Nov. 10, 1959 J. W. O'BRIEN 2,911,804

ROLLING MILL COUPLING

Filed April 12, 1956 2 Sheets-Sheet 1

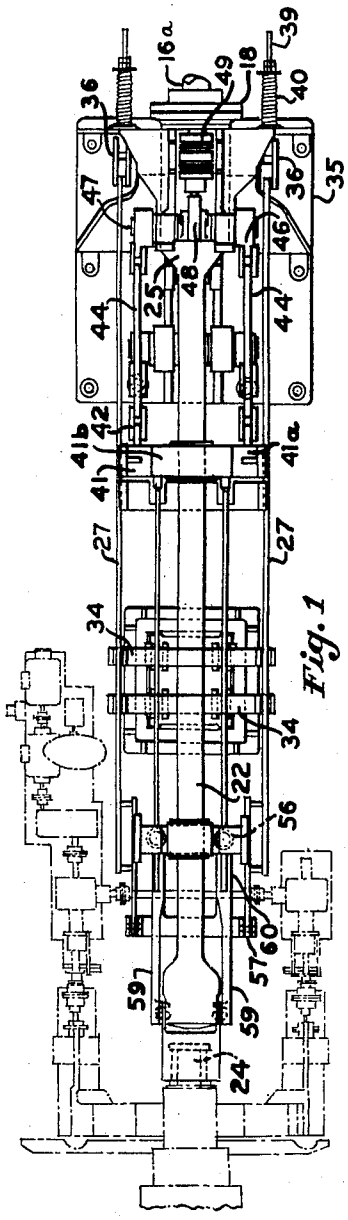


Fig. 1

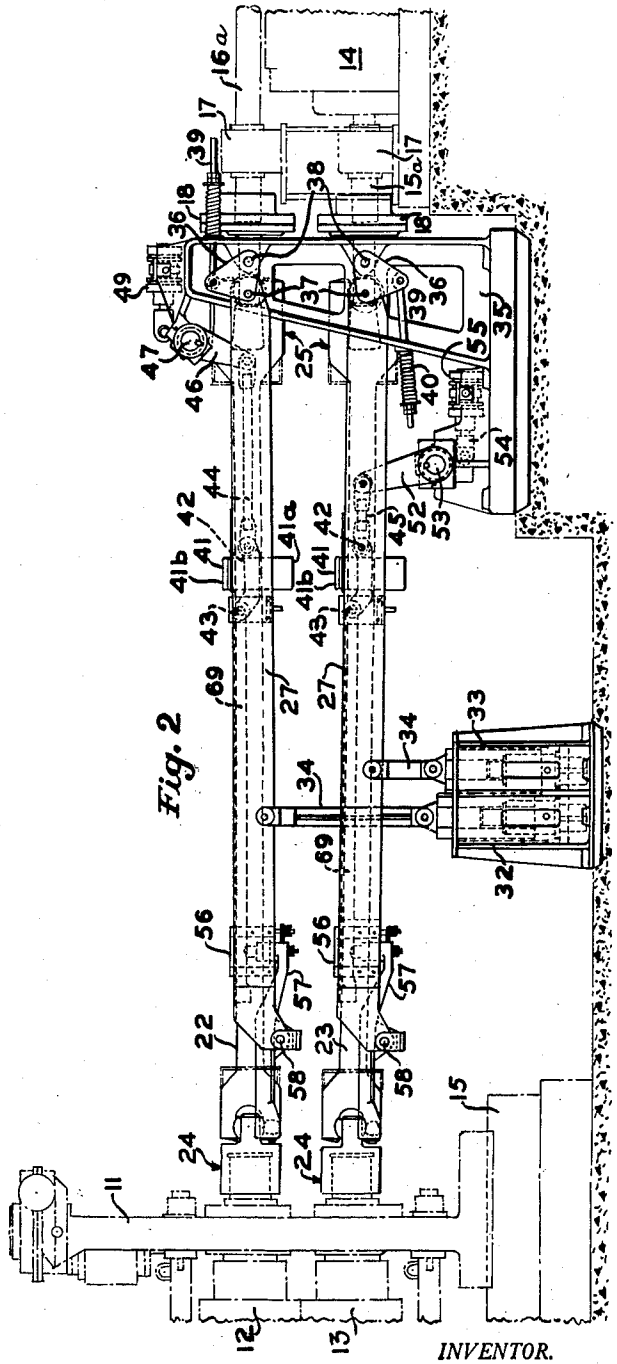


Fig. 2

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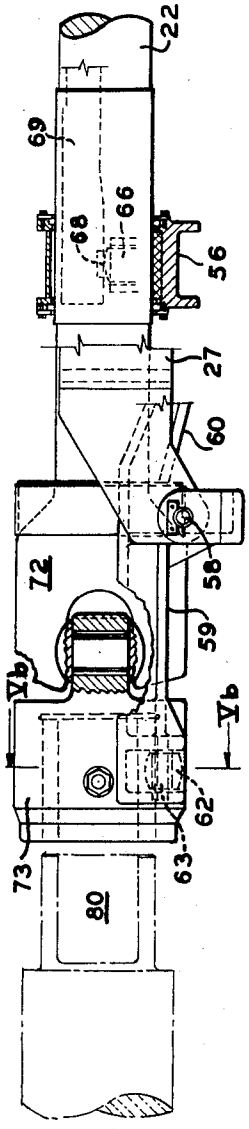


Fig. 3

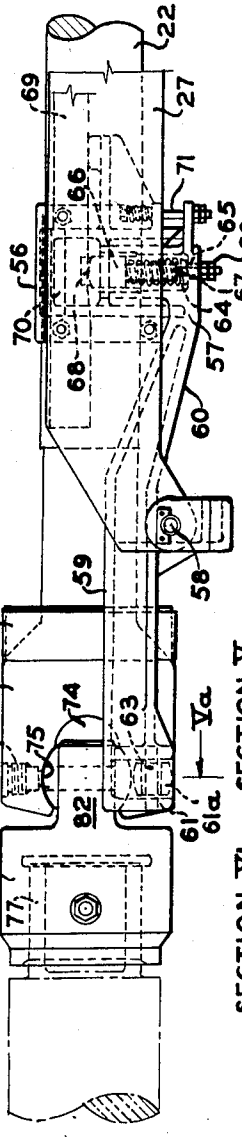


Fig. 4

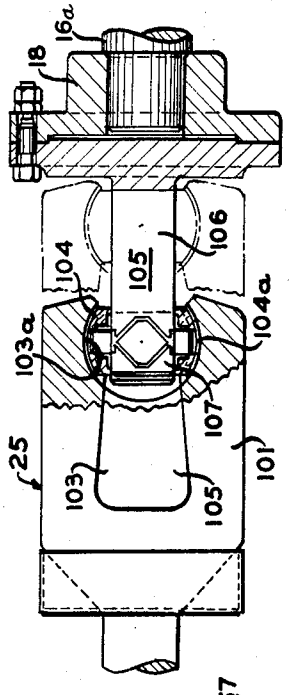


Fig. 6

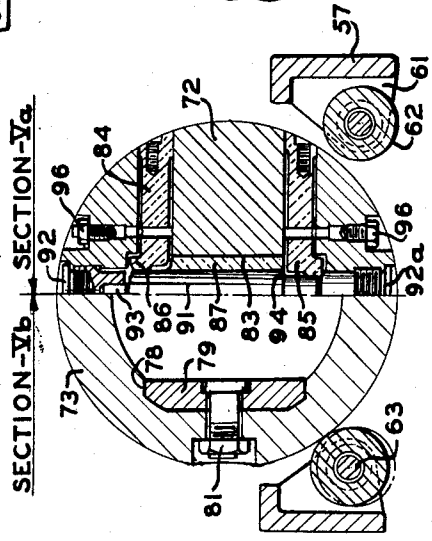


Fig. 5

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ROLLING MILL COUPLING

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8 Claims. (Cl. 64—7)

This invention relates to apparatus for driving the rolls of a rolling mill and in particular to the couplings interposed between the driving means and the rolls in which there are provided supporting means adapted to be placed in position to engage with the female roll-neck engaging coupling member, pivotally connected to the spindle, for maintaining the member in axial alignment with the spindle when the coupling is disconnected from the roll neck at the time, for example, when one or more rolls or even the entire mill is being removed.

In those cases where customarily employed coupling members are used for providing a driving connection between the rolls of a mill and the power means, no supports whatsoever have been provided for the pivotal female members when such members are disconnected from the mill roll necks so that the members immediately droop downward when disconnected from the rolls. Now, when they are to be reconnected to the mill roll necks, is is necessary by exercising considerable effort to raise the female members the required angle in order to align the axes thereof with those of the spindles so that the roll neck may be readily inserted in the end of the coupling member. Heretofore, for aligning the coupling members, various means have been employed, including jacks or even a crane and it is obvious that in the employment of such means there are introduced delays and inefficiencies. In addition, when the coupling members are raised normally by the use of bars, levers or the like there is considerable danger present inasmuch as the coupling members may be caused to slip away from the holding members thereby endangering the workmen when the member swings downward. In larger mills, especially, such members have considerable size and weight so that any means employed for adjusting them should be positive and dependable.

It has also been the practice heretofore to disconnect the female members of the couplings from the couplings themselves and permit them to remain on the necks of the rolls when the rolls or mill stands are removed, thereby necessitating the maintenance of a large supply of such members. Thus, when a boot or other closure is employed for encasing each coupling, the boot or closure must be removed from each of the couplings before they can be disconnected thereby resulting in further time delay during shutdown of the mill.

It is, therefore, one of the objects of this invention to provide means not only for disconnecting the spindles from the rolls of a mill but also for maintaining the coupling free end female member in axial alignment with the spindles while so disconnected.

It is another object of this invention to provide a supporting means adapted to be maintained in a disengaged position during the time the coupling free end member is connected to the roll neck but which automatically comes into engagement with the free end member on disengagement of such member from the roll necks.

Still another object of this invention is to provide a

coupling supporting means for supporting the free end of the coupling when the drive shaft is not in engagement therewith which will be fully automatic, and relatively simple of construction and economical of maintenance and operation.

A further object of this invention is to eliminate the necessity for disconnecting the boot or closure surrounding each of the couplings when the couplings are to be disconnected from the mill rolls.

This invention further contemplates rolling mill driving spindles adapted to be withdrawn readily as a unit in a direction away from the mill thereby to disconnect the couplings thereof from the mill rolls in order to provide sufficient clearance for permitting the entire mill stand as a unit to be lifted vertically and removed from its foundation.

These objects, as well as the other novel features and advantages of this invention, will become apparent from the following description and accompanying drawings in which:

Fig. 1 is a plan view of a rolling mill driving system incorporating in one form the coupling disconnecting and supporting means herein disclosed;

Fig. 2 is a side elevation view of the apparatus shown in Figure 1;

Fig. 3 is an enlarged partial side elevation view showing the roll neck disconnected from the spindle coupling and the coupling supporting means in position for supporting the female or free end member of the coupling;

Fig. 4 is a view similar to Fig. 3 in which there is shown the roll neck and coupling member in their engaged position and the coupling supporting means in its withdrawn or inoperative position;

Fig. 5 is a composite sectional view of the coupling taken on lines V*a*—V*a* and V*b*—V*b* of Figs. 3 and 4 respectively, and

Fig. 6 is a partial sectional elevation view of the upper coupling on the motor side of the driving system.

With reference to Figs. 1 and 2, there is shown therein in combination with the illustrated embodiment of the present invention a rolling mill 11 comprising a pair of horizontally arranged rolls 12 and 13 vertically adjustable in the windows of the housings thereof which housings are affixed to a base 15 in the usual manner. Although in this particular instance a two-high mill is shown, it will be readily apparent that the present invention is equally applicable to various other mill arrangements such as three, four or more high mills. Rolls 12 and 13 are driven by separate motors, the motor 14 and its motor shaft 15*a* for driving the lower roll 13 being shown while only a partial showing is made of the motor shaft 16*a* for the top roll 12. Both motor shafts 15*a* and 16*a* are supported in a suitable bearing stand 17 and connected to the individual driving spindles 22 and 23 by suitable heavy mill type couplings 18. For connecting the ends of the rolls to the adjacent spindle ends and to the mill couplings 18, universal type couplings 24 and 25 are provided at each end of the spindles, the construction of which will be more fully discussed hereinafter. As shown, the spindles 22 and 23 extend in a longitudinal direction with their axes parallel and are supported by pairs of individual parallel frames 27. The frames 27 in turn are pivotally supported and adapted to be moved vertically independently of each other on vertical movement of the rolls to which they are connected and in order to permit such action the upper frame is connected to a constant pressure piston-cylinder assembly 32 and the lower frame connected to a similar piston-cylinder assembly 33, both connections being made by means of links 34 located approximately midway between the frame ends. The piston-cylinder assemblies are provided with the necessary constant pressure, from a source not shown,

which is sufficient to balance the weight of the entire assembly when the rolls **12** and **13** are in their driving arrangement. When the rolls have been disconnected from the couplings the pressure is interrupted so that the cylinders maintain the frames in their normal parallel relationship. The ends of the frames **27** on the motor side are pivotally connected to a vertical support **35** by individual triangular bell cranks **36** to which they are pivotally secured by pins **37** and the cranks pivotally connected to the supports **35** by pins **38**. Also secured to the cranks **36** there are rods **39** on which adjustable springs **40** are mounted for positively urging the bell cranks in a clockwise direction as viewed in Fig. 2 thereby maintaining a force, controlled by the usual lock nut arrangement, for maintaining the spindles and frames in such a position that the axes of the spindles are axially aligned with the motor shaft axes. It will be apparent that when the driving arrangement includes a pinion stand between the motors and spindles, the frames and bell cranks could be very conveniently mounted in a similar fashion on the pinion stand housing thereby eliminating the necessity for having the support **35**.

Between the support **35** and the balance piston-cylinder assemblies **32** and **33** there are provided trusses **41** extending between the side members of each pair of frames and having surfaces parallel to the vertical inside opposed surfaces of the side members and top overhanging portions which rest on the upper surfaces of the frames for slidable movement therealong. Each of the trusses is of one-piece construction, the central portion **41***a* of which is recessed for receiving a bearing for supporting the respective spindles. The bearings are interlocked with the housings of the trusses and the spindles provided with enlarged diameter portions which fit into the recessed bearings thereby to prevent axial movement between the spindles and the bearings. A removable top half bearing cap **41***b* is provided to complete the bearing assemblies for the trusses. The trusses **41** are provided with two pairs of uniformly spaced longitudinal links **42** and **43** which extend from their opposite sides, one pair in the direction of the drive and the other pair in the direction of the mill. Two pairs of rods **44** and **45** are connected to the links **42**. For the top spindle **22**, the outer ends of the rods **44** are secured to a pair of arms **46** pivotally mounted on opposite ends of a trunnion shaft **47** mounted on top of the support **35**. To the trunnion shaft **47** an arm **48** is keyed to which there is connected a piston-cylinder assembly **49** which is also mounted on the top of the support **35**. The ends of the rods **45** in the bottom spindle arrangement are in a similar manner connected to individual arms **52** mounted on a common trunnion shaft **53** to which there is keyed an arm **54** having piston-cylinder assembly **55** connected thereto. On the actuation of the cylinders **49** and **55**, the trusses **41** are moved along the frames **27** and the spindles being interlocked with the truss bearings move in a direction towards or away from the mill as the case may be.

At the mill end of the spindles, as best shown in Figs. 3 and 4, there are secured to the frames by suitable bolts stationary trusses **56** each comprising a two-piece segmental bearing for receiving and rotatably supporting the spindles. The ends of the frames project downwardly terminating in bosses which fit into U-shaped openings of coupling supporting members **57**, both being provided with complementary openings through which pins **58** are inserted for pivotally connecting the two elements together. These coupling supporting members **57** have a rigid central cross member and extend in the direction toward the couplings **24**. Their ends are in the form of two spaced prongs **59** having opposed projections **61** including openings **61***a* for receiving freely rotatable rollers **62**, suitable pins **63** securing the rollers therein. The other ends of the coupling supporting members extend downwardly and take the form of two prongs **60** including at each of their ends vertically disposed cylindrical recesses **64** having a closed bottom with a small diameter opening **65** therein. In the recesses there are received plungers **66** having enlarged upper portions and lower stem portions which extend through the openings **65**, the stems being threaded to receive suitable adjusting lock nuts **69***a*. In engagement with the lower surfaces of the enlarged portions of the plungers and seated in the bottom of the recesses **64** there are compression springs **67** which exert a pressure upward upon the plungers, which pressure may be adjusted by means of the lock nuts. The top of the plungers **66** have slots **68** of which the bottom surfaces are shaped convexly for adapting them to engage the bottom surfaces of cam bars **69** shown in Fig. 4 to be connected to the brackets **43** of the movable trusses **41**. The bars **69**, arranged to move axially in guideways **70** provided in the stationary trusses **56**, are retained at their top surfaces in the guides whereby their bottom surfaces are held in alignment with the slots **68** of the plungers **66**. Toward the left, as viewed in Fig. 4, the cam bars **69** define a cam surface which extends downward which is sufficient as the cam bars are moved to the right to depress the plungers **66** against the action of the springs **67** and cause the coupling supports to rise whereby the rollers **62** will come into contact with and support the coupling member **23** as shown in Fig. 3. At the extreme end of the coupling supporting members, openings are provided which correspond to openings in the stationary bearing trusses **56** into which individual bolt and spring assemblies **71** are inserted, having adjusting nuts therefor, by which means the ends of the coupling supporting members can be adjusted vertically relative to the couplings whereby in the operation of the mill, the rollers will not come in contact with the couplings.

With reference particularly to the universal type couplings **24** employed at the mill side, as shown in Figs. 3, 4 and 5, the couplings **24** comprise annular driven members **72** secured to the spindles and annular driving members **73** universally connected to the member **72**. The members **72** may be made as an integral part of the spindle or made separately and secured thereto by welding or otherwise. Each end of the driven member **72** is provided with axial openings **74** having spherical opposed cavities **75** through which openings **76** are formed perpendicular to the axis of the opening **74**. Each driving member **73** is provided with axial openings **77** having opposed recesses **78** for receiving replaceable wear plates **79**, held in place by bolts **81**, which engage the flat parallel surfaces of the pods **80** of the roll neck. The other ends of each of the coupling driving members **73** are formed into a rectangular projection **82**, centrally located on the longitudinal axis of the coupling member and provided with an opening **83**. This projection is adapted to be inserted into the opening **74** of the coupling member **72** in which there are positioned opposed bronze slippers **84**, having centrally arranged openings **85**, which are secured within the cavities **75** of the driven member. The slippers, as best shown in Fig. 5, are provided with a spherical raised portion **86** which fits into complementary spherical grooves provided in the coupling cavities **75**. Bushings **87** are inserted in the openings **83** of the driving members **73** and form a continuation of the raised portion of the slippers. A pin **91** is passed through each of the bushings and held in place by threaded retaining plugs **92** and **92***a*. The pin at the upper end is rounded so as to provide a bearing surface for engaging a rounded retainer pin **93** which is secured in an opening in the end of the plug **92**. Near the opposite end of the pin **91** there is a reduction in diameter to form a shoulder **94** which engages with the adjacent surface of the slippers **84** so that it is not necessary for the plug **92***a* to be in engagement with the adjacent end of the pin **91**. When it is desired to remove the pin **91** from the coupling, it is

necessary to remove both plugs **92** and **92***a* and then the pin may be struck from beneath and passed through the upper opening of the coupling. Set screws **96** are provided for regulating the amount of lubricant which is supplied to the coupling from a reservoir **97** to the coupling through suitable passageways.

As shown in Fig. 6, the couplings **25** at the motor side of the spindles are somewhat different from couplings **24** just described, in that they permit the spindle to be retracted axially without affecting the driving arrangement between the couplings and the motor shafts. The motor end of each of the spindles has a driving member **101** formed as an integral part thereof including an axial opening **103** having opposed spherically shaped surfaces **103***a* to receive slippers **104** similar to the construction of the couplings **24**. The slippers **104** are provided with spherical raised portions **104***a* which slide in spherical grooves formed in the coupling member. The axial opening **103** of the member **101** extends a substantial distance to provide a sufficient depth of opening for the center web **105** of the rigid coupling **18** to extend into when the coupling spindles are moved to the right. There is a slot **106** cut in the web **105** which extends approximately for the entire length of the web. The web or projection **105** of the motor coupling **18** engages with a pin **107** which is positioned within an opening extending through the slipper. On axial movement of the spindle, therefore, the coupling member **25** simply moves further into the slot **106** of the mill coupling **18** without affecting the driving arrangement of the two elements.

The operation of the present invention may be briefly summarized as follows: When couplings are connected to the mill rolls in driving relationship the carrier members **57** will be held out of engagement with the pivotal or female coupling members inasmuch as the lowest point of the cam bars **69** will at ths time be in engagement with the plungers **65**. Now, for example, if it is desired to remove the rolls and the housings as a unit the constant pressure is interrupted in the balance piston-cylinder assemblies **32** and **33** and the air cylinder assemblies **49** and **55** are actuated to cause the movable trusses **41** to slide over the frames **27** in a direction away from the stand and toward the motors thereby retracting the spindles sufficiently to disengage the respective couplings thereof from the ends of the rolls so that the mill stand will now be free and clear to be lifted vertically away from its foundation. During this movement the cam bars **69** are moved to the right thereby to bring their high points into engagement with the spring biased plungers **66**. The displacement of the plungers causes the coupling supporting members **57** to rise so that the rollers **62** are brought up into engagement with the free pivotal coupling member **73** thereby to support these members and maintain them axially aligned with the spindles when they are disengaged from the ends of the rolls. The rolls may then be removed from the mill or, if desired, the entire mill may be removed and replaced by another. On replacement of the rolls or entire mill, as may be desired, the piston-cylinder assemblies **49** and **55** are again actuated for advancing the spindles slowly to the left toward the roll which is in alignment with the spindle axis and since the coupling members **73** are maintained in axial alignment with the spindles by the rollers **62**, the couplings are readily slipped over the roll necks. It may be necessary, in some instances, to rotate the spindles slightly in order to line up the wear plates **79** of the coupling members and the pod surfaces of the roll neck and this is readily accomplished by slowly rotating the motors connected thereto. As the couplings are brought into their driving relationship with the rolls, the plunger **66** moves to the low point of the cam surface and the ends of the coupling supporting members **57** are tilted downward by the action of the springs **67** thereby to disengage the rollers **62** from the coupling members **73**. Constant pressure is then again applied to the cylinder assemblies **32** and **33** for balancing the weight of the frames, spindles and associated members.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. a universal coupling for use with a rolling mill and a driving spindle comprising a driven member rigidly secured to the end of the spindle and a driving member affixed to said first-mentioned coupling member and movable angularly relative thereto, said second-mentioned coupling member operatively arranged to be connected in driving relationship to the end of a rolling mill roll, a pair of parallel frames spaced on opposite sides of said spindle and extending in an axial direction relative thereto, a bearing slidably mounted upon said frames and secured to said spindle to prevent relative axial movement therebetween, means connected to said bearing for moving said spindle in an axial direction, a pair of cam bars connected to and movable with said bearing and extending in a direction parallel to the axis of said spindle and a member pivotally secured to the coupling ends of said frames, said member including a pair of cam followers operatively arranged to engage with said cam bars whereby on actuation of said means to disconnect and retract said spindle from the end of said roll said cam followers are displaced to engage said member with and support said driving member in axial alignment with respect to said driven member.

2. A universal coupling for use with a driving spindle comprising a driven member rigidly secured to the end of the spindle and a driving member affixed to said first-mentioned coupling member and movable angularly relative thereto, said second-mentioned coupling member operatively arranged to be connected in driving relationship to an element for imposing a torque thereon, a pair of parallel frames spaced on opposite sides of said spindle and extending in an axial direction relative thereto, means for supporting said frames, a truss slidably secured to said frames, a bearing mounted upon said truss and secured to said spindle to prevent relative axial movement therebetween, means connected to said truss for moving said truss and spindle in an axial direction, a pair of cam bars connected to and movable with said truss and extending in a direction parallel to the axis of said spindle, and a member pivotally secured to the coupling end of said frames having a pair of spaced rollers carried thereby, said member including a pair of cam followers operatively arranged to engage with said cam bars whereby on actuation of said means to disconnect and retract said spindle from said element said cam followers are displaced to bring the rollers of said member to engage with and support said driving member in axial alignment with respect to said driven member.

3. In combination with a universal coupling having a driving member and a driven member pivotally secured thereto and adapted to be connected to a rolling mill roll, apparatus for maintaining said members in axial alignment with respect to each other comprising a frame operatively connected to said driving member and means operatively connected to said frame adapted to raise said frame vertically thereby to engage and support said driven member in an axially aligned relationship with respect to said driving member.

4. A universal coupling comprising a driving member, a driven member pivotally connected to said driving member, means secured to said driving member adapted to move said driving and driven members in a substan-

tially axial direction, separate supporting means operatively connected to said last mentioned means which on axial movement of said members in one direction is caused to engage with and support said driven member in an axially aligned relationship with respect to said driving member and on movement of said members in the opposite axial direction is disengaged from and permits said driven member to pivot freely with respect to said driving member.

5. A universal coupling according to claim 4 in which said separate means comprise a frame adapted to embrace a substantial portion of the periphery of said driven member from beneath when in supporting relationship with respect thereto.

6. A universal coupling according to claim 4 in which said separate means comprises a frame and a pair of rotary elements connected thereto and adapted to embrace a substantial portion of the periphery of said driven member from beneath when in supporting relationship with respect thereto.

7. A universal coupling according to claim 4 in which said separate means is connected to said means for moving said driving and driven members axially and is adapted to pivot in a vertical direction, means maintaining said frame in the lower of two vertical positions and yieldable on movement of said members in the first of said axial directions thereby to permit said frame to pivot upward to the higher of two vertical positions thereby to engage with and to support said driven member in an axially aligned relationship with respect to said driving member.

8. For use with a rolling mill and a spindle, a universal coupling comprising a driving member rigidly connected to said spindle, a driven member angularly movable with respect to and connected to said driving member, means for connecting said driven member to the neck of a rolling mill roll, a frame extending axially of the spindle, a coupling supporting member pivotally mounted upon said frame, means for moving said spindle and coupling members as a unit in an axial direction and a cam intermediate said coupling supporting member and said frame and so arranged and disposed whereby on axial movement of said spindle and coupling members in one direction said coupling supporting member is engaged with one of the members of said coupling thereby to maintain said member in axial alignment with respect to the other of said members and on axial movement of said spindle and coupling members in the opposite direction said coupling supporting member is withdrawn from supporting relationship with respect to said coupling member.

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