Jan. 22, 1929. 1,700,054

L. IVERSEN

ROLLING MILL

Filed July 3, 1926 3 Sheets-Sheet 1

Fig. 1.

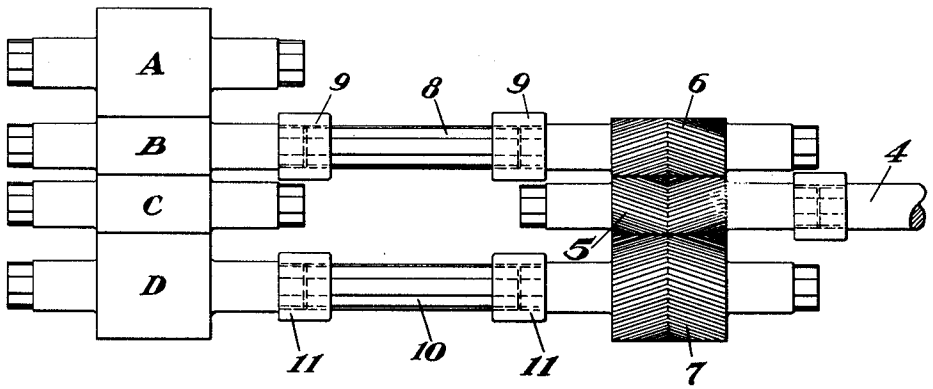


Fig. 5.

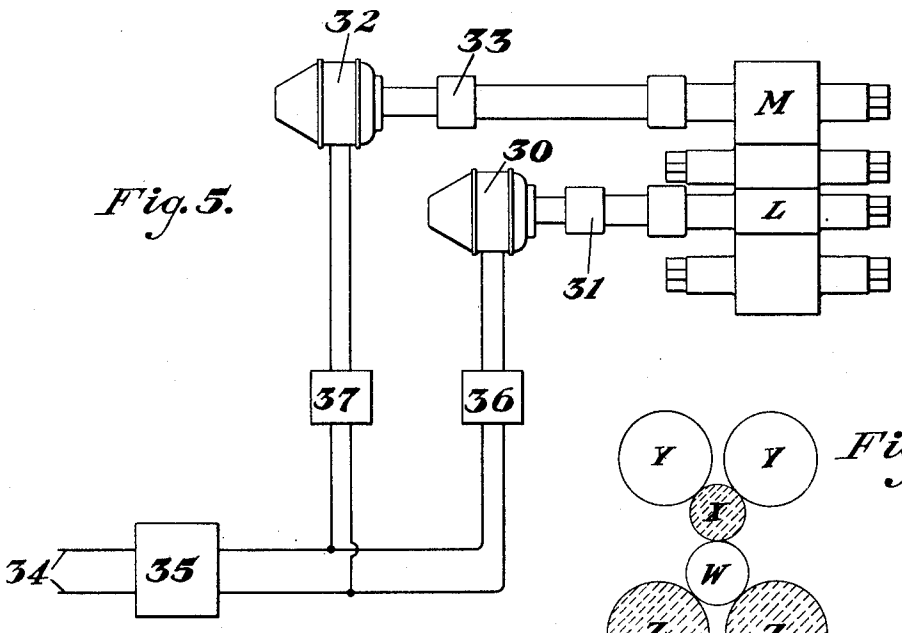


Fig. 6.

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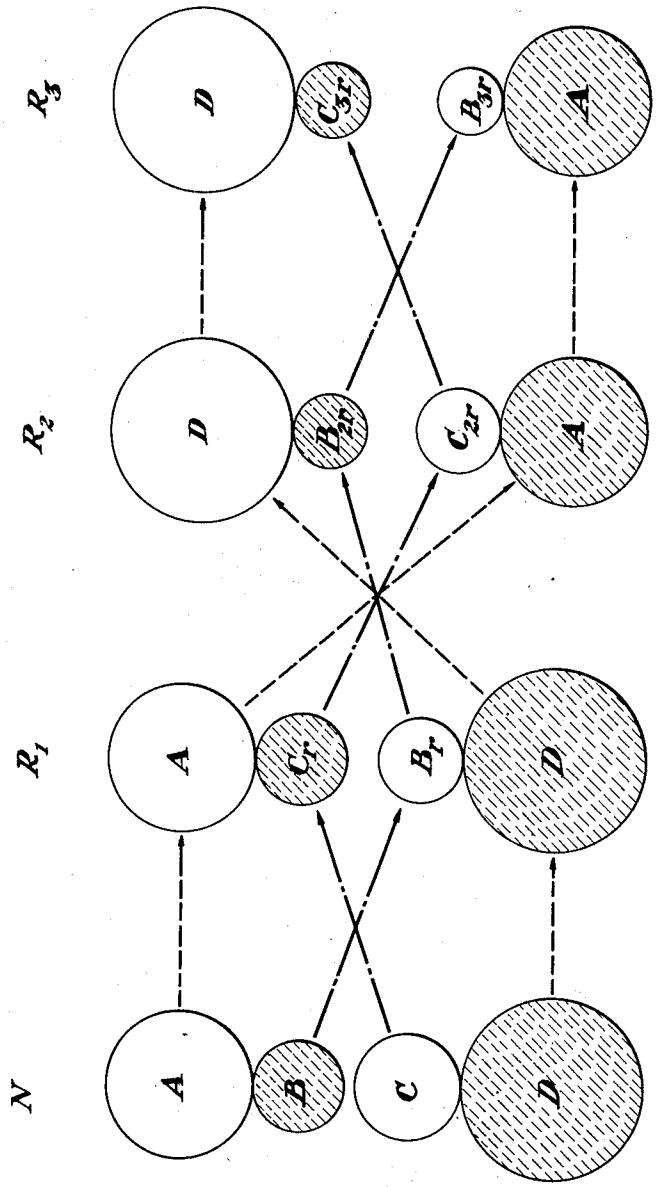
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Fig. 2.



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ROLLING MILL

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Fig. 4.

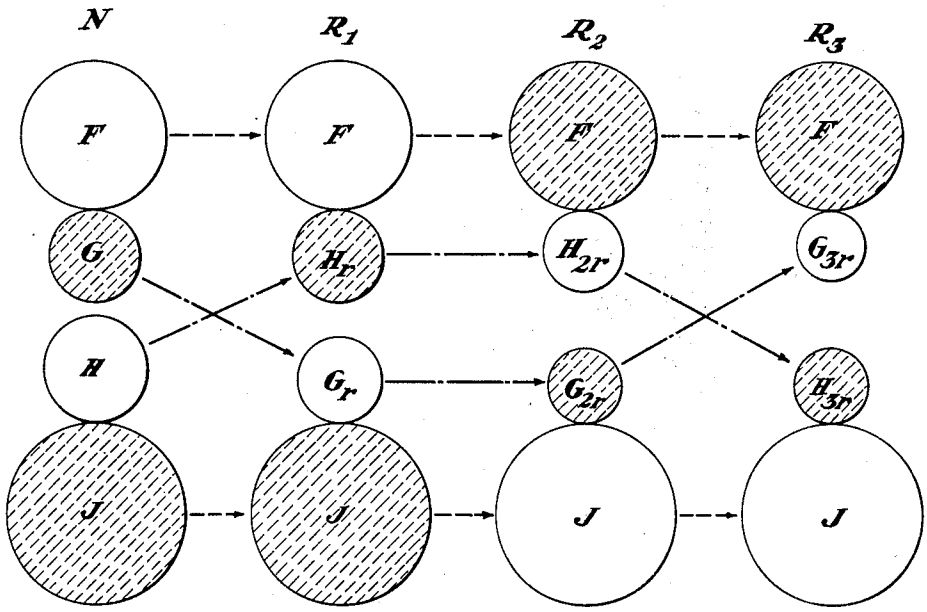
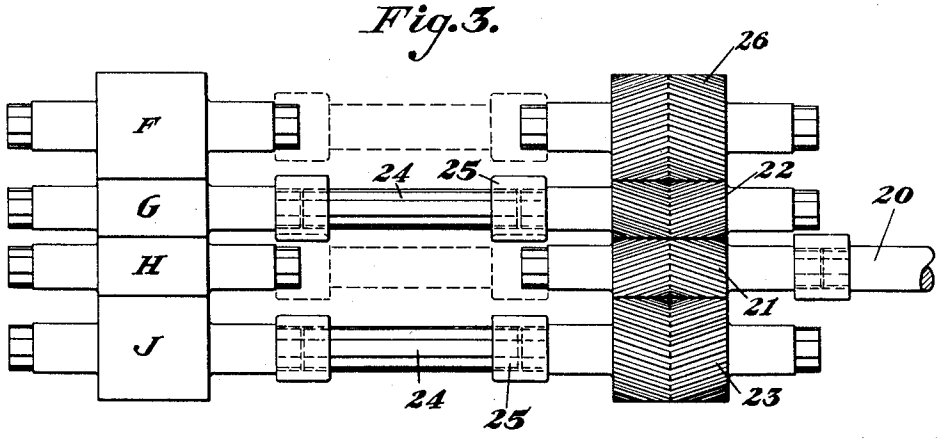


Fig. 3.



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Patented Jan. 22, 1929. 1,700,054

UNITED STATES PATENT OFFICE.

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ROLLING MILL.

Application filed July 3, 1926. Serial No. 120,308.

This invention relates to rolling mills and particularly to a rolling mill wherein supported working rolls are employed.

In certain kinds of rolling, particularly the rolling of sheets and strip material it is found desirable to use working rolls of relatively small diameter and to provide backing up rolls which supply the additional resistance to rolling forces which is necessary to prevent the deflection of the small working rolls under load.

In some cases a three-high mill is used in which case only one of the working rolls is provided with a backing up roll. In this case the unsupported working roll is generally of larger diameter than the supported roll. It is usual practice, however, in mills of this character, to provide a four-high mill in which the working rolls are of the same diameter and are both supported.

It is usual practice in a four-high mill to transmit the power through the spindles to the two working rolls. This has numerous disadvantages. In the first place, it is always desirable to make the working rolls as small as possible in order to reduce the power required for rolling and also to permit of rolling thinner material. This makes it exceedingly difficult to provide spindles and couplings of adequate size and the requirements of space for the spindles and couplings has made is necessary to employ working rolls of a larger diameter than would otherwise be used.

A further disadvantage of the old method of driving is that any slight difference in the diameter of the working rolls will cause one of the rolls to tear and mark the material being rolled.

I provide for positively driving one working roll and frictionally driving the other. Preferably the second working roll is frictionally driven by applying power to its backing up roll. This arrangement materially simplifies the design of the mill and leaves ample room for the spindles and couplings. It therefore permits of the use of smaller working rolls than heretofore. Also the marking and tearing of the sheet is eliminated since there is no positive force which causes the peripheries of the two working rolls to move at different velocities.

With the above described arrangement, there is necessarily a definite relation between the diameter of the driven working roll, and the diameter of the driven backing up roll, provided that the same pinion housing is always employed. From a practical point of view, it is, of course, essential that the pinions be undisturbed. During mill operation, it becomes necessary to redress the working rolls, but it is generally undesirable to redress the backing up rolls which are preferably hardened and ground to size. I provide an arrangement which permits of redressing the rolls and maintaining the proper relationship between the driven working roll and the driven backing up roll. It will be understood that if such relationship were not maintained, the peripheral speeds of the two rolls would differ, thus causing marking of the sheet.

In the accompanying drawings which illustrate the present preferred embodiment of my invention and certain modifications thereof, Fig. 1 is a diagrammatic view illustrating my invention as applied to a four-high mill.

Fig. 2 is a diagrammatic view showing the manner of changing the roll so as to secure several redressings of the working rolls.

Fig. 3 is a view similar to Fig. 1 but showing a modified construction.

Fig. 4 is a diagrammatic view similar to Fig. 2 but showing the manner of changing the drive in the form of the invention shown in Fig. 3 so as to secure a suitable number of roll drillings.

Fig. 5 is a diagrammatic view illustrating another form of the invention whereby proper control of the roll speeds may be had, and

Fig. 6 is a diagrammatic view of a so-called "cluster mill" to which my invention may be applied.

Referring first to Fig. 1, there is shown a mill stand comprising working rolls B and C provided with backing up rolls A and D respectively. Power is supplied from any desired source through a power shaft 4 and is communicated to a pinion 5. This pinion drives pinions 6 and 7. The pinion 6 is connected to the working roll B through a spindle 8 and couplings 9 and the pinion 7 is connected to the backing up roll D through a spindle 10 and couplings 11.

It will be seen that this arrangement leaves the spindles 8 and 10 spaced a sufficient dis-

tance apart to permit the use of parts of ample dimensions. It will be apparent that if it were attempted to attach a coupling 9 to the pod of each of the working rolls B and C, it would be necessary to materially reduce the diameter of the couplings.

The working roll C is driven by a frictional engagement between the peripheries of such working roll and its backing up roll D. In opration, a leader is passed between the working rolls B and C, the power being supplied as heretofore described. Since the roll C is frictionally driven from the backing-up roll D, there is no tearing or marking of the sheet such as is frequently encountered in the ordinary type of mill, and an improved product is therefore secured.

With the above described arrangement, it will be seen that the peripheral speed of the roll B should equal the peripheral speed of the roll C and therefore the peripheral speed of the roll D. Since the relative rotation of the two rolls is governed by the ratio of the pinions 6 and 7, it follows that a definite relationship must be maintained between the diameter of the driven working roll and the driven backing-up roll.

This relationship may be readily attained for a new mill, but it will be disturbed as soon as the working rolls become pitted and must be redressed.

Fig. 2 illustrates the manner in which the desired ratio must be maintained over several redressings, that is to say, over the life of the working rolls.

In Fig. 2, the position N indicates the set-up of the mill when the rolls are new. The positions R^1, R^2, and R^3 illustrate the set-up of the mill after each of the redressing operations, and the arrows indicate the changed position of the various rolls. In each case the driven rolls are cross hatched with dotted lines.

Referring to the position N, it will be noted that the rolls are the same as shown in Fig. 1. This view, however, more clearly shows that the roll B is somewhat smaller than the roll C. In practice, the roll C will be greater in diameter than the roll B by an amount corresponding to the amount of material which is removed from the roll for a redressing operation.

The mill is operated with the rolls in the position shown until the working rolls B and C become worn to such an extent that redressing is necessary. The working rolls are then removed from the mill and turned. After this operation, the roll C will be of the same diameter as the original diameter of the roll B. This is indicated at the position R^1, the roll being marked C_r.

The roll B has also been reduced in diameter as is indicated at B_r. The rolls A and D remain in their original positions. Obviously the diameter of the roll B_r is unimportant, in so far as speed is concerned because if there is no slip, it will have the same peripheral speed as the roll D regardless of size. It is, of course, desirable to keep the working rolls nearly enough of the same size to do away with any tendency of the rolled material to curl.

When it again becomes necessary to redress the rolls, both of the working rolls will have been so far reduced in diameter that the original ratio between a working roll and the backing up roll D can no longer be secured. I therefore make the rolls A and D of different sizes and transpose them for the next stage. This is indicated at R_2. The roll B will always be smaller than the roll C, and after its second redressing as indicated at B_{2r}, will reduce the diameter of the roll B to such a point that it will be in the same ratio to the roll A as was the original roll B to the roll D. In this position, the roll C as indicated at C_{2r} will again be the bottom working roll.

For the next position as indicated at R_3, the working rolls will again be transposed, the roll C_{3r} being the upper and driven working roll while B_{3r} will be in contact with and driven by the backing-up roll A. The rolls will generally be of such size that this number of redressings will exhaust their life, but it will be understood, of course, that if it is desired to still further reduce the diameter of the working rolls by subsequent redressings, this may be accomplished by using another pair of backing up rolls instead of the rolls A and D.

Fig. 3 shows a modified form of mill in which the working rolls are indicated by G and H and the backing up rolls by F and J. In this form of the invention, power is supplied through a shaft 20 connected to a pinion 21. This pinion is geared to pinions 22 and 23, the pinion 22 being substantially in line with the working roll G and the pinion 23 being substantially in line with the backing up roll J. They are connected to such rolls through spindles 24 and couplings 25, the arrangement so far described being identical with the arrangement shown in Fig. 1.

In this form of the invention, however, I provide an additional pinion 26 which meshes with the pinion 22 and is substantially in line with the backing up roll F.

In Fig. 4, I have illustrated the relative position of the rolls when the working rolls are new and also after the first, second and third redressings by the letters N, R_1, R_2, and R_3, just as these positions are indicated in Fig. 2.

The rolls G and H have the same relative diameters as rolls B and C and the first roll change is made by simply reversing these work rolls as indicated at R_1. The diameter of the roll H_r will be the same as the original diameter of the roll G and of course the roll

G_r will be smaller than its original diameter.

For the second and third redressings, the spindles are reversed as indicated in Fig. 3 so that instead of driving the top working roll and the bottom backing up roll, I then drive the bottom working roll and the top backing up roll. This is indicated by the dotted cross hatching in Fig. 4. At the position R_2 the roll G_{2r} and the backing up roll F will be driven and the diameter of the backing up roll F will be of such size that it bears the proper ratio to the roll G_{2r} to eliminate slippage.

For the next redressing, the position of the working rolls is again reversed as indicated and G_{3r} and H_{3r}. The diameter of the drilled roll H_{3r} will be the same as the diameter of the roll G_{2r}.

Fig. 5 illustrates still another way of eliminating the effect of redressing. In this form of the invention, a work roll L is connected to a motor 30 through suitable connections 31 and the backing-up roll M of the other working roll is connected to a motor 32 through suitable connections 33. Each of these motors is supplied with current from a common circuit 34 and they may be simultaneously controlled by a controller 35. Individual controllers 36 and 37 are provided for the motors 30 and 32 respectively so that their relative speeds may be changed as desired in this manner, the rolls L and M may be driven at such speeds as to eliminate any tendency toward slipping.

Fig. 6 illustrates a modified form of mill to which the invention may be readily applied. In this form of the invention, a pair of work rolls W and X are each provided with two backing up rolls Y and Z. I have indicated by dotted cross hatching, the rolls which are driven. Any of the various expedients heretofore illustrated or described may be employed for taking care of the redressing of the working rolls.

I claim—

1. A mill stand comprising a pair of working rolls each having a backing up roll and means for frictionally driving one of the working rolls through its backing up roll, and means for positively driving the other working roll.

2. A mill stand comprising a pair of working rolls each having a backing up roll, means for positively driving one of the working rolls, the other working roll being frictionally driven from its backing up roll, and means for positively driving the last mentioned backing up roll.

3. A mill stand comprising a pair of working rolls each having a backing up roll, a driving pinion adapted to be connected to a source of power, a pinion operatively connected to one of the working rolls and meshing with the drive pinion and another pinion operatively connected to the backing up roll of the other working roll and meshing with said drive pinion.

4. A mill stand comprising a pair of working rolls each having a backing up roll, drive means connected to one of the working rolls, the other working roll being undriven, and drive means connected to the backing up roll of the last mentioned working roll, the backing up roll of the first mentioned working roll being undriven.

In testimony whereof I have hereunto set my hand.

LORENZ IVERSEN.