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PHOTOGRAPHIC PROCESSING WEB MATERIAL

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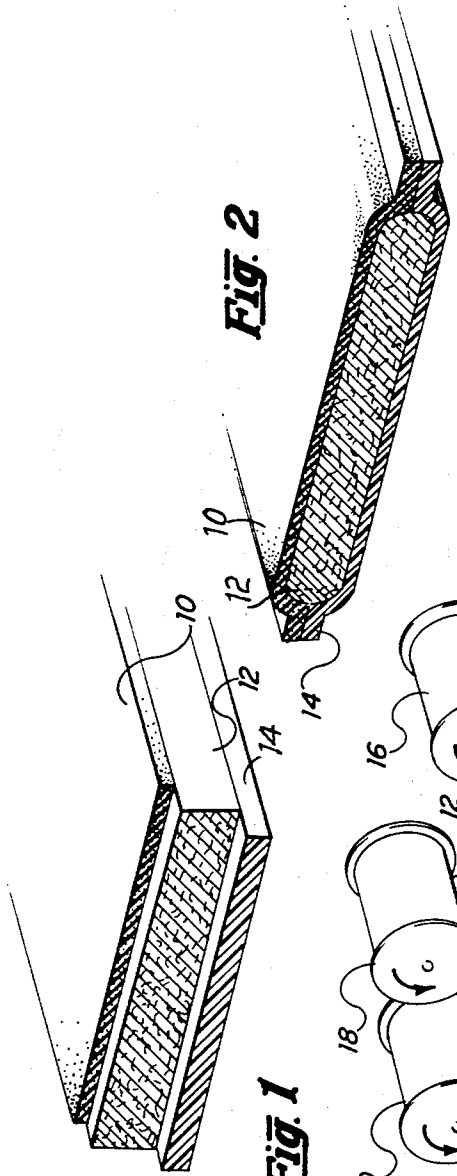


Fig. 1

Fig. 2

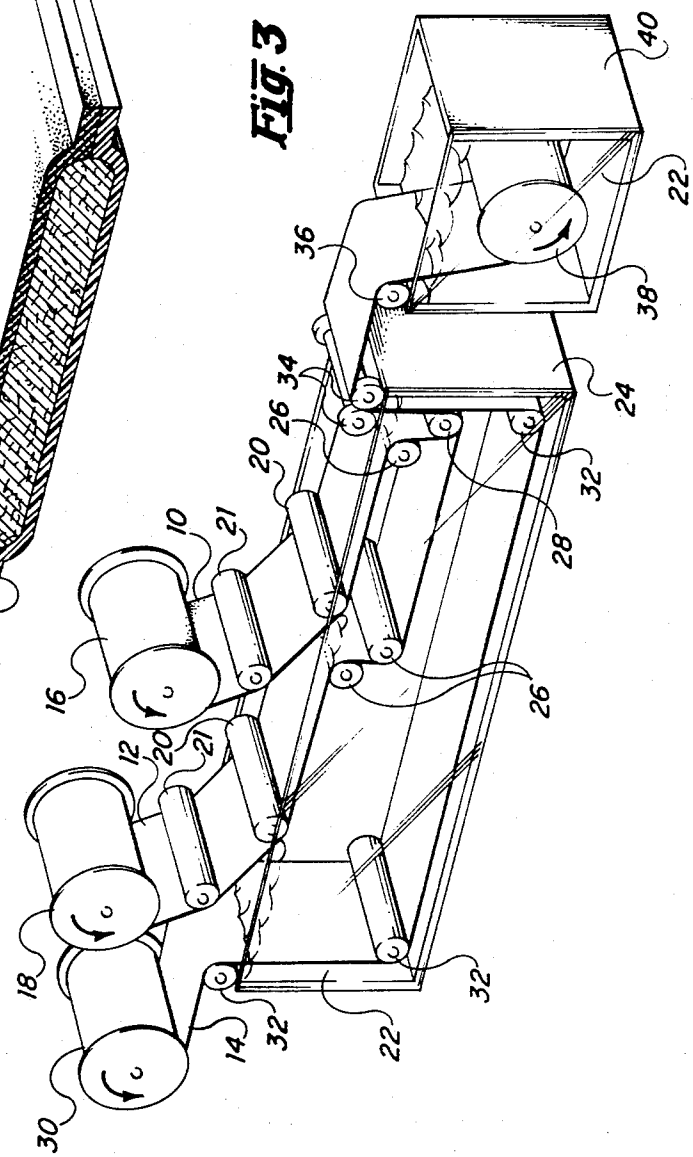


Fig. 3

JEROME S. GOLDHAMMER
ALAN MILLER
INVENTOR.

BY Jacque L. Master
AGENT.

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PHOTOGRAPHIC PROCESSING WEB MATERIAL

Jerome S. Goldhammer, Barrington, and Alan Miller, Rosemont, Ill., assignors to Chicago Aerial Industries, Inc., Barrington, Ill., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

A three layered, strip-like, laminated carrier web for contact processing of photographic materials. Each of the three layers serves a different purpose so that together they provide a thin, strong, highly absorbent and adsorbent composite web which has a long shelf life by virtue of its mechanical construction. Also, the method of constructing such a three layered web by means of lamination while submerged in processing solution, subsequent edge-sealing of the two outer laminations, and winding of the composite web on a spool submerged in the processing solution.

This invention relates generally to photographic processing using a staturated web processing system and more particularly to improvements in construction of the web material itself.

In the saturated web processing of photographic materials, one or more carrier webs or strips of material coated or saturated with various processing chemicals are brought into contact with the material they are designed to react with. Generally the processing chemicals are comprised of aqueous solutions of low viscosity to enhance permeating of the absorbent web material. For most applications, the chemicals employed in saturated web processes are in the form of a monobath, that is, a reagent that both develops and fixes exposed photographic material. Use of monobaths while permitting greater mechanical simplicity in processing apparatus utilizing saturated webs, also has some inherent disadvantages. Chief among these disadvantages is the relatively high pH typical of monobath processing materials; the pH of monobaths is typically from 11 upward. Because of this strong alkaline condition, many materials that would otherwise be useful for the web material must be discarded due to their short shelf life caused by their reaction with or decomposition in the presence of the processing solution.

In manufacturing the saturated web material, minimum thickness, maximum wet strength, absorbency and shelf life are of prime importance. In some applications employing liquid monobaths or other liquid chemicals and intermittent operation, the saturated web must be capable of supporting as much as 3 lbs. for each inch of its width. Additionally, the web should be capable of absorbing or adsorbing processing solution on the order of about three times or more its own weight. This absorbency is necessary to satisfy the processing solution requirements of photographic film for full development from the solution stored in the absorbent layer. Unfortunately, most materials capable of achieving the absorbency requirements have relatively low wet strentgh and are easily torn by any jerking action sustained during transport. While this tendency to tearing can be alleviated by laminating the absorbent web material with an inert plastic of higher

strength, it has been found that air bubbles formed in processing solutions and trapped in the fibers of laminated webs are almost impossible to remove with any presently known techniques and, these air bubbles result in discontinuities in the developing action.

Another and frequently encountered problem when using prior art saturated web processing materials, is scratching or abrading of the film emulsion by rubbing contact with the web. This problem is magnified when the emulsion is softened by the action of strong alkalies or heat. Since saturated web processing usually utilizes strongly alkaline solutions at room temperatures or above, the problem has been quite serious and hasn't generally been successfully solved without compromising some desired characteristics of the web material.

Accordingly, it is a general object of this invention to provide a new and improved composite web material having vastly increased storage life and capable of overcoming the several other deficiencies of the prior art web materials.

Another object of this invention is to provide a novel composite web material capable of achieving processing results that are superior to that presently possible with web processing materials.

Another and important object of the invention is to provide a new and improved saturated web material having improved contact characteristics to thereby overcome any abrading of the photographic materials emulsion.

Yet another object of the invention is to provide a new and improved saturated web material in a multi-layer form that yields a greater freedom from discontinuities in developing action than it is possible to achieve with contemporary laminated web materials.

In accordance with a specific illustrative embodiment of the invention, these and other objects are attained in a novel multi-layer saturated web material. A feature of the invention is the use of three distinct layers in the web material. These layers comprise a relatively strong and desirably air and solution impervious backing film, an absorbent solution storing layer and a microporous film contact layer. An advantageous feature of the invention is realized when the backing film layer and the microporous contact layer are edge sealed with the absorbent saturated material trapped therebetween. While the various features of novelty are pointed out with particularity in the claims appended to and forming a part of this specification, for a better understanding of the invention and its advantages, reference is had to the accompanying drawing and descriptive matter in which are illustrated and described illustrative embodiments of the invention.

In the drawing:

FIGURE 1 is a cross section taken through a three layer web material.

FIGURE 2 is a cross section taken through a preferred form of three layer web material; and

FIGURE 3 is a schematic illustration of apparatus employed in fabricating the multi-layer saturated web of the invention.

Referring now to the drawing and particularly to FIGURE 1 thereof, there is shown an illustrative embodiment of the tri-layer saturated web of the invention. As there shown, the top or film contact layer **10** of the inventive web material is comprised of a microporous mat. For some embodiments of the invention this microporous mat **10** has been made from thermoplastic materials following

the process described in the United States Patent No. 3,020,597 of R. Smith-Johansen, although other microporous materials with similar characteristics can equally well be employed. Necessarily, the materials used in forming the microporous mat must be chemically compatible with the materials used in processing the photographic material. Among the materials found most satisfactory for use in the microporous mat are polyvinyl chloride (PVC), polyethylene, and polypropylene. These materials are unaffected by the normal range of processing solutions and temperatures and, additionally, being thermoplastics permit the achievement of other desirable features as discussed in connection with FIGURE 2. PVC, polyethylene and polypropylene, in addition to their chemical inertness in the processing solutions, possess other advantages as well. Among these advantages are an ability to be wetted by the processing solutions, an ability to achieve relatively uniform porosity and, most important, the achievement of a surface finish that by most known objective standards is almost completely free of any abrasive characteristics when brought into contact with soft gelatinous emulsions on photographic materials.

Backing film **14** makes up a second layer in the inventive web material. Film **14**'s principal function in the inventive structure is to provide the relatively high tensile strength necessary to permit handling of the saturated web materials which, without its presence, would be subject to tearing as it is transported through using apparatus. Like all components of the web material, film **14** must be manufactured from material that is inert in the presence of the processing solutions employed. Like microporous mat **10**, it has been found that PVC, polyethylene and polypropylene are highly advantageous materials for use in the backing film **14**. Additionally, considerable success has been achieved utilizing grain oriented polyester films as the backing film **14**. Of course, unlike the microporous mat **10**, since a primary requirement for backing film **14** is to impart strength, a high wet strength material must be utilized.

Most if not all of the monobath processing solutions employed in the saturated web processing system, oxidize extremely rapidly. Frequently, the solutions become useless because of oxidation after only 1 to 4 hours exposure to air at room temperature. Since this effect is highly undesirable and tends to reduce the use of saturated web processing systems, any technique that increases the open shelf life of the saturated web is highly advantageous. One method of increasing the open shelf life is realized when backing film **14** is made from air and processing solution impervious material. With these properties and embodying the construction of FIGURE 1, useful shelf life is increased by several hours since oxidation of spool wound web material can only proceed from the edges inward and the web is usually supplied in a width somewhat greater than the exposed width of film it is used in conjunction with.

Interposed between microporous mat **10** and backing film **14** is a layer of absorbent material **12**. Typically this material is comprised of a non-woven cloth. In selecting materials suitable for use in the absorbent layer **12**, immunity from attack by the processing solutions must be considered as in the case of the contact layer **10** and the backing layer **14**. However, the most important characteristic of absorbent layer **12** is its absorbency relative to its thickness. For many reasons, all obvious, it is desirable that the layer **12** and the entire composite web material be maintained as thin as possible. Generally, absorbent layer **12** can be no more than 5 or 6 mils thick. Even with this restriction on the thickness of layer **12**, it must still have the capability of absorbing or adsorbing sufficient processing solution so that it will be possible to later extract a sufficient amount to permit the processing of photographic film. Among the materials available in such thicknesses, very few are both absorbent enough and sufficiently immune to procesing solution attack. The most satisfactory materials for use in absorbent layer **12** that have been found to date comprise polyethylene, polypropylene, polyester, PVC, asbestos, cotton, hemp and glass fibers. Of these, the best all around material found, and hence preferred, is asbestos.

While preparing a three layer composite web material such as shown in FIGURE 1, does permit the achievement of a web having high wet strength combined with high absorbency and good contact characteristics, such a web when wound on spools remains subject to drying and oxidation of the processing solution because of surface contact with the atmosphere at the edges of the web. As pointed out above, this problem has been severe since open shelf life of the process solution containing webs at room temperatures and above was limited to about between one and eight hours; the longer life not being realized by prior art web materials but achievable by the inventive web materials of FIGURE 1. Manifestly, such a limitation on open shelf life severely limits the number of uses of saturated web processing systems. In attempting to overcome this limitation on open shelf life and still maintain the various advantageous features achieved with their three layer composite web material, applicants have discovered that the open shelf life can be prolonged to between seven and thirty days at room temperature by heat-sealing together the edges of the microporous mat **10** and the backing film **14** that form the upper and lower layers of their composite web. Additionally, securing the mat and film together provided other distinct advantages. Among these advantages was the elimination of a tracking problem that occurred when layered material not secured together was fed through processing apparatus. However, and almost as important as the increase in open shelf life and improved tracking that is accomplished by heat sealing the edges, the heat sealing also permitted the applicants to achieve a web material freer of entrapped air and hence incipient developing discontinuities than it had been possible to achieve with the best of the prior art saturated web materials.

As pointed out above when the absorbent layer **12** is physically bonded to the backing film **14**, it has proven impossible to remove all of the air bubbles contained in the processing solution and that were trapped between the two and in the absorbent layer itself and, these air bubbles result in processing discontinuities. Adding to the dilemma was the problem that if the two layers were not bonded it was practically impossible to properly guide them through any photographic processing apparatus. It is a feature of the invention that this dilemma has been resolved by applicants' three layer web material having the two outer layers edge sealed together and having an absorbent layer secured therebetween. By edge sealing the top and bottom layers together with the absorbent material layer trapped therebetween, the tracking problems encountered with unbonded separate layers were overcome and since the absorbent layer is not bonded to the backing layer, it is possible to remove almost all entrapped air bubbles.

Manufacture of the inventive web material is advantageously accomplisehd by the apparatus shown in FIGURE 3. There both the microporous contact mat **10** and absorbent layer **12** are saturated with processing solution by the "kiss" method. The contact mat **10** and absorbent layer **12** are supplied from the large stock rolls indicated at **16** and **18** respectively. Each of the materials **10** and **12** is guided by a series of rollers **20** and **21** so that it makes contact with the processing solution **22** in tank **24** at a small oblique angle whose extent is determined by the necessity of securing a meniscus between the top surface of the solution **22** and the material to be saturated. Generally, this angle which is exaggerated in the figure for illustration purposes has been found to be on the order of between one and five degrees. The material is further conducted along the surface of the processing liquid and then over drive rollers **26** toward layering roller **28**. By maintaining the

path between rollers **20** and **26** approximately 12 to 18 inches long as a minimum for material on the order of 1 to 6 mils thick, it has been found that absorbency is nearly perfect with entrapments of air maintained at an absolute minimum. Level of the processing solution in the tank is maintained by means of a float valve apparatus to isnure that the material is transported along the surface of the solution. Because the float valve apparatus is conventional and forms no part of the invention, it is not shown in the drawing or described further herein. Backing film **14** is supplied from a stock roll **30** and is conducted by means of drive rollers **32** toward layering roller **28**. It is an advantageous feature of the invention that the three layered materials of the inventive saturated web maerial are brought into mating contact beneath the surface of the processing liquid **22**. By thus wet winding the materials, it has been found that inclusions of air in the composite web are maintained at a minimum.

From layering roller **28** the three layered material is conducted by a pair of guide rollers **34** to the exterior of the processing tank **24**. When contact layer **10** and backing layer **14** are thermoplastics, the paired guide rollers **34** may advantageously be heated and thus, by heat sealing, provide the sealed edge construction preferred in the composite web material. From paired rollers **34**, the composite saturated web material is passed over guide roller **36** to be wound on a storage spool **38** contained in a winding tank **40**. Applicants have found that winding their web material onto spools **38** while the spools are submerged beneath the surface of processing solution further reduces air bubble inclusions in their web material and hence, reduces processing discontinuities.

In the foregoing description of the processing apparatus employed in saturating and fabricating the inventive web material, all references to driving motors, clutches and similar associated apparatus have been deleted since they form no part of the invention and are of the type conventionally found in the winding and reeling arts.

Another method of producing the inventive three layer composite web material involves a quite different approch. In this alternate production method, the microporous mat contact layer is first formed or placed upon the absorbent layer resulting in these two being loosely bonded together. Of course, when the microporous mat is formed or positioned directly on the absorbent layer, that layer must be inert in the presence of any solvents used in producing the microporous structure and be stable at the fusion temperatures employed to fuse the thermoplastic powders used. After the microporous contact layer is formed on the absorbent layer, this composite material is "kiss" saturated with processsing solution, united with a backing film and edge sealed following the same general method diagrammed in FIGURE 3 and described in conjunction therewith. However, the length of the path on the surface of the liquid traversed by the composite absorbent material after its "kiss" contact, must be somewhat longer than when individual absorbent materials are saturated.

Certain photographic negative materials have a dye or anti-halation coating on their backs. These coatings normally must be removed before the negatives can be viewed or used for printing of positives. These coatings are soluble in and are normally dissolved by the use of sulfite solutions. Since the monobaths employed with the three layer composite web material of the invention normally contain sulfite, it would be desirable to combine the halide processing function accomplished with the saturated web with a dissolving of the anti-halation coatings. It is a feature of the invention that this combination of developing and coating dissolving can be achieved with but a slight change to the inventive web material. By introducing numerous small perforations in the backing film of the web material and spacing these perforations away from the edges of the web, the web is able to deliver a sufficient quantity of the sulfite containing processing solution to the back of photographic film it is wound in contact with to effect the dissolving action while simultaneously effecting the developing-fixing action. Applicants have found that as few as ten $\frac{1}{32}$ inch diameter perforations per square inch accomplish this desirable result although other sizes and quantities have also proven advantageous. Because these holes will not be aligned with each other on successive wraps when the web is wound up, no loss of solution thru evaporation will occur.

We claim:

1. A three-layer composite saturated web photographic processing material comprising the combination of
- a strip-like absorbent layer,
- a microporous mat contact layer positioned adjacent said absorbent layer and overlapping the edges thereof, and
- an air and processing solution impervious backing film layer positioned adjacent said absorbent layer and overlapping the edges thereof and bonded to said microporous mat contact layer.

2. A three-layer composite saturated web photographic processing material comprising the combination of
- a strip-like absorbent layer,
- a microporous mat contact layer positioned adjacent said absorbent layer and overlapping the opposite edges thereof that define said absorbent layers width, and
- an air and processing solution imprevious backing film layer positioned adjacent said absorbent layer and bonded to said microporous mat contact layer.

3. A three-layer composite saturated web photographic processing material comprising the combination of
- a strip-like absorbent layer,
- a microporous mat contact layer positioned adjacent said absorbent layer and overlapping the edges thereof, and
- a backing film layer positioned adjacent said absorbent layer overlapping the edges thereof and sealed to said microporous mat contact layer.

4. A three-layer composite saturated web photographic processing material comprising the combination of
- a strip-like absorbent layer,
- a microporous mat contact layer positioned adjacent said absorbent layer and overlapping the edges thereof, and
- a backing film layer of an air impervious material positioned adjacent said absorbent layer overlapping the edges thereof and sealed to said microporous mat layer, said backing film layer having numerous perforations in the center portion thereof.

5. In a composite tri-layer web material, the combination comprising
- a microporous mat contact layer,
- an absorbent layer positioned adjacent said mat layer, and
- a photographic processing solution impervious backing film positioned adjacent said absorbent layer and edge bonded to said mat layer.

6. In a composite tri-layer web material, the combination comprising
- a contact layer, said contact layer comprising a strip of microporous mat,
- an absorbent layer positioned adjacent said mat layer, and
- an air and photographic processing solution impervious backing film positioned adjacent said absorbent layer and edge bonded to said mat layer.

7. In a composite tri-layer web material, the combination comprising
- a microporous mat contact layer,
- an absorbent layer positioned adjacent said mat layer, and
- a photographic processing solution impervious backing

film positioned adjacent said absorbent layer and edge bonded to said contact layer.

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ROBERT F. BURNETT, *Primary Examiner.*

W. A. POWELL, *Assistant Examiner.*