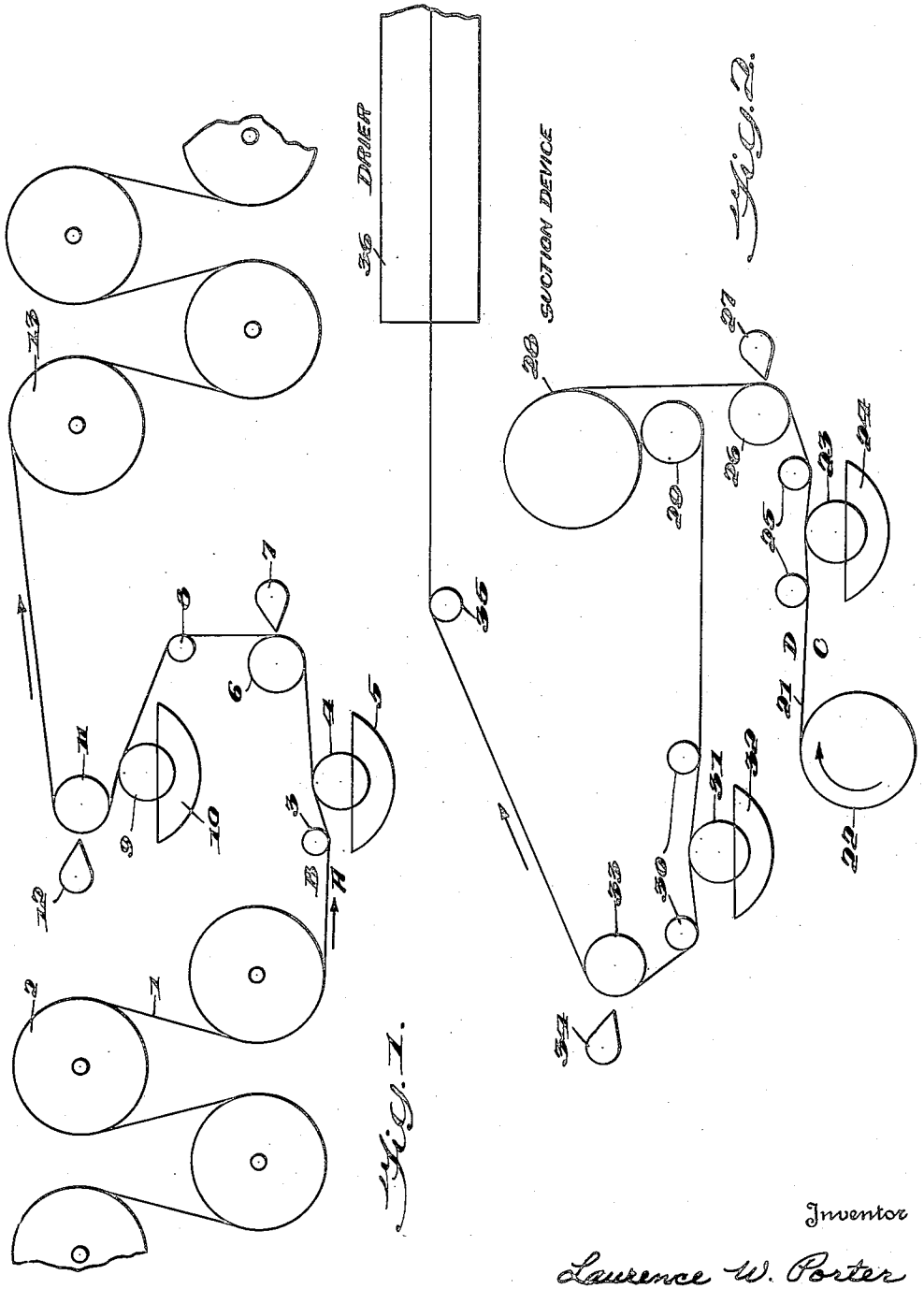
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COATING FLEXIBLE WEB

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COATING FLEXIBLE WEBS

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This invention relates to improvements in coating porous or absorbent webs, e. g., webs of paper and the like, and particularly to methods of coating the opposed sides of a paper web successively by the air-brush method without the necessity of intermediate application of drying heat.

The so-called air-brush method of coating was disclosed in U. S. Patent No. 1,980,923 to Lebel. This method, in conjunction with the use of the improved air-doctor described in U. S. Patent No. 2,139,628 to Terry, has come into wide-spread use in producing better grades of coated paper. The customary procedure when coating paper by the air-brush method is to apply an excess of a fluid coating composition to one side of the paper web; then, while the reverse side of the web is being firmly supported as by a roll, the coated side is subjected to the action of a substantially non-divergent jet of air emitted by the straight slit orifice of a nozzle which extends across the full width of the web. The jet of air issues from the nozzle with substantially uniform velocity throughout its entire extent and impinges upon the wet coating at an angle and in a direction opposite to the direction of web travel, thus cutting away the excess coating and leaving the desired quantity of coating on the web in a layer of exceptionally uniform thickness. The web thus coated on one side is then dried in any convenient manner, whereupon the second side of the sheet may be coated by repeating the procedure used for coating the first side.

It is apparent from the foregoing that air-brush coating as practiced hitherto has been exclusively a one-side process; that is to say, for coating both sides of a web of paper it hitherto has been necessary to do it in two coating steps with intermediate drying between the coating operations, in order that the side first coated should not be marred when it came in contact with the rigid support required to hold the web in position while the second side was being acted on by the air-jet. Suggested methods by which gas pressure is used to support the web while the air-jet is acting on the opposite side have not yet been found wholly satisfactory for commercial operation. Hitherto it has not been considered possible to coat both sides of a web in succession by means of an air-brush using a conventional rigid backing support, without intermediate drying between the two coating operations.

A principal object of the invention is the provision of a process of coating the opposite sides of a porous web in succession by the use of an air-brush while supporting the reverse side of the web with a rigid supporting means, such as a roll.

Another object is to provide an improved arrangement of apparatus for coating both sides of a flexible web.

A further object is the provision of an improved quality of coating printing paper with a moderate weight of coating film.

Other objects and advantages will be apparent from a consideration of the following description.

The invention is applicable to flexible webs of porous and/or absorbent nature. Briefly the invention consists essentially in spreading and smoothing a layer of fluid coating composition upon one side of a web while firmly supporting the reverse side of the web; quickly withdrawing excess liquid from said coating layer into the interior of the web either solely by means of the natural capillarity of the web or by such capillarity plus additional suction applied to the back of the web; then, without practicing a drying operation, spreading and smoothing a layer of fluid coating composition upon the second side of the web while firmly supporting the first coated side of the web while the coating on said first coated side is in a damp but non-mobile condition; and finally drying the two-side coated web.

The type of fluid coating composition suitable for use according to the invention is one in which a solid component is suspended in a liquid carrier or vehicle. In the following the invention will be described in connection with coating a paper body-stock with a mineral-coating composition, that is a fluid composition comprising a pigment component (e. g., clay, calcium carbonate, ochre, aluminum powder, satin white, titanium dioxide and the like) and an adhesive component (e. g., starch, casein, vegetable protein, or equivalent) suspended in an aqueous vehicle.

According to the invention a fluid mineral-coating composition may be applied to one side of a porous and/or absorbent paper web; the web while being firmly supported on the reverse side by a rigid supporting means (e. g. a roll) is immediately passed by a suitable air-jet (e. g. a jet from a Terry air-doctor described in U. S. Patent No. 2,139,628) which acts uniformly across the width of the web and smooths the coating layer thereon, or, preferably which removes excess coating and leaves a predetermined quantity of coating on the web in the form of a smooth layer

of very uniform thickness. At the time the air-jet acts upon the coating the latter must be fluid or mobile, else the results will not be satisfactory. In other words, the coating must be definitely wet at the time the air-jet acts upon the same; and naturally this condition of wetness will continue to exist for a certain time after the action of the jet. It is imperative under the invention that the period of wetness existing after the action of the air-jet shall terminate promptly. Conditions must be so controlled that within a few seconds after the web has passed the air-jet sufficient of the liquid content of the layer of coating shall have been withdrawn from the coating into the body of the absorbent web that the layer of coating on the surface of the web is left in a "set" or relatively firm non-mobile state and in a condition such that it can be touched or preferably even rubbed under moderate pressure without being deformed, marked, scratched, or otherwise marred. The point at which sufficient excess liquid has been withdrawn from a mineral-coating layer to bring about the desired non-mobile, "set," condition can usually be determined by the appearance of the coating: when excess liquid is present the coating layer glistens and looks wet, while as soon as the excess is removed the glistening abruptly stops, and the coating layer is relatively dull in appearance and looks dry. At the latter point the coating layer, though still very damp, of course, is "set" enough so that it can be touched or supported by a roll without being marred. The percentage of liquid remaining in the coating at the time of setting varies over a wide range, depending upon the particular pigment composition used, and other variables.

When the "set" condition described has been attained, fluid coating composition is applied to the second side of the web, and the wet coating layer on the second side is smoothed, or, preferably, excess coating is removed and the remainder smoothed, by a second air-brush, while the first side bearing the damp but non-mobile layer of "set" coating is supported by a rigid support, e. g., a roll. The paper so coated on both sides is then dried in any desired manner.

There are several expedients that may effect, promote, or assist in controlling, quick setting of the coating on the first side of the web prior to applying coating to the second side of the paper. One expedient is to increase the solids concentration in the coating composition. In such a case, obviously less liquid needs to be withdrawn from the composition in order to leave the latter in non-plastic, i. e., "set," condition. Using a paper base or body stock which is quickly absorbent (e. g., one that is only slightly hydrated, or one which has little or no sizing) is likewise conducive to quick penetration by excess liquid from the coating composition. In some cases, as when the body stock is more resistant to penetration by water, the absorption may be facilitated by addition to the coating composition of some wetting or penetrating agent. In other cases the application of suction to the back of the web immediately after the first coating operation assists in drawing liquid from the coating into the body of the web whereby to "set" very quickly the residue on the surface. Obviously these expedients may be used singly or in combination as circumstances may indicate.

It is obvious that other things being equal, the lighter the weight of coating left on the web the less liquid must be withdrawn therefrom to cause it to set. Therefore, the invention is particularly applicable to the production of those papers variously referred to as "semi-coated," "film-coated," "process-coated," or "machine-coated" paper, which have coatings of less weight than those of converter's grades usually considered true coated papers.

The product "semi-coated" paper, referred to above, is a type of paper that has come into quite extended use during the past few years. The grade was originally developed to supplant super-calendered uncoated paper for use in magazines and the like, where reasonably good reproduction of half-tone cuts is required. Semi-coated paper differs from a true converter's grade of coated paper in that its weight of coating is materially less, i. e., usually from 3 to 10 lbs. per ream per side. Likewise, the paper body-stocks of the two grades of paper differ considerably: the conventional body-stock for converter's grades of coated paper is a well-sized, relatively strong, sheet containing only a small quantity of filler, say 10% or less; on the other hand, the body-stock for semi-coated paper is generally considerably weaker; it usually is slack-sized or wholly unsized, and—partly to provide opacity—it contains a relatively high proportion of filler, at least 20% and preferably more.

Semi-coated papers of the nature described comprising a highly filled, slack-sized body stock having a light-weight mineral coating on each side have provided a real and valuable advance in the paper-making art. These papers, however, have in the past had some defects that made them give results falling short of results obtainable by use of conventional coated paper. One respect in which semi-coated papers have been open to criticism is that they have invariably had coatings variable in thickness. This result has been inevitable with the coating methods in use up to the present, i. e., methods involving use of squeeze-rolls or rigid scraper coaters. The lower surface of the coating layer obviously has to follow the contour of the paper body-stock which is comparatively uneven, i. e., is composed of hills and valleys. The upper surface of the coating layer as smoothed by squeeze-rolls or rigid scraper is, on the other hand, relatively level. In consequence, such coating layer has thick and thin places corresponding respectively to the valleys and hills of the body stock. Of course, this condition exists also in much regular coated paper having full weight of coating: naturally, however, the effect is much less marked in the case of coatings of full weight than in the case of light weight coatings, for the difference in actual thickness is not so pronounced in the former case. In contradistinction to prior semi-coated printing papers, the product of the present invention is a semi-coated paper exhibiting on each side a coating layer of substantially uniform thickness, i. e., practically complete elimination of thick and thin areas.

The very uniform coating layer of the new product is, of course, due to the use of the air-brush for smoothing the coating. The air-brush tends to follow the contour of the base being coated, leaving a coating layer of uniform thickness over both the depressions and the high spots of the paper surface. Apparently other methods of coating, i. e., by use of rigid scraper blades or rolls, fail to leave a coating film of uniform thickness upon paper. Even in the case of those coaters in which a preformed uni-

form film of coating is transferred to the paper surface it appears that the coating flows sufficiently under the heavy roll pressure applied during transference so that the resulting film on the paper is not uniform. That air-brush semi-coats would be of more uniform thickness than semi-coats applied by other methods was entirely unobvious and probably would be disputed by many experienced coating operators. Nevertheless the fact is borne out by consideration of the printing-ink absorbency of the new product in comparison with that of semi-coated papers made by prior processes.

Prior semi-coated papers have been deficient in the quality of absorbing printing ink uniformly. This deficiency may be readily shown by observing a sheet freshly printed from a solid plate with sufficient standard black printing ink to give a good impression. The print as it comes from the press has a uniform, glistening wet appearance. If the sheet is non-uniformly absorbent it will be observed that after a time the ink ceases to glisten in spots where it is absorbed, but continues to look wet in isolated pools scattered over the surface. These pools may continue to glisten for a considerable time, say a minute or even several minutes, after the main area of the inked surface has ceased to glisten or, as is said, after it has "set." The uneven absorption of printing ink is in many instances an indication that the printed product will look mottled, and of course is undesirable. The product of the present invention when tested as described shows very uniform absorption; that is, not more than a few seconds elapse between the times when absorption in one area is visible and when the entire printed area has ceased glistening. The substantially uniform absorption of ink exhibited by the product undoubtedly is occasioned by the uniformities of the layer of coating on the sheet.

Another important printing characteristic possessed by the product of the present invention in its preferred form is the property of quick ink-setting. As has been indicated above, the ink is said to be "set" when no area of the printed surface glistens or looks wet. In many prior semi-coated papers it has taken several minutes for all spots of the printed areas to set, and generally speaking it may be said that an ink-setting time of less than five minutes has been exceptionally rare, if not entirely unknown, in a semi-coated paper. The product of the present invention, on the other hand, has an ink-setting time of not over 120 seconds, and preferably of not over about 100 seconds. Quick ink-setting time obviously is advantageous in that it lessens the liability of the ink "offsetting" from the printed area to another sheet as the sheets are piled upon leaving the printing press. Although quick ink-setting time has for some time been recognized as a very desirable quality and has been possessed by some of the converter's grades of coated paper on the market, it has hitherto not been known how to produce this quality in a semi-coated paper. The reason the desirable quick ink-setting time is possessed by the product of this invention is apparently related to the use of the air-brush in coating the product.

In making the above referred-to test for ink-setting time the paper should be printed by means of a solid plate with sufficient ink to give good coverage. Any of the standard black printing inks commonly used for printing glossy coated paper may be used. (For instance, I normally use for my testing ink Geographic Black 148 made by the Sigmund Ullman Co. of New York: other inks thought to be practical equivalents as far as setting time goes include Wolta Black 448 made by E. J. Kelly Co. of Kalamazoo, Neo Black 286 made by Lewis Roberts, Inc., of Newark, Black G, 2549N made by Geo. H. Morrill Co. of Boston, Black K 7800 made by Martin Driscoll & Co. of Chicago, and Black New Star 37825 made by Braden Sutphin Ink Co. of Cleveland.)

It is to be understood that use of an air-brush in making semi-coated paper does not, in and of itself, guarantee that the semi-coated product will possess an ink-setting time of not more than 120 seconds. On some coatings, such as coatings containing high amounts of adhesive or large quantities of non-absorptive pigments like satin-white, printing ink will not set quickly under any conditions. On the other hand, coating compositions containing moderate quantities of adhesive and liberal quantities of ink-absorbing clay or calcium carbonate do, when used to make regular converter's grade of coated paper by customary procedure, produce coatings having quick ink-setting properties. The point made in this connection is that such compositions as the latter when used to produce semi-coated papers by the methods in prior use for producing semi-coated papers have failed to yield coatings having quick ink-setting properties, but that these same compositions when used according to the method above disclosed do, for the first time, produce semi-coated papers which do have the desired quick ink-setting properties.

It should be remembered that even in cases where the coating compositions used are of such character that coating layers therefrom are not quickly absorbent, the product of the present invention still possesses the very valuable quality of even and uniform absorption of ink to a degree not previously shown by semi-coated printing papers. Uniform absorption, even if slow, produces good printing results, although of course it does not avoid the liability of offsetting to the degree that quick ink-setting accomplishes that result.

The invention will be described with greater particularity in the following, taken in connection with the accompanying drawing, in which

Fig. 1 is a schematic representation of an assemblage of apparatus adapted for use in the carrying out of an embodiment of the process of the present invention, and

Fig. 2 is a schematic representation of an assemblage of apparatus adapted for use in the carrying out of another embodiment of the process.

As an example, a method of producing a machine-coated paper is now described in connection with Fig. 1. A paper-making furnish containing fiber and calcium carbonate filler is formed into a web on a Fourdrinier machine, pressed, and at least partially dried in the conventional manner. The web so made has a basis weight of 43 pounds per ream (25 x 38—500): it contains 32% of calcium carbonate filler: its fiber content is 20% of sulphite fiber (coniferous) and 80% of soda fiber (deciduous). The web is not sized. It is not necessary that the paper be absolutely dry at this point. On the contrary, it may be somewhat damp, but it must not be saturated with water, else it will not absorb the necessary quantity of liquid from the coating to be applied. The so-formed web of paper 1 passes

from the drying section of the paper-machine generally indicated at 2, and passes over guide roll 3. Side A of the web passes over roll 4 (driven by means not shown) which dips in a bath of fluid coating composition in vat 5 and carries a layer of said composition into contact with side A of the web leaving an excess of the composition on the web. The web then immediately passes between roll 6, which supports side B of the web, and the air-brush or air-doctor 7 which emits a uniform jet of air in the form of a thin sheet against the coating on side A, removing excess coating and smoothing the remainder to the production of a layer of very uniform thickness. It is advantageous when coating an unsized body stock of the character described, that the distance between applicator roll 4 and air-brush 7 be as short as can be conveniently arranged in order to avoid allowing sufficient time for the paper to absorb enough water to be seriously weakened during that interval. After the web has passed the air-brush 7, provided a coating composition of reasonably high density is used and only a moderate weight left on the sheet, the excess water therein is absorbed by the sheet within a few seconds at the most. In a specific instance, a coating composition of the following composition was used, the parts being parts by weight:

	Parts
Clay	14
Calcium carbonate	14
Oxidized starch	7
Water	65

After excess coating had been removed by the use of the air-brush, the residual coating layer was of a thickness (and density) to provide a final coating of 6 pounds (dry weight) per ream (25 x 38—500). This coating was set to a condition rugged enough to be touched by a supporting roll without marking in one second after passing the air-brush.

After the coating on side A has set sufficiently rugged to be touched, the web is passed over guide roll 8, and side B is coated with excess coating composition by roll 9 (driven by means not shown) which dips in vat 10 containing coating composition. The web then passes between roll 11, which supports side A of the web, and air-brush 12, which latter emits a jet upon coated side B of the web, removing excess coating, to leave substantially the same weight of residue as was left on side A, and smoothing the remainder uniformly upon side B. After passing said air-brush 12 the coating on side B sets in about the same time as that on side A. The web now coated on both sides is then passed to a drying means 13 which may conveniently comprise a set of drying cans or internally heated cylinders similar to those used to dry the web when first made on the paper machine.

It is to be noted that when coated side A touches roll 11 or when either side touches a drying cylinder in drier 13 the coating has already attained a set condition so that it is not marred by the contact. Since in the example described the setting period was found to be less than one second, at a speed of 500 feet per minute the paper needed to travel only 8 feet after the action of the air-jet before it could touch a roll or the like. Since considerably more than 8 feet of space between the various parts of the apparatus is practically necessary in order to give opportunity for operators to attend the devices, no auxiliary expedient need be resorted to other than the provision of a readily absorbent body stock and a coating composition of moderately high density.

The above specific example is not limitative. Thus, the weights of the coating may be varied between wide limits, as desired. Also, the constituents of the coating composition, and their proportions, may be modified as occasion indicates. Moreover, the process tolerates variation in the precise characteristics of the base stock (i. e., of the paper web).

In case the paper body stock is sized or for some other reason not readily absorbent, the withdrawal of water into the body of the sheet may be facilitated by addition to the coating composition of a suitable wetting agent or penetrating agent, of which there are many commercially available. For this purpose naphthalene sulphonic acids, or derivatives thereof, and sulphates of high fatty alcohols are useful As examples of the many effective commercial preparations there may be mentioned those sold under the trade names: "Alkanol," "Nekal," "Gardinol," "Avirol," and "Surfax." These specific agents are by no means exhaustive of wetting or penetrating agents operable in this relation.

Addition of 1 part by weight of "Surfax W. O." to 700 parts by weight of the specific coating composition above described effects a substantial acceleration of the rate of absorption, by a paper web, of excess liquid from the freshly applied coating.

If for any reason it is impossible or inadvisable to make use of the various expedients previously mentioned (i. e., use of slack-sized body stock, high density coating compositions, or wetting agents), it still is usually possible to set the coating sufficiently quickly by sucking the excess liquid into the web by means of a partial vacuum applied to the reverse side of the sheet as will be more fully described in the following, taken with Fig. 2:

Although the embodiment of the invention described above in connection with Fig. 1 involved a coating unit integrated with a continuous process of making a paper web from a fibrous furnish, it is obvious that if desired the coating operation of the invention may be practiced quite apart from the paper making operation, as, for instance, in a coating or converting mill. Such a use is now described as a further embodiment of the invention in connection with Fig. 2. A web 21 of paper body-stock of the type commonly used for converting to coated printing paper (for example a sheet weighing about 50 pounds 25 x 38—500, being composed of sulphite and soda fiber in the ratio of about 6 to 4 and having a filler content of about 10% clay, and being sized with rosin size to give an aqueous ink test of about 60 seconds) is led from unwind reel 22 and by means of guide rolls 25 is made to come in contact on side C with an applicator roll 23 (driven by means not shown) dipping into vat 24 containing fluid coating composition; said roll 23 applies an excess of composition to said side C of the web. The web then passes between rigid supporting means 26 and air-brush 27, which latter emits a jet of air upon the wet coated side C, removing excess coating therefrom and smoothing the remainder thereon in a layer of uniform thickness. Any usual mineral-coating composition may be used, for example one comprising clay 5 parts, calcium carbonate 4 parts, satin white 1 part, casein 1.5 parts, and water 18

parts. About 15 pounds dry weight may suitably be left on one side of the web. Since the web in question is rosin-sized and therefore not so quickly absorbent of water, and since a fairly heavy weight of coating has been applied, it is advantageous to employ means for expediting the quick setting of the coating layer. According thereto, the freshly coated web is passed over suction-device **28** with the uncoated side D of the web making contact with the latter. Said suction-device applies suction to substantially the entire area of the web in contact therewith and withdraws excess liquid from the coating layer into the interior of the web, leaving the coating layer still damp but non-mobile and "set" to a condition sufficiently rugged that it is not marred by contact with hard objects, e. g. rolls. The web passes guide roll **29** and then guide rolls **30** which latter hold the web in contact with applicator roll **31**. Said roll **31** dips in a vat **32** containing fluid coating composition (which may be the same as, or different from, the coating applied to the first side C), and applies an excess of the fluid coating composition to side D of the web. The coated web is then immediately passed between supporting roll **33**, which supports the web on its first-coated side C now in a damp but non-mobile, non-marrable and "set" condition, and air-brush **34**, which latter emits a jet of air against the wet coating on side D, removing excess coating and smoothing the remainder to a uniform layer. The web thus coated on both sides passes over guide roll **35** and thence to a drier **36**, which may be any conventional type, such as a festoon line, a tunnel, a series of drying cans, or the like.

As has been previously pointed out, the suction-device **28**, to be effective in satisfactorily withdrawing liquid from the coating layer, must apply suction over substantially the entire area of the web. In other words, the surface of the suction-device must present no extensive non-active areas to the web, but on the contrary it must be of such a nature that substantially the entire area of the web in contact therewith shall be exposed to suction. A relatively fine wire screen, say 20 to 80 mesh, provides a suitable surface for the suction-device. The surface of the suction-device should travel with the web and at substantially the same speed as the web. Likewise, in order that the desired effect may be achieved quickly it is generally advantageous that the suction applied shall be of considerable magnitude, say equivalent to 12 to 15 inches of mercury or, even better, to 20 to 25 inches. Any suction-device fulfilling the requirements set forth above will in general be effective under the invention, and the invention is not to be considered limited to use of a suction-device of particular construction.

It has in the past been common practice to use a conventional suction-apron to draw a web through a coating machine of the air-brush or other type. Such suction-aprons, however, have been operated at pressures only slightly below atmospheric (say 3–5 inches) and/or have had surfaces exposing relatively large inactive areas, as exemplified by a belt having punched therein holes spaced at considerable intervals. As a result, no actual setting of mineral-coating compositions by means of conventional suction-aprons has been possible, nor has it been apparent that a suction-apron could be so modified as to give this desired effect. A suction-apron so made that it applies suction to substantially the entire area of the web (e. g., a suction-apron having a wire screen surface) and operated at a substantial vacuum (e. g., 12–15 inches, or more, below atmospheric pressure) will act effectively in withdrawing liquid from a coating layer and in setting the coating according to this invention. Because of difficulties in constructing such a suction-apron to operate without excessive leakage of air, this form of suction-device is less suitable than a roll type of suction-device. A suction-roll covered with wire screen and of conventional design such as those commonly used as suction-couch or suction-press rolls on paper-machines, is capable of operating at very high vacuum and is quite satisfactory for the purpose of the invention. The suction drum of an Oliver filter likewise provides a satisfactory suction device under the invention.

The invention provides a practical and simple method for coating both sides of a flexible, absorbent and/or porous web by the air-brush method in a single stage coating operation, which has hitherto been considered impractical. The advantages are obvious from the standpoint of lowered operating cost. Moreover, the process makes possible the drying of the coatings on both sides of the web in a single drying operation, and thereby avoids troubles from curling that sometimes result when a web, especially a thin web, is coated on only one side and then dried before application of coating to the second side. The process of the invention makes possible the economical application of the air-brush method of coating to the lowest priced coated papers, a field from which one-side operations are usually barred by reason of cost. Accordingly, it is now for the first time feasible to use the air-brush method of coating for the production of "semi-coated" or "machine-coated" papers; as a result, a new coated printing paper of this type has been produced, superior to any hitherto produced in the class of semi-coated or machine coated papers.

As an illustration of the advantageous ink-setting properties of the semi-coated paper product of the invention the following will serve: A paper base was made from a paper-making furnish of which the fiber was 2 parts sulphite to 3 parts of soda fiber; sufficient calcium carbonate filler was used to give a paper base containing about 25% of mineral filler. This sheet, after being dried, was coated by the method described above to give a coated product of 60 pounds basis weight (per ream of 500 sheets each 25" by 38"), having on each side about 8 pounds of coating layer. The coating composition used comprised protein adhesive, e. g., casein, 15 parts, clay 55 parts, and calcium carbonate 45 parts, together with water to yield a composition of 40% solids content. The coated paper when dried and supercalendered, was printed, by means of a solid plate, with a printing ink of the class generally used for printing glossy coated paper. The ink was absorbed substantially uniformly over the entire area of the print, and the ink-setting time was 120 seconds.

The new semi-coated paper product may be described as a mineral-coated printing paper comprising a filled paper base containing at least 20% of mineral filler, preferably calcium carbonate filler, and having on each side a layer of coating substantially uniform in thickness at all points on the surface, said coating amounting to not more than 10 pounds dry weight per ream, said paper being characterized by the property of absorbing printing ink substantially uniformly

over the entire surface and preferably further characterized by having an ink-setting time of not more than 120 seconds and advantageously of not more than 100 seconds.

By "a porous and/or absorbent web" as used herein is meant a web which can be made to take up and hold a liquid used as a vehicle for solids in a fluid coating composition. A fabric of woven glass fiber is an example of a porous web; a sheet of regenerated cellulose is an example of an absorbent web; and unsized paper is a web which is both porous and absorbent.

By the term "non-fluid" or "non-mobile" as applied herein is meant the condition of a layer of coating composition upon a web after excess liquid has been withdrawn from the coating-layer, leaving the coating still damp but set to such a degree of rigidity and ruggedness that it will be substantially unmarred by contact with a roll over which the web may be passed.

I claim:

1. Method of coating a flexible absorbent web as the same is being continuously advanced, comprising spreading a layer of fluid coating composition comprising a liquid and a suspended solid upon one side of a web, thereafter applying suction to the reverse side of the web whereby excess liquid in said coating layer is withdrawn into said web leaving the coating layer damp but non-mobile and set, spreading a layer of fluid coating composition upon the second side of the web while firmly supporting the first coated side of the web while the coating layer on said first side is set but still damp, and drying the so coated web.

2. Method of coating a paper web as the same is being continuously advanced, which comprises applying to one side of the web a controlled quantity of a fluid coating composition comprising a liquid and a suspended solid, spreading the composition into a smooth and even layer on the web by means of an air jet while firmly supporting the reverse side of the web, applying suction to said reverse side of the web whereby to withdraw excess liquid from the coating layer into the interior of the web and to set the coating to a damp but non-mobile condition, promptly thereafter applying to the reverse side of the web a controlled quantity of fluid coating composition, spreading the composition into a smooth and even layer on said reverse side of the web by means of an air jet while firmly supporting the first coated side of the web carrying the set but still damp coating layer, and drying the so-coated web.

3. Apparatus for coating both sides of a continuously moving flexible and porous web, including means for applying a layer of fluid coating composition onto one side of the web, means for firmly supporting the reverse side of the web, an air doctor so positioned as to be in operative relation with the fresh coating-carrying side of the web when the latter is firmly supported by said supporting means, a suction device disposed to contact the reverse side of the web and adapted to draw liquid into the body of the web from such coating layer, a second means for applying a layer of fluid coating onto the reverse side of the web, a second means for firmly supporting the web on the opposite side thereof, and a second air doctor so positioned as to be in operative relation with the fresh coating-carrying side of the web when the same is firmly supported by said second supporting means.

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