

July 1, 1924.

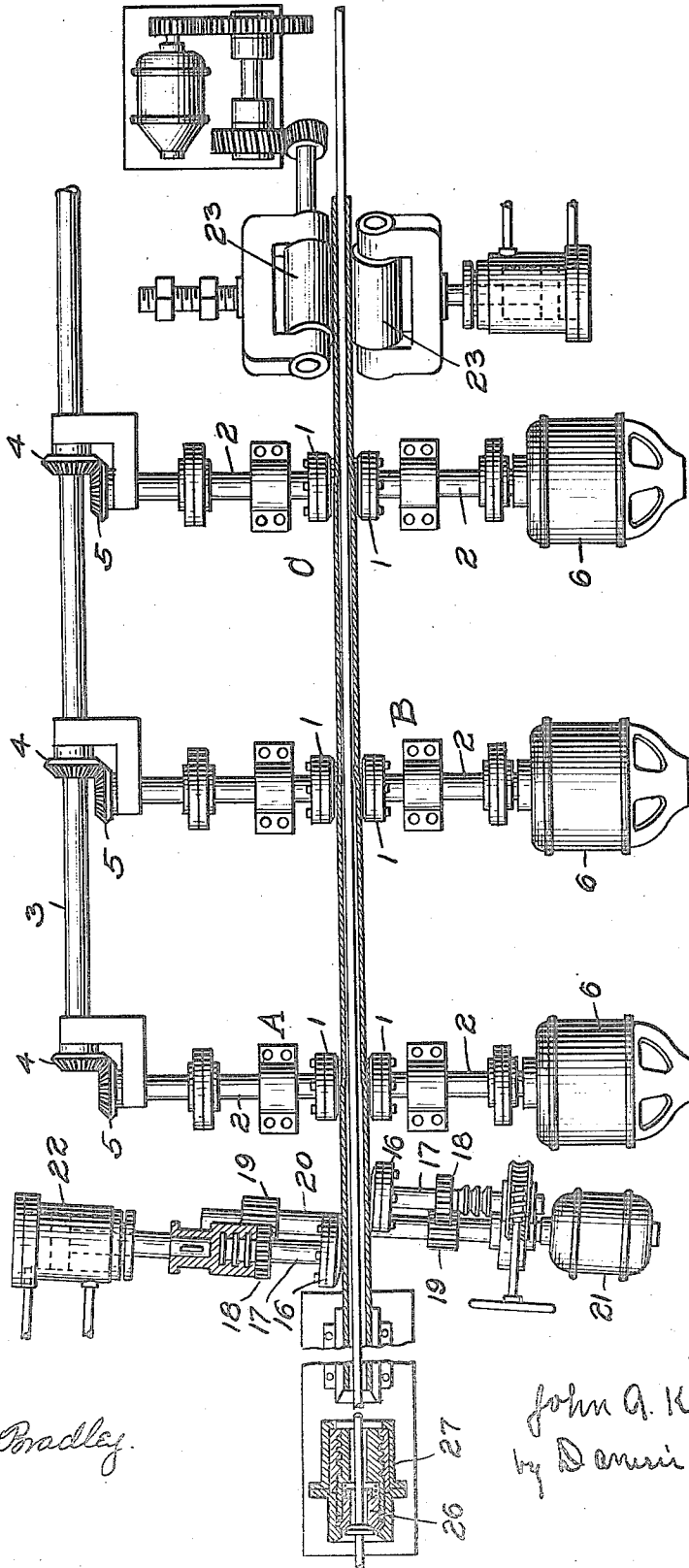
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J. A. KATZENMEYER

METHOD OF MANUFACTURING TUBES AND A CONTINUOUS MILL THEREFOR

Filed Aug. 12, 1922

3 Sheets-Sheet 1



WITNESSES

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INVENTOR

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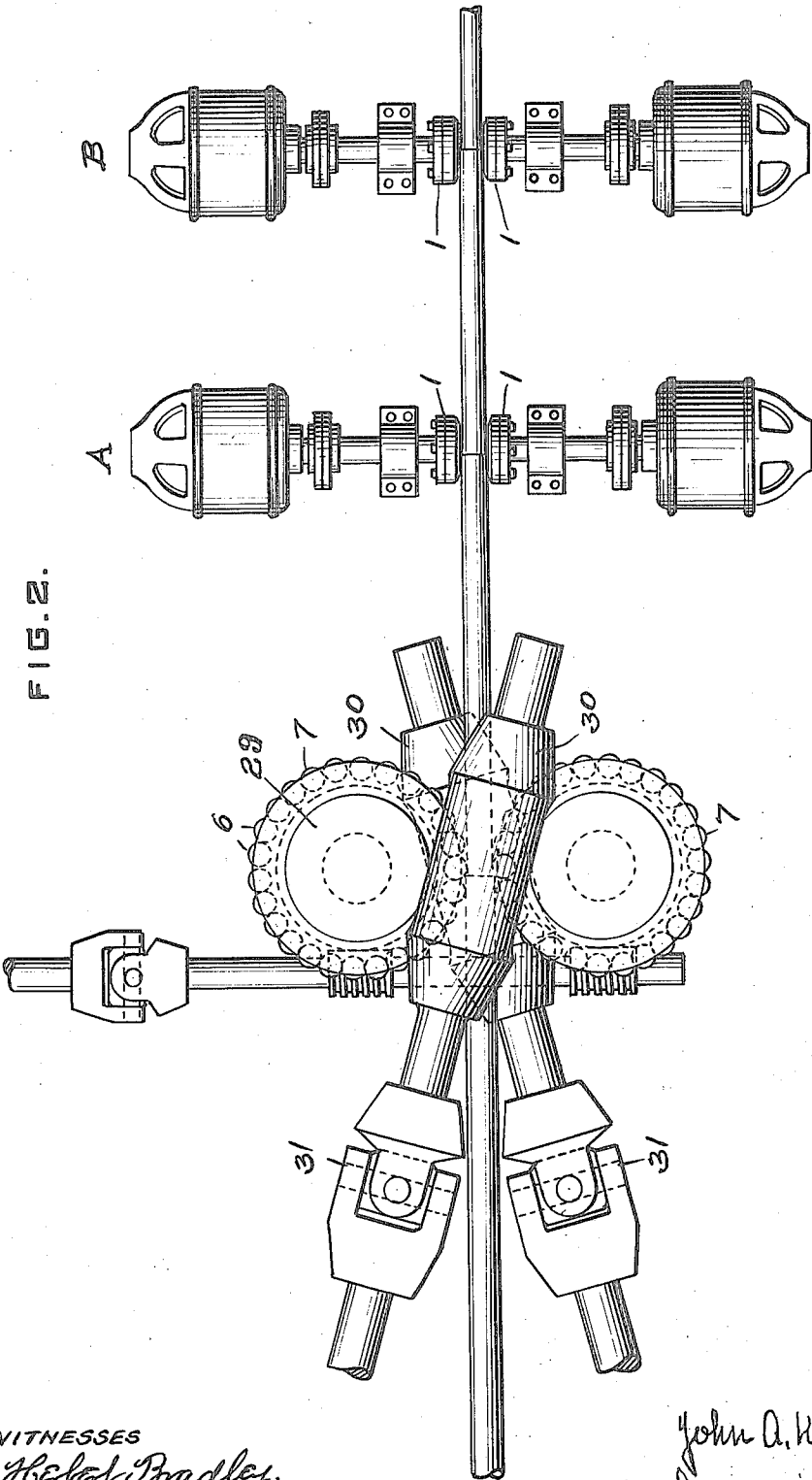
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FIG. 2.



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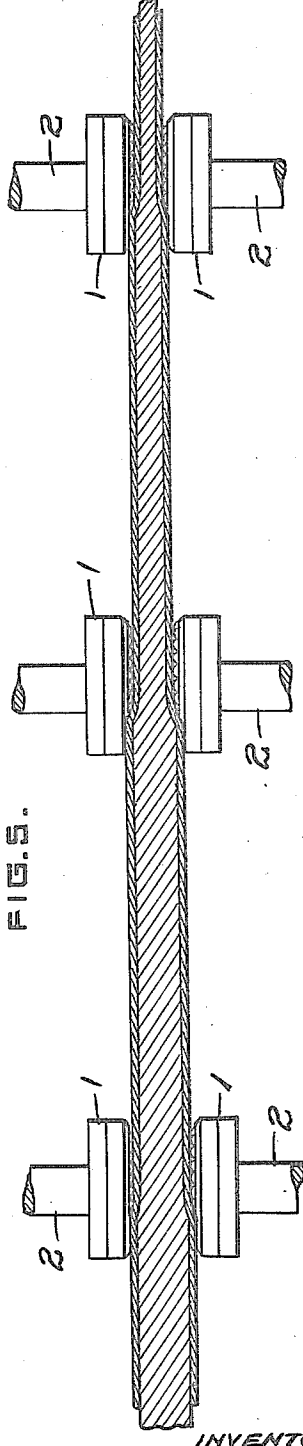
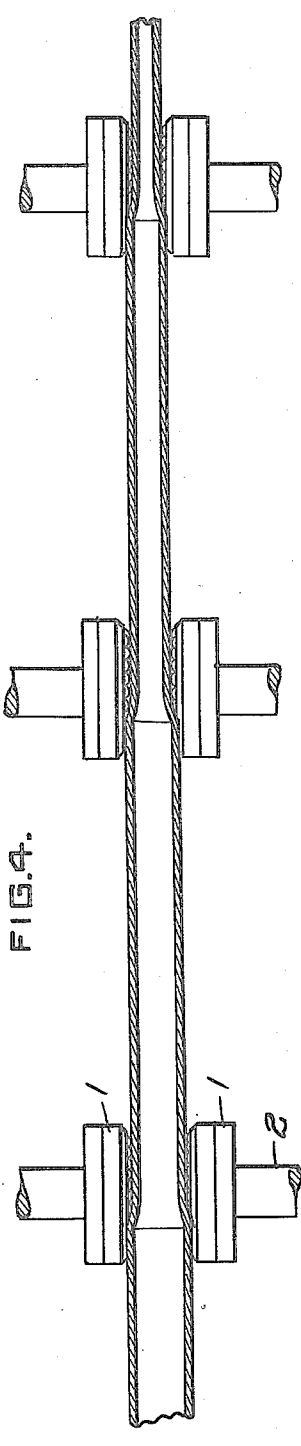
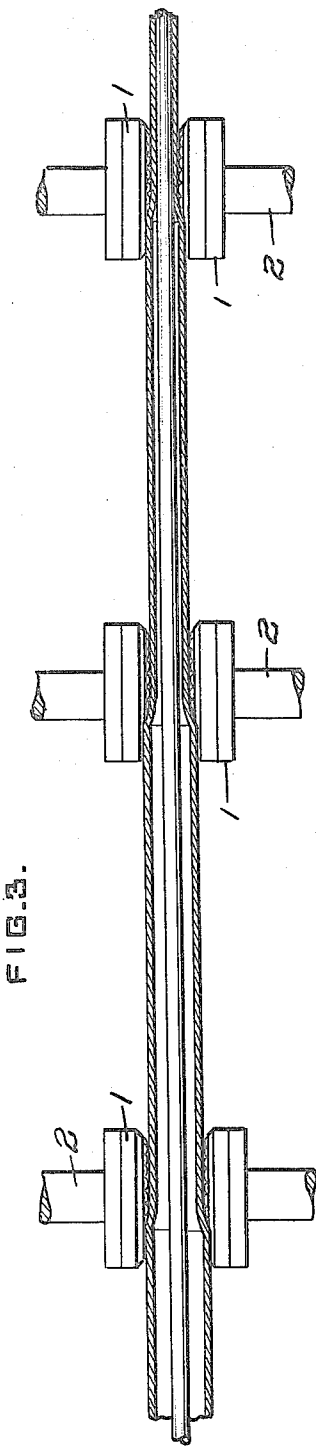
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METHOD OF MANUFACTURING TUBES AND A CONTINUOUS MILL THEREFOR

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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METHOD OF MANUFACTURING TUBES AND A CONTINUOUS MILL THEREFOR.

Application filed August 12, 1922. Serial No. 581,377.

To all whom it may concern:

Be it known that I, JOHN A. KATZENMEYER, residing at Ellwood City, in the county of Butler and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Methods of Manufacturing Tubes and a Continuous Mill Therefor, of which improvements the following is a specification.

The difficulties encountered heretofore in the operation of continuous mills, that is, mills having the stands of rolls arranged in tandem and spaced such distances apart that the article being rolled is in the bite of the rolls of two or more stands of rolls at the same time, are due to the fact that as the operative surfaces of the rolls are continuous, the article is tightly gripped by each pair of rolls and can move forward only at the same speed as such operative surfaces. Hence it has always been the practice to drive each pair of rolls at higher rate than that of the preceding pair, proportional to the reduction and consequent elongation effected by such preceding pair.

As is well known to those skilled in the art, the reduction effected in a pair of rolls is effected by changes of temperature of the article, variations in character of the metal, i. e., hard or soft and other causes, and these changes or variations are not uncommonly encountered in the same article. When bars or rods are being rolled, provision is made for a looping out of the article between pairs of rolls when one pair of rolls delivers at a rate higher than can be taken up by the succeeding pair of rolls. When the delivery of a pair of rolls is below normal, the succeeding pair of rolls will slip on the article, provided the article can withstand the pull, otherwise the article will be torn apart. As will be readily understood, the slipping of the rolls on the article is injurious to the article and rolls, especially the latter, and such slipping will always occur when the article, such as pipes, cannot loop out, whether a pair of rolls delivers the article at a rate higher or lower than that calculated and provided for.

The invention described herein has for its object the construction of a continuous mill wherein each pair of rolls may be operated at a speed independent within wide limits of the speed or rate of rotation of the other pairs of rolls forming the mill. The inven-

tion is hereinafter more fully described and claimed.

In the accompanying drawings forming a part of this specification, Fig. 1 is a plan view of a continuous mill embodying the improvements claimed herein; Fig. 2 is a plan view of a portion of a mill illustrating a modification of the construction shown in Fig. 1; Figs. 3, 4, and 5 are diagrammatic views and illustrate the rolling of pipes in the improved mill on a straight mandrel, a stepped mandrel, and without any mandrel and on a stepped mandrel.

In the construction shown in Fig. 1, each of the stands of reducing members or elements, A, B, C, consists of a plurality of rotating heads 1, each head being mounted on operating shafts 2 which may be driven separately or in unison by means substantially such as shown on one side of the stands of the mill, as for example, by means of a driving shaft 3 carrying beveled pinions 4 intermeshing with corresponding pinion 5 on the shafts of the heads, or, as above stated, each head may be driven by an independent motor 6.

Each of the rotating heads carries a plurality of independently movable reducing elements, each element being so mounted in the head that it will be, by preference, capable of rotating on its axis or of universal movement on its center. The heads are arranged around the path of movement of the article being reduced, as for example, a pipe, and two, three or more may be so arranged as clearly shown in an application filed by me June 5, 1922, Serial Number 566,083. While the reducing elements carried by each head may be constructed and mounted in any suitable manner so as to have freedom of movement, as above stated, and arranged in any suitable manner upon the head, it is preferred to employ the construction shown in the above entitled application. As described and shown in the said application, the reducing elements consist of a plurality of hard metal balls 7, mounted in an annular raceway formed in one side of the head and having its center coincident with the axis of rotation of the head. As shown in Figs. 7, 8, and 9, of said application, each stand of rolls may consist of two, three, or more heads suitably arranged around the path of movement of the article. In operation, the balls carried by the heads will engage the pipe or article being reduced, at a point at

one side of a plane passing through the axis of the article and then move forward in the direction of movement of the article and also upward, but its reducing action is finished or completed at or about the time a ball reaches the plane passing through the axis of the article.

Ordinarily, the action of the reducing elements carried by the head will tend to impart a rotary and longitudinal movement to the article, but such movement should be controlled or regulated, and in some cases a movement independent of that which may be imparted by the action of the heads may be desired. In order to effect a control of movements of the article imparted by the heads, or effect a movement different from that which might be imparted to the heads, suitable means, such as discs 16 are arranged at an angle to the line of movement of the article and on opposite sides of the line of movement. These discs are arranged in advance of the first reducing stand A, and these discs may be driven in any suitable manner, such for example, as that shown in the application above referred to, and consisting of shaft 17 provided with pinions 18 intermeshing with pinions 19 on the shaft 20 which is driven by a suitable motor 21. The discs are movable towards and from each other by suitable means, such for example as the fluid pressure motor 22. As it is also desirable to support the article at the delivery end of the mill and to insure control of the movements of the article after it has left the last stand of reducing elements, suitable means are arranged to effect such control, such means consisting of driven rolls 23 arranged with their axes at an angle to one another, and the path of movement of the article.

In cases where it is desirable to employ a mandrel as an internal support for the pipe, it is held in proper position by any suitable means permitting of the rotation of the mandrel but holding it from any longitudinal movement. A suitable construction for this purpose consists of a tubular head 26 engaging the rear end of the mandrel and so mounted in the thrust block 27 as to permit of the free rotation of the mandrel. It will be understood that my improved mill can be employed in connection with a straight mandrel under which the tube is reduced by the successive operation of the different stands of rolls, as shown in Fig. 3, or with a stepped mandrel, i. e., a mandrel having successive portions reduced in diameter, as shown in Fig. 5; or the pipes or tubes may be passed through the mill without any mandrel or internal support, as shown in Fig. 4.

Instead of employing the feeding and controlling mechanism such as is shown in Fig. 1, the construction shown in Fig. 2 may be

employed. This construction consists of rotating heads 29 carrying the reducing elements, i. e., hard metal balls in a raceway formed in the perimeter of the heads as shown and described in an application filed by me on June 5, 1922, Serial No. 566,064. As shown in Fig. 2 and also in said application, these heads carrying the independently movable reducing elements are arranged on diametrically opposite sides of the path of movement of the article and may rotate in planes parallel with the axis of the article or at a slight angle thereto. In order to effect an onward movement of the article or to control such movement, rolls 30 are arranged on opposite sides of the article and engage the latter at points between the points of engagement of the reducing balls therewith. These rolls are set at an angle to each other and are driven by any suitable means through the universal connection 31. These rolls in addition to operating to control or effect the forward movement of the article, will also effect more or less reduction supplementing the reducing action of the rotating heads. These rolls will effect a spiral displacement of the metal, the transverse displacement being greater than the longitudinal, and hence there will be a tendency to increase the diameter of the article where pipes are being operated on. The enlarging action of the rolls is more than overcome by the reduction effected by the balls, as the latter causes a flow of metal in which the longitudinal component is greater than the transverse flow effected by the heads and balls. If the heads are adjusted so that their planes of rotation are parallel with the axis of the pipe, the transverse flow of metal effected by the balls will be dependent on the rotation of the article.

It is characteristic of the operation of either type of heads, i. e., those having the reducing elements mounted in a raceway in the side of the head, or those having the elements mounted in a raceway in the periphery of the head, that each reducing element is in contact with the tube only for an instant, a fraction of a second, and there can be no gripping action of the tube by the heads as is the case when the reducing surface of the heads is continuous and all parts move at the same rate.

It is characteristic of the improvements described and claimed in this case and also in the applications referred to, that the reducing members carried by the heads will, while in contact with the article, move in the same direction as the article, but at a higher rate, hence when a plurality of such reducing elements are arranged to form a continuous mill, the relative speeds of adjacent members is immaterial within wide limits. In case reduction by one element of the mill should be less than normal, and the

rate of movement of the article to the next element be below normal, the reduction effected by the balls of this latter element will be below normal. On the other hand, if the reduction effected in one stand is greater than normal, the reduction effected by the balls of the succeeding stand will be slightly increased, and there will not be any retardation to the forward movement of the article.

In case an article is fed by one stand of heads to the next stand at a speed higher than the peripheral speed of the heads of the next stand, when a ball of the second coming in contact with such more rapidly moving article, would simply rotate around its center while being carried along to effect reduction. If, on the contrary, the article comes to a stand of rolls at a speed less than the peripheral speed of the head, the ball will rotate on its center backward, without affecting its reducing action. Thus it will be seen that there is no necessary relation within wide limits between the speed of adjacent stands of heads.

I claim herein as my invention:

1. The method herein described of reducing articles which consists in effecting reduction simultaneously at a plurality of points along the article, the reducing members moving in directions transverse and longitudinal of the article, while in contact with the article, at a higher speed than the article.

2. The method herein described which consists in subjecting an article to the reducing action of a plurality of independent reducing members movable transversely and longitudinally of the article while in contact therewith and to the reducing action of continuous reducing surfaces.

3. In a metal reducing mill the combina-

tion of a plurality of stands of reducing elements, each element having a plurality of independently movable members moving in directions transverse and longitudinal of the article.

4. In a metal reducing mill the combination of a plurality of stands of reducing elements, each element having a plurality of independently movable reducing members moving in directions transverse and longitudinal of the article and means for regulating the movements of the article being reduced.

5. In a metal reducing mill the combination of reducing rolls, adapted to effect a longitudinal and a rotary movement of the article being operated on and a reducing element provided with a plurality of independently movable members.

6. In a metal reducing mill the combination of reducing rolls adapted to effect a longitudinal and a rotary movement to the article being operated on, and a rotating head carrying an annularly arranged series of independently movable reducing members, said head being so arranged that its reducing members will engage the article along lines intermediate the lines of contact of the rolls with the article.

7. In a metal reducing mill the combination of reducing rolls adapted to effect longitudinal and rotary movements of the article being operated on, and rotating heads carrying an annularly arranged series of independently movable members, the heads being so arranged that the members will engage the article intermediate the rolls.

In testimony whereof I have hereunto set my hand.

JOHN A. KATZENMEYER.