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A. F. ROCKWELL  
METAL ROLLING DEVICE

Filed June 25, 1919

2 Sheets-Sheet 1

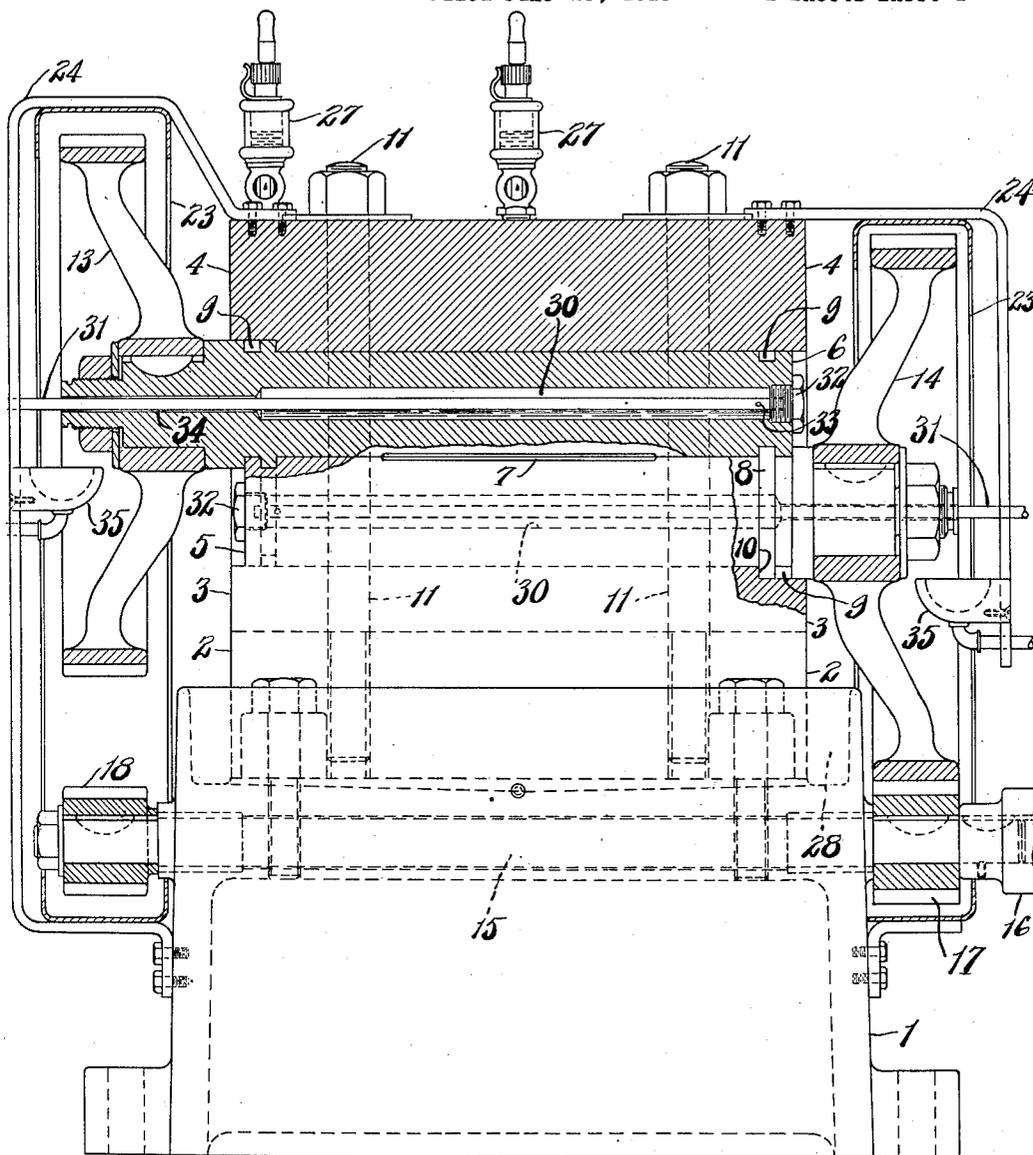


FIG. 1

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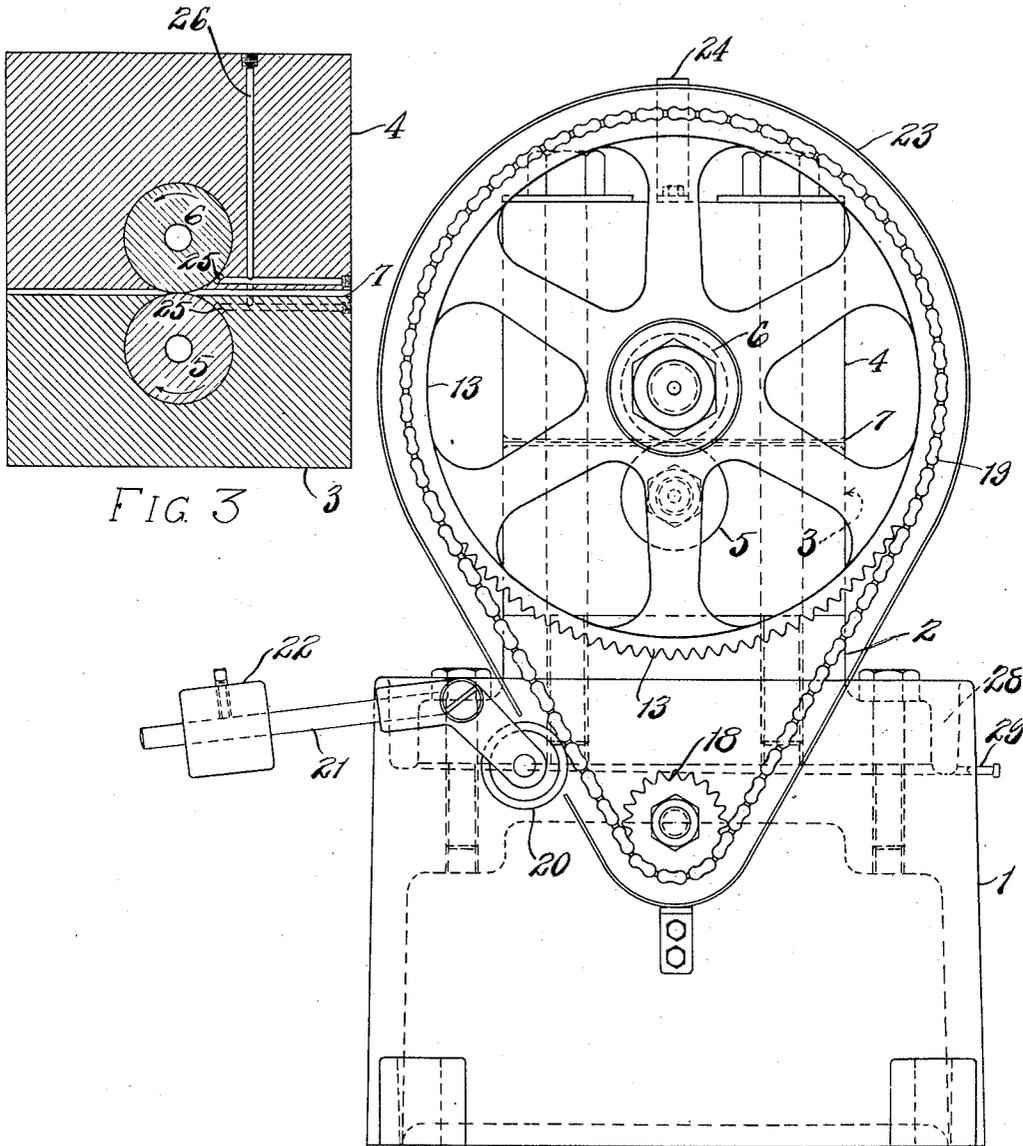


FIG. 3

FIG. 2

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# UNITED STATES PATENT OFFICE.

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## METAL-ROLLING DEVICE.

Application filed June 25, 1919. Serial No. 306,545.

*To all whom it may concern:*

Be it known that I, ALBERT F. ROCKWELL, a citizen of the United States, and a resident of Bristol, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Metal-Rolling Devices, of which the following is a specification.

This invention relates to new and useful improvements in the art of metal rolling.

In metal rolling, and particularly in cases where it is desired to produce thin sheets of brass, such for example, as are used in making up the cellular sections used in the construction of radiators for water-cooled gas engines, it is essential that all springing and bending of the rolls be wholly prevented in order to obviate any irregularity in the uniformity of the thickness of the final sheet. In order to accomplish this, it has been the universal practice to employ rolls having a diameter sufficiently large to prevent springing or bending of the rolls even to an extent that would produce only slight irregularities in the thickness of the thin sheets that represent the final product.

There are a number of extremely troublesome disadvantages in the use of rolls of comparatively large diameter, such as those having a diameter of fifteen or twenty inches, as contrasted with the use of rollers of a diameter as small as one inch, that make it highly desirable to employ the smaller rollers for reducing metal into thin sheet form if suitable means can be found to prevent bending of the rolls and thus give them the only valuable function heretofore achieved in the use of the large rolls. One of these disadvantages arises by reason of the relatively sharp angle that is presented between the peripheries of the rolls of large diameter and the surfaces of the intervening body of metal undergoing the rolling process as well as the relatively very considerable area of contact between the rolls and the metal. The effect of the relatively sharp angle of contact when the larger rolls are used is that as the metal is passed between the rolls it is rolled and squeezed by what is most essentially a compressing action into the reduced or thinned form, and this compression requires the exertion of comparatively enormous power. It has been experimentally determined, on the other hand, that when the metal to be reduced is passed

between rollers of relatively small diameter, the action, instead of being a squeezing or compressing one, is more analogous to what takes place when the metal is pulled through the opening in a draw-plate—that is, the sheet of metal is not reduced so much by a compressing as by a drawing operation in which there is a pronounced flowing action which has very beneficial results in the character of the metal in the finished sheet. The result is that surplus metal instead of being compressed to a considerable extent into the thin sheet form, is pushed or caused to flow back along and into the surfaces of the entering blank, so that there is a well-defined working of the metal at its points of engagement with the small rollers. This flowing action can be produced by the expenditure of power that is proportionately extremely small as compared with the power required to produce the compressing effect characteristic of the work done by the large rolls. In other words, the very considerable area of contact that exists between the circumference of the large rolls and the sheet of metal is not only productive of so great a degree of friction that the surplus metal is prevented from flowing back and being distributed along the length of the plate, but the angle at which the surface of the rolls meets the metal tends to press the metal inwardly upon itself and transversely of its length rather than backwardly and along its length. The exact opposite is the case with the smaller rollers, for here the comparatively wide angle of contact between the surface of the rollers and the metal being worked not only eliminates, to a substantial extent, the friction-producing area of contact which interferes with the flowing of the surplus metal back along its length, but also presents the surface of the compressing rolls at a favorable angle for working the metal by a drawing operation rather than by a compressing action such as takes place when the larger rolls are used.

Not only is a much greater expenditure of power required to reduce a given mass of metal to the required thin sheet form with the large diameter rolls heretofore used, but even with the expenditure of a horse power exceeding by many times that which would suffice for the operation of the smaller rolls, it has been necessary to pass the metal be-

tween the large rolls repeatedly and a far greater number of times than is necessary with the smaller rolls, to reduce the metal to a given thickness. It will be evident that this practice has not been conducive to efficient production, and the result has been that the cost of producing sheet metal by the use of the large rolls is excessively high as compared with the cost of the corresponding product of the rollers of small diameter, the use of which is rendered feasible by this invention.

There is still another feature in which a comparison of the work of the two types of rolls is greatly in favor of the smaller rollers and that is in the convenience and accuracy with which sheets of material having a definite and predetermined degree of thickness in the smaller sizes can be obtained. Because of the rigid character of the backing support of the rollers, as well as the comparatively small diameter and circumference of the rollers themselves, it is possible to accurately produce sheets of any desired thickness because the two factors referred to provide for as close an adjustment of the rollers as may be desired. Not only this, but it is also possible to obtain a much thinner final sheet by the use of the smaller rolls than with the large rolls heretofore used because of the improved operative effect on the metal that takes place, and this is particularly advantageous in the production of sheet metal for radiator cores as will be clear.

The use of the smaller rollers is advantageous in another particular where the metal being operated upon is to be reduced to relatively thin sheets, since, as has been pointed out, it is possible to produce a flowing action in such sheets that would not be possible to secure if rolls of large diameter were used, a flowing action being effected by the large rolls only when comparatively thick metal is being operated upon, thickness of the material providing for a working action on the metal that approaches in some degree the drawing action produced on the thin sheets with the small rollers.

In the drawings,—

Fig. 1 is a view, partly in front elevation and partly in vertical section of a metal-rolling machine embodying the invention;

Fig. 2 is an end elevation of the device shown in Fig. 1; and

Fig. 3 is a vertical section taken through the rollers and the roller-supporting members, and showing the method used for lubricating the rollers.

In the drawings, there is illustrated a metal-rolling machine having a base member 1, to which is bolted a bed-plate 2, and the massive bearing and supporting members 3 and 4, in which the metal-reducing rollers 5 and 6 of comparatively small and

uniform diameter from end to end are journalled throughout their length. The rollers 5 and 6 are placed in such relation to each other as to bring their effective working areas to bear on both faces of an interposed metal strip as it is passed through a passage 7 formed in the central portion of the confronting faces of the bearing members 3 and 4. In order to prevent endwise movement of the rollers 5 and 6 with relation to the bearing member, or in axial relation to each other, flanges 8 on the rollers are arranged to interengage with corresponding grooves 9, also formed in the rollers, and with shoulders 10 formed in the bearing members. The rollers 5 and 6 are held immovably against a to-and-from movement in relation to each other beyond the desired thickness of the product desired through the backing support of the bearing members 3 and 4, which are held in position so that the rollers may move only the desired distance apart, by means of the heavy anchor-bolts 11 extending through both bearing members and into the machine bed-plate 2.

The rollers 5 and 6 are provided with driving wheels 13 and 14, each of which is directly driven from a drive-shaft 15 connected to any suitable source of power, as at 16. Thus, direct drive of both rollers is effected by gearing the drive-wheel 14 of the lower roller 5 directly to the spur-gear 17 keyed to the drive-shaft 15, while the drive-wheel 13 is driven from a sprocket 18, also keyed to the shaft 15, through a suitable sprocket-chain 19. The tension of the chain 19 may be regulated by the pressure of a roller 20 carried by the pivoted arm 21 and on which the position of a weight 22 may be adjusted to provide the required regulation of the degree of pressure required on the chain 19.

In order to adequately lubricate the extending bearing surfaces of the rollers 5 and 6 as they rotate in the bearing members 3 and 4, oil channels 25 are provided which extend for the full length of the bearing surface and which are supplied with lubricating oil through the vertical channels 26 leading from suitable sources, such as the oil-cups 27. I contemplate, also, the application of the oil under pressure whenever circumstances may require. Fig. 3 of the drawing shows the provision referred to for applying oil to the rollers, and it will be seen that if a sheet of metal is passed through the channel 7 from the left-hand end, the oil on the surface of the rollers 5 and 6 will be removed by the pressure and collect in and flow out of the left-hand end of the channel 7, eventually being received in the collecting channel 28 formed in the framework 1 of the machine, and from which it may be removed, as at 29. It will be evident that the removal of oil from the

surface of the rollers at the point of engagement with the metal sheet makes it necessary to apply a substitute quantity as fast as it is removed and at a point very close to the point at which the peripheries of the rollers leave the interposed sheet, and for this reason the oil-distributing grooves 25 are placed at points quite closely adjacent to the passage 7 through which the sheet of material undergoing the rolling operation is passed. By this arrangement, the presence of a film of oil over the entire bearing surfaces of the rollers 5 and 6 is maintained, so that an efficient lubrication of the rollers is maintained at all times.

In addition to the lubrication of the bearing surfaces which has thus been provided for, I also provide means for cooling the rollers and preventing an excessive rise of temperature therein while operating, and I obtain this result by boring out or otherwise forming a core 30 in each of the rollers 5 and 6 in which a cooling-liquid-conveying pipe 31 is mounted. The pipes 31 are mounted at one end in a screw-plug 32, or equivalent member, which serves as a stopper for one end of the core 30 and extends out through the opposite end of the rollers that form the hub portions of the drive-wheels 13 and 14. It will be seen that the cooling liquid entering through the pipes 31 emerges by way of the exit openings 33 into the cores 30 and flows outwardly therefrom through outlet channel portions 34 of reduced diameter, where it is received in suitable catch basins 35 mounted on the supports 24, and flows back by way of the pipes 36 to the reservoir from which it is pumped either to supply a single machine or in common to supply a plurality of machines, in accordance with whatever may be the practice in any given plant.

In the operation of the device, the metal to be reduced is fed into the left-hand end

of the channel 7, as shown in Fig. 3 of the drawings, the channel serving as a guide to swing the edge of the sheet into proper engaging contact with the comparatively small reducing rollers 5 and 6 and to properly direct the sheet as it continues to be fed between the rollers in the subsequent operation. It will be seen that the faces of the rollers present their arcs of curvature to the interposed sheet at comparatively wide angles and that therefore the sheet is caused to pass between the rollers by means of a drawing rather than by a squeezing or pressing action, in accordance with the mode of operation previously referred to and with the already-described important results. It will now be clear that the bearing members 3 and 4, which are of a massive formation as compared with the size of the rollers 5 and 6, form a proper backing support for substantially the entire length of the rollers and effectually prevent any bending thereof, so that extremely thin sheets can be readily and rapidly produced without variations in thickness and with improved efficiency in the operation of the apparatus as well as the product.

What I claim is:—

1. A device for rolling metal into sheet form comprising: a pair of rollers of comparatively small diameter, and means for preventing movement of the rollers away from each other or laterally with relation to each other intermediate their ends.

2. A device for rolling metal into sheet form comprising: a pair of rollers of comparatively small diameter, and bearing members in which said rollers are journaled at and intermediate their ends, said bearing members intermediate the ends of the rollers preventing lateral and also upward and downward movement of the rollers.

ALBERT F. ROCKWELL.