Aug. 19, 1941. D. W. LOSEE 2,252,776

METAL SHEET AND PROCESS OF MAKING AND USING THE SAME

Filed Oct. 10, 1938 2 Sheets-Sheet 1

Fig. 1.

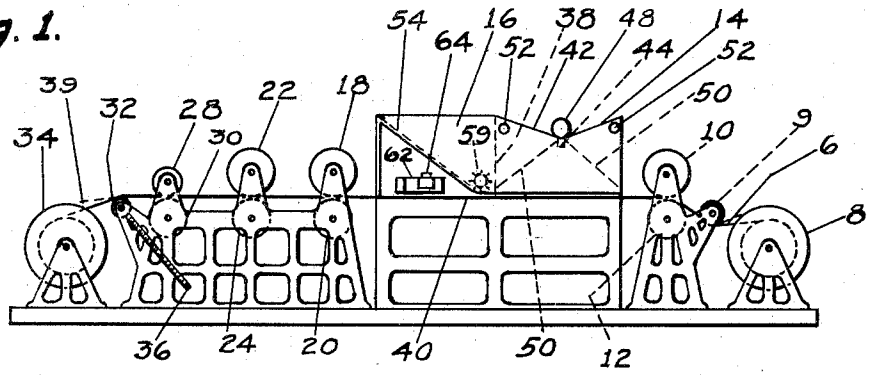


Fig. 2.

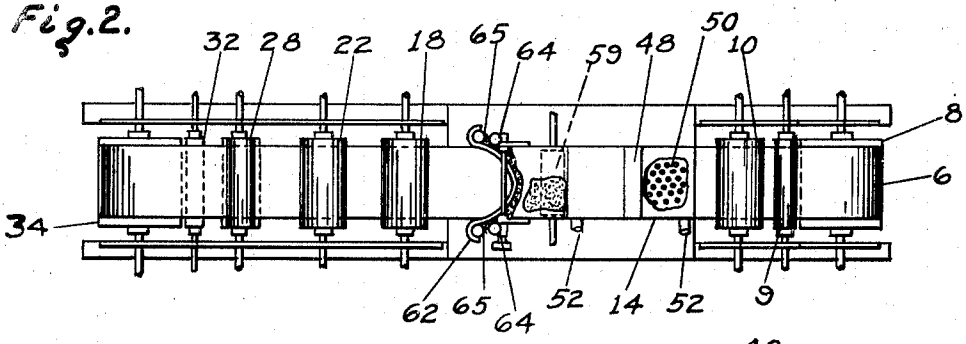
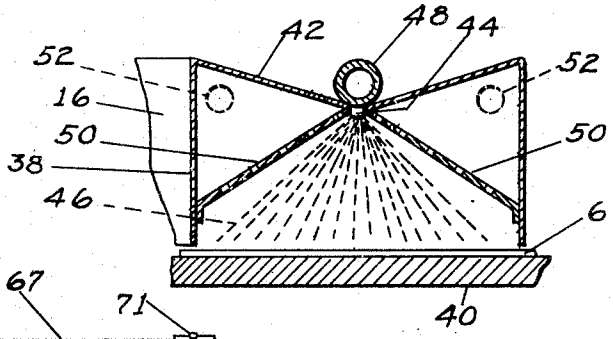


Fig. 3.



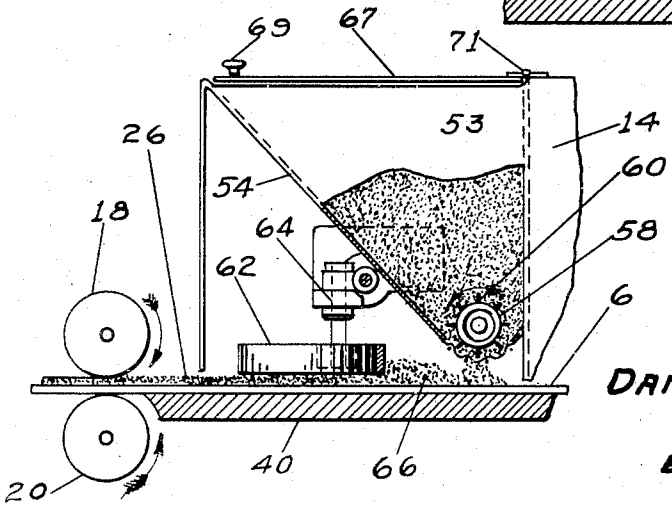


Fig. 4.

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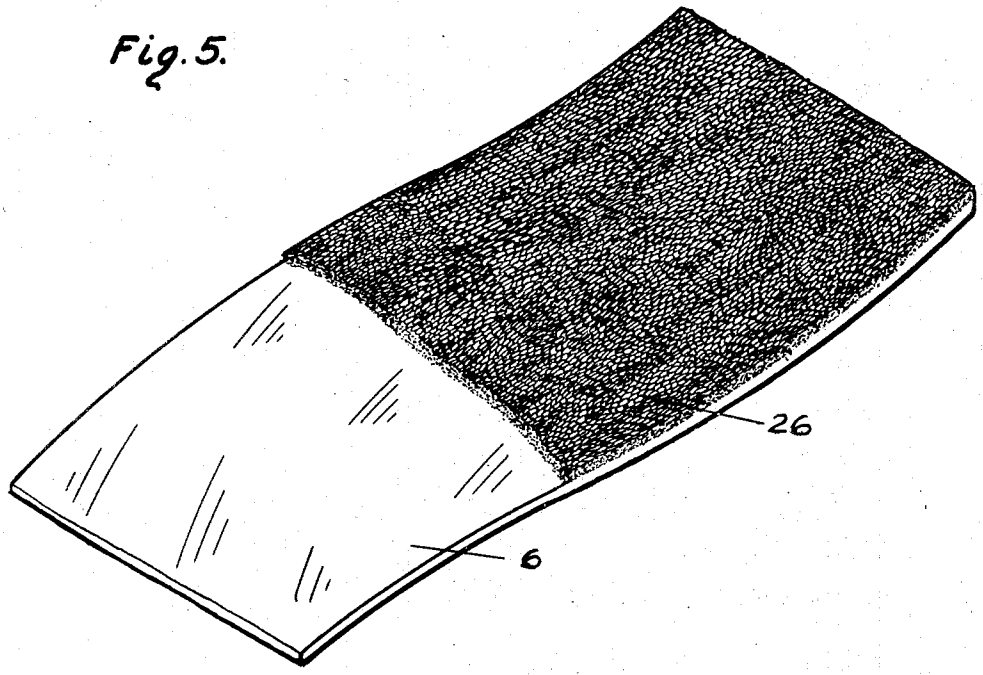
BY Bonifant Hamilton
ATTORNEY.

Aug. 19, 1941. D. W. LOSEE 2,252,776

METAL SHEET AND PROCESS OF MAKING AND USING THE SAME

Filed Oct. 10, 1938 2 Sheets-Sheet 2

Fig. 5.



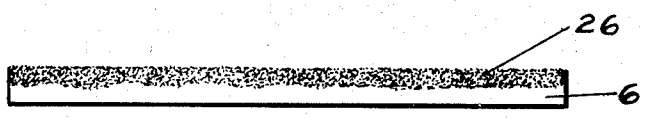


Fig. 6.

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UNITED STATES PATENT OFFICE

2,252,776

METAL SHEET AND PROCESS OF MAKING AND USING THE SAME

Daniel W. Losee, Patchogue, N. Y.

Application October 10, 1938, Serial No. 234,214

14 Claims. (Cl. 101—401.1)

In the art of reproducing photographs or other illustrations by the photogravure or "rotagravure" process, it is the usual practice to obtain negatives from the photographs or illustrations which are to be reproduced. These negatives are carefully retouched and reversed positives are made from them. The positives, usually called "transparencies," are then "planned" or laid out, that is, fixed by means of gummed tape upon a sheet of plate glass in the positions in which they will be printed.

A carbon print is next obtained on "carbon tissue", which is a sheet of paper coated with a gelatin solution to which has been added a pigment, usually red, and sensitized by immersion in potassium bichromate, squeezed on to a sheet of glass and dried. A piece of such carbon tissue is cut slightly larger than the positives and placed along with the positives in a pneumatic printing frame from which the air is extracted, thus bringing the positive and tissue into close contact. These are exposed to light, the positives are removed, and another exposure is given to the tissue through a specially oiled screen, which breaks up the tones of the photograph and provides for the necessary reticulation. The usual ruling of the screen is 150 or 175 lines to the inch. The carbon tissue is next soaked in water and placed on a copper plate or cylinder which previously has been made chemically clean and free from grease. The tissue is then "squeezed" in order to remove all moisture and air from between the tissue and the printing surface, which is then dried.

The next operation, known as "developing", is performed by placing the cylinder or plate, on which the carbon tissue has been fixed, in a tank of water heated to about 104° F. and is kept agitated until the paper is soaked off and the soluble parts of the gelatin film washed away. The parts where the light passes right through the positive become hard and are insoluble, while those parts where the light is retarded by the tones in their various gradations are more or less soluble.

When the development is completed, the cylinder, with all that is left of the gelatin film, is removed from the water bath and thoroughly dried. This remaining gelatin film acts as resist to the mordant to be used in etching the cylinder. All parts of the printing surface which are not required to be etched are protected by an acid-resisting preparation, such as a suitable wax or the like, which is applied by hand.

The printing surface then is etched, which is done by placing the cylinder in baths of varying concentrations of ferric chloride, ranging from 45° to 37° Baumé. The thinner parts of the hardened gelatin acid resist are attached first by the mordant, the thicker parts requiring further etching by the weaker solutions.

The copper cylinders may be reused but only by removing the old work by grinding and polishing in order to prepare them to receive the new work. This grinding of course wears the cylinder and it is necessary to resort to electrolytic deposition in order to restore its original circumference.

These copper cylinders are very cumbersome and difficult to handle, and in order to overcome the disadvantages inherent to their cumbersomeness, it has been proposed to utilize a copper plate which is stretched around a cylinder and secured thereto either by suction or by suitably securing together such as by soldering, welding or the like, the contiguous edges of the sheet which have been brought together by the bending operation which is required to fit the sheets to the curved surface of the backing cylinders.

Obviously, these copper sheets must have sufficient thickness and strength to withstand the requisite manipulations without disruption or irregular distortion of their surfaces, while they must fit closely their supporting rollers. This requisite thickness seriously impairs the flexibility which is necessary for the proper fitting of the sheets to the cylinders, it being difficult to bend these sheets into close conformity to the cylindrical surface of the supporting roller without cracking or breaking the sheets.

It is obvious, also, that when the requisite number of reproductions have been printed from a given sheet, it must be removed from the cylinder and replaced by another sheet which has been prepared to receive new work, or the original sheet reprepared for the new work. Here again the stiffness of the sheets which is inherent to their thickness becomes a definite disadvantage, since the lack of complete flexibility not only retards the removal of the old sheet from its supporting cylinder, through its resistance to the requisite bending, but also resists any attempts to flatten or straighten the sheet after such removal, if it be desired to do so, in order to prepare it to receive new work, the tenacity of the metal being insufficent to withstand these manipulations, so that the sheet frequently is destroyed prematurely.

It will be seen, therefore, that either of these prior practices are open to definite objections,

although up to the development of the present invention, no way was known for avoiding these objection of cumbersomeness and inflexibility.

In printing from the etched cylinders or cylindrically bent sheets, the cylinder revolves in a trough of ink, and a few inches above the trough, there is positioned a "doctor" which is a steel plate with a fine edge which has a slight reciprocating motion that scrapes the surplus ink off the surface, the ink dropping back into the trough. The paper, which is on a reel, passes between the etched cylinder and an impression cylinder. In this way an impression of the etched design is transferred to the paper. The paper then passes over a drying drum, and if the sheet is to be printed on the reverse side, it goes through another pair of cylinders before reaching the delivery end of the machine, where the paper is cut up into sheets or delivered folded according to requirements.

The present invention provides certain improvements which overcome completely the objections to the standard practice, in connection with the use of the cylinders and sheets, as has been pointed out above, the present invention having for one of its objects the provision of a completely flexible metallic surface which is highly resistant to tearing and distortion, which is capable of being etched as readily as the surfaces now employed on the printing cylinders, and which may be applied to, and removed from, the backing cylinders with extreme facility.

A further object of the invention is to provide surfacing elements for use in photogravure operations which are extremely light in weight and therefore are adapted for ready shipment in large numbers to any desired location.

Further objects and advantages of the present improvements will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims; and the invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

In general terms, the present invention comprises the production of what amounts to, in effect, a thin completely flexible metallic sheet, which does not tear readily, and which presents for all purposes to which it is intended, a continuous metallic surface, which is adapted to be etched in preparation for the printing of the illustrations which are to be reproduced, but which is composed of physically separate discrete particles bonded to a surface of a flexible carrier or foundation sheet.

The invention is attained, broadly speaking, by the application of a suitable metallic "powder" to a suitable flexible film-like sheet of either animal or vegetable origin, wherein the metal powder is limited to the surface of the sheet, and bonded thereto, by "powdered" metal it being understood that it is intended to include any form of comminuted metal irrespective of the shape or configuration of the particles thereof. Thus, the particles may be either flakes or granules of any shape.

This metal powder preferably is bonded integrally to the freely flexible sheet base so that for every purpose a continuous metal surface is provided, which, however, preserves the original flexibility of the film base. The coating, which is preferably copper, is bonded integrally to the flexible base, which may be suitably, a cellulose derivative, such as is employed in the manufacture of photographic film, such as cellulose acetate, cellulose nitrate, or the like, and the coating is applied so that it will be capable of being etched readily, while attaining the aforesaid properties of flexibility. The metal coating accordingly is confined to the surface of the sheet, and is bonded thereto most satisfactorily without the interposition of any extraneous bonding or adhesive, in order to avoid difficulties arising therefrom during etching when the finished article is to be placed in service, the union of the metal to the flexible film-like base being obtained by direct adhesion of the metal to the material of the base. The metal is applied in finely divided form, for instance, as a fine powder, it being preferably copper powder wherein the particle size is the smallest that can be obtained practically. This powder may be treated with an organic solvent, such as acetone, which is compatible with the material of the film base, and which, apparently, in some manner which is not explained clearly, enhances the bonding between the metal powder and the base, even after the solvent has evaporated from the metal particles.

The actual bonding of the powder to the base may be obtained in either of two principal ways, viz. (1) the incorporation of the metal powder on the surface of a cellulosic film sheet as the latter is formed from its solution, the bond taking place while the film sheet is in what may be regarded as a "nascent" condition; or (2) by softening a surface of a preformed sheet with a suitable solvent, applying the metal powder thereto while the sheet is still soft and tacky, the powder becoming anchored to the sheet as the surface of the latter sets or hardens incident to the evaporation of the solvent, which anchoring may be accelerated by pressure. The solvent may be applied to the surface in any suitable manner, such as, for example, by spraying.

In either case, the bond between the metal powder and the base is enhanced by a rolling operation as solidification of the film or sheet proceeds which rolling may be accompanied by heat the result being a uniformly coated sheet base, the coating of which is restricted substantially to the surface of the sheet or film, and which is capable of being etched uniformly, while retaining the original flexibility of the base because of the free movement afforded between the particles of the metal powder.

In practice, the thickness of the film-like sheet base may be, for instance, 0.0045 inch, it being superposed with a film of pure copper powder of the thickness of the order of 0.0045 inch, for example, these values being purely illustrative and in no way being intended to be limiting in character. In order for the product to be water-repellant, the metal powder is bonded directly to the film base, as has been described above.

It will be apparent that the invention may be practiced in many different ways, the accompanying drawings showing merely by way of illustration, one form of apparatus by means of which the product of the present invention may be produced.

In the accompanying drawings,

Fig. 1 represents a side elevation of the apparatus.

Fig. 2 represents a plan of the apparatus of Fig. 1,

Fig. 3 is a sectional elevation showing the details of a softening chamber wherein previously prepared film is rendered tacky by the application of suitable solvent,

Fig. 4 is a sectional elevation showing the details of construction of a coating chamber wherein the metal powder is applied to the tacky surface of the film,

Fig. 5 is a much enlarged perspective of the present improved product the view being highly magnified to indicate the structure of the product of the invention,

Fig. 6 is a sectional elevation of the product represented in Fig. 5 the view being also much enlarged and exaggerated for illustrative purpose to show the integral bond between the coating and its carrier sheet.

Referring more particularly to the drawings, a strip of freely flexible film-like sheet of either animal or vegetable origin, and which may be in practice a flexible sheet of a cellulose ester or other cellulosic derivative, is indicated at **6**, which is supplied from a feed roller **8** on which the sheet has been wound, the film sheet **6** passing under a guiding idler roller **9** and then passes between cooperating tension rollers **10**, **12** which suitably straighten and tension the film sheet **6**.

From between the tension roller **10**, **12**, the film sheet passes through a softening chamber, **14**, where a suitable solvent, such as acetone, is sprayed upon it, thereby rendering the surface of the sheet tacky to receive the metal powder, which is supplied in the chamber **16**, which preferably is immediately adjacent to the softening chamber, so that the metal powder is applied to the sheet before the solvent has evaporated, and the surface of the sheet is still soft and tacky from the action of the solvent. A suitable plasticizer may be mixed with the solvent to facilitate softening the surface of the sheet.

The coated sheet passes between suitable pairs of pressure rollers **18**, **20**, and **22**, **24**, where the metal powder coating **26** is pressed into the softened surface of the film sheet. These pressure rollers may be heated to assure a rapid evaporation of the solvent still on the film, thereby hardening the surface of the film and integrally uniting the powdered coating to the film surface.

The coating **26** is smoothed by passing the coated sheet in contact with a high speed smoothing roller **28**, it being supported on the supporting roller **30** during the smoothing operation. From the smoothing roller **28**, the coated sheet passes over an idling roller **32**, which controls the amount of slack in the sheet as it winds upon the rewind roller **34**, a micrometer feed screw **36** being provided for adjusting the idling roller **32** in conformity with the increasing amount of the sheet on the roller **34**, it being necessary to raise the sheet as indicated by dotted line **39**, in order to keep the tension of the sheet constant, as the thickness of the wound sheet layer on the roller **34** increases.

It will be seen that the spray chamber **14** and the coating chamber **16** are separated by the partition **38**. The spray chamber **14** and the coating chamber **16** are each provided with a smooth table-top bottom **40** along which the sheet **6** travels, and which protects the underside of the sheet from the solvent and the coating powder, so that the coating is applied only to one side of the sheet.

In the chamber **14** which is provided with a closure **42**, suitably apertured to receive a spray nozzle **44**, the traveling sheet is subjected to a solvent spray **46**, which is supplied to the nozzle **44** from a supply pipe **48**. Perforated baffle plates **50**, **50** control splashing of the solvent and restrict the spray to the surface of the sheet and solvent vapor is withdrawn from the chamber **14** by suction acting through pipes **52**, **52** which open in the chamber and which convey the solvent vapors to a suitable recovery apparatus.

The solvent-treated sheet with its upper surface tacky, passes into the coating chamber **16** where metal powder **53** (e. g. copper dust) is supplied from a hopper **54** having a suitable small-mesh screen bottom **56** through which the powder **53** passes. For facilitating this passage, there is provided a rotary agitator **58**, which is provided with resilient wipers **60** and which maintains the powdered metal loosened in proximity to its screen **56**. The metal powder is of as small a particle size as is commercially obtainable, for example, of the order of 200–300 mesh. A doctor blade **62** which is adjustable by means of micrometer adjustment screws **64**, spreads the powdered metal coating **66** uniformly over the sheet to a uniform controlled depth, for instance 0.0045 inch for a sheet thickness of 0.0045 inch. This thickness of the coating may be adjusted as may be desired by suitable adjustment of the micrometer screws **64**.

The pressure rollers **18**, **20**, and **22**, **24** between which the now coated sheet next passes, press the coating into the still soft surface of the sheet, and completely dry the same, while the smoothing roller **28** serves to smooth the now integrally anchored particles of the metal, the pressure and smoothing rollers orienting and elongating the metallic particles to produce what may be termed in effect a chemically continuous metallic surface which is homogeneous and uniform and which may be etched in a manner equivalent to a physically continuous metallic surface, while at the same time, since the particles of the metal are freely separable from each other upon bending of the supporting sheet to which the metal particles are bonded, the original complete flexibility of the sheet is retained, so that the resulting coated sheet can be mounted on and removed from the supporting printing rollers without difficulty as the sheets of the material are very light in weight, are highly flexible, and may be cut or otherwise fitted to the rollers very easily, while at the same time are highly resistant to the tearing and crinkling, to which the usual metallic foils are subject, this being due to the free movement between the individual particles of the metal powders; and the metallic surface of the coating is capable of being etched for photogravure printing in the same manner as are the customary copper surfaces. The surfaces of the printing rollers themselves need no preliminary preparation to receive the improved sheets of the present invention, which may be held readily in place on the rollers by suction, as is commonly done in the art with the copper plates referred to previously in this description.

When the improved copper surface of this invention has been etched which is done in accordance with customary practice, reproductions are printed therefrom in the usual manner, and when the work is to be changed, the old sheets may be released very readily from the rollers and new ones applied without difficulty, and without requiring any surface preparation of the roller; nor

are the old sheets injured in any way by their removal from the rollers, so that they will be entirely available for further reproductions as desired. Also, since the sheets may be cut as easily as paper, the reproductions thereon may be selected and rearranged as desired for indefinite variations of arrangements of pictorial or other representations on the printed pages.

The unitary bond between the coating and the film-like sheet base avoids any possibility of the union therebetween being affected either by presence of any water, or by the etching mordant, the nature of this unitary bond being indicated in Fig. 5, wherein, as previously, the film base is indicated at 6 and the coating at 26, which is shown as being bonded directly, and integrally into the surface carrier of the film; while being limited to such surface; and it is found in practice, as has been mentioned previously herein, that for some reason not known, the treatment of the copper powder, prior to its application to the film, with an organic solvent such as acetone, carbon tetrachloride or the like, enhances the union between the copper particles and the film base, even though such solvent may have become apparently entirely evaporated from the metal powder by the time the powder is applied to the base.

The etching of the designs or other illustrations or characters which are to be reproduced by printing is performed on the metal surface of this invention in accordance with usual etching practice, using ferric chloride as the etching mordant. This etching may be done either after fitting the flexible sheets of this invention to the printing rollers, or, preferably prior thereto. This is of particular advantage because the lightness in weight of the sheets facilitates greatly their distribution from any point of preparation to any location where it may be desired to do the printing.

It will be seen from the drawings, see Fig. 2, that there are provided copper dust recovery ducts 65 adjacent to the doctor blade 62 for receiving and recovering the dust that is pushed off by the blade. The coating chamber 16 is shown as being closed by a cover 67, which is provided with an operating handle 69 and held normally closed by a leaf spring 71.

It will be understood that the invention is not limited, necessarily, to the specific details of the process and construction as are described specifically herein, but it will be apparent that such details are subject to various modifications which will become apparent readily to one skilled in the art, without departing from the spirit of the invention; and it will be understood, therefore, that it is intended and desired to include within the scope of the invention such modifications and changes as may be necessary to adapt it to varying conditions and uses. It also is to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. As an article of manufacture a composite film for photogravure printing, comprising a freely-flexible cellulosic film and a layer of copper powder integrally bonded to the film, the said layer consisting of individual particles of powder in independent physical contact with one another said particles being oriented and elongated to produce in effect a chemically continuous and homogeneous uniform metallic surface for etching while maintaining free movement between the individual particles of the powder responsive to flexing the film, the said composite film retaining the original free-flexibility of the cellulosic film.

2. As an article of manufacture, a composite film adapted for photogravure printing, comprising a freely-flexible cellulosic film having its surface coated with metal powder integrally bonded thereto, the said coating being composed of oriented and elongated discrete inter-contacting particles presenting a chemically continuous surface for etching, the composite film being of substantially the same flexibility and thinness as the said cellulosic film.

3. A metallic film for photogravure printing comprising finely comminuted copper powder particles oriented and elongated, and bonded in position by a cellulosic film to form a continuous freely-flexible copper surface.

4. A composite film comprising a cellulosic film having finely divided copper powder particles integrally bonded to a surface of the cellulosic film, the said powder forming normally a continuous coating for the cellulosic film but having its individual particles oriented and elongated and freely separable one from another responsive to a flexing of the film.

5. A composite film comprising a cellulosic film having finely divided copper powder integrally bonded to a surface of the cellulosic film, the said powder having its individual particles elongated and oriented in one direction, the said elongated particles overlapping one another forming normally a continuous coating for the cellulosic film but being freely separable one from another upon a flexing of the film, thereby maintaining substantially unimpaired the flexibility of the said cellulosic film.

6. A film for photogravure printing comprising a film-like flexible base, and a coating of physically separate discrete metal particles bonded to a surface thereof in oriented relation to present a chemically continuous surface for etching.

7. As an article of manufacture a composite film for photogravure printing, comprising a freely flexible cellulosic film and a layer of copper powder integrally bonded to the film, said layer consisting of individual particles of powder in independent physical contact with one another, said particles being oriented to produce in effect a chemically continuous and homogeneous uniform metallic surface for etching while maintaining free movement between the individual particles of the powder responsive to flexing the film, the said composite film retaining the original free flexibility of the cellulosic film.

8. As an article of manufacture, a composite film adapted for photogravure printing, comprising a freely flexible cellulosic film having its surface coated with metal powder integrally bonded thereto, the said coating being composed of oriented discrete inter-contacting particles presenting a chemically continuous surface for etching, the composite film being of substantially the same flexibility and the thinness as the said cellulosic film.

9. A metallic film for photogravure printing comprising finely comminuted copper powder particles oriented and bonded in position by a cellulosic film to form a continuous freely flexible copper surface.

10. A composite film comprising a cellulosic

film having finely divided copper powder particles integrally bonded to a surface of the cellulosic film, the said powder forming normally a continuous coating for the cellulosic film but having its individual particles oriented and freely separable one from another responsive to a flexing of the film.

11. A composite film comprising a cellulosic film having finely divided copper powder integrally bonded to a surface of the cellulosic film, the said powder having its individual particles oriented in one direction, the said oriented particles forming normally a continuous coating for the cellulosic film but being freely separable one from another upon a flexing of the film, thereby maintaining substantially unimpaired the flexibility of the said cellulosic film.

12. The method of producing a film for photogravure printing on a flexible film which comprises applying a coating of powdered metal to a surface of the film and orienting the coating to produce a smooth and chemically continuous surface for etching.

13. The method of producing a film for photogravure printing on a flexible film sheet which comprises applying a coating of powdered metal particles to a surface of the film sheet and pressing and smoothing the coating on the film sheet to orient the metal particles on the sheet to produce a chemically continuous metallic surface while retaining the original flexibility of the sheet.

14. The method of producing a copper film for photogravure printing on a flexible cellulosic film sheet which comprises applying a solvent to powdered copper particles and pressing and smoothing the copper particles on the film sheet to orient the copper particles on the sheet to produce a chemically continuous metallic surface while retaining the original flexibility of the sheet.

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