July 17, 1962 M. V. MOLSBERRY ET AL 3,044,440

PAPER COATING APPARATUS

Filed Aug. 22, 1960 4 Sheets-Sheet 1

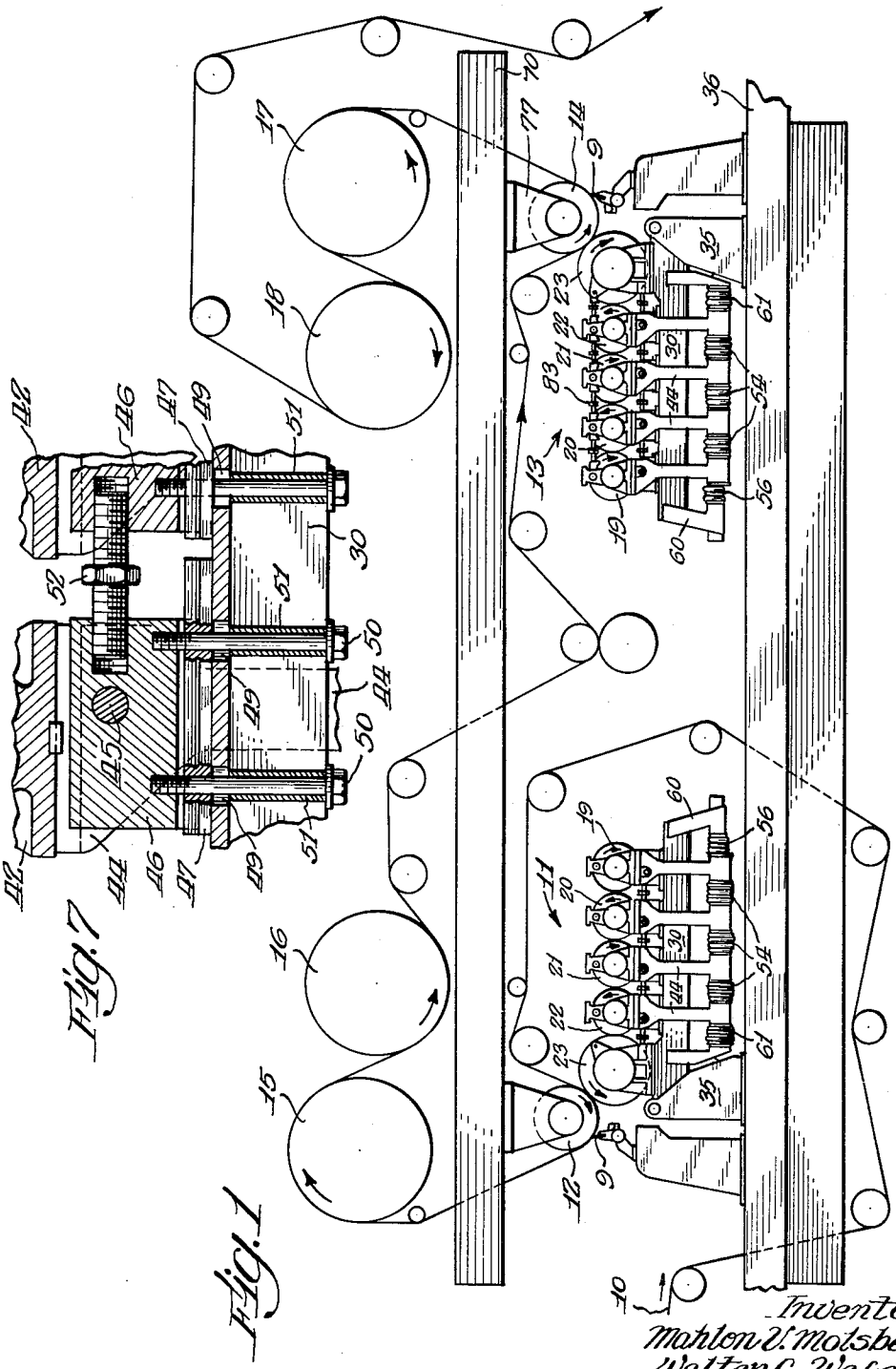

Fig. 1

Fig. 7

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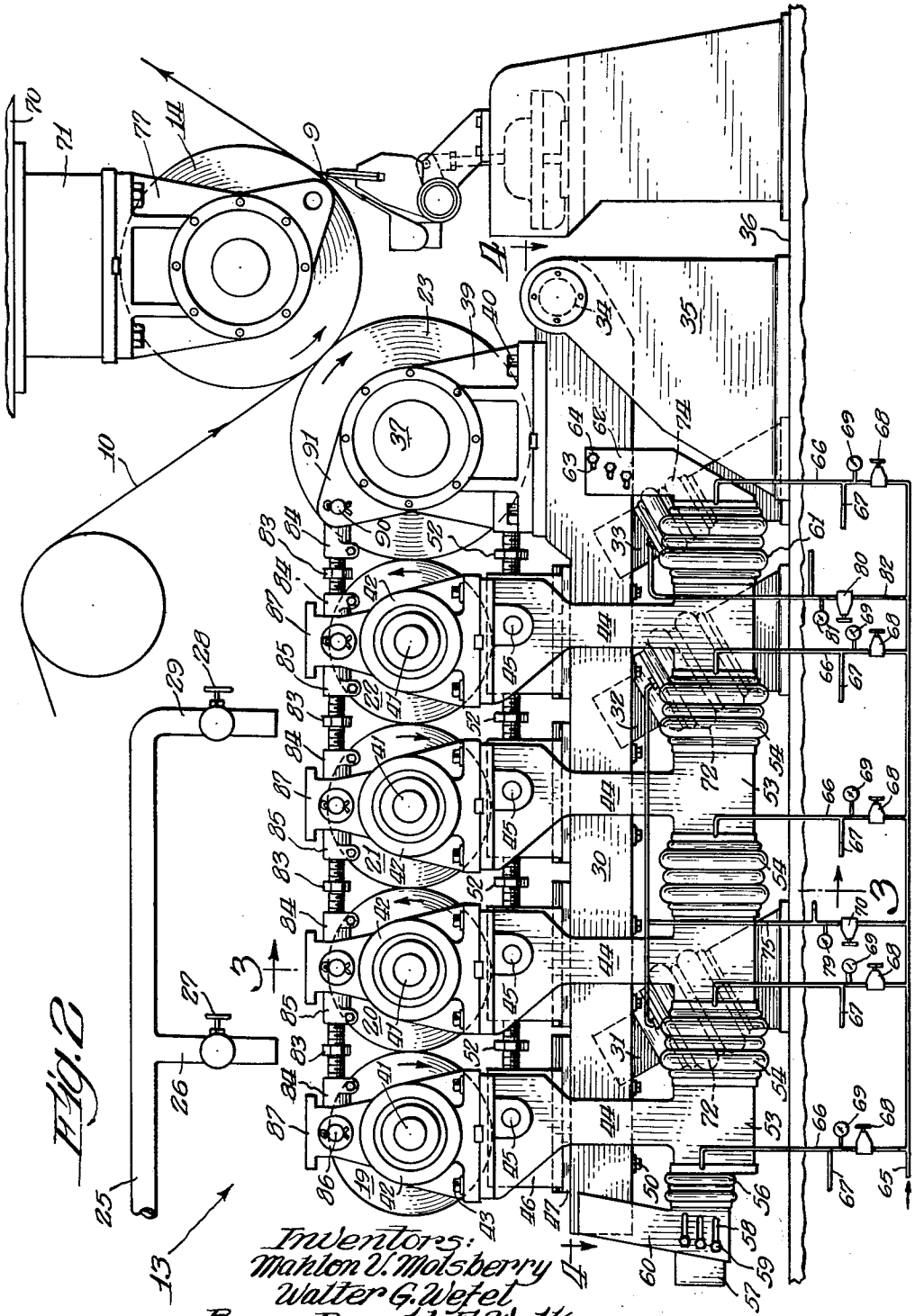

Fig. 2

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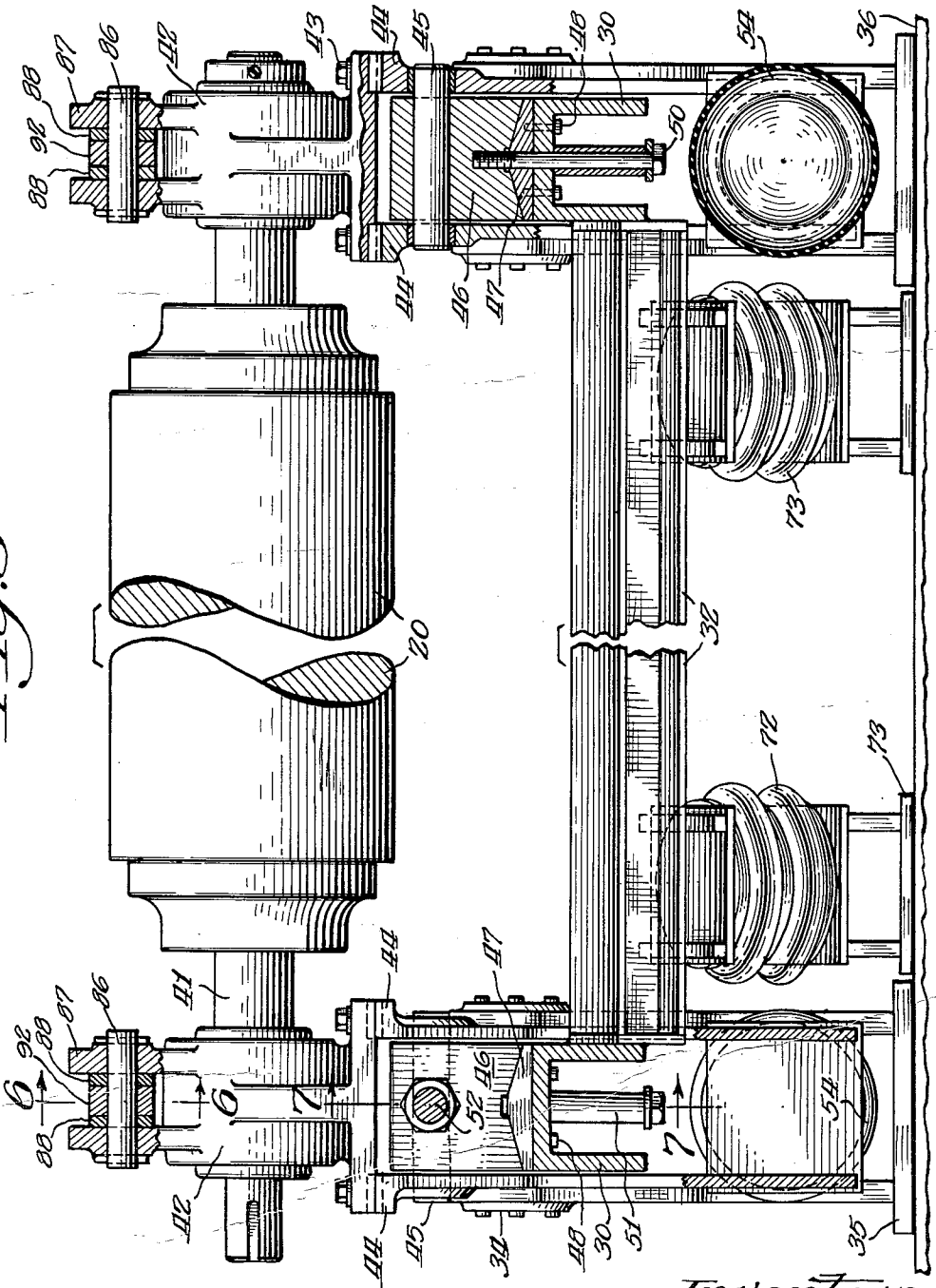

Fig. 3

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PAPER COATING APPARATUS

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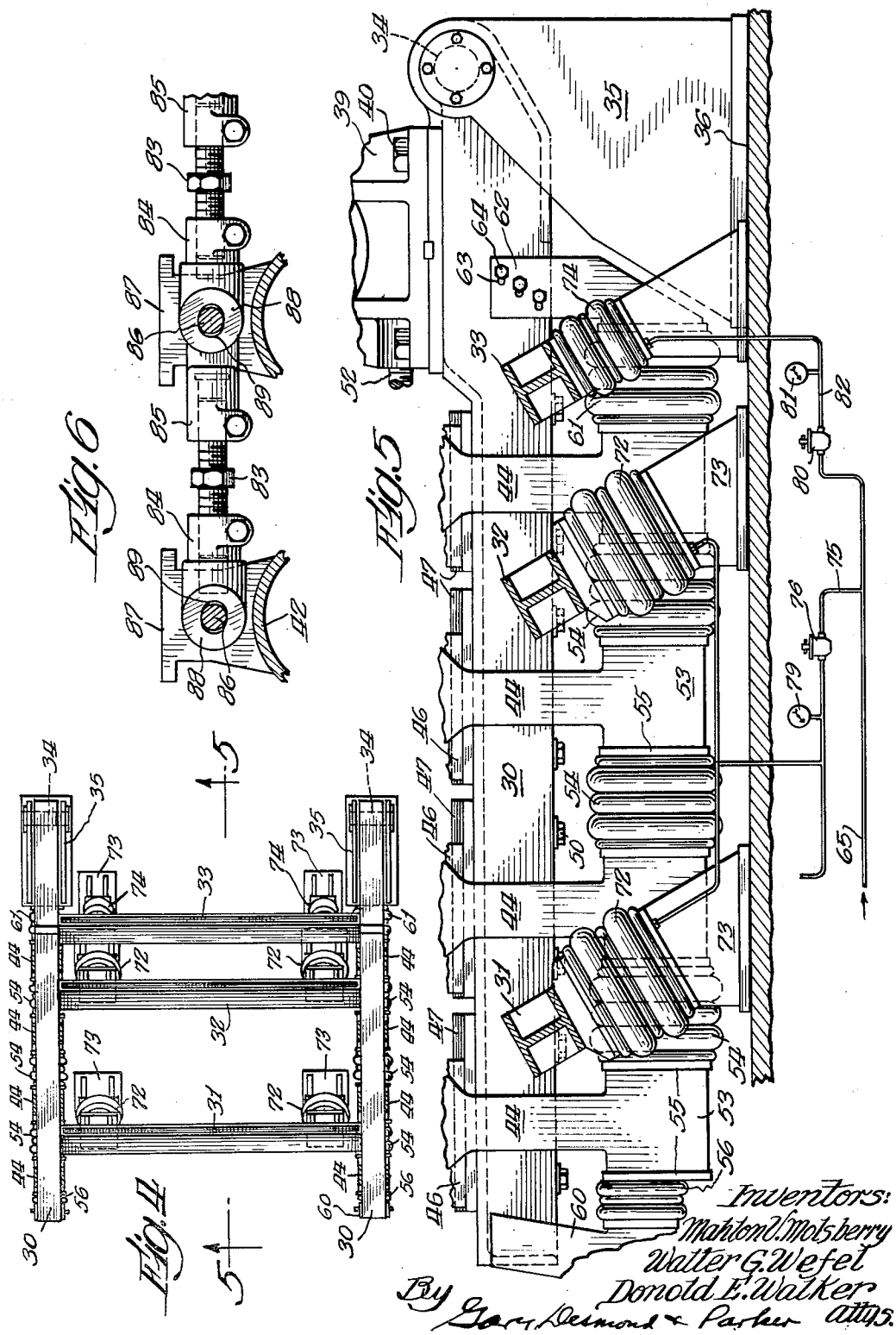

Fig. 6

Fig. 5

Fig. 4

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PAPER COATING APPARATUS

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8 Claims. (Cl. 118—249)

This invention relates to improvements in apparatus for coating paper in a continuous paper-making process and at paper-making speeds.

More particularly, the present invention relates to the provision of improved apparatus for machine-coating paper with relatively high solids content aqueous suspension of mineral pigment and binder whereby to provide publication grades of paper having an enamel-like surface of improved printability.

In general, the apparatus of the present invention comprises a train or a plurality of parallel coating rolls mounted on a unitary support each driven in a direction opposite to an adjacent roll, a pair of rolls at one of the train forming gate or metering rolls between which a pool of coating composition is disposed and maintained from a supply, and a roll at the opposed end of the train forming an applicator roll, arranged to transfer the coating therefrom, substantially in the form of a film, received directly or indirectly from the gate rolls, to a traveling paper web carried by an adjacent backup roll.

In order to properly distribute the coating composition, which may be of thixotropic character, it is necessary first to properly meter it to the desired extent between the initial pair of gate rolls and then suitably distribute it therefrom, either directly to or through distributing rolls, to the final applicator roll which imprints or applies it in the form of a film to the rapidly moving paper web. To this end it is an object of the present invention to provide a new and improved means for adjusting and maintaining the pressure between the respective nips in the aforesaid coating roll train and between the train and the web carried by the backup roll in the coating assembly, within very close tolerances.

It is a particular object of the present invention to provide means for adjusting or regulating the pressure at the nip formed by each adjacent pair of rolls in a manner independent of the pressure between or at the nips of the other rolls in the train.

Further objects of the present invention relate to the provision of pneumatic means for regulating and independently maintaining the spacing or proximity and pressure at the nip of each adjacent pair of rolls in the roll coating train, and to similarly regulate and maintain the spacing or proximity and pressure between the applicator roll of said train and the backup roll or web carried thereby and being coated by means of the applicator roll.

A further object of the present invention relates to means, independently of said pneumatic means, for moving the rolls in the coating train to compensate for surface wear.

Other objects and advantages relate to details of construction and arrangement of parts, as will be apparent from a consideration of the following specification and accompanying drawings, wherein:

FIG. 1 is a diagrammatic side elevational view of a paper coating apparatus in accordance with the present invention.

FIG. 2 is a side elevational view of the wire side coater shown on the right half of FIG. 1 in a relatively enlarged and more detailed form.

FIG. 3 is a section on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary plan view taken substantially on the line 4—4 of FIG. 2.

FIG. 5 is a section on the line 5—5 of FIG. 4.

FIG. 6 is a fragmentary side elevational detail view of optional mechanical means for controlling the pressure at the nip of the respective rolls in the coating train taken on the line 6—6 of FIG. 3.

FIG. 7 is a fragmentary sectional view of the roll spacing adjustment means taken on the line 7—7 of FIG. 3.

Referring to the drawings, and particularly to the diagrammatic assembly view of FIG. 1, means are shown for coating a paper web 10 as it leaves the paper making machine in dry condition, whereupon it is first coated on one side, i.e. the felt side, by means of the roll coater train generally indicated at 11 as it is carried about the backup roll 12, and thereafter coated on the opposed or wire side by means of the roll coater assembly 13 as it travels about the backup roll 14 after having been dried over the drying drum 15 and turned by roll 16. The web 10 after being coated on its second side is again dried by means of the drying drum 17 and passed over the turning roll 18, to suitable calendering and wind-up means, not shown.

Referring more particularly to FIG. 2 which for illustrative purposes shows the operating side of the coating section 13 (the driving mechanism being on the opposed side not shown), the roll coating train comprises metering rolls 19 and 20, distributing rolls 21 and 22, and applicator roll 23. Each of these rolls is separately driven and each roll rotates in a direction opposite that of its adjacent roll, roll 19 rotating clockwise as shown. The gate rolls 19 and 20 are driven at different speeds relative to each other and collectively run slower than the transfer rolls 21, 22. The applicator roll 23 is driven at a rate substantially that of the backup roll 14 which carries the paper web 10.

The aqueous coating composition suspension is delivered between the nip of the gate or metering rolls 19, 20 through the conduit 25, line 26 and valve 27. Should it be desired to employ a lesser number of rolls, as for example when a flexible blade means 9 is employed to doctor or smooth the coating applied to web 10 by roll 23, in such instance the rolls 19 and 20 are jointly spaced or separated from roll 21. In such event rolls 21, 22 become the gate or metering rolls and the coating composition is then supplied to them by closing valve 27 and opening valve 28 in branch line 29 leading from supply conduit 25.

The rolls 19, 20, 21, 22, 23 are all carried on a unitary frame comprising a spaced pair of beams 30, 30 secured together by the cross-ties 31, 32, 33, the beams 30, 30 being pivoted at one end as at 34 to the standard 35 secured to the base or floor 36. Although the applicator roll 23 is shown fixedly mounted on said frame, its shaft 37 being journaled at each end in a bearing and pillow block assembly 39 fixedly secured as at 40 to a beam 30, the individual rolls 19 to 22 are slidably and pivotally mounted. Thus, as shown in the detail of FIG. 3, the roll 20, which is representative of each of the rolls 19 to 22, is mounted by means of its shafts 41 in an opposed pair of pillow block and bearing units 42, the units 42 being each secured as at 43 to a spaced parallel pair of arms 44, 44, these arms freely embracing beam 30.

The coater arm pairs 44, 44 are pivotally mounted, as at 45, on the coater arm pivot pin block 46, the blocks 46 in turn being seated on the stainless steel bearing blocks 47, and the latter being secured to the beams 30 by means of cap screws 48.

Thus, while the roll 20 (similar to the rolls 19, 21 and 22) is rotatably mounted or journaled in bearing and

pillow block units 42, and pivotally supported on the beams 30 on the blocks 46 through the pivots 45, the roll and associated arms are further slidable as a unit longitudinally of the beams 30 to the limit of the longitudinal slots 49 formed in the web of beam 30 and bearing blocks 47, as best shown in FIG. 7. Normally, the pivot pin supporting blocks 46 are held secured in desired position longitudinally of the beam 30 by means of the bolts 50 (held extended for access by means of the sleeves 51), the bolts 50 extending through the slots 49 in the web of beam 30 and in block 47 into threaded engagement as at 51 with the blocks 46.

When it is desired to shift the individual rolls for the purpose of taking up surface wear, the bolts 50 are loosened and the pair of adjacent blocks 46, 46 either drawn together or, when occasion requires, spaced apart by manipulation of the roll wear-adjusting capstan screw 52 which can have either right- or left-hand screws at its opposed ends, or threads of the same direction but of unequal pitch at the opposed ends. After adjustment of the adjacent blocks 46, 46 by means of the capstan screw 52 within the length of the slots 49, the bolts 50 are retightened.

For regulating and maintaining the spacing or proximity and pressure at the nips formed between adjacent pairs of rolls 19 to 23, the present invention provides pneumatic means secured to and between the lower extremities or end portions 53 of the arms 44 as, for example, the air spring 54. This air spring, as well known, is in the form of a hollow bellows composed of fabric-reinforced resilient rubber material of air-impervious character, and each air spring or bellows 54 is secured to transversely extending plate members 55 fixed to and between the pair of arms 44, 44.

A similar air spring 56 is secured at the outer end of the outermost arms 44 and to the member 57 adjustably engaged by means of the slots 58 and screws 59 to the arm 60 secured to the outer end of a beam 30.

Likewise, air spring 61 is secured between the outermost end of the arms 44 which supports roll 22 and the bracket 62 adjustably secured to the beam 30 by means of slots 63 and bolt 64.

As further shown in FIG. 2, compressible fluid, i.e. air, is supplied from a line 65 through branch lines 66 to each of the pneumatic springs 54, 56 and 61, and through branch lines 67 to like pneumatic springs at the opposed drive side of the apparatus, as will be understood.

In advance of each branch line 66 and 67 there is provided a pressure regulator with self-contained relief valve 68 and a pressure gauge 69. Thus, pressure at the nip between rolls 23 and 22 is supplied and controlled in an angular direction by means of the pneumatic spring 61 supplied and controlled in an angular direction acting on the lower end of the arms 44 supporting roll 22 through its pivot 45. Roll 23 is fixedly secured as previously described and therefore any forces acting at the nip between rolls 22 and 23 have no effect on the nip between rolls 23 and 14.

Nip pressure between rolls 21 and 22 is angularly obtained from pressure applied by the pneumatic spring 54 between the lower end portions 53 of each of the arms 44 supporting these two rolls. The force here acts through the arms and pivot pins 45 supporting the rolls 21 and 22. The same will be understood to apply to the nip formed between rolls 20 and 21 and the nip formed between rolls 19 and 20.

Each pneumatic spring or air diaphragm is equipped with a precision regulator with self-contained relief valve 68 which permits each diaphragm or pneumatic spring to maintain a set pressure regardless of forces exerted by adjacent diaphragms. Thus, each set of rolls and arms and corresponding intermediate diaphragm is an independent system retaining its pre-set pressure regardless of external force acting upon it.

Diaphragm 56 is a rapid unloading diaphragm used to unload the nips between adjacent rolls when desired. This is accomplished by exhausting to atmosphere the diaphragm corresponding to the nip to be opened by maintaining the pressure in the other diaphragms and applying pressure to diaphragm 56. The force from the diaphragm 56 will quickly expel the air from the open diaphragm, thus opening the nip.

Although wear may in part be compensated for by angular adjustment, should the multiplied wear on the respective rolls become so great as to cause undue elongation of the air diaphragms, the spacing between the rolls is then preferably adjusted by means of the capstan screws 52 as previously set forth.

The backup roll 14 which carries the web 10 is carried by a pillow block and bearing unit 77 which is secured to an upper deck or overhead beam 70 through the member 71 in a fixed position. In order to regulate the pressure at the nip between applicator roll 23 and backup roll 14, and to support the frame defined by the side beams 30, 30, an additional group of pneumatic springs are provided. These comprise diaphragms 72 extending between the cross-member 31 and the bed plates 73, 73. A similar pair of air springs 72 extend from the bed plates 73 to cross-member 32. A third pair of air springs 74, 74 extend from bed plates 73 to the cross-beam 33. The pneumatic springs or diaphragms 72 acting on the cross-members 31, 32 between the beams 30, 30 are supplied with air through the branch air line 75 leading from main air supply line 65 controlled by a pressure regulator with reducing relief valve 76 and gauge 79 and through branch line 75.

The penumatic springs 72 are suitably regulated so as to support the coating roll train on the pivoted frame with the applicator roll 23 against the backup roll 14 at a zero nip pressure. The desired pressure at the nip formed between applicator roll 23 and backup roll 14 is then maintained by regulating the pressure in the pneumatic springs 74 by means of valve 80, similar to valve 76, and gauge 81 in branch air pressure line 82.

Although the construction and operation of coating section 13 has been described in detail, the construction and operation of coating section 11 is identical, it being mounted on the same bed 36 as coating section 13, except of course that the initial gate roll 19 turns counterclockwise instead of clockwise as in section 13, as viewed in FIG. 1. Likewise, the flexible doctor blade 9 acts against the paper web 10, after being coated, for smoothing the surface thereof. It will also be understood that although, as previously mentioned, the doctor blades 9 are particularly suitable for use when gate rolls 19, 20 are separated and the rolls 21, 22 are employed as gate rolls, if desired, doctor blade 9 can be employed even when the full complement of rolls are employed, as illustrated, with the beneficial effects.

FIG. 1, for illustrative purposes, shows coating section 13 provided with capstan screws 83 between the upper ends 87 of the roll mountings 42, whereas the similar ends in coating section 11 are shown to be without these screws. For operation and control of pressure at the nips of the coating rolls of each coating train 11 and 13, regulation by means of the pneumatic springs acting against their pivoted arms 44 is adequate, and for such reason coating section 11 has been shown without the capstan screws 83. These capstan screws can, however, be employed as an auxiliary to the aforesaid pneumatic springs when properly regulated, or as a safety measure should there be a failure in the supply of compressible fluid to the pneumatic springs.

Thus, as more particularly detailed in FIG. 6, these capstan screws 83 have opposed ends which are threaded in the bushings 84 and 85 in a manner similar to that described with respect to capstan screws 52. These bushings are pivotally engaged through eye portions by pins 86 extending through apertures in the head portions 87

on the roll bearing and pillow blocks **42**. The bushing **84** comprises an eye portion **88**, the aperture of which is elongated in a horizontal direction as shown at **89**. The bushing **85** is similar to the bushing **84** except that the eye portion thereof is of single thickness as best shown at **92** in FIG. 3; whereas the eye **88** of bushing **84** is actually dual or forked and laterally embraces the eye of bushing **85** when the eye of a bushing member **84** and the eye of a bushing member **85** embrace the same pivot pin **86**, as appears from the detail of FIG. 6 and that of the section of FIG. 3. The end bushing **84** shown in FIG. 2 is engaged by the pivot **90** received in the bracket arm **91**.

In normal operation, when the nips between the various rolls are regulated by the pneumatic springs in the manner aforesaid, the arrangement of the capstan screws **83** and their associated bushings **84** and **85** is such that the pivot pins **86** are centered in the slots **89** so that the linkages at the upper ends of the pivot arms **44** will not affect operation of the pneumatic springs but rather provide leeway for angular rocking movement of the arms **44** to the extent desired and within control of the pressure regulator and reducing valves **68** etc., as previously described. Manipulation of the capstan screws **83** may provide a rough adjustment with a final adjustment by means of the pneumatic springs.

Although we have shown and described the preferred embodiment of our invention, it will be apparent to those skilled in the art that changes may be made in the details thereof without departing from the spirit and scope of our invention as set forth in the appended claims.

We claim:

1. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed between them and a pair of intermediate transfer rolls, a base, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end and means pivotally and slidably supporting said gate and transfer rolls thereon, pivot means engaging said beams to said base adjacent said applicator roll supporting end, means for rocking said frame to move said applicator roll toward and away from said backup roll, means for applying and regulating pressure at the nip formed between said pivoted rolls, and separate means associated with said slidable supports for independently regulating and maintaining the proximity at the nip formed between each adjacent roll in said coating train.

2. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of parallel coating rolls including a fixedly mounted applicator roll and a plurality of movable rolls for metering and transferring a film of coating composition to said applicator for transfer thereby to said web, a frame comprising an opposed parallel pair of side beams supporting said applicator roll adjacent one end, mounting means slidably mounted on said beams and pivotally supporting said movable rolls, means engaging said mounting means for holding the latter in adjustable position longitudinally of said beams, and means for independently rocking each of said pivoted rolls whereby to apply pressure at the nip formed between each adjacent roll in said coating train.

3. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of parallel coating rolls including a fixedly mounted applicator roll and a plurality of movable rolls for metering and transferring a film of coating composition to said applicator for transfer thereby to said web, a frame comprising an opposed parallel pair of side beams supporting said applicator roll adjacent one end, arms pivotally mounted on said beams and supporting said movable rolls on their upper end portions, and means secured to the lower end portions of said arms for independently rocking each of said pivoted rolls whereby to apply pressure at the nip formed between each adjacent roll in said coating train.

4. Apparatus for coating a moving web of paper carried by a backup roll comprising a train of parallel coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed between them and intermediate transfer rolls, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end and arms supporting said gate and transfer rolls on their upper end portions, means supporting said arms in pivotal and adjustably slidable engagement on said beams, and pneumatic means engaged to the lower end portions of said arms for independently regulating and maintaining the proximity and pressure at the nip formed between each adjacent roll in said coating train.

5. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed between them and intermediate transfer rolls, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end and arms supporting said gate and transfer rolls on their upper end portions, means supporting said arms in pivotal and adjustably slidable engagement on said beams, pneumatic means comprising flexible bellows engaged between the lower end portions of said arms and between the frame beams adjacent said applicator roll and the arms of the roll adjacent thereto, and means for controllably supplying air under pressure to said bellows for independently regulating and maintaining the proximity and pressure at the nip formed between each adjacent roll in said coating train.

6. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed between them and intermediate transfer rolls, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end and arms supporting said gate and transfer rolls on their upper end portions, means supporting said arms in pivotal and adjustably slidable engagement on said beams, pneumatic means comprising flexible bellows engaged between the lower end portions of said arms and between the frame beams adjacent said applicator roll and the arms of the roll adjacent thereto, means for controllably supplying air under pressure to said bellows for independently regulating and maintaining the proximity and pressure at the nip formed between each adjacent roll in said coating train, and pneumatic bellows means disposed between the arm of the outermost one of said gate rolls and said beams adapted to be expanded when the air pressure is released from one of said first mentioned bellows for facilitating angular spacing of the rolls normally held pressed thereby.

7. Apparatus for coating a moving web of paper carried by a backup roll, comprising a train of coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed therebetween, and intermediate transfer rolls, a base, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end, pivot means engaging said beams to said base adjacent said applicator roll supporting end, pneumatic means for rocking said frame to apply pressure at the nip formed between the applicator and backup rolls, arms supporting said gate and transfer rolls on their upper end portions, means supporting said arms in pivotal and adjustably slidable engagement on said beams, pneumatic means comprising flexible bellows engaged between the lower end portions of said arms and between the frame beams adjacent said applicator roll and

the arms of the roll adjacent thereto, and means for controllably supplying air under pressure to said bellows for independently regulating and maintaining the proximity and pressure at the nip formed between each adjacent roll in said coating train.

8. Apparatus for coating a web of paper carried by a fixedly mounted backup roll comprising a train of coating rolls including an applicator roll for transferring a film of coating composition to said web, a pair of gate rolls for metering coating composition disposed therebetween, and a pair of intermediate transfer rolls, a base, a frame comprising an opposed parallel pair of side beams fixedly supporting said applicator roll adjacent one end, arms supporting said gate and transfer rolls on their upper end portions, means supporting said arms in pivotal and adjustably slidable engagement on said beams, pneumatic means comprising flexible bellows engaged between the lower end portions of said arms and between the frame beams adjacent said applicator roll and the arms of the

roll adjacent thereto, means for controllably supplying air under pressure to said bellows for independently regulating and maintaining the proximity and pressure at the nip formed between each adjacent roll in said coating train, pivot means engaging said beams to said base adjacent said applicator roll supporting end, and pneumatic means comprising flexible bellows disposed between said frame and a supporting base, and means for controllably supplying air under pressure to said bellows for regulating and maintaining the proximity and pressure at the nip formed between said applicator and backup rolls.

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