June 13, 1950 C. P. PUTNAM ET AL 2,511,415

WEB COATING APPARATUS

Filed May 16, 1945 3 Sheets-Sheet 1

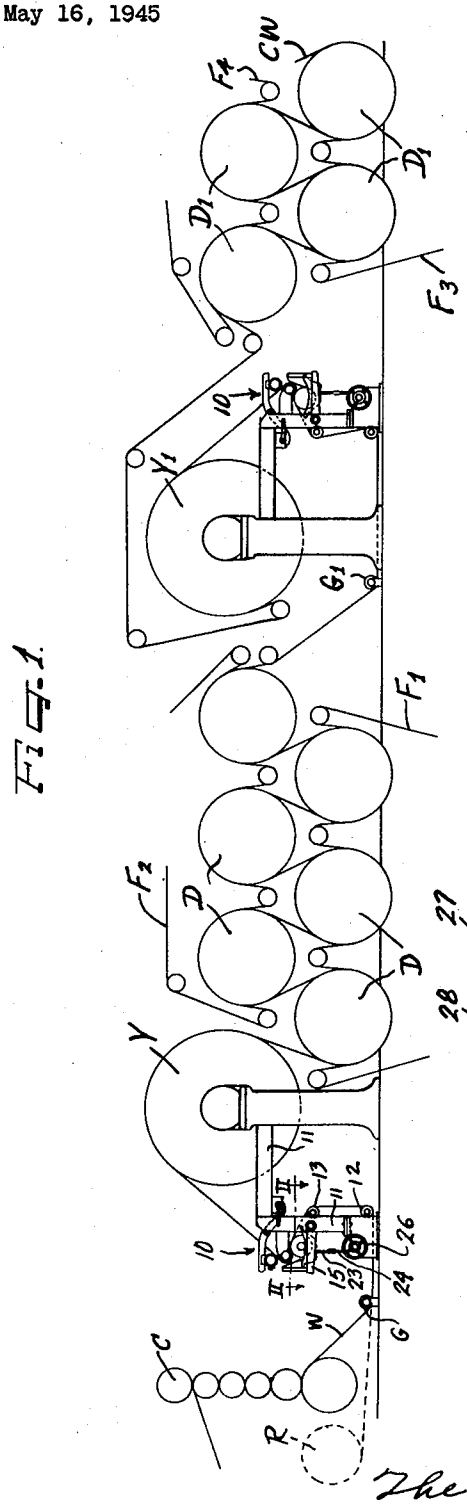


Fig. 1.

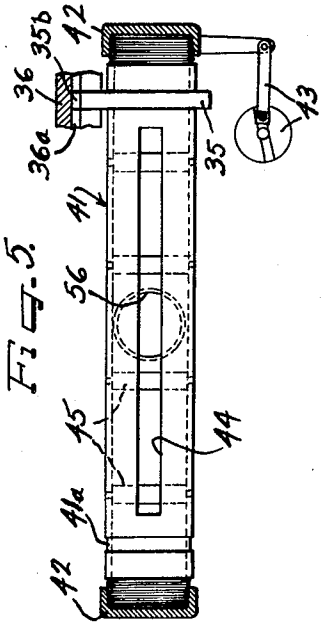


Fig. 5.

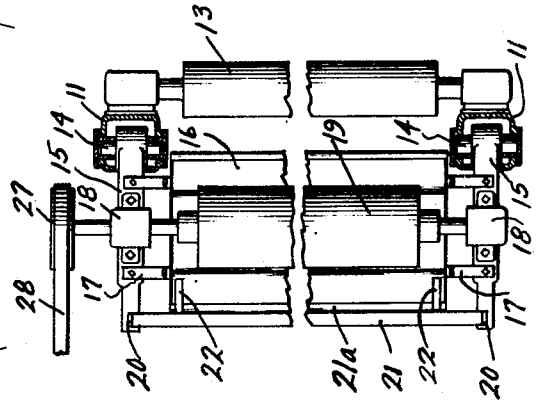


Fig. 2.

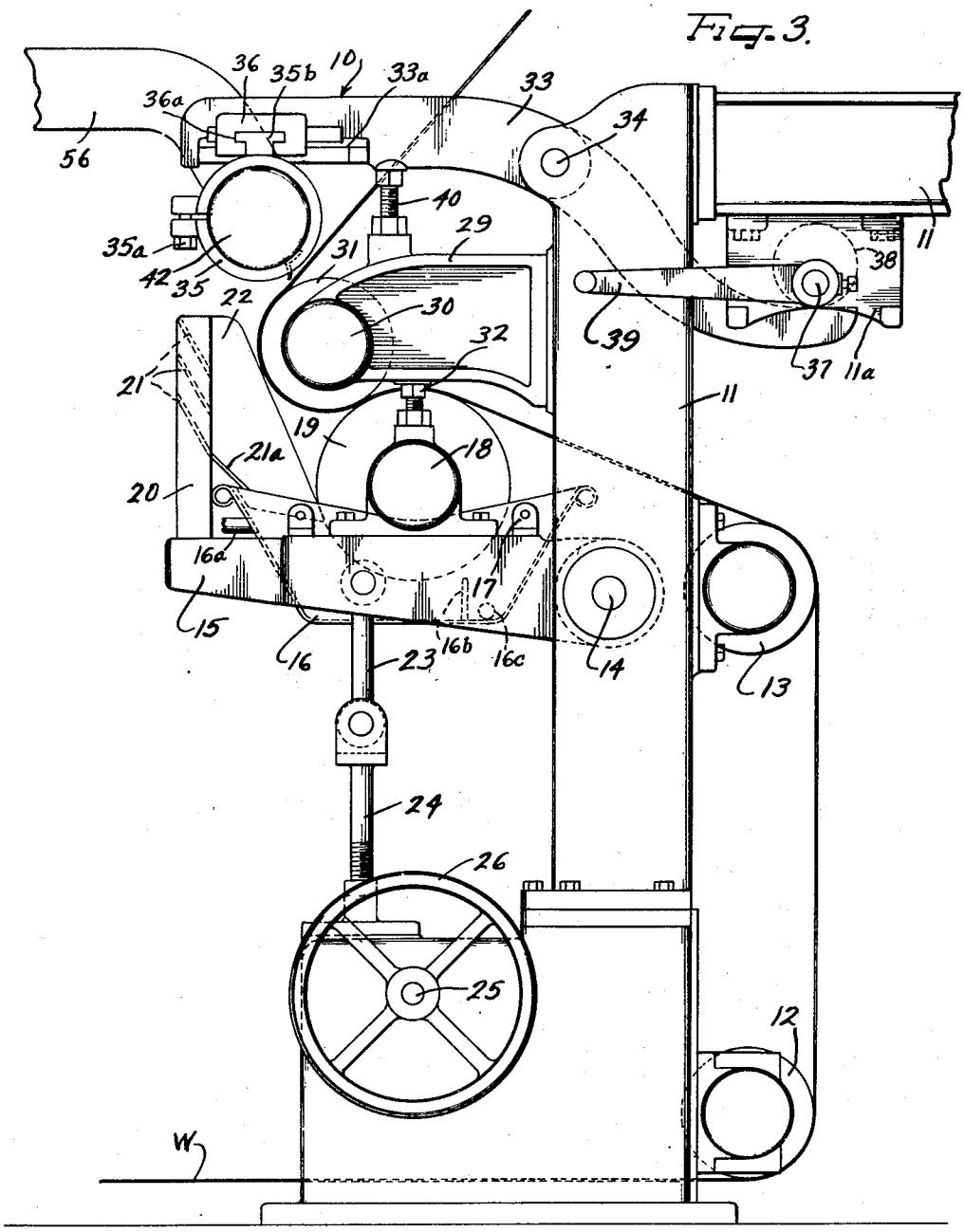
Inventors
Charles P. Putnam
Webster E. Byron Baker
By The firm of Charles W. Hill
Attys.

June 13, 1950 C. P. PUTNAM ET AL 2,511,415

WEB COATING APPARATUS

Filed May 16, 1945 3 Sheets-Sheet 2

Fig. 3.



Inventors
CHARLES P. PUTNAM
WEBSTER E. BYRON BAKER
The Firm of Charles W. Hills
by Attys.

June 13, 1950 C. P. PUTNAM ET AL 2,511,415

WEB COATING APPARATUS

Filed May 16, 1945 3 Sheets-Sheet 3

Fig. 4.

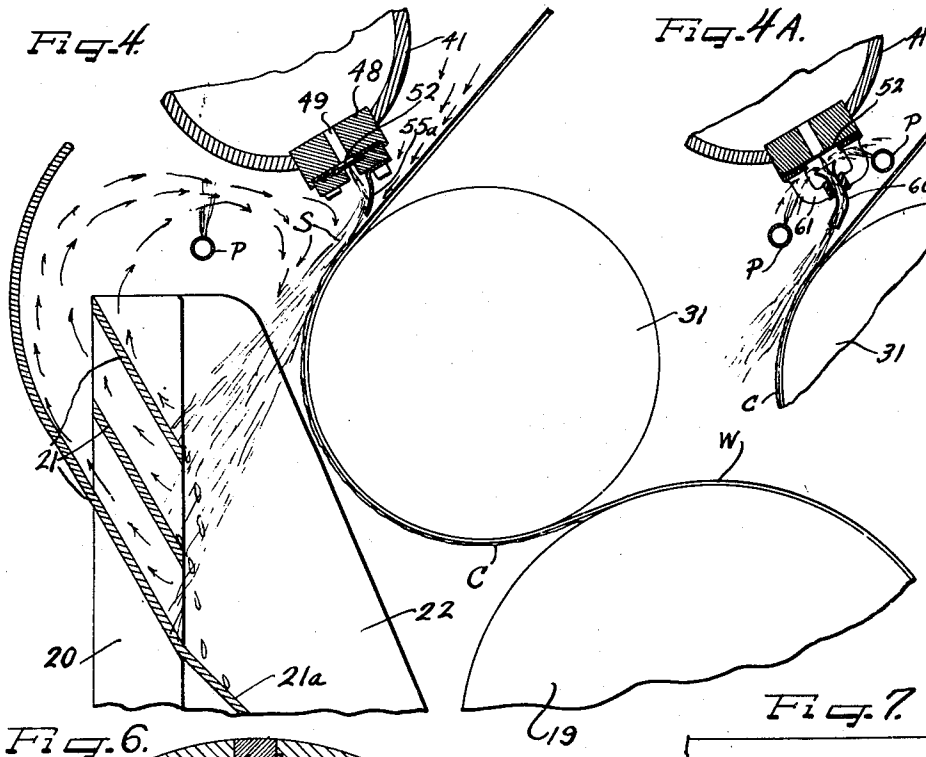


Fig. 4A.

Fig. 6.

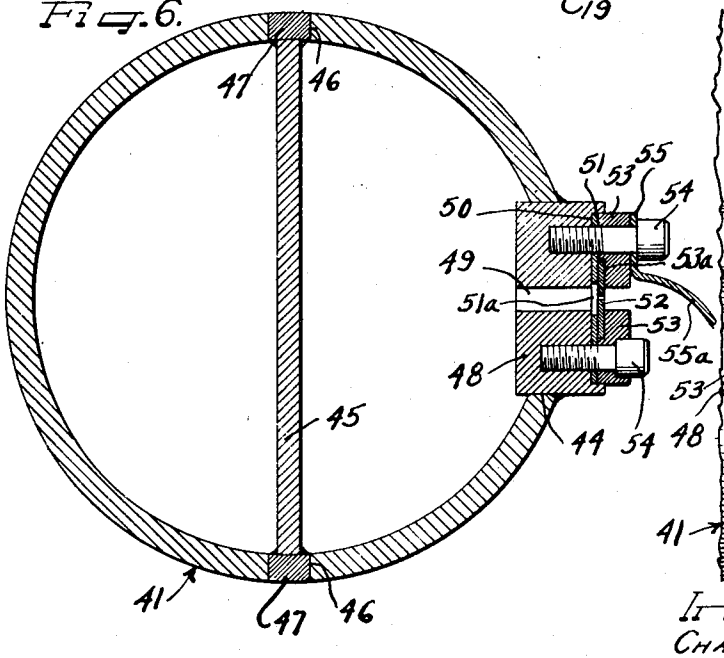
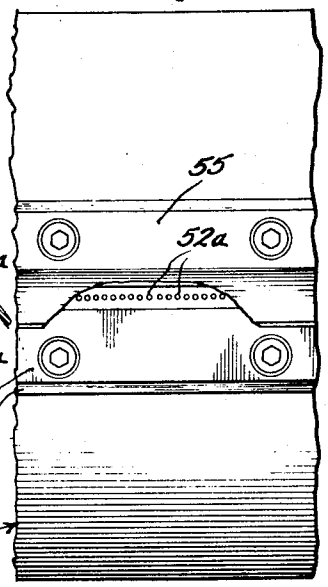


Fig. 7.



Inventors
CHARLES P. PUTNAM
WEBSTER E. BYRON BAKER
The Firm of Charles W. Hills
by Attys.

Patented June 13, 1950 2,511,415

UNITED STATES PATENT OFFICE

2,511,415

WEB COATING APPARATUS

Charles P. Putnam and Webster E. Byron Baker, Lock Haven, Pa., assignors to New York and Pennsylvania Co., Inc., New York, N. Y., a corporation of Delaware

Application May 16, 1945, Serial No. 594,028

8 Claims. (Cl. 91—53)

1

This invention relates to the coating of paper, and particularly to the production of coated web material having a continuous level film of coating material on one or both sides thereof.

According to this invention, traveling paper or other web material from a paper making machine or from a roll receives a film of coating material on one face thereof. A fountain roll applicator can be used to apply the coating to the web. The freshly-coated web is trained around a roll and a gas, such as air, steam, or the like at relatively high pressures and velocities is ejected against the coated face of the web. The gas, due to the high velocity thereof, need only be ejected against the coating in relatively small volumes and will pick up air from the surrounding atmosphere to form a bristle-like brush of gas which efficiently brushes off excess coating material and produces a uniform level coating of desired thickness on the web. The gas, after brushing the coating, is dissipated away from the web. The direction of movement of the gas is opposite to the direction of movement of the traveling web and the angle of the gas path is so arranged relative to the roll around which the coated web is advanced into the gas path that successive increments of the coating film are subjected to a brushing action which not only removes excess coating material but also levels the coating film without interfering with preceding or succeeding increments. Thus, the coated web is trained around a roll cooperating with the fountain roll or other applicator to continuously present successive increments of the coating film to the gas stream for the brushing treatment, and the excess coating material is swept away from the incoming increments of coating film. Baffles are provided for receiving the removed coating material and for directing this material back to the pond of coating material from which the applicator is supplied. These baffles direct the gas away from the coated film and pond of coating material.

In order to compensate for possible loss of volatiles from the droplets of coating material brushed off of the coated web by the gas brush, it may be desirable to maintain a volatile moistened or saturated atmosphere around the path of the droplets. For example, when working with coating colors in water vehicles, steam can be introduced into the atmosphere surrounding the coating material and a hood or cover can be used to confine the moist atmosphere around the coating apparatus.

The coated and gas-brushed web is directed around a cylindrical drier such as a Yankee drier with the uncoated side of the web contacting the drum. This drum dries the coating sufficiently to prevent smearing, and the thus-dried coated web is then trained around drying drums arranged in a plurality of rows as in a paper making machine. The coated side of the web contacts the drums of one row and the uncoated side contacts the drums of the other row. After the coating on the web is dried, the uncoated side of the web can be directed over a second applicator roll to receive a film of coating material thereon and this second coated side is then subjected to a gas treatment the same as the first coated side of the web. The double-coated web is next passed around a second cylindrical drier such as a Yankee drier drum with the freshly-applied coating remote from the drum. The doubly-coated web is then passed around additional drier drums.

2

A feature of the invention resides in the utilization of small quantities of gas, such as air, at such high velocities that surrounding gas is picked up to form a gas brush or gas streams sweeping along successive increments of a coating film on a traveling web in a direction opposite to the direction of travel of the web to brush off excess coating material and level off the coating film.

Another feature of the invention resides in the utilization of a gas brush which efficiently brushes off excess coating from a traveling freshly-coated web without classifying the mineral components of the coating material as to particle size, and without permitting selective drainage of solubles as by absorption into the interior of the web being treated.

An object of this invention is to provide a simple method and apparatus for leveling coatings on traveling web materials such as paper without smearing the coating film.

A still further object of this invention is to use an air brush for removing excess coating material from a coated web wherein air or other gas is directed along the freshly-coated web surface at very high velocities in a direction opposite to the direction of travel of the coated surface.

A specific object of the invention is to provide a coating process and apparatus wherein an air brush removes excess coating material and levels a coated film on a traveling web without classifying, either by density or magnitude, the materials present in particle form in the coating.

A still further object of this invention is to uti-

lize air or other gas at extremely high velocities and in relatively small volumes for brushing freshly-coated web surfaces.

Another object of the invention is to brush freshly-coated web surfaces with high pressure air in relatively small volumes to remove excess coating material and to dissipate air away from the coated surface while returning the removed coating material for coating subsequent surfaces of the web material.

Another object of the invention is to introduce moisture, vapor, or other humidifying material into the atmosphere surrounding the gas brush to compensate for losses of coating material volatiles due to evaporation or the like.

A specific object of the invention is to provide an apparatus for coating traveling web material wherein air at high velocity is brushed against an increment of the surface of the freshly-coated web in a direction opposite to the direction of the web to blow excess coating material off the web and to dissipate the air without interfering with the coating material on the web.

A further object of the invention is to provide a gas brush that is feasible to oscillate for better leveling of coating materials on a web to simulate brushing action produced on a brush coating machine.

Other and further objects of this invention will be apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which, by way of a preferred example only, illustrate one embodiment of the invention.

On the drawings:

Figure 1 is a somewhat diagrammatic side elevational view of paper coating apparatus according to this invention illustrating the coating of both sides of a paper web.

Figure 2 is a broken fragmentary horizontal cross-sectional view, with parts in plan, taken substantially along the line II—II of Figure 1.

Figure 3 is a fragmentary side elevational view, on an enlarged scale, of one of the coating devices of the apparatus shown in Figure 1.

Figure 4 is a fragmentary, somewhat diagrammatic side elevational view of a portion of the coating apparatus illustrating the manner in which the high-velocity air brush of this invention brushes the freshly-coated web surface and returns the removed coating material in one direction while dissipating the air in another direction.

Figure 4A is a view similar to Figure 4 but showing a modified air brush.

Figure 5 is a side elevational view, with parts in vertical cross section, of the air brush tube used in the apparatus of Figures 1, 3 and 4.

Figure 6 is a transverse vertical cross-sectional view of the air brush tube with an air jet orifice plate secured in position.

Figure 7 is a fragmentary plan view, with parts broken away to show underlying portions, of the tube of Figure 6.

As shown on the drawings:

As shown in Figure 1, the reference character W designates a paper web received from either the calender stack C of a paper making machine (not shown) or from a roll R of paper. This web W is fed under a guide roll G to a first coating apparatus 10 for coating one side of the web. The coated paper web emerges from the coating apparatus 10 and is trained around a large-diameter heated roll, such as a Yankee drier drum Y, with the uncoated side of the web contacting

the drum. From the Yankee drier drum Y, the web is alternately trained around top and bottom rows of heated drier drums D. A felt F_1 covers the web around the lower row of drying drums D. A felt F_2 covers the web around the upper row of drying drums D. The web is directed from the last drier drum D under a guide roll G_1 through a second coating apparatus 10 identical with the first apparatus 10 but arranged to coat the uncoated or opposite side of the web W. From the second coating apparatus 10, the web is directed around a second large-diameter heated drier drum, such as a Yankee drier Y_1 and thence alternately around upper and lower rows of heated drier drums D_1. A felt F_3 covers the web around the lower row of drier drums, while a felt F_4 covers the web around the upper row of drier drums. The finished coated web C. W. emerges from the last drier drum D_1 and can be wound into a roll (not shown).

The coating apparatus 10 includes opposed side frames 11, 11 as best shown in Figures 1, 2 and 3. These side frames rotatably carry guide rolls 12 and 13 in superimposed relation to direct the web from the guide roll G. Pivots 14, 14 carried by the side frames 11, 11 tiltably support side arms 15, 15. These side arms carry therebetween a coating pan or trough 16 on straps 17. Bearings 18, 18 are mounted on the arms 15, 15 to rotatably support a fountain or applicator roll 19 arranged to dip into a pond of coating material carried in the pan 16. Coating material is fed to the pan 16 from an inlet 16*a* as shown in Figure 3 and is maintained at a desired level in the pan by a dam or baffle 16*b* controlling flow to an outlet 16c.

Uprights 20 on the free ends of the arms 15, 15 carry a plurality of spaced superimposed inclined baffle plates 21. The bottom baffle plate has a lip portion 21*a* for directing excess coating material into the pan 16. Side guards or plates 22 cooperate with the baffle plates 21 for laterally confining the air blast and removed coating material as will be more fully hereinafter described.

Link rods such as 23 are pivoted to the side arms 15, 15 at their upper ends and to vertical lift rods such as 24 at their lower ends. A cross-shaft 25 (Figure 3) actuates gears (not shown) engaging the lift rods such as 24 to raise and lower the rods for swinging the arms 15, 15 about their pivots 14, 14. The cross-shaft 25 is actuated by a hand wheel 26.

The entire assembly carried by the side arms 15, 15, including the coating material pan 16, the applicator roll 19, and the baffles 21, can thus be raised and lowered by rotation of the hand wheel 26.

The fountain or applicator roll 19, as best shown in Figure 2, has a shaft carrying a pulley 27 driven by a belt 28 or the like for rotating the roll at any desired speed relative to the web W and in either direction.

Upright portions of the side frames 11, 11 carry arms such as 29 with bearing housings such as 30 on the ends thereof rotatably supporting a breast roll 31 receiving the web W therearound from the applicator roll 19. The roll 31 can be driven to advance the web thereon.

Adjustable stops 32 are mounted on the bearing housings 18 for the applicator roll 19 to engage the arms 29 for limiting the upward swinging movement of the applicator roll 19 relative to the breast roll 31. Thus a desired amount of wrap of web around the applicator roll can be

obtained by regulating the level of the roll 19 relative to the guide roll 13 and breast roll 31.

Arms such as 33 are pivoted on the upright portions of the side frames 11, 11 intermediate their ends on pivots such as 34 above the arms 29. Horizontal ways or tracks 33a are provided on the free ends of the arms 33. Straps such as 35 having clamping ears 35a are equipped with T heads 35b slidably mounted in T grooves such as 36a of carriage blocks 36 slidable on the ways 33. The straps 35 can thus be moved toward and away from the breast roll 31 by sliding the carriages 36 on the ways 33. In addition, the straps can be reciprocated longitudinally relative to the breast roll 31 by sliding the heads 35b of the straps 35 in the T grooves 36a of the carriages 36.

Horizontal portions of the side frames 11, 11 carry plates 11a which rotatably support a cross-shaft 37. Cams such as 38 are secured on the cross-shaft 37 and act on the ends of the arms 33 which are remote from the ends of the arms carrying the tracks or ways 33a. A handle 39 is provided to rotate the shaft and actuate the cams 38 for tilting the arms to raise and lower the straps 35 carried thereby. Adjustable stops such as 40 are carried by the upper ends of the arms 29 to engage the arms 33 for limiting the downward movement of the straps 35.

As shown in Figure 5, a tube 41, closed at the ends by means of closure caps 42, has grooves 41a therearound for receiving the straps 35. The tube is thus adjustably secured in the straps 35 and can be tightened in adjusted position by bolts engaging the clamping ears 35a on the straps. Since the straps are slidable in the carriages 36, the tube 41 can, if desired, be reciprocated by an adjustable crank 43. Such reciprocation imparts a better brushing action to the gas streams for avoiding possible tendency toward striation of the coating.

An elongated slot 44 is cut in the tube 41 between the grooves 41a. In order to prevent the tube from spreading due to the slot therein, reinforcing struts 45 (Figures 5 and 6) are inserted through apertures 46 at spaced intervals along the length of the tube. These struts are welded to plugs 47 which, in turn, are welded in the apertures 46 as best shown in Fig. 6.

A block 48 is welded in the slot 44 as best shown in Figures 6 and 7. This block 48 has a slot 49 therethrough along the length thereof. The block 48 has a recess 50 in the outer face thereof receiving a gasket 51 with a slot 51a therethrough aligned with the slot 49. An orifice plate 52 is seated on the gasket 51 and is received in recesses 53a of clamping strips 53 which are secured to the block 48 by means of screws 54. The orifice plate 52 is thus sealingly clamped on the block 48 and the row of holes 52a through the plate is in alignment with the slot 49 of the block. A deflector 55 is carried by the clamping screws 54 on one of the clamping strips 53. This deflector 55 has a curved lip 55a which, as best shown in Figure 4, receives air from the orifices 52a to deflect the air in a flat bristle-like form to provide a brush along the coated surface of the web.

Air or other gas is supplied to the tube 41 from a conduit 56 communicating with the central portion of the conduit as shown in Figure 5.

The paper web W from the guide roll 13 is directed over the top of the applicator roll 19 as shown in Figure 3. The applicator roll is driven by the pulley 27 or other power transmission device mover to rotate through a pond of coating material maintained in the pan 16. The roll picks up a film of the coating material from the pond and the web W being trained around a portion of the film-covered applicator roll 19 receives a film or layer of coating material C thereon as best shown in Figure 4. This coating material C, however, may not have a smooth continuous surface, but may be rather wavy and uneven as shown in Figure 4. The breast roll 31 receives the uncoated side of the coated web from the applicator roll 19. The web is preferably trained around about one-half of the breast roll 31 and leaves the breast roll in anupwardly inclined direction to travel to the Yankee drier drum Y. Successive length increments of the upwardly inclined portion of the coated web, while the web is still on the breast roll 31, have the coating C thereon brushed by streams S of high velocity air composed of air ejected from the tube 41 and air picked up from the atmosphere as shown by the arrows. The curved lip 55a of the deflector 55 fans out or flattens the air jets from the orifice holes 52a so that the jets will have narrow or thin form to provide a series of thin fan-shaped jets. At the same time, the lip deflects the air to direct the flattened jets or streams S thereby confining kinetic energy and producing brushing action in a direction opposite to the direction of travel of the web. The jets or streams S act as bristles of a brush. The deflector thus cooperates with the orifice holes to produce streams of air bristles deflected or bent to contact a length of the coating material in a manner similar to the deflection of the tufts in a brush as applied by a painter in painting a surface. The brushing angle is determined by the setting of the tube 41 in the straps 35. In order to prevent any possible formation of a jet or bristle pattern on the coating, the tube can be reciprocated by the crank 43. The brushing angle of the air streams or bristles can be varied, as explained, for controlling the texture of the coating. A smooth, level coating is thus formed.

The excess coating material and the air streams S are impacted on the baffles 21. These baffles 21 direct the air upwardly away from the coating material and web to dissipate the velocity of the air. Some of the air emerging from the upper ends of the baffles may recirculate back to the air streams S. As shown in Figure 4, the bottom baffle 21 can be extended to better direct the air to be picked up by the main air streams S. This air and other surrounding air can be humidified by steam, vapor or other material ejected from pipe P. The introduction of humidifying material into the air can be regulated to compensate for losses in volatiles due to evaporation from the coating material brushed off of the web. The excess coating material drips off of the baffles 21 and the leg 21a of the lower baffle directs this coating material back to the coating pan 16.

Air or other gas is maintained at relatively high pressures in the tube. Pressures from 20 to 200 lbs. per square inch can be maintained. Since the orifices 52a are quite small, such air pressures will create very high velocity jets through the small orifices. The high velocity jets pick up such large volumes of surrounding air that 50 to 75% of the streams or jets S is composed of picked-up or swept-in atmospheric air. The remaining 25 to 50% of the air streams is composed of ejected air from the tube 41.

As shown in Figure 4A, an injector effect can be obtained for sweeping air from the atmosphere

into the air streams from the tube 41 by suspending an open-ended nozzle 60 on thin legs or straps 61 from the tube 41. The orifice holes in plate 62 direct high pressure air into the nozzle. The nozzle is curved to better produce the effect of deflector lip 55a in flattening and deflecting the jets while confining their kinetic energy to form air bristles and brush them against the coated web on the breast roll 31. As shown by the arrows, air from the atmosphere is sucked into the upper end of the nozzle 60 by the jets from the tube 41. This sucked-in atmospheric air will form a considerable portion of the air bristles. Air about to enter the nozzle from the atmosphere can be humidified by material ejected from pipes P.

Thus only relatively small quantities of high pressure air need be produced for creating an effective high velocity air brush. This high velocity air brush will not classify the different ingredients of coating materials and use of heavier concentration or thixotropic coating materials is facilitated. Thixotropic coating materials such as starch colors are especially desirable for coating paper webs at high speeds since they will rapidly set and thus simplify smearing problems. The high velocity air bristles of this invention have increased kinetic energy to shear the thixotropic material and brush off the excess coating. The heretofore-known air devices or the like will not produce this effect because the air sheets of such devices do not have the high kinetic energy capacity of the individual air bristles produced by this invention. The disposal of the smaller quantities of air after re-expansion to atmospheric pressure is also simplified.

The air brushed coating on the web is dried sufficiently on the Yankee drum Y so that it can be contacted with the heated surface of another heated drum such as D. After passage around a series of such drier drums D, the dried coated web with the coating on one surface thereof can be passed through a second coating machine identical with the first machine but operating in the reverse direction to coat the other face of the web. From this second coating apparatus the web is trained around the second Yankee drier drum Y_1 with the first coated side of the web contacting the drum. The web from the second Yankee drier drum can then be passed around a series of drier drums D_1 to completely dry the web. The finished web C. W., coated on both faces thereof, is then ready for winding into a roll or for further treatment such as printing or the like.

The coating machines of this invention can be operated at relatively high speed since they simplify the heretofore-encountered difficulty of dissipation of large volumes of gas required on prior known air brush type coating machines. Power requirements of these machines are low because only one-half or less of the gas brush is composed of compressed gas, the rest being picked up from the atmosphere.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

We claim as our invention:

1. A coating machine comprising side frames, arms pivotally supported by said frames, a coating pan carried by said arms, a fountain roll dipping in said pan rotatably carried by said arms, baffle means on the free ends of said arms arranged to direct coating material to said pan, a breast roll carried by said side frames adjacent said fountain roll to receive web material from the roll around the underside thereof and to direct the web material in an upward direction, levers pivoted on said side frames above said breast roll, an air tube adjustably carried by said levers, means for tilting said levers to adjustably space the air tube from the breast roll, orifice means along the length of said air tube for ejecting air at high velocities to pick up atmospheric air and form bristles of air brushing the coating materal on the web as it passes in an upward direction around the breast roll to impinge the air bristles and excess coating material against said baffle, and means for raising and lowering said arms to adjustably position the fountain roll relative to the breast roll.

2. A coating machine comprising side frames, guide rolls carried by said side frames, arms pivoted on said side frames, lift means carried by said side frames for swinging said arms, a coating pan carried by said arms, a fountain roll carried by said arms dipping in said coating pan, baffle means carried by said arms in spaced superimposed relation defining therebetween upwardly inclined air flow paths, a breast roll rotatably carried by said side frames, and an air blast tube adjustably carried by said side frames for ejecting air at high velocities in a downward direction to impinge on said baffles and brush coating material on a web traveling upwardly around the breast roll.

3. In a coating machine, a frame, a pan for coating fluid mounted on said frame, a fountain roll journaled in said frame and dipping into said pan, a breast roll journaled in said frame adjacent and above said fountain roll and adapted to have coated web material trained from the top of said fountain roll around and upwardly from said breast roll, an elongated air nozzle mounted in said frame adjacent said breast roll and having a plurality of air ejecting orifices extending therealong and arranged to direct a series of air jets tangentially of said breast roll along the web trained thereover, in a direction opposite to the direction of travel of the web, and a plurality of vertically spaced baffles mounted on said frame in the path of travel of the air jets passing from said web, and defining therebetween upwardly inclined air flow paths for the return of air to said air jets.

4. Coating apparatus comprising a first coating machine, a first large diameter drying drum adjacent said first coating machine, a second coating machine, a second large diameter drying drum adjacent said second coating machine, a coating applicator in each coating machine, a breast roll in each coating machine for receiving a traveling web from the applicator of the machine and for directing the web to the drier drum adjacent each machine, a gas tube in each machine extending transversely across the width of the traveling web passing through the machine adjacent the breast roll and having a multiple orifice structure extending along one side thereof and arranged to eject a plurality of high velocity gas jets, and a deflector element supported in front of said tube and extending along the length of the tube in the path of jets issuing from said orifices and in a direction opposite to the direction of travel of the web to receive the jets thereagainst for confining the kinetic energy of the

jets while flattening the jets into fan-like bristles thereby picking up gas from the surrounding atmosphere and forming brushing streams acting lengthwise on the coating on the web as it travels around the top portion of the breast roll to remove excess coating from the web.

5. A coating machine comprising a coating applicator, a breast roll adjacent the applicator for receiving a traveling web therearound from the applicator, a tube adjacent the breast roll and having a plurality of orifices arranged to eject gas at high velocities, a deflector element supported in front of said tube and extending along the length of the tube in the path of jets issuing from said orifices and in a direction opposite to the direction of travel of the web to receive the jets thereagainst for confining the kinetic energy of the jets while flattening the jets into fan-like bristles thereby picking up gas from the surrounding atmosphere and forming brushing streams along the face of the web on the breast roll in a direction opposite to the direction of travel of the web, and baffle means including a retainer wall and a spaced baffle within the path of movement of the brushing streams and at an acute angle therefrom to receive excess coating material and gas to direct the gas away from the web and to return the excess coating material to the applicator.

6. A web coating machine comprising a coating applicator, a breast roll for receiving therearound coated web material from the applicator, means for simultaneously ejecting a plurality of jets of gas at high velocity adjacent the coated web on the breast roll, and a deflector element supported in front of said means and extending along the length thereof in the path of the jets issuing therefrom and in a direction opposite to the direction of travel of the web material from the applicator to receive the jets thereagainst for confining the kinetic energy of the jets while flattening the jets into fan-like bristles thereby picking up gas from the surrounding atmosphere and forming a gas brush acting on the coating on the web material.

7. A coating machine comprising a coating applicator, a roll adjacent the applicator receiving a coated web around the under side thereof, an air tube adjacent said roll, orifice means extending along the length of said tube and arranged to eject a plurality of jets of air at high velocities, a deflector element supported in front of said tube and extending along the length of the tube in the path of the jets issuing from said orifice means and in a direction opposite to the direction of travel of the web to receive the jets thereagainst for confining the kinetic energy of the jets while flattening the jets into fan-like bristles thereby picking up gas from the surrounding atmosphere and forming air bristles brushing the coating on the web material in a direction opposite to the direction of travel of the web as it travels around the roll to brush off excess coating material away from the web, and means for humidifying the air as it is being picked up by the ejected air jets.

8. In a coating machine, a frame, a pan mounted on said frame and adapted to carry coating fluid, a fountain roll journaled in said frame and dipping into said pan, a breast roll journaled in said frame adjacent and above said fountain roll, said breast roll being adapted to have web material trained from the upper side of the fountain roll around and upwardly thereover, an elongated air nozzle having a plurality of air-ejecting orifices therein and supported in said frame adjacent said breast roll, a deflector element supported in front of said nozzle and extending along the length thereof in the path of jets issuing therefrom and in a direction opposite to the direction of travel of the web to receive the jets thereagainst for confining the kinetic energy of the jets while flattening the jets into fan-like bristles thereby picking up gas from the surrounding atmosphere to form gas bristles substantially tangential to the breast roll along the web trained thereover and in a direction opposite to its direction of travel, and a reciprocating drive mechanism operatively connected with said nozzle to move the nozzle and jets back and forth across the web.

CHARLES P. PUTNAM.
WEBSTER E. BYRON BAKER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,328,541	Palmer	Jan. 20, 1920
1,658,485	Hayward	Feb. 7, 1928
1,980,923	Lebel	Nov. 13, 1934
2,139,628	Terry	Dec. 6, 1938
2,146,507	Mayer et al.	Feb. 7, 1939
2,159,151	Hershberger	May 23, 1939
2,176,093	Merrill	Oct. 17, 1939
2,225,877	Melton et al.	Dec. 24, 1940
2,229,921	Goff et al.	Jan. 28, 1941
2,252,345	Johnson	Aug. 12, 1941
2,356,873	Muggleton	Aug. 29, 1944