

Jan. 15, 1952

W. H. BARRETT ET AL

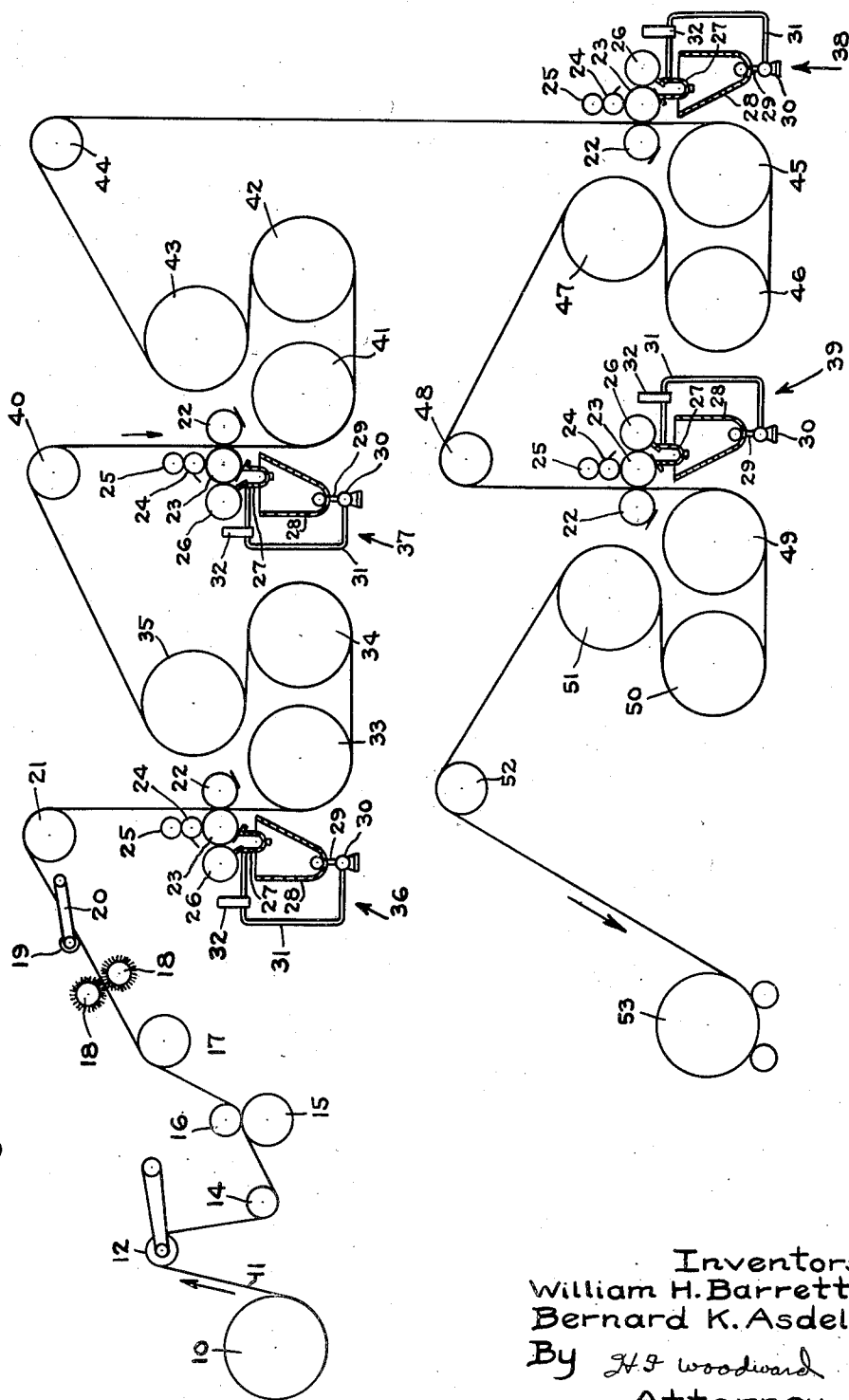
2,582,407

PROCESS FOR COATING PAPER

Original Filed May 24, 1945

5 Sheets-Sheet 1

Fig-1



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5 Sheets-Sheet 2

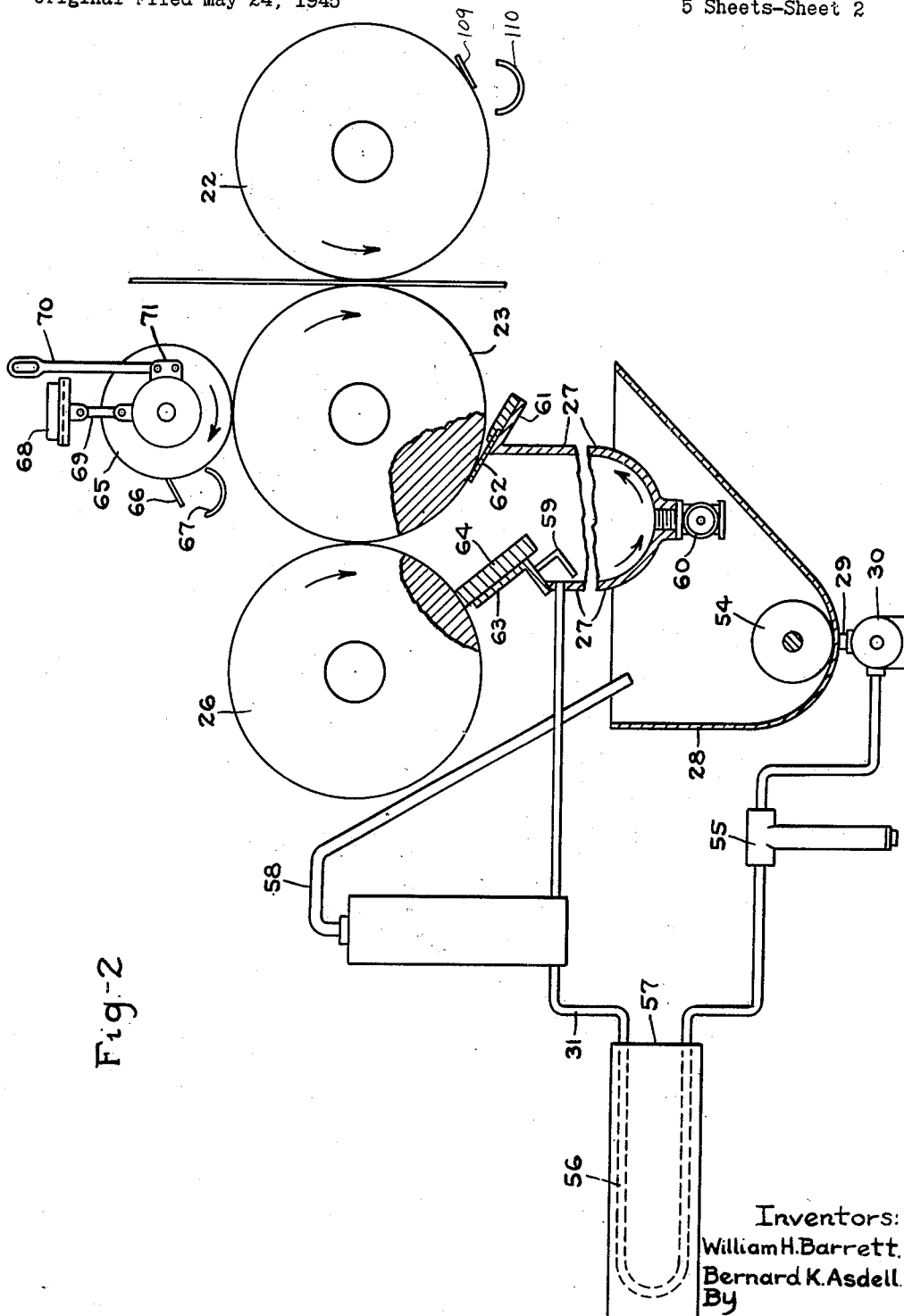


Fig-2

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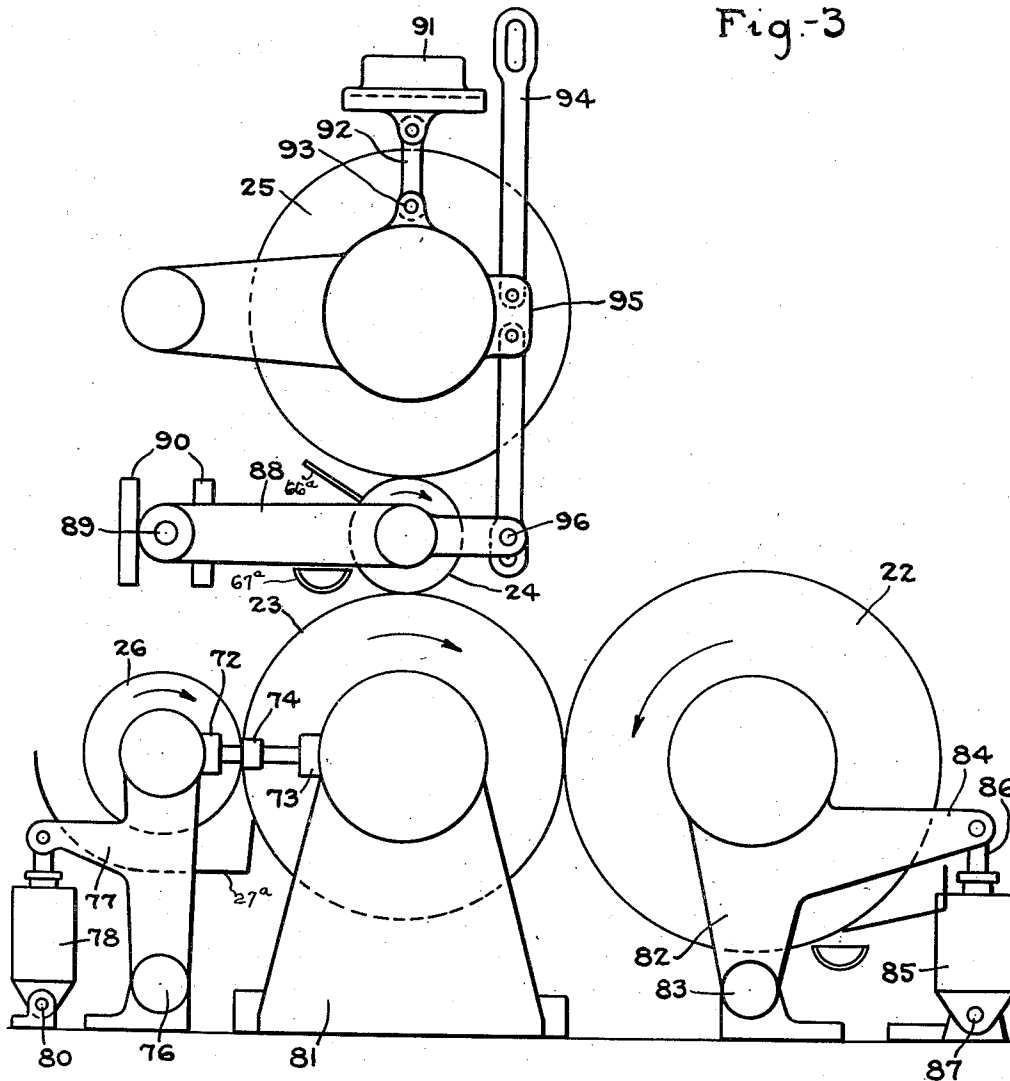
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5 Sheets-Sheet 3

Fig.-3



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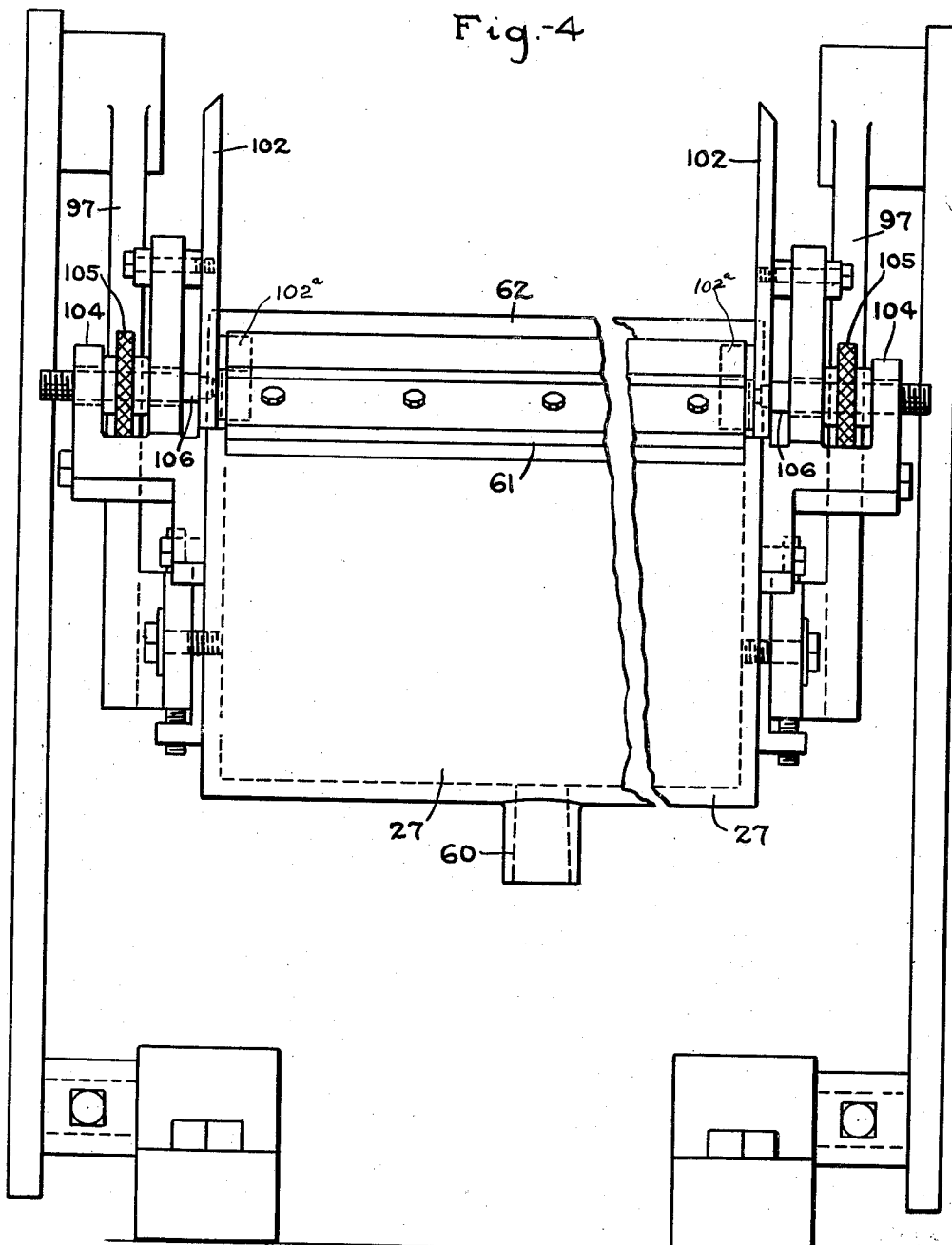
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5 Sheets-Sheet 4

Fig. 4



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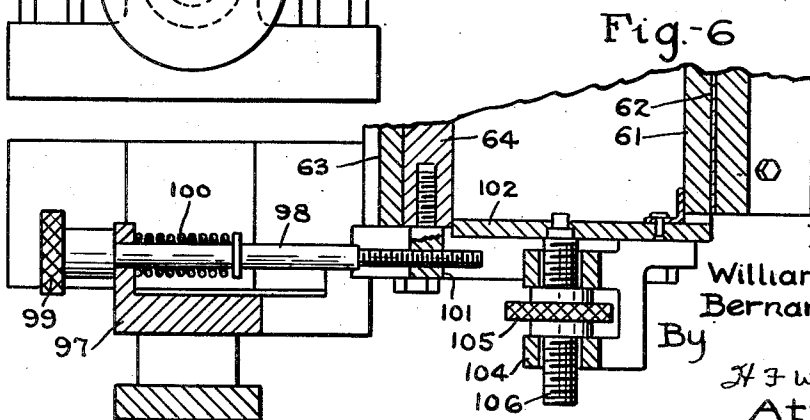
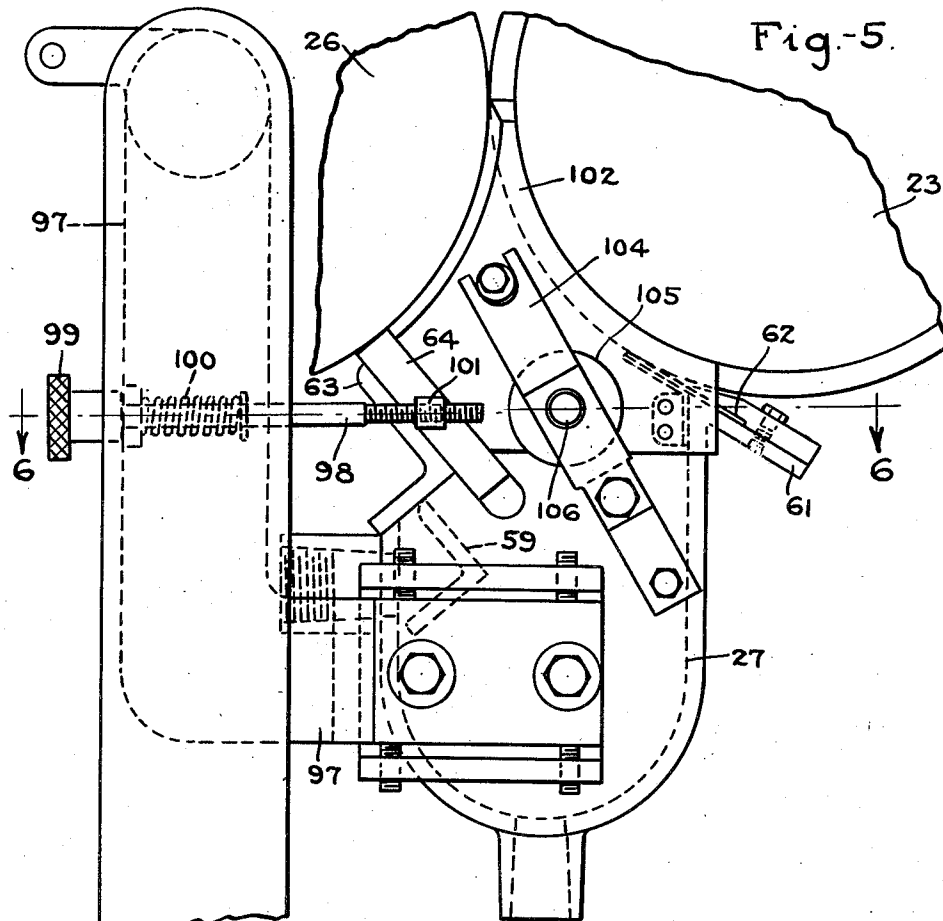
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UNITED STATES PATENT OFFICE

2,582,407

PROCESS FOR COATING PAPER

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Original application May 24, 1945, Serial No.
595,618. Divided and this application May 29,
1946, Serial No. 673,144

5 Claims. (Cl. 117-111)

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This invention relates to new and useful im-
provements in coating and particularly seeks to
provide a novel method and apparatus for apply-
ing a smooth and uniform coating to a con-
tinuously moving web of paper or the like.

The present invention is particularly concerned
with a paper coating apparatus and process to
produce coating superior in respect to smooth-
ness, freedom from imperfections, etc.

The base stock in web form may be of any suit-
able kind and the ingredients contained in the
coating applied thereto may be chosen from a
number of different materials. The coating mix-
ture may include clay, calcium carbonate, satin
white, etc., and an adhesive or binder such as
starch, glue, casein or other suitable material all
contained in an active dispersion.

It is an object of the invention to apply a coat-
ing upon a fast traveling web of paper, and the
term "paper" as used herein is intended to in-
clude any and all materials in web form whereon
a coating may be applied and treated in accord-
ance with the present invention, and no distinc-
tion is intended by the various classes of paper
such as, for example, printing, photography, or
other papers.

One procedure which may be and has been em-
ployed in coating a web of paper is broadly to
apply coating composition to the web in greater
quantity than is required to produce the desired
weight of coating, and then to remove the excess
part by the use of wiping or smoothing device
such as blades or doctor rolls.

Heretofore in following the normal procedure
in applying coating to a moving web of paper
considerable difficulty has been encountered as a
result of a formation or multiplicity of imperfec-
tions in the applied coating. These imperfec-
tions are generally caused as a result of a passage
of a weaving web of paper to which an excess of
coating composition has been applied over some
form of smoothing or wiping device.

According to this invention a uniform film of
coating composition may be applied to one side
of the paper web while the web is firmly sup-
ported on the reverse side by a suitable support-
ing means. It will be observed that the ap-
paratus in this instance comprises one or more
units for treating each side of the paper. The
apparatus may be employed to affect the coating
of paper from which a greater portion of mois-
ture has been removed and generally superior re-
sults are obtained where the paper being coated
contains about 3% to about 10% of moisture. So
far as the coating apparatus is concerned, it may

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be made to operate satisfactorily on paper hav-
ing wide variations in moisture content and may
be applied to various types of webs.

With the foregoing and other objects in view,
the nature of which will become more apparent,
the invention will be more fully understood by
reference to the drawing, the accompanying de-
tailed description, and the appended claims.

In the drawing, which illustrates an embodi-
ment of the invention:

Figure 1 diagrammatically represents in eleva-
tion one form of the apparatus adapted to apply
two coatings of the material to opposite sides of
the web.

Figure 2 is a side view with parts broken away
of a form of a single coating unit.

Figure 3 is a side view of a coating unit show-
ing means for applying pressure between the vari-
ous rolls and the means for separating these rolls.

Figure 4 is a front view and elevation of the
coating fountain with the rolls removed.

Figure 5 is a side view with parts broken away
of a coating fountain; and

Figure 6 is a view taken along line 6-6 of
Figure 5.

Referring to the drawing, a paper web 11 is
withdrawn from a suitable roll 10 and passes over
roll 12. The roll 12 is supported by arm 13 and
so arranged that tension is maintained upon the
moving web of paper. The paper passes over the
roll 14 and between tensioning rolls 15 and 16,
and the web of paper passes over rolls 17 and 21
before reaching the coating unit.

It often occurs that paper having a moisture
content of about 3% to about 10% is resistant to
the absorption of moisture and thus the coating
material does not uniformly wet the paper. This
results in a non-uniform coating being applied
to the web. This difficulty may be overcome by
lightly brushing the surface of the paper just
prior to the application of the coating material.
A suitable way of accomplishing the foregoing is
to softly brush the paper surface by rotating
brush 18. These brushes preferably should rotate
in the opposite direction to the travel of the web,
and while the web is under tension. If the web is
not under sufficient tension when it passes be-
tween the brushes 18, additional tension may be
applied by roll 19 which is supported by arms 20.

The paper web is supported by rotatable rolls
22 when the coating is applied by applicator roll
23. The coating material is supplied to the con-
tainer 28 from a suitable source of supply (not
shown). The coating material is withdrawn from
the coating container through pipe 29 by means

of pump 30 and then forced through pipe 31 in the fountain 27 by pump 30 and the material being forced into the fountain and maintained in the fountain under superatmospheric pressure. A head of the coating material is maintained above the lower nip formed by the metering roll 26 and the applicator roll 23 so that a surplus of coating material is supplied under pressure at the nip of the said rolls. This may be accomplished by connecting member 32 in the supply pipe 31. The coating material is fed to the fountain 27 which has the open top closed by applicator roll 23 and metering roll 26. Positioned above the applicator roll 23 is smoothing roll 24 and there may be positioned above the smoothing roll a roll 25. One of the purposes of the roll 25 is to aid in cleaning the surface of the smoothing roll. It is essential that the smoothing roll surface be clean at the time it is carrying out its function of smoothing the coating upon the applicator roll.

The paper after receiving the coating, passes over suitable drier or driers such as 33, 34, and 35, and then over roll 40. It has been discovered that a smoother and more uniform coating is obtained when the coating on one side is made by two or more applications and at least partially dried between each application.

The four coating units shown in Figure 1 are similar in construction and are indicated generally at 36, 37, 38 and 39. The paper after leaving the driers 41, 42 and 43 passes over roll 44 and then the opposite side receives the coating material either in two or more applications. After receiving the first and second application of coating on the second side, the paper passes over driers 45, 46, and 47 and after the last application of coating material, over driers 49, 50 and 51. The paper after leaving the last drier passes over roll 52 and is wound into suitable roll 53.

In Figure 2 is shown a single coating unit in which the roll 22, 23, and 26 are of about the same diameter. For the most satisfactory results there should be a differential hardness between rolls 22 and 23, between rolls 23 and 26 and between rolls 23 and 65. The coating material is supplied to container 28, which container has an agitator or screw conveyor which keeps the material in motion, thus preventing dead spots in the coating material. The coating material is withdrawn from the container 28 by pump 30 through means 29 and forced into the coating fountain 27 through pipe 31. Positioned in the pipe 31 is a suitable means 55 for removing any heavy or foreign particles that may be contained in the coating material.

It is important that the temperature of the coating material does not substantially vary. For example, a variation of temperature greater than ten degrees will cause the viscosity of the coating material to change and thus result in a variation in the coating material applied to the web of paper. To hold the temperature of the coating material constant, a temperature control means 56 such as a cooling device is so positioned that the pipe 31 passes therethrough. The temperature of the coating material should be maintained below the point where skinning starts. The skinning point varies with the different kinds of coating compositions. The coating composition after passing the temperature control means passes to a member which maintains a head above the lower nip formed by the

metering and applicator roll. Any overflow from the means for maintaining the head passes back to the coating container 28 by means of pipe 58. The coating material forced into the fountain strikes member 59 positioned in the fountain and follows the course indicated by the arrows in Figure 2. This keeps the coating material in constant motion in the fountain.

Secured to the upper wall of the fountain is sealing blade 62 carried by suitable support 61. Also secured to the open side of the fountain is member 63 which supports sealing doctor member 64. The purpose of the doctor member 64 is to seal the fountain and at the same time clean the surface of the metering roll 26 as it leaves the position of the fountain where the coating material contacts this roll. When it is desired to change the coating color or shut down the coating apparatus, any coating material left in the fountain 27 is removed by opening suitable drain 60 positioned in the bottom of the coating fountain. The drain is normally closed by a suitable cut-off valve. The coating fountain as shown in Figure 2 has a partly rounded bottom and with the coating being forced into the fountain and following the path shown by the arrows prevents any dead spots in the coating in the fountain.

The coating material is picked up by the applicator roll 23 and the amount carried by this roll is determined by metering roll 26. The coating material then passes over the surface of the smoothing roll 65 which eliminates any blemishes which might be contained in the film of coating material on applicator roll 23. Any coating material that may be picked up by the smoothing roll 65 is removed from the surface of this roll by suitable doctor 66. The material removed by the doctor 66 is returned to the coating supply by any suitable means, for example, trough 67.

To control the pressure applied to the smoothing roll surface, suitable air diaphragm loading device 68 is provided and this is connected to the smoothing roll shaft through means 69. For separating the smoothing roll from the applicator roll there is provided lift arm 70 which may be connected to any suitable lift means such as a motor, and this arm 70 is connected to the shaft of the smoothing roll 65 at 71. Any coating material that may have accumulated on the backing roll is removed by a suitable doctor blade 109 and returned by trough 110 or other means to coating supply container.

In Figure 3 is shown a modified form of coating unit in which means of separating the metering roll from the applicator roll and the backing roll from the applicator roll and the smoothing roll from the applicator roll. This same means may be utilized for varying and controlling the amount of pressure between these rolls. It is to be understood that the means for separating the rolls may be used with the coating units shown in Figures 1 and 2. This is essential as it tends to control the amount of coating applied to the paper and facilitates cleaning of the coating unit after any particular run or when the coating color is to be changed.

The backing roll 22 is supported by a member 82 which is hingedly mounted at 83. From member 82 extends a substantially horizontal arm 84 and to this member near its outer end is connected piston 85 which is part of pressure cylinder 85. The pressure cylinder 85 is hingedly connected at 85. This cylinder permits the control of pressure as applied by the backing roll

and applicator roll and provides means for separating the applicator roll and the backing roll. Should any coating be transferred to the surface of the backing roll 22 the coating is removed by suitable doctor 108 and the removed coating material is carried away by trough 107.

The applicator roll is supported by suitable members 81 and this roll 23 has a covering that has resilient properties. The covering may be of rubber, synthetic or natural, in fact any material that has resilient properties. By providing the applicator roll with a covering that has resilient properties a superior coating is produced.

The metering roll 26 is movably supported by members 75, which members are hingedly connected at 76. To arm 77, formed as a part of the supporting member 75 is pressure cylinder 78. This pressure cylinder is hingedly connected at 80. The pressure cylinder 78 is used for the purpose of controlling the pressure applied between the metering roll and the applicator roll as well as for quick separation of the metering roll and the applicator roll. There is provided a suitable adjustable means between the rolls 23 and 26 and this means is composed of members 72 and 73 and internally threaded member 74. This suitable means can be adjusted so as to control the space distance between the metering roll and the applicator roll so that the amount of coating remaining on top of the applicator roll is controlled. Positioned above the applicator roll is smoothing roll 24 and any coating picked up by the smoothing roll is removed from the roll surface by the doctor blade 66(a) and the removed coating material is returned to the coating container through suitable catch pan or trough 67.

A pressure ride roll 25 is mounted above the smoothing roll and in contact with the smoothing roll surface. The pressure and riding roll is adapted to rotate in the same direction to that of the smoothing roll and the riding roll speed is so controlled that any tendency of the smoothing roll 24 to whip or to assume a position different from that selected can be controlled.

Connected to the smoothing roll shaft is arm 88 which has connected to its outer end at 89 two pressure indicating scales 90. If the smoothing roll tends to move in either direction from its normal position this movement is indicated on the scales 90. By changing the speed of rotation of the riding roll the tendency of the smoothing roll to move from its normal position is overcome. Means are provided for loading pressure on the riding roll and this is accomplished by air diaphragm member 91 which is connected through means 92 to the shaft of the riding roll. For separating the smoothing roll from the applicator roll and the riding roll from the smoothing roll there is provided motor rod 94 which is connected at 95 to the shaft of the riding roll, and at 96 to arm 88.

A fountain 27 is preferably supported by members 97 in proper relationship to the applicator roll 23 and roll 26. The open top of the fountain has a seal doctor blade 62 positioned along one of the open sides and on the opposite open side is positioned doctor seal 64. On the opposite side end of the top of the fountain is positioned dike member 102 which cooperates with applicator roll 23 and metering roll 26. These seals form part of the fountain and cooperate with the surface of the metering roll and are notched along the edge of the applicator roll as shown in Figure 5.

Dike supports 104 are suitably secured to the fountain sides and the dike adjusting screws are

operatively connected to the dike supports. Secured to the outer end of the dike-adjusting screw is handle wheel 105 for adjusting the position of the dike. Mounted on the inner side of the dike are members 102a which cooperate with the sealing blade 62 and seal in the fountain in any adjusted position of the dike.

To permit adjustment of and positive contact between seal member 64 and the surface of the metering roll 26 there is provided an adjustable doctor pull rod 98 having handle wheel 99 mounted near the outer end thereof. Spring 100 is mounted on the pull rod 98 for maintaining the member 64 in positive contact with the surface of the metering roll. The pull rods are connected to seal member 64 at 101.

The apparatus may be used with coating composition having a solid contents varying over considerable range but applicants' process requires that the coating composition have a solid contents in excess of about 60% to about 75%. Applicants' co-pending application, Serial No. 511,754, filed November 24, 1943, now U. S. Patent No. 2,532,149, for Process of Coating Paper, points out that mineral adhesive coating composition having a solid contents in excess of 60% has thixotropic characteristics.

By way of example the process may be carried out:

The surface of the moving web to be coated is brushed while the paper is under tension and the paper then passes between the applicator roll 23 and the backing roll 22. A coating material is picked up by the applicator roll surface from the fountain 27 and the metering roll controls the amount of coating material that the applicator roll will carry off to the smoothing roll. The smoothing roll then removes any surface defect that may be in the coating film and thereafter the film is transferred to the paper while supported on the backing roll. The film of coating material is then dried and the second application of coating material is applied to the same side. Thereafter in like manner the coating material is applied to the opposite side of the sheet.

Selected amounts of coating material is applied to the sheet, and this is accomplished by controlling the shearing speed between the metering roll and the applicator roll. For example, at a shearing speed of 1,300 feet per minute a coating weight per ream of about nine pounds is obtained by each coating application while at a shearing speed of about 1,500 feet per minute about three pounds of coating per ream is obtained by each coating application. It has been discovered that the coating weight can be more sharply controlled if the shearing speed between the metering roll and the applicator roll and between the smoothing roll and the applicator roll is controlled. As the shearing speed is increased the coating weight per ream of paper is decreased. The shearing speed is the sum of the speed of the applicator roll and the metering roll and likewise the sum of the speed of the applicator roll and the smoothing roll.

To those skilled in the art many modifications and widely different embodiments and applications of the invention in the general field of coating will be readily apparent. It should be understood that the details of our preferred process as described may be subject to some change without departing from either the spirit or scope of the invention. It is intended that the invention is not to be restricted to specific preferred embodiments, minor details, or specific modes of

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operation, other than is necessitated by the prior art and the appended claims. This is a division of application, Serial No. 595,618, filed May 24, 1945, now U. S. Patent No. 2,513,394.

What we claim:

1. The process of coating paper which comprises continuously flowing coating of high solid contents to a body of coating material, maintaining the temperature in the flowing coating composition substantially constant, maintaining a body of coating composition under pressure greater than atmospheric pressure in the area formed by a first and a second rotatable surface, said coating composition comprising mineral pigment and an adhesive having a solid content in excess of 60% and being of a thixotropic nature, the first rotatable surface moving in a direction opposed to the second rotatable surface and the first rotatable surface moving at a speed below that of the second rotatable surface, whereby a controlled amount of coating material is spread on and carried by the second rotatable surface, smoothing the coating material carried by the second rotatable surface by a third rotatable surface moving in the opposed direction to the surface of the second rotatable surface, and then transferring the smooth film of coating material to a moving web of paper moving in the same direction as the direction of the second rotatable surface under rolling pressure.

2. A process of coating a traveling web of paper with about three pounds and upwards per ream with a smooth film of mineral pigment and adhesive coating composition having a solid content in excess of 60% and being of a thixotropic nature, comprising the steps of maintaining a body of the coating composition under pressure and against a rotatable applying surface, flowing coating composition to the body of coating composition, maintaining the temperature substantially constant in the high solids coating composition flowing to the said body of coating composition, spreading coating composition on the rotatable applying surface, applying shearing action to the coating on the applying surface, smoothing the coating on the applying surface and then bringing a moving web of paper into contact with the smooth film on the applying surface to transfer the smooth film on the paper under rolling pressure.

3. A process of coating paper containing about 3% to 10% of moisture with an aqueous mineral-adhesive coating composition having a solid content in excess of 60% and being of a thixotropic nature, which comprises lightly brushing a moving web of paper prior to the application of coating thereto, maintaining a body of said coating composition under pressure and against a rotatable surface, flowing coating composition to the body of coating composition under pressure, maintaining substantially constant temperature in the coating composition flowing to the body of coating composition, spreading and applying shearing action to coating composition on the rotatable surface by a rotatable doctor surface moving in the opposite direction and at a lesser speed than the rotatable surface, smoothing the coating on the rotatable surface and then trans-

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ferring the smooth film to a moving web of paper under rolling pressure.

4. A process of applying a smooth film of mineral pigment and adhesive coating composition to a moving web of paper comprising substantially constant flowing coating composition having a high solid content in excess of 60% and having a thixotropic nature to a body of coating composition, maintaining substantially constant temperature in the flowing coating composition whereby the temperature of the high solids coating composition varies less than about 10° F., maintaining a body of coating composition against a rotatable surface and under pressure greater than atmospheric pressure, spreading coating on the rotatable surface, applying shearing action to the coating on the rotatable surface, smoothing the coating on the rotatable surface and then transferring the smooth film of coating to a moving web of paper under rolling pressure.

5. The process of coating paper which comprises maintaining an aqueous mineral and starch adhesive coating composition under pressure greater than atmospheric pressure and against a rotatable applying surface and a rotatable doctor surface, said coating composition having a solid content in excess of 60% and being of a thixotropic nature, flowing coating composition to said body of coating composition, maintaining substantially constant temperature in the said flowing coating composition, spreading coating composition on the applying surface by said rotatable doctor surface moving in a direction opposed to and at a lesser speed than the applying surface whereby shearing action is applied to the coating composition on the applying surface, smoothing the coating composition to a smooth film on the applying surface and then transferring the smooth uniform film to a moving web of paper.

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