March 2, 1971 G. V. HULTGREN ET AL 3,566,515

ROLL GRINDING MACHINE

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Fig. 1

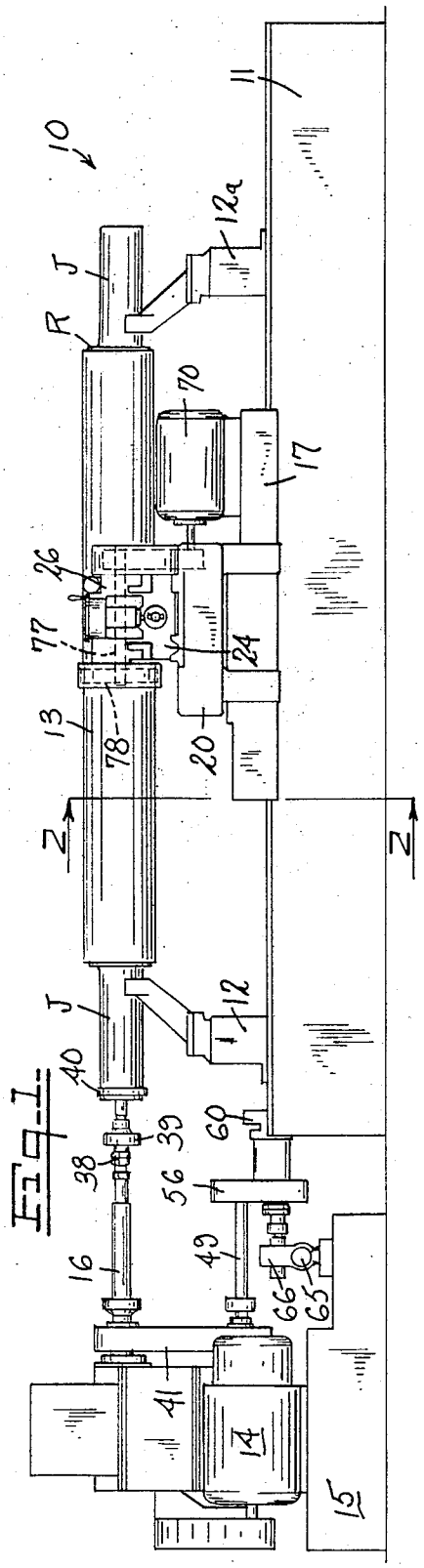

Fig. 2

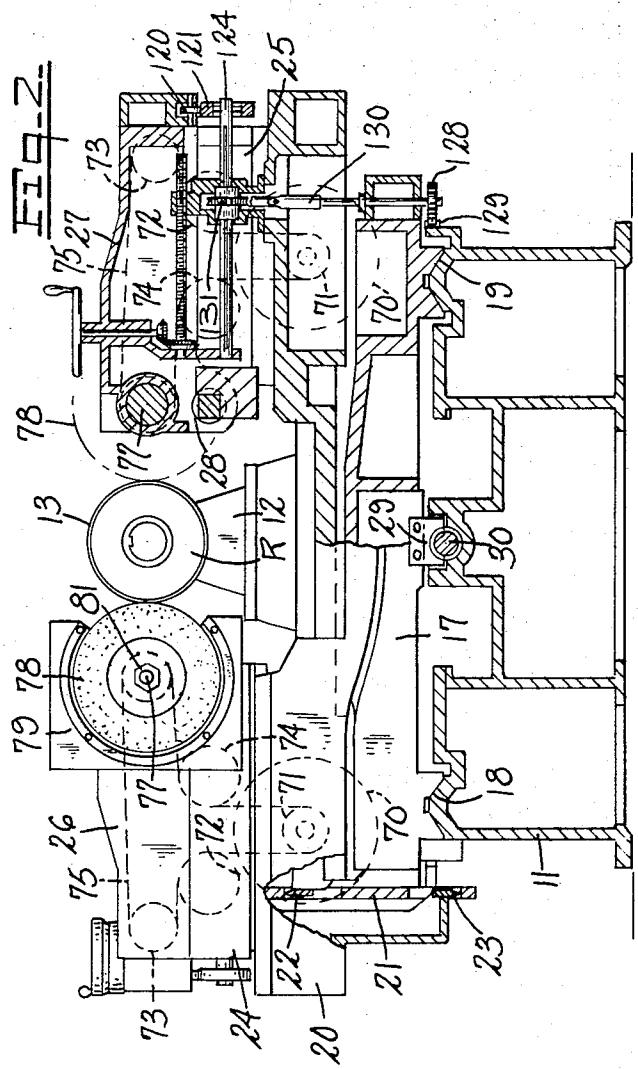

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Fig. 3

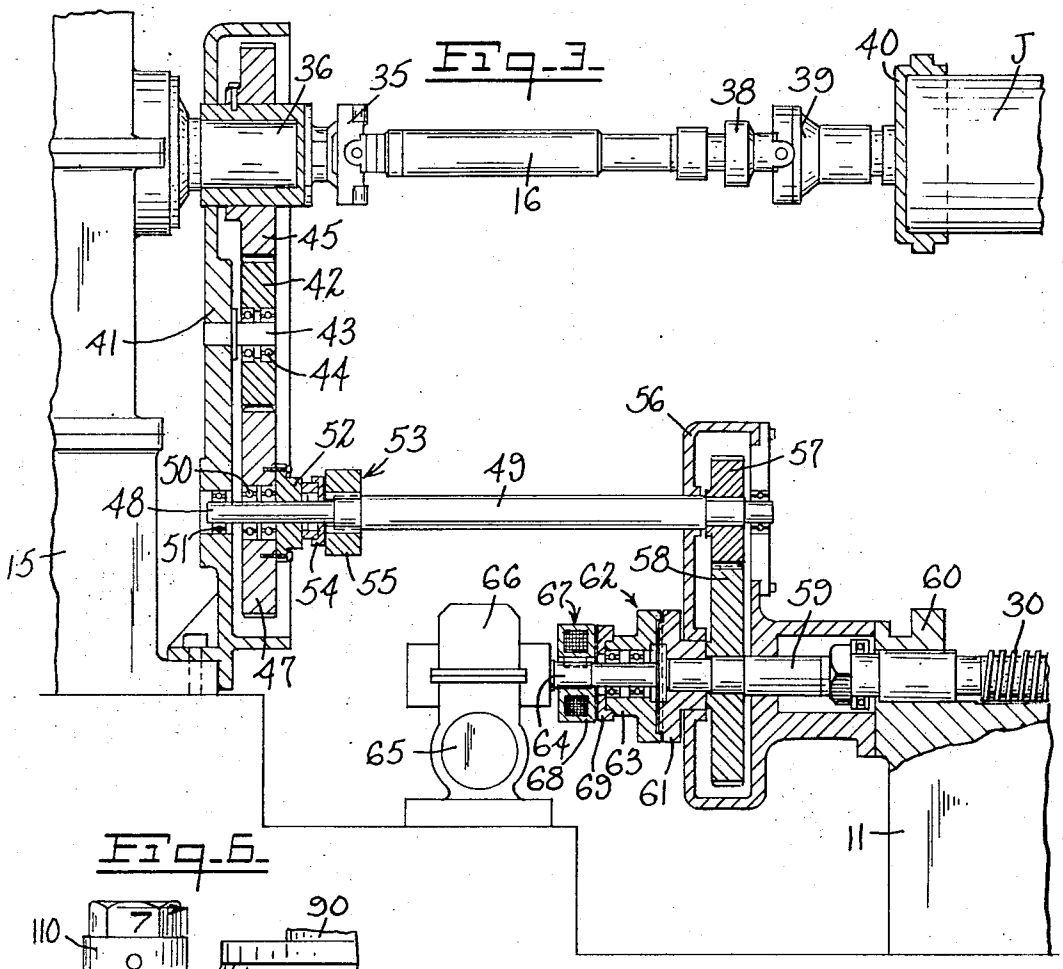

Fig. 6

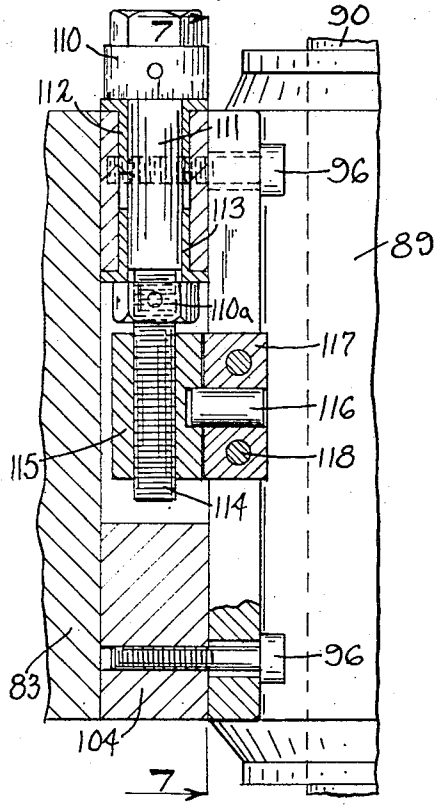

Fig. 9

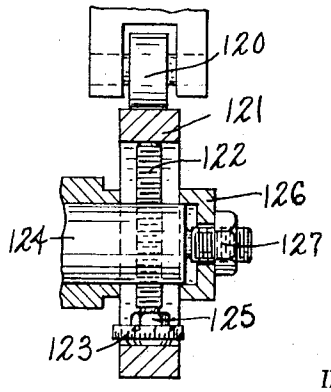

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Fig. 4

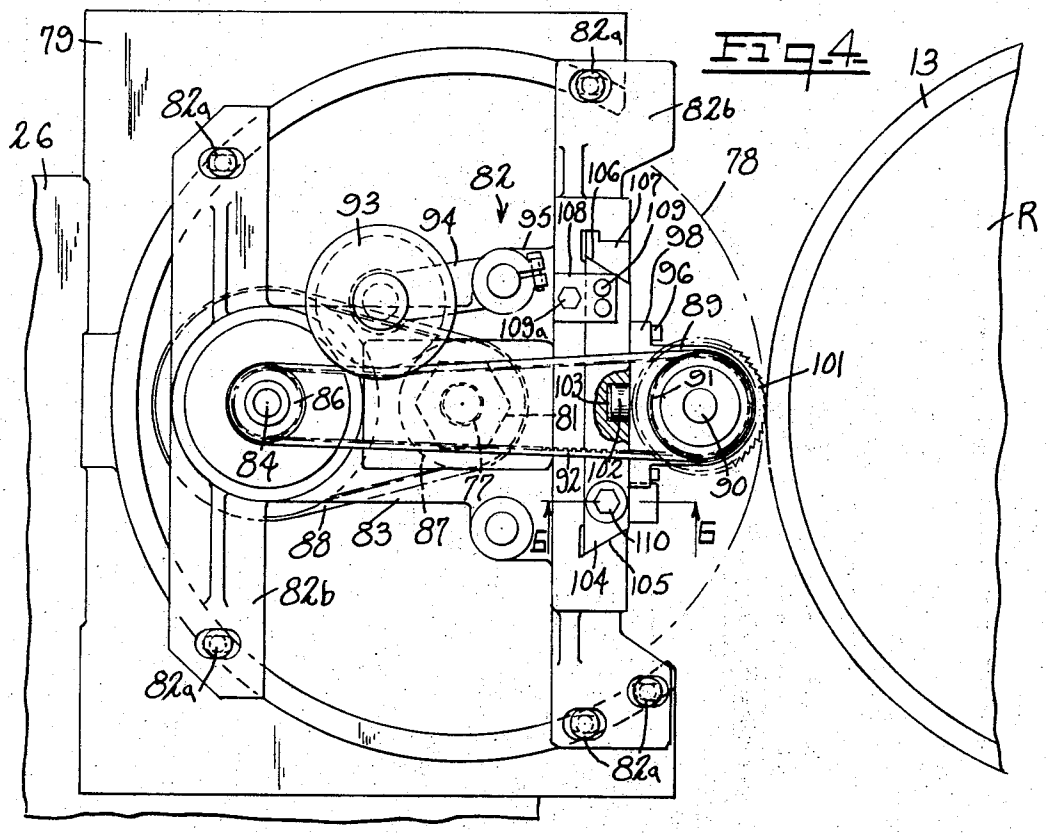

Fig. 5

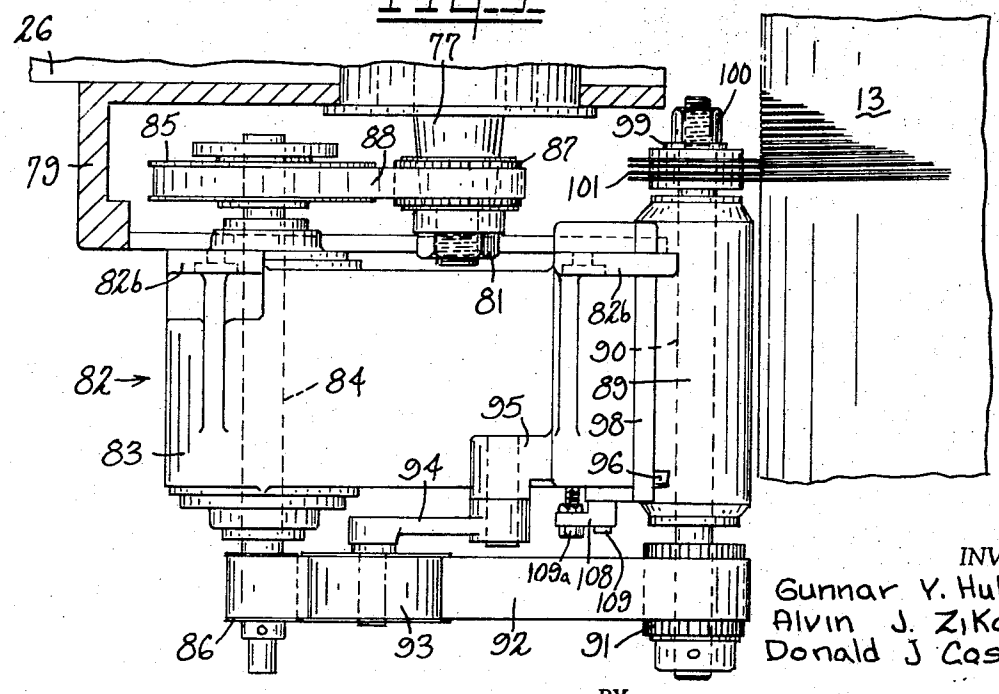

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Fig. 7

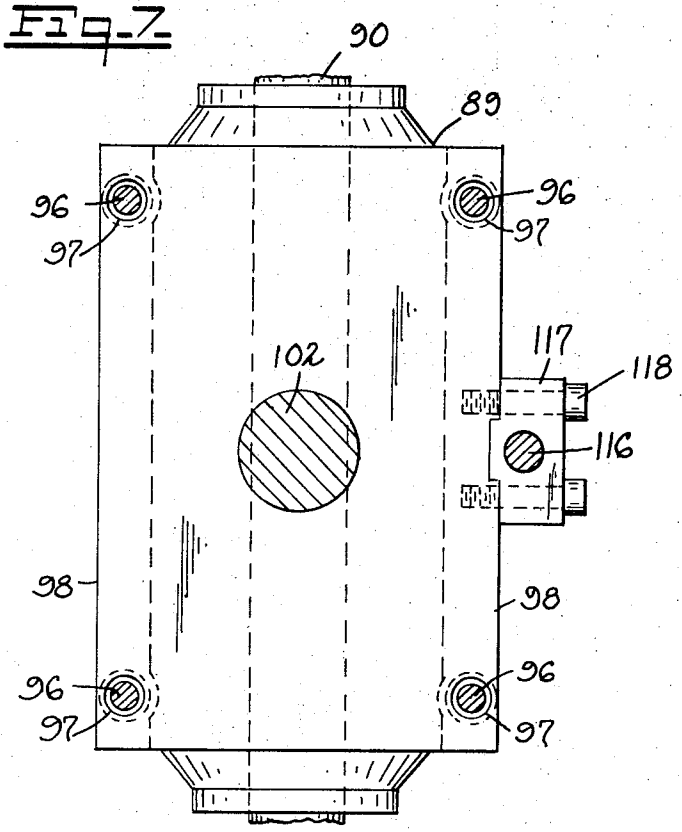
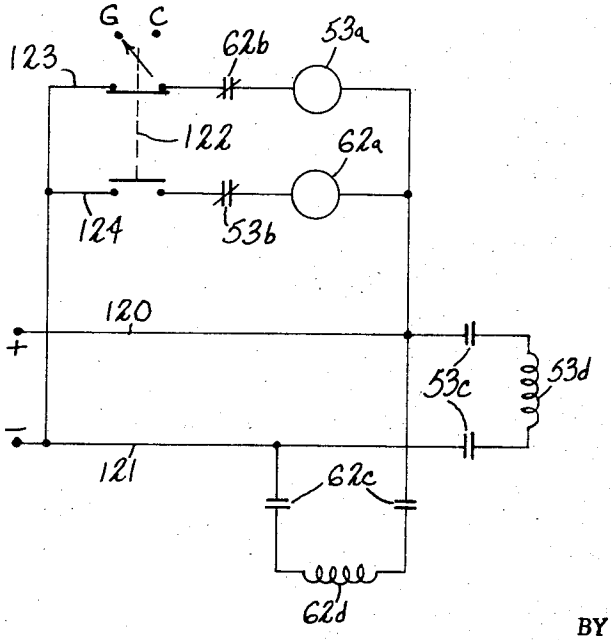


Fig. 8



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3,566,515

ROLL GRINDING MACHINE

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Int. Cl. B26d 3/06; B24b 5/06
U.S. Cl. 29—560 6 Claims

ABSTRACT OF THE DISCLOSURE

A grinding machine provided with a detachable assembly for substituting a grooving cutter for a grinding wheel and driving the cutter from the grinding wheel spindle. Drive means are also provided for synchronizing movement of the grinding wheel carriage with rotation of the roll to be grooved.

This invention relates to roll grinding machines and more particularly relates to roll grinding machines having capability for grooving rolls.

In the paper-making industry in many applications rubber covered rolls are used in de-watering of paper products. It has been found that in many cases by grooving these rubber covered rolls they are much more efficient in removing water than the use of a plain rubber covered roll with a smooth surface.

This invention provides a new and improved mechanism in a roll grinding machine to synchronize the longitudinal movement of circular cutters for grooving roll with rotation of the roll and further provides a new and improved grooving cutting apparatus which may be substituted on the wheel head for the grinding wheel with great facility. Thus, with apparatus embodying the invention the roll may be finish ground. Then the grinding wheel is removed and a grooving cutter attachment substituted therefor. The wheel head carrying the grooving cutter is then synchronized in longitudinal motion along the length of the roll with rotation of the roll itself.

An object of this invention is to provide new and improved apparatus for grooving the face of a calender roll.

Another object of this invention is to provide a new and improved grooving attachment which may be substituted for a grinding wheel.

A further object of this invention is to provide new and improved means for longitudinally moving a grooving cutter along the face of a calender roll in synchronizing with the rotation of the roll.

The features of the invention which are believed to be novel are set forth with particularity and distinctly claimed in the concluding portion of the specification. However, the invention both as to its operation and organization, together with further objects and advantages thereof, may best be appreciated by reference to the following detailed description taken in conjunction with the drawings, in which:

FIG. 1 is an elevation of a grinding machine embodying the invention;

FIG. 2 is a view seen in the plane of lines 2—2 of FIG. 1 and partially cut away in section;

FIG. 3 is an enlarged view of the drive mechanism of FIG. 1 and partially cut away to illustrate the drive mechanism;

FIG. 4 is an enlarged view of a portion of the grinding wheel head shown in FIG. 2 with the grinding wheel removed and a grooving attachment mounted to the grinding wheel head;

FIG. 5 is a plan view of the apparatus of FIG. 4;

FIG. 6 is a sectional view seen in the plane of lines 6—6 of FIG. 4;

FIG. 7 is a view seen in the plane of lines 7—7 of FIG. 6;

FIG. 8 is a schematic diagram of an electrical control circuit utilized in conjunction with the disclosed apparatus; and

FIG. 9 is a view in enlarged section of a portion of the machine shown in FIGS. 1 and 2.

The invention may be embodied in a grinding machine **10** of the type adapted to have two wheels grind a calender roll. The grinding apparatus generally comprises a bed or base **11** having neck rests **12** and **12***a* movable along the leng'h thereof on ways provided therefor (not shown). The neck rests **12** and **12***a* are arranged to support a calender roll thereon which may be of the type having a rubber coating or layer **13** thereon. The roll is rotatably driven through a headstock motor **14** and suitable gearing which is mounted upon a base **15**. The drive means further includes a drive shaft **16** connected to one end of roll R.

A carriage **17** moves along the length of bed **11** on ways **18** and **19**. The machine illustrated is of the swing rest type wherein a swing rest **20** is supported on carriage **17** by means of links **21** connected to the upper part of carriage **17** at **22** and the lower portion of swing rest at **23**. This swing rest arrangement reduces to a minimum small inaccuracies which may be imparted to the roll from a variety of causes, such as uneven settling of the machine foundation, warpage of the bed due to seasoning, distortions in the machine caused by changes in temperatures, etc.

Carried on swing rest **21** on opposite sides of a roll mounted to neck rests **12** and **12***a* are sub-carriages **24** and **25**, each movable toward and away from a roll R on ways (not shown). A typical way construction for movement of the sub-carriage toward and away from the axis of rotation of a roll is shown in U.S. Pat. Re. 25,794. Wheel heads **26** and **27** are mounted to each of sub-bases **24** and **25** and are pivotal thereon as shown at **28** to permit tilting infeed and outfeed of the grinding wheel heads.

The carriage **17** carries thereon a traveling nut **29** which threadably receives traverse screw **30** supported on base **11**. Upon rotation of lead or traverse screw **30**, nut **29** moves along the length thereof carrying carriage **17** therewith.

Reference is now made to FIG. 3. The roll driving assembly includes a yoke **35** which connects the spindle **36** of the headstock to driving shaft **16**. Driving shaft **16** is in turn connected through a yoke **38** to a yoke adaptor **39** which in turn includes a dog **40** adapted to receive the end of a journal of roll R and rotate roll R on journal rests **12** and **12***a*. Mounted to the headstock structure is a support member in the form of a gear case **41** which rotatably supports an idler spur gear **42** on a shaft **43** by means of bearing assemblies **44**. Spur gear **42** is driven by a drive gear **45** mounted to spindle **36**. Idler gear **42** further engages a driven gear **47** rotatably mounted to the end portion **48** of a shaft **49** by means of bearing assemblies **50**. Shaft **49** is further rotatably supported in case **41** by bearing assemblies **51**. Gear **47** carries thereon a clutch adaptor **52** to which is mounted a clutch **53** positioned about shaft **48**. Clutch **53** is of the electrically actuated type. When the drive **54** and drive **55** elements are engaged gear **47** is non-rotatable with respect to shaft **49**, and will drive shaft **49**. If clutch elements **54** and **55** are not engaged gear **47** will merely rotate about shaft **49** on bearing assemblies **50**.

The other end of shaft **49** is rotatably mounted in a gear case **56** and carries thereon a gear **57**. Gear **57** engages a gear **58** on the end of shaft **59** which includes traverse screw **30**. Shaft **59** is supported on bed **11** as shown at **60**. Shaft **59** is connected at the end thereof

to the driven element **61** of a coupling member **62**. The driving element **63** of coupling **62** is rotatably mounted to shaft **64** driven by a motor **65** through a gear box **66**. A clutch **67** having a driving member **68** on shaft **64** is electrically actuated to engage a driven member **69** connected to coupling member **63**.

At this point it may be noted that if clutch **53** is engaged and clutch **67** disengaged, shaft **49** drives shaft **59** and traverse screw **30** through gears **57** and **58**. When clutch **53** is disengaged and clutch **67** engaged, shaft **59** and traverse screw **30** will be driven from motor **65** and gear box **66**. In this manner, the movement of the carriage **17** along ways **18** and **19** may be synchronized with the speed of rotation of roll R.

Reference is again made to FIGS. 1 and 2. Each grinding wheel **78** is normally driven by a motor **70**. Each motor **70** has a pulley **71** on the shaft thereof and idler pulleys **72**, **73** and **74** define a path for a drive belt **75**. The belt **75** passes about a pulley **76** at one end of the grinding wheel spindle **77** and the grinding wheel **78** is mounted to the other end of the spindle.

Each grinding wheel is received within a housing **79** which is shown in FIG. 2 with its cover removed. The grinding wheel end of spindles **77** are tapered (FIG. 5) to receive the grinding wheel thereon. When it is desired to arrange the grinding machine for grooving the wheel guard cover (not shown) is removed from the grinding wheel housing **79** and then nut **81** is removed from the threaded end of the spindle and the grinding wheel removed.

At this time, a cutter head assembly **82** (FIGS. 4 and 5) is mounted to grinding wheel head **26** and is adapted to be driven through spindle **77**. Cutter head assembly **82** comprises a housing member **83** which rotatably mounts therein a shaft **84**. Mounted to shaft **84** are pulleys **85** and **86**. Assembly **82** is mounted directly to grinding wheel guard or housing **79** as by means of a plurality of bolts **82***a* which are received through mounting arms or flanges **82***b* extending from housing in the existing bolt holes for the removed cover plate.

When this change in the mode of operation is to occur, a spindle pulley **87** is placed on the tapered end of spindle **77** and pulleys **85** and **87** are connected by an endless timing belt **88**. When motor **70** drives spindle **77**, pulley **85** drives shaft **84** and in turn pulley **86**. Mounted to housing **83** and included within assembly **82** is a housing **89** for a cutter spindle **90**. Spindle **90** receives on the end thereof a timing pulley **91** which is connected to timing pulley **86** by means of an endless timing belt **92**. The back side of belt **92** passes beneath a tension-adjusting pulley **93** carried on an adjustable arm **94** extending from a bracket **95** adjustably mounted to housing **83**. Spindle housing **89** is secured to housing **83** by a plurality of bolts **96** received in oversized passages **97** in the flanges **98** on housing **89**.

The cutter head is mounted to spindle **90** as by means of a collar **99** and nut **100** threadably received on the end of spindle **90**. The cutter head may carry a plurality of cutters **101** adapted to groove the surface of roll R.

In operation, when spindle **77** is driven, pulley **85** drives shaft **84** which in turn drives pulley **86**, timing belt **88** and timing pulley **91**. The cutters are then rotated and will cut into the surface or rubber coating on roll R as carriage **17** moves along the length of bed **11**. By virtue of the couplings previously described, the carriage moves at a speed synchronized with rotation of the roll so that the grooves defined in the surface of the roll have a predetermined pitch.

Spindle housing **89** has an annular projection **102** thereon which is received in a mating socket **103** defined in an adjusting block **104** having upper and lower inclined surfaces **105** and **106** defining a longitudinal slot in housing member **83**. This longitudinally extending slot provides a mounting means for housing **89**. Adjusting block **104** is received in housing **83** as shown more clearly in FIG. 4 and is rigidly locked therein by means of a longitudinally extending gib **107** engaging surface **106** which comprises a mounting member for housing **89**. Adjusting block **104** which comprises a mounting member for housing member **89** is longitudinally positioned with respect to housing **83** by means of a bolt **109***a* carried in bracket **108**. Bracket **108** is carried on block **104** by means of bolts **109**. Block **104** is so positionable to allow the introduction of the grooving cutters at the proper lead position into a previously grooved roll.

Spindle housing **89** together with spindle **90** therein is adapted to have limited rotational movement about the axis of projection **102** in socket **103**. Such rotational motion is provided as a means for inclining the angle of the cutter blades **101** to give a predetermined degree of lead to the spiral grooves defined on a roll R. To provide a predetermined degree of tilt, the bolts **96** are loosened in their oversized apertures. The spindle head may now be tilted to a calibrated position by means of an assembly shown in FIGS. 6 and 7. An adjusting screw or bolt **110** having a cylindrical shank portion **111** is received in flanged bearings **112** disposed within a bushing **113** in a bore in adjusting block **104**. The flanged bearings are retained in position between the head of bolt **110** and a nut **110***a* threadably received on threaded portion **114** of adjusting bolt **110**. The threaded portion **114** is further received in an adjusting nut **115** which is connected as by means of a pin **116** to a block **117** secured to the underside of spindle head **89** as by means of bolts **118**.

When adjusting bolt **110** rotated, it will produce longitudinal motion in adjusting nut **115** inasmuch as nut **115** cannot rotate because of the pin connection to block **117**. Such longitudinal motion of nut **115** produces similar longitudinal motion of block **117** which results in a torque on spindle head **89** about the center of projection **102**. The head of nut **110** may be calibrated as shown in FIG. 6 in degrees or fractions thereof to permit the operator to set the desired pitch of the spindle head **89** and hence the cutter blades **101**.

It may thus be seen that the cutter head assembly may be mounted to the grinding machine in place of a grinding wheel with great facility and driven directly from the grinding wheel spindle. Moreover, the spindle itself may be adjusted longitudinally with respect to the cutter head assembly as by means of bolt **109***a*, and may be pitched by means of the pitch or helix adjusting mechanism of FIG. 6.

The engagement of clutches **53** and **62** are controlled by their coils **53***d* and **62***d*, respectively, which may be selectively energized through lines **120** and **121** (FIG. 8) and commutator and brush assemblies (not shown). The energization of the clutches is controlled by relays **53***a* and **62***a* which are also connected across lines **120** and **121**. When switch **122** is in a first position indicated at G, relay **53***a* in line **123** is energized. When relay **53***a* is energized it drops out its contact **53***b* in line **124** to prevent energization of clutch **67** and picks up its contact **53***c* in lines **120** and **121** to energize coil **53***d*. When this occurs, clutch **53** is engaged and shaft **49** is driven from spindle **36** and, in turn, through gears **57** and **58** drives shaft **59**. At this time the traverse of the grinding wheel carriage **17** along bed **11** is synchronized with the rotation of drive shaft **16** and, hence, roll R.

When the machine is to be operated solely in the grinding mode the switch **122** is thrown to the terminal or position marked C. This will open line **123** and close line **124**. At this time relay **62***a* is energized, it drops out its contact **62***b* in line **123** and picks up its contact **62***c* to energize coil **62***d*. Clutch **62** is engaged and shaft **59** with traverse screw **30** thereon is driven directly from motor **65** and gear box **66**. During this operation, clutch **53** is not engaged and shaft **49**, which is back driven through gear **57** merely rotates with respect to gear **47** in bearing assembly **51**.

The apparatus may also include mechanism for impart-

ing curvilinear motion to the grinding wheel heads **26** and **27** as they travel along the length of a roll. As previously pointed out, each grinding wheel head is pivotally mounted to its carriage at **28**. The rear end of wheel heads **26** and **27** are supported through a cam follower **120** on an eccentrically adjustable crowning cam **121**. Cam **121** has rotatably secured therein substantially diametrically thereacross a lead screw **122**. Screw **122** carries a collar **123** having dimensional graduations thereon, and is threadably received through shaft **124**. One end **125** of screw **122** is hexagonally formed to allow it to be rotated by a wrench or similar device. Cam **121** is retained in place by a clamping disc **126** and nut **127**. Upon rotation of screw **122** the center of cam **121** is displaced with respect to the axis of shaft **124**. Accordingly, cam **121** is made eccentric with respect to shaft **124**

Reference is now made to FIGS. 1 and 2. Shaft **124** is rotated with movement of carriage **17** along the bed of the machine by reason of the connection of a pinion **128** to a rack **129** on bed **11**. The pinion **128** is affixed to a shaft **130** which carries thereon a worm (not shown) in engagement with a worm gear **131** on shaft **124**. With this arrangement, when shaft **124** is coaxial with cam **121** rotation of shaft **124** will impart no vertical movement to cam follower **120**. However, when cam **121** is positioned to be eccentric with respect to shaft **124** movement of the carriage along the bed will impart vertical movement to cam follower **120** and, hence, provide provision for grinding a crown on the roll.

It will be apparent that this control will be utilized with the grooving assembly when a roll to be grooved has previously been provided with a crown.

It may thus be seen that the objects of the invention set forth above as well as those made apparent from the foregoing description are efficiently attained. Other embodiments of the invention and modifications to the disclosed embodiment thereof which do not depart from the spirit and scope of the invention may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all modifications and embodiments of the invention which do not depart from the spirit and scope thereof.

What is claimed is:

1. For use in combination with a roll grinding machine having means for rotatably supporting a roll, first drive means for rotating the roll, a base, a carriage including a grinding wheel head movable along said base, second drive means for moving said carriage, said wheel head having a power operated spindle normally adapted to receive a grinding wheel thereon: a groove cutting assembly comprising a first housing member rotatably mounting a shaft therein, at least one grooving cutter thereon, a

second housing member mountable to said wheel head, said second housing having power transmission means for connecting said shaft to the spindle, said second housing member having mounting means adapated to movably mount said first housing member so as to allow selection of the longitudinal position of said at least one grooving cutter along a roll on the grinding machine.

2. The assembly of claim **1** wherein a slot is defined in said second housing member longitudinally with respect to a roll on said machine and slidably receives therein a block carried by said first housing member.

3. The assembly of claim **1** wherein said first housing and second housing are constructed and arranged to permit limited pivotal movement of said first housing with respect to said second housing.

4. The assembly of claim **1** further defined in that said first housing includes a mounting member received in said mounting means of said second housing, said mounting member having a cylindrical socket defined therein, said first housing having a cylindrical projection received in said socket, a plurality of clamping bolts passing through enlarged bores in said first housing member and received in said mounting member, and cooperating means on said mounting member and said first housing member for imparting pivotal motion to said first housing member with respect to said mounting member.

5. The assembly of claim **3** wherein said cooperating means comprises a screw on said mounting member and a nonrotatable nut on said first housing member receiving said screw.

6. The combination of claim **1** further including means for disabling said carriage drive means and connecting said roll drive means to move said carriage in timed relation to rotation of the roll.

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