gears 24 mounted on shafts 25 likewise extending between the cross bars 19 and 20, in a manner such as to connect all the gears on the carrying rolls in a series.

For each set of main rolls there are two mandrels 26, which during the rolling process are horizontal and each is provided with a shaping or forming head consisting of a conical nose 27 and a short cylindrical portion 28 which cylindrical portion is located between the rolls during the rolling or shaping process, and each is also provided with a long shank 29, the rear end of which extends for a short distance within a recess 30 of a supporting yoke or cross member 31, which bears against two of the standards which support the two rolls of the next adjacent set. A portion of each of the mandrels corresponding to the rolls 12 and 13 is shown at 32, and it will be seen that these mandrels are directly in line with the mandrels 26 and that the nose 33 of each mandrel 32 is adjacent to and at the rear of the yoke 31 which supports the mandrels 26. The heads of the mandrels corresponding to the several sets of rolls are preferably of the same size or diameter so that the internal diameter of the metal stock will remain practically the same during the rolling process.

From the apparatus so far described it will be seen that as the metal, which may be a billet provided with a suitable opening extending through the same, is fed or forced through the rolls 10 and 11, its external diameter is decreased and its length is increased. It will also be seen that the metal or partially formed tube on passing through the rolls 10 and 11 will move longitudinally of the shank 29 of the mandrel and will be carried by the carrying rolls toward the next adjacent set of rolls 12 and 13 and toward the head of the mandrel between said rolls. Before the forward end of the partially formed tube can pass to the adjacent set of rolls it is necessary that the yoke 31 be lowered or moved out of the path of the oncoming metal. I shall now describe the part of the apparatus whereby this is accomplished.

Secured to the uprights supporting two adjacent sets of rolls and above the rolls are cross bars 35. Extending between the bars 35 is a rock shaft 36 provided at one end with an arm 37 secured thereto, and extending between the two bars 16 mounted on the upper ends of the pair of uprights 14 and 15 supporting each set of rolls is a cross bar 38. Also secured to the rock shaft vertically above the two mandrels are two downwardly extending arms 39 longer than the arm 37, one of the arms 39 being shown in Fig. 1. To the lower end of each arm 39 is pivoted an arm 40 which extends toward the rolls 10 and 11. Each of the arms 40 is suspended by a rod, cable, or other device 41 from the cross bar 38, and is thereby normally kept out of engagement with the apparatus below the same. It will be seen that after the rear end of the metal passes beyond the head of the mandrel, if the shaft 36 is rocked and the arms 39 are swung toward the rolls 10 and 11, the free end of each arm 40 will swing downward toward the shoulder formed by the head of the corresponding mandrel, and the parts are so designed that the end of the arm 40, when the shaft 36 is rocked a sufficient amount, will engage this shoulder on the end of the mandrel. It will also be seen that if the shaft is rocked a sufficient distance the arm 40 will shift the mandrel longitudinally and the rear end of the mandrel will pass from the recess in the yoke. To rock the shaft, in order to so shift the end of the mandrel from the yoke, I have connected to the outer end of the arm 37, which is attached to the end of the shaft 36, a piston rod 42 which is connected to a piston 43 located within a cylinder 44 which may receive a motive fluid of any suitable character. The passage of the motive fluid to the cylinder may be controlled by hand, the force or pressure of the fluid in the cylinder being sufficient to cause the engagement of the arms 40 against the shoulders of the mandrels to kick the mandrels free of the yoke 31. When the yoke 31 and the shank 29 of each mandrel are free of each other, the yoke may be lowered in any suitable manner, but in the present case said yoke is connected to a piston rod 45, which in turn is connected to a piston 46 located within a cylinder 47. The passage of the motive fluid to this cylinder so as to operate the yoke 31 may also be controlled by hand. It is to be understood that this same apparatus will be provided for each set of rolls and mandrels, and that the different supporting yokes and mandrels will be successively shifted in the manner above described. Thus it will be seen that, after the metal passes through one set of rolls and the rear end of the partially formed tube is free of the head of the corresponding mandrel, before the forward end reaches the yoke 31, the piston 43 will be actuated and the mandrel is shifted free of the yoke by admitting the motive fluid to the cylinder 44. Immediately after the mandrel is shifted the yoke 31 is lowered by admitting the motive fluid to cylinder 47, and the partially formed tube is then free to pass without interruption to the next adjacent rolls. The same process of shifting the mandrels and the supporting yoke is carried out for each set of rolls so that the metal can pass without interruption to as many sets of rolls and over as many mandrels as is desired or necessary to produce a tube of the proper thickness of shell or wall, and of proper length, the external diameter or dimensions of the tube and the thickness of the metal wall being gradually decreased as the metal

passes successively through the different sets of rolls.

I do not desire to be confined to the exact details shown but aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

What I claim is,—

1. In combination, in a seamless tube rolling mill, a pair of coöperating rolls having shaping or forming portions, a mandrel cooperating with said rolls, a support for the rear end of the mandrel, said support and mandrel having horizontally extending overlapping portions, means for shifting the mandrel longitudinally after the metal has passed the forward end thereof so as to cause the mandrel and support to be disengaged, and means for moving said support transversely out of the path of the oncoming metal.

2. In combination, in a seamless tube rolling mill, a pair of rolls having forming or shaping portions through which the metal is adapted to be forced, a mandrel coöperating with said rolls and having a shaping or forming head at its forward end, a support for the rear end of the mandrel, said support having a socket in which the rear end of the mandrel projects horizontally, means for shifting said mandrel longitudinally when the metal passes beyond the forward end thereof so that the mandrel is clear of the support, and means for shifting said support transversely out of the path of the oncoming metal.

3. In combination, in a seamless tube rolling mill, a plurality of sets of rolls arranged in a row or series, said rolls having shaping or forming portions of successively varying sizes, a series of mandrels arranged in a line and each coöperating with one set of rolls, said mandrels having shaping or forming portions at their forward ends, a support for the rear end of each mandrel, the supports and the mandrels corresponding thereto having horizontally extending overlapping portions, means for successively shifting said mandrels longitudinally out of engagement with their respective supports so that the overlapping portions are disengaged, and means for successively shifting said supports transversely out of the path of the oncoming metal.

4. In combination, in a seamless tube rolling mill, a plurality of sets of rolls arranged in a row or series, said rolls having shaping or forming portions of successively varying sizes, a series of mandrels arranged in a line, each mandrel coöperating with one set of rolls and having a shaping or forming portion at its forward end, a support for the rear end of each mandrel, said support having a socket in which the mandrel extends, means for shifting each mandrel longitudinally out of engagement with its support when the metal passes beyond the shaping or forming portion at its forward end, and means for shifting the support for each mandrel out of the path of the oncoming metal.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

JOSEPH C. HARKNESS.

Witnesses:
VICTOR C. LYNCH,
N. L. MCDONNELL.