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COATING APPARATUS

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2 Sheets-Sheet 1

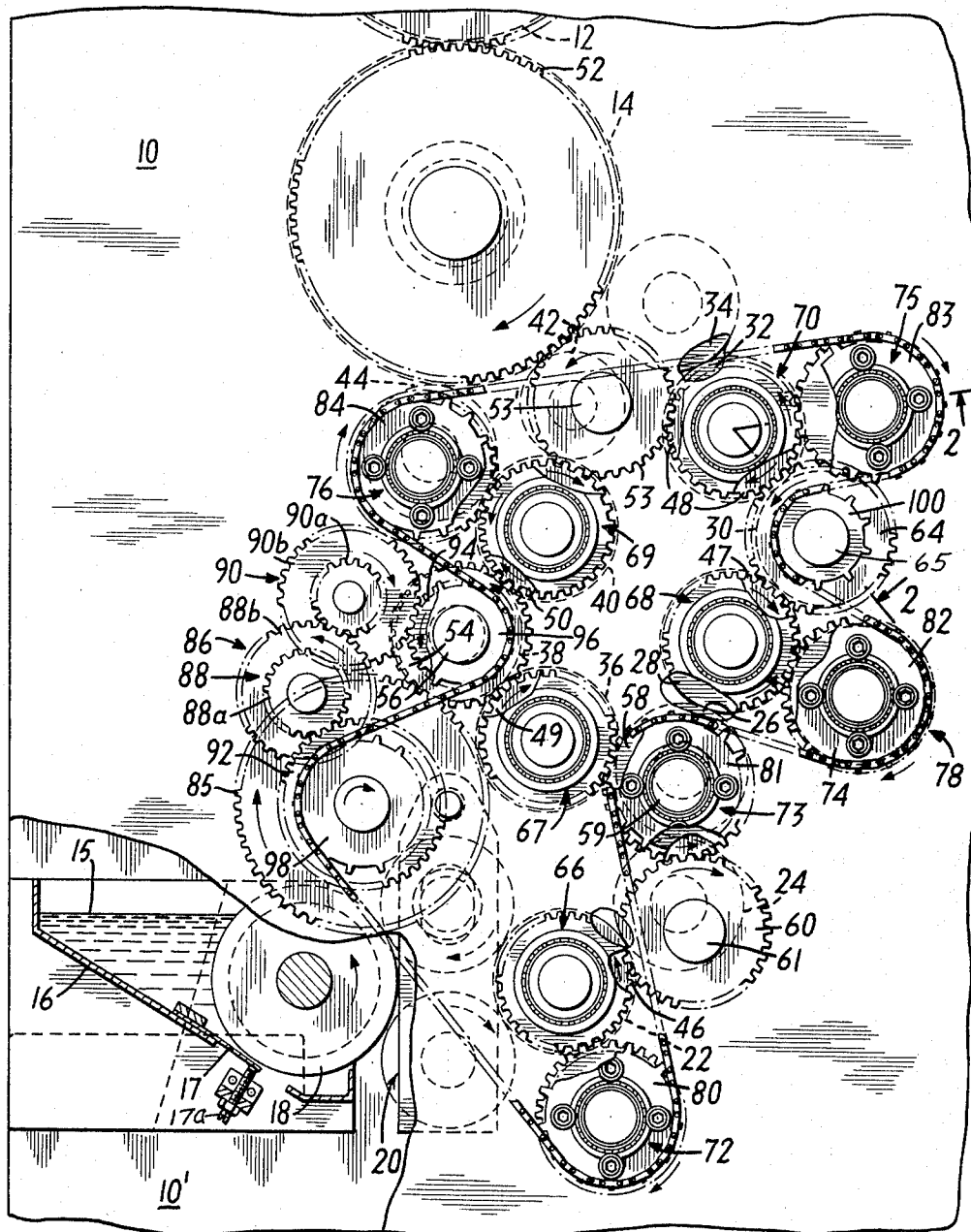


FIG. 1

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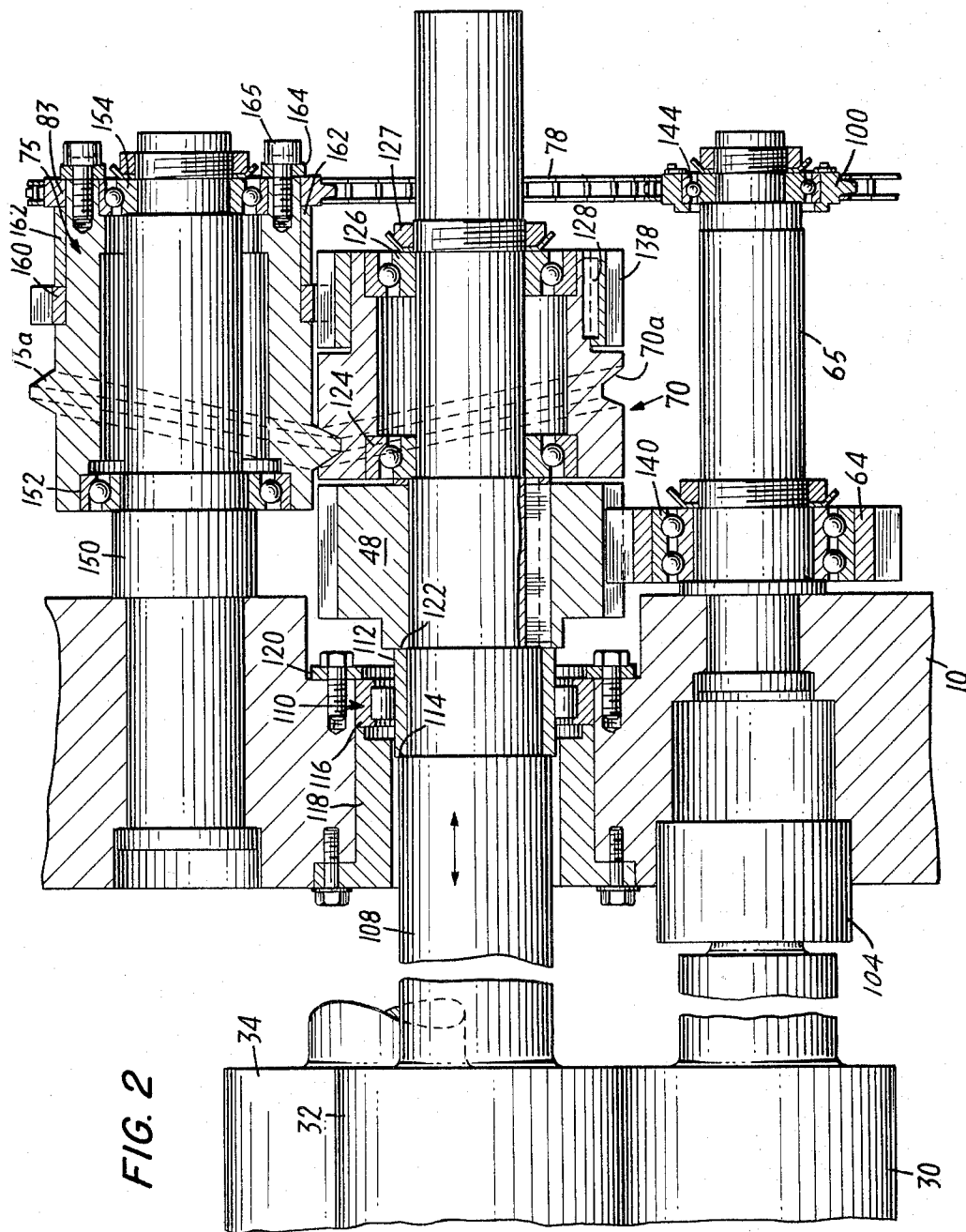
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COATING APPARATUS

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This invention relates to coating apparatus and, more particularly, to apparatus for transferring a liquid or semi-liquid from a reservoir onto a receiving surface as a film or thin coating. The apparatus is particularly well suited for use in coating ink onto the plate carried on the plate cylinder of a rotary printing press, but it may also be utilized in many other coating processes for liquids, semi-liquids, pastes and the like. As used herein, it is intended that the term "liquid" include semi-liquids, pastes and the like, namely, all materials capable of being transferred, spread and coated onto a receiving surface by means of a system of rolls.

There are many occasions in industrial processes in which it is required that a thin film of liquid be coated onto a receiving surface. For example, various thin coatings are applied to paper, fabrics, metals and other sheet materials, and in printing, ink and, in planographic methods of printing, water are applied to the printing plate. Many types of coating apparatus utilize a plurality of rotatable distribution rolls, some of which are stationary and others longitudinally vibrated, to transfer, spread and work a film of the liquid supplied to one or more first rolls from a reservoir and to provide a film on the receiving surface having the desired characteristics. In such apparatus the liquid film from the first distribution roll is conveyed successively along one or more series of rolls, each series including alternate longitudinally vibratory and longitudinally fixed rotating rolls, to one or more final distribution rolls which apply it as a thin film to the receiving surface.

One problem encountered in the design of coating apparatus of this type is to arrange the rolls in the desired relative positions to accomplish thorough spreading and working of the liquid into a film having the desired thickness, uniformity and other characteristics and, at the same time, to provide appropriate mechanisms for rotating the rolls and for vibrating the vibratory rolls of the apparatus. Usually, the design of the apparatus requires compromising the desired relative positioning of the rolls to obtain optimum transfer of the liquid and positioning them in such a way that the mechanisms for rotating and vibrating them can be physically accommodated.

In one conventional arrangement of ink distribution rolls for coating ink onto the plate in rotary printing presses, a central shaft extending between the end frame members of the press has a main drive gear mounted on one end which meshes with drive gears affixed on the shafts of four longitudinally vibratory transfer rolls arranged at 90° angular spacing about the drive shaft. Disposed between and outwardly of the longitudinally vibratory rolls are three longitudinally fixed rolls each of which contacts a pair of the vibratory rolls at points about 120° apart. On the opposite end of the main drive shaft from the rotary drive gears is a planetary gear arrangement which drives a cam member rotatably mounted on the drive shaft outwardly of the planetary gears. A complementary cam member is rotatably mounted on each of the vibratory transfer rolls and is driven by the cam member on the main drive shaft to impart longitudinal vibration to the vibratory rolls.

While ink coating apparatus of the type described above functions quite satisfactorily, there are several lim-

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itations inherent in the mechanical drives which detract somewhat from its usefulness. A principal one is the inflexibility of the geometrical relationship between the several transfer rolls. More particularly, the clustering of the vibratory rolls around the main drive shaft makes it impossible to position the rolls in the best locations for optimum transfer and spreading of the ink through the system. Moreover, the number of rolls that can be provided in that conventional apparatus is limited due to the cluster arrangement to not more than four vibratory rolls, as disclosed, or perhaps five or six, at most. In printing press ink distributing apparatus it is usually desirable to provide more than four vibratory rolls and, further, as many as ten or twelve longitudinally stationary rolls. The above described conventional apparatus is not adapted to meet these requirements.

Another limitation of the above described conventional distributing apparatus is the location of the rotary drive for the rolls on one end of the press and the vibratory drive for the vibratory rolls on the opposite end of the press. For one thing, this makes lubrication and other service and repair of the apparatus more difficult, inasmuch as cover plates on both sides of the press must be removed. More importantly, the arrangement also requires a drive shaft extending completely through the press from one end to the other and located in a central region of the press. Thus, it may be impossible to locate other equipment in the press, such as dryers, heaters or other auxiliary devices.

The above, as well as other, limitations of the apparatus presently known in the art are overcome, in accordance with the invention, by providing a novel and improved coating apparatus which is characterized, particularly, by its versatility, being susceptible of being arranged in a great many configurations, and by its efficient utilization of available space for the drive mechanisms. The apparatus comprises a reservoir or fountain for the liquid, a rotatable fountain roll partially immersed in the reservoir and arranged to pick up a film of the liquid of predetermined thickness, a plurality of longitudinally vibratory distribution rolls disposed parallel to and spaced apart from each other, and a plurality of longitudinally stationary distribution rolls disposed parallel to the first rolls. Means are provided for transferring the liquid film from the fountain roll to at least one of the distribution rolls, and the rolls are arranged to contact other rolls so that the liquid is spread, worked, and transferred through one or more paths which include both vibratory and stationary rolls. The vibratory rolls are driven by a gear system disposed at one end thereof, and the stationary rolls are driven by the vibratory rolls. On the same ends of the vibratory rolls as the gear system are rotatable, driven cam members, and associated with each of the driven cam members on the vibratory rolls is a cooperating driving cam member which is separately mounted and is driven by a drive arrangement separate from the rotary drive of the rolls. The independently mounted driving cams rotate the cams on the vibratory rolls and impart longitudinal vibration to them. Preferably, the driving cams are driven by means of a chain and sprocket drive, or by a similar type system, which has the advantage of enabling the location of the driving cams in positions where they least interfere with other mechanisms of the apparatus.

The coating apparatus, in accordance with the invention, as previously mentioned, has the significant advantage of being easily arranged in numerous configurations. Thus, the angular relationships between the various distribution rolls, both the stationary and the vibratory rolls, enables the best possible working and spreading of the liquid film for the particular equipment in which the apparatus is used. Moreover, as many rolls, both

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stationary and vibratory, as desired may readily be provided. By reason of the separate drive of the driving cams, wide variations in the frequency of vibration of the vibratory rolls are possible. Moreover, means for varying the amplitude of vibration through an infinite range of variation from no vibration to maximum vibration for each vibratory roll can be provided. While the chain and sprocket drive for the driving cams may be coupled to the press motor through an appropriate gear drive arrangement, it is also possible to use a separate variable speed motor so that the vibration frequency of the vibratory rolls can be varied for particular uses of the apparatus.

The coating apparatus, according to the invention, also eliminates the necessity of having a main drive shaft which extends through the equipment in which it is installed from one end to the other and thereby enables the placement of auxiliary equipment in that space. In addition, providing both the rotary drive and the vibratory drive on one end of the apparatus facilitates lubrication, other maintenance, and repair. Fabrication and assembly of the apparatus are also simplified, inasmuch as the principal bearing retainers, gear keys and the like are all disposed at one end.

For a better understanding of the invention, reference may be made to the following description of an exemplary embodiment, taken in conjunction with the figures of the appended drawings, in which:

FIGURE 1 is an end view of a rotary press with the end cover or housing removed to show the rotary and vibratory drives and with portions of the cams, gears and the press frame broken away to more clearly illustrate the structure of and cooperation between the various parts; and

FIGURE 2 is an end view in section of an exemplary rotary and vibratory drive cluster for the vibratory rolls, the view being taken generally along the line 2—2 of FIG. 1, and in the direction of the arrows.

In FIG. 1, all of the distribution rolls are located between end frame members 10 and 10' of the press and, therefore, are shown in dotted lines, except for small segments where the frame member 10 and adjacent elements have been broken away. Moreover, some of the gears and sprocket wheels overlie other gears and the underlying gears are shown by solid lines only at those places where the outermost elements are broken away, but it will, of course, be apparent that members having portions broken away are circular and, similarly, that portions of elements revealed where other elements have been broken away are portions of complete circular members.

The illustrative embodiment of the invention is an ink coating apparatus for an offset lithographic press which includes, as shown at the very top portion of FIG. 1, a blanket cylinder 12 and a plate cylinder 14. Ink 15 which is to be coated onto the plate cylinder 14 is contained in an ink fountain 16, which may be of any suitable type. A coating of the ink 15, the thickness of which can be controlled by adjusting a flexible blade 17 extending across the fountain with keys 17a, is picked up by a fountain roll 18, which is disposed laterally in the reservoir 16, and is transferred from the fountain roll 18 to a ductor 20, the ductor shown being but one type out of many which are known to those skilled in the art and can be used in apparatus according to the invention. The ductor 20 is oscillated back and forth between contact with the fountain roll 18 and with the first of a series of distribution rolls to transfer ink from the fountain roll to the distribution rolls. Other transfer arrangements, such as rotary brushes, can be used.

The first distribution roll 22, which receives ink from ductor 20, is hard and smooth and is vibrated longitudinally, as will be described in greater detail hereinafter. The first roll 22 is in contact with a second longitudinally stationary, rubber-covered roll 24. From the

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roll 24 the ink is transferred to another longitudinally stationary rubber-covered roll 26. The ink film is then conveyed along two paths which consist, first, of a right path comprising, in succession, a vibratory roll 28, a stationary roll 30, a vibratory roll 32, and a longitudinally stationary applicator roll 34. The left path along which the ink film is conveyed consists of, again in succession, a vibratory roll 36, a stationary roll 38, a vibratory roll 40, and a pair of longitudinally stationary applicator rolls 42 and 44. The three applicator rolls 34, 42 and 44 apply the ink, which has been spread and worked into a uniform film by the distribution roll system, onto the surface of the plate on the plate cylinder 14, the application of course being selective due to the nature of the surface of the plate carried by the plate cylinder 14, parts of which are rendered non-printing by a water coating for example, as is well known. As mentioned previously, the sizes and relative positions of the distribution and applicator rolls can readily be varied in accordance with the design criteria which are well known to those skilled in the art to obtain optimum spreading and working of the ink.

The vibratory rolls of the coating apparatus are rotated by a gear drive train, and the stationary rolls are frictionally driven by them. Accordingly, the rubber-covered rolls are merely journaled in suitable bearings in the press frame members 10 and 10'. Similarly, the far ends of the vibratory rolls are journaled in bearings (not shown) in the far-end frame member 10', as illustrated in FIG. 1, but are journaled in the near-end frame member 10 with their shafts extending through and outwardly from the frame member 10.

The gear drive train for rotating the vibratory rolls is disposed on the outside of and directly adjacent the frame member 10 and comprises gears, which are designated by the reference numerals 46 to 50, keyed on the shafts of the vibratory rolls. The rotary drive gears 46 to 50 are driven through two drive paths by a gear 52 on the plate cylinder 14 coupled to the press motor (not shown). More particularly, the plate cylinder gear 52 meshes with an idler gear 53 journaled on a stud 53'. One drive path from the idler gear 53 runs generally downwardly and comprises, in succession, the drive gear 50 on the vibratory roll 40, an idler gear 54 separately journaled on a stud 56, the drive gear 49 on the vibratory roll 36, and idler gear 58 separately journaled on a stud 59, an idler gear 60 journaled on a stud 61 and the drive gear 46 on the first distribution roll 22. The other rotary drive path comprises the first idler gear 53, the rotary drive gear 48 on the vibratory roll 32, an idler gear 64 journaled on a stud 65 and the rotary drive gear 47 on the vibratory roll 26.

As previously mentioned, the rolls 22, 30, 32, 36 and 40 are vibrated longitudinally. The longitudinal vibration is imparted to these rolls by cooperative cams consisting of a cam member rotatably mounted in a longitudinally fixed position on the shafts of each of the vibratory rolls outwardly of the drive gears 46 to 50. The cam members on the vibratory rolls, which hereinafter will be referred to as driven cam members, are designated by the reference numerals 66 to 70. The driven cams 66 to 70 cooperate with and are driven by driving cam members 72 to 76, which in turn are driven by a link chain 78 which engages sprocket wheels 80 to 84 adjustably affixed on the driving cam members 72 to 76, as will be described in more detail hereinafter.

The chain 78 is driven from the press motor (not shown) through a main vibratory drive gear 85, which meshes with the idler gear 54 of the first rotary drive path, through a gear train 86, which comprises double-gears 88 and 90. More particularly, the gear 85 includes a small diameter gear 92 which meshes with the small diameter gear 88a on the gear 88. The large gear 88b meshes with the small diameter gear 90a of gear 90, and the large diameter gear 90b on the gear 90 drives a

sprocket drive gear 94 which is separately journaled on the stud 56 and is coupled to a rotatable drive sprocket 96. The gear train 86 is arranged to provide one cycle of vibration of the vibratory rolls for about every 20 feet of paper fed to the press. The chain 78 is passed around idler sprockets 98 and 100, as well as the sprockets 80 and 84 on the driving cams 72 to 76.

Referring now to FIG. 2, which illustrates a typical rotary and vibratory drive arrangement for a vibratory roll of the ink coating apparatus of FIG. 1, the longitudinally stationary, rubber-covered roll 30 is journaled in an adjustably mounted bearing arrangement 104 of a type commonly used in the trade which permits easy removal of roll 30, and also easy adjustment of roll 30 to the vibratory roll 32. The mounting is such that the roll 30 is arranged for rotation but is held in a substantially fixed position longitudinally.

The shaft 108 of the vibratory roll 32 extends through the frame member 10 and is journaled in a bearing 110 which has an extended inner race 112 fixedly mounted on the shaft 108 and movable therewith relative to frame member 10. The inner race 112 bears against a shoulder 114 on the shaft 108, and the outer race 116 is clamped between an insert 118, which is provided to facilitate the installation of the roller 32, and a ring 120 fastened to the frame member 10. The rotary drive gear 48, which has extended teeth because of the longitudinal movement of the vibratory roll 32, is keyed on the shaft 108 and not only bears against a shoulder 122 on the shaft 108 but serves to hold the inner race 112 of bearing 110 in its fixed position on the shaft 108.

The driven cam member 70 is journaled on the shaft 108 of the roll 32 outwardly of the rotary drive gear 48 by bearings 124 and 126. The bearing race 112, gear 48 and cam member 70 are all held on the roll shaft 108 by a retainer 127. The cam 70 is cylindrical and has a trapezoidal-shaped groove 70a formed in its perimeter which lies on a plane forming an angle with the axis of the roll 32. Secured at the outer end of the cam 70 by a key 128 is a gear 138.

The idler gear 64, which forms part of the rotary drive gear train from the plate cylinder and drive gear 48 on the vibratory roll 32, is journaled by a ball bearing 140 on the inner end of a fixed stud 65 mounted in the frame member 10. Journaled by a bearing 144 on the outer end of the stud 65 is the idler sprocket 100 for the cam drive chain 78.

The driving cam member 75 of the vibratory drive system is mounted on a stud 150 secured on the frame member 10 by an inner bearing 152 and an outer bearing 154, which are held in position by a suitable arrangement of shoulders on the stud 150 and on the interior bore of the cam member 75. A generally trapezoidal rib 75a having a shape and size in cross-section complementary to that of the groove 70a in the driven cam 70 is provided on the periphery of the cam member 75. It is disposed in a plane lying at the same angle to the axis of the cam as that formed by the plane of the groove in the driven cam. As will be described in more detail hereinafter, the rib 75a and matching groove 70a in the respective cam members 75 and 70 are arranged to provide an infinite range of vibration of the roll 32 between no vibration and a vibration having an amplitude equal to twice the distance measured longitudinally of the cam members between parallel planes through the center line of the rib, or of the groove, at the longitudinally farthest apart points thereon.

Mounted in a set-back portion adjacent the outer end of the cam member 75 is a gear ring 160 which meshes with the gear 138 on the driven cam 70. Adjacent the gear 160 is a spacer 162, and outwardly of the spacer is the sprocket 83 for the cam chain drive. The gear ring 160, spacer 162 and sprocket 83 are all clamped in fixed positions on the cam member 75 by a clamp ring 164 which is fastened to the cam member by bolts 165.

When the bolts 165 are loosened, however, cam 75 may be rotated relative to the sprocket 83, and cam 75 and cam 70 can be rotated relative to chain 78.

The relative positions of the cams 70 and 75, as they are shown in FIG. 2, are such that the innermost points on the driving cam rib 75a and on the driven cam notch 70a contact each other. Accordingly, when the driving cam 75 is rotated by the chain 78, thereby driving the driven cam 70 through the gears 160 and 138, the cam rib 75a on the driving cam 75 will ride in the cam groove 70a in the driven cam 70 without causing any longitudinal movement of the driven cam and corresponding vibration of the vibratory roll 32.

However, loosening of the clamping 164, as described above, enables the rotation of the driving cam 75 relative to the driven cam 70 through an infinite number of relative angular positions between that illustrated in FIG. 2 and a position in which the outermost point on the cam rib 75a of cam member 75 resides on the innermost point of the cam groove 70a of cam member 70. In all such positions, the driving cam member 75 causes vibratory movement of the driven cam member 70, and therefore, longitudinal vibration of the vibratory roll 32. Depending on the relative positions of the cams 70 and 75, the amplitude of vibration of the vibratory rolls 32 can be changed in accordance with the particular ink used and variables in the operation of the press. Moreover, the relative positions between each pair of driving and driven cams can be varied so that the vibrating cycle of any vibratory roll can be set in any desired phase relationship with the other vibratory rolls.

As previously stated the particular rotary and vibratory drive cluster illustrated in FIG. 2 is typical of those provided throughout the coating apparatus of FIG. 1. It will be observed that there are several clusters of rotary drive gears, vibratory and longitudinal stationary rolls, and cam vibratory drives for the vibratory rolls, and each of these clusters have generally the same structure as that of the cluster illustrated in FIG. 2. In some cases, additional gears are included in the cluster, and some of the sprockets are mounted eccentrically to provide for tightening the chain. The proper mounting of the gears is readily accomplished by providing offsets on the studs on which they are mounted. Additionally, some gears, for example, the idler gear 60 and the sprocket and chain drive gears 88 and 90 are mounted on separate studs, as previously indicated.

It will be noted that for each vibratory roll, a driven cam is mounted on the roll shaft and a driving cam is mounted on a stud adjacent the driven cam. An important advantage of the apparatus in accordance with the invention, is that each of the driving cams can be positioned at any point about the circumference of the driven cam, and particularly, that point which is most geometrically and mechanically expedient for the particular configuration of distribution rolls. Accordingly, the distribution rolls may be located in the best possible relative positions to provide the most effective ink spreading and working without being restricted by having to meet particular geometrical configurations governed by the mechanical requirements of rotary and vibratory drives. The chain and sprocket drive also facilitates the designing of the apparatus in a manner which is controlled almost entirely by the ink transfer requirements, as opposed to the mechanical drive requirements.

The above-described embodiment of coating apparatus, in accordance with the invention, is merely exemplary, and many modifications and variations of it can be made by those skilled in the art without departing from the spirit and scope of the invention. All such modifications and variations are intended to be within the scope of the invention as defined in the appended claims.

I claim:

1. A liquid distributing system, comprising a reservoir for the liquid, a rotatable roll partially immersed in and

arranged to pick up a coating of the liquid, a plurality of first rotatable distribution rolls disposed parallel to and spaced-apart from each other, a plurality of second distribution rolls disposed parallel to said first rolls and in rolling contact with at least one of said first rolls, means for transferring the liquid coating from said rotatable pickup roll to at least one of said first and second distribution rolls, said first and second distribution rolls arranged to transfer and spread the liquid thereon along at least one path including alternate adjacent first rolls and second rolls, a drive gear train at one side of the apparatus for imparting rotation to said first rotatable distribution rolls, said drive gear train including a gear carried at the same end of each of said first distribution rolls, a first cam member rotatably mounted on and longitudinally affixed to each of said first distribution rolls at the same end of the first distribution roll as the said gear, a plurality of second cam members, one of said second cam members being rotatably mounted and longitudinally fixed adjacent each of said first cam members and cooperative with said first cam member to impart axial reciprocation of predetermined amplitude to each of said first distribution rolls, means for rotating one of said cam members, and gear means to impart rotation from said one cam member to the other cam member.

2. Liquid coating apparatus, comprising a reservoir for the liquid, a rotatable roll partially immersed in and arranged to pick up a film of the liquid, a plurality of first rotatable distribution rolls disposed parallel to and spaced apart from each other, a plurality of second distribution rolls disposed parallel to said first rolls and in rolling contact with at least one of said first rolls, means for transferring the liquid film from said rotatable pick up roll to at least one of said first and second distribution rolls, said first and second distribution rolls arranged to transfer and spread the liquid along paths including alter-

nate adjacent first rolls and second rolls, a drive gear train at one side of the apparatus for imparting rotation to said first distribution rolls, said gear train including a gear fixedly carried at the same end of each of said first distribution rolls, a first cam member rotatably mounted on and longitudinally affixed to each of said first distribution rolls at the same end of the first distribution roll as said gear, a plurality of second cam members, one of said cam members being rotatably mounted and longitudinally fixed adjacent each of said first cam members and cooperative with said first cam member to impart axial reciprocation of predetermined magnitude to each of said first distribution rolls, chain means for rotating said second cam members, gear means on said first and second cam members for imparting rotation to said first cam members, clamp means securing said gear means on one of said cam members and means for loosening said clamp means to facilitate infinite relative adjustment of said cam members for the purpose of varying the axial displacements imparted to said first distribution rolls.

3. A liquid distributing system as set forth in claim 1 wherein each of said second cam members is mounted for infinite adjustment relative to said cam rotating means between predetermined limits for the purpose of varying the amplitude of axial reciprocation of each of said first distribution rolls independently of the other first distribution rolls.

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