May 15, 1928.

1,669,879

M. D. MORRIS ET AL

DIE ROLLING MILL

Filed March 16, 1926

2 Sheets-Sheet 1

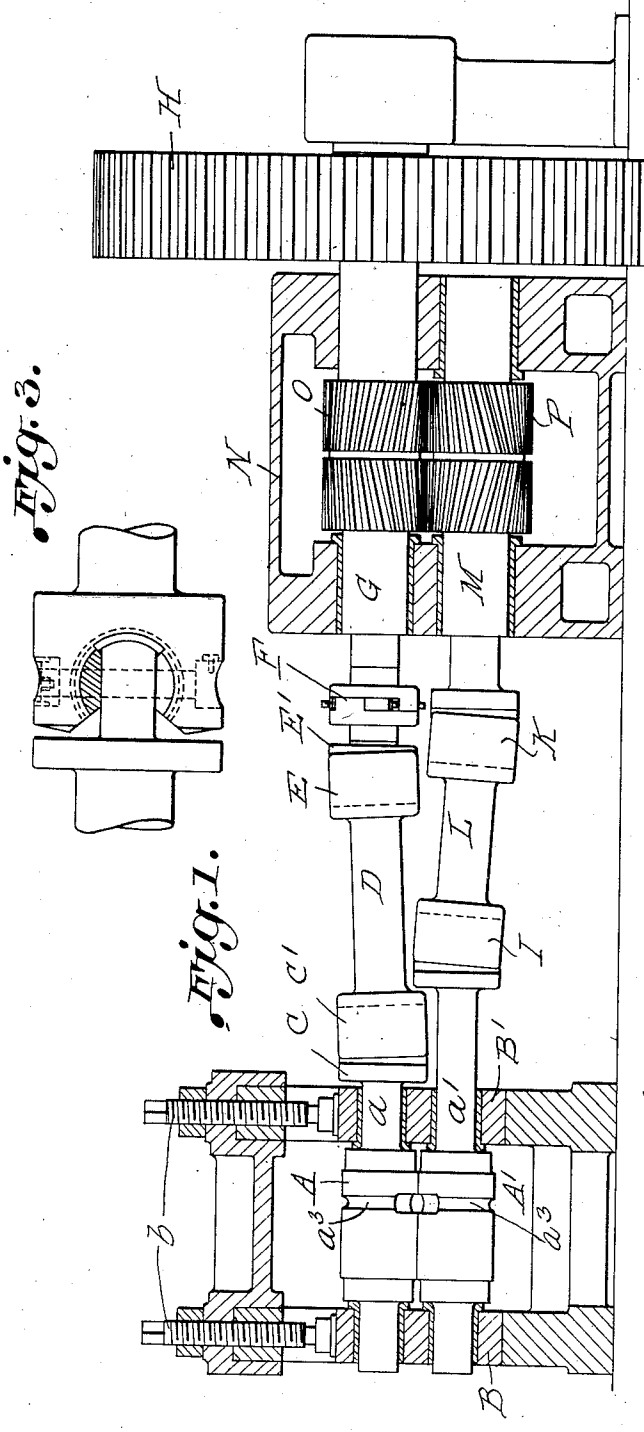

Fig. 1.

Fig. 3.

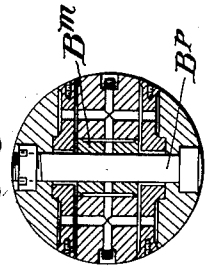

Fig. 4.

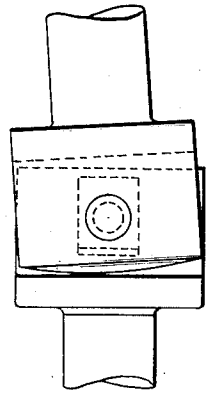

Fig. 2.

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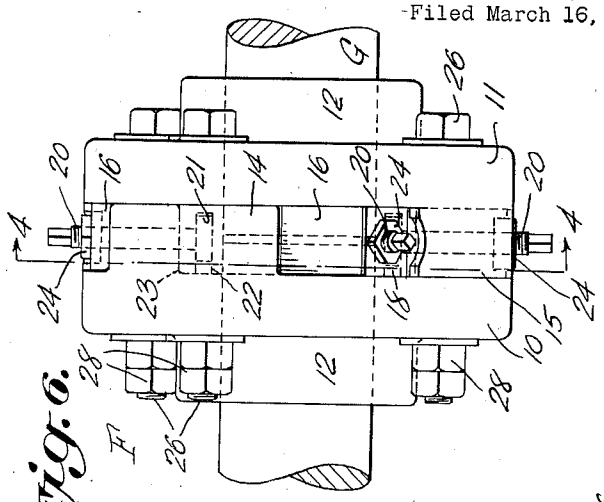

Fig. 6.

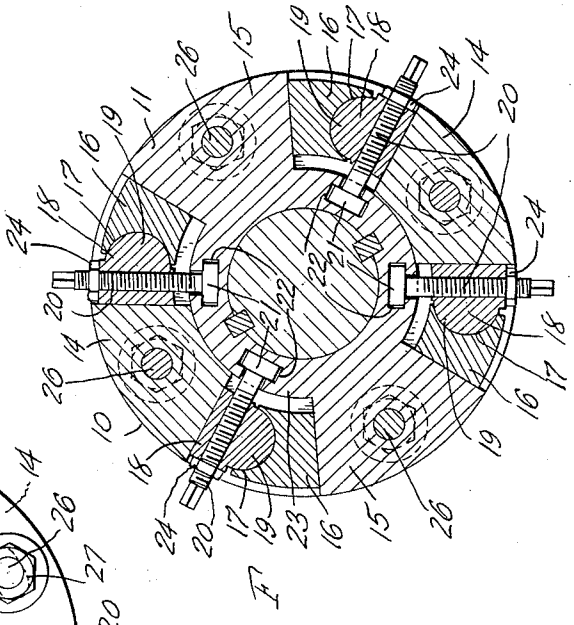

Fig. 7.

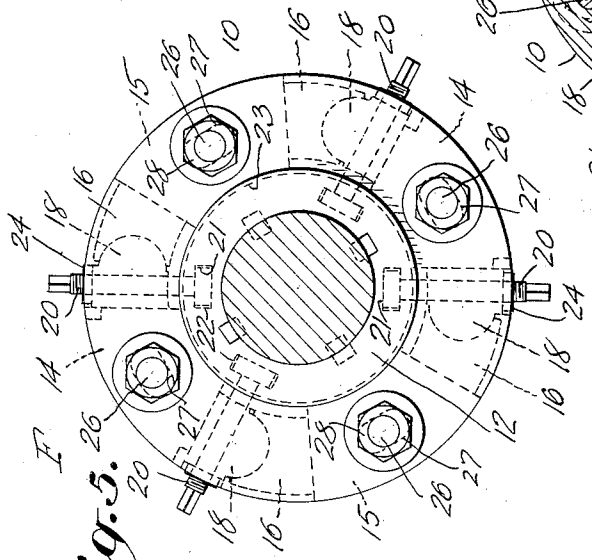

Fig. 5.

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UNITED STATES PATENT OFFICE.

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DIE-ROLLING MILL.

Application filed March 16, 1926. Serial No. 95,130.

This invention relates to die rolling and more particularly to apparatus for accurately die rolling from a leader bar a series of connected articles or die rolled blanks.

Two high mills for die rolling from a leader bar a series of connected articles have been utilized for many years and such die rolling has been often resorted to when large quantities of articles have been required that are capable of being die rolled. Die rolling can only be used to advantage when the demand for the articles justifies the necessarily large outlay in equipment which includes the mill, the die rolls, the mills and rolls for rolling the leader bars and the furnaces.

Die rolls for forming a series of connected articles or die rolled blanks are furnished with matrices or dies which constitute the die roll pass. These matrices are sunk or otherwise machined in the rolls and it has long been recognized that in order to obtain articles of substantially exact contour and dimension, it is necessary not only to match the matrices or die portions of one roll with those of its companion roll, but to drive both rolls at the same angular velocity so that their matrices are at all times maintained in matched relation.

In all those mills (with which we are familiar) that have been designed for the die rolling of a series of connected articles or die rolled blanks the die rolls have been geared together by gears of the same pitch diameter in order to obtain a constant angular velocity ratio of the rolls and means have also been provided for obtaining relative circumferential adjustment of the rolls for the purpose of matching their matrices. Such a device and one which is typical of many heretofore designed and used is illustrated and described in Cramer Patent No. 502,280 of August 1, 1893.

In all the devices or mills heretofore designed (with which we are familiar) or utilized for the purpose of die rolling a series of connected die rolled blanks or other articles it has been necessary for the manufacturer doing the die rolling to carry gears of different and the proper diameter for different sized die rolls.

The necessity for this where accurate die rolling is desired is obvious. The gears, in order to operate properly must mesh approximately on the pitch line and therefore each co-operating pair of rolls must have gears of proper size. In these prior devices the mechanism for obtaining relative circumferential adjustment of the rolls for the purpose of matching their matrices has ordinarily been so intimately associated with the gears connecting the rolls that whenever the rolls were changed, either for the purpose of utilizing rolls of different diameter or for replacing the used rolls with rolls of the same diameter, it has been necessary to change this matrix matching mechanism and it has therefore also been necessary for the manufacturer doing the die rolling to carry a number of these mechanisms for this purpose.

An object of our invention is to produce an organized apparatus for die rolling from a leader bar of suitable cross section and with extreme accuracy a series of connected articles or die rolled blanks; apparatus which does away with the necessity for changing gears or matrix matching mechanisms when the die rolls are changed even though a change is made from rolls of one diameter to rolls of a materially different diameter.

A further object of this invention is to produce a roll driving mechanism of more or less universal application that is, a mechanism which may be utilized for driving the rolls of a die roll mill no matter what diameter rolls (within reasonable limits, of course) are utilized, a mechanism constructed to transmit motion by lower pairing and employing means for obtaining relative circumferential adjustment of the die rolls for the purpose of matching their matrices.

A further object of this invention is to provide driving connections for use between a pinion stand and the rolls of a die roll mill which connections can readily be adjusted to give and maintain a constant angular velocity ratio of the rolls and which include mechanism for obtaining relative circumferential adjustment of the die rolls for the purpose of matching their matrices and at the same time maintaining said constant angular velocity ratio.

These, as well as other objects which will appear to those skilled in the die rolling art, we attain by means of the organized apparatus and the individual elements thereof described in the specification and illustrated

in the drawings accompanying and forming part of this application.

In the drawings, Figure 1 is a view partly in longitudinal section and partly in elevation of an organized apparatus embodying our invention; the apparatus includes a mill provided with a pair of die rolls, a pinion stand and driving connections between the stand pinions and the die rolls.

Figures 2, 3 and 4 are detailed views of a universal joint suitable for use in the driving connections between the stand pinions and rolls and Figures 5, 6 and 7 are views respectively in end elevation, in side elevation and sectional elevation of the preferred mechanism included in the driving connections for obtaining accurate relative circumferential adjustment of the die rolls for the purpose of matching and maintaining their matrices in matched relation.

As illustrated in the drawings A and A′ represent the upper and lower rolls of a two high die rolling mill. The rolls as shown are provided with matrices or dies a^3 which are sunk or otherwise formed therein. The matrices are adapted when adjusted in matched relation and during rolling to form, from a leader bar of the desired section, a series of connected articles or die rolled blanks.

The rolls, as is usual, are provided with necks or shafts a and a' and these are journaled within suitable bearings mounted in windows in housings B and B′ in the usual manner.

The bearings for upper roll A are slidable in the windows and the roll is held in proper position for rolling by means of screw downs b which are constructed and operated in the usual manner. The upper roll shaft a, which is materially shorter than the lower roll shaft a' has rigidly secured thereto or formed thereon one element C of a universal joint. This element C is preferably formed as an integral part of roll shaft a so that the roll, roll shaft and element C constitute a single piece.

The other member C′ of the universal joint or coupling which co-operates with members C is connected to one end of a spindle D. The other end of the spindle is provided with an element E similar to element C′. An element E′ similar to the element C is carried by one portion of the coupling F for securing accurate relative circumferential adjustment of the rolls for the purpose of matching and maintaining their matrices a^3 in matched relation.

Another member of coupling F is carried on and secured to a shaft G which constitutes the main drive shaft of the organized apparatus and which is provided with a gear H adapted to be driven by a suitable motor and pinion not shown. Shaft G is journaled within suitable bearings in a pinion-stand housing N and said shaft carries a pinion O which meshes with a pinion P of the same pitch diameter carried on a shaft M, which is also journaled in suitable bearings within the pinion-stand housing N.

Lower roll A′ is driven from pinion P by means of a driving connection consisting of a spindle L and universal joints I and K similar in all respects to the spindle and joints of the upper driving connection.

It will be obvious that under certain circumstances the universal joints I and K and the spindle L may be done away with and the shaft a' of roll A′ may be directly and rigidly connected with the shaft M of pinion P.

In most cases it is advisable and advantageous to drive the lower roll A′ through a driving connection such as shown in the drawing since it avoids the necessity of absolute alignment of the shafts A′ and M.

By adjusting the universal joints of each driving connection in such manner that the crosses of their two joints lie in parallel planes with the corresponding arms of the crosses lying in the same planes, we are able to obtain a constant angular velocity ratio of the rolls.

Because of the fact that the adjustable coupling F for securing relative circumferential adjustment of the rolls for matrix matching is carried by one of the pinion shafts, or in other words is carried outside of or beyond the universal joints of the driving connection in which it is included, the necessary relative circumferential adjustment can be obtained while maintaining the constant velocity ratio of the rolls.

It will be seen that if roll A′ is driven directly from pinion P, this constant angular velocity ratio of the rolls can still be maintained if the crosses of the universal joints of the upper driving connection between gear H or pinion O and roll A are maintained in parallel planes with the corresponding arms of the crosses in the same planes.

The rolls A and A′ are of the same diameter, and pinions O and P are of the same pitch diameter.

Coupling members C, E′ as well as the shafts of the lower roll A′ and the pinion P are bifurcated and the ends of the spindle D and L are also bifurcated. Each bifurcated end of the spindle carries a cylindrical bearing member B^m which is secured in place by a bolt-like pin B^p. The cylinder B^m cooperates with the coupling member associated therewith thus forming two universal joints for each driving connection.

The axes of spindles D and L lie in the same vertical plane and the staggering or offsetting of the universal joints of one driving connection with respect to those of the other, as illustrated in the drawings allows

the use of very large universal joints in comparison to the roll diameter and thereby insures absolute freedom from back lash or distortion.

The universal joints of both driving connections as well as coupling F for matching the roll matrices, transmit motion by lower pairing and by this we mean that large identical surfaces in contradistinction to line or point contacts are utilized to transmit motion at substantially right angles to such large surfaces. Only by the use of large contact surfaces is it possible to avoid wear and deformation and thus maintain the matrices in matched relation.

While any suitable adjustable coupling may be utilized it is preferable to use one as illustrated in which motion is transmitted through lower pairing and the coupling illustrated in Figures 5, 6 and 7 includes two coupling members 10 and 11, each provided with a hub portion 12. A bore provided with suitable keyways extends through the hub and body portion of each coupling member to permit the member to be rigidly secured to the end of a shaft.

The two adjacent faces of the coupling members are provided with sector shaped projections 14 and 15 formed respectively on the coupling members 10 and 11. The projections of the other member are so made that the spaces between projections are being considerably wider circumferentially than the projections themselves.

The projections of the two coupling members are spaced apart and between the radial faces thereof wedges are positioned which are movable toward and from the common axis of the coupling members for the purpose of obtaining relative circumferential adjustment of the same. This relative circumferential adjustment changes the angle between adjacent faces of projections 14 and 15. The wedge blocks are made in two parts which are capable of relative adjustment to compensate for variations in this angle.

In the construction shown in the drawing each wedge block includes a part 16 having a concave recess 17 and a part 18 having a convex projection 19 located within recess 17.

The outer faces of the wedge blocks are flat and are adapted to bear against the adjacent radial faces of the projections 14 and 15. The contacting faces of the convex projections and the concave recesses are substantially semi-circular and offer large bearing surfaces for withstanding the stresses encountered during rolling. These semi-circular bearing surfaces make it possible to arrange the outer flat faces of the two parts of the wedge members at different angles one to the other.

In the construction shown, bolts 20 are employed for adjusting the wedge blocks toward and from the common axis of the coupling member. Heads 21 of these bolts are arranged inwardly of projections 14 and 15. These adjusting bolts are provided at their outer ends with portions adapted to be engaged by a wrench for turning the same and since each bolt is threaded through a portion 18 of one of the wedges it will be obvious that the turning of the bolts will produce a radial movement of a wedge made up of its two parts. The bolts are locked in adjusted position by means of lock nuts 24.

The coupling members are held together by means of bolts 26 which extend through holes in one member and slots 27 in the other member. Nuts 28 are provided for drawing the coupling members together and slots 27 permit relative circumferential adjustment of the two coupling members. Nuts 28 will of course be loosened to permit the coupling members to be adjusted and then tightened to hold the abutting faces of the members in contact.

What we claim as new and desire to secure by Letters Patent is:—

1. The combination with a mill provided with rolls having matrices therein forming a die roll pass, of a pinion stand and driving connections between the stand pinions and said rolls and which include devices so constructed and arranged as to obtain a constant angular velocity ratio of said rolls; said driving connections also including means for obtaining relative circumferential adjustment of the rolls without changing said velocity ratio.

2. The combination with a mill provided with rolls having matrices therein forming a die roll pass for rolling from a leader bar a series of connected blanks, of a pinion stand and driving connections between the stand pinions and said rolls and which include devices so constructed and arranged as to obtain a constant angular velocity ratio of said rolls, said driving connections also including means for obtaining, without changing said velocity ratio, relative circumferential adjustment of the rolls for the purpose of matching their matrices said means being constructed to transmit forces by lower pairing.

3. The combination with a mill provided with rolls of equal diameter and having matrices therein forming a die roll pass, of a pair of intermeshing pinions of the same pitch diameter and driving connections between said pinions and rolls, each connection including a spindle and two universal joints, the universal joints of one driving connection being offset with relation to those of the other, said driving connections also including means located beyond said spindles for obtaining relative circumferential ad-

justment of said rolls for the purpose of matching their matrices.

4. The combination with a mill provided with a pair of rolls of equal diameter and having matrices therein forming a die roll pass, of a pair of intermeshing pinions of equal pitch diameter, driving connections between said pinions and rolls, each connection including a spindle and two universal joints, the shafts of the rolls as well as the shafts of the pinions being of unequal length whereby the universal joints of one driving connection are offset with relation to those of the other, and means mounted on one of said pinion shafts for obtaining relative circumferential adjustment of said rolls for the purpose of matching their matrices.

5. The combination with a mill provided with rolls having matrices therein forming a die roll pass for rolling from a leader bar a series of connected blanks, of a pair of intermeshing pinions, driving connections between said pinion and rolls, each connection including a spindle and two universal joints, the shafts of the rolls as well as the shafts of the pinions being of unequal length whereby the universal joints of one driving connection are offset horizontally with relation to those of the other and means mounted on one of said pinion shafts and constructed to transmit motion through lower pairing for obtaining relative circumferential adjustment of said rolls for the purpose of matching and maintaining their matrices in matched relation.

6. The combination with a mill provided with rolls having matrices therein forming a die roll pass, of a pair of intermeshing pinions, driving connections between said pinions and rolls at least one of said driving connections including a spindle and two universal joints, and means carried by one of the pinion shafts for obtaining relative circumferential adjustment of said rolls for the purpose of matching and maintaining their matrices in matched relation.

7. The combination with a mill provided with rolls having matrices therein forming a die roll pass for rolling from a leader bar a series of connected blanks, of a pinion stand having a pair of intermeshing pinions of the same pitch diameter and superposed driving connections between said pinions and rolls, the upper driving connection including a spindle, two universal joints and screw and wedge operated means for obtaining accurate relative circumferential adjustment of said rolls for the purpose of matching and maintaining their matrices in matched relation.

8. The combination with a mill provided with rolls having matrices therein forming a die roll pass, of a pair of intermeshing pinions and driving connections between the pinions and rolls and one at least of which includes a spindle and two universal joints and means carried by one of the pinion shafts for obtaining relative circumferential adjustment of said rolls for the purpose of matching their matrices.

9. The combination with a mill provided with rolls having matrices therein forming a die roll pass, of a pair of intermeshing pinions and driving connections between said pinions and rolls and so constructed and arranged as to obtain a constant angular velocity ratio of said rolls and means carried by one of the pinion shafts for obtaining relative circumferential adjustment of said rolls for the purpose of matching their matrices without changing said velocity ratio.

10. The combination with a mill provided with rolls of the same diameter and having matrices therein forming a die roll pass, of a pinion stand provided with a pair of intermeshing pinions of the same pitch diameter and driving connections between said pinions and rolls, each connection including a spindle and two universal joints, the universal joints of one driving connection being horizontally offset with relation to those of the other, and means carried by the shaft of the upper of said pinions for obtaining relative circumferential adjustment of said rolls for the purpose of matching their matrices.

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