

July 14, 1953

W. A. ZONNER
PAPER COATING MACHINE

2,645,199

Filed May 11, 1950

6 Sheets-Sheet 1

Fig. 1.

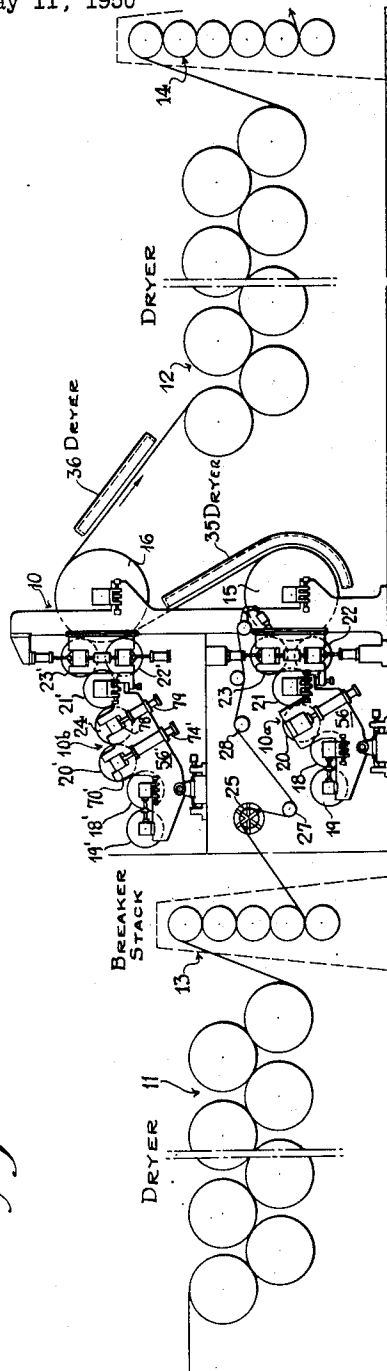
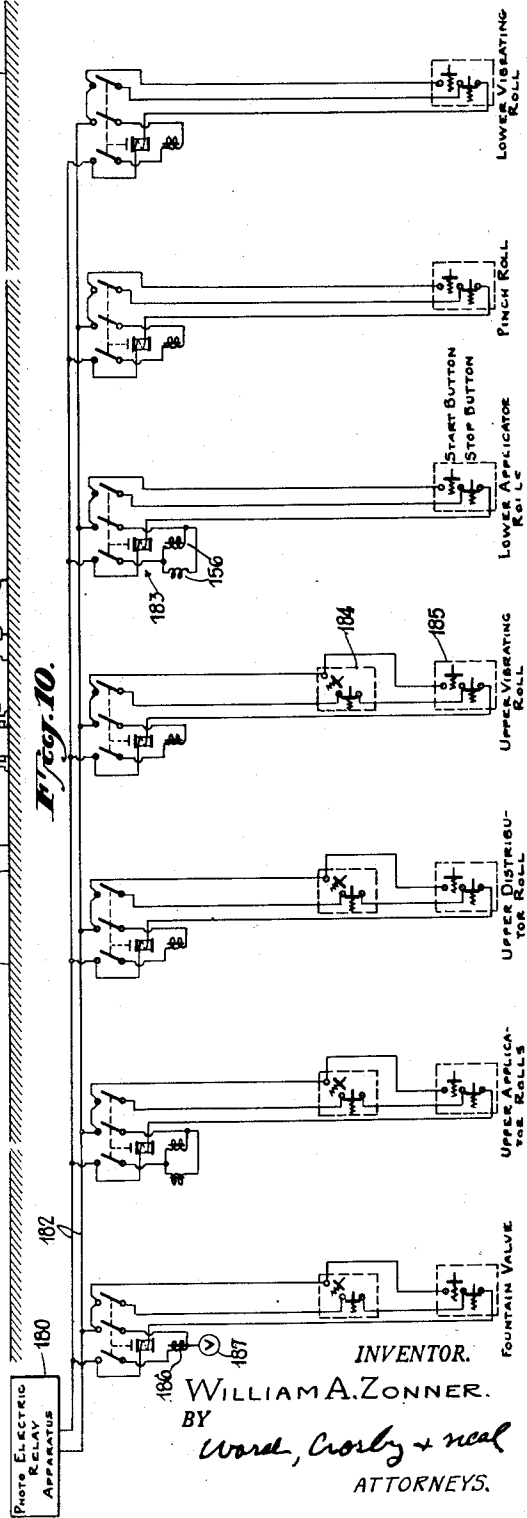


Fig. 10.



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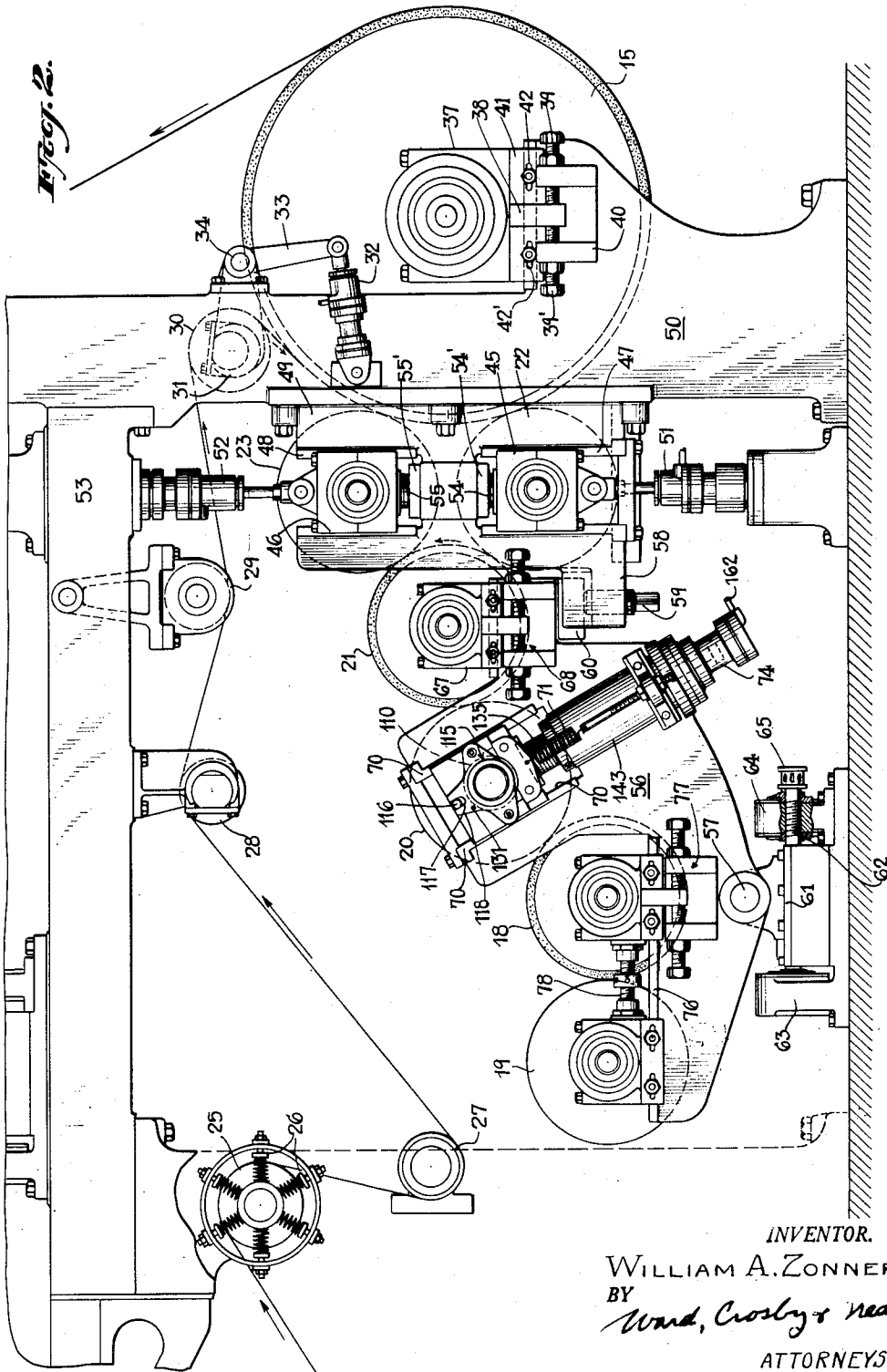
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6 Sheets-Sheet 3

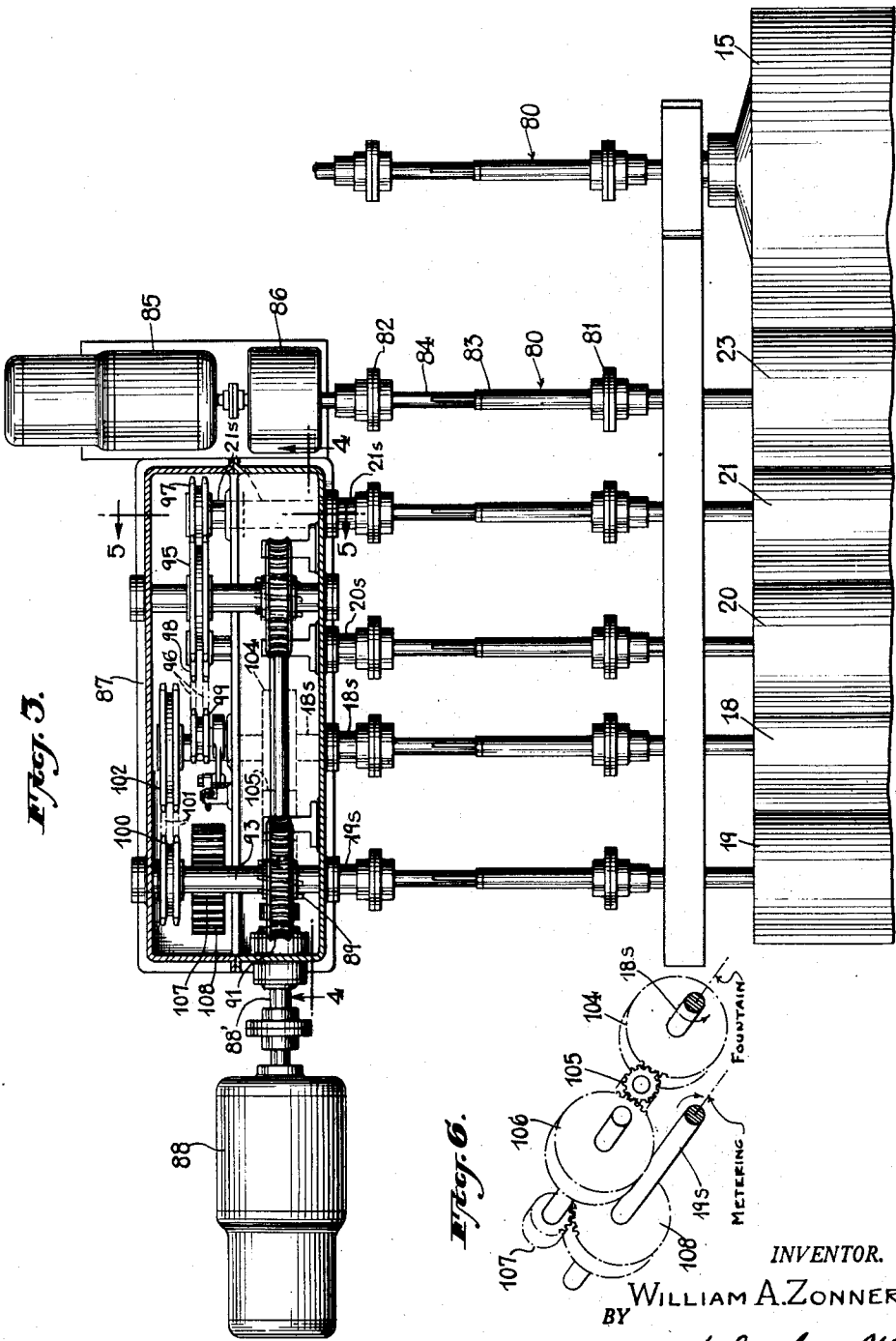


Fig. 6.

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Fig. 5.

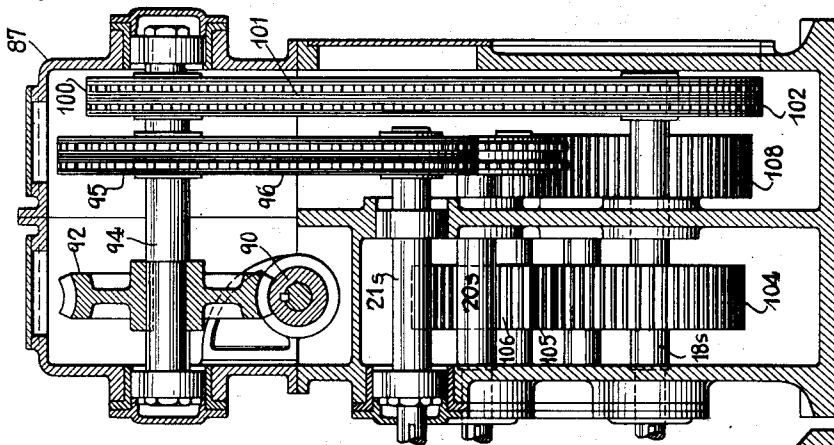
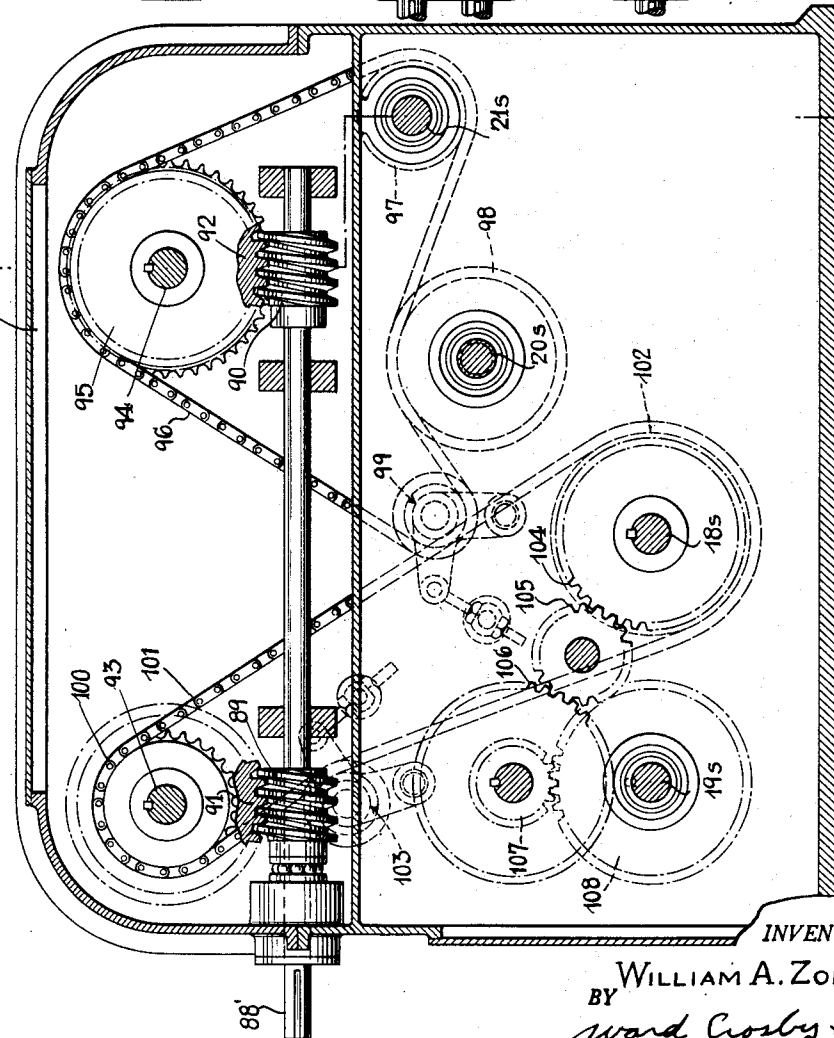


Fig. 4.



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Fig. 7.

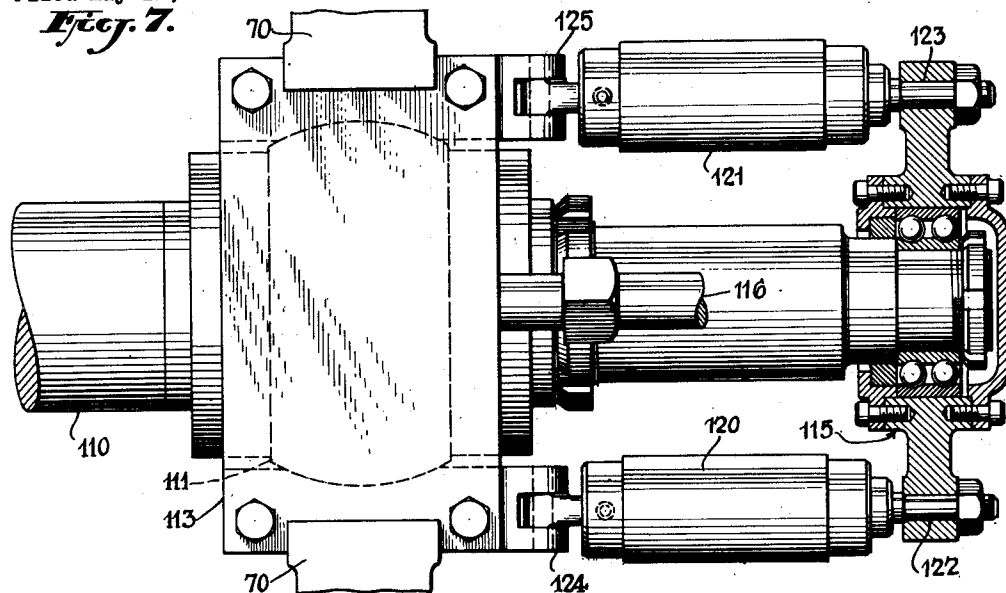
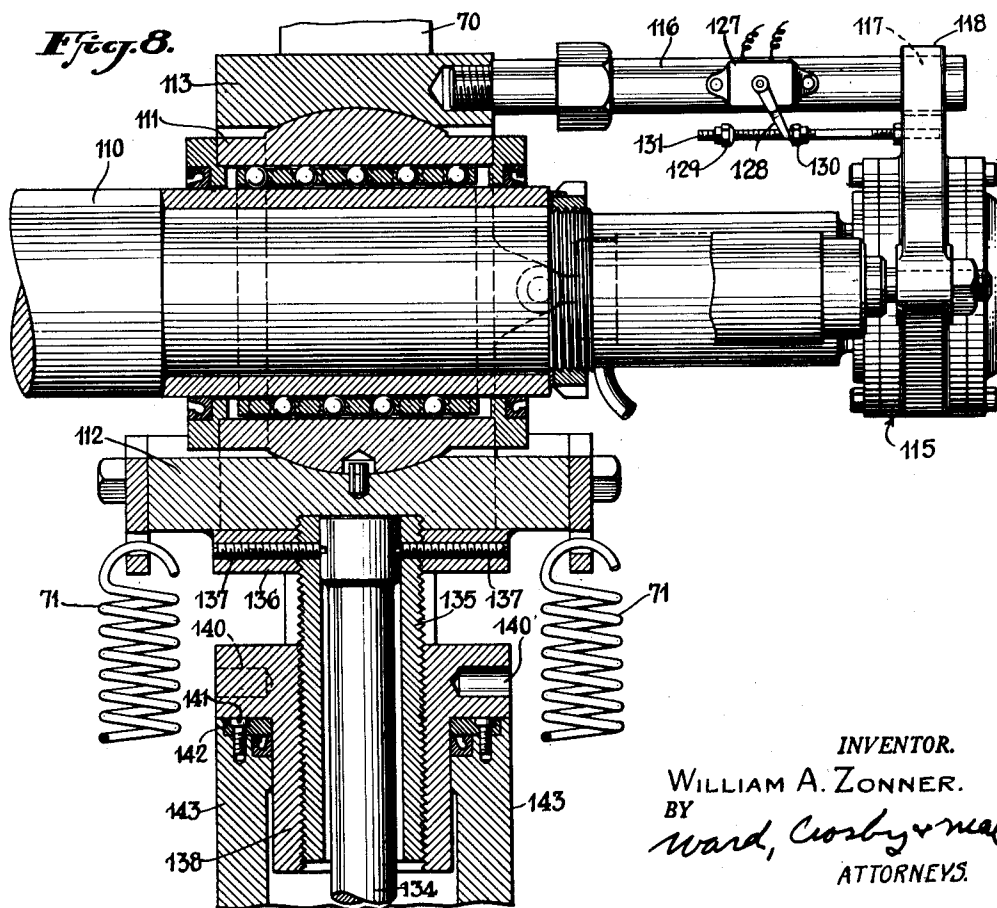


Fig. 8.



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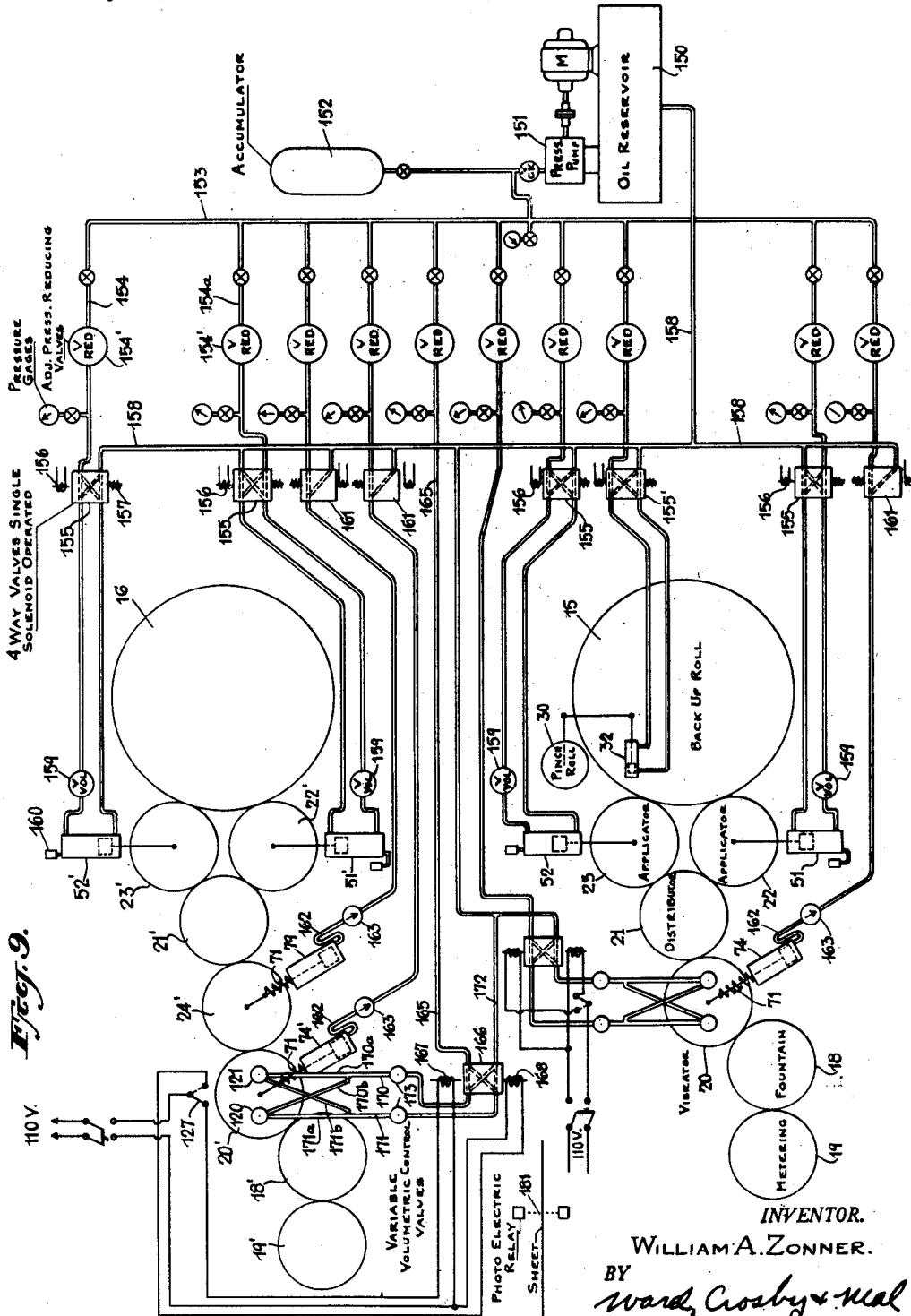
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UNITED STATES PATENT OFFICE

2,645,199

PAPER COATING MACHINE

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Application May 11, 1950, Serial No. 161,302

14 Claims. (Cl. 118—1)

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This invention relates to the coating of paper and more particularly to apparatus adapted, among other possible uses, to the rapid and economical coating of printing and publication paper during the process of its manufacture on the paper making machine, viz by so-called "on-the-machine" coating.

The apparatus of this invention in its preferred form is of the type wherein the coating mixture is transferred successively from one to another of a plurality of distributor rolls to provide a uniform thin film of the mixture which is continuously transferred to applicator roll means and thence on to the paper as the latter travels over a back-up roll. Also in its preferred form the machine is of the type having lower and upper "decks," that is a lower "deck" comprising fountain roll means, distributor rolls, applicator and back-up rolls for coating the under surface of the paper web, which then passes to a similar upper "deck" arranged for coating the other surface of the web.

Apparatus of this general type may be placed at an intermediate point within the "dryer" section of the paper making machine, so that the coating is applied to the paper after it has been partially dried on numerous of the initial dryer rolls of the paper machine and whereby after the coating is applied, the paper will travel over the remainder of the dryer rolls for more complete drying of the web with the coating thereon.

Since coating apparatus of this type involves numerous large and heavy rolls of a length corresponding to the width of the paper being made, and these rolls must be very accurately positioned and rotate at high speeds appropriate for high-speed paper manufacture, the construction, maintenance and efficient operation of such apparatus involves numerous difficulties. Although certain machines of this class as heretofore installed are highly efficient in normal operation, their construction and maintenance has involved excessive expense. The present invention is particularly directed to improvements for minimizing such expense and for facilitating accurate, rapid and convenient adjustment of the various rolls when necessary, and easy removal and replacement of any worn or damaged roll without disturbing other rolls.

With coating machines of this type, one of the difficult problems is to bring the successive rolls together in proper order and in accurately adjusted positions when the machine is being started, and so that coating mixture will be present between rolls promptly after they come

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together, and thus prevent "burning" and consequent serious injury to such of the rolls as have to be made of rubber or the like and which, because of their different relative speeds, would become quickly overheated by friction in the absence of coating mixture thereon. Also it is important that the rolls be brought together at such a time and in such a way that an excess of coating material will not accumulate on any of them or be applied to the back-up roll in the absence of paper thereon. Also, when the machine is to be shut down or the paper web breaks, it is important that the various rolls be separated in the proper order to insure that the back-up roll will not be coated in the absence of paper, and so that the supply of coating to the distributor rolls will be promptly cut off, but again without the possibility of "burning" one roll against another. Since the various rolls are large and heavy and their relative adjustments have to be highly accurate to insure application of the desired thin uniform smooth coating to the paper clear across the web, the problem of normally bringing the rolls together and promptly separating them when necessary, has heretofore involved control devices which have been excessively complicated, or which tend to get out of proper adjustment on repeated use.

Heretofore it has been the practice when it is necessary to separate the rolls to move the gate or fountain rolls and distributor rolls all back away from the applicator rolls and to move them in the reverse direction together again when operations are resumed, but such movement of the gate rolls sometimes involves disturbance of the necessary accurate spacing therebetween and the bringing of the heavy rolls quickly together may sometimes disturb the necessarily accurate adjustment of the spacing or pressure applied between the various distributor rolls and the applicator roll. These difficulties, however, are overcome with the present invention by a construction so arranged that while the gate rolls remain undisturbed in normal position, certain of the distributor rolls and the applicator roll means are separated from the others by moving same individually and transversely of the series of rolls. Thereby any disturbance of the relative normal positions and adjustments of the rolls is minimized by reason of the fact that alternate rolls only have to be moved, and each roll which is moved may be individually accurately controlled free of the inertia of any other rolls.

Also in prior machines of this class, it has

been the practice upon separating the rolls, to move the back-up roll, which is heaviest of all, and yet in normal use must be adjusted to a position with highest accuracy. However, with the present invention a novel roll arrangement is provided whereby the back-up rolls do not normally have to be moved or readjusted in starting and stopping the machine, whereas the applicator roll means, which are relatively light and easy to move and maintain in adjustment, are individually moved away from or toward the back-up and distributor rolls when stopping and starting the machine.

The machine of the present invention in its preferred form also is provided with four applicator rolls, one pair of which successively applies two coatings to one surface of the web and the other pair of which similarly apply successive coatings to the other surface of the web. The construction of prior practical machines of this class have been such that only a single applicator roll could be applied to each web surface and still permit the applicator and back-up rolls to be promptly separated and brought together with accurate adjustment in starting and stopping the machine. Also with the present invention the applicator rolls are preferably made of "velvet" finished hard metal such as chromium, which will uniformly release the film of coating mixture onto the paper, and the back-up rolls are made with surfaces of resilient rubber or the like. The term "velvet finished" has reference to a somewhat dulled although even surface which has been deprived of the lustre or glossy appearance of the usual chromium-plated surface. Also the surface speed of the applicator rolls preferably is slightly greater than that of the traveling web. With this combination of features the metal surfaces of the applicator rolls release and wipe smooth coatings with a "level" surface onto the paper while the resilient back-up roll accommodates any irregularities in the paper and prevents same from interfering with the formation of the desired "level" coated surface. Heretofore in machines of this class the roll arrangement was such that the applicator roll had to have a rubber surface, which would tend to become somewhat irregularly worn and tacky and thus would not uniformly release the coating, and in some cases would irregularly displace fiber from the paper. Since with such rubber applicator rolls a metal back-up roll would be used, it is apparent that the reverse side of the paper would be "level" and that the irregularities in the paper would be presented on the surface being coated.

The above and other novel features of the invention will appear more fully from the following detailed description when taken in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings:

Fig. 1 is a somewhat schematic side elevational view of portions of a paper making machine in which coating apparatus comprising the preferred form of the invention is interposed;

Fig. 2 is an enlarged side elevational view of the lower "deck" of the same apparatus;

Fig. 3 is a plan view of one example of a drive mechanism for the rolls of the lower "desk," substantially similar drive mechanism also being provided for the upper deck;

Fig. 4 is a vertical sectional view taken substantially along line 4—4 of Fig. 3;

Fig. 5 is a vertical sectional view taken substantially along line 5—5 of Fig. 4;

Fig. 6 is a somewhat schematic perspective view showing the arrangement of the gears for driving the metering roll;

Fig. 7 is a top view of a typical bearing and associated parts for one end of one of the vibrator rolls;

Fig. 8 is a vertical sectional view showing in further detail the mechanism of Fig. 7;

Fig. 9 is a schematic diagram of the hydraulic connections for the control of the positions of the various rolls; and

Fig. 10 is a schematic diagram of the electrical circuit connections for controlling the solenoid-operated hydraulic valves of Fig. 9.

Referring to Fig. 1 of the drawings in further detail, the coating apparatus embodying the invention is indicated generally at 10, interposed between two groups of the dryer rolls 11, 12 of a paper making machine. Preferably a so-called "breaker stack" 13 is interposed just ahead of the coating apparatus for the purpose of flattening under pressure any slightly protruding fiber or other irregularities on the partially dried paper just prior to its entry into the coating apparatus. A conventional calender 14 is located at the end of the paper machine for machine calendering the finished coated paper.

The apparatus 10 as here indicated comprises lower and upper back-up rolls 15, 16, around which it will be apparent that the paper travels in succession for receiving first a coating or coatings on its under surface and then either one or two coatings on its upper surface, the coatings for the under surface being furnished by the lower deck rolls indicated generally at 19a, whereas the coatings on the upper surface of the web are furnished by the rolls of the upper deck generally indicated at 19b. These corresponding rolls of the two decks respectively are identified on the drawings by the same reference numerals, the numerals for the upper deck rolls being accompanied by prime marks.

The lower deck as shown comprises a pair of gate rolls, i. e. a fountain roll 18 and a metering roll 19, a first distributor roll 20 being provided in a position partially overlying the fountain roll 18 and contacting therewith on one side, whereas its other side contacts with a second distributor roll 21. A pair of applicator rolls 22, 23 are interposed between the distributor roll 21 and the back-up roll 15.

In the upper deck the rolls are substantially the same and the mounting and control means therefor are substantially the same except that in the upper deck an additional distributor roll 24 has to be provided in order that the direction of rotation of the applicator rolls may correspond to the direction of travel of the paper over the upper back-up roll 16, which rotates in the direction opposite from the rotation of back-up roll 15. Also the surface coverings of certain rolls of the two decks necessarily differ because of the interpositioning of the extra upper distributor roll 24. That is, while both back-up rolls are covered with resilient rubber or the like and the applicator rolls preferably are all made with velvet finished chromium surfaces and the distributor rolls 21, 21' are rubber covered, yet in order that alternate rolls will have surfaces of metal and rubber, respectively, the extra distributor roll 24 in the upper deck preferably has a metal surface, roll

20' a rubber surface, roll 18' a metal surface and roll 19' a surface of rubber or the like. In the lower deck, roll 20 preferably has a hard metal surface, roll 18 a surface of rubber or the like, and roll 19 a hard metal surface. The remaining details as to the operation, construction and mounting of the rolls of both decks will be made apparent from the description given hereinafter of Fig. 2 which shows a side elevational view of the lower deck.

It should be mentioned that while various of the successive rolls as described herein and in the appended claims are referred to as being in "contact" or being "substantially tangent" when in normal use, there is actually, of course, normally present a thin film of the coating mixture between the gate rolls, distributor rolls and applicator rolls and a layer of paper plus the coating between the applicator rolls and the back-up rolls, and in thus referring to the rolls as being in "contact" or "tangent," it is meant that they are brought together, usually under pressure, and are separated only by a thin film of coating, or coating and paper. Also, while certain of the rolls are referred to as being rubber covered, it will be understood that various synthetic resilient materials similar to rubber or artificial rubber may be used.

The paper web, after leaving the "breaker stack" is first preferably passed over an idler roller 25, the bearings for which are resiliently mounted in a known way by means of radially extending coiled springs 26 (Fig. 2). The web is preferably wrapped over a considerable arc about roll 25 and then passes over idler rolls 27, 28, thence over an idler roll 29 which preferably is of a type adapted to flatten out any wrinkles that may tend to occur in the web. For example, a roll of the type well known in the art as a "Mt. Hope" roll may be used for this purpose. From this point the web passes over another idler roll 30, the bearings 31 for which are so mounted that in normal operation the surface of this roll will be spaced somewhat from the surface of the back-up roll 15, but upon breakage of the web, provision is made for bringing this roll down to a position whereby it will grip the paper against the back-up roll and thus keep the web under control until the broken end passes over the back-up roll 15. For this purpose a fluid pressure operated cylinder and piston unit 32 is provided, having one end connected to the frame of the machine and its other end connected to one arm of a bell crank 33 pivotally mounted on the frame of the machine at 34. The other arm of this bell crank serves to support a bearing 31 for roll 30. It will be understood that the bearings at both ends of the roll 30 are similarly controlled and the fluid pressure operated devices as at 32 may be energized by suitable control means responsive to photoelectric cells located at appropriate points and sensitive to the breakage of the paper web, as hereinafter explained in further detail.

While in describing Fig. 2, reference generally will be made to the bearings and frame parts for only one end of each roll as shown in this figure, it will be understood that corresponding bearings, operating devices and frame parts of like construction are to be provided at the other ends of the rolls.

In order to subject the paper web to drying treatment after it is coated on the back-up roll 15 and before the coating can come into contact with the back-up roll 16, a suitable known form of drying apparatus may be positioned as at 35,

and after the upper surface of the web is coated on the upper back-up roll, it may be similarly subjected to drying treatment by drying apparatus positioned as at 36 (Fig. 1).

Referring now in further detail to Fig. 2, the back-up roll 15 has bearing blocks as at 37 which have depending lugs at 38 adapted to be adjustably positioned horizontally by two opposed adjusting bolts 39, 39' equipped with lock nuts and threaded through a bracket member 40 mounted on the main frame of the machine. In order to confine the movement of these bearing blocks to horizontal adjustments, they may be provided with depending portions 41 slotted as at 42, 42' for receiving bolts fixed in the main frame. In normal use of the machine, once the back-up roll has been adjusted by this means to an appropriate position horizontally, the position of this roll will not have to be readjusted or changed unless the thickness of the rubber covering on the roll is changed.

The applicator rolls 22, 23 are supported in bearing blocks as at 45, 46 which are slidable respectively in slideways 47, 48 formed in a sub-frame portion 49 suitably bolted to the main frame portion 50. The bearing block 45 is pivotally connected at its lower side to a fluid pressure operated unit 51 for moving the applicator roll 22 either up into normal active position as shown, contacting with both rolls 15 and 21, or down into withdrawn position, as when the paper web breaks or it is desired to shut down the machine. Similarly, the bearing block 46 for the upper applicator roll 23 is connected to a fluid pressure unit 52 operative either to lower the roll 23 down into the normal operating position as shown, or to withdraw same upwardly to separate it from rolls 15 and 21 when the web breaks or the machine is to be shut down. The unit 51 as shown may be mounted on the floor and the unit 52 may be suspended from a horizontal frame part 53.

At the upper end of the slideway 47 and at the lower end of the slideway 48 respectively, stop means 54, 55 are provided for limiting the movement of the bearing blocks 45, 46. These may comprise threaded stud-like members adjustable vertically in the sub-frame member 49, in order to determine the positions which the rolls 22, 23 will assume when in normal operation, as will be more fully explained below in connection with the similar bearings for roll 20.

The rolls 18, 19, 20 and 21 are all carried in bearing blocks which are mounted on a tiltable frame part 56 which is pivotally mounted at 57 at the region below the gate rolls. The end of this frame part adjacent the roll 21 is supported so as to be vertically adjustable in position in order that the same may be tilted about the pivot 57. For this purpose, the sub-frame part 49 is formed with a lug portion 58 containing a set screw 59, the upper end of which bears against a protruding part 60 on the member 56. Thus by adjusting the set screw 59, the vertical position of the distributor roll 21 may be adjusted for proper contact with both of the applicator rolls 22, 23. This adjustment is of a semi-permanent nature, and once proper adjustment is made, it ordinarily will not have to be altered except in case the coverings for the rolls are altered or replaced, or in case there should be irregular settling of the foundation for the machine, etc. It will be apparent that as the vertical position of roll 21 is altered by this adjustment, the positions of the rolls which supply coating to roll 21, viz

rolls 18, 19 and 20, will be altered to the extent necessary to keep same in contact, in view of the fact that they are all carried by the pivoted frame part 56.

In order to adjust the position horizontally of the group of rolls 18-21 inclusive, so that roll 21 will properly engage the applicator rolls, the pivot 57 is made adjustable horizontally. That is, this pivot may be carried on a bearing block-like structure 61 through which a shaft 62 extends, such shaft being free to rotate but being suitably fixed against relative longitudinal movement in the portion 61. This shaft may be supported in bearing structures as at 63, 64, the latter having threaded engagement with the shaft so that when the shaft is turned as by a capstan-like means 65, the pivot 57 will be adjusted in horizontal directions. This adjustment also may be of a semi-permanent nature, subject to the same factors as the adjustment by set screw 59.

The distributor roll 21 is carried by bearing blocks as at 67, adjustable horizontally by means substantially the same as above described for adjusting horizontally the position of the back-up roll 15.

The bearing blocks for the distributor roll 20 are carried in slideways as at 70, which are positioned at an angle directed upwardly and rearwardly from the applicator rolls. That is, the center line of this slideway is preferably approximately at right angles to a line connecting the axes of the rolls 18 and 21 so that when this roll 20 is moved out of normal position contacting with the rolls 18 and 21, such movement will be transverse to the series of rolls. The bearing blocks for roll 20 are normally held down to hold the roll in normal active position by gravity, supplemented by adjustably tensioned helical springs as at 71. Thus these springs, as aided by gravity, normally hold the bearing blocks for this roll down against adjustable stop means as described hereinafter in further detail in connection with Fig. 8. For moving the roll 20 out of normal position, viz upwardly and rearwardly, fluid-operated pressure units as at 74 are provided attached to the frame part 56. The fluid pressure units 74 (one being provided for each end of roll 20) are preferably connected to a source of pressure supply so as to act only in one direction, viz to move the roll 20 out of normal position. In order to bring the roll back down into normal position and hold it there with a predetermined pressure independent of whatever the fluid pressure supply may be, the springs 71, as aided by gravity, are relied on.

Preferably the roll 20, as well as the corresponding roll 20' of the upper deck, have mechanisms of known type within or on their bearing blocks for causing these rolls to oscillate in position longitudinally for more effectively distributing uniformly the coating as received from the fountain roll 18 and transferred to the distributor roll 21. One suitable form of such mechanism for this purpose is more fully described hereinafter.

The bearing blocks for the fountain roll 18 and the metering roll 19 are slidable horizontally along slideway 76 forming a part of frame portion 56. The position of roll 18 in horizontal directions may be semi-permanently adjusted by devices at 77 the same or similar to those above described for adjusting horizontally the back-up roll. The bearing blocks for the metering and fountain rolls 18 and 19 are interconnected by a double ended adjustable threaded stud 78 which

may be adjusted by turning same so as to adjust the nip of the gate rolls.

In the upper deck, the extra distributor roll 24 (as will be apparent from Fig. 1) has its bearing blocks mounted in a slideway 78 directed upwardly and rearwardly at the same angle as the slideway 70' for the roll 20'. Also the sliding of the roll 24 downwardly into position may be controlled by the same spring arrangement as shown at 71 in Fig. 2 for roll 20, and roll 24 may be pushed out of normal position by a fluid pressure unit as at 79 acting in the same way as the units 74, 74' for the rolls 20, 20'.

With the above-described arrangement of the rolls, it will be apparent that all of the applicator and distributor rolls may be quickly moved by fluid pressure units individual to each of the movable rolls, out of contact with each other, and out of contact with the gate rolls and back-up rolls without disturbing either the positions of the heavy back-up rolls and without disturbing the positions of the gate rolls, which might cause alteration of the fine adjustment of the fountain nip. Thus the problems arising from the inertia involved in moving a whole group of distributor and gate rolls together, as was necessary with prior practice, is avoided, and when the rolls are brought together, any pounding effect against the stop means therefor is minimized, since each stop means has to resist only the inertia involved with an individual roll, rather than a group of rolls. Thus any tendency of jamming the stop means out of proper fine adjustment is avoided. Furthermore, the arrangement is such that at least one of the distributor rolls in each deck (21, 21') does not have to be moved at all in starting and stopping the machine. These factors all contribute to reduction of the expense of constructing and maintaining the machine, as well as facilitating the easy accurate adjustment of the various roll positions and the proper accurate retaining of such adjustments.

It will be further apparent that, with the above-described roll arrangement, each of the distributor and applicator rolls may be individually removed for repair or replacement without disturbing other rolls. This may be accomplished by the use of an overhead crane, supplemented by any suitable simple carriage means for supporting certain of the rolls as they are moved vertically and then endwise out of the machine. The rolls 23, for example, may be moved individually first upwardly and then endwise out of the machine upon disconnecting the fluid pressure operating units therefor. Similarly the applicator roll 22 may be removed by first lowering it below slideway 47 and then moving it endwise on a carriage out of the machine. To remove the rolls 21, 21', the rolls 23, 23' are first moved up to their upper positions, whereupon clearance will be available for moving rolls 21, 21' upwardly and slightly rearwardly out of contact with the other rolls. To remove the extra distributor roll 24 of the upper deck, the roll 20' is first thrust upwardly by its pressure operating units, whereupon sufficient clearance will be available for removing roll 24 upwardly and rearwardly. It will be apparent that rolls 20, 20' may be readily removed upwardly and rearwardly. The gate rolls 18, 19 may be removed by sliding them rearwardly on slideway 76, and then lifting them upwardly. It will be apparent that the back-up rolls 15 and 16 also may be slid for-

wardly and removed upwardly without disturbing any other rolls.

When the paper web breaks or the machine is to be stopped, the applicator rolls are first and immediately withdrawn from normal operating position, so that coating composition will not be applied to the rubber back-up rolls. Then the oscillating distributor rolls 20, 20' are promptly moved up to an inactive position to discontinue the supply of coating to the subsequent rolls, and, in the case of the upper deck, this is followed promptly by moving the extra distributor roll 24 out of contact with roll 21', or the rolls 20', 24 may be moved up substantially simultaneously, roll 20', however, going up slightly further than roll 24 so that they will come out of contact. In starting up the machine, to bring the rolls together, the order of movement of the various rolls is reversed.

While it will generally be preferred to use both pairs of applicator rolls in order to apply successively two coatings to each side of the paper, it will be apparent that either one of each of such pairs may be withdrawn from normal position by the fluid pressure operating units therefor, so as to apply only a single coating to each surface of the web.

The back-up rolls are provided with suitable drive means whereby they will have a surface speed equal to that of the paper running through the paper machine. The applicator rolls, however, are preferably driven by suitable means so as to have surface speeds slightly different from that of the paper, for example, five feet per minute faster in the case of applicator rolls 23, 22', applicator rolls 22, 23' preferably running faster still. This insures that the coating will be applied with a slight wiping action, contributing to the obtaining of a smooth "level" coat. The driving of the applicator rolls slightly faster than the paper, and the second of each pair slightly faster than the first, also assures that the paper, where it is being coated, will be maintained under slight extra tension, thus preventing any bulging or wrinkling effects and insuring that the paper surfaces being coated will be held firmly spread out against the velvet finished hard metal applicator rolls, whereas any irregularities in the thickness of the paper will be pressed into the rubber back-up rolls and thus not interfere with forming the desired level coating. Since no rubber rolls are brought into contact with the paper surfaces being coated, the troubles due to tackiness of rubber applicator rolls as heretofore used in this class of machine, are avoided.

Distributor rolls 21, 21' may be driven by suitable means to have surface speeds approximating that of rolls 23, 22', while the extra distributor roll 24 is driven somewhat slower, and the oscillating rolls, fountain rolls, and metering rolls still slower in succession.

Reference will now be had particularly to Figs. 3-6 inclusive, which illustrate a preferred arrangement of drive gearing for the various rolls, these figures showing such arrangement as applied to the lower "deck," but it will be understood that similar driving means is to be provided for the rolls of the upper "deck."

As will be apparent from Fig. 3, the shafts for each of the rolls respectively may be driven by flexibly coupled telescopic connections such as indicated generally at 80. That is, each of these connections may comprise a pair of flexible couplings as at 81, 82 of any suitable known type, permitting a considerable degree of angular

movement, these couplings being interconnected by telescoping shaft portions as at 83, 84, which are splined against relative rotational movement, but are free to telescope longitudinally, so that in view of the flexible couplings, each of the rolls of the coating machine may be adjusted in position and also moved into and out of active position as above described, without disconnecting the drive means therefor.

The back-up roll 15 may be driven from the same source of power as used to drive the paper machine.

The flexible drive connections for each of the applicator rolls, as at 23, etc., may be driven from individual variable speed motors as at 85, connected through suitable reduction gearing 86.

The drive gearings for the distributor rolls, including the vibrator roll and also for the gate rolls, are preferably all contained in a gear housing 87 (one such housing for each "deck"), the gearing therein all being driven by a single variable speed motor as at 88, so that if, for example, the speed of the gate rolls is either increased or decreased, then the speeds of the distributor rolls will all be increased or decreased in proportion, which is desirable for the proper control of the transfer of coating material from the gate rolls onto successive distributor rolls.

Referring now more particularly to Fig. 4, the shaft 88' of motor 88 extends into the housing 87 and has fixed thereon a pair of worm gears 89, 90, which respectively mesh with gears 91, 92, which are fixed to shafts 93, 94, respectively. Shaft 94 has sprocket and chain connections, as indicated at 95, 96, 97, 98, with shafts 21s, 20s. The latter shafts are for driving the distributor roll 21 and the vibrator roll 20. Suitable means of known type, as indicated at 99, are provided for adjustably tightening the chain 96.

Shaft 93 has sprocket and chain connecting means, as indicated at 100, 101 and 102 for driving shaft 18s, the latter shaft serving to drive the fountain roll 18. Suitable means of known type are provided, as indicated at 103 for adjustably tightening the chain 101.

A shaft 19s is provided for driving the metering roll 19 and such drive is dependent upon the drive for the fountain roll 18. The arrangement of gearing for this purpose will be readily apparent from Fig. 6 (see gears 104-108 inclusive). This arrangement of gearing insures that if anything should happen to interrupt the rotation of the fountain roll, the rotation of the metering roll will likewise be interrupted. Thus irregular wear or abrasion of one against the other will be avoided, for example, if the drive chain 101 or other parts of the drive for the fountain roll should break or become disconnected.

Reference will now be had to Figs. 7 and 8, which illustrate in further detail a typical bearing and associated parts as arranged for supporting and controlling the "vibrator" rolls.

The vibrator roll shaft end is indicated in Figs. 6 and 7 at 110 and same is mounted for rotation, as well as for endwise reciprocation in bearing 111, such bearing being carried in housing parts as at 112, 113 which have internal walls of spherical shape as shown, and these housing parts being carried in the slideway 70, hereinabove referred to, for permitting the roll to be shifted from active to inactive position and vice versa under the control of the hydraulic devices, such as at 74 (see Fig. 2). That is, device 74 acts to thrust the vibrator roll up to inactive position when the machine is stopped, the springs 71

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serving to supplement gravity, if desired, in returning the roll down to active position when the fluid is withdrawn from the hydraulic devices 74.

The outer end of shaft 110 carries a bearing 115, with respect to which the shaft is free to rotate, but with respect to which the shaft is not free to reciprocate. This bearing is held against rotation by guide pin 116, fixed at one end in the bearing block portion 113, the other end of pin 116 extending slidably through an opening 117 in a lug portion 118, which protrudes up from bearing 115. In order longitudinally to oscillate or "vibrate" the shaft 110 and consequently, the roll 20 carried thereby (or the roll 20'), a pair of hydraulic devices are provided as at 120, 121. One end of each of these devices, as shown, is suitably fixed as at 122, 123 with respect to the bearing assembly 115, and the other end of each of these devices is pivotally connected as at 124, 125 to the housing portion 113. It will be understood that the hydraulic devices 120, 121 comprise suitable well-known forms of cylinder and piston assemblies, so that when the pistons therein are reciprocated by control arrangements (hereinafter described in connection with Fig. 9), the bearing assembly 115, together with the shaft 110, will be reciprocated back and forth longitudinally.

As shown in Fig. 8, a control switch 127 may be secured at a suitable point along the guide pin 116 for controlling an electrical circuit, as hereinafter described, which in turn controls the valves for the hydraulic system for actuating the hydraulic devices 120, 121. The switch 127 may be actuated by a lever 128, which in turn is actuated by stops 129, 130 which are secured in adjustable positions along a rod 131, one end of such rod being fixed to the bearing assembly 115. The switch 127 may be of a suitable known type which, after the operating lever has been moved substantially to the limit of its travel in one direction, will snap into a position to connect one circuit, and when the operating arm is moved to the limit of its travel in the other direction, the switch will snap over to connect an alternative circuit. Preferably, the construction of the switch and the adjustment of the members 129, 130 are such that the alternative circuits will be connected in each case after the roll shaft 110 has travelled lengthwise for a distance of about one inch. The electrical connections for the switch 127 and their relationship to the hydraulic control apparatus will be hereinafter further described in connection with Fig. 9.

Referring now to the lower portion of Fig. 8, a piston rod extension for the hydraulic device 74 is indicated at 134. The upper end of this rod extension is suitably fixed with respect to the bearing block portion 112 as by hollow threaded member 135, which in turn is secured to the member 112 as by a flange portion 136, welded thereon and carrying threaded pins 137 which extend into the member 135, as shown. The member 135 is surrounded by a threaded nut 138, which may be adjusted longitudinally of the member 135 by engaging a wrench in radial apertures as at 140. The nut 138, as shown, is formed with a peripheral flange 141, adapted to engage the upper surfaces as at 142 formed on fixed frame portions 143. The flange portion 141 thus provides a stop means which determines the lowest position of travel of the bearings for the roll 20 (or roll 20') and the position of the adjusting nut 138 with respect to the rod extension 134, may be very accurately adjusted to deter-

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mine the pressure with which roll 20 bears against the adjacent rolls 18, 21 (or in the case of roll 20', the pressure with which same bears against rolls 18' and 24). Generally similar accurately adjustable stop means is provided for positioning each of the above-mentioned applicator rolls, as well as the additional distributor roll 24 of the upper "deck." However, it will be understood that in the case of the applicator rolls 22, 23, 22', 23', springs as at 71 will be omitted, inasmuch as the hydraulic devices for these rolls are double acting, whereas the hydraulic devices for the rolls 20, 20' and 24 are preferably single acting and serve only to thrust these rolls up to inactive position when the machine is stopped.

The provision of means for accurate adjustment of the applicator rolls when in active position is of particular importance, in that by this means one may accurately adjust the relative amounts of coating which pass, for example, from the roll 21 onto the rolls 22 and 23 and thence onto the paper. Usually it will be desired to apply about the same amount of coating by means of the two applicator rolls 22, 23 (as also in the case of the upper "deck" rolls 22', 23'). However, if desired, the stop means for rolls 23 and 22' may be so adjusted that these rolls, which are the first to apply coatings respectively to the two surfaces of the sheet, will apply a thicker coating; and, at the same time, rolls 22 and 23' may have their stop means so adjusted that they will apply a thinner finish coating. Conversely, if desired, the positions of rolls 23, 22' may be adjusted so that these rolls will apply the thinner coatings. The provision of individually adjustable stop means for each end of each of the adjustable rolls as herein described, makes it possible for the operator to very finely adjust the thickness of the coating along the length of each of the rolls quite independently of the adjustment of the other rolls, and without interfering therewith.

Referring now to the diagram of Fig. 9 showing the hydraulic control equipment, a fluid reservoir containing oil, for example, is indicated at 150. A motor driven pump 151 connected to this reservoir serves to provide, with the aid of an accumulator tank 152, a continuous supply of oil under pressure to line 153, having a plurality of branches, one for each control valve for each of the hydraulic control devices for the various rolls which have such devices. For example, a branch line 154 runs through a pressure reducing valve 154' and a shut-off valve, as indicated, and past a pressure gauge, into a four-way valve 155 which is operated in one direction by a solenoid 156 and in the other direction by a spring 157. This valve, normally when the machine is in operation, is held in one position by the solenoid then being energized and in this position, the valve permits fluid to be supplied to hydraulic device 52' for roll 23' in a direction so as to hold this roll down in active position. Then, when the current in solenoid 156 is cut off, the spring 157 will shift the position of valve 155 so as to admit fluid to the underside of the piston and hydraulic device 52' and to allow fluid to escape from the upper side of such piston, the escaping fluid passing through a return line 158 back to the reservoir 150. Similarly, when the solenoid 156 is again energized at the time the machine is to be started, the position of the valve 155 is shifted to allow fluid pressure to thrust the piston of device 52' downwardly while allowing fluid to escape from the underside of the piston back to the return line and reservoir.

An adjustable volumetric control valve 159 is preferably inserted in the line which admits the fluid into the hydraulic device 52' for forcing the roll 23' down into active position, this valve being adjustable so as to bring the roll into position as gradually as desired to prevent the stop means for its bearings from being jammed or injured. Also, the upper end of the cylinder of hydraulic device 52' may be connected to a small chamber as at 160 which will normally be filled partly with air and partly with liquid to provide cushioning means in the body of fluid so that the downward thrust of the roll 23' against the stop means for its bearing will be cushioned, even though the fluid is admitted at a quite rapid rate to insure prompt positioning of the roll.

The hydraulic control means for the other applicator rolls 22', 22 and 23, as will be apparent from Fig. 9, are the same as for roll 23', all being controlled through four-way solenoid and spring operated valves as at 155. Also, similar equipment may be used for operating the so-called pinch roll 30 in the lower "deck" by the hydraulic device 32 hereinabove mentioned, this device being also controlled by a four-way solenoid and spring-operated valve 155'. That is, when the machine is running and the solenoid of valve 155' is energized, the piston of hydraulic device 32 will be held in the left-hand position shown for holding the pinch roll away from the back-up roll 15; and when the solenoid valve is deenergized upon stopping the machine, this valve will be shifted to allow fluid to operate the piston of device 32 in the direction for bringing the pinch roll down to apply pressure to hold the paper against the back-up roll 15.

The hydraulic devices 74, 74' and 79 for moving the rolls 20, 20' and 24 act only in one direction, that is, to move the rolls out of position, and accordingly, these are controlled by three-way solenoid and spring-operated valves, as at 161. That is, with these valves, the solenoids are normally energized while the machine is operating and the solenoids act to hold the valves in a position such that the hydraulic devices 74, 74', 79 are simply connected to the liquid return line 158; but when the solenoids for valves 161 are released upon stopping the machine, they act to shift the valves under the influence of the valve springs to positions such that fluid pressure is applied to force the pistons of devices 74, 74', and 79 upwardly to move the rolls 20, 20' and 24, respectively, out of normal position and against the pressure of the springs 71.

The cylinders of devices 74, 74' and 79 are preferably made with extra space within the lower ends thereof, so as to accommodate further movement of the pistons downwardly in the event the roll surfaces become worn or are re-covered and the above-described stop means has to be readjusted to permit further downward travel of these pistons. Hence, if the liquid were allowed to drain completely out of these extra spaces in the lower ends of these cylinders, air might accumulate therein, thereby causing the pistons to operate with a jumpy movement when liquid pressure is again applied. To avoid this and to insure that these spaces always remain filled with liquid, the inlet connections thereto are preferably formed with upwardly directed gooseneck-like portions as at 162.

The pressure connections to the devices 74, 74' and 79 also preferably include adjustable volumetric control valves as at 163 of a suitable known type which will permit free flow therethrough in

one direction, but an adjustable limited rate of flow in the other direction. Thus, these valves may be arranged and adjusted so that, upon the application of liquid under pressure thereto from the valves 161, liquid may be admitted to devices 74, 74' at a faster rate than to the device 79, whereby rolls 20, 20' will be moved up more quickly and further than roll 24.

It may also be here noted that the pressure-reducing valves 154', as connected in the several branch pressure lines 154, 154a, etc., are each independently adjustable depending upon the weight of the corresponding roll structure which is to be elevated or held in place by the liquid under pressure flowing therethrough. That is, for example, applicator rolls 22 and 22' have to be held up under pressure against the rolls which contact therewith and against the action of gravity, and hence a relatively high pressure will be necessary in the pressure lines to devices 51, 51' during their normal operation while the machine is running. On the other hand, applicator rolls 23, 23' in normal operation will be held down in position by the action of gravity so as to apply pressure to the rolls which contact therewith and consequently, only a relatively low pressure is required through the pressure lines to devices 52, 52' during normal operation, yet the fluid pressure should, of course, be sufficient to raise these rolls 23, 23' fairly promptly against the action of gravity when the machine is to be stopped.

The volumetric control valves 159 which are located in the pressure lines to the hydraulic devices for the applicator rolls may be readily so adjusted as compared with the adjustments of the volumetric control valves 163 (for rolls 20, 20' and 24) that the several rolls will be moved to inactive position in the proper sequence as hereinabove described, assuming that all of the solenoids of valves 155 and 161 are deenergized concurrently.

The hydraulic circuits for oscillating the so-called "vibrator" rolls 20, 20' will now be described with particular reference to the control of roll 20' in the upper "deck." (Like control means is provided for roll 20 in the lower "deck" and thus need not be separately described, although shown in Fig. 9.) A branch pressure line 165 runs into a four-way double solenoid-operated valve 166, this valve being movable to one position by solenoid 167 and to its other position by solenoid 168. These solenoids are normally energized alternatively by the two-way switch 127 (operated in the manner above described in connection with Fig. 8), so that when the roll 20' is to be oscillated longitudinally in one direction, solenoid 167 will be energized, and during the reverse longitudinal movement of this roll, solenoid 168 will be energized. When valve 166 is in one position, pressure from branch line 165 will be admitted to pipe line 170, thence through branch lines 170a and 170b to hydraulic devices 121, 120 to operate these devices in one direction while liquid from the low pressure sides of the pistons thereof is allowed to escape through connections 171a, 171b and 171, back to valve 166, thence to branch return line 172. When the switch 127 is moved to its other position, say at the end of a one inch longitudinal travel of roll 20', then the position of valve 166 will be reversed, and the hydraulic devices 120, 120' will operate in the opposite direction.

Variable volumetric control valves 173 are preferably inserted in the lines 170 and 171 to permit

adjustment of the rate of oscillation of the oscillator roll.

It will be understood that the arrangement of control apparatus, as shown in Fig. 9, is for controlling the ends of the rolls at one side of the coating machine, and that a similar arrangement of controlling apparatus is provided for the other side of the machine, although the same reservoir, pump, and accumulator may be used for both sides, and, if desired, the branch line pressure regulating valves 154', and also valves 155, 161, etc., may be common to both sides of the machine.

The electrical control circuits for the solenoids of valves 155, 155', 161 and 166 will now be described with reference to Fig. 10.

As schematically indicated, a suitable known type of photoelectric relay apparatus 180 may be provided, the photocells of which may be located, as indicated at 181, at the left hand side of Fig. 9, in a position adjacent the sheet of paper passing through the machine, so that upon breakage of the sheet, the photoelectric relay is actuated. Normally, during operation of the paper machine, the photoelectric relay apparatus is conditioned to apply current to lines 182 (Fig. 10). For convenience, we will now refer first to that part of the circuit of Fig. 10 which is provided for the control of the "lower applicator rolls." A relay 183 having three contacts is so connected that, when the contacts are closed, solenoids 156 will be energized, these being the solenoids accompanying the valves 155, which control the connections for hydraulic devices 51, 52 for the lower applicator rolls (Fig. 9). As will be apparent from Fig. 10, relay 183 is under the control of "start" and "stop" buttons; that is, the "stop" button is held normally closed by a spring, and the "start" button is held normally in open condition also by a spring. With the connections as shown, it will be apparent that when the "start" button is momentarily pressed, a circuit will be established through the magnet of relay 183 (assuming that lines 182 are energized and thus this relay will be closed and will be maintained closed upon release of the "start" button by reason of a holding circuit provided through the normally closed contacts of the "stop" button. Thus, solenoids 156 will continue to be energized through relay 183 until such time as the holding circuit through the relay is interrupted by momentarily pressing the "stop" button, whereupon the relay contacts will be opened and the solenoids 156 deenergized. As above explained, whenever the solenoids 156 are energized, the hydraulic control devices for the applicator rolls will be subjected to pressure in a direction to hold the applicator rolls in active position.

From inspection of Fig. 10, it will be apparent that similar circuits are provided for the control of the upper applicator rolls, the upper distributing rolls, the upper vibrating roll; also for the pinch roll 30 and for the lower vibrating roll. In the control circuits for all the upper rolls, the "stop" and "start" button equipment may be duplicated at upper and lower levels, as schematically indicated at 184 and 185, for example, to permit the operator to control the upper rolls, either while he is standing at the upper deck, or while he is at the floor level.

As indicated at the left hand end of Fig. 10, a similar "stop" and "start" button and relay control circuit is provided for controlling a solenoid 186, which in turn controls a valve 187, located in the pipe line through which the coating

mixture is being fed to the fountain rolls of the machine.

It will be understood that each of the several lower "stop" buttons of the circuits of Fig. 10 may be operated individually, or, if desired, any simple bar or the like may be mechanically arranged so that all of these "stop" buttons may be pressed simultaneously; and similarly, all of the lower "start" buttons may be arranged to be pressed individually or simultaneously.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various further modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains. Reference should accordingly be had to the appended claims in determining the scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. In a machine for coating sheet material, the combination comprising a series of contacting rolls for metering the coating composition and then distributing same onto applicator means, a pair of side frame members on which said rolls are journaled, pivots adjacent the metering roll means for supporting said frame members for pivotal movement about an axis parallel to the roll axes, adjustable screw means for moving said pivots in a direction transverse to the roll axes to move the frame members and rolls as a unit toward or from the applicator means, and adjusting screw means adjacent the applicator means for there supporting said frame members at a variable height, whereby adjustment of said latter screw means acts to tilt the frame members and rolls as a unit about said pivots to vary the distributor roll elevation with respect to the applicator means.

2. In a machine for coating sheet material, the combination comprising a distributor roll journaled on a horizontal axis, means for delivering coating composition at a predetermined rate onto said roll, a back-up roll around which the sheet material is carried while being coated, said back-up roll being journaled on an axis parallel to that of said distributor roll and having its surface spaced substantially to one side from the surface of said distributor roll, a pair of applicator rolls journaled normally in positions whereby the surface of each is substantially tangent to the surfaces of both said distributor roll and said back-up roll, the axes respectively of said applicator rolls being above and below the plane which is common to the axes of said distributor and back-up rolls, frame means constructed and arranged to slidably receive the journals for said applicator rolls and permit movement thereof upwardly and downwardly, and power means connected to the applicator roll journals for slidably moving each of same, whereby either or both of said applicator rolls may be brought into said normal tangential relationships with the other rolls or in separated relation thereto.

3. In a machine for coating sheet material, the combination comprising a distributor roll journaled on a horizontal axis, means including a metering roll for delivering coating composition at a predetermined rate onto said distributor roll, a back-up roll around which the sheet material is carried while being coated, said back-up roll being journaled on an axis parallel to that of said distributor roll and having its surface spaced substantially to one side from the surface of said

distributor roll, a pair of applicator rolls journaled normally in positions whereby the surface of each is substantially tangent to the surfaces of both said distributor roll and said back-up roll, the axes respectively of said applicator rolls being above and below the plane which is common to the axes of said distributor and back-up rolls, frame means constructed and arranged to slidably receive the journals for said applicator rolls and permit movement thereof respectively upwardly and downwardly from their normal positions, and power means connected respectively to the journals of said applicator rolls for slidably moving each of same, whereby the upper applicator roll may be forced up into spaced relation to the distributor and back-up rolls or lowered to said normal tangential relation thereto, and the lower applicator roll may be forced up into its said normal tangential position or lowered into spaced relation to the distributor and back-up rolls.

4. In a machine for coating sheet material, the combination comprising a rubber-covered distributor roll journaled on a horizontal axis, means for delivering coating composition at a predetermined rate and as a thin layer onto said roll, a rubber-covered back-up roll around which the sheet material is carried while being coated, said back-up roll being journaled on an axis parallel to that of said distributor roll and having its surface spaced substantially to one side from the surface of said distributor roll, and a pair of chrome-plated applicator rolls journaled normally in positions whereby the surface of each is substantially tangent to and under pressure against the surfaces of both said distributor roll and said back-up roll, said distributor roll serving to distribute the layer of coating composition carried thereby, partly on each of said applicator rolls in succession in the form of films, each of substantially uniform thickness, said chrome-plated applicator rolls serving to release and apply the films carried thereby onto the sheet material as successive level coatings while pressing the sheet surface areas being coated, into level condition, the rubber on the back-up roll being sufficiently resilient to meanwhile accommodate irregularities in the thickness of the sheet.

5. In a machine for coating sheet material, the combination comprising a rubber-covered back-up roll around which the sheet material is carried while being coated, and a pair of chromium-covered applicator rolls journaled normally in positions whereby the surface of each rotates under pressure against the sheet material on said back-up roll, means for delivering coating composition at a predetermined rate onto each of said applicator rolls in the form of films, each of substantially uniform thickness, said chromium-covered applicator rolls serving to release and apply said films onto the sheet material as successive coatings while pressing the sheet surface areas being coated, into level condition, the rubber on the back-up roll being sufficiently resilient to accommodate irregularities in the thickness of the sheet while same is thus under pressure.

6. In a machine for coating sheet material, the combination comprising a rubber-covered distributor roll journaled on a horizontal axis, means for delivering coating composition at a predetermined rate and as a thin layer onto said roll, a rubber-covered back-up roll around which the sheet material is carried while being coated, said back-up roll being journaled on an axis parallel to that of said distributor roll and having

its surface spaced substantially to one side from the surface of said distributor roll, and a velvet-finished chromium-covered applicator roll journaled normally in position whereby its surface is substantially tangent to and under pressure against the surfaces of both said distributor roll and said back-up roll, said distributor roll serving to distribute coating composition carried thereby in the form of a film of substantially uniform thickness on said applicator roll, the chromium covering of the applicator roll serving to release and apply such film onto the sheet material as a level coating while pressing the sheet surface areas being coated, into level condition, the rubber on the back-up roll being sufficiently resilient to accommodate irregularities in the thickness of the sheet while same is thus under pressure.

7. In a machine for coating paper and the like sheet material, the combination comprising a plurality of normally substantially contacting rolls journaled side-by-side in a series and including a distributor roll, a back-up roll spaced to one side therefrom and around which the paper is carried during coating thereof, gate roll means spaced to the other side from said distributor roll, at least one intermediate distributor roll for carrying coating composition from said gate roll means onto said first-named distributor roll, an applicator roll for carrying coating from said first-named distributor roll and applying it to the paper on said back-up roll, frame means having slideways which extend transversely of the series of rolls for slidably receiving the journals for said intermediate distributor and applicator rolls, and power means connected respectively to the journals of each of intermediate distributor and applicator rolls to move same along said slideways for opening the nips between all the rolls while the other rolls remain in normal position.

8. In a machine for coating paper and the like sheet material, the combination comprising means for metering, distributing and forwarding coating composition to an applicator, said means including a series of normally substantially side-by-side contacting rolls; viz. a metering roll, a fountain roll, two intermediate distributor rolls and a final distributor roll, one of said intermediate rolls partially overlying said fountain roll, a pair of side frame members on which said rolls are journaled, said frame members having slideways for the roll journals, the slideways for said fountain and metering roll journals being directed horizontally, and those for the intermediate roll journals being directed upwardly and rearwardly, whereby the nips between all said rolls may be independently adjusted or opened.

9. In a machine for coating paper and the like sheet material, the combination comprising a plurality of normally substantially contacting rolls journaled side by side in a series for metering, distributing and applying coating material to the sheet material, fluid-operated cylinder and piston devices connected to the bearings of certain of said rolls for thrusting same out of contact with adjacent rolls when the machine is to be rendered inactive, a source of fluid under pressure for actuating said devices, connections from said source individual to said devices for each of said certain rolls, an adjustable pressure reducing valve and also an adjustable volumetric control valve in each of said connections, and additional valve means in each of said connections for alternatively admitting fluid to said devices for each of said certain rolls to actuate same in one direction or to release such fluid from said devices

when the pistons therein are to be moved in the reverse direction.

10. In a machine for coating paper and the like sheet material, the combination comprising means for guiding the sheet material through the machine, a plurality of normally substantially contacting rolls journaled side by side in a series for metering, distributing and applying coating material to the sheet material, fluid-operated cylinder and piston devices connected to the bearings of certain of said rolls for thrusting same out of contact with adjacent rolls when the machine is to be rendered inactive, a source of fluid under pressure for actuating said devices, connections from said source individual to said devices for each roll, solenoid-operated valve means in each of said connections for alternatively admitting fluid to each of said devices to actuate same in one direction or to release such fluid from said devices when the pistons therein are to be moved in the reverse direction, photo-electric relay apparatus operable in response to breakage of the sheet material running through the machine, and electrical circuits controlled by said relay apparatus and connected to control the solenoids of said valve means to actuate the latter and thus cause actuation of said devices upon said breakage of the paper.

11. In a machine for coating paper and the like sheet material, the combination comprising a distributor roll, means for supplying coating material thereto, a back-up roll spaced to one side from said distributor roll and around which the paper is carried during coating thereof, a pair of applicator rolls for carrying coating from said distributor roll and applying it to the paper on said back-up roll, frame means having slideways which extend transversely of the rolls for slidably receiving the journals for said applicator rolls, fluid-operated cylinder and piston devices connected to the journals of said applicator rolls for thrusting same in opposite directions out of contact with said distributor and back-up rolls when either applicator roll is to be rendered inactive, a source of fluid under pressure for actuating said devices, connections from said source individual to said devices for each applicator roll, adjustable pressure reducing valves in each of said connections, solenoid-operated valve means in each of said connections for alternatively admitting fluid to said devices to actuate same in one direction or to release such fluid from said devices when the pistons are to be moved in the reverse direction, and electrical connections controlling said solenoid-operated valve means for each applicator roll concurrently or individually, whereby the applicator rolls may both be moved to inactive position or one may be moved to inactive position when but a single coating is to be applied to the paper.

12. In a machine for coating paper and the like sheet material, the combination comprising means for guiding the sheet material through the machine, a plurality of normally substantially contacting rolls journaled side by side in a series for metering, distributing and applying coating material to the sheet material, fluid-operated cylinder and piston devices connected to the bearings of certain of said rolls for thrusting same out of contact with adjacent rolls when the machine is to be rendered inactive, a source of fluid under pressure for actuating said devices, connections from said source individual to

said devices for each roll, solenoid-operated valve means in each of said connections for alternatively admitting fluid to said devices to actuate same in one direction or to release such fluid from said devices when the pistons thereof are to be moved in the reverse direction, and electrical control means for simultaneously operating the solenoids of said valve means upon breakage of the sheet material, and said fluid connections having therein adjustable volumetric control valves whereby the rate of movement of said devices for each roll may be controlled individually.

13. In a machine for coating paper and the like sheet material, the combination comprising a distributor roll covered with resilient material, means for supplying coating material thereto, a back-up roll covered with resilient material and spaced to one side from said distributor roll and around which the paper is carried during coating thereof, a velvet-finished metal-covered applicator roll for carrying coating from said distributor roll and applying it to the paper on said back-up roll, means for normally holding said applicator roll under substantial pressure against said distributor roll and against the paper on the back-up roll, and driving means for said rolls respectively, the driving means for the applicator roll normally driving same at a surface speed somewhat greater than the surface speed of said back-up roll.

14. In a machine for coating paper, the combination comprising a distributor roll having a resilient covering and journaled on a horizontal axis, means for delivering coating composition at a predetermined rate and as a thin layer onto said roll, a back-up roll having a resilient covering and around which the paper is carried while being coated, said back-up roll being journaled on an axis parallel to that of said distributor roll and having its surface spaced substantially to one side from the surface of said distributor roll, and an applicator roll having a metal covered surface and journaled normally in a position whereby its surface is substantially tangent to and under pressure against the surfaces of both said distributor roll and said back-up roll, said distributor roll serving to distribute coating composition carried thereby in the form of a film of substantially uniform thickness on said applicator roll, the metal covering of the applicator roll serving to release and apply such film onto the paper as a level coating while pressing the paper surface areas being coated, into level condition, the resilient surface on the back-up roll accommodating irregularities in the thickness of the paper while same is thus under pressure.

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