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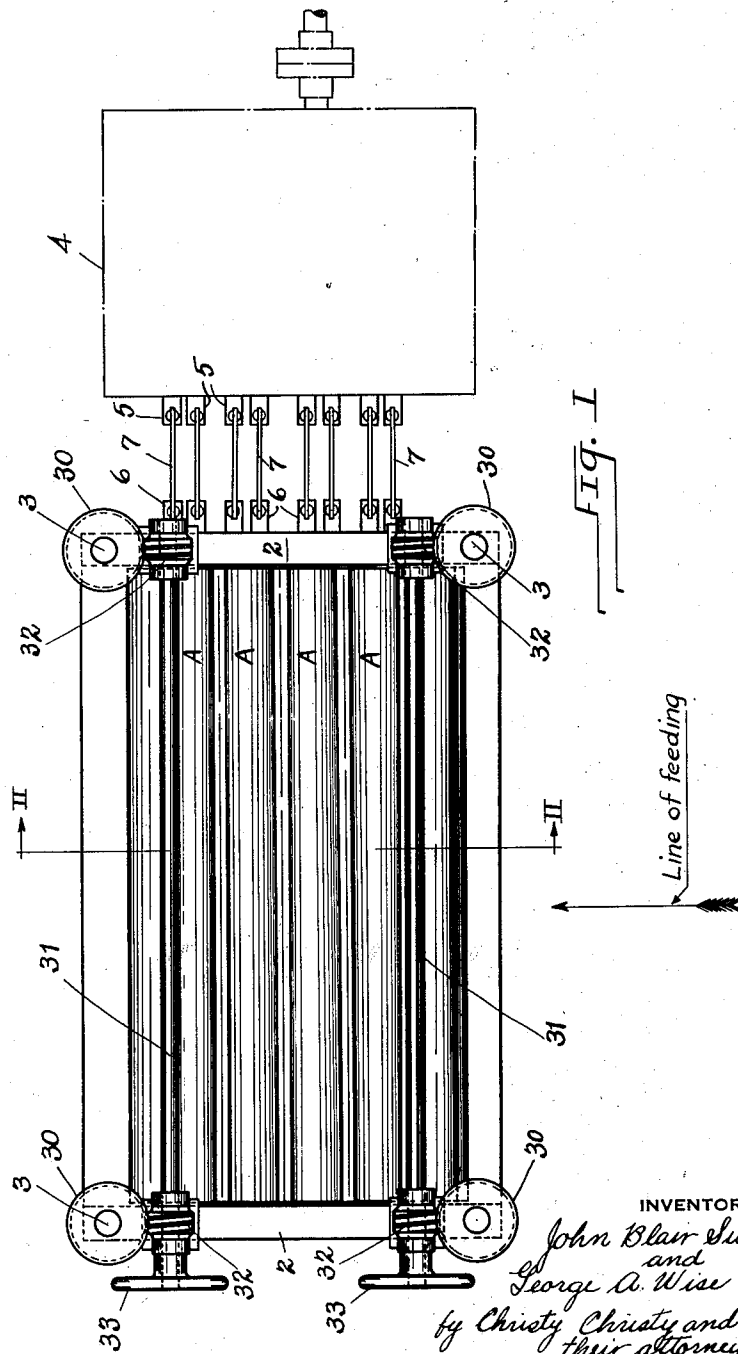
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1,890,342

SHEET FLATTENER

Filed April 3, 1931

2 Sheets-Sheet 1



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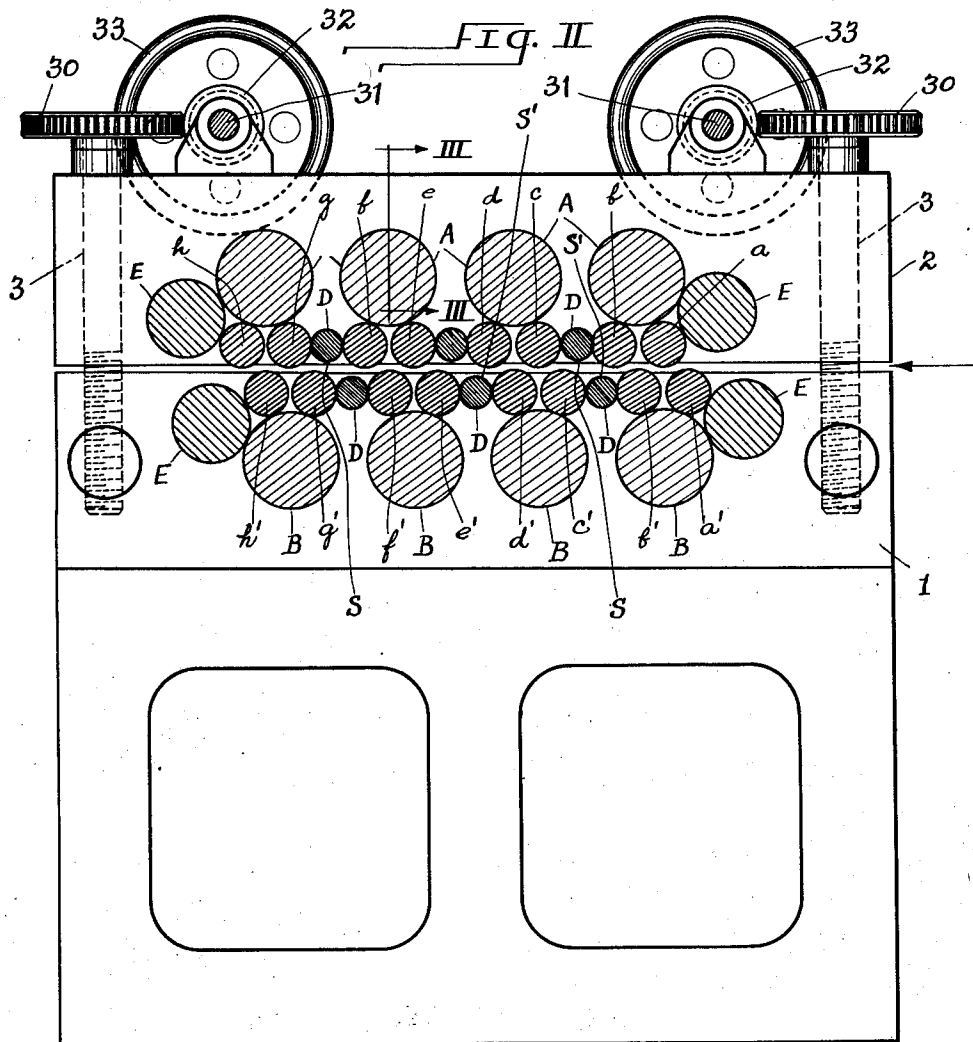
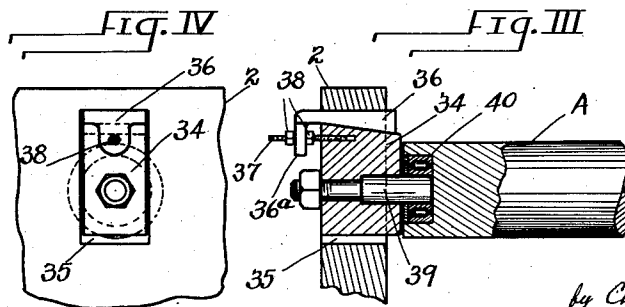
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2 Sheets-Sheet 2



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SHEET FLATTENER

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This invention relates to a new and improved roll arrangement for utilizing small diameter working rolls in the levelling of sheets.

As is well known, sheets coming from the rolling mills, as well as sheets after annealing, pickling, etc., are not flat and must be put through a levelling machine to condition them for commercial use. This invention covers a new roll arrangement which permits the utilization of small working rolls, while rigidly supporting the rolls, by means of suitable backing and spacing rolls, in all directions against working pressures exerted thereon.

By our roll arrangement, we accomplish the levelling of sheets on short centers by means of small working rolls rigidly supported in all directions against working pressures. The simple means by which we accomplish this are plainly shown in the accompanying drawings. Fig. I is a view in plan from above, showing a machine embodying the invention; Fig. II is a view in cross section, to larger scale, and taken on the plane II—II of Fig. I; Fig. III is a fragmentary view in cross section, taken on the plane III—III of Fig. II; and Fig. IV is a side elevation of that portion of the machine which is shown in Fig. III.

In the embodiment of the invention which we have chosen to illustrate, there is a machine frame. This frame comprises two end members 1, with each of which members 1 there is associated an upper frame element 2. The relative position of the members 1 and 2, with respect to each other, is determined by means of two adjusting screws 3. Of these adjusting screws more will presently be said. Trunnioned at their ends in the opposed frame member 2 are the rolls *a, b, c, d, e, f, g,* and *h*, which rolls constitute an upper reach or train of sheet-flexing instrumentalities. In the lower frame members 1 a co-operating train of rolls (*a', b', c', d', e', f', g',* and *h'*) is trunnioned; these latter rolls are staggered with respect to the rolls in the upper reach, and between these two trains of rolls the sheet to be flattened is passed.

The above-identified rolls are the sheet-engaging rolls of the machine, and the rolls of each train are powerfully rotated in such di-

rection as to move a sheet between such trains from right to left, Fig. II. Conveniently, a gear reduction machine 4 is driven by an electric motor (not shown), and this gear machine 4 is provided with driving stems 5. The stems correspond in number and in relative position with the necks 6 of the sheet-engaging rolls, and universal couplings 7 are provided, to connect each working roll with a corresponding driving stem.

The working rolls are each of small diameter; they are clustered in groups (cf. *a, b, a', b'—c, d, c', d'* etc., Fig. II of drawings); and the rolls of each group are laterally arranged with exceedingly small intervals between their adjacent faces. The staggering of the rolls, their small diameters, and their close organization are factors, in consequence of which the machine effects the desired acute flexing of a sheet moving through it. The path of the sheet is indicated by the arrow in Fig. II.

The upper pair of each group of working rolls (for example, the rolls *a, b* of group *a, b, a', b'*) is reinforced or supported by a backing roll A, while the corresponding lower rolls of each group are provided with a backing roll B. Each of the backing rolls (A, B) is of relatively large diameter and of sufficient strength to prevent flexing or bowing of the working rolls. That is to say, the backing rolls are effective to prevent the working rolls from flexing approximately in a vertical direction, i. e. in such direction as would tend to bend the working rolls away from the sheet moving between them.

Advantageously, the backing rolls are co-extensive in length with the working rolls.

It is for simplicity of expression that we refer to the sheet-engaging rolls as working rolls.

Provision is also made to prevent the working rolls from bending or bowing in a lateral direction, that is, in a horizontal plane. Such provision against the lateral bowing of the outer working rolls *a, a', h, h'* presents little difficulty, for the question of roll clearance does not present a problem; this will be perceived upon referring to Fig. II of the draw-

ings. Rolls E, trunnioned in the frame members, serve well to this end.

The lateral support of the intermediate working rolls, however, presents a difficulty which will be appreciated by engineers who are familiar with sheet-flattening machines. For instance, if an intermediate supporting roll of sufficient strength is employed in the customary manner, it destroys (because of its size) the close center-to-center arrangement of the working rolls which is desired, and interferes with the utilization of backing rolls of required size. We have discovered that rolls of relatively small diameters—rolls which in themselves may not be of sufficient strength to support the working rolls laterally—may be interposed in such manner that they are subject merely to compression forces while they are functioning in their supporting capacity.

It will be noted that we provide small intermediate rolls D, organized upon this principle. That is, a roll D is interposed between the working rolls *b* and *c*, and in this position the roll D is manifestly subject to oppositely directed compression forces, which compression forces are caused by the tendency of the rolls *a* and *b* to bow laterally toward each other. Of course, any tendency for these working rolls (*a*, *b*) to bow away from each other is prevented by the supporting thrusts of the backing rolls A. Such thrusts as the backing rolls A create are obviously directed toward one or the other of the lateral supporting rolls D and E. In other words a closed chain of compression forces exists between each succeeding pair of backing rolls. Accordingly the working rolls, the small lateral supporting rolls, the end supporting rolls, and the backing rolls constitute a series of interbracing and co-operating rolls.

We have shown the rolls D to be so trunnioned in the machine frame that their axes are in common plane with the axes of the working rolls with which they are associated. It is desirable that the rolls D should be so trunnioned.

It is desirable that the lower or nether surfaces S of the rolls D in the upper train should lie, as they indeed do lie, below the plane of the axes of the working rolls, but not so far below said plane as to touch a sheet on its way through the machine. Similarly, the upper faces S' of the rolls D (in the lower train) lie above the plane of the axis of the working rolls, with which they are in contact.

The upper train of working rolls, together with their backing rolls, and lateral supporting rolls, are all so trunnioned as to admit of group adjustment with respect to the lower train of rolls. Advantageously, such adjustment is obtained by rotating the screws 3 which unite the frame portions 1 and 2.

Fixed to the upper ends of each screw 3 is a worm gear 30, and, conveniently two shafts 31 carry adjacent their ends worms 32, severally in mesh with the respective worm gears 30. Hand wheels 33 are secured to the ends of the shafts 31, whereby, it will be perceived, rotation of the screws may be effected to rotate screws 3 in concert, and to obtain the shifting of frame member 2 with respect to members 1. So, such roll adjustment may be readily effected.

We contemplate independent adjustment of each roll, that is, adjustment of each end of each roll, and in Figs. III and IV we have illustrated an adjustable roll bearing which may be incorporated in either frame member for this purpose. In this case it is one end of a backing roll A which we show adjustable in one of the frame elements 2.

A block 34 is located in an opening 35 in the frame 2; a wedge 36 is secured to the block by means of a screw 37, and nuts 38 are in threaded engagement with this screw, one nut on each side of the portion 36a of the wedge, whereby the wedge may be shifted either inward or outward of the frame 2 and the block 34 may, accordingly, be inched upward or downward, as desired.

The backing rolls may be provided, as in this case they are provided, with antifriction bearings. To this end a journal 39 is secured to the block 34, and a race of roller bearings 40 is housed in the end of roll A, co-operating with the journal member 39 to provide a simple, inexpensive and efficient bearing.

We claim as our invention:

1. A sheet-flattening device including two upper rolls for engagement with the upper surface of the sheet to be flattened, a lateral supporting roll between said upper rolls, the nether surface of which supporting roll projects below the plane of the axes of said upper sheet-engaging rolls, and a plurality of lower rolls for engagement with the nether surface of said sheet to be flattened and co-operating with said upper sheet-engaging rolls to effect a flexing of said sheet when the rolls revolve and the sheet moves between them.

2. A sheet-flattening device including two upper rolls for engagement with the upper surface of the sheet to be flattened, two lower rolls for engagement with the nether surface of such sheet, which last-mentioned rolls are axially so disposed with respect to the first-mentioned rolls as to effect a flexing of said sheets when the rolls revolve and the sheet moves between them, and an intermediate roll between each pair of said sheet-engaging rolls, which intermediate rolls are of smaller diameter than said sheet engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls, the nether surface of said upper intermediate roll ly-

ing below the plane of the axes of its associated sheet-engaging rolls, and the upper surface of the lower intermediate roll lying above the plane of the axes of its associated sheet-engaging rolls.

3. A sheet-flattening device including two upper rolls for engagement with the upper surface of the sheet to be flattened; a lateral supporting roll between said upper rolls, the nether surface of which supporting roll projects below the plane of the axes of said upper sheet-engaging rolls, a large backing roll for each of said sheet-engaging rolls, each of which backing rolls is in such engagement with its associated sheet-engaging roll that the lines of its roll-supporting thrust extend downward and inward toward said lateral supporting roll, together with a plurality of lower rolls for engagement with the nether surface of said sheet to be flattened and cooperating with said upper sheet-engaging rolls to effect a flexing of said sheet when the rolls revolve and the sheet moves between them.

4. A sheet-flattening device including two upper rolls for engagement with the upper surface of the sheet to be flattened, two lower rolls for engagement with the nether surface of such sheet, which last-mentioned rolls are axially so disposed with respect to the first-mentioned rolls as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, an intermediate roll between each of said pairs of sheet-engaging rolls, which intermediate rolls are of smaller diameter than said sheet-engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls without contacting the sheet moving between them, a large backing roll in contact with each of said sheet-engaging rolls, each of which backing rolls is in such engagement with its associated sheet-engaging roll that the lines of its roll-supporting thrust extend downward and inward toward said intermediate rolls.

5. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, and an intermediate roll revolubly disposed between two of the sheet-engaging rolls in each train, which intermediate rolls are of smaller diameter than their associated sheet-engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls with-

out contacting the sheet moving between them.

6. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, an intermediate roll revolubly disposed between two of the sheet-engaging rolls in each train, which intermediate rolls are of smaller diameter than their associated sheet-engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls without contacting the sheet moving between them, and large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls.

7. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, intermediate rolls revolubly disposed between pairs of the sheet-engaging rolls in each train, the nether surfaces of which intermediate rolls project below the planes of the axes of the sheet-engaging rolls which they contact, and large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls.

8. In a sheet-flattening device the combination of a machine frame, an upper train of sheet-engaging rolls which are trunnioned at their ends in said frame and are organized for engagement with the upper surface of the sheet to be flattened, a lower train of sheet-engaging rolls which are also trunnioned at their ends in said frame and are adapted to engage the nether surface of the sheet to be flattened, the rolls of said lower train being axially so disposed with respect

to the rolls of said upper train as to effect a flexing of the sheet when the rolls revolve and the sheet moves between them, backing rolls for the support of said sheet-engaging rolls, and means which afford adjustment of all the trunnioned ends of said upper train of rolls and its backing rolls as a unit with respect to said lower train of rolls.

9. In a sheet-flattening device the combination of a machine frame, an upper train of sheet-engaging rolls which are trunnioned at their ends in said frame and are organized for engagement with the upper surface of the sheet to be flattened, a lower train of sheet-engaging rolls which are also trunnioned at their ends in said frame and are adapted to engage the nether surface of the sheet to be flattened, the rolls of said lower train being axially so disposed with respect to the rolls of said upper train as to effect a flexing of the sheet when the rolls revolve and the sheet moves between them, backing rolls for the support of said sheet-engaging rolls, and means which afford adjustment of said upper train of rolls and its backing rolls as a unit with respect to said lower train of rolls, together with auxiliary means which afford independent adjustment of the ends of said backing rolls.

10. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, an intermediate roll revolubly disposed between two of the sheet-engaging rolls in each train, which intermediate rolls are of smaller diameter than their associated sheet-engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls without contacting the sheet moving between them, large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls, and means which afford adjustment of said upper train of rolls and its intermediate and backing rolls as a unit with respect to said lower train of rolls.

11. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame

and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, an intermediate roll revolubly disposed between two of the sheet-engaging rolls in each train, which intermediate rolls are of smaller diameter than their associated sheet-engaging rolls, and are disposed for the lateral support of the sheet-engaging rolls without contacting the sheet moving between them, large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls, means which afford adjustment of said upper train of rolls and its intermediate and backing rolls as a unit with respect to said lower train of rolls, together with auxiliary means which afford independent adjustment of the ends of said backing rolls.

12. In a sheet-flattening device the combination of a machine frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, intermediate rolls revolubly disposed between pairs of the sheet-engaging rolls in each train, the nether surfaces of which intermediate rolls project below the planes of the axes of the sheet-engaging rolls which they contact, large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls, and means which afford adjustment of said upper train of rolls and its intermediate and backing rolls as a unit with respect to said lower train of rolls, together with means which afford independent adjustment of the ends of said backing rolls.

13. In sheet-flattening apparatus the combination of a frame, a train of rolls trunnioned in said frame and extending in an upper reach for engagement with the upper surface of the sheet to be flattened, a second train of rolls trunnioned in said frame and extending in a lower reach for engagement with the nether surface of such sheet, the sheet-engaging rolls in said lower reach being

axially so disposed with respect to the sheet-engaging rolls in said upper reach as to effect a flexing of said sheet when the rolls revolve and the sheet moves between them, intermediate rolls revolvably disposed between sheet-engaging rolls in each train, which intermediate rolls are of smaller diameter than their associated sheet-engaging rolls and are disposed for the lateral support of the sheet-engaging rolls without contacting the sheet moving between them, large backing rolls for each train of said sheet-engaging rolls, which backing rolls are in such engagement with their associated sheet-engaging rolls that components of their roll-supporting forces react in lines extending toward said intermediate rolls, together with end rolls for the lateral support of the sheet-engaging rolls at the ends of each train.

14. The combination of claim 13, in which the nether surfaces of said intermediate rolls in the upper train of rolls lie below the plane of the axes of their associated working rolls, as described.

In testimony whereof we have hereunto set our hands.

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