June 22, 1954 J. S. FRIDOLPH 2,681,636

PAPER COATING MACHINE

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Fig-1

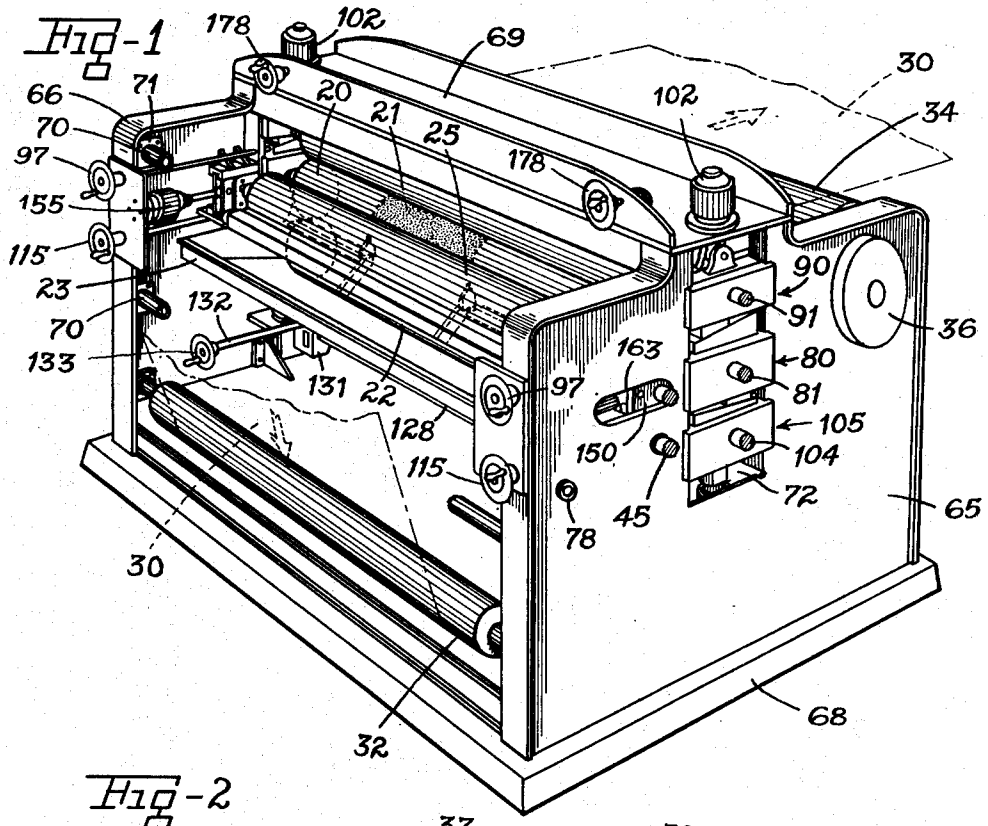
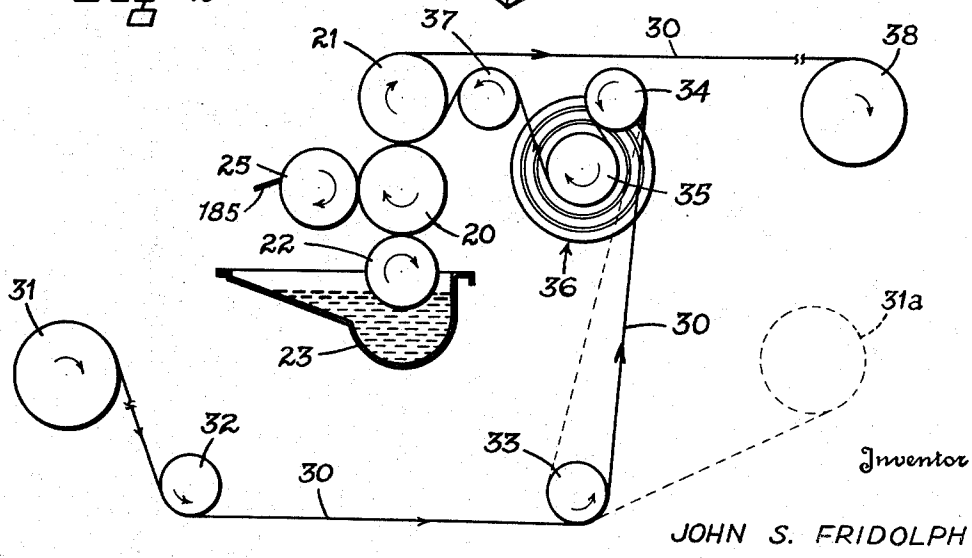


Fig-2



Inventor

JOHN S. FRIDOLPH

By

Marechal & Biebel

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PAPER COATING MACHINE

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Fig-3

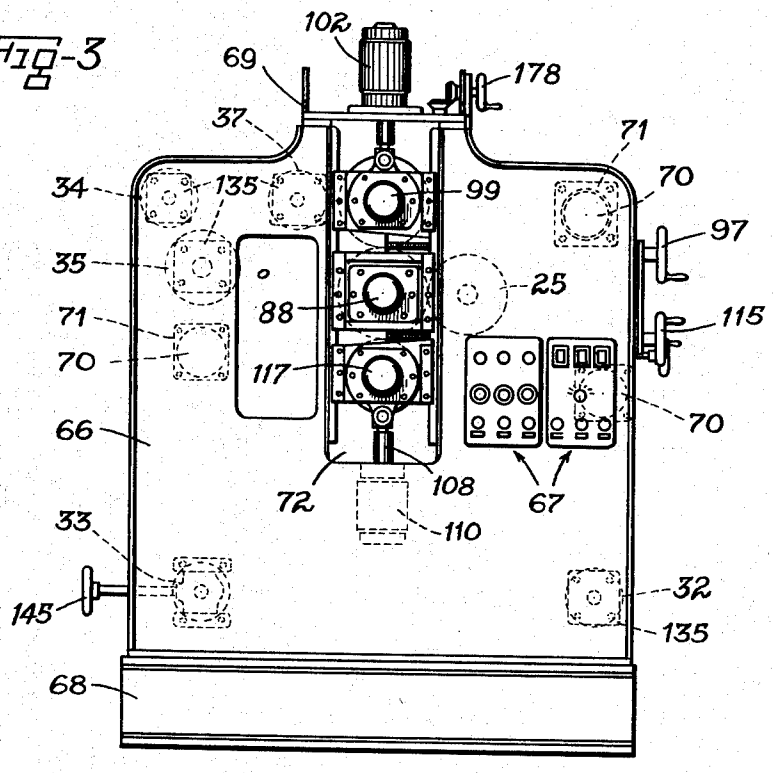


Fig-5

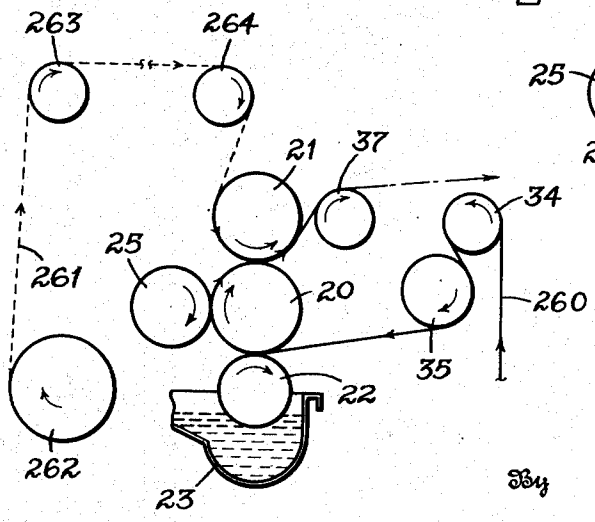
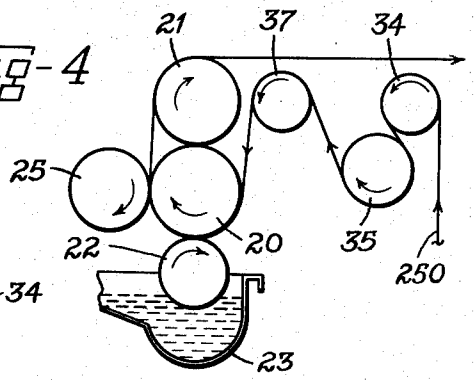


Fig-4



Inventor

JOHN S. FRIDOLPH

By

Marechal & Biebel

ATTORNEYS

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PAPER COATING MACHINE

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Fig-6

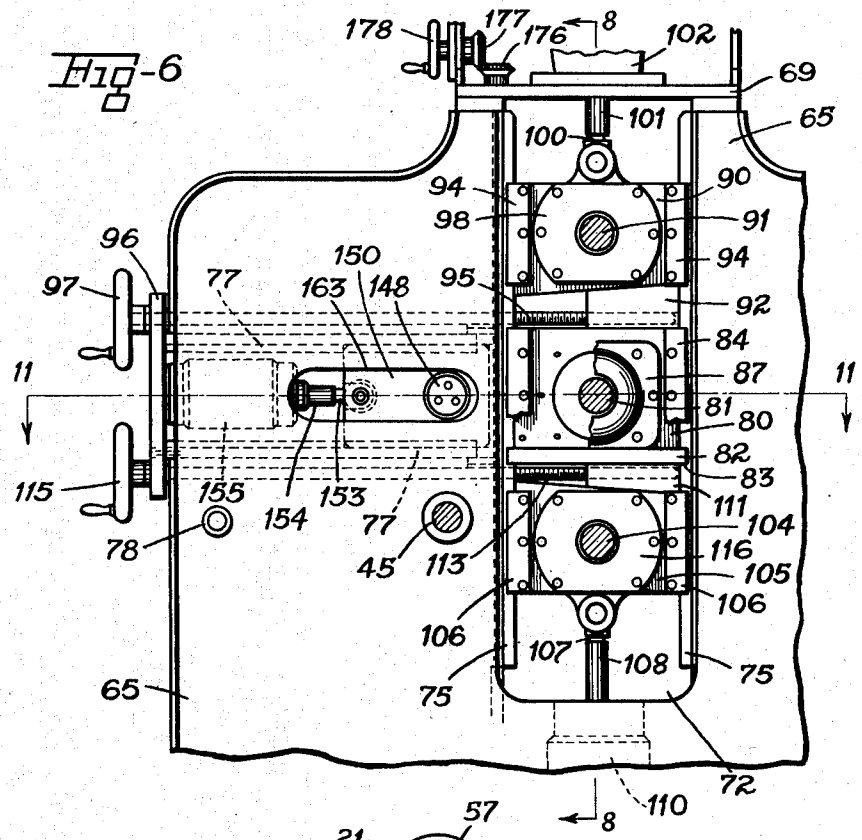
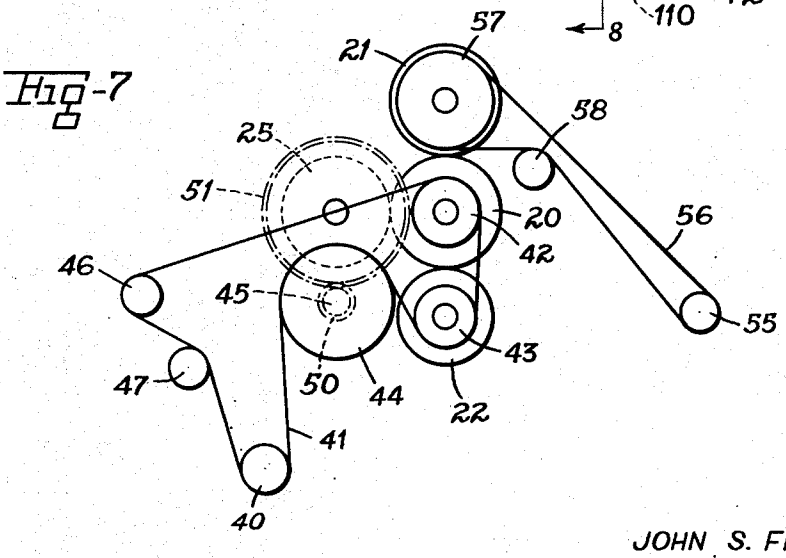


Fig-7



Inventor

JOHN S. FRIDOLPH

By

Marshall & Bibel

ATTORNEYS

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PAPER COATING MACHINE

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Fig-8

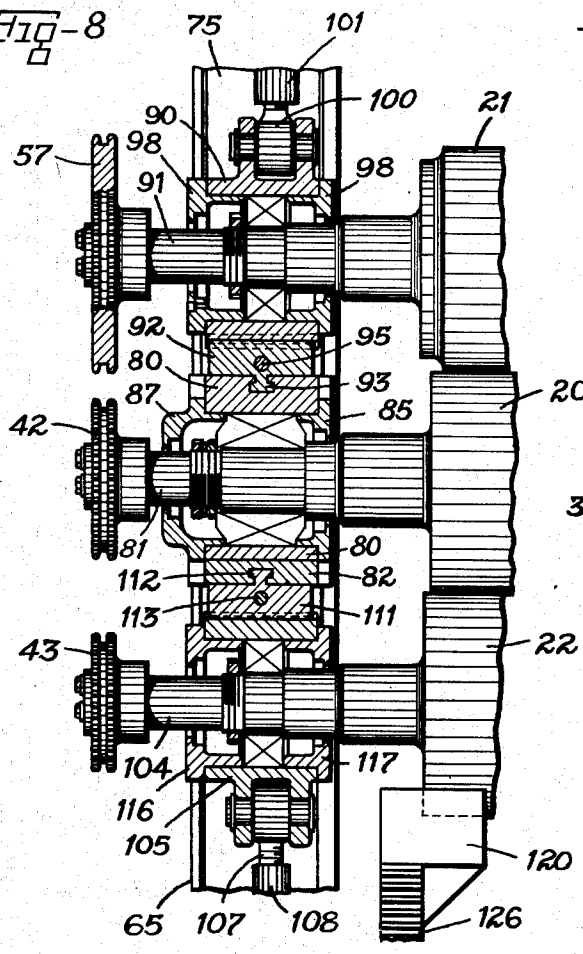
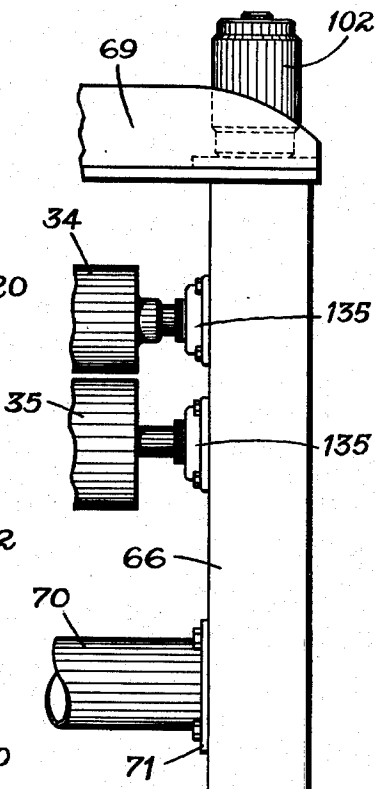


Fig-9



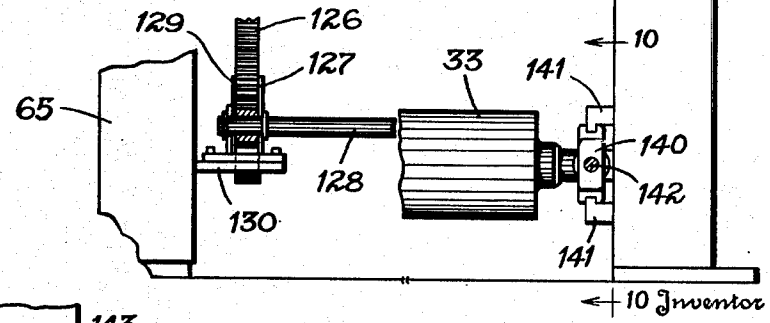
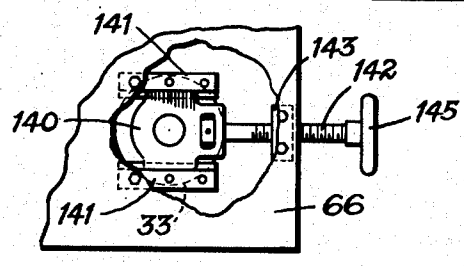


Fig-10



Inventor

JOHN S. FRIDOLPH

By

Marechal & Biebel

ATTORNEYS

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PAPER COATING MACHINE

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Fig-11

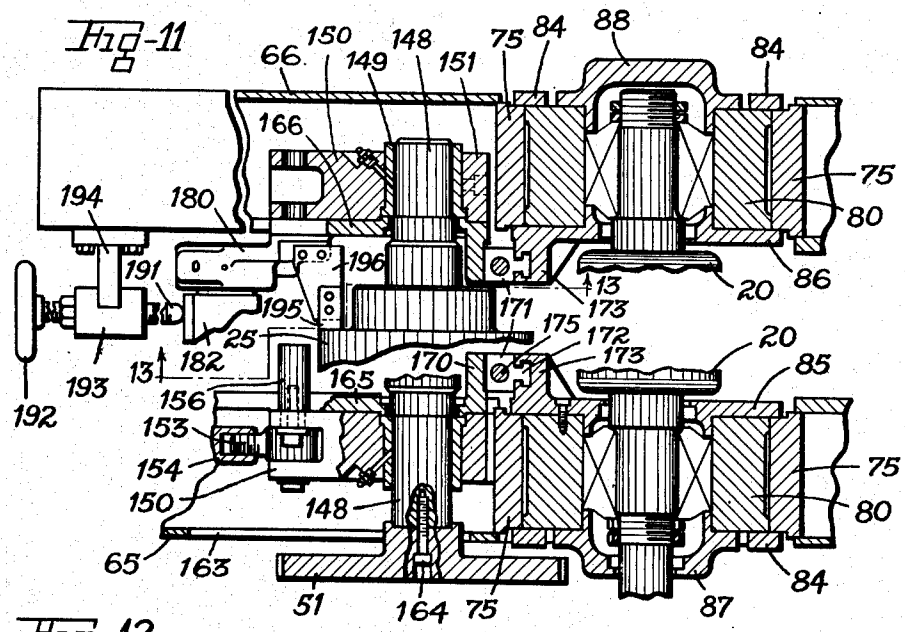


Fig-12

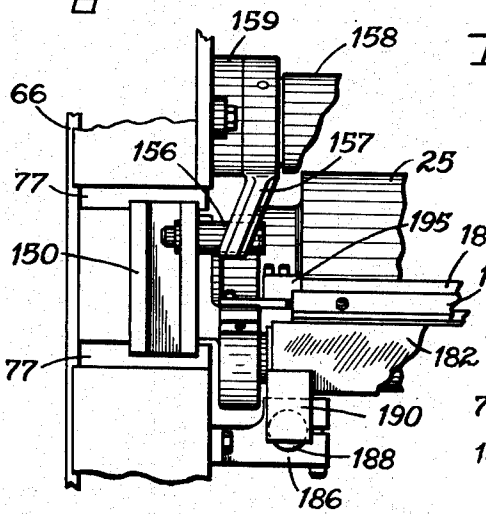


Fig-13

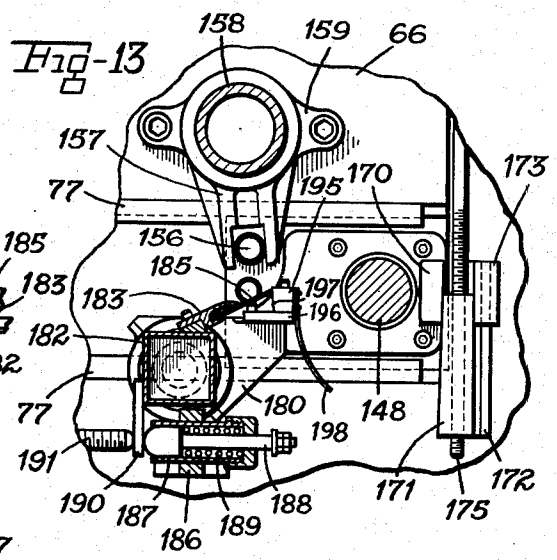
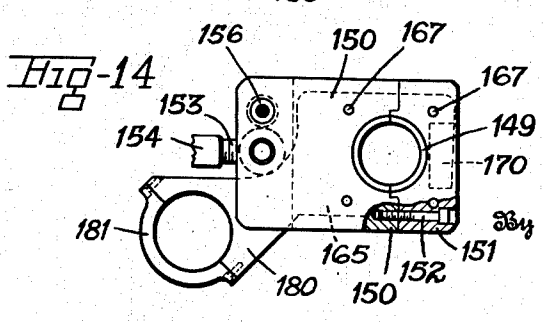


Fig-14



Inventor

JOHN S. FRIDOLPH

By

Marechal & Biebel

ATTORNEYS

June 22, 1954 J. S. FRIDOLPH 2,681,636

PAPER COATING MACHINE

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Fig-15

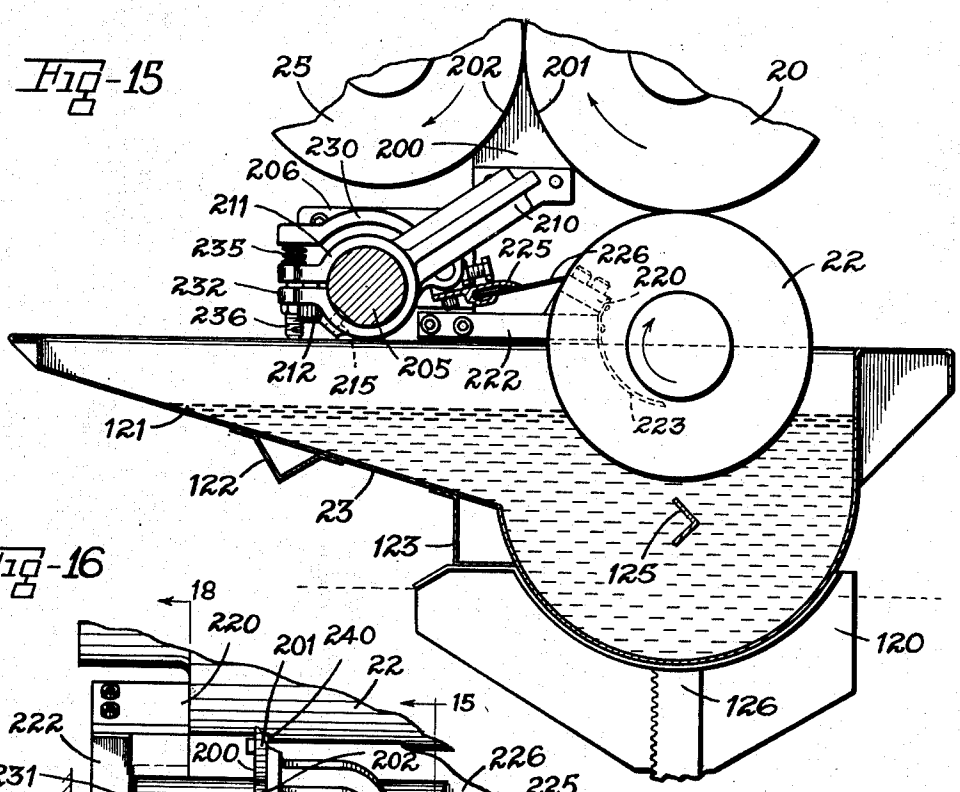


Fig-16

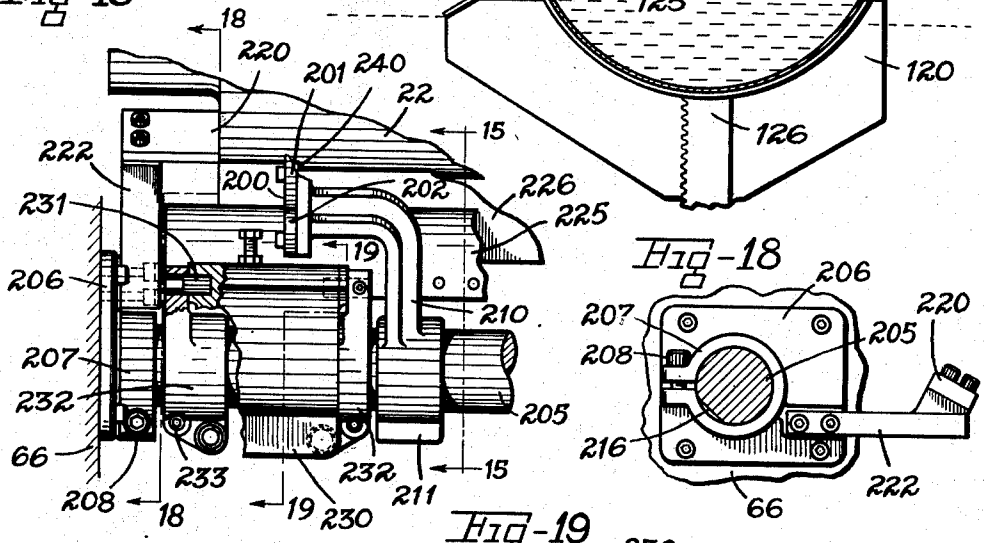


Fig-18

Fig-19

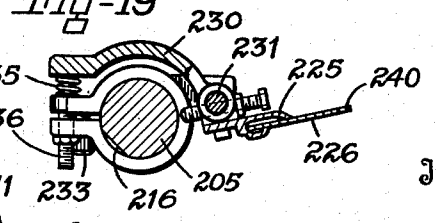
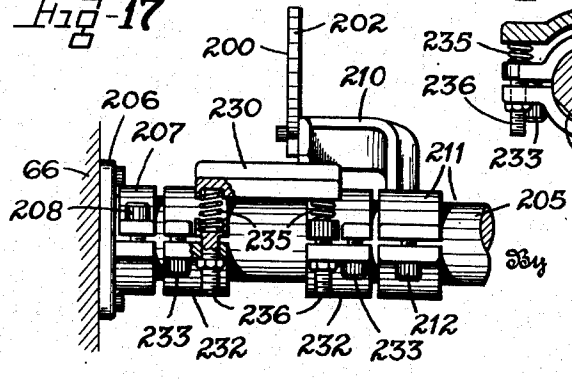


Fig-17



Inventor

JOHN S. FRIDOLPH

By

Marechal & Biebel

ATTORNEYS

Patented June 22, 1954

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UNITED STATES PATENT OFFICE

2,681,636

PAPER COATING MACHINE

John S. Fridolph, Middletown, Ohio, assignor to The Black-Clawson Company, Hamilton, Ohio, a corporation of Ohio

Application January 15, 1951, Serial No. 206,029

11 Claims. (Cl. 118—249)

1

This invention relates to apparatus for applying coatings to web materials such as paper.

One of the principal objects of the invention is to provide web coating apparatus of the reverse roll type in which the coating applied to the web may be controlled with a high degree of accuracy both with respect to the uniformity of thickness thereof and also with respect to the width of the coated area, and thus to provide such apparatus which will be capable of producing uniform results with a wide range of coating compositions.

These desired results are achieved in accordance with the invention by means of web coating apparatus of the reverse roll type in which the coating roll is mounted in fixed position in the supporting frame, and a feed roll and an impression roll are mounted in adjustable relation with the coating roll in positions respectively below and above the coating roll and are provided with individual adjusting and pressure applying units for controlling their effective nip clearances with the coating roll. In addition, a metering or doctor roll is mounted to form a metering nip with the coating roll at a position intermediate the feed and impression rolls and is adjustable laterally with respect to the coating roll to control the effective thickness of the coating carried by the coating roll to the nip thereof with the impression roll. Guide rolls and a tensioning roll are also mounted in the same frame with the other rolls for selectively controlling the web travel to and from the coating roll as desired.

It is a further object of the invention to provide such web coating apparatus wherein the several operating rolls and guide rolls are so mounted and arranged that the direction of web travel may be readily selected to adapt the apparatus to applying a finish coating on a single web or to laminating a plurality of webs as desired.

Another object of the invention is to provide such web coating apparatus in which the coating roll is arranged in generally horizontal relation with the metering or doctor roll in such relation with the position of initial application of coating composition to the coating roll that the coating on the coating roll is carried upwardly into the nip of the coating and metering rolls to provide an inverted fountain at which the coating is metered to the desired thickness for the web, with the metering roll being driven in such direction that the surface thereof moves downwardly through this metering nip to carry off surplus coating composition and with the metering roll being equipped with doctor or wiper members for

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cleaning such surplus coating composition therefrom.

An additional object is to provide web coating apparatus having the above inverted fountain arrangement at the metering nip thereof in which the effective width of the metered coating on the coating roll is determined and controlled by means of adjustable end dams mounted in predetermined relation with the coating roll such that the coating composition in the metering nip is retained within the desired limits axially of the coating roll, and in which provision is also made for initially limiting the effective width of the coating applied to the coating roll ahead of the metering nip in accordance with the adjusted spacing of the end dams.

It is also an object of the invention to provide web coating apparatus including a coating roll and a feed roll for applying the coating composition to the coating roll in which wiping members are arranged to limit the effective width of the coating transferred from the feed roll to the coating roll by removing the coating composition from the ends and the end portions of the face of the feed roll ahead of the nip formed by the feed and coating rolls in accordance with the effective width of coating to be applied to the web by the coating roll.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

Fig. 1 is a somewhat diagrammatic and simplified view in perspective illustrating the general appearance of web coating apparatus in accordance with the invention and with the drive members broken away for clarity of illustration;

Fig. 2 is a schematic view illustrating the direction of passage of the web through the apparatus in a reverse roll coating operation with the coating being metered before application to the web;

Fig. 3 is a view in elevation of the control side of the apparatus;

Fig. 4 is a schematic view illustrating a coating operation of the apparatus in which the coating is metered after application to the web;

Fig. 5 is a view similar to Fig. 4 illustrating the operation of the apparatus for laminating;

Fig. 6 is a fragmentary view in side elevation of the control side of the apparatus to show the adjustable mountings of certain of the rolls, the view partly broken away to illustrate details of internal construction;

Fig. 7 is a schematic view of the drive arrangement for the several rolls of the apparatus;

Fig. 8 is a fragmentary section on the line 8—8 of Fig. 6;

Fig. 9 is a fragmentary view of the front end of the machine;

Fig. 10 is a fragmentary view on the line 10—10 of Fig. 9;

Fig. 11 is a fragmentary view in horizontal section taken on the line 11—11 of Fig. 6;

Fig. 12 is a fragmentary view in elevation showing the mounting arrangement for the metering roll, looking from left to right in Fig. 13;

Fig. 13 is a fragmentary section on the line 13—13 of Fig. 11;

Fig. 14 is a detail view partly in side elevation and partly broken away showing one of the bearing housings for the metering roll;

Fig. 15 is a fragmentary view in vertical section showing the arrangement of the end dam and wiping doctors at the control side of the apparatus, the view being generally in section on the line 15—15 of Fig. 16;

Fig. 16 is a fragmentary plan view of the end dam and doctor arrangement of Fig. 15;

Fig. 17 is a fragmentary side elevational view looking from left to right in Fig. 15 and with parts broken away to illustrate structural details;

Fig. 18 is a fragmentary section on the line 18—18 of Fig. 16; and

Fig. 19 is a fragmentary view on the line 19—19 of Fig. 16.

Referring to the drawings, which illustrate a preferred embodiment of the invention, Figs. 1, 2 and 3 show the general arrangement and operative relation of certain of the major component parts of the web coating apparatus, in which a coating roll 20 is mounted for rotation in fixed location and in vertical alignment with an impression roll 21 and a feed roll 22, each vertically adjusted with respect to the roll 20 and with the feed roll extending into a pan 23 adapted to contain a supply of coating composition. A metering or doctor roll 25 is mounted with its axis in the same horizontal plane as the axis of the coating roll 20 and is adjustable with respect to roll 20 in this horizontal plane to vary the effective clearance at the nip thereof.

Fig. 2 illustrates the operative relation of these several rolls in carrying out a reverse roll coating operation on a web 30, which is shown as passing from a supply roll 31 around a guide roll 32, a squaring roll 33, a guide roll 34, a tensioning roll 35 having a brake or clutch 36, a guide roll 37, through the nip of rolls 20 and 21, and around roll 21 to a wind-up roll 38. Thus with the rolls rotating in the directions indicated by the arrows in Fig. 2, the coating composition in pan 23 is first applied to the coating roll by the feed roll 22, and this coating is metered at the inverted fountain provided by the metering nip of rolls 20 and 25 before application to the web at the nip of rolls 20 and 21. It will also be noted that if desired, the supply roll may be located on the same side of the machine as the wind-up roll, as indicated at 31*a* in Fig. 2, to leave the opposite side of the machine open and unobstructed for ready access.

Fig. 7 illustrates schematically a drive arrangement found satisfactory for the apparatus. The coating roll 20, feed roll 22 and metering roll 25 are shown as driven by a common motor 40 through a chain 41 running around sprockets 42 and 43 on rolls 20 and 22 respectively, a sprocket 44 on a shaft 45, a fixed idler 46 and a tensioning idler 47. The rolls 20 and 22 are thus directly driven by chain 41 at relative speeds determined by the number of teeth on sprockets 42 and 43 respectively, and the shaft 45 carries a pinion 50 meshing with a drive gear 51 on metering roll 25. A separate drive is provided for the impression roll 21 from a reversible motor 55 through a chain 56, a sprocket 57 on roll 21 and a tensioning idler 58.

The major structural members of the apparatus include an end stand 65 at the drive side of the apparatus and a similar end stand 66 at the control side of the apparatus, on which control panels are indicated diagrammatically at 67. These stands are supported on a common base 68 and are connected in spaced relation by a top brace 69 and a plurality of cross ties 70. Three of these cross ties 70 are shown, and they have squared ends 71 bolted to the respective end stands 65 and 66. Each of the end stands is formed with a deep slot 72 at the upper end thereof to receive the bearing blocks or bearing housings for the several rolls 20, 21 and 22 and these slots are provided with vertical plates or bars 75 at either side thereof which form tracks for the adjusting movements of the bearing blocks for rolls 21 and 22 with respect to roll 20. Similarly each of the end stands 65 and 66 is provided with a pair of horizontal channeled tracks 77 for receiving and guiding the bearing blocks for the metering roll 25 in adjustable relation with coating roll 20, and the bearing in end stand 66 for the shaft carrying idler 46 is indicated at 78 in Fig. 6.

The bearing blocks 80 for the journals 81 of coating roll 20 are supported in stationary position in each of the end stands 65 and 66 by means of a bar 82 set in an opposed bar of notches 83 in the tracks 75. Gibs 84 are bolted to the block 80 in overlapping relation with the outer edges of tracks 75, and inside caps 85 and 86 are also bolted to the block 80 and include guide portions similarly overlapping the inner edges of the tracks. An outer end cap 87 at the drive side of the apparatus is apertured to receive the shaft extension on journal 81 for the sprocket 42, and the other end cap 88 at the control side of the apparatus is closed to enclose the bearing as shown in Fig. 11.

The bearing blocks 90 for the journals 91 of the impression roll 21 are supported on the respective bearing blocks 80 by means of horizontally adjustable wedge members 92 each having a tapered upper surface engaging the oppositely tapered lower surface of the bearing block 90. The wedge 92 has a T-shaped extension 93 along the lower side thereof slidable in a complementary slot in the upper surface of bearing block 80 to maintain the wedge in guided relation with the bearing blocks, and gibs 94 are bolted to both sides of the bearing block 90 to maintain the block in guided relation with the tracks 75. These parts are duplicated at both ends of the apparatus, and adjusting movement of each wedge 92 is effected by a shaft 95 threaded in the wedge and extending outwardly beyond the end stands 65 and 66 through a bearing plate 96, to receive a hand wheel 97.

The bearing block 90 is provided with apertured end caps 98 at the drive side of the apparatus to receive the shaft extension on journal 91 for the sprocket 57, and at the control side of the apparatus, the bearing block 90 is provided with a similarly apertured inner end cap 98 and a closed outer end cap 99. Each

of the bearing blocks 90 is also provided with an integral yoke portion on its upper side for receiving a connecting link 100 to the piston rod 101 of an air cylinder 102 mounted on top brace 69 for applying pressure to roll 21 in the direction of the coating roll 20. With the arrangement of wedges 92 as described, the minimum spacing of bearing blocks 80 and 90 is readily determined to control the effective width of the nip of rolls 20 and 21 under the pressure of cylinders 102.

A similar adjustable mounting arrangement is provided for the journals 104 of the feed roll 22 and includes bearing blocks 105 at each end of the roll which are slidably guided in tracks 75 by gibs 106 and include integral yoke portions for receiving the links 107 connecting with the piston rods 108 of air cylinders 110 mounted in the lower portion of each end stand. The upper surface of each bearing block 105 is tapered for engagement with the oppositely tapered surface of an adjusting wedge 111 having a T-shaped extension 112 thereon slidable in a complementary slot in the under side of the bar 82. Each wedge 111 is provided with a threaded adjusting shaft 113 similar to the shaft 95 and having a hand wheel 115 located below the hand wheel 97 as shown. The end caps 116 and 117 for the bearing blocks 105 are shown as of the same construction as described for the bearing blocks 90.

In addition to the adjustable mounting of the feed roll 22, the container pan 23 is provided with an adjustable mounting shown in Figs. 1, 8 and 15. The two ends of the pan are each received in one of a pair of supporting stirrups 120 at opposite sides of the apparatus, the pan including a semi-cylindrical lower portion seating in the complementary shaped stirrups. The pan also includes a shallow portion 121 of substantial width which extends well beyond the metering roll 25 to receive any coating composition dripping therefrom and also to provide a substantial surface area of coating composition in the pan without requiring an excessive volume thereof. Stiffening members 122 and 123 are provided on the pan, with the member 123 also serving as a shoulder for seating on the upper surface of the stirrup members 120 to prevent tipping of the pan. A baffle 125 extends lengthwise of the pan in closely spaced relation below roll 22 to cooperate with the roll as it rotates in promoting even circulation of the coating composition in the pan while reducing possible aeration thereof.

The stirrup 120 at the drive side of the apparatus is supported for vertical adjustment by a vertical rack 126 meshing with a pinion 127 supported on a shaft 128 in a housing 129 mounted on a bracket 130 extending from the side frame 65. The shaft 128 extends across the apparatus to a housing 131 (Fig. 1) containing a duplicate arrangement of rack and pinion, and the housing 130 also contains a drive arrangement such as a worm and pinion (not shown) operated by a shaft 132 and hand wheel 133 to raise and lower the racks and thus to adjust the effective height of pan 23 and also to permit ready lowering of the stirrups 120 for removal of the pan for cleaning or the like.

The guide roll 34 and the tensioning roll 35 are shown in Fig. 9 as each mounted on side frame 66 by means of fixed bearings 135, and similar bearings may be provided for the opposite end of guide roll 34 on side frame 65 and for both ends of the guide rolls 32 and 37. The end of the tensioning roll 35 at the drive side of the apparatus is shown as provided with a suitable brake or clutch unit indicated diagrammatically at 36, satisfactory results having been obtained with an air operated brake 36 for frictionally loading roll 35 to effect desired tensioning of the web 30.

The squaring roll 33 is adjustable readily in the apparatus at the control side by means of a bearing block 140 (Figs. 9 and 10) slidable in guides 141 mounted on the side frame 66. The bearing block 140 is provided with a control shaft 142 threaded in a feed nut 143 bolted or otherwise secured to the side frame 66, and the shaft 142 has a hand wheel 145 for ready rotation thereof. The opposite end of the squaring roll 33 may be mounted on side frame 65 by suitable fixed bearing providing for sufficient angular movement of the roll with bearing block 140 to effect the desired squaring action on the web.

The adjustable mounting of the metering roll 25 is shown in detail in Figs. 6 and 11–14. The end journals 148 of the roll are supported by bushings 149 in two-piece bearing housings each comprising a main block 150 and an end part 151 bolted to the block 150 at 152 (Fig. 14) to facilitate removal of the roll from the apparatus. These bearing housings are horizontally slidable in the channeled tracks 77 as shown in Fig. 12, and each block 150 is channeled at its rearward end to receive a link 153 for connection to the piston rod 154 of an air cylinder 155.

Provision is made for maintaining the metering roll 25 in accurate alignment with coating roll 20 to prevent possible damage to the bearings in the event that the cylinders 155 fail to act in unison. For this purpose, each of the bearing blocks 150 carries a pin 156 which is received within a downwardly extending yoke portion of an arm 157 pinned to a hollow torsion rod 158 extending across the apparatus and supported at its opposite ends by bearings 159 bolted to the end stands 65 and 66. With this arrangement, if the air cylinders 155 should fail to act in unison, movement of one bearing block 150 will be translated through the arms 157 and torsion rod 158 into corresponding movement of the other bearing block to maintain the bearings at all times in accurate alignment across the apparatus and thus to prevent possible damage thereto in the event of uneven operation of the air cylinders.

At the drive side of the apparatus, the end stand 65 is provided with a slot 163 to receive the hub of the gear 51, which has a pilot recess therein for receiving the end of the journal 148 in accurately concentric relation as shown in Fig. 11 and is secured to journal 148 by three screws 164. Each of the bearing housings 150—151 is provided with an inner end cap 165 at the drive side of the apparatus and 166 at the control side, these caps being bolted to the bearing housings at 167. In order to provide for accurate lateral adjustment of the metering roll 25 with respect to coating roll 20, each of the caps 165 and 166 includes a tapered boss portion 170 engaging the oppositely tapered surface of a wedge 171 which is vertically adjustable and includes a T-shaped extension 172 slidable in a complementary guide slot in a boss portion 173 on each of the inner end caps 85 and 86 of the bearing blocks 80. An adjusting shaft 175 is threaded in each of the wedges 171 and carries a beveled gear 176 at its upper end which is operated by a beveled gear

177 and hand wheel 178 mounted on the top brace 69.

The end caps 165 and 166 also act as supports for doctor members arranged for wiping contact with the ends and surface of the metering roll 25. Each cap includes a downwardly extending arm portion 180 which cooperates with a retainer 181 to support the journal portion at opposite ends of a square shaft 182 extending across the apparatus. The upper surface of shaft 182 carries a holder 183 for a doctor blade 185, and the shaft 182 is normally biased in such direction as to maintain doctor 185 in engagement with roll 25.

For this purpose, a bracket 186 is mounted on the inner side of each of the end stands 65 and 66 to carry a small housing 187 supporting a plunger 188 and compression spring 189. An arm 190 is welded to the shaft 182 in position for engagement by the end of plunger 188 under the biasing force of spring 189. To release the doctor blade from contact with the roll, a retracting screw 191 having a hand wheel 192 is threaded on a retractor nut 193 carried by a bracket 194 bolted to the inner surface of the end stand 66. The screw 191 is in line with the arm 190 and may be screwed inwardly against this arm to tilt shaft 182 against springs 189 and thus to release the doctor blade 185 from engagement with roll 25.

Doctors are provided for wiping each end of the metering roll 25. Referring to Figs. 11–13, the doctor 195 at the control side of the apparatus is bolted to a bracket 196 which is in turn bolted to a shoulder on the end cap 166. Each of these doctors 195 is a small block of metal having close running contact with the end of roll 25 to scrape off any coating material accumulating thereon, and each doctor 195 has a surface 197 curved on substantially the same radius as the working surface of the roll 25 and coaxial therewith to receive and support the ends of the doctor blade 185 and thus to prevent relative wearing between the surface of roll 25 and the edge of the doctor 185. It will be noted that with the pan 23 of the configuration shown, the portion 121 thereof extends well beyond the roll 25 and the doctors 185 and 195, as indicated in Fig. 2, so that coating composition removed from the roll by these doctors will drop back into the pan by gravity for reuse. Also, in order to prevent the coating material from working its way across the ends of the roll to the journals 149, a small metal apron may be bolted or otherwise secured to each doctor 195, as indicated at 198 in Fig. 13, to cause surplus material collecting on the doctor to run back down into the pan. This apron need not clean the end of the roll beyond the doctor 195 but need only control a minimum set volume of the material so that the material cannot accumulate in operation sufficiently to flow to the journals of the roll.

The apparatus is provided with an arrangement of combined doctors and dam members cooperating with the feed roll 22 and with the coating roll 20 and metering roll 25 to limit the effective width of the coating applied to the web to desired dimensions less than the full axial extent of the rolls. Referring to Figs. 15–17, an end dam 200 is provided at each side of the apparatus for engagement in the nip of rolls 20 and 25 at which the coating on roll 20 is metered to the desired thickness for the web. This dam is a flat metal plate pointed at its upper end and having its opposite edges 201 and 202 ground on the same radius of curvature as the rolls 20 and 25 respectively for close running engagement with these rolls.

The dams 200 are mounted in laterally fixed relation with the coating roll 20 to assure a properly close fit between the edges 201 thereof and the surface of roll 20 in operation. A shaft 205 is mounted at each end by means of brackets 206 bolted to the inner surfaces of the end stands 65 and 66 and each including a clamp portion 207 and a bolt 208 for clamping the shaft 205 against rotational movement. Each dam 200 is bolted to one end of a bracket 210 having a clamping portion 211 mounted on the shaft 205 and provided with a clamp bolt 212, and the bracket 210 is prevented from rotation on shaft 205 by means of a set screw 215 in the clamp 211 engaging a flat 216 on shaft 205. The brackets 210 may accordingly be adjusted lengthwise of shaft 205 to conform with the desired effective length of the nip of rolls 20 and 25 between the dams 200, but with these brackets and the shaft 205 constructed as shown, the edges 201 of the dams are at all times maintained in the proper lateral relation with the surface of roll 20.

It will be seen that the relative spacing between the edges 201 of the dams 200 and the surface of metering roll 25 will be subject to variation as the roll 25 is adjusted in accordance with the desired metering clearance between its surface and the coating roll 20. However, with the inverted fountain effect provided by the arrangement of the rolls as shown, and since the direction of roll 25 is downwardly through the nip, any of the coating composition which may leak past the dams along the surface of roll 25 will be carried on downwardly for return to the pan 23 either by direct gravity action or by means of the doctor 185, thus preventing any wet bead or bleeding of the dams from affecting the edge of the coating on the web. This result is further aided by the absence of static head on the material in the nip, which might otherwise tend to force the material between the coating roll and the dam. Another advantage of this arrangement is that when the machine is shut down, any of the coating composition present in the nip will readily drain down into the pan, thus greatly facilitating cleaning of the rolls.

The feed roll 22 is provided with doctor means for wiping the ends thereof and also for wiping the end portions of its surfaces as required to limit the initial application of coating composition to the coating roll 20 only in the area thereof passing between the dams 200. Referring to Figs. 15–19, the feed roll 22 is provided at each end with a doctor 220 comprising a flat plate bolted to a supporting arm 222 which in turn is bolted to the supporting bracket 206 or shaft 205. The inner end of this doctor plate engages the end of roll 22 adjacent its periphery to remove therefrom any coating composition which might otherwise be transferred to roll 20 at an undesired area, and such coating composition will then drop back by gravity into pan 23. Each doctor 220 may be provided with an apron 223, as shown in Fig. 15 similar to the apron 198 as described for preventing possible accumulation of coating material on the doctor and resulting damage to the journals of roll 22.

The holder 225 for the doctor blade 226 engaging the face of roll 22 is mounted on shaft 205 by means of a plurality of links 230 each pivoted by pins 231 in a pair of clamps 232 secured to shaft 205 by clamp bolts 233. Each of the clamps

232 carries a compression spring 235 for biasing the associated link 230 in clockwise direction as viewed in Fig. 19 to urge the doctor holder and doctor blade towards the surface of roll 22, the springs 235 being provided with tensioning bolts 236, and the doctor blade is thus free to travel in effective engagement with roll 22 as the latter is adjusted vertically with respect to roll 20.

The doctor blade 226 is proportioned to provide an effective length in contact with the feed roll 22 only along the portions of the surface of roll 22 which lie axially beyond the adjusted positions of the dams 200, in order to effect transfer of coating composition from roll 22 to the roll 20 only in the portion of the surface of roll 20 which lies between the dams. For example, if it is desired in use to employ a single doctor blade 226, the edge thereof may be ground away in its central portion as indicated in Fig. 16 to leave a shoulder 240 adjacent each end of the blade at a predetermined position aligned with the inner surface of the adjacent dam 200, the doctor blade being thus formed in coordinated relation with the predetermined spacing of the dams 200 in accordance with the effective width of the coating desired on the web.

With this arrangement, as the roll 22 rotates to pick up coating composition from pan 23, the portions of the doctor blade 226 lying beyond the shoulders 240 wipe the surface of the roll clean at positions ahead of the nip of rolls 22 and 20, while the cut-away central portion of the doctor blade between shoulders 240 permits the coating composition on the corresponding portion of the feed roll to be carried on up to roll 20 and transferred thereto in the area which passes between the dams 200. Similar results may be obtained by substituting for a single doctor blade 226 a pair of separate similar blades of short lengths, corresponding respectively to the length of the portion of blade 226 extending from each shoulder 240 to the end of the blade, with one such separate blade being positioned at each end of the holder 225. In either event, for a change in the desired effective width of the coating, it is merely necessary to substitute a different single doctor blade having a center section of the proper length ground away or to substitute a different pair of short blades of the proper length to leave an unwiped portion on feed roll 22 of the proper width. Also in each case, the end doctors 222 function in all adjusted positions of the feed roll to wipe its ends clean at the portions adjacent the ends of the surface of the roll where undesired transfer of coating composition to roll 20 might otherwise occur.

As already described, Fig. 2 illustrates the operation of the apparatus for reverse roll coating with the coating being metered before application to the web. Fig. 4 shows a different coating operation on the apparatus in which an unmetered coating is applied to the web and the excess is then metered off, this result being obtained by rearranging the threading of the web 250 through the rolls as shown so that it wraps around the coating roll 20 to receive the coating composition initially at the nip of roll 20 with roll 22. Excess coating is then metered off at the metering nip of rolls 20 and 25, and the dry side of the web is led over the front radius of the impression roll 21 to the wind-up station.

It is also practical by further rearranging the threading of the web to carry out a laminating operation on this apparatus without in any way changing its physical structure or mode of operation. Fig. 5 illustrates such a laminating operation in which the first web 260 is threaded around coating roll 20 to receive a coating of adhesive from roll 22 in the same manner as in Fig. 3, with the adhesive coating being metered by roll 25. A second web 261 from a supply roll 262 is guided to the impression roll 21 as by idlers 263 and 264, which may for example be suspended from the ceiling and the direction of rotation of roll 21 is reversed as compared with Figs. 2 and 4 so that web 261 is brought around roll 21 as shown. The two webs are thus brought together and laminated at the nip of rolls 20 and 21, and the same advantages of accurately controlled width and thickness of adhesive coating are thus provided for laminating as well as for applying a finish coating.

It will thus be seen that the invention provides apparatus having outstanding advantages for use in the production of coated or laminated webs of paper and like materials, particularly from the standpoint of convenient operation and accurate control to give results of high uniformity and efficiency. With the brake roll and squaring roll incorporated directly in the apparatus for ready adjustment of tension and the direction of travel of the web, control is effected readily and accurately from the resulting centralized arrangement, and in fact the requirement for tension control at the unwind stand is greatly minimized, it being usually found necessary to operate the brake at the unwind stand only to the extend of supplying minimum hold-back pressure so that the unwind roll does not freewheel. Also, with the micrometer control provided at both ends of each of the operating rolls to adjust with high accuracy the effective width of each of the several operating nips, the operator is assured of closely controlled regulation of the operating conditions of the apparatus in accordance with desired production standards.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Web coating apparatus comprising a frame, a coating roll mounted in fixed location in said frame, a container for coating composition supported in said frame below said coating roll, a feed roll mounted between said coating roll and said container to form with said coating roll a lower nip for applying said coating composition to said coating roll, means for adjusting the relative spacing of said rolls, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip open along the lower side thereof for receiving said coating composition applied to said coating roll by said feed roll, means for effecting predetermined adjustment of said metering roll in said horizontal plane to regulate the thickness of said coating composition on said coating roll, a pair of end dams supported on said frame at opposite ends of and below said metering nip to limit the width of coating carried by said coating roll beyond said nip, means cooperating with said feed roll for limiting the application of said coating composition to said coating roll to an effective width correlated with relative spacing of said end dams, means for conveying a web to be coated

to and from coating relation with said coating roll, drive means for said rolls effective to cause said coating and metering rolls to travel respectively upwardly and downwardly at said metering nip for metering the coating on said coating roll, a doctor for removing said coating composition from said metering roll, and said container including a portion extending beneath said metering nip and said doctor to receive said coating composition by gravity from said metering nip and said doctor.

2. Web coating apparatus comprising a frame, a coating roll mounted in said frame, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, means in said frame below said nip for applying coating composition to said coating roll for metering at said nip, a pair of end dams for limiting the effective length of said nip to limit the width of coating carried by said coating roll beyond said nip, said dams each having the opposite edges thereof curved about substantially the same radius of curvature as said rolls respectively, means in said frame for supporting said dams below said nip and in closely fixed relation with the surface of said coating roll to prevent travel of said coating composition on said coating roll outwardly of said dams, means for adjusting said dams on said supporting means axially of said coating roll while maintaining said closely fixed relation thereof, means for conveying a web to be coated to and from coating relation with said coating roll, a drive for rotating said rolls in directions causing said coating roll and said metering roll to travel respectively upwardly and downwardly through said nip, and means cooperating with said applying means to limit the effective width of said coating composition initially applied to said coating roll in accordance with the adjusted relation of said dams.

3. Web coating apparatus comprising a frame, a coating roll mounted in said frame, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, a pair of end dams for limiting the effective length of said nip, said dams each having the opposite edges thereof curved about substantially the same radius of curvature as said rolls respectively, means supporting said dams in said frame for adjusting movement lengthwise of said rolls to vary the effective length of said nip, means for applying a coating composition to said coating roll for metering at said nip, means for limiting the initial application of said coating composition on said coating roll to the portion thereof corresponding with the relative spacing of said dams, means for adjusting said metering roll with respect to said coating roll to vary the effective width of said nip, means cooperating with said supporting means to maintain said dams in fixed close relation with said coating roll to prevent leakage of said coating composition between said coating roll and the adjacent said curved edges of said dams irrespective of the adjusted position of said metering roll with respect to said coating roll, and means for conveying a web to be coated to and from coating relation with said coating roll.

4. Web coating apparatus comprising a frame, a coating roll mounted in said frame, means for conveying a web to be coated to and from coating relation with said coating roll, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, a reservoir for coating composition below said coating roll, a feed roll positioned between said coating roll and said reservoir to form with said coating roll a lower nip for transferring coating composition from said reservoir to said coating roll for metering at said metering nip, means for rotating all of said rolls in the same predetermined angular direction to cause relative reverse rotation of said rolls through said nips and also to cause the surface of said coating roll to move upwardly to said metering nip from said lower nip, a pair of end dams for limiting the effective length of said metering nip, said dams each having the opposite edges thereof curved about substantially the same radius of curvature as said coating roll and said metering roll respectively, means in said frame for supporting said dams below said metering nip and in closely fixed relation with the surface of said coating roll to prevent travel of coating composition along said coating roll from said metering nip outwardly of said dams, and means correlated with the adjusted positions of said dams for removing coating composition from the portions of said feed roll axially outwardly of the vertical planes of said dams to effect application of coating composition to said coating roll only in the portions thereof lying between said dams.

5. Web coating apparatus comprising a frame, a coating roll mounted in said frame, means for conveying a web to be coated to and from coating relation with said coating roll, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, a reservoir for coating composition below said coating roll, a feed roll positioned between said coating roll and said reservoir to form with said coating roll a lower nip for transferring coating composition from said reservoir to said coating roll for metering at said metering nip, means for rotating all of said rolls in the same predetermined angular direction to cause relative reverse rotation of said rolls through said nips and also to cause the surface of said coating roll to move upwardly to said metering nip from said lower nip, a pair of end dams for limiting the effective length of said metering nip, said dams each having the opposite edges thereof curved about substantially the same radius of curvature as said coating roll and said metering roll respectively, means in said frame for supporting said dams in substantially vertical planes below said metering nip and in closely fixed relation with the surface of said coating roll to prevent travel of coating composition along said coating roll from said metering nip outwardly of said dams, doctor means for controlling the transfer of coating composition from said feed roll to said coating roll, said doctor means having portions thereof in wiping contact with the surface of said feed roll only in the portions of said surface lying axially outside of said vertical planes of said end dams to provide for transfer of coating composition from said feed roll to said coating roll only in the portions thereof lying between said end dams, means supporting said feed roll for adjusting movement with respect to said coating roll, and means for maintaining said doctor

means in said wiping engagement with said feed roll in all adjusted positions of said feed roll with respect to said coating roll.

6. Web coating apparatus comprising a frame, a coating roll mounted in said frame, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, a reservoir for coating composition below said coating roll, a feed roll positioned between said coating roll and said reservoir for transferring coating composition from said reservoir to said coating roll for metering at said metering nip, means for rotating all of said rolls in the same predetermined angular direction to cause relative reverse rotation of said rolls through said nips and also to cause the surface of said coating roll to move upwardly to said metering nip from the nip thereof with said feed roll, a pair of end dams adjustably supported on said frame at opposite ends of said metering nip to limit the width of coating carried by said coating roll beyond said nip, means for adjusting said feed roll with respect to said coating roll, doctor means engaging the ends and predetermined portions of the surface of said feed roll adjacent said ends corresponding with the end portions of said coating roll located axially outwardly of said dams to remove coating composition from said end portions of said feed roll to limit the application of coating composition to said coating roll to the portions thereof intermediate said doctor means and said dams, and supporting means for said doctor means cooperating with said adjusting means for said feed roll to maintain said doctor means in effective engagement with said feed roll in substantially all the adjusted positions thereof.

7. Web coating apparatus comprising a frame, a coating roll mounted in said frame, means for conveying a web to be coated to and from coating relation with said coating roll, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, a reservoir for coating composition below said coating roll, a feed roll positioned between said coating roll and said reservoir for transferring coating composition from said resevoir to said coating roll for metering at said metering nip, means for adjusting said feed roll with respect to said coating roll, doctor means including blade portions having a total length less than the length of said coating roll, means supporting said doctor means with said blade portions located in spaced relation and in cleaning engagement with portions of said feed roll adjacent opposite ends thereof to remove coating composition therefrom and thereby to effect application of coating composition to said coating roll only in the area thereof lying between the inner ends of said blade portions, and additional doctor members engaging the ends of said feed roll adjacent said doctor blade portions.

8. Web coating apparatus comprising a frame, a coating roll mounted in said frame, means for conveying a web to be coated to and from coating relation with said coating roll, a second roll forming a nip with said coating roll, means for applying coating composition to one of said rolls for transfer between said rolls at said nip, supports for said second roll mounted for adjusting movement in said frame with respect to said coating roll to vary the effective width of said nip for regulating said transfer of coating composition between said rolls, doctor means adapted to engage said second roll in advance of said nip for removing a predetermined excess amount of said coating composition therefrom to effect predetermined limitation of the amount of said coating composition reaching said nip, additional means adapted for engagement with the ends of said second roll to remove coating composition therefrom, and means mounting both said doctor means and said additional doctor means on said supports for movement with said second roll to maintain effective engagement therebetween in all adjusted positions of said second roll with respect to said coating roll.

9. Web coating apparatus comprising a frame, a coating roll mounted in fixed location in said frame, means for conveying a web to be coated to and from coating relation with said coating roll, a container for coating composition supported in said frame below said coating roll, a feed roll mounted between said coating roll and said container for applying said coating composition to said coating roll, means for adjusting the relative spacing of said rolls, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip open along the lower side thereof for receiving said coating composition applied to said coating roll by said feed roll, means for effecting predetermined adjustment of said metering roll in said horizontal plane to regulate the thickness of said coating composition on said coating roll, a doctor blade adapted to engage the surface of said metering roll following passage thereof through said metering nip to remove said coating composition therefrom, doctor members adapted to engage the ends of said metering roll to remove coating composition therefrom, said doctor members including curved surface portions having substantially the same radius of curvature as said metering roll and aligned therewith, means supporting said doctor blade and doctor members for movement with said metering roll, said doctor blade being longer than said metering roll and having the end portions thereof in engagement with said curved surfaces of said doctor members to reduce friction with respect to the surface of said metering roll, and means for biasing said doctor blade continually into engagement with said curved portions of said doctor members.

10. Web coating apparatus comprising a frame, a coating roll mounted in fixed location in said frame, an impression roll and a feed roll located respectively above and below said coating roll with the axes thereof in substantially the same vertical plane as the axis of said coating roll to form respectively upper and lower nips with said coating roll, means for moving said feed and impression rolls in said vertical plane to adjust said upper and lower nips, a container for coating composition supported in said frame below said feed roll to provide for transfer of said composition by said feed roll to said coating roll at said lower nip, a metering roll mounted in said frame with the axis thereof in substantially the same horizontal plane as the axis of said coating roll to form with said coating roll a metering nip, means for moving said metering roll in said horizontal plane to adjust said metering nip, drive means for rotating all of said rolls in the same predetermined angular direction to cause relative reverse rotation of

said rolls through said nips thereof and also to cause the surface of said coating roll to move upwardly from said lower nip to said metering nip for metering by said metering roll of the coating composition applied to said coating roll by said feed roll, means cooperating with said impression roll to guide a web to be coated through said upper nip for application thereto of said metered composition from said coating roll at said upper nip, and means including doctor members cooperating with end portions of at least one of the lower three said rolls and having a total length less than the length of said coating roll for limiting the effective width of said coating composition carried by said coating roll through said metering nip, said last named means being adjustable in accordance with the width of said web to be coated by said apparatus.

11. Web coating apparatus as defined in claim 10 wherein said drive means includes a reversible drive for said impression roll separate from the drive for said lower three rolls to provide for change in both the speed and direction of rotation of said impression roll with respect to said coating roll.

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