Aug. 2, 1938. F. A. WALDRON 2,125,364

APPARATUS FOR DRYING AND IMPREGNATING

Original Filed Feb. 18, 1930 3 Sheets-Sheet 1

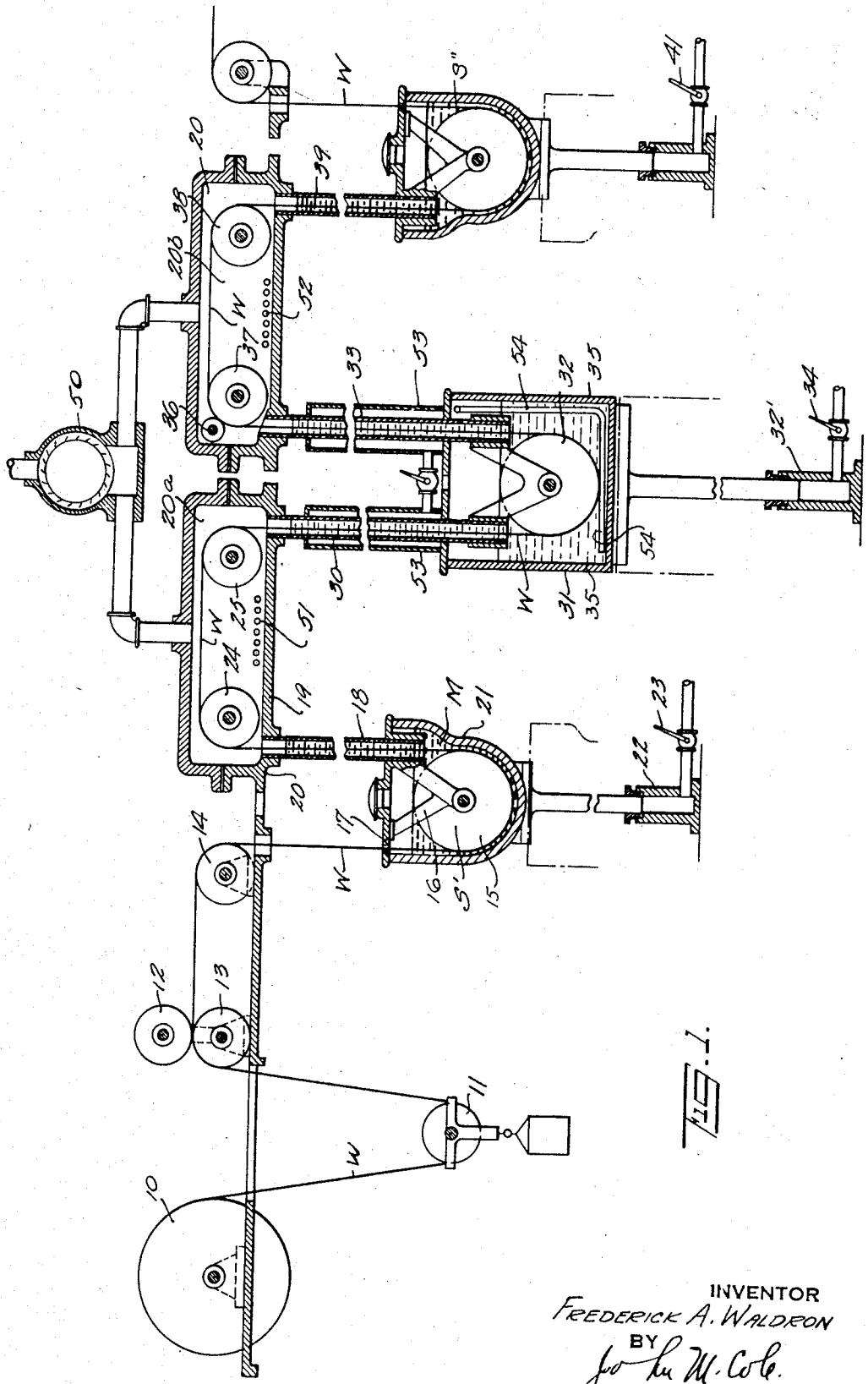

FIG. 1.

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Original Filed Feb. 18, 1930 3 Sheets-Sheet 2

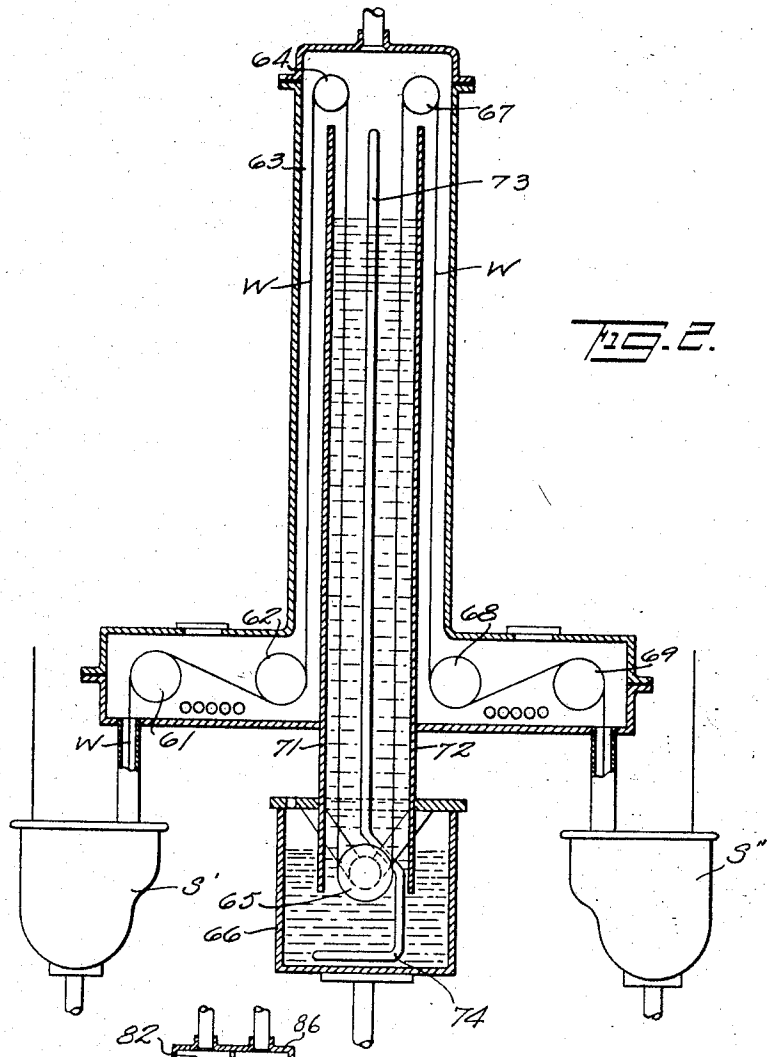

FIG. 2.

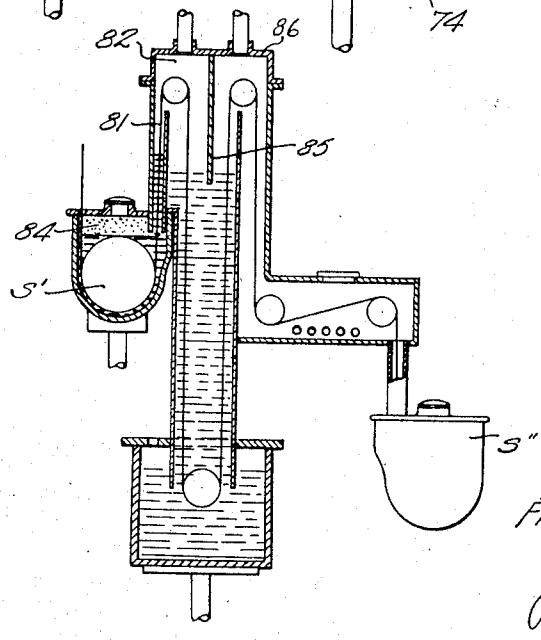

FIG. 3.

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APPARATUS FOR DRYING AND IMPREGNATING

Original Filed Feb. 18, 1930 3 Sheets-Sheet 3

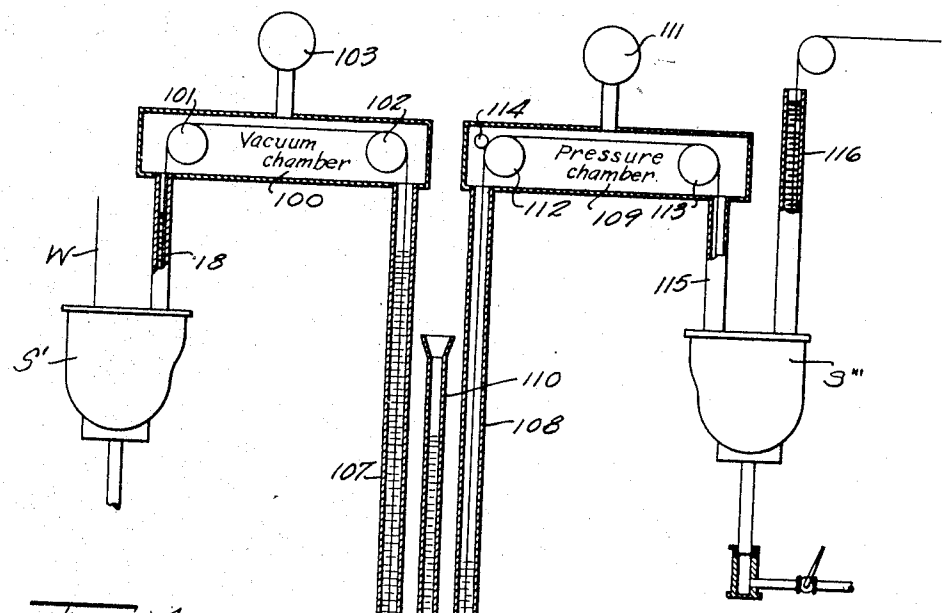

FIG. 4.

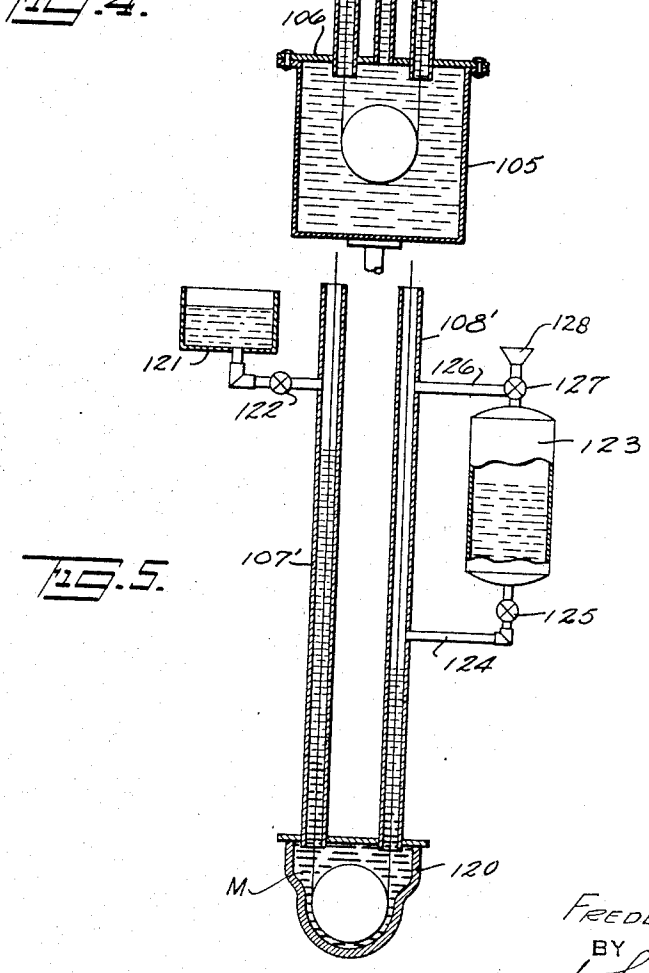

FIG. 5.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR DRYING AND IMPREGNATING

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Renewed December 22, 1937

6 Claims. (Cl. 91—55)

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 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 15 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 15 and extends upwardly through the bottom wall 19 of a vacuum chamber 20. The guide roller 15 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 15, 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 20a 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 is also a guide roller **32**, this guide roller being adapted to receive the strip after it passes beyond the tube **30**. Another tube **33** is placed on the other side of the guide roll **32** so that the material W may pass up from the guide roll **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 squeeze roll **36** and a guiding roll **37** in the compartment **20***b* and then over a guide roll **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 passes into winding or reeling mechanism of any desired type.

In Figure 1 the guide rollers **24** and **25** are shown in one compartment **20***a* of the vacuum chamber, and the guide rollers **37** and **38** are shown in the other compartment **20***b* 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 separate 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 jacks are operated to lower all the liquid seals. This operation is carried out without disturbing the mounting of the guide rollers. The material is threaded through the machine and then the hydraulic jacks operated to raise the liquid containers and immerse the guide rollers and lower the ends of the suction tubes. Suction is then applied and this will cause mercury or other liquid to rise up in the end seals and will cause the coating material in the container **31** to be sucked up into the columns **30** and **33**. The height of these columns will depend upon the degree to which the chamber is exhausted and the specific gravity of the liquid employed.

As the fluid in the tank **31** is open to the atmosphere, it will be apparent that the supply of coating material may be replenished without stopping operations. The pressure difference between the coating fluid and the vacuum chamber may be atmospheric pressure or greater, depending upon the degree of vacuum and the depth to which the material W is submerged in the tank. In some processes it would be desirable to apply heat in the compartment **20***a* and for this purpose steam coils **51** are shown. Similarly, steam coils **52** may be placed in the compartment **20***b* to assist in driving off the moisture and volatile material. The tubes **30** and **33** may be steam jacketed, as indicated at **53**, and a steam coil **54** may be placed in the tank **31**, if desired.

It will be noted that in carrying out this process the material, whether a strip of covered wire, paper, or textile fabric, is first passed through neutral seal of mercury, after which it passes into a heated vacuum chamber which removes the occluded air and gases from the strip. It is then subjected to gradually increasing pressure in the coating liquid until a pressure above atmospheric is reached. 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 had been no evacuating of air. 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 the 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. Here the strip W passes through an inlet seal S' and is carried about rollers **61** and **62** in the vacuum chamber. It then passes upwardly through a passage **63** and passes about a roller **64** mounted at a high elevation. The material W then passes about a fixed roller **65** 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 **67** and then downwardly into the compartment having the rollers **68** and **69** and is carried out through the vacuum seal S''.

In this form of construction the impregnating and coating material is sucked up into one large tube formed by the walls **71** and **72** which also form walls of the vacuum chamber as will be obvious. This arrangement may be found more convenient in certain installations as it does not require elevating the vacuum chambers so far above the support for the liquid container. The coating material may be heated by a steam pipe indicated at **73** and a steam coil **74**.

In the form of construction diagrammatically illustrated in Figure 3, the admission seal is indicated at S'. The suction tube **81** from the seal extends upwardly into the upper part of the vacuum chamber **82**. The strip is passed about the rollers as indicated and is taken out through the exhaust seal S''. This figure indicates a washing or preliminary treatment bath at **84**. This floats on the mercury in the seal and may act to clean the material as it passes through the bath. In order to separate the gases in the two sides of the vacuum chamber, a baffle **85** is supported from the cover **86**, as indicated. This baffle is adapted to pass down between the sides of the loop of fabric passing through the machine, and to enter into the liquid sucked up into the liquid column, as indicated.

Figure 4 shows a modified form of apparatus and a modified process wherein the material passes from the impregnating and coating solution into a pressure chamber instead of into a vacuum chamber. In this figure the admission seal is indicated at S'; the seal and suction tube **18** may be the same as previously described. The flexible material is passed through this liquid seal into a vacuum chamber **100**, similar to the compartment **20***a* shown in Figure 1 and con-

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 squeeze roller 114, similar to the corresponding parts shown in Figure 1. Directly underneath the roller 113 is an exit tube 115 leading below the surface of the liquid in an exhaust seal S'''. This seal is substantially the same as the seal S'', but is provided with a riser 116 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 were 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 three way valve 127. The other side of this 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. The liquid is poured in 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, 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, and means to support the liquid holders of the seals and the impregnating liquid container so that they may be raised or lowered without disturbing the guiding means for the strip.

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 therein 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 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.

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 therein 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 therein 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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