Oct. 10, 1967 JEAN-PIERRE FRANCK 3,346,465

METHOD OF MAKING WIRE CLOTH FOR PAPER MACHINES

Filed Sept. 24, 1963 5 Sheets-Sheet 1

Fig. 1
PRIOR ART

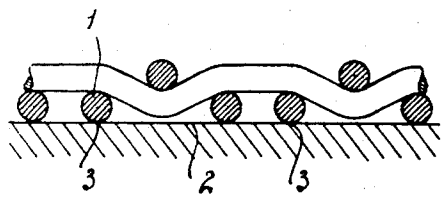


Fig. 2
PRIOR ART

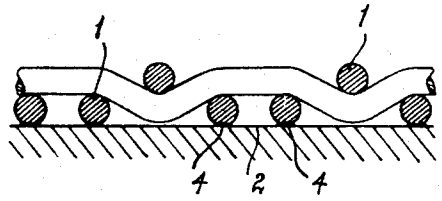


Fig. 3

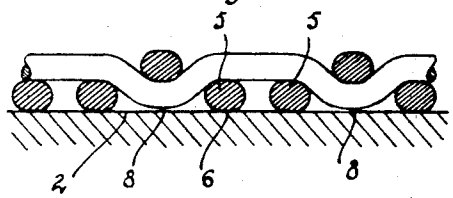


Fig. 4

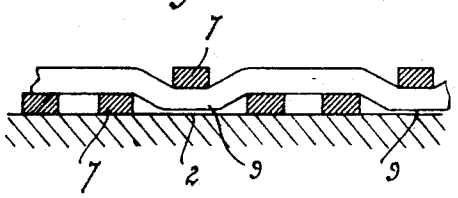
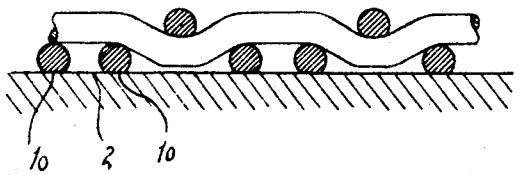


Fig. 5



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METHOD OF MAKING WIRE CLOTH FOR PAPER MACHINES

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Fig. 6

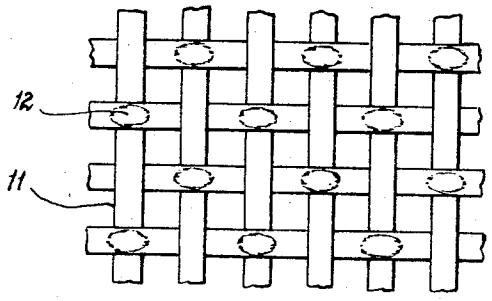


Fig. 7

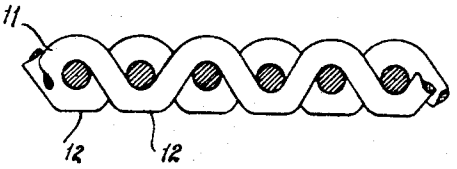


Fig. 8

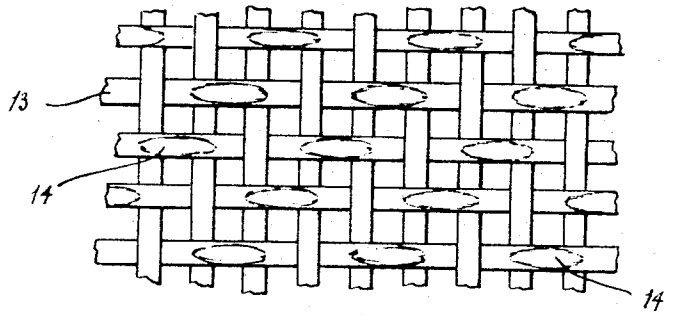
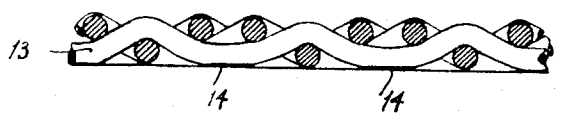


Fig. 9



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METHOD OF MAKING WIRE CLOTH FOR PAPER MACHINES

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Fig. 10

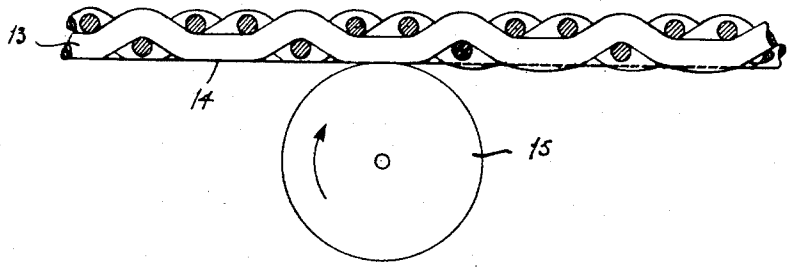


Fig. 11

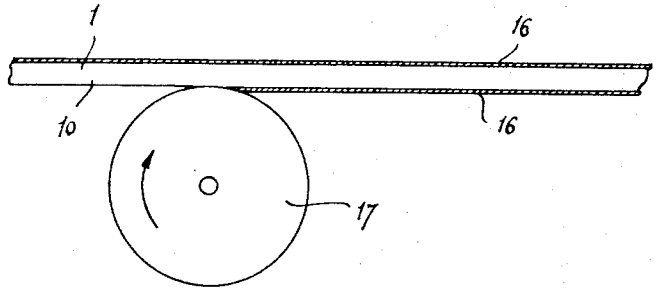
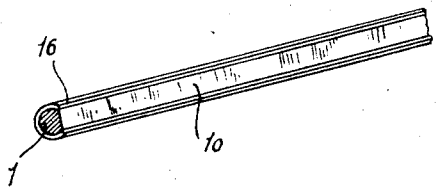


Fig. 12



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METHOD OF MAKING WIRE CLOTH FOR PAPER MACHINES

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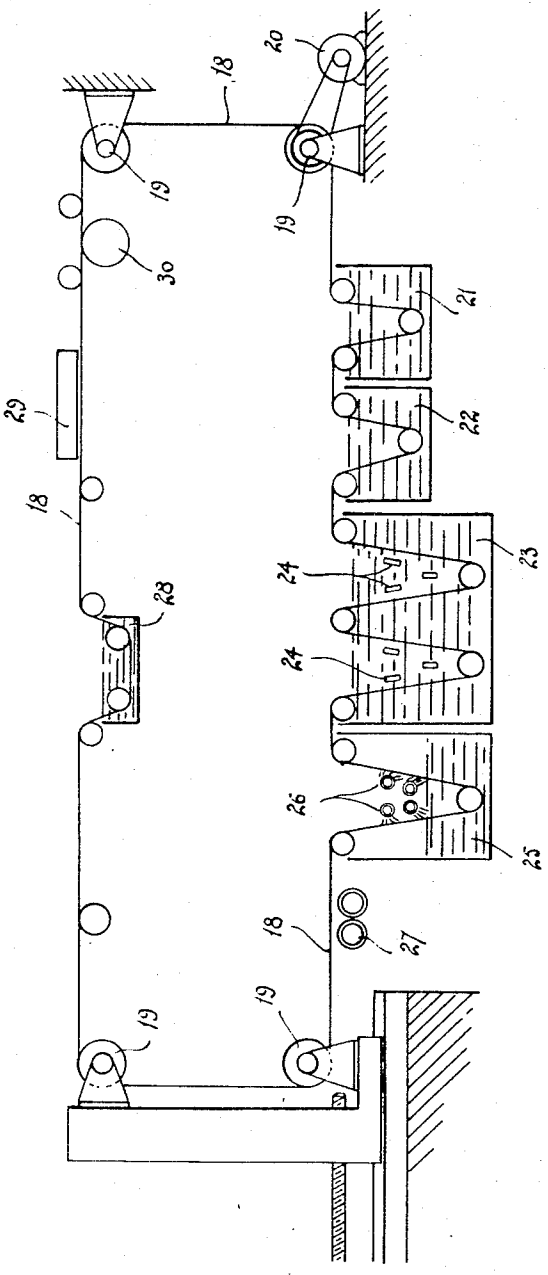

Fig. 13

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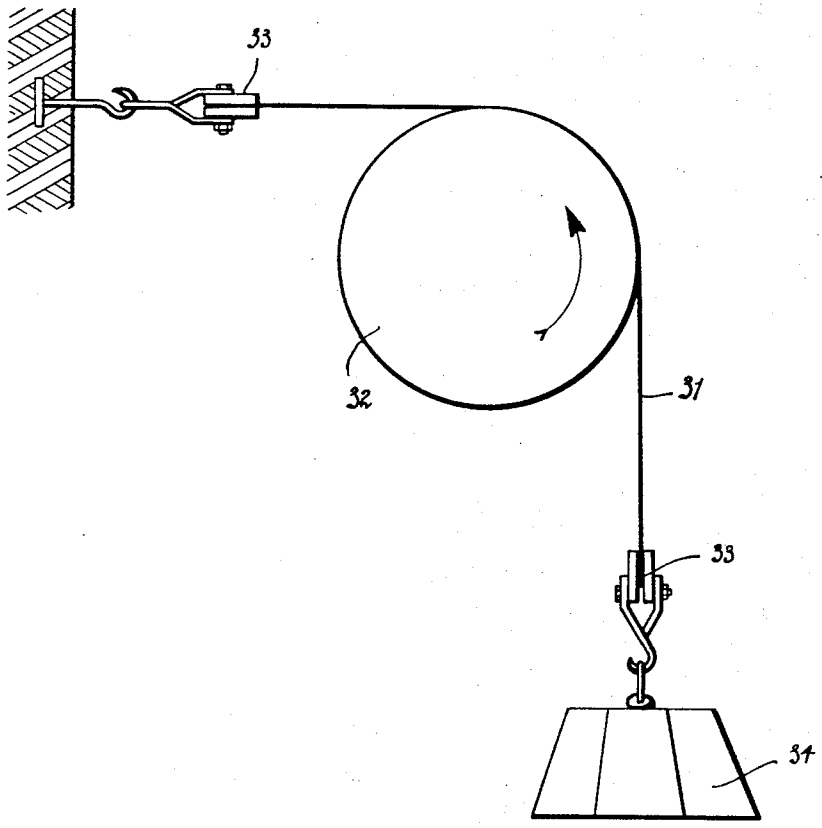
Fig. 14



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METHOD OF MAKING WIRE CLOTH FOR PAPER MACHINES

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Claims priority, application France, Oct. 30, 1962, 913,855
4 Claims. (Cl. 204—15)

ABSTRACT OF THE DISCLOSURE

Wire cloth for paper machines is made by coating the wire with an electrically insulating varnish, after which the face of the cloth intended to come into contact with the machine is ground until visible flat facets of the base metal are produced, then a metal resistant to wear is electrolytically deposited on the flat facets, and finally the varnish is removed.

The present invention relates to wire cloth intended for use on paper machines, and is directed to improvements in these wire cloths intended to increase substantially their resistance to wear and in consequence their working life.

Wire cloths for paper machines are generally manufactured of Phosphor bronze, this alloy being chosen for its qualities of ductility, flexibility and resistance to corrosion, which are well adapted to the working conditions to which they are subjected. In practice, it is especially wear by abrasion which puts them out of service.

In order to prevent rapid wear, these wire cloths have been made from other alloys, for example of stainless steel or special bronzes but their strong tendency to cold-hardening and their bad weldability always constitute a stumbling block to their manufacture and to their use. For this reason therefore, these cloths of alloys other than Phosphor bronze have not achieved any great development up to the present time, so that in most cases, it is wear by abrasion which is the essential cause of replacement of these wire cloths.

The invention has for its object to remedy this weakness by making the usual cloths of Phosphor bronze more resistant to abrasion.

The invention is characterized in that the lower face of the cloth, namely that which is intended to come into contact with the parts of the paper machine, is arranged so as to comprise flat facets which form a larger contact surface with the said parts, and the facets are coated, by electrolysis or other means, with a covering of metal which is resistant to wear.

The production of the flat facets intended to form the wearing surface can be carried out on the wires before weaving or on the woven wire cloth. Thus, the wire cloth can be woven by employing wires of flattened section, in particular rectangular and square section. Alternatively, wires can be utilized on which a flat has been formed to produce the wearing surface. When the facets are formed on the woven cloth, they can advantageously be obtained by partial grinding.

The preparation of the facets is preferably combined with an insulating coating of the cloth in order that only the wearing surface is allowed to be exposed during the subsequent passage through the electrolytic bath or other process such as immersion in a chemical bath, metallization under vacuum, etc., ensuring the formation of the coating of wear-protection metal.

The metallic deposit which is resistant to wear may be of chromium, nickel, copper, iron, tin, cobalt, molybdenum, aluminum, and generally speaking of any metal or compound such as a metallic oxide or the like, capable of giving the cloth a better resistance to abrasion. It may also be produced by alternate or simultaneous deposits of these metals, and can have a thickness from a fraction of a micron up to several tenths of a millimeter.

Wire cloths thus prepared have the same flexibility as the conventional cloths. However, their resistance to wear is increased to a very considerable extent.

It should be observed that the wire cloth according to the invention is different from the previous arrangements in which it has been proposed to coat the entire surface of the wire cloth with a deposit of nickel or other metal, for the purpose of making it resistant to corrosion, particularly when the cloth is utilized in an acid medium. This protection has furthermore proved illusory, since the deposit applied to the cloth rapidly splits during the bending of the cloth in use, and corrosion starts at the gaps or fissures.

This question of resistance to corrosion does not arise directly in the present invention, which is essentially directed to resistance to abrasion and to that end comprises not only an electrolytic deposit of a suitable metal—which may be whole or partial—but also the arrangement of the contact and wearing surfaces so as to receive this deposit on the contact and wearing areas.

In order to obtain a suitable wearing surface of adequate area and adapted for the electric deposition of a suitable metal, various methods of operation may be employed.

In accordance with a first method, instead of weaving the cloth in the usual manner with round wires, the weaving is carried out by means of warp or weft wires, or simultaneously of warp and weft wires of flattened section, preferably having flat or substantially flat faces, or alternatively the cloth is woven using round wires on which there has been previously formed a flat portion intended to constitute the wearing surface.

The arrangement of the wearing surface may also be effected on the wire cloth itself after weaving, either by subjecting it to a flattening operation, by rolling or compression, so as to cause the formation of facets which constitute the wearing surface, or by grinding the face of the cloth in order to produce these facets.

The electrolytic deposition of metal resistant to abrasion is applied to the wires or to the cloth thus prepared, with a wearing surface created systematically on at least one face. This deposit can be made over the whole of the surface of the wires or the cloth, or in accordance with a preferred form, only on the portions which form the wearing surface.

It is known that it has already been proposed to employ for wire cloth wires having a rectangular or flattened section, or to crush the cloth formed by round wires so as to produce a flat external surface.

The invention is totally different from this consideration of flatness, since it contemplates the formation of flat facets, not on the outer surface which receives the paper, but on the inner surface in contact with the parts of the paper machine. Furthermore, the invention contemplates the coating of these flat portions by wear-resistant metal.

The wire cloths obtained in accordance with this method retain the flexibility which they had before the treatment, provided that the galvanic deposit (which would be liable to stiffen the cloth) is restricted to the wearing surfaces only and that it is kept within reasonable thicknesses. The resistance to abrasion of these wire cloths is on the other hand enormously increased, even if a metallic deposit is chosen which does not have excessive hardness (in order to prevent the cloth from becoming abrasive in its turn). A protection of the cloth against corrosion has not been specially sought in this process.

The galvanic coating of the wire cloth or of the wires used in weaving it can be applied to all wire cloths and more particularly to endless Fourdrinier wires for paper machines, for endless cloths for cylinder machines and for dandy rolls, laying rolls and design rolls, etc. These cloths may have any size of mesh and may be manufactured in all known types of weaving (such as for example plain weaves, long crimp weave, serge, twill, so-called fabrics with double and triple warp wires, repp fabrics, etc.) by employing metal wire, single or composed of a number of twisted strands, of any dimensions and any section (for example of round, rectangular, tubular, flattened section) in any alloy and more particularly alloys with a base of copper, iron or nickel (such as for example bronzes, brasses, nickel silver, ordinary steels, stainless steels). There may even be employed wire cloths in which only the warp wires (or only the weft wires) are of metal, the weft wires (or warp wires) being formed by single threads or multiple threads of synthetic material. In this case of course, only the metal wires would be coated by a galvanic deposit.

The invention will be more fully described with reference to the accompanying drawings, in which:

FIGS. 1 and 2 show in cross-section an element of wire cloth of a conventional type, by way of comparison and explanation;

FIG. 3 shows a cross-section of an element of wire cloth according to the invention;

FIG. 4 is a view in cross-section of another form of construction;

FIG. 5 is a cross-section of an alternative form of construction;

FIG. 6 is a plan view of an element of wire cloth of plain weave, prepared according to the invention;

FIG. 7 is a view in cross-section of the cloth shown in FIG. 6;

FIG. 8 is a plan view of an element of wire cloth of long crimp weave prepared so as to form the wearing surface;

FIG. 9 is a view in cross-section of the wire cloth shown in FIG. 8;

FIG. 10 illustrates the grinding of the cloth in order to form the wearing surface;

FIG. 11 shows the preparation of a wire in order to provide it with flat faces intended to constitute the wearing surface;

FIG. 12 shows the wire thus obtained;

FIG. 13 is a diagram of the installation for electrolytic treatment of the wire cloth;

FIG. 14 is the diagram of an apparatus for checking wear.

In the normal case (FIG. 1), wire cloths are woven with warp wires **1** of Phosphor bronze of round section. In this case, the contact surface between the cloth and the abrasive parts **2** of the paper machine is constituted by the lines of contact **3** between the round warp wires and the said abrasive parts during the operation of the wire cloth. At the outset, the wearing surface reduced to the lines of contact **3**, is practically nil. After a few hours or days of service of the wire cloth on the paper machine, these lines of contact become enlarged by abrasion and form contact surfaces **4** (FIG. 2).

According to the invention, these contact and wearing surfaces **4** are previously created on the wire cloth, and their resistance to abrasion is ensured by the electrolytic or other deposit of a hard metal.

One means of giving the wire cloth an adequate surface of wear consists in weaving the cloth with oval warp wires **5** (FIG. 3) the surfaces **6** of which correspond to the flat side of the oval, forming after weaving flat portions which constitute the wearing surface.

As shown in FIG. 4, warp wires of rectangular or square section can also be utilized, having their sides in contact with the abrasive surface **2** and constituting the wearing surface.

In order to form the wire cloth, it is also possible to employ wires of oval or rectangular section for the weft wires, which assist by their faces **8** (FIG. 3) and **9** (FIG. 4) in forming the wearing surface in contact with the parts **2** of the machine.

Instead of starting with wires of oval or rectangular section for weaving the cloth, it is also possible to start with wires of circular section, as in the usual methods of construction, along the length of which there has been formed a flat **10** (FIG. 5) for example by grinding.

This grinding of the wire can be effected in particular in a simple manner by holding the wire of round section against a grindstone constituted by a cylinder of abrasive material (for example of emery), rotating at high speed about its axis, and causing the wire to pass at constant speed perpendicularly to the axis of the grinder. These wires with a flat face are then woven, in the warp or in the weft, or both in the warp and the weft, in such manner that the flats **10** constitute the wearing surface of the cloth.

A further method of construction consists of weaving the wire cloth following the usual methods with wires of round section (or oval, rectangular), and then rolling the cloth between two presses.

The wearing surface can also be formed by grinding the inner face of the endless wire cloth woven with wire of round section (or oval, or rectangular, or other). This grinding, carried out on wire cloth of plain weave **11** (FIGS. 6 and 7) produces facets **12** which are substantially flat. On a cloth **13** of long crimp weave (FIGS. 8 and 9), there are formed in the same way substantially flat facets **14** which constitute the wearing surface.

FIG. 10 illustrates the formation of the facets **14** on the wire cloth **13** by means of the rotating grinder **15**, with a relative lateral movement of the cloth perpendicularly to the axis of the grinder. These facets **12** or **14** are intended subsequently to receive a deposit of metal resistant to abrasion.

It should be noted that the wearing surface formed on the cloth, that is to say the ratio between the total surface area of the facets **12**, **14** on the one hand and the total surface area of the woven cloth on the other, may be more or less large, depending on the degree of rolling or grinding, and on the type of fabric employed. For example, on a fabric of long crimp weave (FIGS. 8 and 9), this ratio may exceed 15/100 after the grinding of the cloth, that is to say the wearing surface represents more than 15% of the area of the cloth.

When the suitable wearing surface has once been formed, either the wires intended for weaving or the cloth are coated electrolytically with a deposit of hard metal resistant to abrasion.

When the treatment is applied to the wires, those of oval or rectangular section or of round section being provided with flats (produced by rolling or grinding) are coated with hard metal in a galvanic bath following the usual methods of electrolysis. This is effected for example by causing the suitably de-greased wires to pass at constant speed into a bath, of which they constitute the cathode (or, when so required the anode), and which contains salts, acids or bases of the metal to be deposited and which is furthermore traversed by a direct electric current which produces the electrolysis. After passing out of this bath, they are washed, dried and wound. They are then woven so as to constitute the warp, taking care that the flats which have previously been formed on the wire, form the wearing surface of the cloth.

However, it is preferable to limit the galvanic deposit of hard metal to the flat portions of the wires only. This can readily be achieved by taking care to coat the wires **1** with an insulating material, for example a coating of varnish **16**, before grinding the flat **10** (FIGS. 11 and 12). The action of the grinder **17** removes the varnish only along the flat **10**, which is then treated galvanically as previously described, the remainder of the surface of the

wire being protected by the coat of varnish **16**. After galvanic treatment and after washing, this varnish is rapidly removed by passing the wire through an appropriate solvent.

When the fabric is prepared so as to comprise a sufficient wearing surface, it is treated galvanically in order to deposit a layer of hard metal on the facets of the said wearing surface. This is effected by causing the endless welded fabric to pass through a galvanic bath.

To this end, the endless cloth **18** is stretched as shown in FIG. 13 by means of cylinders **19**, of which one is put into rotation at an appropriate constant speed by a motor **20**. In a tank **21**, it is subjected to a de-greasing operation which can be carried out by solvent or electrolytically, and in a further tank **22** a neutralization following the electrolytic de-greasing. It then passes into an electroplating bath **23** of suitable size, in which it acts as the cathode (or when so required as the anode). This bath contains salts, acids or bases of the metal to be deposited together with the suitably arranged anodes or cathodes **24**, and it has passed through it a direct electric current which effects the electrolysis. The cloth is coated with hard metal in this bath, and it is then copiously washed with water in a tank **25** by distributors **26** of water under pressure. It is then dried, either by hot air distributors **27** or by infra-red heating, or by contact with a heated cylinder. The cloth is then ready for use on a paper machine.

Instead of this treatment by continuous process, it is possible to treat pieces of cloth of small dimensions and to produce an endless cloth by joining together and welding a number of these pieces. In this case, the galvanic deposit must be removed (electrolytically or by chemical means) from the extremities of the pieces which are to be welded together, as this deposit may be troublesome for welding, after which the welds made on the basic metal of the wires are electrolytically coated with the hard metal. The pieces of wire cloth can also be sewn together.

It is preferable to restrict the galvanic deposit of hard metal to the wearing surfaces only, on the one hand for reasons of economy of electric current and deposited metal, and on the other hand and especially because the cloth thus retains the properties of flexibility of the metals or alloys of which the wires are made, for example Phosphor bronze. The deposit of metal in fact only affects the wearing facets and there is none at the parts of the meshes of the wire cloth which are subjected to bending during its service on the paper machine.

In this form of embodiment, the cloth woven with wire of round (or other) section of the usual alloys is welded to an endless form. It is then stretched by means of the cylinders **19** (FIG. 13) and is entirely coated with a layer of insulating material, such as a varnish which is not attacked by the galvanic bath, and applied by dipping into a tank **28** or by painting with a spray gun. This varnish is dried for example by infra-red elements **29**. It is then ground on its inner face, for example by the grinder **30**, formed by a metal tube having a length greater than the width of the cloth, on which is wound in a spiral a band of fine grain emery cloth, and which rotates at high speed about its axis, the cloth being slowly moved perpendicularly to this grinder which is pressed against the cloth. A wearing surface is thus formed and grinding is continued until a satisfactory wearing surface is obtained. The unground parts of the wire cloth remain covered with insulating material. The cloth is then subjected to the treatments previously described: de-greasing, neutralization, electrolytic deposit of metal, rinsing and drying.

By dipping into a suitable solvent, the insulating material applied on the cloth before grinding is dissolved. There is thus obtained an endless wire cloth on which only the wearing surfaces are coated with hard metal resistant to abrasion.

Instead of treating the endless cloth, pieces of cloth of small size can be treated in the same manner, after which they are joined together by welding or by sewing.

In the foregoing description, emphasis has been laid on the size of the wearing surface created before the galvanic treatment. It is clear that the fact of choosing a cloth woven with flat wire or of flattening the cloth by rolling, or again by lightly grinding its inner surface, increases the wearing surface of the cloth. It is, however, possible by means of the present method to coat cloths galvanically without attempting previously to increase the wearing surface. In this case, the galvanic coating is obviously much less effective; this is particularly the case with a cloth made of wires of round section which is coated galvanically without previous rolling, flattening or grinding. In this case, the wearing surface is reduced to points or lines of wear.

The examples given above are furthermore not in any way restrictive and other means and alternative methods may be adopted to produce a cloth having a good wearing surface with a galvanic coating. By wearing surface, it has especially been intended to mean the inner face of the endless cloth which is subject to considerable abrasion, but other parts of the cloth may also be included, such as its outer surface, which in certain cases may also be subjected to heavy abrasion.

Example

A wire cloth is manufactured in the usual manner in long crimp weave using warp wires of Phosphor bronze with 8% of tin and having a breaking strength of 54 kg./mm.^{2} and a diameter of 0.23 mm., and weft wires of brass having 75% of copper and 25% of zinc and a diameter of 0.25 mm. It comprises 25 warp wires per cm. and 20 weft wires per cm. The cloth is made endless by welding the warp wires, and is then entirely coated with varnish currently used in electro-plating work.

The endless cloth is stretched by cylinders and treated as described with reference to FIG. 13:

(a) Ground on its inner face by the grinder **30** until a satisfactory wearing surface has been obtained, namely: on warp wires and per square centimetre, 166 ovals having a major axis with a length of 0.5 mm. and a minor axis of 0.20 mm. in width; the unground parts of the wire cloth remaining covered with insulating varnish;

(b) Passed for one minute into the tank **21** containing the usual cold electrolytic de-greasing bath, comprising caustic soda, sodium cyanide and sodium carbonate, followed by a slightly acid neutralizing bath **22**;

(c) Passed into a chromium bath **23**, in which the cloth forms the cathode, containing water, chromic acid, sulphuric acid (the whole having a density of about 25° Baumé), and also anodes **24** of lead, suitably arranged. An electric current having a density of 40 amperes per square decimetre of cloth surface not insulated, at a voltage of 6 volts between anode and cathode deposits from this bath over a period of 10 to 12 minutes, a coating of chromium of about 10 microns in thickness on the cloth, which moves slowly in front of the anodes;

(d) Rinsed strongly with water in the tank **25** and then dried by passing into a flow of hot air.

When this treatment is completed, the endless cloth is carefully wound on metal tubes and dipped into a solvent (acetone) which entirely dissolves the insulating varnish applied before grinding. There is obtained in accordance with the method described, an endless wire cloth of which only the wearing surface is treated and which is ready to be used on a paper or cardboard machine.

On the metal fabric thus produced, abrasion tests were carried out as indicated in FIG. 14. A perfectly flat piece of the cloth **31**, for example, with a width of 15 cm. and a length of 30 cm., is pressed against a perfectly smooth cylinder **32** of ordinary steel so that it encloses the latter over 90° of its periphery. Jaws **33**, one of which is loaded with a weight **34** of 4 kg., grip the two extremities of the piece of cloth at a distance of 30 cm. from each other, giving the required pressure between the cloth and the

cylinder. The latter rotates in the proper direction (marked by an arrow) at 400 r.p.m. and abrades the wearing surface of the cloth.

A small fan keeps the cloth and the cylinder at the ambient temperature during the tests.

After three million revolutions of the steel cylinder, this sample of woven cloth, treated in the galvanic bath, does not lose the fine coating of chromium which covers its wearing surface. An identical wire cloth which had not been treated, that is to say not varnished, not ground, not chromium-plated, which before testing had a thickness of 0.64 mm. measured by micrometer, had a thickness of only 0.48 mm. after a million revolutions of the steel cylinder **32**, which means that it was practically worn-out.

This test can be carried out by spraying or immersion in a liquid medium which is slightly acid or basic (pH value comprised between 5 and 8) corresponding to the conditions of working of the wire cloth on the paper machine; the corresponding results are just as conclusive.

What I claim is:

1. A method of manufacturing wire cloth for paper machines, comprising coating wire with an electrically insulating varnish, grinding wire cloth comprising thus-coated wire on the face of the cloth that will come into contact with the machine until visible flat facets of the base metal are formed, and electrolytically depositing on

said flat facets a metal that is more resistant to wear than is the metal of the wire cloth.

2. A method as claimed in claim **1**, in which said cloth is woven from wires which have been coated with said electrically insulating varnish prior to weaving.

3. A method as claimed in claim **1**, in which said wires are woven into wire cloth and then coated with said electrically insulating varnish after weaving.

4. A method as claimed in claim **1**, and thereafter removing the insulating varnish that remains on said cloth.

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