

[54] ROLLING MILLS

[75] Inventor: Nicholas Arthur Townsend, Bexley,
England

[73] Assignee: The British Iron and Steel Research
Association, London, England

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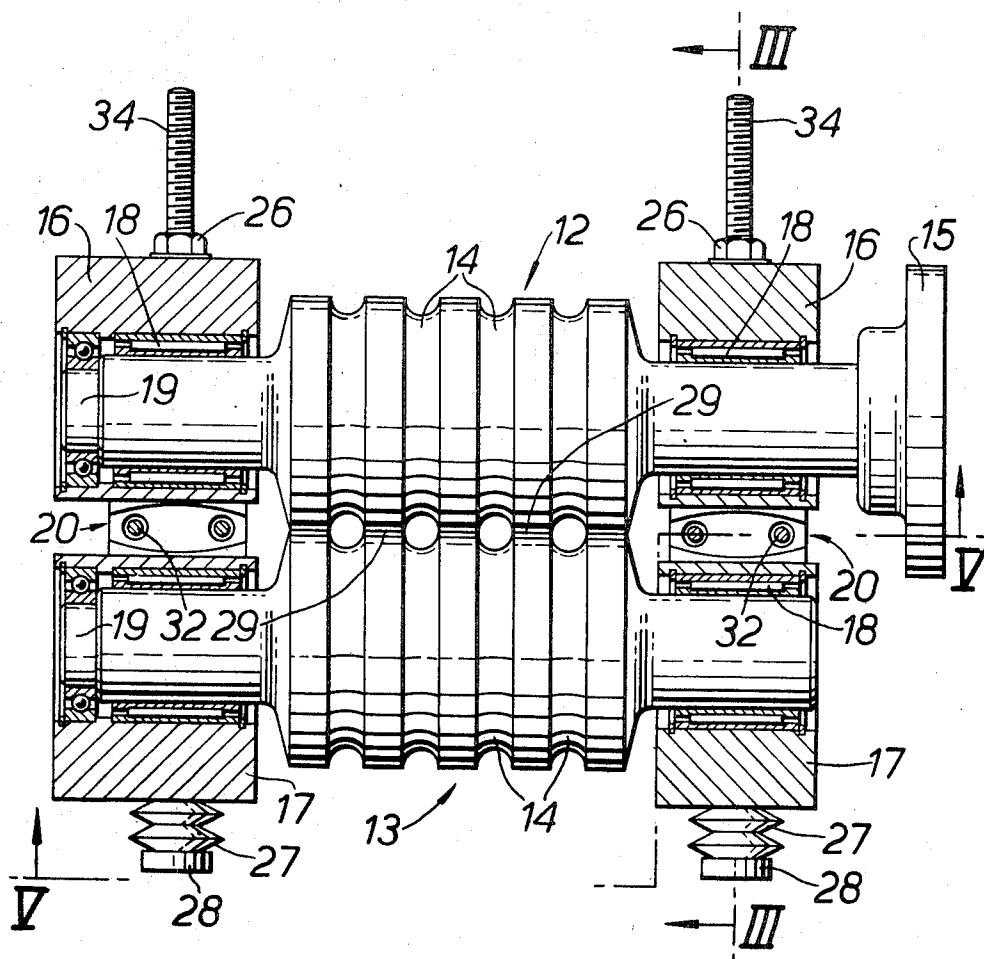
Primary Examiner—Milton S. Mehr
Attorney—Leo A. Rosetta et al.

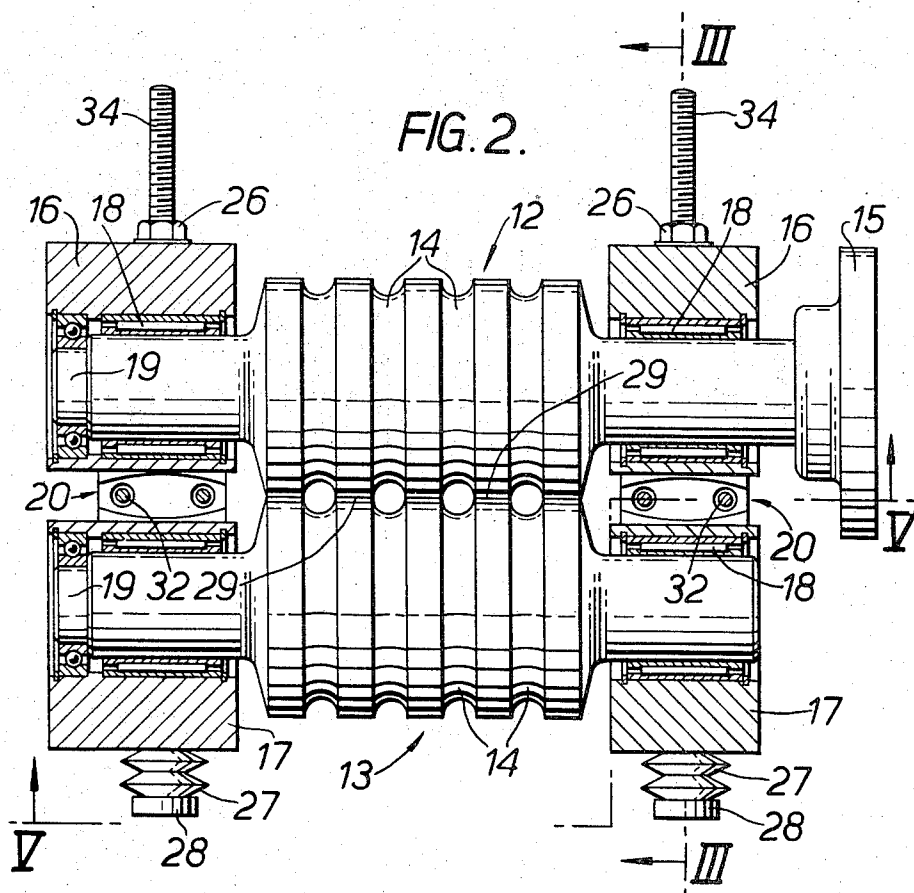
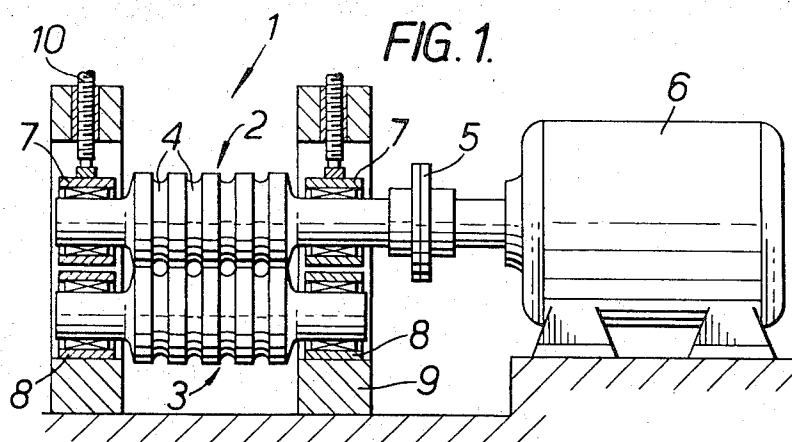
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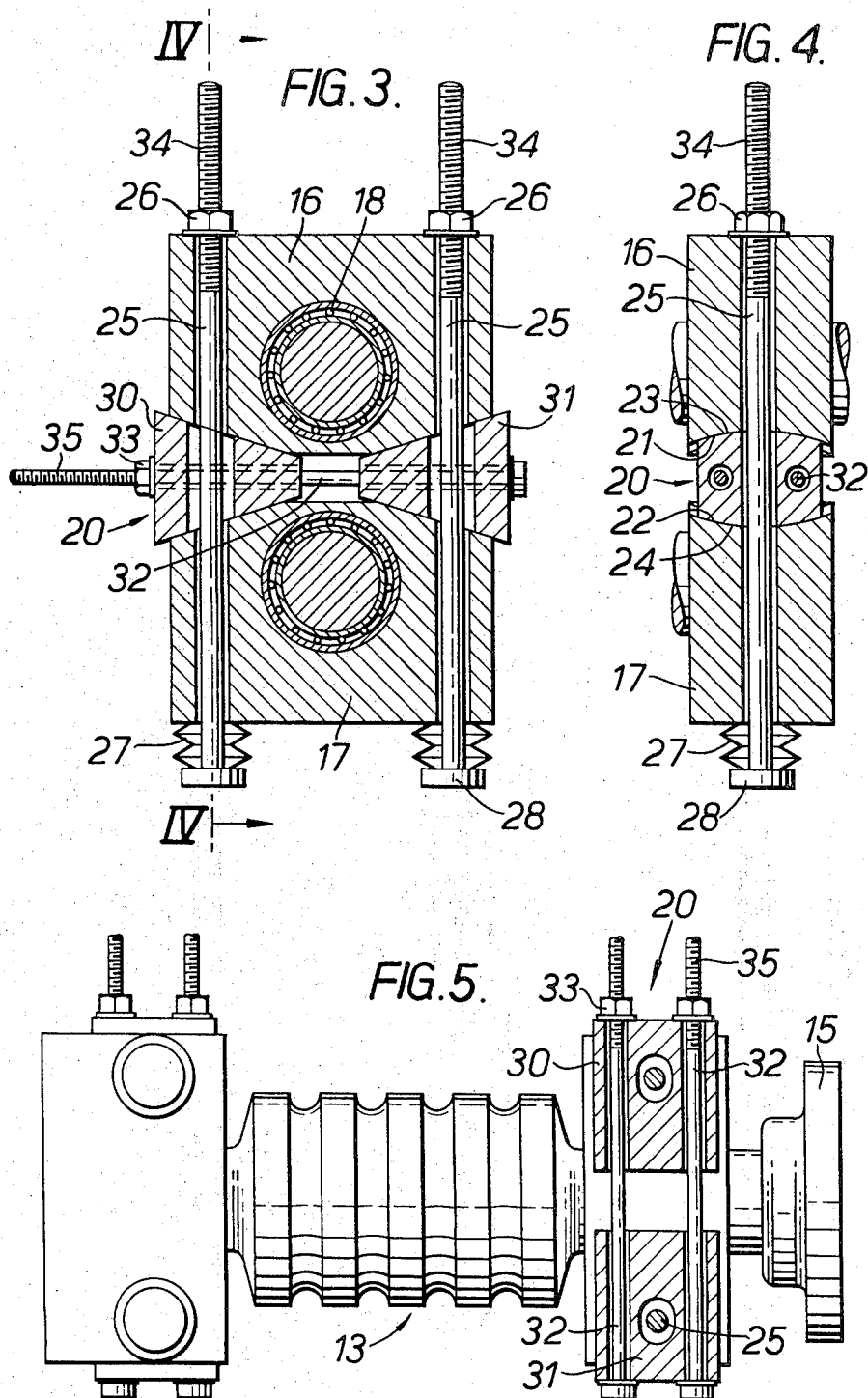
ABSTRACT

A rolling mill stand for rolling metal bars has two grooved work rolls. Only one of the work rolls is directly driven from the drive motor, the other work roll being driven by frictional engagement with the driven roll. The two work rolls are pressed together with a force greater than twice the rolling load to permit the rolling torque to be transmitted from the driven work roll to the other roll.

11 Claims, 5 Drawing Figures







ROLLING MILLS

At present, metal products with 'shaped' cross-sections, e.g., rods, bars, billets and structural sections, are generally rolled in a series of conventional two-high rolling mill stands. Basically, such stands comprise a pair of contra-rotating, co-operating work rolls both of which have cut in them grooves shaped to form the cross-section of the product. In such stands, for various practical reasons associated with the rolling process it is desirable for both rolls to transmit substantially equal amounts of rolling torque during rolling. In practice, this is achieved by coupling both rolls to one prime-mover (generally an electric motor) via cardan shafts and a pinion gearbox.

According to one aspect of the invention a rolling mill stand is provided including two work rolls, at least one of the work rolls having one or more recesses running circumferentially around the surface of the roll characterised in that only one work roll has a coupling for connecting it to a drive motor and in that means are provided for squeezing the two work rolls together so that in use the necessary rolling torque is supplied to the second roll by frictional force between the mating surfaces of the coupled first work roll and the second work roll.

The work rolls may be supported by back-up rolls, or alternatively there may be no back-up rolls present. Preferably the work roll ends are held in roll chocks, a tension member being provided for pressing the roll chocks towards one another thus squeezing the two work rolls together. The roll chocks are generally separated by a spacer, which may consist of one or more wedges, which is adjustable to alter the spacing between the rolls.

The surfaces of the spacer which bear against the roll chocks are preferably curved as seen in a cross section parallel to the plane of the roll axes, to permit the roll chocks to rock in the plane containing the roll axes as the work rolls flex. The surfaces of the spacer which bear against the chocks may be coated with a substance having a low coefficient of friction.

The tension member can include a prestressing bolt passing through the roll chocks and secured externally of the roll chocks. Resilient members may be incorporated with the tension member so that any excessive loads on the mating surfaces of the work rolls can be absorbed by the resilient members.

The work rolls should preferably be squeezed together with a force greater than twice the rolling load.

We have found that the rolling mill stand of the invention has the following advantages over existing conventional rolling mill stands:

1. There is a significant saving in capital costs, because there is now no need for the gearbox and cardan shafts. There is also a considerable reduction in the floor area and foundations which are necessary to support the stand and its drive motor.

2. Smaller diameter work rolls can be used than is possible in conventional stands. In conventional mills the coupling size generally limits the minimum distance between the work roll axes and this limits the minimum useable work roll diameter. Smaller rolls have various advantages, including the reduction of widthways errors caused by variable rolling conditions thereby leading to improved product dimensional tolerance, and they also allow a greater reduction per pass to be taken.

3. Further improvements in product dimensional tolerance are achieved because of the greatly increased stiffness of the rolling mill stand as compared with conventional mill stands.

4. Routine stand changing procedure is also speeded up because only one coupling requires disconnection and reconnection, and access to the coupling is greatly improved.

In the accompanying drawings:

FIG. 1 shows a general arrangement in elevation and partly in section of one embodiment of a rolling mill stand according to the invention;

FIG. 2 shows in elevation a cross-section of another and preferred embodiment of a rolling mill stand according to the invention;

FIG. 3 shows a cross-section on line III—III of FIG. 2;

FIG. 4 shows a cross-section on line IV—IV of FIG. 3, and

FIG. 5 shows a view on line V—V of FIG. 2.

In FIG. 1, a rolling mill stand 1 is shown with two work rolls 2 and 3, both work rolls having recesses 4 running circumferentially around their surfaces in which the product is worked. Only the first work roll 2 is connected by a coupling 5 to a drive motor 6. The ends of the work rolls 2 and 3 are held in upper and lower rolls chocks 7 and 8 respectively which are mounted within a housing 9. A conventional screw-down mechanism is shown at 10. The work rolls 2 and 3 are squeezed together by hydraulic capsules (not shown) between the housing 9 and the lower roll chocks 8 so that in use the necessary rolling torque is supplied to the second work roll 3 by frictional force between the mating surfaces of the coupled first work roll 2 and the second work roll 3.

In FIGS. 2 to 5, a first and second work roll 12 and 13 respectively are mounted together as shown. Both rolls 12 and 13 have recesses 14 running circumferentially around their surfaces in which the product is worked and the rolls contact one another at mating surfaces 29. Only the first work roll 12 has a coupling 15 for connecting it to a drive motor (not shown). The ends of the work rolls 12 and 13 are held in upper roll chocks 16 and lower roll chocks 17 respectively. Cylindrical roller bearing 18 support each roll end radially within each roll chock 16, 17 and the roll ends distant from the coupling 15 are also axially located by spherical thrust bearings 19.

Each upper and lower roll chock 16, 17 is separated from one another by a spacer in the form of a wedge system 20. The wedge system 20 comprises two opposed wedges 30 and 31. The surfaces 21, 22 of the wedge system 20 which bear against the roll chocks 16, 17 are curved as seen in a cross-section parallel to the plane of the work roll axes. The faces 23, 24 of the roll chocks 16, 17 which bear against the wedge system 20 having a matching curvature, thus permitting the roll chocks 16, 17 to rock in the plane containing the work roll axes as the work rolls 12, 13 flex during normal use. The surfaces 21, 22 of the wedge system 20 are coated with PTFE which is a substance having a low coefficient of friction.

Tension members consisting of prestressing bolts 25 passing through the roll chocks 16, 17 and secured externally of the roll chocks 16, 17 by their respective nuts 26 on the threaded portions 34 of the bolts 25 are provided for squeezing the two work rolls 12, 13 to-

gether, so that in use the necessary rolling torque is supplied to the second work roll 13 by frictional force between the mating surfaces 29 of the coupled first roll 12 and the second work roll 13. The work rolls 12, 13 are squeezed together with a force greater than twice the maximum rolling load. There are no back-up rolls bearing on the work rolls 12 and 13.

"Belville" or dished washers 27 incorporated with the tension members are positioned under the lower heads 28 of the prestressing bolt 25. These resilient members have highly non-linear load/deflection characteristics and reduce the danger of overloading the mating roll surfaces and bearings through some mishap, for example, abnormal roll expansion through lack of cooling water. Then, if the rolls expand abnormally, there is relatively little change in the bearing load, and the mill stiffness is unaffected.

The wedge system 20 is adjustable by means of tie rods 32 with threads 35 at one end and nuts 33 to change the distance between roll chocks 16 and 17 and thus the distance between the work roll centres.

In order to correctly prestress the rolling mill stand the following procedure is used.

With the wedge system 20 removed, the rolls 12, 13 are squeezed together in a hydraulically powered press or jig with a force greater than twice the maximum rolling load. The wedge system 20, tie rods 32 and prestressing bolts 25 are then inserted and known prestressing tools are applied to the wedge tie rods 32, and the prestressing bolts 25. Tensile forces are applied simultaneously to the tie rods 32 and prestressing bolts 25 and the forces gradually increased at a fixed ratio until the prestressing bolt load is the same as the force between the rolls. The ratio of the load applied to the prestressing bolts 25 and that applied to the tie rods 32 is arranged to be equal to the mechanical advantage of the wedge system 20, which when the surfaces of the wedge system are coated with a material having a very low coefficient of friction, is approximately $\frac{1}{2} \tan \theta$, where θ is the semi-included angle of the wedge system 20.

The nuts 26 and 33 on the threaded portions 34 and 35 of the prestressing bolts 25 and the tie rods 32 respectively are then locked up and the externally applied prestressing loads removed. The force between the rolls and the separating force between the chocks 16, 17 are now equal and greater than twice the rolling load.

The work rolls used in the rolling mill stand may be slightly barrel-shaped. This would promote the even loading of the mating roll surfaces and so minimise the incidence of roll surface fatigue by compensating to some extent for roll flexure which occurs when rolling. The wedge system may be two opposed wedges or in a single part.

Rolling mill stands according to the invention are a significant advance over known types of stand, giving advantages in terms of cost, ease of operation and the dimensional tolerances of the products which can be rolled in them.

We claim:

1. A rolling mill stand comprising two work rolls, at least one of the work rolls having one or more workpiece-engaging recesses disposed circumferentially around its surface, roll chocks for supporting each

work roll at its ends, means for driving only one of the work rolls from a drive motor, and prestressing means for squeezing the surfaces of the two work rolls together into frictional engagement with each other, so that the rolling torque is transmitted from the driven work roll to the other work roll solely by friction between the mating said surfaces of the two work rolls.

2. A rolling mill stand according to claim 1 in which the prestressing means is adapted to squeeze the work rolls together with a force greater than twice the rolling load.

3. A rolling mill stand according to claim 1 in which the ends of each work roll are held in roll chocks and a tension member presses the roll chocks towards one another.

4. A rolling mill stand according to claim 1 which is two-high.

5. A rolling mill stand which comprises two work rolls, at least one of the work rolls having one or more workpiece-engaging recesses disposed circumferentially around the surface of the roll, roll chocks for supporting each work roll at its ends, a spacer separating the roll chocks from one another, means for driving only one of the work rolls from a drive motor, and prestressing means including a tension member for squeezing the surfaces of the two work rolls together into frictional engagement with each other, so that the rolling torque is transmitted from the driven work roll to the other work roll by friction from the mating said surfaces of the two work rolls.

6. A rolling mill stand according to claim 5 in which an adjusting device is provided to the spacer to permit variation in the spacing between the roll chocks.

7. A rolling mill stand according to claim 6 in which the adjusting device includes a tie rod threaded at one end and a nut movable on said thread to adjust the spacing between the roll chocks.

8. A rolling mill stand according to claim 5 in which the surfaces of the spacer which bear against the roll chocks are curved as seen in a cross-section parallel to the plane of the roll axes, and the surfaces of the adjacent roll chocks have matching curvatures so that the roll chocks are permitted to rock in the plane containing the roll axes as the work rolls flex.

9. A rolling mill stand according to claim 5 in which resilient members are incorporated with the tension member so that any excessive loads on the mating surfaces of the work rolls can be absorbed by said resilient members.

10. A rolling mill stand according to claim 5 in which the spacer includes a wedge system.

11. A rolling mill stand comprising two work rolls, at least one of the work rolls having one or more workpiece-engaging recesses disposed circumferentially around its surface, roll chocks for supporting each work roll at its ends, means for driving only one of the work rolls from a driven motor, and a prestressing bolt passing through the roll chocks squeezing the surfaces of the two work rolls together into frictional engagement with each other, so that the rolling torque is transmitted from the driven work roll to the other work roll solely by friction between the mating said surfaces of the two work rolls.

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