EMBOSSING MACHINE DRIVE

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Application April 4, 1949, Serial No. 85,453

11 Claims. (Cl. 74—392)

This invention relates to a synchronizing drive for a machine wherein two rotatively driven parts, adjustable toward each other, must be maintained in very accurate angular synchronism. More particularly, the invention relates to a drive of the above indicated character for the rolls of an embossing machine for paper, cloth, and the like.

In machines for embossing paper, cloth, and the like, of the type in which the drive of the present invention is particularly useful, there is employed a hardened steel roll provided on its periphery with the desired pattern in relief, such steel roll lying above and parallel to a bottom roll, the bottom roll being constantly strongly urged into contact with the upper roll. Such bottom roll is conventionally formed by pressing together a large number of paper discs, the paper roll being quite hard but yet sufficiently soft so that the upper, steel roll impresses therein a pattern corresponding to the pattern on such upper roll. Continued rotation on the two rolls with an interposed layer of thin material such as paper and cloth during the embossing operation results in wear of an appreciable amount on the paper roll, use of such roll being continued until the roll reaches a predetermined minimum diameter, after which it is discarded.

In embossing machines of the described type it has been attempted to maintain the two rolls in synchronism by means of meshing gears one of which is mounted fixedly on the neck of one roll and the other of which is mounted fixedly on the corresponding neck of the other. It will be appreciated, however, that, as the bottom roll wears in such machine, the meshing engagement of the two gears changes progressively. Thus, although the two gears continue to maintain approximately angular synchronism between the two rolls, such change of meshing engagement of the gears introduces numerous variations in the peripheral engagement of the two rolls. In addition, the change in diameter of the lower roll is sometimes so great that one or both gears has to be ground down on their peripheries in order that the points of their teeth do not engage the roots of the teeth of the other gear.

Thus the described prior synchronizing gears of embossing machines of this type have been faulty because of the progressive change of the mesh of the gears and, as a result, accelerated wear of such gears results. Furthermore, maintenance costs are high due to the necessity of altering the gears as the paper roll wears. Such continual variation in the mesh between the gears results in momentary angular accelerations and decelerations of one roll with respect to the other, thereby causing faulty peripheral synchronism of the rolls, the machine, as a result, yielding a goods treated thereby which have a non-uniform pattern. Such non-uniformity of peripheral synchronism further accelerates the wearing down of the paper roll.

In the embossing machine drive of the present invention the gears maintaining synchronism between the rolls of the machine are so mounted as to retain a constant meshing relationship regardless of the change in diameter of one or more of the rolls. Broadly, the drive of the invention provides a flexible driving means between the rolls, the preferred primary driving means maintaining synchronism between the two rolls being gears which are fixedly mounted with respect to each other during operation of the machine, so that the manner of mesh of the gears remains constant. As a result such primary driving gears remain unaltered during the wearing down of any particular paper roll, and may be continued to be used when a new, larger, diameter paper roll is substituted for the old paper roll. Such gears need, therefore, seldom to be replaced and an embossing machine embodying such drive requires much less maintenance. Also, a more uniformly embossed product results from use of the machine, and the paper roll in the machine, because of the markedly increased accuracy of peripheral synchronism, is worn down at a much slower rate than formerly.

It is, accordingly, an object of the invention to provide an improved drive for elements such as the cooperating rolls of an embossing machine wherein the maintenance of the synchronizing gears is minimized, a more uniform synchronized drive is produced, and a more perfect, more uniform product is obtained.

The invention has as a further object the provision of a compact, efficient, easily constructed and maintained drive for machines of the above type.

These and further objects of the invention will be more readily apparent in the following description of preferred embodiments thereof shown in the accompanying drawings, in which Fig. 1 is a view in perspective from the front of an embossing machine of the described type embodying the synchronizing drive of the invention;

Fig. 2 is a view of the machine in side elevation, the view being taken in a direction from right to left in Fig. 1;
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Fig. 3 is a view partially in elevation and partially in longitudinal vertical section through the machine of the invention, portions of the machine in the longitudinal center being omitted; Fig. 4 is an enlarged view partially in elevation and partially in vertical section through the flexible synchronizing driving means between rolls of the machine; and Fig. 5 is a view in front elevation of a portion of an alternative construction of the synchronizing driving means of the invention.

As above mentioned, Figs. 1, 2, 3, and 4 show a first embodiment of the synchronizing drive of the invention, and Fig. 5 shows a second embodiment thereof. In Fig. 1 the embossing machine is shown comprising two spaced vertically extending side frame members 2 and 4, such side frame members being connected together by means of the bottom cross-rods 6 and the top cross-rod 8. Each side frame member is provided with a vertically extending guideway, that on member 2 being shown at 10, and that on frame member 4 being designated 12. Supported between the side frame members in vertically aligned parallel relationship are the top steel embossing roll 14 and the bottom paper embossing roll 16. Roll 14 is mounted for rotation by means of the bearing chocks 18 and 20 slidingly mounted and retained on guideways 10 and 12, respectively. Roll 16 is rotatably mounted in the beat in chocks 22 and 24 which are elastically mounted and retained upon guideways 10 and 12, respectively. Cooperating with the seat 30 on chock 18 is a vertical screw 25 which is threadedly engaged in an overhanging portion of frame member 2. A similar screw 26 is provided in frame member 4 for cooperation with seat 32 on chock 20.

Screws 25 and 26 are initially adjusted, upon installation of a new roll 10, to bring the roll 14 into the desired horizontal alignment. During regular operation of the embossing machine, screws 25 and 26 are not normally adjusted. Roll 16 is thrust upwardly into contact with roll 14 by means of the plungers 34 and 36 which engage abutments 38 and 40 on chock members 22 and 24, respectively. Plungers 34 and 36 are urged upwardly with the desired predetermined force by means of conventional weighted lever systems, the resulting weights of the upwardly urged plungers 34 through levers (not shown) being shown at 42 and those acting upon plunger 36 through similar levers being shown at 44.

As shown in Figs. 2 and 3 the embossing machine is driven by means of the electric motor 46 which drives through belt 48 into the adjustable speed changing mechanism 50. The drive proceeds from speed change box 50 to delivery sprocket 51 thereon through the chain 52 to the sprocket 55 affixed to the right-hand end of countershaft 54, as shown in Fig. 3. Countershaft 54 runs horizontally along the back of the machine and carries upon its left-hand end, as shown in Fig. 1, a sprocket 56. From sprocket 56 there runs a chain 58 which is entrained over sprocket 59 on the left-hand roll neck of roll 14.

The synchronizing driving mechanism between the two rolls 14 and 16 is shown at the right end of Fig. 2. As there shown, a pinion gear 62 is fixedly keyed upon the right-hand end of the roll neck 64 of roll 14. A vertically disposed side plate 66 is mounted upon the outer side of frame member 4, being spaced therefrom by spacer sleeves of which one is shown at 68 and being retained thereon by means of the lower front stud 70 and the two rear studs 72 and 74, as shown in Fig. 2.

Secured to plate 66 is the horizontal laterally extending support member 76. Member 76 carries at its outer end a vertically extending support 78 which has a bearing 80 disposed in its upper end. Plate 66 has a circular opening 83 therein which is generally coaxial with the roll neck 82 of the roll 16, as shown more clearly in Fig. 4. Opening 83, which is of a diameter substantially exceeding the outer end 85 of the roll neck 82, has a shallowly curved interior edge of the flange portion of the outwardly projecting sleeve member 84. Member 84 is fixedly retained in position on plate 66 by means of the studs 88. A ring gear 90 having within it the bearing bushing 82 is rotatably supported on the outer cylindrical surface of sleeve 84, as shown. Gear 80 is permanently in mesh with gear 82 on the neck of roll 14, the axes of such two gears remaining fixed with relation to each other during regular operation of the embossing machine.

Affixed to the outer surface of gear 80 is the elongated hollow shaft or housing 94. One of the side members of the embossing machine 92 and 94 together is shown at 96. A stepped stub shaft 98 supports the outer end of member 94 upon the standard 76. As shown, the smaller portion of the stub shaft is rotatably supported in bearings 80, the larger portion of such a stub shaft being keyed in the end boss 100 in housing 94.

Stub shaft 98 terminates inwardly with the flange 102, which is positioned within the outer end portion of housing 94. Flange 102 constitutes an end portion of the flexible coupling which is generally designated 103. The coupling shown is of the type known as the "Oezyman sphere gear coupling" which allows a misalignment between the coupling parts of as much as 2° while maintaining zero backlash between such parts. A coupling of the type described is also designated the "Barcus aligning shaft coupling," such coupling being made by the Barcus Engineering Company, Baltimore, Maryland.

The outer portion of coupling 103 is completed by the cylindrical housing 104 which is secured to flange 102 by means of angularly spaced studs 106. Member 104 carries within it the straight, angularly spaced, radially directed gear teeth 108 with weights 109 which are outwardly directed gear teeth 112 on the inner coupling part 110. Part 110 is provided with a central bore 114 within which is keyed the outer end of the shaft 116. Shaft 116, which is disposed coaxially with the housing 94 and with gear 80, is connected at its inner end to another flexible coupling 118 which is similar to coupling 113. The inner end of shaft 116 is keyed within the bore 122 in the inner coupling part 120. Part 120 carries on a projecting flange the outwardly directed rounded gear teeth 124 which fit within the inwardly directed straight gear teeth 126 on the outer coupling part 128. Part 128 of coupling 118 is keyed, as shown, to the outer projecting end 130 of the roll neck 82 of roll 16.

The manner of operation of the synchronizing drive above described will be clearly apparent. In such unit shown, a pinion gear 62 is fixedly keyed upon the right-hand end of the roll neck 64 of roll 14. Roll 14, in turn, drives gear 62 which is permanently in mesh with gear 99, gear 90 rotating on a fixed axis. Roll 16 is, of course, mounted for vertical movement, in response to thrust from the lever system, which is independent of the gear 90. Thus the mesh of the two gears 92 and 99 remains constant during operation of the ma-
The drive proceeds from gear \( 90 \) through the hollow shaft or housing \( 94 \) back through the flexible drive system composed of the flexible coupling \( 16 \), the shaft \( 16 \), and the second flexible coupling \( 18 \), to the neck of the roll \( 16 \).

Because of the accurate and fixed meshing relationship between the gears \( 62 \) and \( 90 \), and because of the type of flexible coupling preferably employed, in which the backlash is at least substantially zero, the drive maintains at all times an integral operation of the hollow shaft or housing \( 14 \) and \( 16 \), such synchronism being maintained both overall and also incrementally, that is, at any given instant. In addition to such angular synchronism, the drive of the invention maintains substantial peripheral synchronism between the rolls, excepting, of course, the effect introduced because of the constantly diminishing diameter of roll \( 16 \). The drive of the invention, however, introduces no additional variable factors to such constantly diminishing diameter of roll \( 16 \), and thus variation in peripheral synchronism between the teeth occurs only gradually. Thus the product treated by an embossing machine embodying the drive of the invention is distinguished by its substantial and continued uniformity.

In the alternative embodiment of the synchronizing drive of the invention, shown in Fig. 5, the main parts thereof are the same as those shown in Figures 1 to 4, inclusive, and are thus similarly designated. In the construction shown in Fig. 5 the drive from the prime mover through the change speed mechanism is effected directly from the hollow shaft or housing \( 94 \), consequently, countershaft \( 54 \) and the sprockets thereon, as well as the sprocket \( 60 \) at the left-hand end of roll \( 14 \), as shown in Fig. 3, are omitted.

In their stead there is provided a sprocket \( 132 \) which embraces and is keyed to the housing \( 94 \). The driving chain from the output end of the change speed mechanism \( 58 \), designated \( 134 \) in Fig. 5, is entrained directly over the delivery sprocket \( 51 \) of means \( 50 \) and over the sprocket \( 132 \) on housing \( 94 \). The construction shown in Fig. 5 has the advantage because of its simplicity, and thus because of the added ease of its maintenance. In addition it eliminates the necessity for several parts and, consequently, reduces the cost of the synchronizing drive.

Whereas for purposes of illustration I have shown and described two preferred embodiments of the drive for embossing machines of my invention, it is to be understood that such embodiments are illustrative only and that the invention is capable of considerable variations as to its details of construction and also as to its manner of application. The invention is, therefore, to be defined by the scope of the claims appended hereto.

I claim as new the following:

1. In a machine including two rotary driven members mounted on axes parallel and adjacent to each other, means for mounting the first member with its axis is fixed position during operation of the machine, means for mounting the second one of the members so that its axis may move toward the axis of the first member, the improved means to drive such two rotary members in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the first one of said rotary driven members, a second gear mounted on a fixed axis generally coaxial with the second driven member and permanently meshing with the first gear, a first, hollow, shaft connected to and rotatable with the second gear, said hollow shaft lying generally coaxial with the second rotary driven member and extending away from said second rotary driven member to a point substantially removed from the second gear and further removed from said second rotary driven member, a second shaft lying within the hollow shaft and connected thereto substantially at said point spaced from the second gear and to the second rotary driven member and rotatable with the hollow shaft, the two shafts rotating at the same speed as the second gear, said train incorporating serially thereof a flexible driving connection, and means for rotatably driving the connected system consisting of the two rotary driven members, the first and second gears, and the first and second shafts.

2. In an embossing machine including two rolls mounted on axes parallel to each other, means for mounting the first roll with its axis in a fixed position during operation of the machine, means for mounting the second roll so that its axis may move toward the axis of the first roll, the improved means to drive such two rolls in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the first roll, a second gear mounted on a fixed axis and permanently meshing with the first gear, a first driving means connected to and rotatable with the second gear, said first driving means extending away from said second roll to a point substantially removed from the second gear and further removed from said second roll, a second driving means connected to the first driving means substantially at said point spaced from the second gear and to the second roll and rotatable with the first driving means, the train consisting of the first and second driving means rotating at the same speed as the second gear, said train incorporating serially thereof a flexible driving connection, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, and the first and second driving means.

3. In an embossing machine including two rolls mounted on axes parallel to each other, means for mounting the first roll with its axis in a fixed position during operation of the machine, means for mounting the second roll so that its axis may move toward the axis of the first roll, the improved means to drive such two rolls in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the first roll, a second gear mounted on a fixed axis and permanently meshing with the first gear, a first driving means connected to and rotatable with the second gear, said first driving means extending away from said second roll, a second driving means extending away from said second roll to a point substantially removed from the second gear and further removed from said second roll, a second driving means connected to and rotatable with the second gear, said train incorporating serially thereof a flexible driving connection, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, and the first and second driving means.
4. In an embossing machine including two rolls mounted on axes parallel to each other, means for mounting the first roll with its axis in fixed position during operation of the machine, means for mounting the second roll so that its axis may move toward the axis of the first roll, the improved means for driving the two rolls in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the first roll, a second gear mounted on a fixed axis generally coaxial with the second roll and permanently meshing with the first gear, a first, hollow shaft connected to and rotatable with the second gear, said hollow shaft lying generally coaxial with the second roll and extending away from said second roll to a point substantially removed from the second gear and further removed from said second roll, a second shaft lying within the hollow shaft and connected thereto substantially at said point spaced from the second gear and to the second roll and rotatable with the hollow shaft, the train consisting of the hollow shaft and the second shaft rotating at the same speed as the second gear, said train incorporating serially thereof, a flexible driving connection, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, and the first and second shafts.

5. In an embossing machine including two rolls mounted on axes parallel to each other, a frame for mounting the first roll with its axis in fixed position during operation of the machine, means for mounting the second roll in such frame so that its axis may move toward the axis of the first roll, the improved means to drive such two rolls in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the neck of the first roll, a second gear permanently meshing with the first gear, means on the frame for mounting the second gear on a fixed axis generally coaxial with the second roll, an elongated housing member connected to the outer end thereof to the aforementioned neck of the second roll, said driving shaft including a flexible coupling connected serially thereof, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, the housing and the driving shaft.

6. In an embossing machine including two rolls mounted on axes parallel to each other, a frame for mounting the first roll with its axis in fixed position during operation of the machine, means for mounting the second roll in such frame so that its axis may move toward the axis of the first roll, the improved means to drive such two rolls in opposite directions in synchronism with each other comprising a first gear fixedly connected to and rotatable with the neck of the first roll at a position outside the frame, a second gear permanently meshing with the first gear, means on the frame for mounting the second gear outside the frame on a fixed axis generally coaxial with the second roll, the second roll having a neck extending freely through the second gear, an elongated housing member connected to the outer end thereof to the aforementioned neck of the second roll, said driving shaft including a flexible coupling connected serially thereof, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, the housing and the driving shaft.
face of the second gear coaxially therewith and extending away from said second roll to a point substantially removed from said second gear and further removed from said second roll, an outboard bearing connected to the frame of the machine rotatably supporting the outer end of the housing, a driving connection lying within the housing from the outer end thereof to the neck of the second roll at the first frame member, said driving connection comprising a first flexible coupling connected to the housing substantially at the outer end of the latter, a shaft connected at its outer end to the inner end of the first coupling, a second flexible coupling connected to the inner end of the shaft, the inner end of the second coupling being fixedly connected to the aforesaid neck of the second roll, and means for rotatably driving the connected system consisting of the two rolls, the first and second gears, and the driving means connecting the second gear to the second roll.

9. In the combination set out in claim 8, the flexible couplings being of the backlash free gear type.

10. In an embossing machine including two rolls mounted on axes parallel to each other, means for mounting the first roll with its axis in fixed position during operation of the machine, means for mounting the second roll so that its axis may move toward the axis of the first roll, the improved means to drive such two rolls in opposite directions in synchronism with each other, comprising a first, pinion, gear fixedly connected to and rotatable with the neck of the first roll at a position outside a first one of the side frame members, a second, ring, gear permanently meshing with the first gear, means on the outer side of the first side frame member for mounting the second gear on a fixed axis generally coaxial with the second roll, the second roll having a neck extending freely through the second gear, the first and second gears having pitch diameters the ratio of which at least closely approximates the ratio of the diameters of the respective rolls, an elongated housing member connected to the outer face of the second gear coaxially therewith and extending away from said second roll to a point substantially removed from said second gear and further removed from said second roll, an outboard bearing connected to the frame of the machine rotatably supporting the outer end of the housing, a driving connection, lying within the housing, from the outer end thereof to the neck of the second roll at the first frame member, said driving connection comprising a first flexible coupling connected to the housing substantially at the outer end of the latter, a shaft connected at its outer end to the inner end of the first coupling, a second flexible coupling connected to the inner end of the shaft, the inner end of the second coupling being fixedly connected to the aforesaid neck of the second roll, a rotary prime mover, and means for connecting the prime mover to the housing whereby to rotate the latter and to effect driving of the connected system of the two rolls, the first and second gears, and the driving means connecting the second gear to the second roll.

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