The present invention relates to apparatus for coating, drying and impregnating and is more particularly directed toward apparatus for continuously carrying out drying, impregnating and coating operations on flexible strip and web material, such as insulated wire, wire cloth, paper and textile fabrics.

According to the present invention, material is passed from the atmosphere through a liquid seal (preferably mercury) and communicating with a vacuum chamber, so that air and gases may be removed from the strip. The vacuum chamber is associated with one side of a liquid seal having a coating and impregnating liquid.

The surface of this liquid may be exposed to the atmosphere so as to permit the sucking up of the liquid. In this manner the strip material is passed directly from the vacuum into the liquid and carried underneath the surface of the liquid so as to be subjected to a pressure difference depending upon the amount of vacuum and the depth of immersion below the exposed surface of the coating or impregnating and sealing liquid. The strip material then passes upwardly through the liquid seal and into either the same chamber, to another vacuum chamber, or to a pressure chamber, depending upon details to be pointed out.

The coating or impregnating material to be applied to the strip is carried in a container open to the atmosphere which enables the replenishing of the fluid without destroying the vacuum or interfering with the continuity of the process. Hydrostatic liquid columns are maintained between the liquid in this container and the chamber or chambers so that the strip material may pass continuously through the coating bath without affording any opportunity for the absorption of air or gases by the vacuum treated material. The strip material may be subjected to liquid pressures of varied amounts, depending upon circumstances as will be pointed out hereafter.

After the material has passed through the impregnating and coating solution, it is taken to a chamber at a pressure other than atmospheric, and in this chamber it may be heated and dried either under pressure or vacuum, as occasion requires. The material is then passed through another liquid seal, preferably employing mercury, to compensate for the pressure difference between this second chamber and the atmosphere and to permit the continuous operation of the process by which the strip is passed back to the atmosphere.

The accompanying drawings show diagrammatically several of the possible embodiments in which the present invention may take form, it being understood that the drawings are illustrative of the invention rather than limiting the same.

In these drawings:
- Figure 1 is a diagrammatic sectional view through one form of apparatus employing vacuum in both chambers;
- Figures 2 and 3 show fragmentary diagrammatic views through slightly modified forms of apparatus, also employing vacuum throughout;
- Figure 4 is a diagrammatic view of a modified form of apparatus employing pressure in the 15 second chamber; and
- Figure 5 is a fragmentary view of a modified form of pressure impregnating apparatus.

The material to be coated may be brought in directly from the machine in which it is made or which applies earlier treatments to it, or it may, as shown in Figure 1, be withdrawn from a reel 10. The strip or web W may then pass through a tensioning device 11 and through pressure finishing rolls 12 and 13. These rolls may be driven, if desired, and may or may not be heated according to the particular process employed.

The strip W then passes over a guide roller 14 and is led down underneath a guide roll 16 in a seal S. This guide roller is supported on guide brackets indicated at 16 permanently supported in any desired manner. A suction tube 18 has its lower end adjacent the roller 16 and extends upwardly through the bottom wall 19 of a vacuum chamber 20. The guide roller 18 is adapted to be submerged in a vertically movable container 21 supported on a vertically adjustable pedestal, such as an hydraulic jack 22 under the control of a three way valve 23.

When the container 21 is in the lower or dotted position, it is below the guide roller 18, so that the web or strip may be passed about this roll. This container 21 is adapted to receive a sealing liquid preferably of an inert nature. Usually mercury M is employed. The amount of mercury employed is such that, when the container 21 is in the elevated position, the surface of the mercury is slightly above the lower end of the tube 18.

The strip W passes from the guide roller 15 up into the left compartment 26a of the vacuum chamber 20, and about guide rollers 24 and 25 in the vacuum chamber, and then passes downwardly through a suction tube indicated at 30. The lower end of this tube extends into a container 31.
adapted to contain the coating- or impregnating liquid. This tube is permanently supported in place, as also is a guide roller 32, this guide roller being adapted to receive the strip after it passes beneath the roller tube 33 placed on the other side of the guide roller 32 so that the material W may pass up from the guide roller 32 to again enter the right compartment of the vacuum chamber 20. The liquid container 31 is carried on a vertically adjustable pedestal, such as an hydraulic jack 32', and may be lowered to the dot and dash line position or raised to full line position by a three way control valve indicated at 34. When it is in the upper position, the surface of the liquid 35 in this container is above the lower ends of the tubes 30 and 33. It will, of course, be understood that the column of liquid supplied will be sufficient to keep the lower ends of the tubes sealed when the suction is applied.

The upwardly moving material passes between a guide roller 36 and a guiding roller 37 in the compartment 20b and then over a guide roller 38. It is then directed downwardly through a tube 39 and mercury seal S', similar to the tube 18 and mercury seal S' at the left. This mercury seal may be raised and lowered by a control valve 41. The material is taken from this seal and passed into winding or rolling mechanism of any desired type.

In Figure 1 the guide rollers 24 and 25 are shown in one compartment 20a of the vacuum chamber, and the guide rollers 37 and 38 are shown in the other compartment 20b of the vacuum chamber. This is largely a matter of convenience, depending upon the particular material being operated upon and whether or not it is desirable to maintain a water connections from the air pump 50 to the vacuum chamber, or to employ two vacuum pumps so as to facilitate recovery of volatile materials.

When one desires to thread the material W through the apparatus, the hydraulic jack 32' is raised on a vertically adjustable pedestal, such as an hydraulic jack 32', and may be lowered to the dot and dash line position or raised to full line position by a three way control valve indicated at 34. This acts to force the coating material into the interstices of the fabric and insure a much heavier and more uniform coating than would be possible with pressure alone, especially when there has been no evacuating of the vacuum chamber. The flexible strip material is then carried up through the coating material, the excess coating material squeezed off and the strip or web subjected to heat in the vacuum chamber to drive off volatile matter thereby leaving a heavy uniform load of impregnating material or a coating which is very intimately combined with the strip material to be coated, has a high degree of uniformity and other desirable properties. The cured or dried material is then passed out of the apparatus through the neutral liquid seal S' where it may be wound or stored in any desired manner.

In the modified form of construction diagrammatically illustrated in Figure 2, the layout of the apparatus is generally the same as that shown in Figure 1. The strip W passes through an inlet seal S' and is carried about rollers 51 and 52 in the vacuum chamber. It then passes upwardly through a passage 53 and passes about a roller 54 mounted at a high elevation. The material W then passes about a fixed roller 55 similar to the roll 32 and adapted to be immersed in a tank 66 similar to the tank 31. The material then passes about another elevated roller 56 and then downwardly into the compartment 20c having the rollers 55 and 66 and is carried out through the vacuum seal S'.
taining guiding rollers 101 and 102. This chamber is connected to an exhaust pump 103, as indicated. The container for the impregnating liquid is indicated at 105. This container may be similar to the container 31 and is mounted on a vertically adjusted pedestal, as before described. A cover 106 is clamped or bolted to the top of the container 105 and tubes 107 and 108 extend upwardly from this cover.

The tube 107 leads to the vacuum chamber 100, while the tube 108 leads to the pressure chamber 109. A stand pipe 110 is connected to the cover 106, as indicated, and this stand pipe permits replenishing the supply of liquid in the container 105 without opening up the container.

Pressure is maintained in the chamber 109 by an air pump 111. This chamber carries guide rollers 112 and 113 and a squeegee roller 114, similar to the corresponding parts shown in Figure 1. Directly underneath the roller 113 is an exit tube 116 leading below the surface of the liquid in an exhaust seal 117". This seal is substantially the same as the seal 118", but is provided with a riser 119 into which the fluid (mercury) may be forced when the pressure is applied in the pressure chamber.

In this form of construction the positive pressure applied in the chamber 109 will force the fluid down in the tube 108, while the suction of chamber 100 will suck it up in the tube 107. There will thus be a total difference of pressure in the fluid equal to the total of the vacuum and pressure. There will, of course, be added pressure where the material passes under the guide roller in the pressure tank 105.

When the apparatus is arranged as shown in this figure, the evacuated material will be subjected to coating material at higher pressure (and at higher temperature if desired) than would be the case where vacuum only was employed. The material passing into the pressure chamber may be completely dried under pressure in the pressure chamber or it may be carried out through the exit seal and subjected to air drying.

Figure 5 shows a modified form of pressure treating apparatus devised to overcome the large sizes which would be necessary in the arrangement shown in Figure 4. In this former arrangement the column lengths would be very large.

In Figure 5 the reference characters 107' and 108' indicate tubes similar to the tubes 107 and 108 of Figure 4 and interposed in the system in the same manner. Instead of connecting these tubes to a container for the impregnating liquid, they are connected to a mercury container 120. Impregnating liquid is placed in each column, as indicated in the drawings. To permit the introduction of the liquid into the suction column a container 121 and valve 122 may be employed. The suction will draw the liquid into the column whenever necessary. The liquid supply for the column 108 is carried in a tank 123 having a drain pipe 124 and valve 125 to control the flow into the pipe or tube 108'. The upper part of the container is connected to the pipe 108' by a pipe 126 and thereon to the vacuum chamber 127. The lower part of the pipe valve opens into a filling tube or funnel 128.

When one desires to insert a supply of liquid into the tank 123, the valve 125 is closed and the valve 127 adjusted to close communication with the pipe 126 and to open the tank to the atmosphere. This can be done, and then the valve 126 closed to shut off communication with the atmosphere and then to admit air from the pipe 126. The valve 125 may then be opened to allow the liquid to drain into the liquid column as necessary.

The present invention is particularly devised for the treatment of typewriter ribbons. In the ordinary process of coating typewriter ribbons now in use, there is a lack of pigment and a very long delay between the time that the material is applied to the ribbons and the time when it is sufficiently cured to permit marketing the finished product. By employment of the present process it is possible to obtain a real impregnating action producing a heavier and greater pigment content than where coated by the present state of art, and the finished and cured material is available in a much shorter time.

It will be understood that the drawings are intended to diagrammatically illustrate forms of apparatus by which the process can be carried out. The details of construction are omitted for the sake of simplicity.

What is claimed is:

1. Apparatus for continuously coating, impregnating and heat treating a fabric strip, comprising a vacuum chamber through which the strip is passed under reduced pressure, a liquid seal open to the atmosphere for sealing the inlet through which the strip is brought into the chamber, a second liquid seal open to the atmosphere for sealing the outlet through which the strip is withdrawn, a container adapted to contain the liquid to be applied and open to the atmosphere, impregnating liquid in the container, the vacuum chamber being in communication with the container below the surface of the liquid therein whereby a column of liquid is maintained, and means to direct the strip from the vacuum chamber through the liquid column into the container and to continue it to the vacuum chamber, whereby the strip is first subjected to the vacuum to remove air and gases, then to the impregnating liquid and to gradually increased pressure up to pressure above atmospheric and then continued to the vacuum for heat treating.

2. Apparatus for continuously coating, impregnating and heat treating a fabric strip, comprising a vacuum chamber through which the strip is passed under reduced pressure, a liquid seal open to the atmosphere for sealing the inlet through which the strip is brought into the chamber, a second liquid seal open to the atmosphere for sealing the outlet through which the strip is withdrawn, a container adapted to contain the liquid to be applied and open to the atmosphere, impregnating liquid in the container, the vacuum chamber being in communication with the container below the surface of the liquid therein whereby a column of liquid is maintained, and means to direct the strip from the vacuum chamber through the liquid column into the container and to continue it to the vacuum chamber, whereby the strip is first subjected to the vacuum to remove air and gases, then to the impregnating liquid and to gradually increased pressure up to pressure above atmospheric and then continued to the vacuum for heat treating.

3. Apparatus for continuously coating, impregnating and heat treating a fabric strip, comprising a vacuum chamber through which the strip is passed under reduced pressure, a liquid seal open to the atmosphere for sealing the inlet
through which the strip is brought into the chamber, a second liquid seal open to the atmosphere for sealing the outlet through which the strip is withdrawn, each of said seals comprising
a stationary guide, a tube extending from adjacent the guide to the vacuum chamber, and a movable container for sealing liquid adapted to receive the guide and lower end of the tube and to be raised and lowered, a similarly movable container adapted to contain the liquid to be applied and open to the atmosphere, liquid in the container, the vacuum chamber being in communication with the last mentioned container below the surface of the liquid wherein whereby a column of liquid is maintained, and means to direct the strip from the vacuum chamber through the liquid column into the last mentioned container and to continue it to the vacuum chamber, whereby the strip is first sub
ject to the vacuum to remove air and gases, then to the impregnating liquid and to gradually increased pressure up to pressure above atmosphere, and then continued to the vacuum for heat treating.

4. Apparatus for continuously coating, impregnating and heat treating a fabric strip, comprising a vacuum chamber having two compartments through which the strip is passed under reduced pressure, a liquid seal open to the atmosphere for sealing the inlet through which the strip is brought into the first compartment, a second liquid seal open to the atmosphere for sealing the outlet through which the strip is withdrawn from the second compartment, each of said seals comprising a stationary guide, a tube extending from adjacent the guide to the vacuum chamber, and a vertically movable container for sealing liquid adapted to receive the guide and lower end of the tube, a container adapted to contain the liquid to be applied and open to the atmosphere, liquid in the container, each of the compartments of the vacuum chamber being in communication with the last mentioned container below the surface of the liquid wherein whereby the liquid is sucked up to maintain an hydrostatic column, and means to direct the strip from the first compartment through the liquid column into the last mentioned container and to continue it to the second compartment, whereby the strip is subjected to the vacuum to remove air and gases, then to the liquid under gradually increased pressure up to pressure above atmospheric, and then continued to the vacuum for heat treating.

5. Apparatus for continuously drying web material comprising a vacuum chamber through which the web is passed, said chamber being in communication with a plurality of liquid seals, one open to the atmosphere for sealing the inlet through which the web is brought into the chamber, a second seal open to the atmosphere for sealing the outlet through which the web is withdrawn, and an intermediate dual seal open to the atmosphere at one side and in communication with the vacuum chamber and through which the web is passed, each of said seals comprising stationary web guiding means, a liquid container, and means to raise and lower the container.

6. In drying, impregnating, coating apparatus and the like, a vacuum chamber, a liquid container open to the atmosphere, liquid in the container, the vacuum chamber being in communication with the container below the surface of the liquid wherein whereby the liquid is sucked up to maintain an hydrostatic column, means to guide a strip of material from the vacuum chamber down through the liquid, below the surface of the liquid, to submit it to a pressure corresponding to height of liquid column seal above the material and to guide the strip back into the vacuum chamber, and means to raise and lower the container.

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