Aug. 18, 1942. H. R. HARRIGAN 2,293,691

APPARATUS FOR COATING WEB MATERIAL

Original Filed Oct. 25, 1939 5 Sheets-Sheet 1

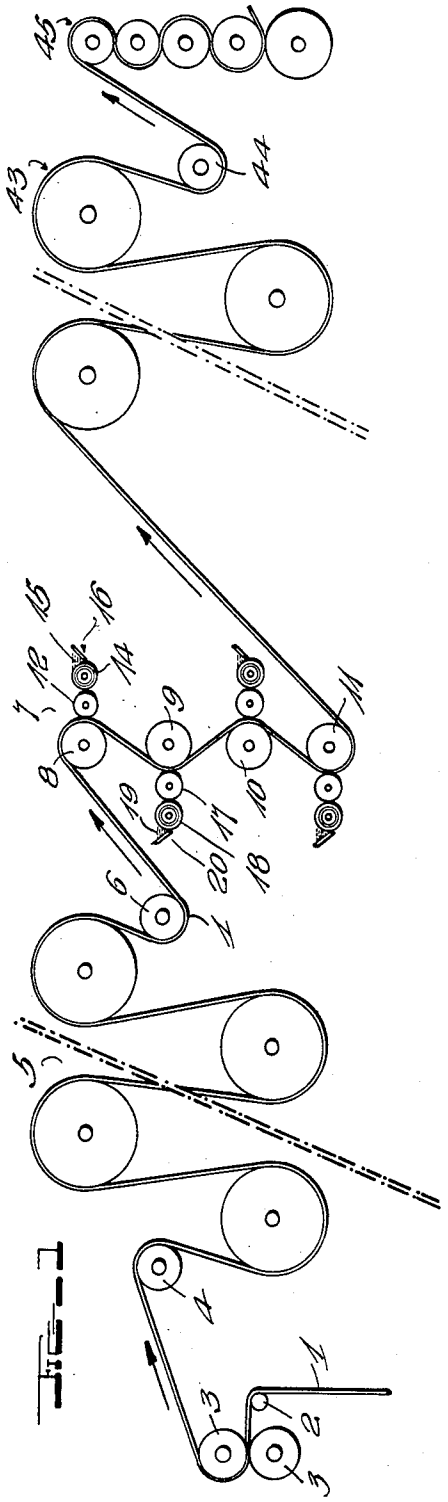

FIG. 1

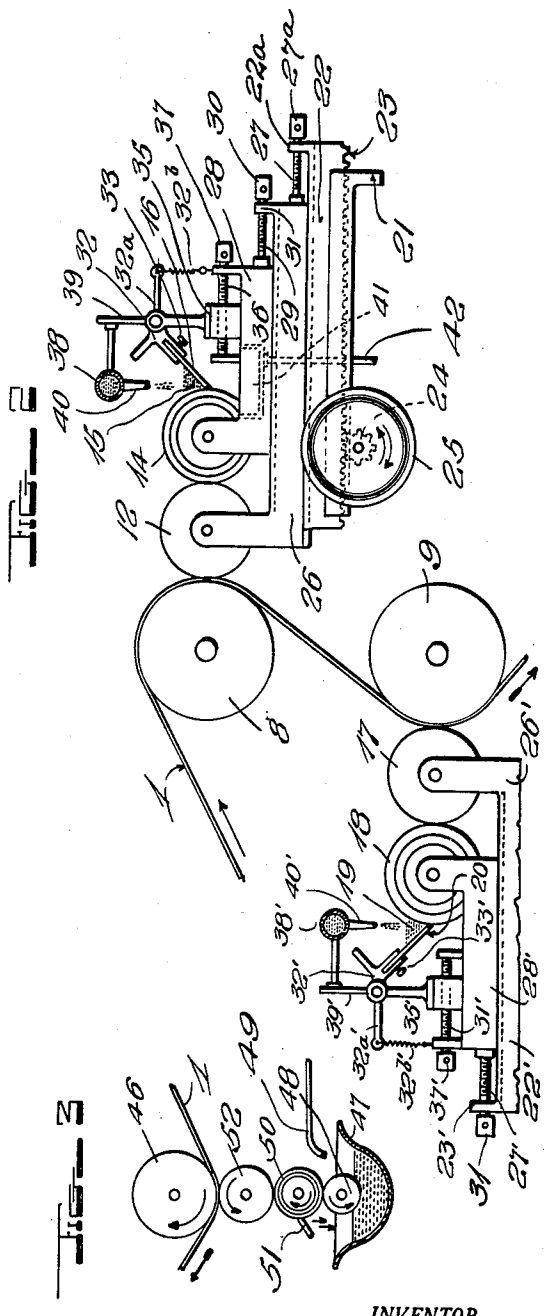

FIG. 2

FIG. 3

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FIG. 4

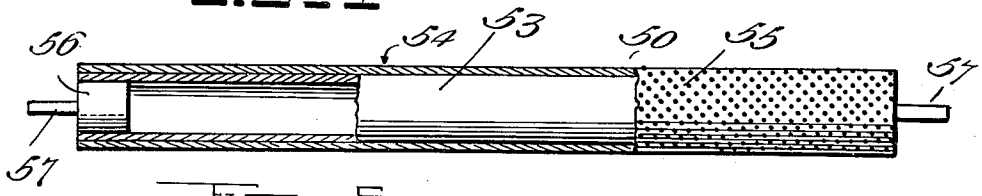

FIG. 5

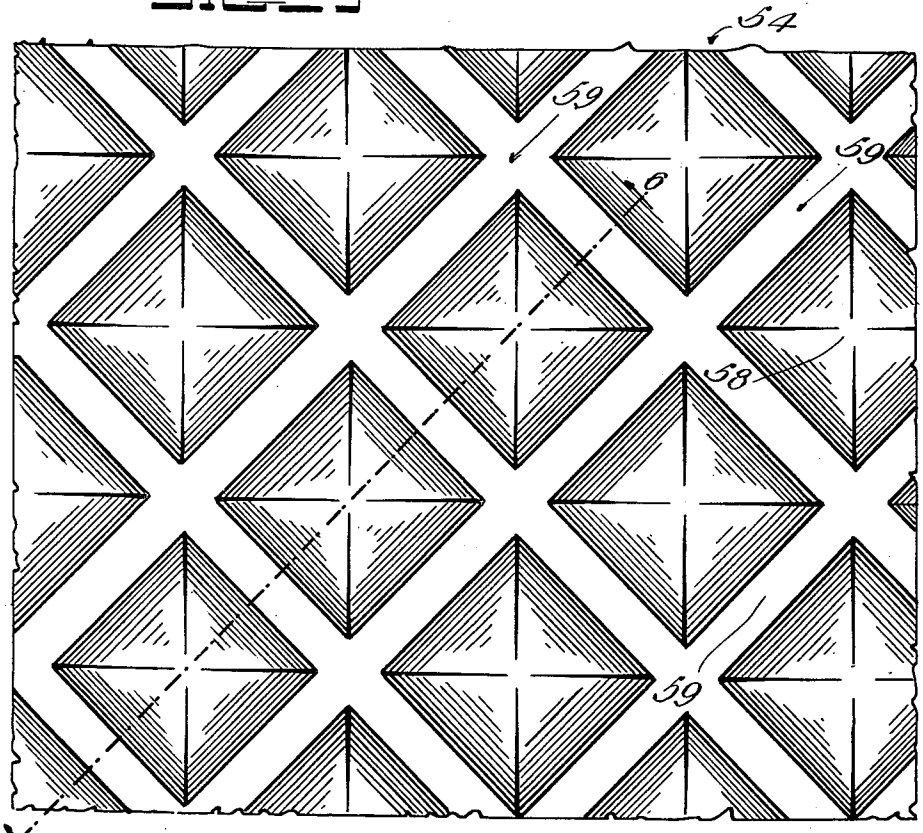

FIG. 6

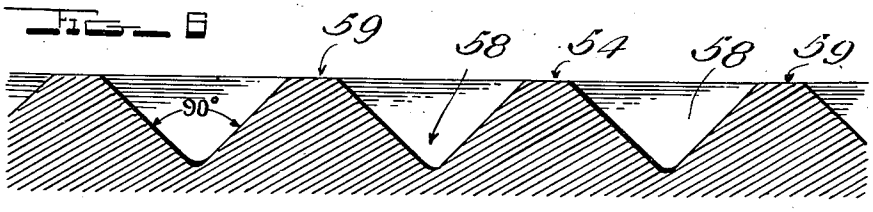

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FIG. 7

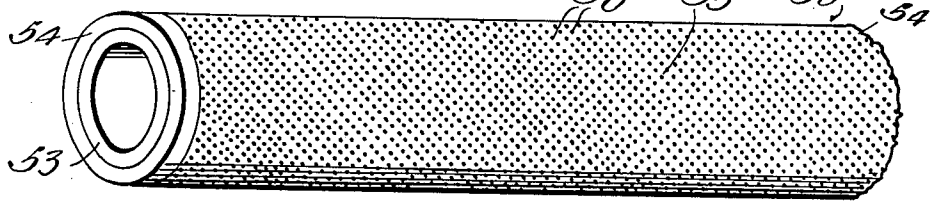


FIG. 8

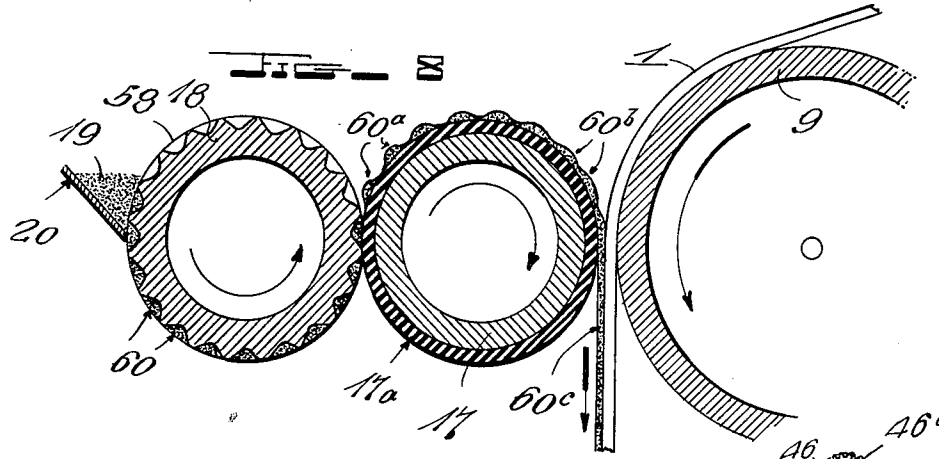


FIG. 10

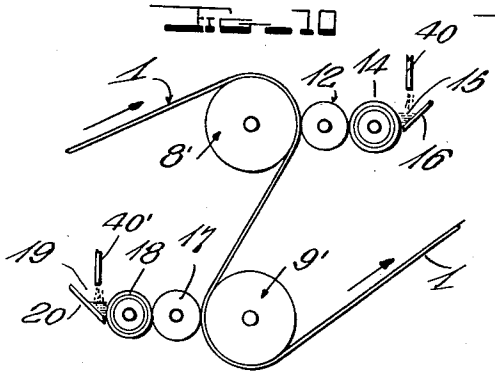


FIG. 9

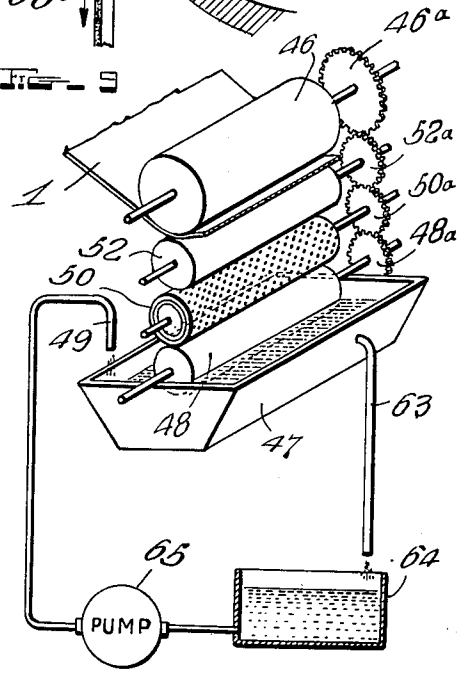
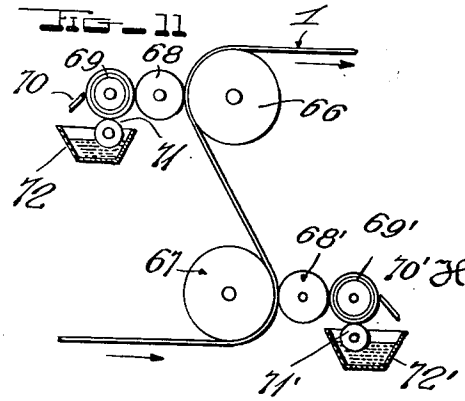


FIG. 11



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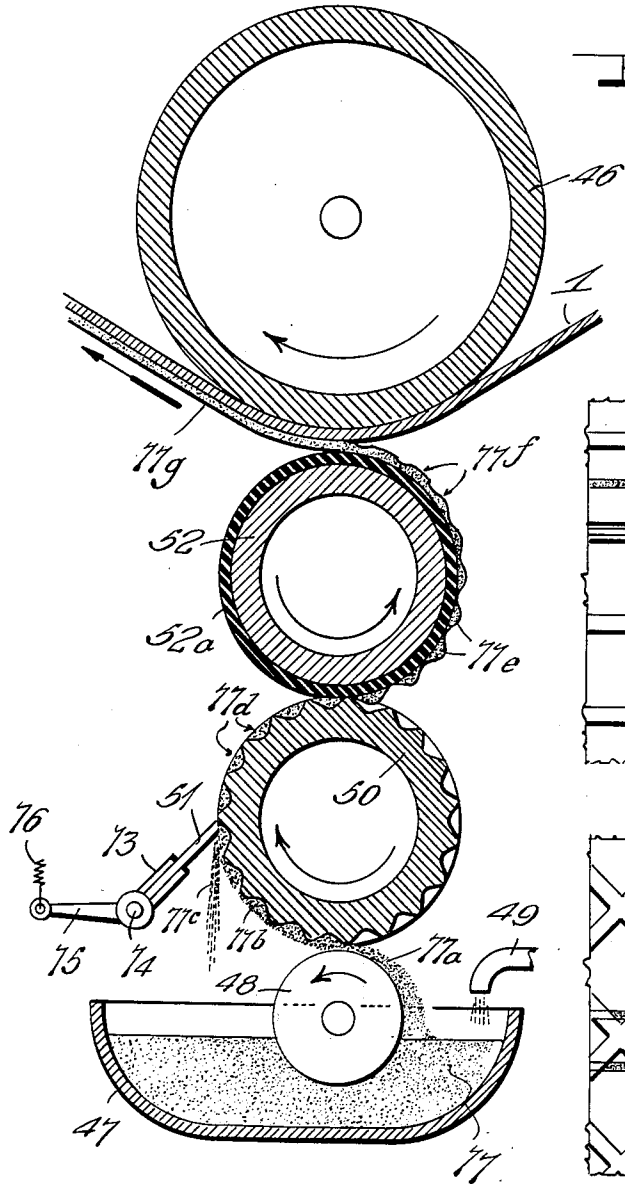

FIG. 12

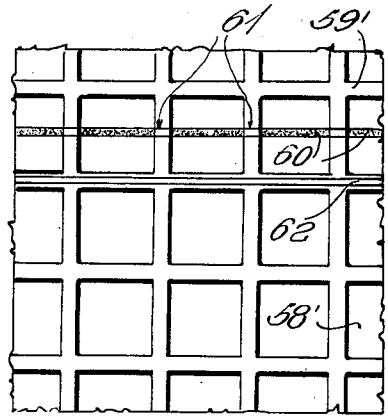

FIG. 13

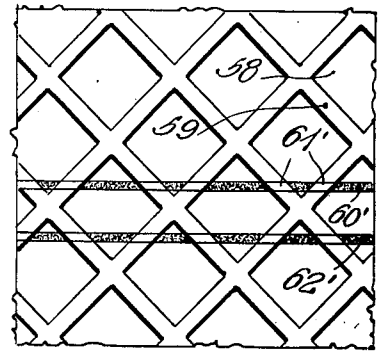

FIG. 14

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FIG. 15

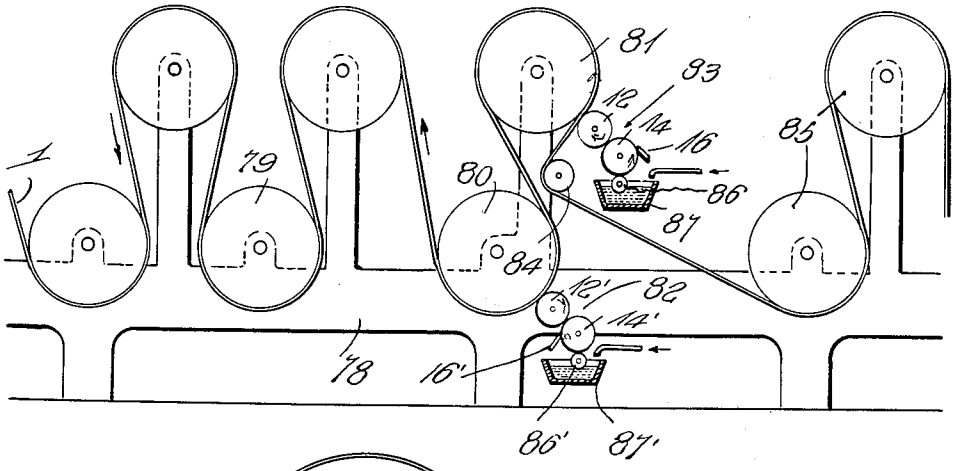
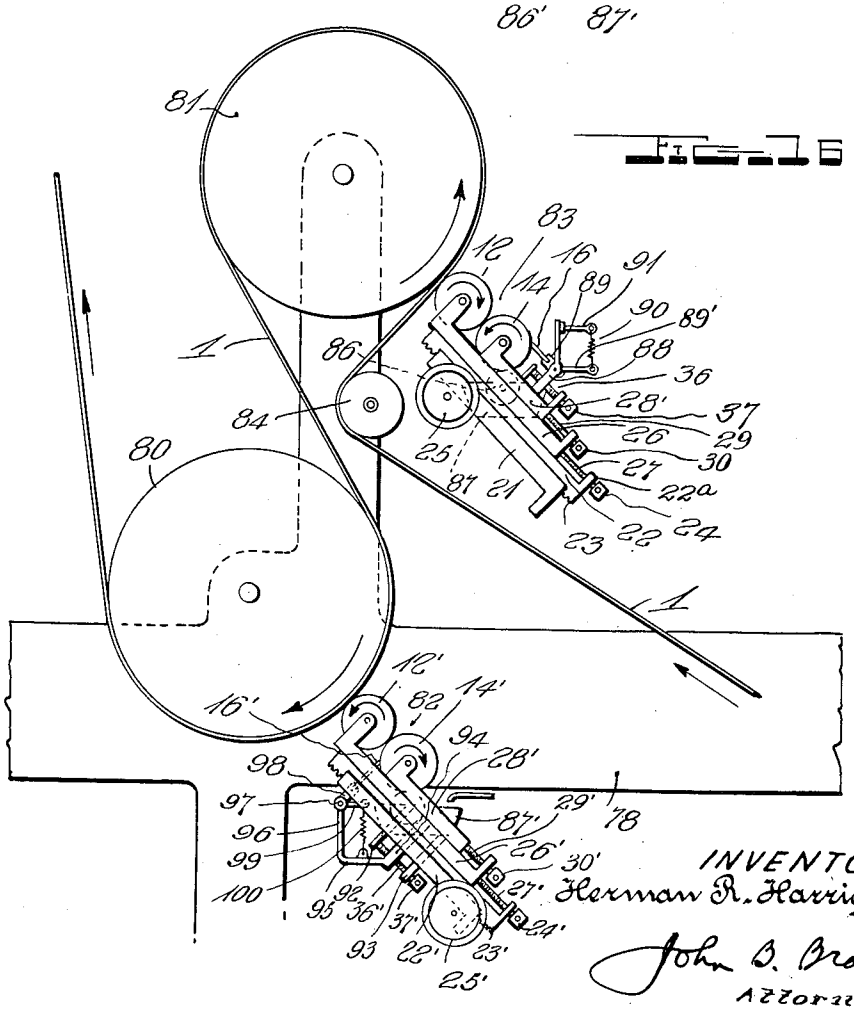


FIG. 16



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Patented Aug. 18, 1942

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UNITED STATES PATENT OFFICE

2,293,691

APPARATUS FOR COATING WEB MATERIAL

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Original application October 25, 1939, Serial No. 301,280. Divided and this application March 27, 1940, Serial No. 326,291

4 Claims. (Cl. 91—50)

My invention relates to an apparatus for coating web material with a film of ink which is uniform in character for producing a smooth surface on the web material.

This application is a division of my application Serial No. 301,280, filed October 25, 1939, for Process of printing, coating, and/or decorating web material.

One of the objects of my invention is to provide an apparatus for coating web material by use of an engraved roller having preformed pockets of uniform size providing carriers for ink from which a regulated coating of ink may be applied to the web of material through the intermediary of a resilient surface offset roller.

Another object of my invention is to provide an apparatus for applying continuous and uniform films of ink to web material in which ink is applied to a roller having a multiplicity of recesses in the surface thereof serving as carriers for the ink and from which excess ink is struck off to enable a continuous and uniform film of ink to be applied through an intermediate offset roller to web material.

Still another object of my invention is to provide an apparatus for delivering a preformed film of ink to web material which is advancing at the same speed at which the web is travelling for insuring a uniform application of the film to the web material.

A further object of my invention is to provide an assembly of rollers by which ink may be delivered to a distributing roller and transferred to an offset roller for impressing a continuous and uniform film of ink upon web material where means is provided for positively driving the ink distributing roller, the offset roller and the bed roll all at the same peripheral speed.

A still further object of my invention is to provide a construction of ink distributing roller particularly adapted for collecting, carrying and delivering an aqueous mixture or oil in water emulsion printing ink to an offset roller for subsequent impression in a continuous film upon web material.

Another object of my invention is to provide a construction of apparatus for applying a uniform film of ink to web material in which an offset resilient roller is employed to coat the web material and wherein the offset resilient roller is in turn supplied with ink through an engraved roller having pockets of uniform size distributed over the surface thereof and forming carriers for ink coacting with means for striking off excess ink for insuring the release of a regulated coating to the offset roller for subsequent transfer in a uniform continuous film to the web material.

Still another object of my invention is to provide a novel construction of distributing roller coacting with a transfer roller in a system for coating web material in which the distributing roller has pockets of uniform size distributed over the surface thereof in the form of inverted or truncated cones or pyramids in which the area of the bottom of the pockets is substantially smaller than the area of the top surface of the pockets and in which a uniform depth of ink may be maintained and transferred as a regulated coating to the transfer roller for impression as a continuous film upon the web material.

A further object of my invention is to provide a construction of distributing roller for coaction with a transfer roller in a system for coating web material wherein the distributing roller contains uniformly distributed recesses in the surface thereof forming containers for ink which coact with leveling means for insuring the removal of excess ink and enabling the transfer of a uniform film of ink from the distributing roller to the transfer roller for subsequent impression upon web material in such manner that existing differences in thickness of the ink released from the recesses are equalized by merging of one portion of the ink film with an adjacent portion thereof to provide a continuous and uniform film of ink on the web material.

A still further object of my invention is to provide a construction of distributing roller for coaction with an offset roller in engagement with web material passing over a bed roll in which preformed recesses for ink are arranged in parallel spiral paths around the surface of the distributing roller for delivering a uniform and continuous film of ink to the offset roller for impression upon the web material passing over the bed roll while maintaining substantially uniform wear between the surfaces of the distributing roller and the offset roller.

Other and further objects of my invention reside in an improved apparatus for impressing a regulated coating of ink upon web material as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 schematically illustrates the application of my invention in the printing of paper; Fig. 2 is an enlarged side elevational view of a fragmentary portion of the mechanism represented in Fig. 1 showing the means for controlling

the thickness of the film of ink which is impressed upon the paper sheet material; Fig. 3 is a fragmentary view illustrating a modified form of regulating the impression of ink upon the web material; Fig. 4 is a side elevational view partially broken away and illustrated in section showing the distributing roller employed in the system of my invention for regulating the quantity of ink supplied to the transfer roller; Fig. 5 is a fragmentary view of the surface of the distributing roller greatly magnified to illustrate the ink receiving receptacles in the surface of the roller; Fig. 6 is a cross sectional view taken on line 6—6 of Fig. 5; Fig 7 is a perspective view of a fragmentary portion of the distributing roller employed in the system of my invention; Fig. 8 is a schematic view showing the distributing roller, the transfer roller and a bed roll illustrating in magnified section the manner of regulating the thickness of the film of ink which is applied to the web passing over the bed roll; Fig. 9 is a fragmentary perspective view showing a further arrangement of apparatus for impressing a regulated film of ink upon web material in accordance with my invention; Fig. 10 schematically illustrates the application of my invention to a paper machine in which paper is passed around a pair of bed rolls and a uniform film of ink supplied to opposite sides of the web of paper; Fig. 11 is a fragmentary view of a modified arrangement of apparatus for impressing a uniform film of ink upon opposite sides of a web of paper passing over a pair of bed rolls; Fig. 12 is a schematic view illustrating the manner of accurately regulating the thickness of the film of ink applied to a web of paper with the apparatus of my invention; Figs. 13 and 14 are theoretical views showing by comparison the advantages obtainable by the spiral arrangement of recesses on the surface of the distributing roller coacting with an offset transfer roller by which uniform wear and consequently uniform distribution of ink is transferred to the offset surface of the transfer roller for subsequent impression upon the web material; Fig. 15 illustrates a further modified arrangement of inking means for applying a film of ink to a web of paper; and Fig. 16 is an enlarged view of the ink applying system embodied in Fig. 15.

For purposes of explaining the principles of my invention, I have illustrated my invention as applied to paper making machinery in the process of making paper, but it is to be understood that my invention is generally applicable to processes of coating web material generally. The process carried out by the apparatus of my invention as exemplified by the application of my invention in the coating of paper embraces the forming of the paper web and removing the excess water therefrom, printing upon the wet web by means of a roller having a resilient surface which receives its ink or color from a distributing cylinder or roller. The cylinder or roller of my invention may be formed by the electrolytic deposition of copper on a steel cylinder to obtain a sheathing of extremely close grain. My invention is not limited to the electrolytic deposition of the sheathing, but embraces any method for obtaining a close grain metal surface which may be suitably engraved, knurled, or recessed. Any close grained metal that may be engraved, knurled or recessed is sufficient to meet the requirements of my invention and it is not necessary that a sheath be employed, as a hollow or solid drum may be utilized. The important essential is that the surface shall be close grained. The surface of the roller is then treated by knurling, engraving or recessing the surface of the roller in such manner that the aligned elements of the knurling, engraving or recessing extend along axes which are disposed at approximately 45° with respect to the longitudinal axis of the roller and are spiraled around the roller. The character of the knurling, engraving or recessing is important and I have found that inverted pyramid recesses formed in the surface of the roller provide means for distributing a film of ink of uniform depth to the offset roller for delivery to the web material as it passes through the machine. The roller will uniformly distribute to the offset roller a quantity of ink which will form a uniform film of ink that may be transferred to the offset by reason of the arrangement of a doctor which functions to strike the excess ink from the distributing roller. The pyramid shaped pockets in the roller constitute means for retaining equal minute portions of ink as the excess ink is struck off by the doctor so that the roller serves to distribute uniform quantities of ink to the offset roller which correspondingly serves to apply the ink to the web in the course of the passage of the web through the machine. I utilize an ink of very special characteristic in carrying out the process of my invention, that is, an aqueous mixture or oil in water emulsion that readily adheres to the web material.

By reason of the easy release of the ink from the inverted pyramid shaped pockets and because of the measurements that are obtained by striking off the quantity in each pocket by flexible doctors or scrapers, the spread of ink is obtained without the use of high pressure. Consequently deflection is of minor importance with the process of my invention which permits the effective use of the invention on wide machines and with smaller and lighter parts. There must be a sufficient volume of ink to enable the ink to merge into a solid film of uniform depth on the paper. I have found the inverted pyramids highly successful in obtaining quick release of the ink and there is less tendency for the ink to remain in the pockets. The pockets are relatively large and the space between the pockets relatively small and the tendency of the ink to flow into a uniform film is considerably increased. The construction of the distributing roller and the flexible doctor which coacts therewith are such that any irregularities or distortion in the surface of the distributing roller or misalignment thereof do not cause any defect in the transfer of ink to the paper. The inverted pyramids forming the ink receiving receptacles provide the best method of retaining a predetermined and measured quantity of ink that is leveled and impressed on the offset roller, thereby producing a uniform level of ink on the web material.

Referring to the drawings in more detail, reference character 1 indicates the wet web of paper as it passes through the paper making machine and passes over guide roller 2 through the bed rolls 3 and over guide roller 4 through the drier rollers represented generally at 5. The paper 1, while still wet passes around guide roller 6 and is delivered to the assembly of rollers as indicated generally at 7 by which the process of coating the web is carried out in accordance with my invention. The assembly of rollers 7 comprises sets of bed rolls 8, 9, 10 and 11 around which the paper web 1 in a moist state, subject only to the initial drying by passage through drier

rolls 5 passes. Coating is effected on both sides of the web 1 by accurately aligned coating mechanism which I have illustrated more clearly in Fig. 2. The coating mechanism is associated with each of the bed rolls 8, 9, 10 and 11 as shown in Fig. 1. The offset roller which coacts with bed roll 8 is indicated at 12 receiving ink from distributing roller 14 constructed with recessed pockets therein which are filled with ink from a suitable ink supply designated generally at 15 and the recesses leveled off by the coaction of the doctor 16 with the surface of roller 14. Similarly, ink is supplied to offset roller 17 coacting with bed roll 9 through distributing roller 18 having recesses in the surface thereof which are continuously supplied with ink from the ink supply designated generally at 19 which is leveled in the recesses in the surface of distributing roller 18 by coacting doctor 20.

Referring to Fig. 2, the coating mechanism will be understood more clearly as comprising sets of associated and horizontally or vertically adjustable supports or carriers for the several rollers. The frame of the machine is indicated for example generally at 21 which serves as a carrier for transversely adjustable support 22. The support 22 is provided at one side thereof with a toothed rack 23 which is engageable by a pinion 24 carried on a shaft journalled with respect to frame 21 and manually controllable by a hand wheel 25 by which the entire assembly of the distributing and offset rollers may be advanced or retracted with respect to the aligned bed rolls. The offset roller 12 is journalled in adjustable carrier 26 which may be advanced or retracted with respect to bed roll 8 by means of adjusting screw 27 which engages screw threads in carrier 26 and passes freely through the up-standing lug on support 22 as indicated at 22*a* and which may be rotatably adjusted by head 27*a* engageable by a suitable wrench or tool. The carrier 26 is reciprocative with respect to carrier 22 by adjustment under control of screw 27. Similarly, carrier 28 in which there is journalled the distributing roller 14, is also adjustable on carrier 26. This adjustment is effected by rotating screw 29 which passes freely through up-standing lug 31 on carrier 26 by gripping the wrench engaging head 30 thereof and rotating screw 29 in screw threads formed in carrier 28. Thus the distributing roller 14 may be independently adjusted in spacial relation to offset roller 12, while offset roller 12 is also independently adjustable with respect to the web of material which passes over press roll 8. I have shown the doctor 16 coacting with the recessed surface of distributing roller 14. For the purpose of regulating the film of ink transferred by roller 14 to the offset roller 12 and impressed upon the web of paper, I mount the doctor 16 in a special form of carrier shown at 32 from which it may be readily removed or replaced by means of set screws 33. The carrier 32 includes an arm 32*a* which is connected through a spring 32*b* with an up-standing lug 34 on carrier 28. The carrier 32 is supported on movable member 35 which may be advanced or retracted on screw 36 by adjusting the head 37 by means of a suitable wrench. Adjustment of carrier 32 thus controls the adjustment of doctor 16 with the surface of distributing roller 14 controlling the amount of ink which is delivered to the recesses in the surface of the distributing roller 14 and the amount of ink that is struck off at the extremities of the recesses. The ink is supplied through a reservoir 38 supported with respect to movable block 35 through the support indicated at 39 for delivering through spout 40 the required amount of ink which I have represented as controlled at 15 over the doctor 16 for delivery to the recessed pockets in distributing roller 14. A tray 41 is provided beneath the wiping edge of the doctor 16 and the ink recovered for reuse through pipe line 42. Similar parts are provided for adjustably mounting distributing roller 18 and offset roller 17. I have designated corresponding parts by similar characters primed to distinguish the characters from the characters previously used in association with the assembly involving distributing roller 14 and offset roller 12. Similar assemblies are associated with bed rolls 10 and 11 shown in Fig. 1. The paper after passing through the assemblies as described, passes to the driers represented generally at 43 and under guide roller 44 through the calender rolls 45.

The ink which is employed in the system of my invention is an aqueous mixture or oil in water emulsion which does not have the tendency of coalescing in the pockets in the surface of the distributing roller but is fluid enough to fill the pockets and yet not sufficiently fluid to flood the doctor. The ink is sufficiently viscous to maintain the conical pattern imparted thereto by the inverted conical recesses as the ink is delivered to the offset roller and yet sufficiently plastic to merge into a layer when applied to the wet web material by a process of revolution and the settling of the particles of ink into a uniform layer or film. That is to say, the ink possesses a high degree of viscosity, surface tension and density. The flowing properties of the ink are such that the ink will flow a substantial distance before breaking into drops. The ink will spread within wide limits to make a perfect film merging in a uniform depth on the offset roller. With respect to density of the ink, the percentage of solids to the vehicle is carefully selected. I have used inks containing 33% solids which were found to render the process inoperative, whereas ink containing 66% of solids enabled the process to work very well. The viscosity in general should fall within limits of 500 and 1000 centipoises. The principal characteristic of the ink is that because of the water soluble properties of the ink, the ink will readily mix with and be absorbed by the wet paper.

The ink may be applied to the web material in a variety of ways. I have illustrated in Fig. 3 a modified manner of impressing ink upon web material 1 as it passes beneath a bed roll 46. In this arrangement, an ink trough 47 is provided within which an inking roller 48 operates for delivering ink which is replenished through pipe 49 to the surface of distributing roller 50. Doctor 51 strikes or levels off excess ink from the surface of roll 50 and returns the excess ink to the trough 47. Distributing roller 50 makes surface contact with offset roller 52 to which a uniform film of ink is supplied and which is transferred to the web material 1. It will be understood that the peripheral speed of the inking roller, the distributing roller, the offset roller and the associated bed roller is the same. Such uniform speed may be effected through a system of gears, chain and sprockets, bits or other suitable means. The important characteristic of the assembly is that the peripheral speeds be uniform and that the inking, distributing and offset rollers and the bed roll each be positively driven. The par-

ticular mechanism by which this is accomplished may be varied in detail.

Referring to Fig. 4, I have illustrated the construction of one of the distributing rollers represented by reference character **50** as comprising a hollow steel drum **53** carrying the electrolytically disposed close grained metal sheath **54**, the surface of which is recessed in a spiral pattern running at approximately 45° with respect to the longitudinal axis of the roller as indicated at **55**. The ends of the drum **53** have plugs **56** set therein from which extend the shaft members **57** for driving the roller.

Figs. 5 and 6 illustrate on a magnified scale, the preformed shape of the pocket or recesses in the surface of the distributing roller **50**. Recesses are knurled, engraved or otherwise formed in the surface **50** in rows disposed approximately 45° with respect to the longitudinal axis of the roller and are spiraled around the roller. The recesses are substantially in the form of inverted pyramids or cones shown at **58**. The apex of the pyramids or cones extend radially downward toward the center of the distributing roller and are rounded to readily release the ink and prevent accumulation of the ink in the pockets. The walls of the inverted pyramids or cones are disposed at approximately 90° with respect to each other. The open bases of the inverted pyramids or cones terminate adjacent each other in the surface of the distributing roller, leaving a relatively narrow surface band indicated at **59** between the pockets **58**. It is highly desirable that this surface band be narrow in order that the maximum amount of ink may be distributed through the open bases of the pockets **58** and also to reduce to a large degree the amount of surface friction established by the inking roller, the doctor and the offset roller in contacting the surface of the distributing roller. This will be clear by reference to Figs. 13 and 14. In Fig. 13 I have shown the result which would be obtained in using a distributing roller having recesses **58'** therein which extend around the surface of the roller in paths normal to the axis of the roller, separated by narrow surface bands **59'**, while in Fig. 14 I have shown the arrangement of recesses **58'** separated by spiral surface bands on the surface of the distributing roller in accordance with my invention. The ink which accumulates in the recesses **58'** has been shown in Fig. 13 represented by the successive darkened portions of the strip-like element **60** separated by the light portions representing the surface of the distributing roller at **61** (Fig. 13). I have indicated a light strip extending longitudinally of the surface of the distributing roller at **62** in Fig. 13 which is coextensive with the narrow band surface **59'**. The strip elements **60**, **61** and **62** represent elements extending longitudinally of the offset roller which would normally contact the surface of the distributing roller. With the recesses arranged as shown in Fig. 13, it will be apparent that very substantial surface friction with inherent wearing occurs along the element **62** on the band width surface of the distributing roller. Also it will be observed that for the entire longitudinal strip **62** there is no supply of ink for that corresponding element of the offset roller. On the other hand, reference to the element of my invention as illustrated in Fig. 14 will show that for strip elements **60'** and **62'** only a relatively small part of such elements extend across the surface bands **59** at any time. Moreover, within the elements **60'** and **62'** there is always a substantial supply of ink for the corresponding elements of the offset roller. Thus the spiral arrangement of pockets insure minimum wear of the distributing roller and maximum supply of ink to the offset roller for any longitudinal element of the distributing roller.

The perspective view of the distributing roller shown in Fig. 7 will make clear the spiral arrangement of pockets **58** in the surface of the distributing roller **50** and the manner in which the close grained sheath **54** is carried by the hollow steel drum **53** and subject to renewal thereon.

In Fig. 8 I have shown a theoretical view somewhat out of proportion for the purpose of theoretically illustrating the manner in which a uniform film of ink is applied to a web of material in accordance with my invention. It will be seen that the ink supplied at **19** is received in the recesses **58** of the distributing roller **18** and is leveled therein by the coaction of doctor **20** with the surface of the distributing roller in the course of rotation thereof. The offset roller **17** which is traveling at the same peripheral speed as the distributing roller **18** receives the ink **60** as represented at **60*a*** and carries the ink by movement in a clockwise direction toward the web material **1**. As heretofore noted, the viscosity, surface tension and density of the ink are such that the individual charges or deposits of ink **60*a*** merge by a resolution of forces due to gravitation and rotation as indicated at **60*b***. The merging charges or deposits of ink **60*a*** form into a film of uniform thickness as represented at **60*c*** on the surface of web material **1** as bed roll **9** rotates as shown. The offset roller **17** has a resilient surface indicated at **17*a*** constituted by a composition or rubber covering. This covering has a plastometer reading of approximately 120 measured with a ⅛ inch ball. The pliability and resiliency of the offset surface is such that a uniform film of ink is applied to the web material **1**.

In Fig. 9 I have shown in perspective view the manner in which inking roller **48**, distributing roller **50**, offset roller **52** and bed roll **46** are driven at the same peripheral speed. I have shown intermeshed gears **48*a***, **50*a***, **52*a*** and **46*a*** carried by the shafts of the respective rollers. These gears have teeth which are somewhat elongated so that upon operation of the rollers by adjustments as described in Fig. 2, the gears remain meshed to a sufficient extent to insure continuous and positive driving of the rollers. While I have indicated an arrangement of gears, it will be understood that other arrangements may be employed for insuring uniform peripheral speed of the several rollers. Ink is supplied from trough **47** to inking roller **48**. The supply of ink is replenished in trough **47** from spout **49** through which the ink is continuously pumped as it overflows from trough **47** through pipe **63** into reservoir **64** from which the ink is pumped by pump **65** through spout **49** for return to trough **47**.

My invention is equally applicable to machines whose purpose it is to coat web material independently of the machines by which the web material may be actually formed. That is, in the case of paper I may apply a coating in accordance with the principles of my invention by a machine which is entirely independent of the paper making machine. In Figs. 10 and 11 I have indicated two forms of such machines. In Fig. 10

I have shown the web material 1 passing around bed rolls 8' and 9' which correspond to bed rolls 8 and 9 of Fig. 1 except that bed rolls 8' and 9' may be mounted in an independent machine as distinguished from the paper machine schematically shown in Fig. 1. Ink delivered through spout 40 is accumulated at 15 and applied to the surface of distributing roller 14 and equalized thereon by the coaction of doctor 16 with roller 14. The ink is then applied through offset roller 12 to the web material 1 coacting with bed roll 8'. The opposite side of the web material is coated by ink delivered through spout 40' and accumulated at 19 for covering the surface of distributing roller 18 with which doctor 20 coacts. A film of ink is thus applied to offset roller 17 and impressed upon web material 1.

In Fig. 11 I have shown web material 1 passing around bed rolls 66 and 67 with each of which there is associated a coating mechanism. Offset roller 68 applies a uniform film of ink to web material 1 by virtue of the ink coating delivered by distributing roller 69 which is supplied with ink from inking roller 71 in coaction with doctor 70. Inking roller 71 receives its ink from trough 72. The opposite side of the web material 1 is coated with a film of ink by operation of offset roller 68', distributing roller 69' and inking roller 71' coacting with doctor 70'. Inking roller 71' receives its supply of ink from trough 72'. Thus it will be seen that the ink may be delivered to the distributing roller in substantially vertical planes while the ink is transferred to the web material in a horizontal plane.

In Fig. 12 I have shown an enlarged theoretical view of the arrangement of inking roller 48, distributing roller 50 and offset roller 52 for applying a uniform film of ink upwardly against web material 1 operating against bed roll 46. It will be observed that ink delivered to trough 47 through spout 49 forms a pool 77 in which inking roller 48 is submerged. The ink is picked up by rotation of the inking roller as indicated at 77*a* and is delivered to the recesses or pockets in distributing roller 50 as indicated at 77*b*. Excess ink is struck off from the pockets 77*b* by coaction of doctor 51 with the surface of the distributing roller, the excess being returned as indicated at 77*c* to the pool of ink 77 in trough 47. Doctor 51 is mounted in carrier 73 pivotally mounted at 74 from which arm 75 projects. Arm 75 is continuously urged by spring 76 in a direction which causes doctor 51 to engage the surface of distributing roller 50 and strike off the excess ink to equalize the ink retained in the recesses or pockets as represented at 77*d*. The offset roller 52 receives the charges or deposits of ink from the pockets in the distributing roller by adherence of the ink to the resilient surface 52*a* as indicated at 77*e*. By virtue of the forces of gravitation combined with the rotation of the offset roller 52, the ink due to its viscosity, surface tension and density merges as represented at 77*f* and is applied in a substantially uniform film at 77*g* to the web material 1. It will be understood that the arrangement illustrated in Fig. 12 is considerably magnified in order to clearly bring out the method of securing the coating or uniform thickness on the web material in accordance with the principles of my invention.

I have hereinbefore described the advantages of extending the recesses or pockets 58 in a spiral path as illustrated in Fig. 14 as distinguished from paths normal to the axis of the distributing roller as illustrated in Fig. 13 whereby frictional wear is reduced and a larger quantity and more uniform distribution of ink is secured.

In Fig. 15 I have illustrated a further arrangement of apparatus for applying a film of uniform thickness to web material. For purposes of illustrating my invention, I have shown the method in Fig. 15 as applied to a paper making machine having frame 78 with sets of drier rollers 79 over which the paper 1 moves. The paper is guided around driers 80 and 81 where it is coated in accordance with the principles of my invention by coating mechanism which is arranged at approximately 45° with respect to the longitudinal axis of driers 80 and 81. One side of the web material 1 is coated by the mechanism represented generally at 82 while the opposite side of the web material is coated by the mechanism illustrated at 83. The web material after leaving drier 81 passes around guide roller 84 to the additional driers represented generally at 85. The coating mechanism illustrated at 82 and 83 is generally similar to the mechanism illustrated in Fig. 2 except that the mechanism is mounted at approximately 45° with respect to the longitudinal axes of the driers 80 and 81. The frame 21 of mechanism 83 and frame 21' of mechanism 82 extend approximately at 45° with respect to the axes of driers 81 and 80 respectively. Similar parts of mechanism 83 have been indicated by primed characters in describing mechanism 82. The mechanisms, while generally the same as that illustrated by corresponding reference characters in Fig. 2, differ to the extent that the adjustable support for the doctor 16 is so arranged with respect to the distributing roller 14 that excess ink accumulated by inking roller 86 from trough 87 is removed from the surface of distributing roller 14 and returned to the trough 87. The arrangement of the inking roller and trough in the mechanism shown at 82 has been designated at 86' and 87' respectively. The screw 36 engages adjustable member 88 which supports the carrier 89 for the doctor 16. Carrier 89 is provided with a connecting means 89' for spring 90 which connects with the arm 91 of carrier 89, thereby continuously urging doctor 16 into cooperative contact with the surface of distributing roller 14. Because of the fact that web material is traveling clockwise around drier 80 and counterclockwise around drier 81, the direction of rotation is opposite in the respective mechanisms. I therefore find it desirable to mount the support for the doctor 16 in mechanism 83 above the distributing roller and the support for the doctor 16' in mechanism 82 below the distributing roller so that the doctor coacts at all times in removing excess ink from the surface of the distributing roller in each arrangement. The manner of adjusting the spacial relation of the distributing roller 14, the offset roller 12 and the doctor 16 under control of hand wheel 25 is the same as the arrangement illustrated in Fig. 2 and corresponding parts have been indicated by similar or primed reference characters in each case. In the mechanism shown at 82, the screw 36' is journaled in members 92 and 93 which project downwardly from carrier 28' through slots in support 22', rack 23' and carriers 26' and 28'. The adjustable screw 36' engages member 94 having a laterally extending projection 95 thereon from which a vertical member 96 extends forming a journal 97 for the doctor 16' which is supported in carrier 98. An arm 99 extends from carrier 98 and is connected through spring 100 with laterally projecting

member 95 whereby doctor 16' is constantly urged into contact with the surface of distributing roller 14'. The spacial relation of offset roller 12' and distributing roller 14' as well as doctor 16' may be readily controlled by a combination of adjustments including hand wheel 25' and rotating screw 29'.

It will be understood that in the arrangement of the mechanism illustrated at 82, the support for the doctor extends downwardly, whereas in the arrangement shown at 83 the support for the doctor extends upwardly. However, the operating mechanism is similar in each instance and the same adjustments may be effected.

I have described my invention in certain preferred embodiments but I realize that modifications may be made. I do not intend any limitations upon my invention other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In an apparatus for applying a uniform film of fluid coating material to a web material such as paper, a bed roll, means for guiding web material to be coated over said bed roll, a support movable toward and retractable from the surface of the web material passing over said bed roll, a multiplicity of mounting members carried by said support and individually adjustable with respect to said support, a roller having a substantially smooth and non-absorbent surface journaled in one of said mounting members and adjustable in contacting relation with the surface of the web material to be coated, a feeding roller having a multiplicity of equal and uniform surface indentations regularly spaced and operative to measure equal minute portions of the fluid coating material journaled in another of said mounting members and adjustable in contacting relation with the substantially smooth and non-absorbent surface of said first mentioned roller and operative to deposit on the surface of said first mentioned roller said minute portions of fluid coating material, the surface of said first mentioned roller being wetted by said fluid coating material, whereby the minute portions of said material tend to merge into a continuous surface film of substantially uniform thickness under the action of the surface tension of the fluid coating material on the surface of said first mentioned roller for application to the web material.

2. In an apparatus for applying a uniform film of fluid coating material to a web material such as paper, a bed roll, means for directing the web material to be coated over said bed roll, a support adjustable toward or away from the surface of the web material passing over said bed roll, a plurality of auxiliary supporting members carried by said support and individually adjustable with respect to said support, a roller upon which the film of coating material is to be formed journaled in one of said auxiliary supporting members, a feeding roller journaled in another of said auxiliary supporting members and a coating delivery and doctoring means carried by another of said auxiliary supporting members, said feeding roller having a multiplicity of equal and uniform indentations regularly spaced and operative to measure equal minute portions of the fluid coating material, and said first mentioned roller having a substantially smooth and non-absorbent surface upon which the film of coating material is to be formed; said rollers being operative in surface contact for effecting removal of said minute portions of fluid coating material from the recesses in said feeding roller to the substantially smooth and non-absorbent surface of said first mentioned roller as separate minute charges of coating material which tend to merge into a continuous film of substantially uniform thickness on the said substantially smooth and non-absorbent surface of said first mentioned roller.

3. In an apparatus for applying a uniform film of fluid coating material to a web material, means comprising a bed roll for supporting said web material, a support, a pair of mounting members carried by said support, a substantially smooth, resilient and non-absorbent coating transfer roll operable in rolling contact with said web material while on said bed roll, said transfer roll being journaled in said pair of mounting members, said mounting members being adjustable with respect to said support whereby said transfer roll may be moved toward or away from said bed roll, a second pair of mounting members carried by and adjustable with respect to said first mentioned mounting members, a coating feed roll having a multiplicity of equal and uniform surface indentations operable in rolling contact with said transfer roll journaled in said second pair of mounting members, coating delivery means supplying fluid coating to said feed roll adjustably mounted on said second mentioned mounting members, doctoring means disposed in contact with the surface of said feed roll between said coating delivery means and said transfer roll, said doctoring means being adjustably mounted on said second mentioned mounting members, and means for driving said bed roll, said transfer roll, and said feed roll in rolling contact at substantially uniform speed.

4. In an apparatus for applying a uniform film of fluid coating material to a traveling web of material, a bed roll over which said web travels and is supported, a transfer roll adjustable relatively to said bed roll for transferring coating material to said web, said transfer roll having a smooth, resilient and non-absorbent surface, a support for said transfer roll, a coating feed roll having a multiplicity of identical and uniformly spaced surface pits, a mounting adjustable on said support for said coating feed roll, coating delivery and doctoring means for supplying said coating material to said feed roll, a second mounting for said coating delivery and doctoring means adjustably positioned on said first mounting, means for adjusting said second mounting to properly position said coating delivery and doctoring means with respect to said feed roll, separate means for adjusting said first mounting to properly position said feed roll with respect to said transfer roll without altering the adjustment of said first mounting, and means for driving said bed roll, transfer roll and feed roll at substantially the same peripheral speed.

HERMAN R. HARRIGAN.