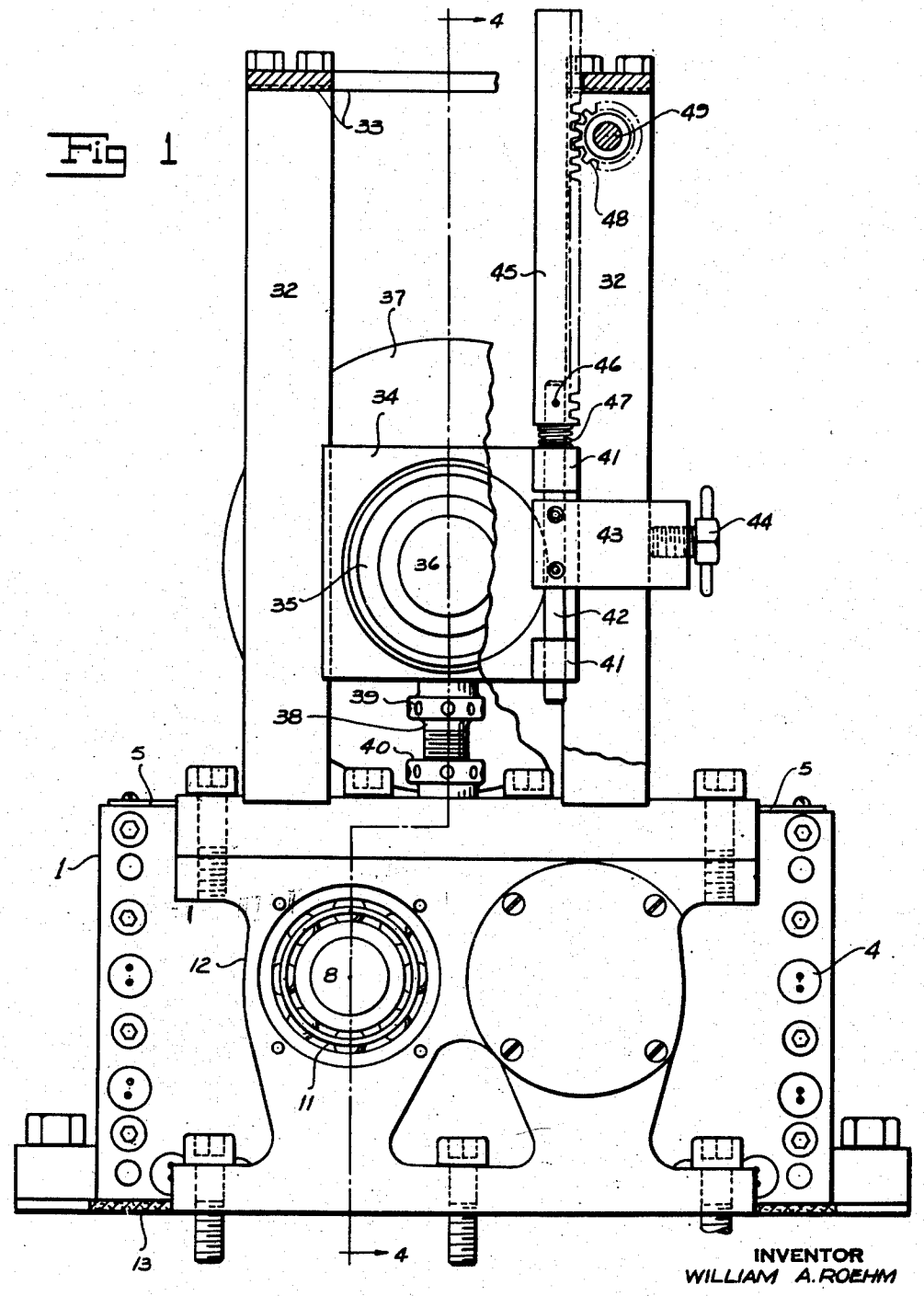
June 28, 1949. W. A. ROEHM 2,474,691

WEB COATING APPARATUS

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Fig 1



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WEB COATING APPARATUS

Filed March 20, 1946 4 Sheets-Sheet 2

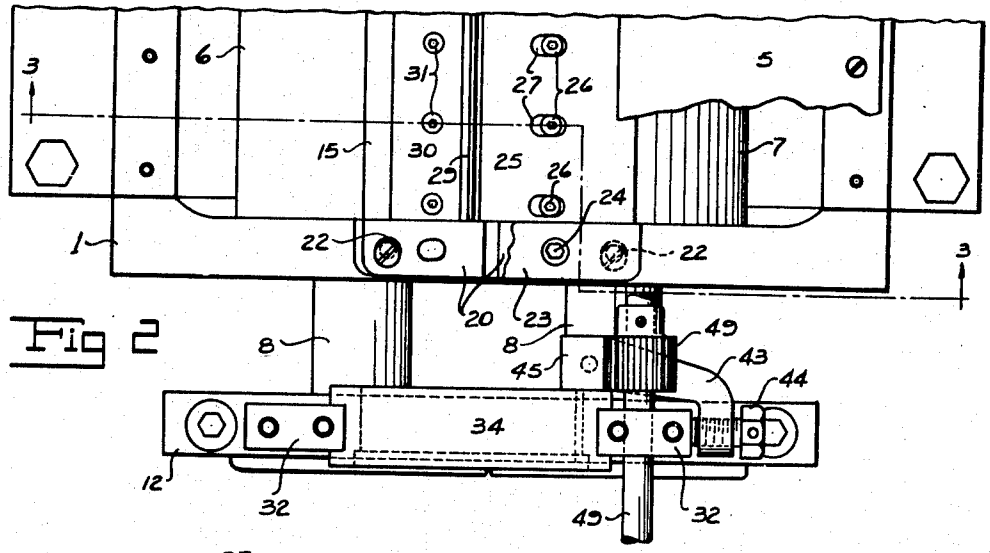


Fig 2

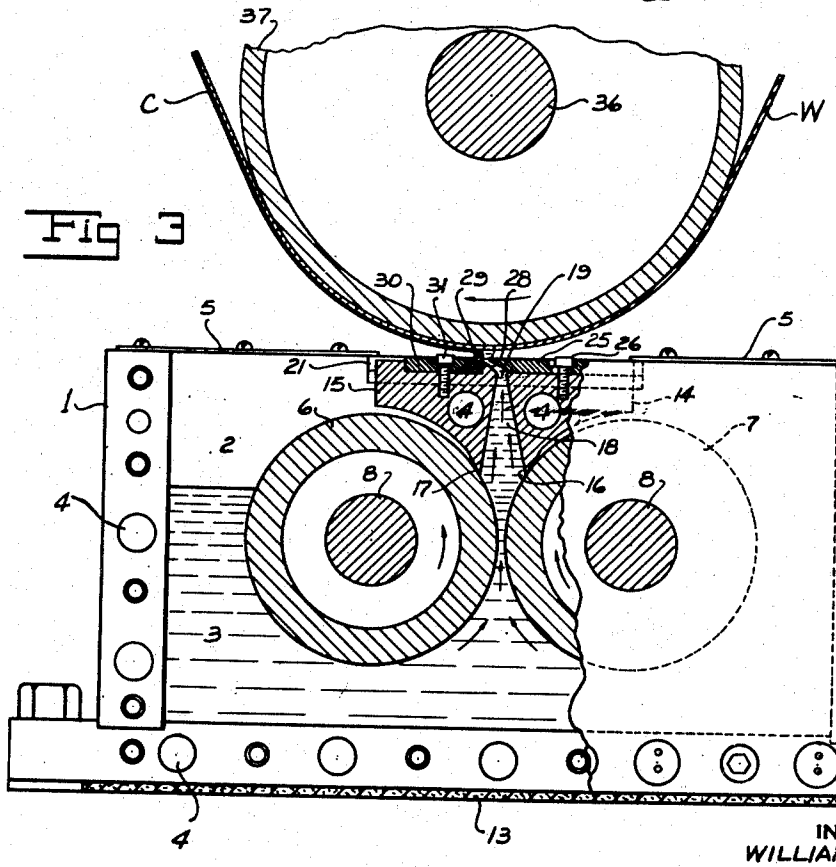


Fig 3

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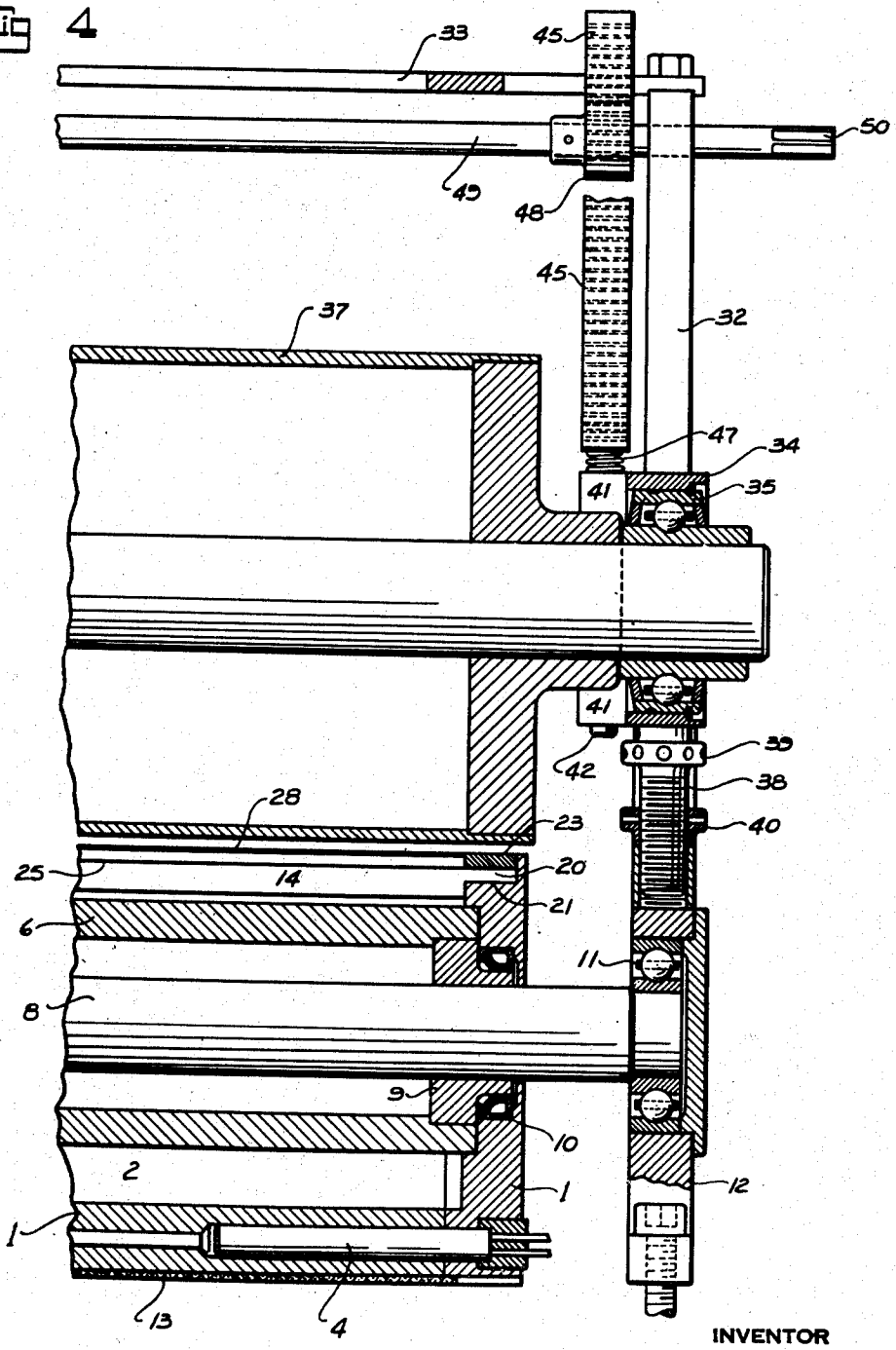
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WEB COATING APPARATUS

Filed March 20, 1946 4 Sheets-Sheet 3

Fig 4



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WEB COATING APPARATUS

Filed March 20, 1946 4 Sheets-Sheet 4

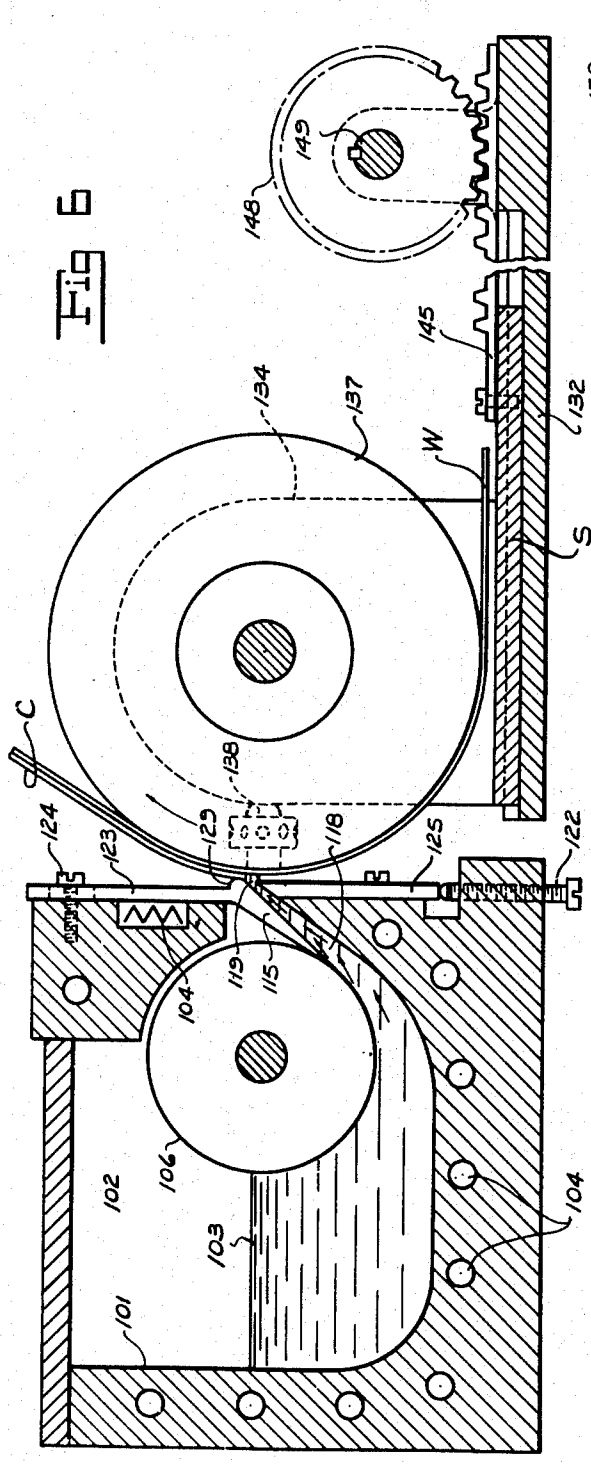


Fig 6

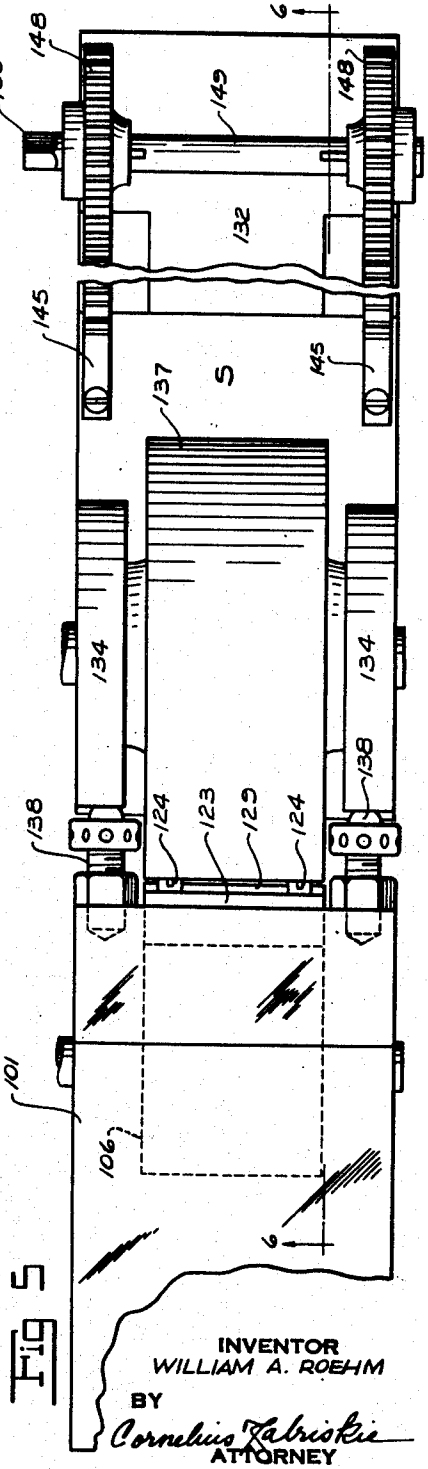


Fig 5

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UNITED STATES PATENT OFFICE

2,474,691

WEB COATING APPARATUS

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Application March 20, 1946, Serial No. 655,831

12 Claims. (Cl. 91—43)

1

This invention is a method of and apparatus for coating web stock, such as paper or other materials, adapted to be fed along a predetermined path past a coating station where coating material is applied to the web.

The object of this invention is to provide a more efficient and economical method of and apparatus for handling various types of coating materials, more particularly coating materials of the heavier or viscous kinds and for applying them to a traveling web in such a way as to produce a uniform coating of the desired thickness on the surface of the latter.

The method of this invention comprises, generally speaking, the feed of coating material to an outlet through a passage leading from a reservoir containing such coating material. One or more of the walls of this passage moves in the direction of the outlet and contact with the coating material and the friction (skin or surface friction) between the moving passage and the material is utilized to feed the coating material through the passage to and through the outlet. As the coating material issues from the outlet, it impinges upon and is applied to a web traveling past said outlet and at such distance therefrom as to lay upon the web a coating of the desired thickness. The depth or thickness of this coating may be controlled by regulating the distance between the outlet and the web.

In practice, the moving portion of the passage which leads to the outlet may conveniently comprise a portion of the surface of one or more traveling endless belts or a portion of the convex surface of one or more feed rolls immersed in or dipping into a pool of the coating material. This roll or rolls are preferably so positioned as to form within and below the surface of the pool a relatively constricted space below the surface of the pool. In this relatively constricted space, the coating material is particularly susceptible to the action of skin friction with the roll or rolls, so that when such roll or rolls are rotated, the coating material is fed in the direction of rotation of the roll or rolls to and through a tapering throat leading to a constricted mouth, the lips of which are adjustable to vary the distance between them and thus provide an outlet opening appropriate to the particular material fed and the thickness of the coating to be ap-

2

plied to the web. The web may be conveniently guided past this opening by a back-up roll adjustable toward and away from the forward lip of the outlet mouth, which acts as a smoothing and leveling dam or weir to insure that the web, as it leaves the point of application, will carry a smooth coating of uniform depth.

The apparatus of this invention provides for heating of a coating material to be applied and for the maintenance of this material at satisfactory working temperatures during application. Coating materials of widely different characteristics and types may be applied in accordance with this invention, including heavy viscous plastic coating compositions which have been extremely diffcult to handle with prior known procedures and apparatus.

Features of the invention, other than those referred to, will be apparent from the hereinafter detailed description and appended claims, when read in conjunction with the accompanying drawings.

The accompanying drawings show different forms of apparatus embodying the present invention and adapted to carry out the method of this invention, but the showing therein made is to be understood as illustrative, only, and not as defining the limits of the invention. In the drawings:

Figure 1 is a side elevation of apparatus embodying this invention with a part of the upper portion thereof broken away in the interest of clearness.

Figure 2 is a fragmental plan view showing the near side of the apparatus as illustrated in Figure 1, the far side being of the same construction. In Figure 2 the back-up roll of the traveling web is removed and a portion of the tank cover is broken away.

Figure 3 is a section of the line 3—3 of Figure 2.

Figure 4 is a section on the line 4—4 of Figure 1.

Figure 5 is a plan view of a modified form of construction.

Figure 6 is a section on the line 6—6 of Figure 5.

In the accompanying drawings and more particularly in Figures 1–4, 1 designates a tank or

fountain having therein a chamber 2 to contain coating material 3. The fountain is shown as provided within its walls with electric heating elements 4 in the form of resistance coils, although, if desired, steam, hot water or oil passages may be employed in lieu thereof for heating purposes. In any event, the walls of the tank are heated to a sufficient temperature to maintain the coating material in satisfactory condition for application. The top of the tank or fountain is provided with covers 5 to prevent solvent evaporation or oxidation or slopping over of the coating material during operation of the apparatus.

Immersed in the coating material in the fountain are two feed rolls 6 and 7. These rolls are mounted on shafts 8 extending through the opposite end walls of the tank which are provided with bushings 9 and associated liquid seals 10 (see Figure 4) and these shafts are supported for rotation by anti-friction bearings 11 carried in frames 12 which are supported in upright frames positioned in spaced relation to the front and back walls of the tank 1. The frame and the tank are anchored to a suitable foundation or an appropriate bed plate as may be desired. The shafts 8 extend beyond the frame 12 at the back of the machine and are geared together for simultaneous rotation in opposite directions. The gearing is of any conventional type which will permit one or both of the shafts to be adjusted toward and away from one another to vary the distance between the peripheries of the rolls 6 and 7. A heat insulating plate 13, such as asbestos, underlies the tank so that undue heat is not transmitted to the foundation or base plate.

The rolls 6 and 7 are positioned, in the structure shown in these figures, with their axes in the same horizontal plane, but are tangentially spaced apart to provide between them a constricted passage. The minimum horizontal width of this passage may be below the surface of the pool 3 of coating material, as clearly shown in Figure 3.

Above this constricted area and extending transversely of the tank are two feed passage blocks indicated by the reference characters 14 and 15. The block 14 will hereinafter be termed the blade block, while the block 15 will be termed the dam or weir block. These two blocks are so shaped at their under sides as to form, along the lower edges of their adjacent bases, knife edges 16 and 17, respectively, adapted to engage with the peripheries of the rolls 6 and 7 and form therewith substantially liquid tight joints. The adjacent faces of these blocks are upwardly inclined to form an upwardly tapering passage or throat 18 between them, terminating at its upper end in a relatively constricted mouth 19 in the form of a slot extending from the front to the back of the machine.

Both blocks 14 and 15 are provided at their opposite ends with projecting flanges 20 operating in horizontal slides 21 (Figure 4), so that they may be adjusted in said slides to contact the knife edges 16 and 17 of the respective blocks with the peripheries of the feed rolls 6 and 7. The adjustment of the blocks for this engagement is accomplished by rotation of eccentric adjusting pins 22 (Figure 2) and when in proper position, these screws, as well as the flanges 20, are adapted to be rigidly secured in position by clamp plates 23 (Figure 3) clamped down by machine screws 24.

Positioned on the upper face of the blade block 14 is a plate or blade 25 secured to the block by means of screws 26 which pass through elongated holes 27 in the blade to permit of adjustment thereof. The forward edge of this blade 25 is undercut to form a lip 28 which will be hereinafter referred to as the rear lip. The forward lip of the feed opening is in the form of an interchangeable bar or strip 29 which constitutes a weir or dam as will be presently explained. This strip 29 is removably seated in a channel extending transversely along the block 15 and it is adapted to be clamped firmly in the channel by means of a clamp plate 30 held in place by screws 31. The forward edge of the strip 29 is chamfered and the clamp plate 30 is complementarily chamfered, so that when the screws 31 are tightened the forward lip strip 29 is clamped firmly in position.

The blocks 14 and 15 are shown in Fig. 3 as cored for heating units 4, so that these parts may be kept at the desired temperature.

Extending upwardly from the frames 12 at the opposite sides of the machine are upstanding guides 32, tied together at their tops by plates 33 and mounted for vertical sliding adjustment between the guides 32 at the front and back of the machine are bearing blocks 34, each of which carries a bearing 35 and these two bearings support the opposite ends of a shaft 36 which projects through them. To one end of this shaft is attached an appropriate gear, so that it may be driven, and this gear is interlocked by suitable variable speed gearing connections with the shafts 8 of the feed rolls to operate in timed relation therewith. The shaft 36 carries between the bearing blocks 34 a back-up roll 37 which, as shown in Figure 3, is positioned directly above the outlet mouth of the fountain.

The periphery of the roll 37 is at all times spaced from the upper edge of the dam or weir 29. The proper spacing is provided for by means of micromatic stop screws 38, one of which threads into the top of each side frame 12 beneath the corresponding bearing block 34. The head 39 of each of these stop screws is provided with perforations into which a wrench may be inserted, to vertically adjust the screw which may be then locked in adjusted position by means of a lock nut 40. These stop screws very accurately adjust the spacing between the back-up roll 37 and the upper edge of the dam 29 for the bearing blocks of the back-up roll seat firmly upon these stop screws which limit the downward movement of this roll.

The web to be coated, indicated in the drawings by the reference character W, is adapted to be led about the roll 37, as shown in Fig. 3. In order to provide for convenient leading of the web about the roll, previous to the coating operation, or for replacement of the web in the event of breakage, for any reason, it is desirable that the roll be retractable upwardly away from the fountain. To provide for this, each of the bearing blocks 34 is provided with vertically spaced apart lugs 41 (Fig. 1). A vertical rod 42 passes loosely through holes in these lugs and between the lugs a bracket 43 is rigidly secured to the rod 42. This bracket reaches around the distant face of the corresponding guide 31 and carries a set screw 44 which may be engaged with the guide 32 to lock the rod in position. The upper end of each rod 42 extends into a socket in the lower end of a rack 45 and is secured to the rack by means of a pin 46 (Fig. 1) and between the lower end of each rack and the corresponding lug 41 is

positioned a compression spring 47. The springs 47 assist gravity in holding the bearing blocks 34 against the stops 38, but permit the roll 37 to raise in the event of obstruction and thus guard against damage.

The racks 45 at the front and back of the machine extend vertically and each meshes with an adjusting pinion 48. These two pinions 48 are fixed on a horizontal shaft 49 which is mounted to rotate in two of the upright guides 32. The shaft 49 projects beyond one of the guides and is squared at 50 so that a hand wheel or wrench may be applied thereto for the purpose of raising and lowering both racks 45 simultaneously and if the set screws 44 are released the raising of these racks will lift the back-up roll away from the fountain mouth and allow adequate clearance for placement or replacement of the web or for any other purpose.

When conditioning the machine for operation, the web is passed about the under side of the roll 37 and the roll is then lowered until the bearing blocks 34 engage with the stop screws 38 which act to positively limit the relation between the periphery of this roll and the dam lip 29. When in this adjustment, the set screws 44 are tightened so as to preclude inadvertent lifting of the back-up roll due to the tension of the paper on the web or for any other reason.

In utilizing the apparatus thus far described to coat a web, the chamber 2 of the fountain is charged with the desired coating material 3 up to a surface level preferably above the horizontal plane of the axes of the feed rolls 6 and 7, so that these feed rolls dip into the bath. If the coating material is such as requires heating thereof or if this is preferable, the heating units 4 are energized for this purpose and the bath is brought up to the desired coating temperature. The machine is then started and the feed rolls are caused to rotate in opposite directions, the roll at the left of Figure 1 rotating in a counterclockwise direction, while the roll at the right is rotated in clockwise direction. Thus the peripheries of these rolls rotate in the direction of the outlet mouth and as they thus rotate, they create skin friction with the coating material in which they are immersed. The coefficient of this friction will of course depend upon several factors, such as the character of the coating material, the speed at which the rolls are driven, the spacing between the rolls and other like factors. In any event practice has demonstrated that, as the rolls rotate in the manner described, they set up a very definite flow of the liquid upwardly between the spaced bite of the rolls and in so doing feed the coating material upwardly into the throat 18. The throat fills very quickly and the material therein is put under pressure of the inflowing material which causes such material to be forced through the mouth 19 of the outlet passage and between the lips 28 and 29 into contact with the web W traveling about the backing roll 37.

The relative adjustment between the feed rolls 6 and 7, i. e., their distance apart, their speed of operation, and the adjusted position of the rear blade 25 will in a large measure regulate the amount of coating material fed between the lips to the web and the speed of the web and the thickness of the coating desired will, in a large measure, dictate the amount of coating material that should be fed. The optimum condition is that wherein substantially the same amount of coating material is fed to the web as will provide for a coating C of adequate thickness, without undue backing up of the coating material over the top of the rear blade 25. Slight backing up, such as indicated in Figure 3, is desirable for it insures an adequate supply of coating material to give the desired thickness of coating and serves to compensate for uneven conditions of the web surface.

When this machine is in operation, with the parts properly timed, the web will move past the outlet mouth at a speed to pick up more than an adequate supply of coating material to give the desired coating, but as the web passes over the dam or weir which constitutes the forward lip 29, this dam will permit the web to carry along with it only sufficient coating material to give a uniform coating of the predetermined thickness. The top edge of the dam is shown as straight and relatively thin so as not to produce undue dragging on the coating material. At the same time it permits the passage thereover of an absolutely smooth uniform surface. In other words, the upper edge of the dam levels and smooths the exposed surface of the coating and experience has shown that even though the web contains marked irregularities, such as is found, for example, in crepe Kraft paper, the dam will insure an absolutely smooth and uniform exposed surface on the resulting coating. If the upper edge of the dam is notched or serrated, however, it will form striations in the exposed surface of the coated film and if this dam is rectilinearly reciprocated, these striations will be of a wavy nature.

The thickness of the coating will of course depend upon the spacing between the surface of the web and the top edge of the dam, and this spacing is so accurately controlled and regulated by the stop screws 38 that micromatic adjustment of the thickness of the coating is readily attainable.

An important feature of this invention is found in the wide variety of coating materials which may be applied according to this invention. Very heavy bodied and extremely tacky materials, which under prior procedures have produced no end of difficulty, may be effectually and readily handled and applied to the web by this apparatus and the apparatus will also work with high efficiency in dealing with lighter or less viscous coating materials. Heavy plastics which are not adapted to gravity or pump feed, may be applied without difficulty by the apparatus of this invention.

One of the few conditions under which difficulty may be experienced in practising this invention through the upright feed of coating material to a web by passing it between feed rolls as stated, is that wherein the coating material is so heavy and non-flowable that the rotation of the rolls will simply feed the material in contact therewith while the remainder of the bath will be so stiff that it will not quickly flow into contact with the rolls to displace the material already fed. In dealing with such heavy bodied materials, it has been found thoroughly practical to operate the apparatus in inverted position so that, for example in Figure 3, the entire structure is inverted, with the web running underneath and the tank inverted and above the web, so that the weight of the material in the tank will cause it to bear down upon the feed rolls 6 and 7 and effect practically continuous contact with these rolls, so that the material can be frictionally engaged therewith and forced

thereby through the throat and mouth to the web. When the apparatus is inverted as stated, the top plates 5 shown in Figure 3 will form the bottom of the tank and should be made thicker and provided with heating elements, while the bottom of the tank shown in Figure 3 should be replaced by plates, such as the top plates 5.

Heretofore it has been common to apply viscous coating materials by passing them beneath a cutter in spaced relation to a web. This practice places quite a strain on the web which not infrequently causes tearing of the latter. With this invention, however, it is found that very viscous materials may be handled and applied evenly in the manner stated without placing any undue stress on the web. Roll 37 in practice, may be either positively driven or it may be rotated by the web as the latter is drawn about the same under tension.

In the form of the invention as thus far described, two opposed feed rolls are utilized to feed the coating composition to the web. This feed is substantially a vertical feed. It is possible, however, to utilize one roll for this purpose either as a vertical feed or as a lateral feed and in fact two rolls may be utilized for a lateral feed. However, by way of illustration, Figures 5 and 6 show a single roll lateral feed. In these figures 101 designates the tank or fountain containing the coating material 103 in the chamber 102. A single feed roll 106 is immersed in the bath and with the periphery of this roll is engaged the knife edge of the block 115. This block is carried by a vertically adjustable plate 123 adapted to be locked in the desired position of adjustment by set screws 124. The forward lip or dam 129 is rigid with the block 115 and the plate 123.

The bottom of the tank is curved upwardly beneath the roll 106 to merge into the lower wall of the throat 118 which tapers to an outlet mouth 119 below the dam 129. The plate 125 corresponds to the plate 25 and is adjustable toward and away from the dam 129 by means of adjusting screws 122.

The stop screws 138 correspond to the screws 38 and are adapted to bear against the blocks 134 which carry the bearings for the back-up roll 137.

The bearing blocks 134 in these figures are mounted on a dove-tail slide *s* for longitudinal adjustment in a correspondingly shaped guide in a plate 132 rigidly mounted with respect to the tank 101. To the slide *s* are affixed racks 145 meshing with pinions 148 and shaft 149 which carries these pinions is squared at 150 to receive a hand wheel or wrench by means of which the back-up roll 137 may be moved toward and away from the fountain for the same reason as the roll 37 is moved toward and away from its subjacent fountain.

Heating elements 104 serve to maintain the parts at the desired operating temperatures.

In this form of the invention the single feed roll 106 will act against only one side of the body of the coating material in the passage to the converging throat, but the friction with this portion of the material will be sufficient to feed through the constricted throat most of the coating materials that are commonly used in the coating of webs. The feed, however, is not as efficient as a double roll feed hereinbefore described.

The apparatus of this invention is relatively simple to operate. It does not require attention of skilled workmen for when once in proper adjustment, this operation requires minimum supervision. Inasmuch as the feed rolls rotate within the liquid in the fountain, they will serve to agitate and stir up the liquid unless it is extremely heavy and in so doing will preclude stratification or settling as is so often the case with gravity feeders.

The feed roll or rolls have been found to operate with marked efficiency for the purposes stated. They produce the desired pressure on the coating material as it is applied to the web at the outlet mouth, but this pressure may be adjusted so that it is not excessive for it can be very nicely controlled in a manner hereinbefore described.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, and at least one feed roll contacting said pool and a portion of the circumference of which forms part of the wall of the feed passage, said roll being rotatable in a direction to feed the coating material from the pool through said passage to and through the outlet mouth and against said surface under the thus mechanically generated hydraulic pressure, said outlet mouth being provided adjacent its forward edge with a dam spaced from said surface a distance substantially equal to the thickness of the coating desired on the surface.

2. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, and at least one feed roll contacting said pool and a portion of the circumference of which forms part of the wall of the feed passage, said roll being rotatable in a direction to feed the coating material from the pool through said passage to and through the outlet mouth and against said surface under the thus mechanically generated hydraulic pressure, said outlet mouth having at its forward edge a dam spaced from said surface a distance substantially equal to the thickness of the coating desired on said surface and at its rear edge an adjustable lip to regulate the area of the outlet mouth.

3. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, and at least one feed roll contacting said pool and a portion of the circumference of which forms part of the wall of the feed passage, said roll being rotatable in a direction to feed the coating material from the pool through said passage to and through the outlet mouth and against said surface under the thus mechanically generated hydraulic pressure, said outlet mouth being provided adjacent its forward edge with a dam spaced from said sur-

face a distance substantially equal to the thickness of the coating desired on said surface, and means for varying the spacing between the surface and the dam to correspondingly vary the thickness of the coating on said surface.

4. An apparatus comprising: a fountain adapted to contain a pool of coating material and having an outlet throat leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, opposed feed rolls spaced from one another to form between them a passage leading to said throat and in contact with opposite walls thereof, said rolls contacting the pool of coating material and rotatable in counter directions to collectively feed such material between them from the pool to and through the throat and through said outlet mouth to and onto said surface under the thus mechanically generated hydraulic pressure.

5. An apparatus comprising: a fountain adapted to contain a pool of coating material and having an outlet throat leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, opposed feed rolls spaced from one another to form between them a passage leading to said throat and in contact with opposite walls thereof, said rolls contacting the pool of coating material and rotatable in counter directions to collectively feed such material between them from the pool to and through the throat and through said outlet mouth to and onto said surface under the thus mechanically generated hydraulic pressure, said outlet mouth being provided adjacent its forward edge with a dam spaced from said surface a distance substantially equal to the thickness of the coating desired on said surface.

6. An apparatus comprising: a fountain adapted to contain a pool of coating material and having an outlet throat leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, opposed feed rolls spaced from one another to form between them a passage leading to said throat and in contact with opposite walls thereof, said rolls contacting the pool of coating material and rotatable in counter directions to collectively feed such material between them from the pool to and through the throat and through said outlet mouth to and onto said surface under the thus mechanically generated hydraulic pressure, said outlet mouth having at its forward edge a dam spaced from said surface a distance substantially equal to the thickness of the coating desired on said surface and at its rear edge an adjustable lip to regulate the area of the outlet mouth.

7. An apparatus comprising: a movable member having a surface traveling therewith, a stationary outlet mouth positioned in close proximity to said surface, spaced apart throat forming members leading from said outlet mouth in divergent relation, a pair of feed rolls mounted on parallel horizontal axes and contacting with the divergent portions of the throat forming members on one side of the common plane of the axes of said rolls, a fountain adapted to contain a pool of coating material with which said rolls contact on the opposite side of said common plane, and means for rotating said rolls in opposite directions to feed the coating material from the pool between the rolls to and through the throat between the throat forming members

to and through the outlet mouth and onto said traveling surface under the hydraulic pressure generated by the thus rotating rolls.

8. An apparatus comprising: a movable member having a surface traveling therewith, a stationary outlet mouth positioned in close proximity to said surface, spaced apart throat forming members leading from said outlet mouth in divergent relation, a pair of feed rolls mounted on parallel horizontal axes and contacting with the divergent portions of the throat forming members on one side of the common plane of the axes of said rolls, a fountain adapted to contain a pool of coating material with which said rolls contact on the opposite side of said common plane, and means for rotating said rolls in opposite directions to feed the coating material from the pool between the rolls to and through the throat between the throat forming members to and through the outlet mouth and onto said traveling surface under the hydraulic pressure generated by the thus rotating rolls, and a leveling member beyond the outlet mouth and spaced from said surface a distance equal to the desired thickness of the coating on said surface.

9. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, at least one cylindrical feed roll independent of the outlet mouth and positioned rearwardly of and in spaced relation thereto, said roll contacting said pool and a portion of the circumference of which roll forms part of the feed passage back of the outlet mouth, and means to rotate said roll in a direction to feed the coating material from the pool through said passage and through the outlet mouth and against said surface under the thus mechanically generated hydraulic pressure.

10. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a movable member having a surface positioned in close proximity to the outlet mouth and adapted to travel past the same, at least one smooth surfaced cylindrical feed roll independent of the outlet mouth and positioned rearwardly of and in spaced relation thereto, said roll contacting said pool and a portion of the circumference of which roll forms part of the feed passage back of the outlet mouth, and means to rotate said roll in a direction to feed the coating material from the pool through said passage and through the outlet mouth and against said surface under the thus mechanically generated hydraulic pressure.

11. An apparatus comprising: a fountain adapted to contain a pool of coating material and provided with an outlet passage leading to an outlet mouth having normally stationary walls, a portion of the wall of the passage independent of and back of the outlet mouth and in contact with the pool of coating material being movable in the direction of said mouth, and means for moving the movable portion of the wall of the passage in said direction to feed coating material from the pool through the passage to and out through the outlet mouth.

12. An apparatus comprising: a fountain adapted to contain a pool of coating material and having a feed passage leading to an outlet mouth, a member movable across the mouth in

such close proximity thereto that coating material issuing from said mouth will directly impinge upon the surface of said member, at least one feed roll having a smooth cylindrical periphery contacting said pool and positioned wholly back of the outlet mouth and spaced therefrom, a portion of the periphery of said roll forming a part of the wall of the feed passage, and means to rotate said roll to feed the coating material from the pool through said passage and through the outlet mouth and apply it against the surface of said movable member by virtue of the thus mechanically generated hydraulic pressure.

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