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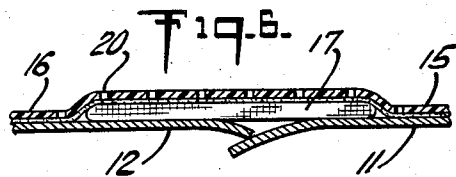
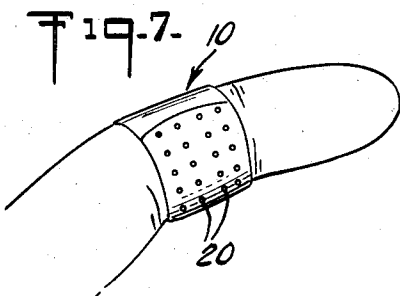
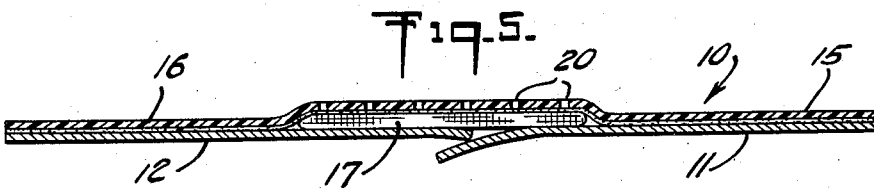
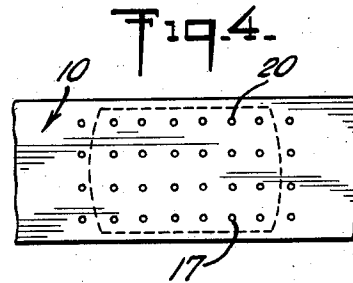
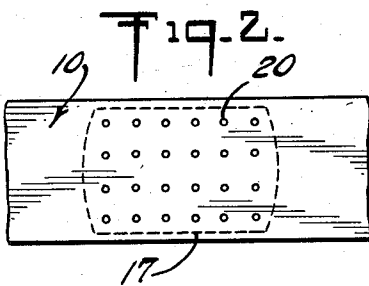
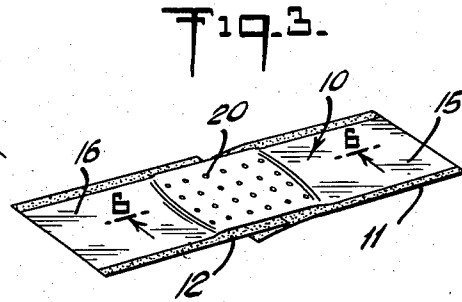
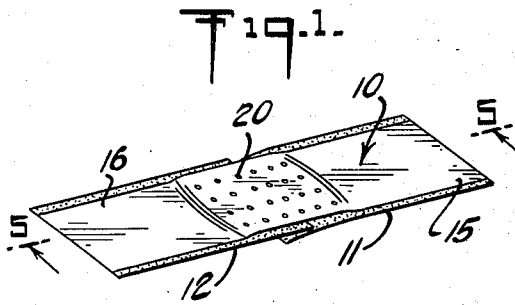
W. J. GROSS ET AL

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DRESSING

Filed April 22, 1959

2 Sheets-Sheet 1



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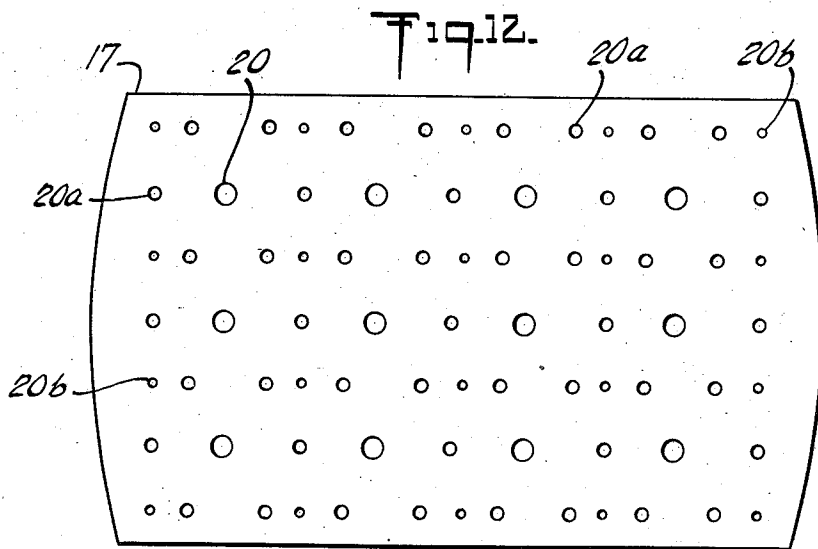
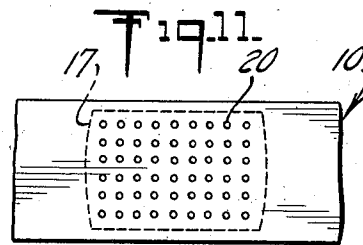
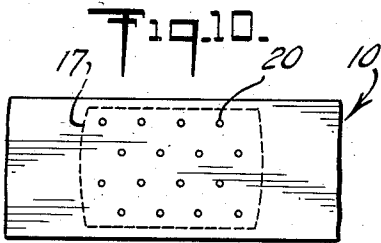
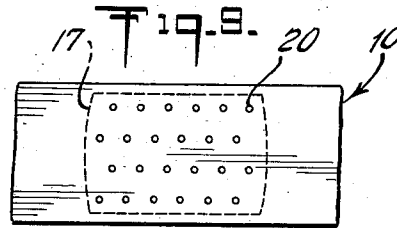
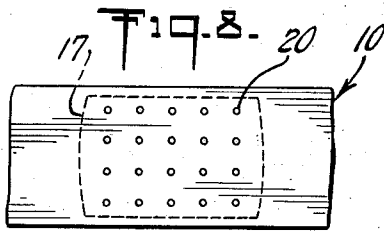
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2,898,910

DRESSING

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Application April 22, 1959, Serial No. 808,055

10 Claims. (Cl. 128—156)

This invention relates to a plastic-backed adhesive bandage having a plurality of uniformly spaced openings in the backing over the pad and an unexpectedly small but critical total open area to minimize or avoid maceration of the skin adjacent the wound area when the bandage is in normal use.

Plastic adhesive bandages generally consist of a strip of extensible and conformable plastic, coated on one side with a pressure-sensitive adhesive, with an absorbent dressing pad secured to the adhesive near the midpoint of the strip, leaving exposed areas of adhesive on opposite sides of the pad. The backing over the pad area may be provided with vent holes to permit aeration of the wound. The pad may be formed of suitable fibrous material (e.g., rayon, cotton, and the like) but its weight is required by the United States Pharmacopeia to be not less than that of a compress of the same area composed of four layers of 44 x 36 gauze. For the pad on the popular $\frac{3}{4}$ in. wide adhesive bandage, this is equivalent to 0.11 grams in weight, the pad area being about 0.583 square inch.

Plastic tape backings are desirable for such bandages since they are flexible, elastic, conform to body surfaces, generally provide superior skin adhesion properties, and tend to remain clean. Due to the good fitting qualities of such backings, better protection is afforded to a wound than is the case with less conformable cloth-backed bandages. Such dressings present a neat, inconspicuous appearance, and in the preferred embodiments having very small openings are not subject to fraying of threads from the pad or soiling of the pad. By having a relatively small ratio of open area to total backing area over the pad, the film backing is not weakened significantly by the perforations, and is able to withstand the normal stresses of flexing and tension during wear without tearing or destroying the bandage.

Under conditions of normal usage, adhesive bandages frequently become wet with water from external sources, due, for example, to washing of a bandaged area. Under such circumstances, where the adhesive bandage is plastic-backed and the pad area of the bandage covers 0.4 square inch of skin surface, or more, the skin under the pad tends to become waterlogged, cracked and discolored (whitened) in appearance. This condition of the skin (known as "maceration") interferes with wound healing and in some instances, due to secondary infection, may result in conditions much more serious than those of the original wound.

The problem of wound maceration was not normally encountered in using cloth-backed adhesive bandages. However, with the advent of the currently more popular plastic-backed adhesive bandages during the past decade, the maceration problem became acute. Prior to the present invention, so far as we are aware, no one had been able to provide a plastic-backed adhesive bandage having a pad area of at least 0.4 inch in area, which satisfactorily minimized or avoided the maceration problem, and which, at the same time, retained the characteristic physical properties of plastic backings that were

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responsible for the popularity of plastic adhesive bandages in the first instance. Briefly stated, a major object of the present invention is to provide a plastic-backed adhesive bandage which satisfactorily overcomes the maceration problem which has confronted the adhesive bandage art ever since the advent of plastic-backed adhesive bandages.

This object is achieved in accordance with the invention by providing a plastic-backed adhesive bandage having a dressing pad of at least 0.4 square inch in area, with a multiplicity of strategically located, substantially uniformly distributed perforations in the backing at the locus of the pad, and a small but critical total open area, all as hereinafter more particularly described in connection with the several figures of the drawings showing enlarged views (not necessarily drawn to scale) of adhesive bandages in accordance with the invention. In the following description, like reference numerals refer to the same component parts of the adhesive bandages shown in the various figures of the drawings.

Fig. 1 is an isometric view of an adhesive bandage according to the invention as seen from the rear or backing side of the bandage.

Fig. 2 is a detailed and enlarged view of a portion of the bandage of Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing another modification of the invention.

Fig. 4 is a detailed view on a larger scale of the bandage shown in Fig. 3.

Fig. 5 is a longitudinal section taken on plane 5—5 of Fig. 1.

Fig. 6 shows a longitudinal section of the bandage shown in Fig. 3 taken on plane 6—6 of the latter figure.

Fig. 7 illustrates the bandage applied to the palmar side of the finger between the first and second knuckles.

Figs. 8 through 12 show portions of the adhesive bandage constructed according to still other embodiments of the invention.

One discovery of importance to the invention is that the rate of transfer of liquid water through the pad (from the side adjacent the skin to the opposite side) is substantially lower than the rate of evaporation of water from the outer surface thereof, and accordingly only an unexpectedly small but critical total open area is required in the plastic backing to permit removal of water sufficiently rapidly to avoid maceration. The open area of the backing is therefore preferably formed of relatively small openings properly distributed to minimize the distance of liquid travel from the skin to the outer surface of the plastic sheet, the holes being large enough to pass water, under normal usage conditions, having in mind the pressures which may be exerted on the pad. Either the number or the size of the openings or both is sufficiently small so as not to interfere with the required strength of the backing, nor the function of the backing in covering and retaining the pad and protecting it from becoming quickly soiled and unsightly in normal wear.

Referring to Figs. 1 to 12, reference number 10 designates a plastic extensible backing. The usual removable facing strips 11 and 12 protect the underlying, otherwise exposed, areas of pressure-sensitive adhesive on tabs 15 and 16, respectively. Tabs 11 and 12 overlap above the absorbent dressing pad 17, shown more clearly in Figs. 5 and 6. Pad 17 is large enough to cover a substantial area of the skin (i.e., at least 0.4 sq. in. in area) and may be, for example, 0.93 in. average length and $\frac{5}{8}$ in. in width. Backing 10 is perforated by holes 20 in an area adjacent to pad 17. The pad area is indicated by the dashed lines in the figures, except Fig. 12 which shows a much enlarged pad area only.

We have found that the structural features of our plastic-backed adhesive bandages may be correlated within prac-

tical limits with the observed incidence of "non-maceration" when the bandage is in normal use by the equation:

$$P=227\frac{(A)^{3/2}}{(a)^{1/2}}$$

wherein "P" is indicative or reflective of the percent incidence of non-maceration; "A" is the "fraction of open area" over the pad and may be expressed as

$$A=\frac{n\times\text{area of each opening}}{\text{area of pad}}$$

where n=number of openings, and "a" is the average area in sq. in. units per opening for all of the openings therein (i.e., total open area divided by the number of openings). In accordance with the present invention, the values of "a" and "A" are so controlled that the value of "P" as calculated by the formula is at least equal to about 25.

In producing bandages having this minimum "P" value, particular emphasis is laid on the minimum value of "A." Thus "A" must be large enough to provide adequate open area to achieve the desired freedom from maceration (i.e., to attain the minimum "P" value of 25); yet the value of "A" should be maintained below about 0.25, otherwise we have found that the covering, protecting and strength characteristics of the backing will be substantially impaired. Thus the number of and the total open area of the perforations is maintained below an "A" value which tends to produce undesirable weakening of the plastic tape backing and undesirable exposure of the pad to accidental contamination or soiling with the result that the bandage becomes useless or unsightly after a short period of use. Generally speaking, the larger the number ("n") of holes used, the smaller their average diameters should be. Correspondingly, if the average diameter of the holes is large, the number of the holes employed should be small. In short, the value of "A" should be kept below about 0.25, either by appropriately decreasing the average diameter of the holes while increasing the number, or by decreasing the number of holes while increasing the average diameter.

The above-mentioned formula may be rewritten as:

$$a=\frac{P}{227N^{3/2}}$$

where "N" is a number of holes per square inch. If "P" is constant, this formula becomes:

$$a=\frac{K}{N^{3/2}}$$

where $K=P\div227$.

As illustrated in the following table of changes in "a" and "A" if "P" is constant:

Holes per Square Inch	Area of Hole	Fractional Open Area
	a	A
N	.35a	.71A
2N	.02a	.57A
3N	.001a	.10A
100N		

if the number of holes (N) is increased, the value of "a" must be decreased, and as a consequence the value of "A" is decreased. Thus, the invention enables the provision of a plastic bandage having the desired maximum non-maceration with minimum fractional open area.

Except for the limitation as to the minimum value of "A" that it pass water, the invention provides for the obtention of maximum desired non-maceration by using the larger number of small openings. This results in minimum impairment of the strength of the backing and its effectiveness in protecting the bandage against accidental soiling. By providing the backing with openings which are smaller than required for passage of the fibrous material of which the pad may be made, a further advantage is obtained; i.e., completely eliminating passage of fiber ends through the backing. As a basis for comparison of the plastic-backed adhesive bandages of the invention with those of the prior art, the following standard test is useful.

STANDARD TEST

The adhesive bandages tested are of the usual 3/4 in. width size having pad area of 0.583 sq. in. and pad weight of 0.12 to 0.13 grams per pad. These bandages are placed on the fingers of individuals and worn by these individuals for a period of 24 or 48 hours. During this period the individuals perform everyday activities including washing hands, etc., which cause the dressing pads of the bandages to become saturated with water. In many instances at least three or four bandages of different types are placed on the hands of each individual, one bandage on each finger. At the end of the test period, the adhesive bandages are removed and the test area rated for non-maceration.

Non-maceration is taken as a condition in which there is no swelling and practically no discoloration, i.e., whitening, of the skin in the area in question.

The types and characteristics of various embodiments of the invention are set forth in the following table together with the test results for some of them.

Adhesive bandages

Type			Characteristics				Test Results		
Fig.	No. Holes		Hole Diam. in Inches	“a”	“A”	“P”	Total Tested	Non-Maceration	
	Per Pad	Per Sq. In.						No.	Percent
2	24	41	0.032	.00080	.033	48	549	303	55.
4	32	55	0.032	.00080	.044	74	523	342	65.
8	20	34	0.044	.00154	.053	70	130	87	67.
10	16	27	0.032	.00080	.022	26	124	36	29.
9	21	36	0.040	.00126	.0454	63			
11	54	93	0.014	.00015	.0139	30			
12	1 S 20	34.3	.01	0.00078	0.03	83.3			
	1 M 47	80.6	.015	0.000177					
	1 L 12	20.6	.03	0.000707					

1 (The letters S, M and L refer to small (205 in drawing), medium (204 in drawing) and large (20 in drawing) holes, respectively.)

The fractional open area per square inch "A" is given by: $A=aN$, and this may be written as:

$$\frac{KN}{N^{3/2}}=\frac{K}{N^{1/2}}$$

The adhesive bandages of the invention show at least about 29% non-maceration when subjected to this standard test using at least 100 adhesive bandages in the test.

This result is at least about 50% higher than those obtained with a known previously marketed vented plastic-

backed bandage so tested. This prior art adhesive bandage was provided with two holes over the pad, each 0.126 inch in diameter, and each being on the longitudinal median line of the bandage with its center set $\frac{5}{16}$ of an inch from the midpoint of the pad. Under the standard test conditions this two-hole prior art $\frac{3}{4}$ in. bandage shows about 19% non-maceration (average of at least 100 of these bandages), and this figure may be taken as a "norm" in the standard test.

Very often a slight increase in percentage of non-maceration achieved according to the teachings of the invention reflects a substantial and important decrease in the level of severe maceration.

The adhesive dressings of the invention have backings which are extensible films of organic hydrophobic plastic. Suitable plastics include vinyl and vinylidene halide polymers and copolymers thereof. Particular resins are copolymers of major proportions of vinyl chloride with vinyl acetate, vinylidene chloride and/or maleic anhydride. Other particular resins are vinylidene chloride polymers and especially the copolymers of major proportions of vinylidene chloride with vinyl chloride, vinyl acetate, acrylonitrile and/or maleic anhydride. The adhesive mass is suitably of known rubber-resin type (synthetic and/or natural rubbers).

Suitable amounts of plasticizer, stabilizer and preferably also pigment known in the prior art are mixed into the above-described vinyl polymer to make a composition satisfactory for an extensible and conformable plastic backing. Desired conformability to body contours is also obtained according to the invention by utilizing a film thickness preferably not greater than 6 mils (thousandths of an inch). The thickness, however, is great enough to provide adequate tensile strength.

Although a usual $\frac{3}{4}$ in. plastic strip has been described in the foregoing specification, the principles of the invention apply just as well to larger and smaller bandages, as long as the size of the pad is at least .4 sq. in. in area which, as previously stated, defines the area in which the maceration problem becomes acute. Other modifications and equivalents within the scope of the invention are intended to be included within the scope of the appended claims.

This application is a continuation-in-part of application Serial Number 504,882, filed April 29, 1955, now abandoned.

The claims are:

1. An adhesive bandage useful for surgical purposes and adapted to avoid undesirable maceration when in contact with the body under normal usage conditions, comprising a backing of extensible plastic, a commensurate layer of pressure-sensitive adhesive on said backing and an absorbent dressing pad secured to a portion of said layer

of adhesive backing, said layer of adhesive and said pad being covered by at least one overlying facing strip adapted to be removed therefrom prior to use of the bandage, said pad having a weight at least equal to that of a compress of the same area composed of four layers of 44 x 36 gauze and having an area sufficient to cover at least 0.4 square inch of skin surface, the portion of said backing in contact with said pad having a plurality of substantially uniformly spaced openings, which openings are of a size large enough to permit passage of water and have open areas defined by the expression

$$P = 227 \frac{(A)^{3/2}}{(a)^{1/2}}$$

where the symbol "a" represents the average area per opening in sq. in. units for all of said openings and the symbol "A" represents the ratio of open area to area of the pad, the magnitude of "P" is at least 25, the magnitude of "A" is not greater than about 0.25, and said pad being adapted to transfer liquid water from the surface thereof (which in use is adjacent to said skin surface) to the openings in the backing at least as efficiently as said compress.

2. A bandage of claim 1 wherein the number of openings is at least about 17 per square inch of pad area.

3. A bandage of claim 1 in which the backing comprises vinyl polymer resin and has a layer of pressure-sensitive adhesive to which the pad is secured.

4. A bandage of claim 3 wherein the openings are holes of at least about 0.02 inch equivalent diameter.

5. A bandage of claim 4 wherein the holes are of at least about 0.03 inch equivalent diameter.

6. A bandage of claim 5 having about 41 holes per square inch of pad area, and the equivalent hole diameter being about 0.032 inch.

7. A bandage of claim 5 having about 34 holes per square inch of pad area, the hole diameter being about 0.044 inch.

8. A bandage according to claim 3 in which "A" is not greater than about 0.05 and "P" is at least 48.

9. A bandage of claim 5 wherein the average hole diameter is about 0.126 inch.

10. A bandage of claim 3 wherein the holes are of different sizes, the largest hole diameter being about 0.03 inch, and "P" is about 83.

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