

Aug. 18, 1942.

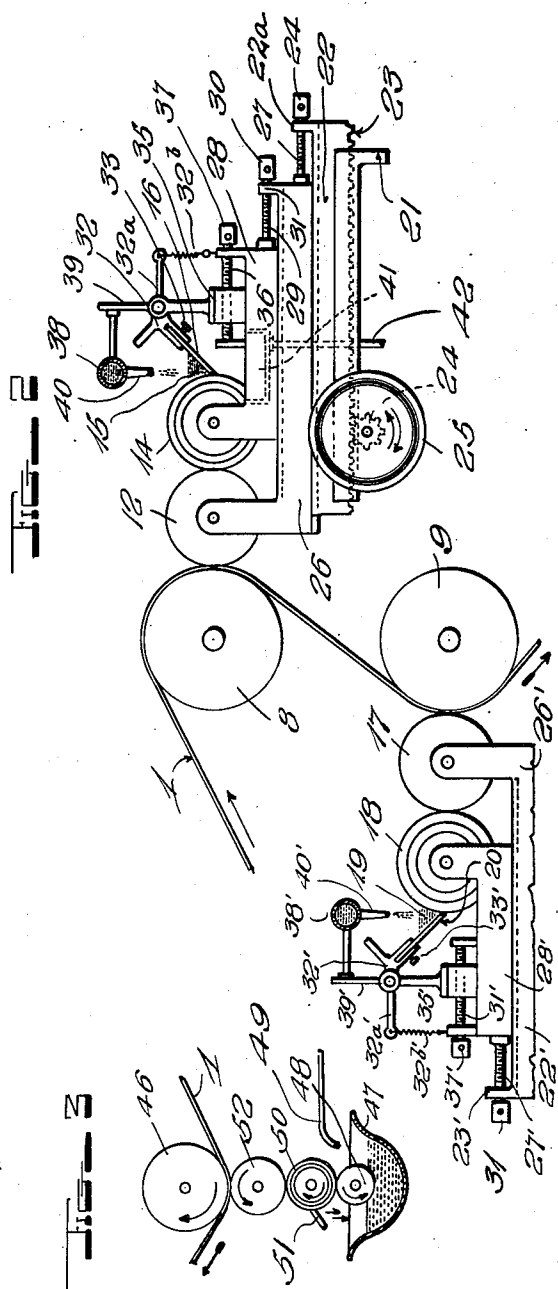
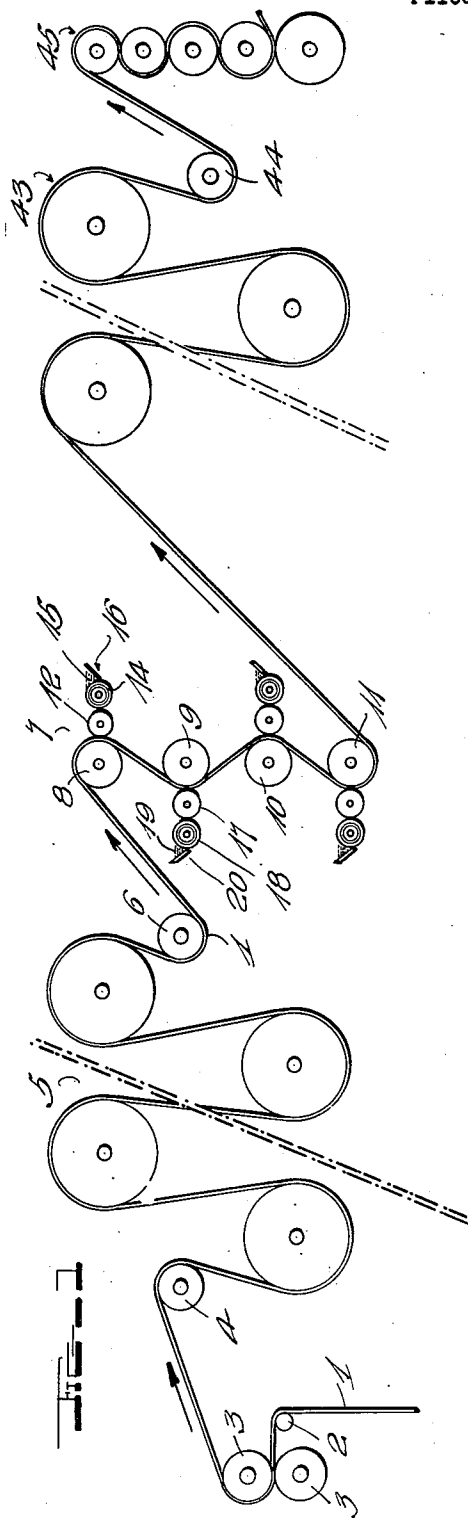
H. R. HARRIGAN

2,293,690

PROCESS OF COATING WEB MATERIAL

Filed Oct. 25, 1939

5 Sheets-Sheet 1



INVENTOR.
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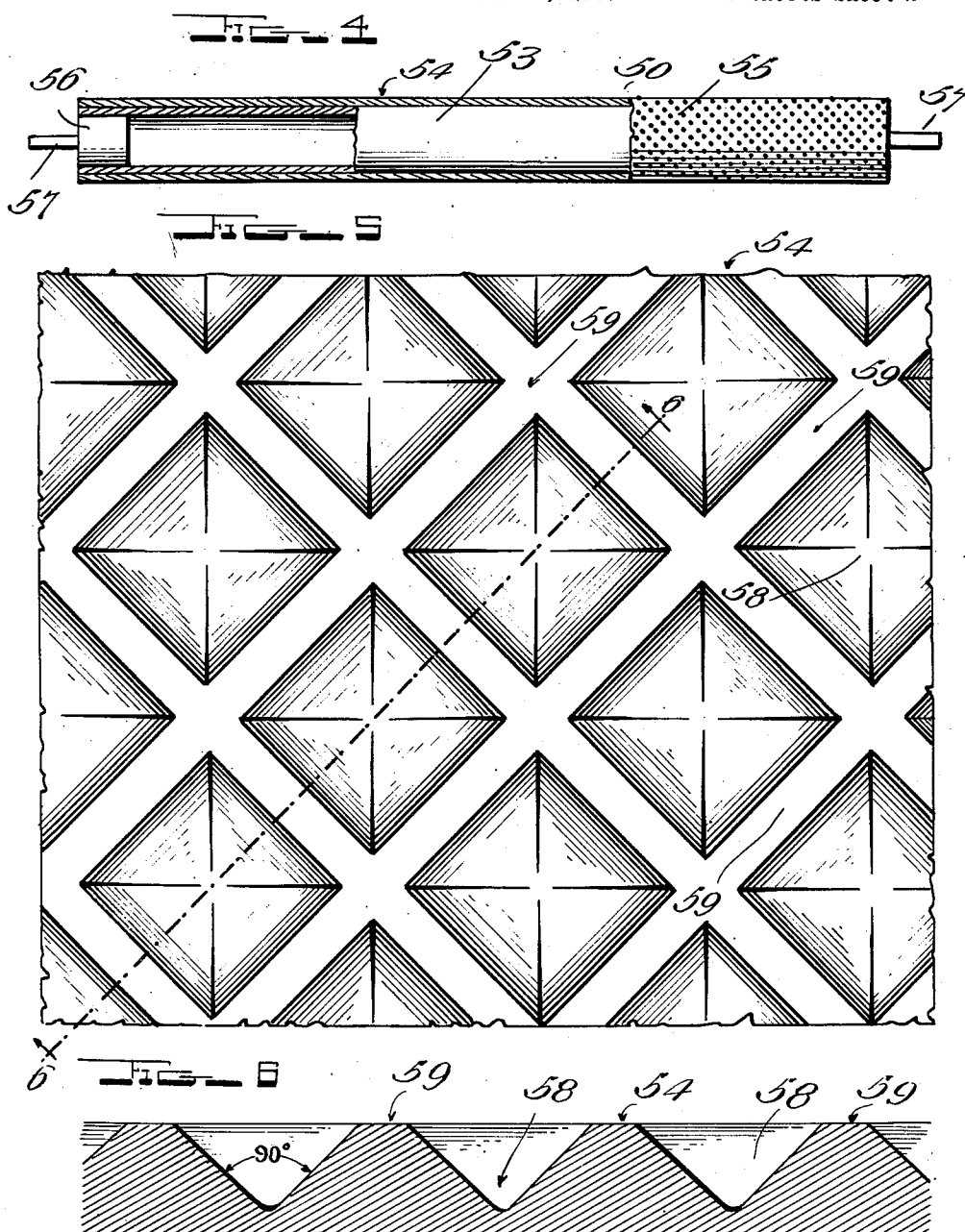
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2,293,690

PROCESS OF COATING WEB MATERIAL

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5 Sheets-Sheet 2



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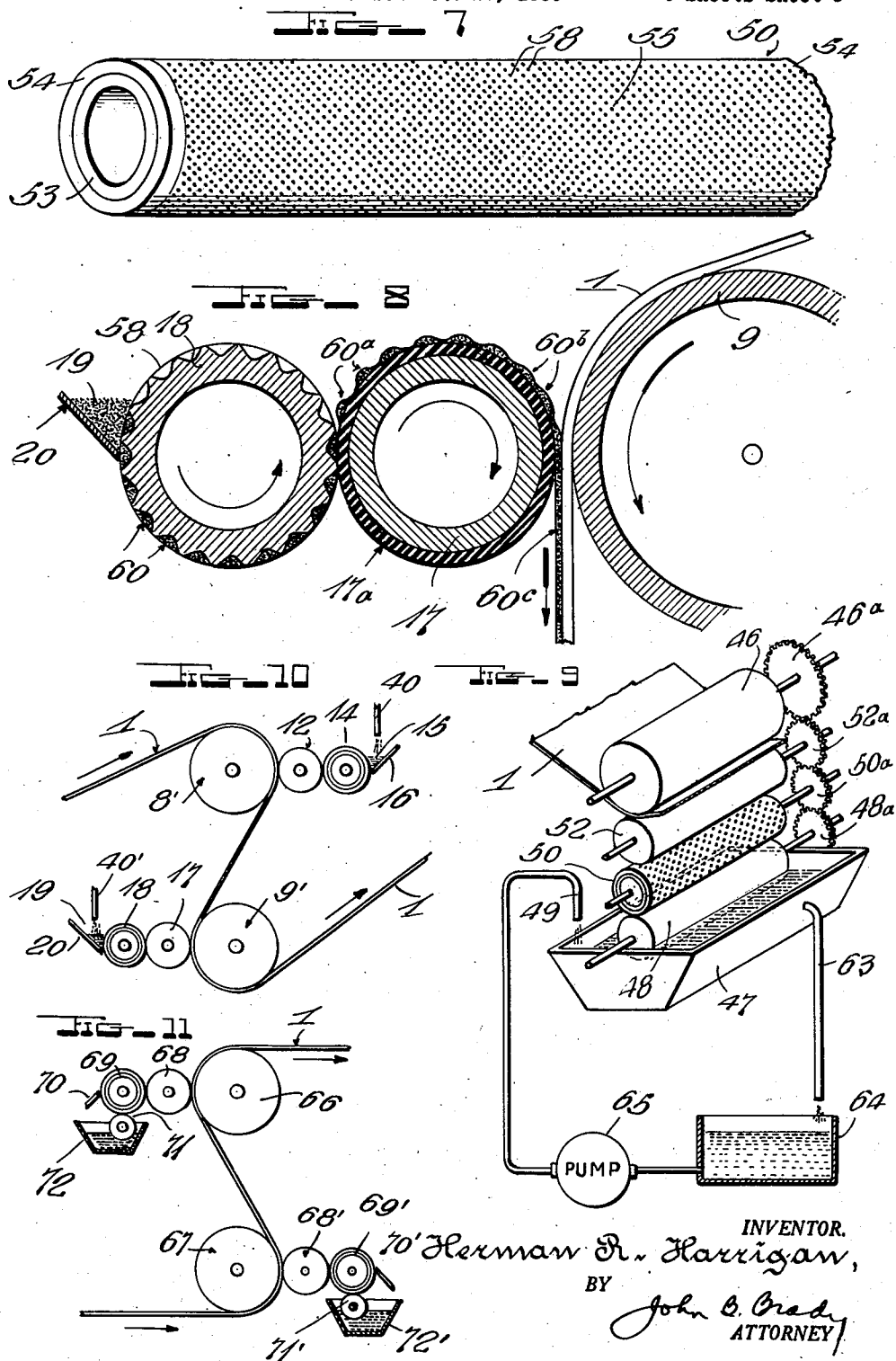
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PROCESS OF COATING WEB MATERIAL

Filed Oct. 25, 1939

5 Sheets-Sheet 3



Aug. 18, 1942.

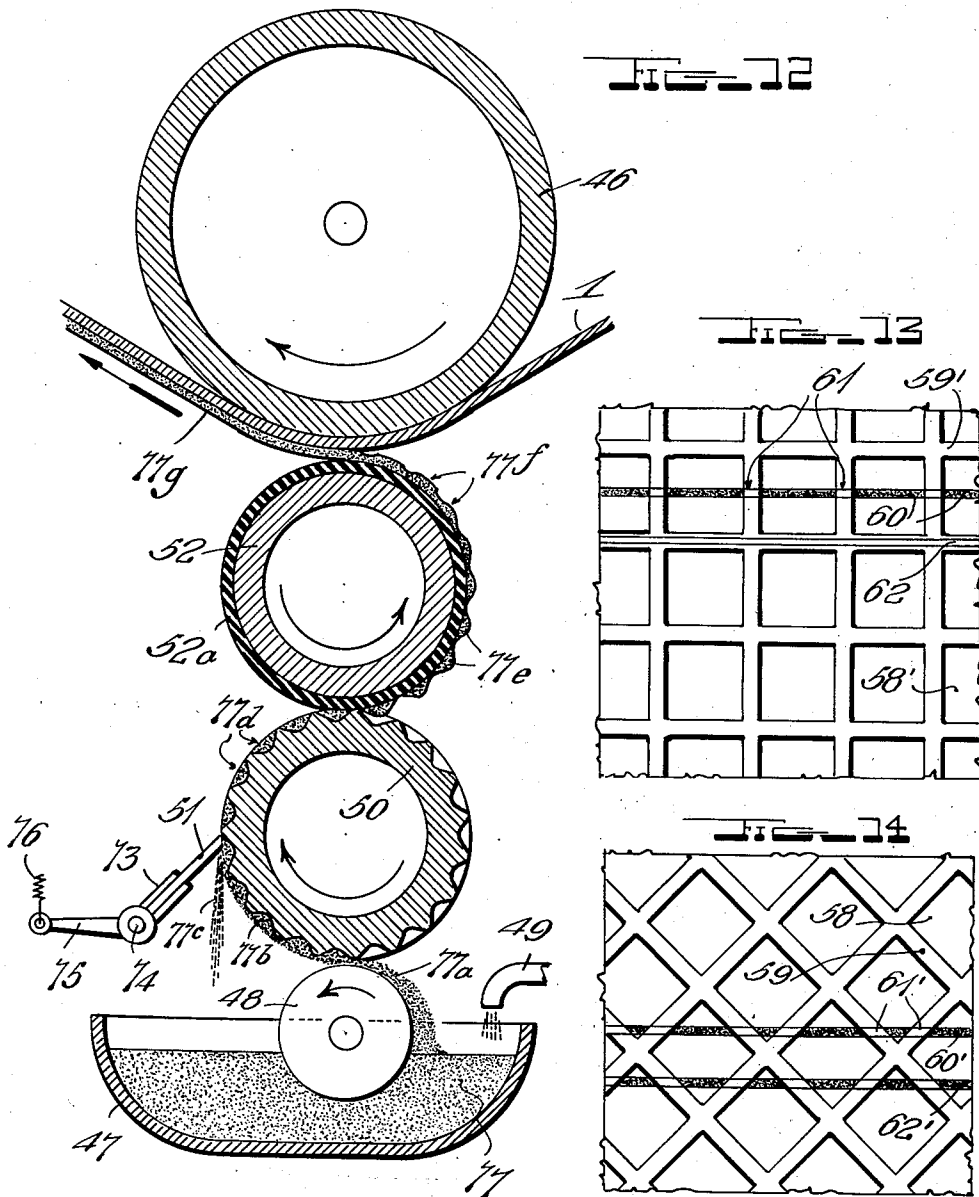
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2,293,690

PROCESS OF COATING WEB MATERIAL

Filed Oct. 25, 1939

5 Sheets-Sheet 4



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2,293,690

PROCESS OF COATING WEB MATERIAL

Filed Oct. 25, 1939

5 Sheets-Sheet 5

FIG. 15

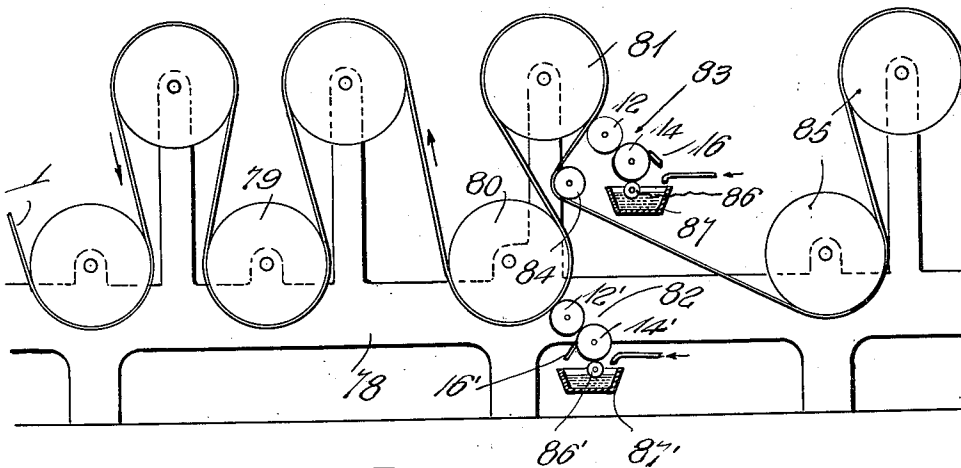
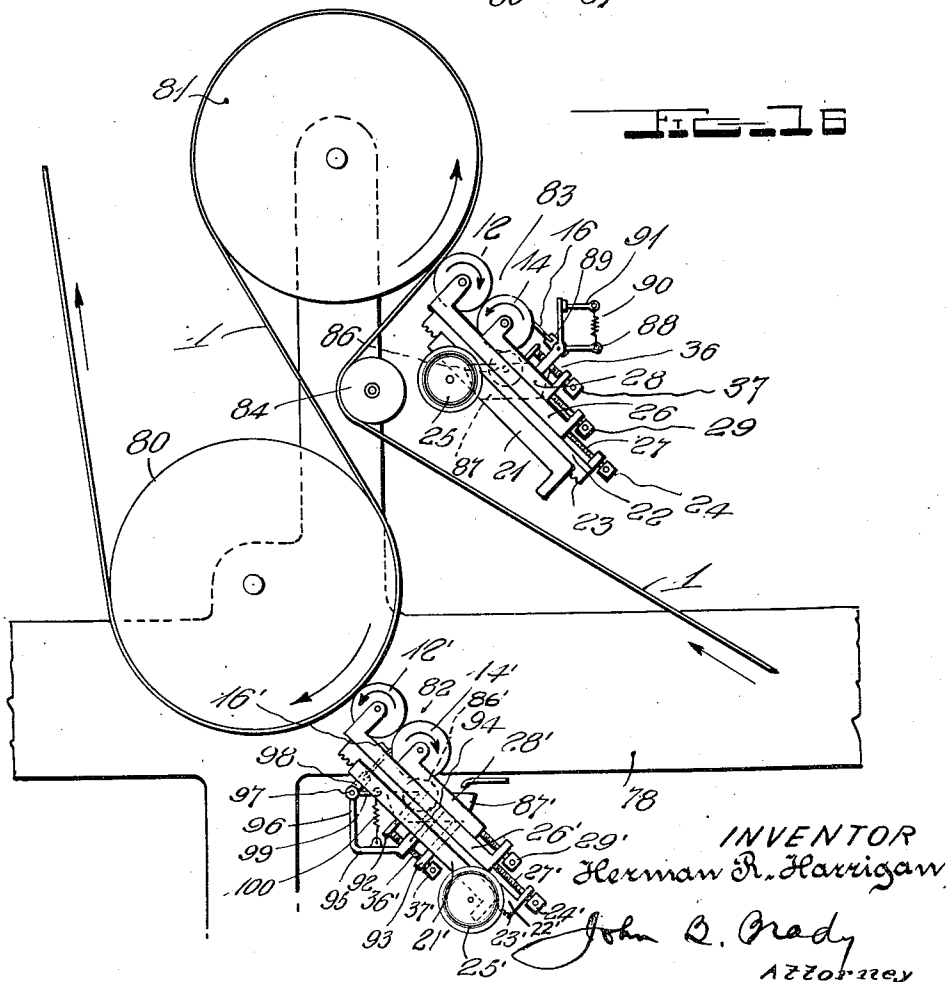


FIG. 16



UNITED STATES PATENT OFFICE

2,293,690

PROCESS OF COATING WEB MATERIAL

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Application October 25, 1939, Serial No. 301,280

3 Claims. (Cl. 117—111)

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

One of the objects of my invention is to provide a method of coating web material by which a uniform and continuous film of ink may be applied to the web of material in predetermined arrangement for insuring a uniform product in large quantity production.

Another object of my invention is to provide a process of 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 off-set roller.

Still another object of my invention is to provide 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 off-set roller to web material.

A further object of my invention is to provide a method of 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 still further object of my invention is to provide a method of coating web material by which ink may be delivered to a distributing roller and transferred to an off-set roller for impressing a continuous and uniform film of ink upon web material where provision is made for positively driving the ink distributing roller, the off-set roller and the bed roll all at the same peripheral speed.

A further object of my invention is to provide a method of applying a uniform film of ink to web material in which an off-set resilient roller is employed to coat the web material and wherein the off-set 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 off-set roller for subsequent transfer in a uniform continuous film to the web material.

Another object of my invention is to provide a method for coating web material by employing

a distributing roller in coaction with a transfer roller, the distributing roller containing 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 further object of my invention is to provide a method of coating web material employing a distributing roller in coaction with an off-set roller in engagement with web material passing over a bed roll, preformed recesses for ink being arranged in parallel spiral paths around the surface of the distributing roller for delivering a uniform and continuous film of ink to the off-set 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 off-set roller.

Other and further objects of my invention reside in an improved method 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 method of 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 method 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 method of my invention; Fig. 8 is a schematic view showing the distributing roller, the transfer roller and a bed roll illustrat-

ing 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 method of 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 method of 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 according to the method 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 off-set transfer roller by which uniform wear and consequently uniform distribution of ink is transferred to the off-set 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 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 off-set roller for delivery to the web material as it passes through the machine. The roller will uniformly distribute to the off-set roller a quantity of ink which will form a uniform film of ink that may be transferred to the web material 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 off-set 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 off-set 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 passes in a moist state, subject only to the initial drying by passage through drier rolls 5. 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 off-set 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 off-set 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 journaled with respect to frame 21 and manually controllable by a hand wheel 25 by which the entire assembly of the distributing and off-set rollers may be advanced or retracted with respect to the aligned bed rolls. The off-set roller 12 is journaled 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 22a and which may be rotatably adjusted by head 24 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 journaled 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 off-set roller 12, while off-set 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 coating with the recessed surface of distributing roller 14. For the purpose of regulating the film of ink transferred by roller 14 to the off-set 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 32a which is connected through a spring 32b 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 off-set 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 off-set 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 calendar 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 off-set 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 off-set 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 off-set 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 off-set 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 off-set rollers and the bed roll each be positively driven. The particular 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 characters 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 invert-

ed 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 off-set 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 59 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 off-set 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 off-set 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 off-set roller. Thus the spiral arrangement of pockets insure minimum wear of the distributing roller and maximum supply of ink to the off-set 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 off-set roller 17 which is traveling at the same peripheral speed as the distributing roller 18 receives the ink 60 as represented at 60a 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 60a merge by a resolution of forces due to gravitation and rotation as indicated at 60b. The merging charges or deposits of ink 60a form into a film of uniform thickness as represented at 60c on the surface of web material 1 as bed roll 9 rotates as shown. The off-set roller 17 has a resilient surface indicated at 17a constituted by a composition or rubber covering. This covering has a plastometer reading of approximately 120 measured with a 1/8 inch ball. The pliability and resiliency of the off-set 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, off-set roller 52 and bed roll 46 are driven at the same peripheral speed. I have shown intermeshed gears 48a, 50a, 52a and 46a 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 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 off-set 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 off-set 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. Off-set 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 off-set 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 off-set 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 77a and is delivered to the recesses or pockets in distributing roller 50 as indicated at 77b. Excess ink is struck off from the pockets 77b by coaction of doctor 51 with the surface of the distributing roller, the excess being returned as indicated at 77c 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 77d. The off-set 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 52a as indicated at 77e. By virtue of the forces of gravitation combined with the rotation of the off-set roller 52, the ink due to its viscosity, surface tension and density merges as represented at 77f and is applied in a substantially uniform film at 77g 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 of 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 method of 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, printed and/or decorated by the mechanism illustrated at 83. The web material after leaving driers 85 passes around guide roller 84 to the rollers 80 and 81 where it is coated and thence to the additional driers represented generally at 79. 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. As shown in Fig. 16, 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 88 for spring 90 which connects with the arm 91 of carrier 28', 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 off-set 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 carrier 26', support 22', and frame 21'. 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 off-set 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 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. The method of coating a web of paper, which

comprises flowing an excess of a highly viscous aqueous coating composition having considerably in excess of 33% solids content onto a rotating surface having regularly arranged and uniformly sized pits over an area thereof at least the width of the web of paper to be coated, doctoring away the excess of said coating composition to leave substantially equal volumes of said composition in said pits, rotating said pitted surface into contact with a non-absorbent resilient surface to transfer thereto the coating composition from said pits, the viscosity and other characteristics of said coating composition being such that said coating composition is deposited from said pits on said resilient surface as mounds that tend to coalesce and level off into a film of substantially uniform thickness over said resilient surface, allowing the mounds to coalesce on the resilient surface, bringing the web to be coated into contact with said film formed on said resilient surface, subjecting the portion of said web in contact with said film to rolling pressure to cause said film to uniformly and continuously coat said web surface and to cause the solids content of said film to be pressed onto and compacted with the surface fibers of said web to be made an integral part thereof, and drying the thus coated web.

2. The method of coating paper, which comprises advancing a wet web of paper, flowing an aqueous surfacing mixture having considerably in excess of 33% solids content onto a rotating film forming intaglio surface dimensionally pitted over an area at least the width of said web for substantially uniform, volumetric measurement, transferring said surfacing mixture from said pitted surface to a resilient transfer surface and forming thereon a continuous film of predetermined uniform thickness by the mutual action of the forces of said mixture and said resilient surface, bringing the surface of the web through-

out its entire width into contact with said film while on said resilient transfer surface, subjecting the portion of the web in contact with said film to rolling contact pressure to cause the film to uniformly coat the entire surface of said web and to cause the solids content thereof to be pressed onto and compacted with the surface fibers of said web to be made an integral part thereof as said film is applied thereto, and drying the thus coated web.

3. The method of coating a web of paper, which comprises flowing an excess of a highly viscous aqueous coating composition having a minimum viscosity of about 500 centipoises and having considerably in excess of 33% solids content onto a rotating surface having regularly arranged and uniformly sized pits over an area thereof at least the width of the web of paper to be coated, doctoring away the excess of said coating composition to leave substantially equal volumes of said composition in said pits, rotating said pitted surface into contact with a non-absorbent resilient surface to transfer thereto the coating composition from said pits, the viscosity and other characteristics of said coating composition being such that said coating composition is deposited from said pits on said resilient surface as mounds that tend to coalesce into a film over said resilient surface, allowing coalescence of said mounds on said resilient surface to take place, bringing the web to be coated into contact with said coating composition on said resilient surface, subjecting the portion of said web in contact with said coating composition to rolling pressure to cause said composition to uniformly and continuously coat said web surface and to cause the solids content of said composition to be pressed onto and be compacted with the surface fibers of said web and drying the thus coated web.

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