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Farrar

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[54] **VACUUM IMPREGNATING APPARATUS FOR TREATING WEBS**

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[73] Assignee: **Sir James Farmer Norton & Co., Limited**, Manchester, England

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **68/19.1**, 68/20, 68/22 R, 68/205 R

[51] **Int. Cl.** **B05c 5/02**, B05c 9/08

[58] **Field of Search** ..... 68/19, 19.1, 22 R, 68/205 R, 181 R, 20

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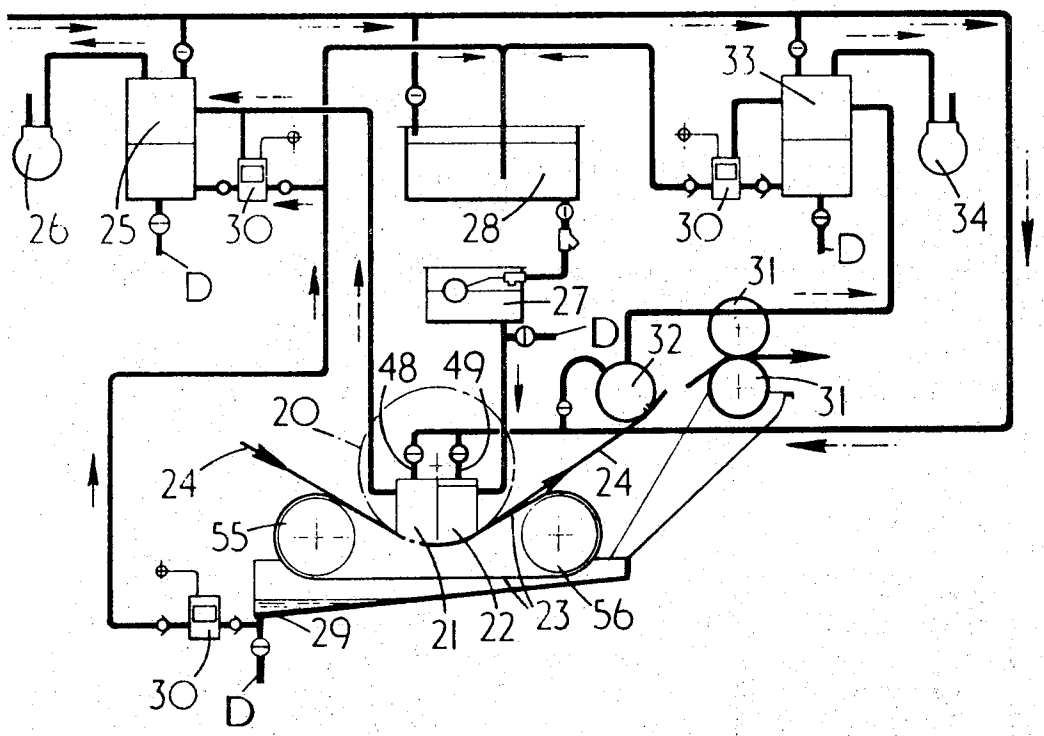
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Assistant Examiner—Philip R. Coe
Attorney—Richard C. Sughrue et al.

[57] **ABSTRACT**

A vacuum impregnating apparatus in which cloth is passed firstly past a vacuum unit which removes air from the cloth interstices. The evacuated cloth immediately being presented to an impregnation unit which delivers impregnating liquid into the evacuated cloth. The impregnated cloth is then subjected either to the action of a squeezing nip or suction unit to remove excess impregnating liquid.

17 Claims, 12 Drawing Figures



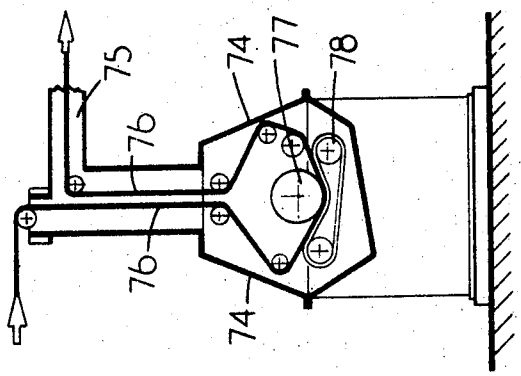


FIG. 9

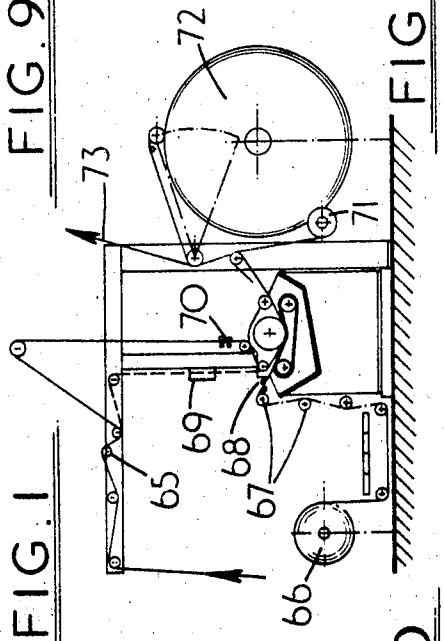


FIG. 8

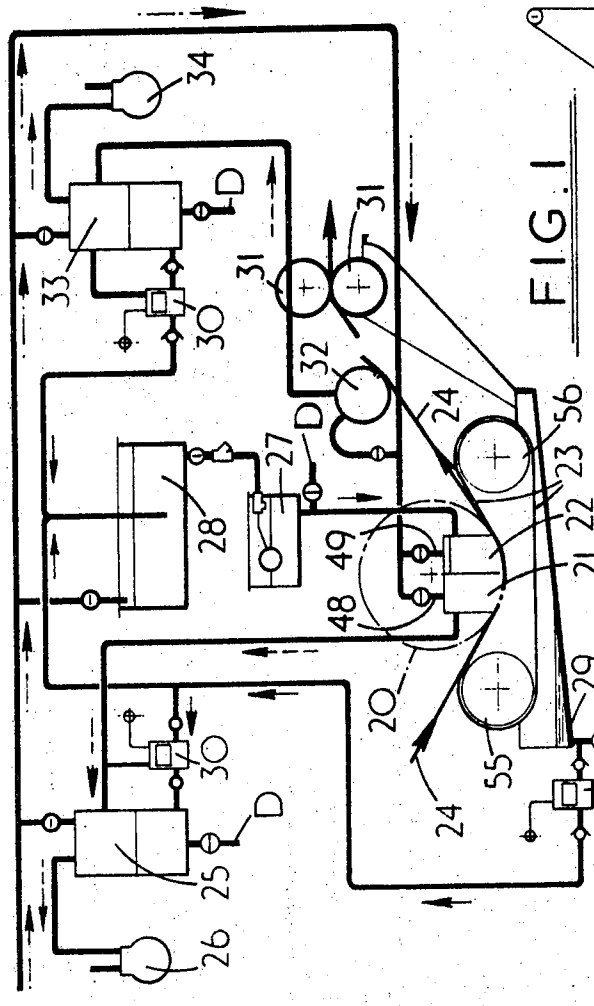


FIG. 1

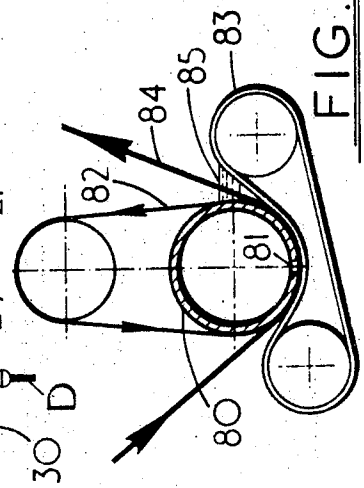


FIG. 10

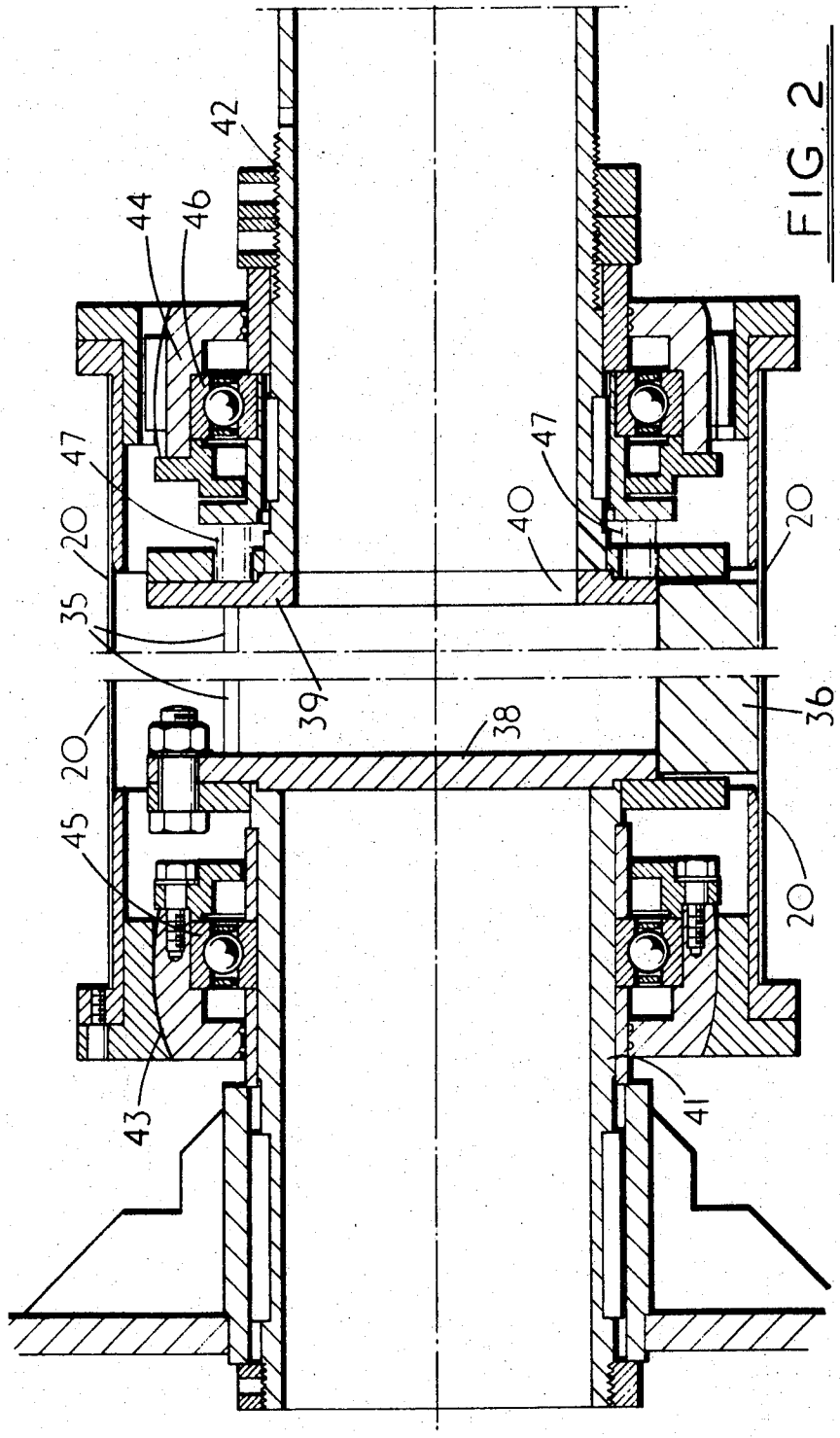


FIG. 2

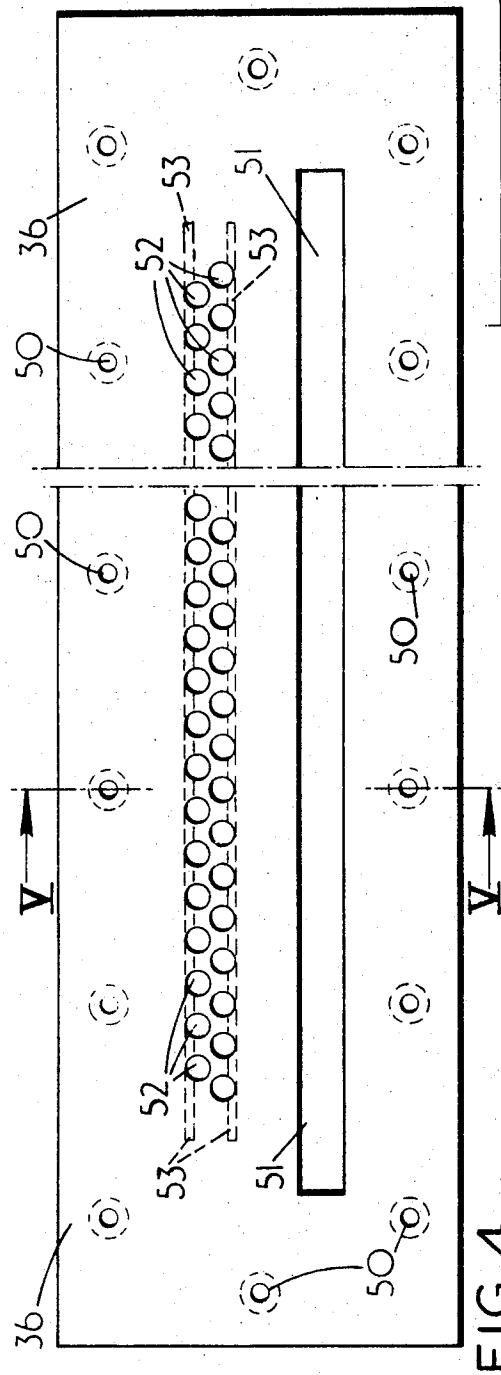


FIG. 4

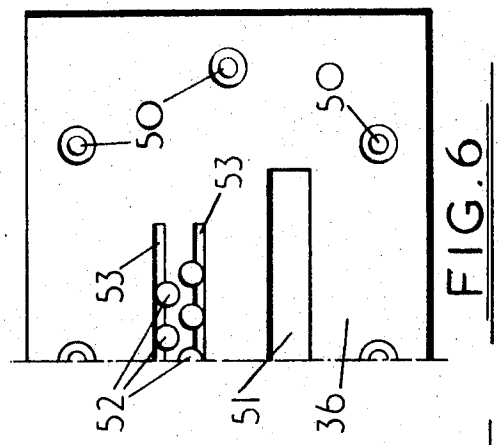


FIG. 6

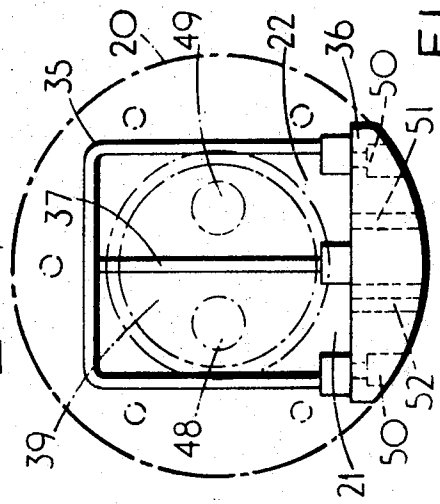


FIG. 3

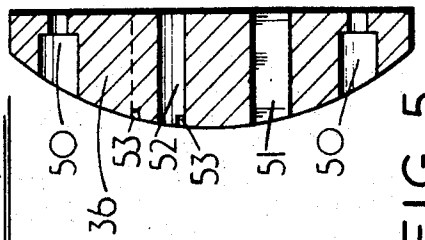


FIG. 5

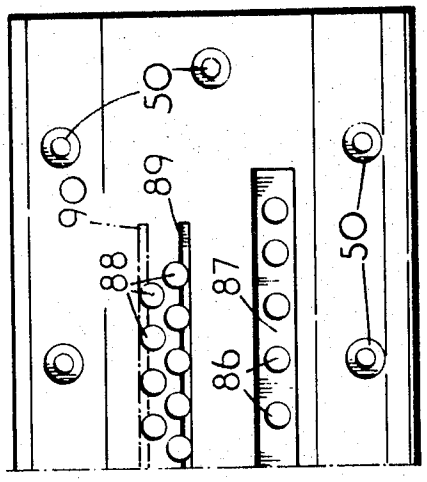


FIG. 12

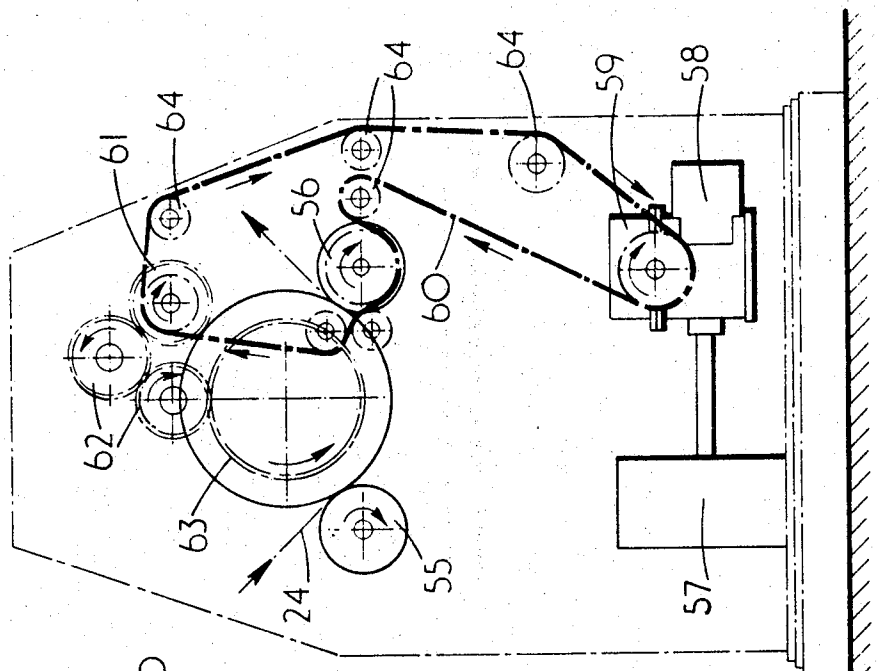


FIG. 7

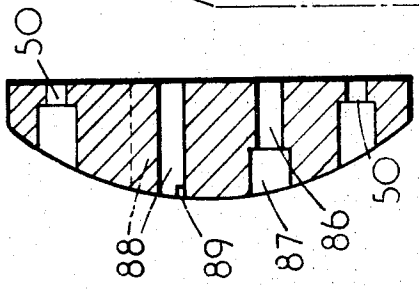


FIG. 11

VACUUM IMPREGNATING APPARATUS FOR TREATING WEBS

This invention relates to apparatus for treating textile and other webs with liquids and/or fluids. Such liquids and/or fluids may be inter alia, bleaching chemicals, dyestuffs, and/or finishing compounds.

The present invention is particularly concerned with apparatus for impregnating textile and other webs with such liquids and/or fluids.

Hitherto with conventional methods of impregnation which, for the most part, comprise immersing the web in a tank containing a treating liquid followed by squeezing between a pair of rolls, it has been impossible to obtain the desired complete saturation of the webs by the treating liquid. To assist liquid absorption of pick-up webs have been previously prepared by scouring to render them absorbent. When webs are not properly or uniformly or levelly prepared across the width, not only has it been found difficult to force liquor into the web but the degree of absorption of the liquor by the web frequently varies across the width with the result that the appearance of the web is not uniform.

The present invention provides apparatus which increases the absorption of treating liquid and/or fluid into webs and in consequence which obviates or mitigates the need for previous scouring and preparation in many cases, and further which ensures at the same time a perfectly uniform or level saturation and therefore uniform or level effect on the web across its width.

According to the present invention there is provided apparatus for use in the impregnation treatment of a textile or other web with a liquid and/or a fluid, the apparatus comprising a vacuum chamber having a slot or other opening past which a web can be moved, an impregnation bath immediately after the vacuum chamber, and an impervious, vacuum-sealing belt, band or the like for moving the web past the vacuum slot in close contact therewith and past or through the impregnating bath.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of an impregating apparatus according to the present invention;

FIG. 2 is a fragmentary sectional view of a cylindrical screen and its mounting and within which the vacuum chamber and impregnating bath are disposed;

FIG. 3 is a sectional end view of the vacuum chamber and impregnating bath within the cylindrical screen;

FIG. 4 is a plan view of a wearing member disposed within the cylindrical screen and providing vacuum slots or openings and impregnating medium outlets;

FIG. 5 is a section on the line V—V of FIG. 4;

FIG. 6 is a fragmentary underneath plan view corresponding to FIG. 4;

FIG. 7 is a diagrammatic view of the drive of the apparatus;

FIG. 8 shows an example of an entry and exit arrangement for the apparatus;

FIG. 9 is a diagrammatic view of an apparatus according to the invention when it is to be used with solvent liquors;

FIG. 10 is a diagrammatic view of another modified apparatus;

and,

FIGS. 11 and 12 are a sectional view and a fragmentary underneath plan view of a modified wearing plate.

Reference is made firstly to FIG. 1 of the drawings.

The apparatus comprises basically a cylindrical porous metal screen **20** in which is housed a wetting-out unit consisting of a vacuum box **21** and a liquor box **22** serving as an impregnation unit, and a rubber or other elastomeric endless belt **23** impervious to the treating liquor.

The textile web or cloth which is to be impregnated is indicated at **24.**

The web **24** is transported through the wetting-out unit between the porous metal cylinder or band **20** and the rubber belt **23.** The web **24** which is trapped between the cylinder **20** and the rubber belt **23** passes successively under a vacuum slot and the outlets of the liquor box **22.** The web **24** is not subjected to any tension or drag from the suction slot due to the fact that the cylinder **20** and the belt **23** are driven.

It will be manifest that the rubber belt **23** provides an effective seal to obviate or mitigate loss of vacuum.

The suction circuit is indicated by dotted arrows and comprises the vacuum box **21,** a high vacuum receiver **25** and a high vacuum pump **26.**

The liquor circuit is indicated by full arrows and comprises the liquor box **22,** a liquor level trough **27** which, in use, is at the same level as the liquor box **22,** a liquor supply tank **28** fed from mixing tanks (not shown) and a drip trough **29.**

Pumping traps for the suction and liquor circuits are indicated at **30.**

A washing circuit is also provided for the apparatus and is indicated by dot-dash arrows. This circuit uses, say, hot water and serves to wash out the receiver **25,** the supply tank **28,** the liquid level trough **27** and the liquor box **22** and vacuum box **21.**

After impregnation the web **24** is subjected to means for removing excess liquor. Such extraction means may be either a squeezing nip **31** or suction extraction. In the latter case, there is a suction box **32** with an appropriate slot which is connected to a suction receiver **33** and a suction pump **34.** The suction box **32** and receiver **33** are connected to the washing circuit.

In either case excess liquor is returned to the storage tank **28.**

Any liquor which is drawn into the high vacuum line is trapped and pumped into the storage tank **28.**

The above-described apparatus is a recirculatory apparatus. Where the apparatus is to be used with liquors unsuitable for recirculation, the storage tank **28** is omitted and the liquor level trough **27** is fed directly from mixing tanks (not shown). Also drains are provided at locations D, the piping between two of these locations and the drip trough **29** and the trough **27** respectively being omitted.

The wetting-out unit will now be described in greater detail.

The unit comprises a tube **35** closed at its bottom by a high density polyethylene wearing plate **36** and subdivided internally by a partition **37** to define the vacuum box **21** and the impregnation box **22.** The tube **35** is closed at one end by a plate **38** and at its other end abuts a plate **39** formed with an opening **40.**

The plates **38** and **39** are secured respectively to stationary tubes **41** and **42** of the machine. Surrounding each tube **41** or **42** is a rotatable annular mounting **43,** or **44** there being a bearing **45** between tube **41** and annular mounting **43** and a bearing **46** between tube **42**

and annular mounting **44.** The annular mountings **43** and **44** have secured thereto the ends of the porous metal cylinder **20** which is constituted of very thin flexible mesh material, for example electrically-deposited pure nickel with a mesh size of, for example, between **25** mesh and **100** mesh. These mesh sizes are non-limitative as it appears unlikely that the mesh size is critical.

The annular mounting **43** and bearing **45** are position stationary while the annular mounting **44** and bearing **46** are axially movable relative to the tube **42** under the action of springs **47** between the plate **39** and the mounting **46** to ensure tensioning of the cylinder or band **20.**

The vacuum circuit is connected to the vacuum box **21** by convenient piping **48** and the liquor circuit is connected to the impregnation box **22** by convenient piping **49.**

The wearing plate **36** is most important and is provided with a series of holes **50** for securing it to the tube **35** by bolts or studs (not shown). The impregnation box outlet is constituted by an elongate slot **51.** This construction ensures that there is uniform application of the treating liquor to the web or cloth **24** thus avoiding "spotting", i.e., non-uniform application of the treating liquor. The suction slot or opening is constituted by two parallel rows of staggered holes **52** with the bottom ends of the holes **52** in each row being connected by an elongate slot **53.** The provision of these slots **53** ensure uniform removal of the air from the cloth or web **24** thus avoiding "striping" on the cloth or web.

The spacing between the vacuum holes **52** and slots **53** and the impregnation slot **51** is small, say between one and two inches and preferably one and a half inches. It is important that this distance be as small as possible to ensure that no air or as little air as possible enters the evacuated interstices of the web of cloth **24** before entry of the treating liquor.

In a modified wearing plate (FIGS. **11** and **12**), the impregnation box outlet is constituted by a series of holes **86** communicating with an elongate slot **87,** while the vacuum or suction slot is constituted by two parallel rows of staggered holes **88** with the bottom ends of the holes **88** in the row adjacent the vacuum holes **86** being connected by an elongate slot **89.** The holes **88** in the other row may also be connected by an elongate slot **90** (shown in phantom line).

It is appropriate to mention here that the impervious endless belt **23** passes round two rollers or drums **55** and **56,** the roller or drum **56** being driven as hereinafter described and the roller or drum **55** being mounted so as to apply a tension to the belt **23.** This mounting may conveniently be a pair of arms carrying the roller **55,** the arms being pivotal to effect the tensioning. Alternatively, the roller **55** may be mounted on a slide arrangement.

The apparatus drive arrangement is illustrated in FIG. **7** of the drawings. The prime mover is an electric motor **57** with speed reducer **58** whereof the output sprocket **59** drives, via a belt or chain **60,** the roller **56.** The belt or chain **60** also drives a gearwheel **61** which through a gear train **62** rotates a large-diameter gearwheel **63** fast with the cylindrical screen assembly **20.** Guide rolls or sprockets for the belt or chain **60** are indicated at **64.**

Various entry and exit arrangements may be used with the apparatus, for example, entry from wagon or batch and exit to plaiter or batch or predryer or other machine.

A convenient but non-limitative entry and exit arrangement is shown in FIG. **8.**

The entry arrangement comprises entry rails **65,** an entry batch **66,** scroll and tracking rolls **67,** uncurlers **68,** driven openers **69,** and cloth guider **70.** These entry arrangement components are not all used together but are optional depending on the kind of material being treated.

The exit arrangement comprises a delivery batch **71,** a giant batch **72** or a feed **73** to other machines.

In use a web or cloth **24** is fed through the wetting-out unit where it is successively evacuated of air and immediately impregnated with treating liquor as aforesaid, excess moisture being thereafter removed by the suction slot or squeezing nip.

This apparatus allows total saturation or "liquor-logging" of the web or cloth with many advantages, viz:

1. Dyeing — Levelness and uniformity of shade (in some instances stronger shade than normal padding.) Freedom from skitteriness or "frostiness." Complete penetration.

Easy impregnation of water-repellent or hydrophobic fibres, e.g., synthetic fibres.

Many unscoured fabrics, especially knitted cottons, can be dyed as well as if they had been scoured. (But it is necessary to confirm that size and impurities do not interfere with the dyeing or fixation process).

Elimination of the seam line apparent on circular knit goods pad-dyed conventionally.

2. Bleaching.

By vacuum impregnating the bleach liquor, the same degree of whiteness can be obtained with appreciably less chemical (viz. peroxide) and the reaction time reduced. Vacuum impregnation puts the bleach liquor where it is needed-right in the fibre almost instantaneously.

3. Finishing.

The more uniform and more thorough penetration of resin into the fibres improves crease resistance and other such properties.

If the above-described apparatus is used with solvents, it is additionally provided (see FIG. **9**) with hinged covers **74** and a connection **75** to a solvent evaporator. The cloth feed path is indicated at **76** and the porous drum and rubber belt at **77** and **78** respectively.

An alternative construction of apparatus is diagrammatically shown in FIG. **10** and comprises a vacuum chamber or tube **80** connected to a high vacuum pump (not shown) and having in its wall a vacuum slot **81.**

An endless belt **82** in the form of a pervious screen passes around the vacuum chamber **80.**

A second endless belt **83** of an impervious nature is located adjacent the vacuum slot **81** with one of its runs passing partially around the vacuum chamber **80** in the region of the vacuum slot **81.** This impervious belt **83** forms with the wall of the vacuum chamber **80** upstream of the vacuum slot **81** in the direction of travel of a web **84** an impregnation treating bath **85,** for example, a dye bath, appropriate side walls (not shown) for the bath being provided.

This impervious belt **83** is of relatively substantial proportions and is provided with propelling means, such as described with reference to FIG. **7.**

In use, all air is evacuated from the web **84** by passing it past the vacuum slot **81** in the wall of the chamber which is, in turn, almost completely evacuated by the high vacuum pump. The web **84** is trapped as it passes past the slot **81** between the two endless belts or bands **82, 83,** the impervious belt **83** serving as a seal to prevent loss of vacuum.

After passing the slot **81** and while still evacuated the web **84** is immersed inthe liquid with which it is desired it should be impregnated. The web **84** from which all air has been evacuated thoroughly absorbs the liquor immediately. It is only necessary thereafter to remove surplus moisture from the web by either passing the web through a pair of conventional squeeze rollers or over a second slot to which suction is applied to withdraw in this case the surplus moisture which has not been absorbed by the fibres of the web. In the event that such a suction device is used for removing the surplus liquor, the surface of the web opposite to the suction slot is open to the air and there is therefore no question of evacuating the web as when passing over the first slot.

The belts need not be endless and the treating bath need not be defined by the vacuum chamber and the impervious belt.

What is claimed is:

1. Apparatus for use in the impregnation treatment of a textile or other web with a liquid and/or a fluid, the apparatus comprising a vacuum chamber having a slot or other opening past which a web can be moved, an impregnation bath immediately after the vacuum chamber, an impervious, vacuum-sealing belt, band or the like for moving the web past the vacuum slot closely adjacent thereto and past or through the impregnating bath, and a porous member disposed immediately adjacent the vacuum chamber and the impregnation bath and between them and the imprevious belt to define with the latter a path for the web.

2. Apparatus as claimed in claim **1,** in which the impregnation bath has an impregnating medium outlet opening on to the porous member between which and the vacuum sealing belt the web can be moved in close contact with said outlet by the vacuum-sealing belt.

3. Apparatus as claimed in claim **1,** in which the porous member is a porous flexible metal cylinder within which is located stationarily in tandem the vacuum chamber and the impregnation bath, whereof the vacuum slot or opening and the impregnation outlet are closely adjacent to one another.

4. Apparatus as claimed in claim **3,** in which the porous metal cylinder houses internally a tube subdivided internally along the axis of the cylinder by a partition to form the vacuum chamber and the impregnation bath and is closed at its bottom by a wearing plate bearing on the internal surface of the cylinder and constituting the bottom of the vacuum chamber and the impregnation bath, the wearing plate being apertured to provide the vacuum opening and the impregnation outlet.

5. Apparatus as claimed in claim **4,** in which the impregnation outlet is defined by an elongate slot.

6. Apparatus as claimed in claim **5,** in which the slot connects the tops of a row of holes formed in the wearing plate.

7. Apparatus as claimed in claim **4,** in which the vacuum opening is defined by two rows of holes in the wearing plate with the holes of one row staggered relative to the holes of the other row and with the bottoms of the holes in one of the rows merging in a elongate slot at their trailing edges in the direction of movement of the web, while the holes in the other row merge in an elongate slot at their leading edges in the direction of movement of the web.

8. Apparatus as claimed in claim **4,** in which the wearing plate is formed of high density polyethylene.

9. Apparatus as claimed in claim **3,** in which the porous metal cylinder is constituted by thin flexible mesh material and is supported at its ends by annular mounting and bearing assemblies, one of which is position stationary and one of which is axially movable by spring means axially to tension the flexible porous cylinder and prevent sag.

10. Apparatus as claimed in claim **3,** in which the vacuum sealing belt extends around an arc of the prous cylinder, the belt being endless and passing around a pair of rollers, one of which is movable for tensioning said belt while the other is driven.

11. Apparatus as claimed in claim **10,** comprising a prime mover driving the belt roller via an endless belt, which belt also drives the porous cylinder via a gear train.

12. Apparatus as claimed in claim **1,** in which the impregnation bath is part of a recirculatory circuit including a liquor supply tank connected to the impregnation bath for feeding liquor to the impregnation bath, a liquor level tank also connected to the impregnation bath to ensure topping up of the latter and a drip through under the impregnation bath and vacuum sealing belt to collect excess liquor, the impregnating liquor being fed gravitationally out of the impregnation bath.

13. Apparatus as claimed in claim **1,** in which the vacuum chamber is connected to a high vacuum pump via a high vacuum receiver.

14. Apparatus as claimed in claim **1,** and further comprising, after the impregnation bath, a squeezing nip to remove excess liquor from the web.

15. Apparatus as claimed in claim **1,** and further comprising, after the impregnation bath, a suction pump connected to a suction box via a suction receiver, which further apparatus serves to remove excess liquor from the web.

16. Apparatus as claimed in claim **1** in which, when the apparatus is used with solvents, the vacuum-sealing belt, porous member, vacuum chamber, and impregnation bath are enclosed in a casing closed by hinged covers, and the casing is connected to a solvent extractor.

17. Apparatus as claimed in claim **1** in which the vacuum chamber is a vacuum tube with a vacuum slot, the porous member is a driven endless pervious belt surrounding the vacuum tube, and the impervious belt arcs around the vacuum tube in the region of the vacuum slot and defines with the wall of the vacuum tube the impregnating bath.

* * * * *