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G. A. BRENNAN

3,267,052

ADHESIVE APPLICATOR CRAYON

Filed April 29, 1963

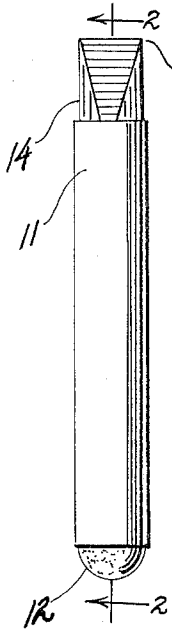


FIG. 1

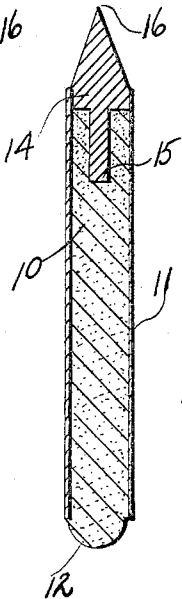


FIG. 2

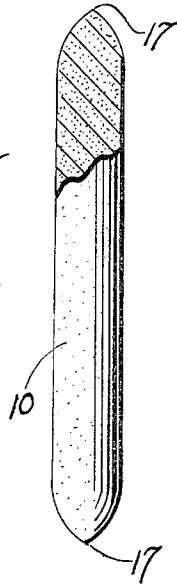


FIG. 3

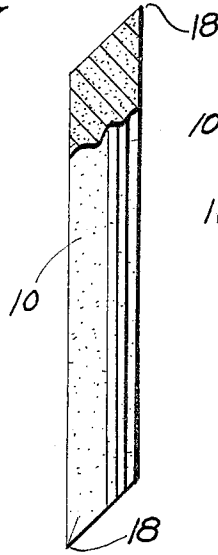


FIG. 4

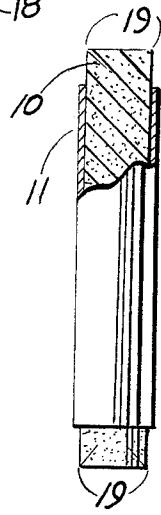


FIG. 5

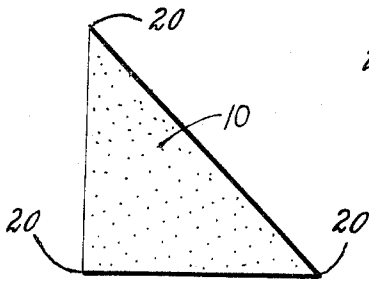


FIG. 6

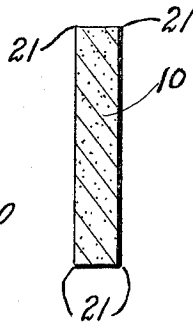


FIG. 7

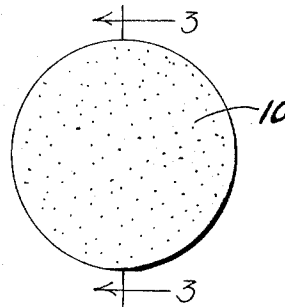


FIG. 8

GEORGE ANDREW BRENNAN
INVENTOR.

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3,267,052

ADHESIVE APPLICATOR CRAYON
George Andrew Brennan, 2203 Walnut St.,
Philadelphia 3, Pa.

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2 Claims. (Cl. 260-5)

This application is a continuation in part of my prior application filed March 4, 1958, Serial No. 718,997, that of February 25, 1957, Serial No. 641,855, and my pending application filed July 28, 1960, Serial No. 45,820.

This invention relates to adhesive devices and to methods of applying adhesives. More particularly, the invention pertains to implements, tools or crayons formed of special thermoplastic adhesive compositions and to methods of applying adhesives for joining together objects, e.g. sheets of paper, without the need for heating devices, mechanical fastening devices or liquid adhesives.

There are a multitude of known commercially available adhesive devices, products and compositions which may be employed to adhere or fasten two sheets of paper or similar material together. In connection with such devices it is necessary to consider not only the shortcomings of and limitations of various types of adhesives themselves, but to also consider the deficiencies in the receptacles or containers of adhesives, applicators or combinations of container and applicator.

The adhesives heretofore available can be classified into four major categories, i.e., solvent activated, chemically activated, heat activated, and pressure activated.

The solvent activated group of adhesives encompasses a wide range extending on one hand from gummed paper, such as postage stamps, which are moistened just prior to use, to the common liquid glues and cements which are kept in solution by a solvent, and then permitted to dry to form a bond.

Gummed papers are convenient, in that they are non-liquid and require no elaborate containers or applicators but this advantage is somewhat offset by the fact that unless a person is willing to moisten them from the mouth, it becomes necessary to have a water applicator, which may have many of the same drawbacks as an applicator of a liquid adhesive.

Liquid glues and cements are frequently sold in dispensing containers, such as flexible metal foil tubes, or plastic flasks, with nozzle type applicator tops, or in glass jars or metal cans with screw tops and various types of spreaders.

Regardless of the type of applicator used, all liquid adhesives have the common problem of evaporation of the solvent, leaving the adhesive in an unsuitable if not unusable state. Failure to promptly reclose containers aggravates this condition, and faulty closures make the condition unavoidable.

Flexible tubes become cracked or punctured, permitting the contents to leak out, or when accidentally crushed they develop internal pressure which causes the adhesive to spurt out uncontrollably when opened.

Nozzles tend to clog with hardened adhesive, which is increased when nozzle cap is lost, bent or broken.

Screw caps become coated with adhesive and are difficult to open, while brushes and spreaders become caked with hardened adhesive and are clumsy to use.

Many solvents used are both toxic and inflammable, and will permanently damage furniture finishes and synthetic fabrics.

Even water soluble glues tend to mar varnish, and cause paper and other fibrous materials to swell, making paper wrinkle or distort.

Water soluble adhesives are impractical to remove from paper, once applied, often making messy joints, especially where the papers must be accurately aligned or positioned. Once a liquid coated paper is laid in place

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even lightly, there is an inevitable transfer of the adhesive to the surface on which it was laid. Frequently these liquid adhesives have a tendency to seize to the paper within seconds from the time they are brought into contact, so that further repositioning of the papers becomes practically impossible.

Many types of liquid glues, muscages, and cements tend to stain through paper with age, or to cause dyes in the paper to run.

Obviously all adhesives stored in glass jars or bottles are subject to breakage, and most other containers may be spilled, or when the liquid level becomes lowered the air space above the liquid permits evaporation of the solvent even within a tightly sealed container.

It is also a common problem that solvent liquified adhesives dry at an uncontrollable rate, and it is not generally practical to either retard or accelerate the drying time appreciably.

In the industrial field, and especially the paper laminating industry, heat sealing adhesives have become widely used to overcome these problems and also to achieve better bonds between foils, waxed papers and plastic film.

However, while heat sealing adhesives solve many of these problems, the cost of applicators, and sealers, with their bulk, warm up time, maintenance problems, and burn and shock hazards, makes these devices largely unsuited for home or intermittent use.

Chemically activated adhesives are remarkably strong, and may be made to harden very rapidly, but are the most costly, have the shortest shelf-life, and may be very toxic. Some have no known solvent when chemically set, and so the setting becomes both an advantage and a disadvantage. Chemically activated adhesives are seldom if ever needed to bond paper, and rarely used on most flexible sheetings other than metals.

Another class of adhesives consists of those which are permanently tacky and depend upon external pressure to achieve a bond.

These are largely limited to various types of sheetings with a pre-coated surface of a so-called pressure sensitive adhesive. Such tapes have been coated on both sides so they may be introduced between two surfaces to be joined, but because such tapes are generally difficult to handle, and may require special masking strips to prevent the bonding of such tapes to themselves, they are costly and slow to use.

Pressure sensitive adhesive tapes may be used to fasten edges or adjoining surfaces of articles or materials, but unless the tape is highly transparent the appearance of joint may be objectionable.

Such tapes do have a great advantage over most other adhesives in that they can be peeled off from hard surfaces again, and thus have many temporary uses for which liquid or other permanent adhesives would not be suited. The tapes also have the advantage of instant adhesion. However, when applied to paper or other fragile surfaces they are difficult to remove without damage to the surface.

From the foregoing analysis of the adhesive field it is obvious that no single adhesive is ideally suited to all materials and uses, and that even within the area for which it is best suited, every known adhesive has one or more disadvantages, some of which have been enumerated above.

It is the object of the present invention to provide a new adhesive tool capable of applying a useful pressure sensitive adhesive coating directly from a non-fluid mass, the coating being easily and rapidly applied in either thin continuous films suitable for the temporary joining of thin sheet materials such as paper, foils, or plastics; or when desired, more adhesive deposits of a heavier nature which are suitable for more permanent bonding of such films.

It is a further object of this invention to achieve the aforementioned object while largely or completely avoiding each and every shortcoming previously discussed for all adhesives in all classifications.

Other objects and advantages of the invention will be apparent from the description and claims.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawings forming a part thereof, in which:

FIG. 1 is a view in elevation of an adhesive crayon in accordance with the present invention.

FIG. 2 is a longitudinal sectional view taken approximately on the line 2—2 of FIG. 1.

FIG. 3 is an elevation and cut away view of another form of this invention.

FIG. 4 is an elevation and cut away view of another form of this invention.

FIG. 5 is an elevation and cut away view of another form of this invention.

FIG. 6 is an elevation view of another form of this invention.

FIG. 7 is a cross sectional view of FIG. 8 taken at line 3—3 of FIG. 8.

FIG. 8 is an elevation of another form of this invention.

It should be understood, of course, that the description and drawings herein are illustrative merely and that various modifications and changes can be made in the components and their properties and in the methods disclosed, without departing from the spirit of the invention.

The invention in its broadest aspects is based upon the use in varying proportions as hereinafter referred to, of a tack providing component or factor, a plastisizing and tack enhancing component or factor, a mark-off promoting and film spinning component or factor, a frictional heat generating component or factor and a delayed hardening component or factor. These 5 components or factors may be supplied by as few as three materials or by five or more. But in all cases, three materials are essential: a hard resin, a soft rubber or rubber like material, and a soft wax. Each of the three basic ingredients performs three or more primary and secondary functions when in the presence of the other two basic ingredients, as will be more fully described elsewhere in this specification.

These components are combined in the form of a pressure sensitive, thermoplastic adhesive which is shaped into an elongated or crayon-like body. This body being capable of being frictionally activated at the working end or tip of the crayon by the frictional heat generated in and on the surface of the adhesive as it is drawn across the surface of a firm, dry material, such as a sheet of paper.

This frictional heat at the working tip of the tool or crayon is achieved first from the frictional contact between the working tip of the tool and the material upon which it is drawn, and secondly, by the internal friction generated within the adhesive itself, as it is suddenly elongated in the direction of stress produced by the movement of the tool across the surface of the contacting material.

This motion of the tool tip across the contacting material thus softens the material so that it is free to be spun off the contacting point in a continuous adhesive film. The spinning or stretching of the adhesive contributing additional frictional heat generated within the adhesive and further softening the material. It is thus rendered both easier to spin off the tool and easier to effect the transfer from the tool tip to the contacting surface. This is referred to as mark-off. The material of the tool is thus transferred and left in an abnormally tacky and softened state.

Several mildly pressure sensitive adhesive crayon-like devices have previously been developed, including those made entirely of adhesive waxes and resinous materials.

In my prior applications, Serial No. 641,855, and Serial No. 718,997 there were disclosed solid adhesive wax crayons which utilized a low molecular weight polymer of isobutylene to both provide additional tack to a tacky blend of microcrystalline waxes, and also to facilitate its application to a firm surface from the solid state. However, the large proportions of waxes in the formulations limited their adhesiveness so that their primary usefulness was in the field of paper toys, such as paper dolls, where mild or temporary adhesives were all that was desired.

In my recent application, Serial No. 45,820, now pending, it was disclosed that more adhesive materials could be successfully substituted for part of the wax or waxes in earlier formulations. This was made possible by using the frictional heat generated by the movement of the adhesive on a firm, dry surface, to cause the adhesive to soften at the point of contact and become less cohesive and more adhesive than in the unactivated and unsoftened state. This frictionally activated adhesive was then in condition to be spun off the body of the crayon by the same motion of the crayon which produced the frictional heat. Thermoplastic adhesive resins were taught to be especially useful in both increasing the adhesiveness of the adhesive body, and also in generating frictional heat when used as described.

It was also disclosed that hydrocarbon polymers, and especially low molecular weight polymers of isobutylene, such as the non-solid polymers with molecular weights of from 1,000 to about 20,000 were useful not only as an adhesive ingredient, but also that they contributed to the frictional heat and softening of the material at the working face or tip of the tool or crayon, and to the spinning off of thin, ribbon-like films of this softened adhesive.

It was also recognized in the pervious application that small quantities of butyl rubber or natural rubber latex had beneficial effects in low concentrations, especially in the presence of plasticizing oils.

Various other valuable ingredients and rules for formulating satisfactory and useful adhesive bodies were previously known and disclosed in my last application on this subject.

As now comprehended and claimed, this invention is based upon the ability of certain combinations of soft wax, hard resin, and soft rubbers to produce at least five cooperating actions within the adhesive composition used to manufacture the crayons or adhesive tools described here. Table I shows the factors supplied by each type of material.

TABLE I		Contributes
Material:		
Hard Resin	-----	Tack Frictional heat Film spinning
Soft rubber	-----	Tack Frictional heat (Internal) Film spinning
Soft wax	-----	Plasticizing and tack enhancing Mark off Delays hardening Tack (Mild)

The soft wax or waxes may be used in proportions of from about 20% to as high as 75% in special cases.

The soft waxes plasticize and enhance the tack of the resins, both in the unactivated state, and especially when frictionally activated with heat. They largely contribute the ability of the crayon to mark-off or transfer to a surface over which the crayon is drawn. Japan, stearic acid, paraffins and spermaceti are most important for this action. But probably the most important contribution of the soft wax is to maintain the applied film of adhesive

in a softened and activated state for a period of time. For unless this were done the coating would return to a relatively hard and tackless condition within a few seconds required for the frictional heat to dissipate.

The soft wax can also contribute directly to the tack of the adhesive. For this purpose microcrystalline waxes with melting points below about 180° F. are most useful, with bees wax, Japan, ozokerite, ceresin and hard tallow also useful to lesser degrees.

The hard resins found most suitable for this purpose are brittle at 70° F. although they may undergo some "cold flow" over a period of time. The processed resins are also preferred over unprocessed natural resins, although natural wood rosin, para-coumarone-indene, dammar and ester gum resins are of some limited value. The hydrogenated terpenes, including polymerized terpenes, phenolic terpenes, and polymerized rosin esters and hydrogenated rosins with melting points of approximately 150° F. or more have been found the most useful.

One or more resins in proportions of from 15% to 75% by weight, may be used to achieve various functions, in the adhesive.

The resin or resins contribute largely to the adhesiveness of the crayon, control the softening point in combination with the waxes used, contribute greatly to the creation of frictional heat, both at the surface, and to a lesser degree, to internal friction. Where no special hardener, such as a hard wax, is used, the resin determines the overall hardness of the crayon.

The rubber ingredients found to be most generally suited are actually hydrocarbon polymers with molecular weights of from about 1,000 to 25,000, and in quantities of from about 1% to 35% by weight. However, other rubbers such as butyl or natural latex may be used singly, in place of, or in combinations with these lower molecular weight polymers in proportion up to about 15%, providing that they are sufficiently plasticized to reduce their "nerve" or toughness and increase their tack. Soft waxes, especially Japan wax, can plasticize the rubber, but the use of a suitable plasticizing oil is often desirable. Generally these should be of a mineral origin, naphthenic and paraffinic oils which are highly saturated are suitable. These oils will also improve the tack of the harder resins, although fatty acid oils of animal or vegetable origin have a much greater tack producing action on the resins suggested.

Butyl rubber may be defined as a synthetic rubber-like material which is a copolymer of an olefine and a diolefine, for example, a copolymer of a major proportion of isobutylene and a minor proportion of a diolefine copolymerizable therewith, such as, butadiene-1,3, isoprene, 2,3-dimethyl butadiene-1,3, pentadiene-1,3, is referred to in British Patent 523,248, and in Industrial and Engineering Chemistry, 32, pages 1283 et seq. (1940).

The rubber ingredient should be of such softness in the crayon composition as to tend to spin a film when the adhesive is stroked rapidly across a sheet of paper. While this film spinning action is essentially the function of the rubber, it also generates considerable frictional heat especially within the film of adhesive as it is drawn off the crayon. The soft rubber also adds tack, especially in combination with the resin.

All three prime ingredients may be used in more than one form to achieve the desired characteristics. The waxes in particular admitting of many combinations.

In addition to these three primary and essential ingredients, several additional modifying agents have been found useful in formulating various adhesive crayons, especially where a particular characteristic or use is desired.

One of these is the area of hard waxes and related materials. These are generally in the group with melting points of from about 180° F. to over 200° F. and include oxidized microcrystalline wax, oxidized paraffin, hydrogenated vegetable oils, such as castor oil, carnauba, mon-

tan, candelilla, sugar or rice wax. Various high melting resins, such as polymerized and phenolic terpenes, alone or with high melting waxes are useful, as is low molecular weight polyethylene resin. This latter material makes possible adhesive films that have a relatively clean peeling property.

The use of plasticizing oils has already been mentioned in the discussion of softening high molecular weight rubbers, and in increasing the tack of higher melting point resins.

Another additive that is considered essential for any crayon where prolonged holding properties are essential, is in the area of oxidation inhibitors.

Because rubbers, resins, and most waxes and oils are subject to deterioration through oxidation, and especially so when spread out in thin films on porous materials, such as paper, the use of stabilizing chemicals is most desirable.

Many excellent oxidation inhibitors are widely available under a variety of trade names, and suited to this use. One such group is the sterically hindered phenols, such as 2,6-di-tert-butyl-p-cresol or 2,6-di-tert-butyl 4 methylphenol. These can be used in proportions of from about .01% to 1.0% or even higher. The use of an oxidation inhibitor is also valuable in helping to prevent darkening of the molten adhesive during the compounding and forming operations.

To compare the relative holding power of coatings applied from various formulations of the present adhesive crayons, and to compare these with previous compositions it was found necessary to modify previously used test procedures.

Smooth vellum cards of about 50 pound stock and three by five inches in dimensions were joined in a one square inch area by applying a heavy coating of the test crayon to one card by repeated rapid strokes in an area slightly more than one square inch, and centrally located to the side edges but near one end of the card. This was immediately covered with the opposite end of a duplicate uncoated card and the two pressed together at the adhesive location by means of a one kilogram weight resting on a one square inch soft rubber pressure block for five seconds at 72° F.

The test sample was then permitted to cure for a measured period of hours. At the end of the cure period the sample was tested by clamping the free ends of the cards in a tensiometer, calibrated to 3 kilograms in 14.5 inches, in increments of 100 grams.

In previous tests, thin films of test crayons were employed to join paper strips with a light weight, and the test was concluded as soon as the joint was complete. Not only did the thin adhesive coatings give less consistent results, but they were not indicative of the maximum strength of the adhesive. Nor did this show the effect of time on the various adhesives used.

TABLE II

Formula	2 Minutes	2 Hours	12 Hours	24 Hours
956-----	1,200	1,550	1,200	1,200
971-----	900	1,300	2,400	1,500
998B-----	900	2,600	3,000	1,300
999B-----	1,150	2,200	2,900	1,300
1,000-----	700	2,650	2,450	2,100
1,035-----	550	1,600	1,700	1,700
1,037-----	800	2,000	3,100	2,200
1,038-----	650	2,700	2,200	2,100

¹ Plus.

NOTE: All readings are grams per square inch when sealed with one kilogram weight. Soft microcrystalline wax has an approximate rating of 150 at all time intervals shown.

It is a phenomenon of the wax-resin-rubber mixtures which form a basis for this invention that they remain in a subnormal state of softness for a period of time, ranging from some minutes to many hours, after the coating has been applied. In many cases the holding strength of joints increases greatly in a matter of minutes. Table II

shows the relative strength of some typical formulations of crayons at various time intervals. It should be pointed out that these are not maximum strengths for any formulation, as the strength of joints can be increased by using higher joining pressures. In the tests, only approximately 50% of the one square inch test area was actually found to have been joined. Even with these joints, however, some formulations increased in strength by as much as 2,000 grams per square inch in two hours curing time, and reached a maximum of over 3 kilograms in 24 hours or less.

While no calibrated test was devised to indicate the relative ease of application of various formulations of crayons, there is a very wide difference in this ability. The tougher and more cohesive the formulation, the more difficult it is to separate a film of the material from the crayon body. It has been found that the higher the initial strength of a formulation tested, the more difficult

the film of adhesive will be to separate from the crayon in the manner taught by this invention.

However, the cured strength of a given adhesive crayon is in no way indicative of the ease of application.

A related observation is that in two adhesive crayon formulations of equal cured strength, the formulation with the lower softening temperature will apply a film in the manner taught, with less physical effort than the formulation with the higher softening point. For this reason the softening point of the formulation should be generally kept as low as practical.

It should be mentioned that while the successful application of a film of adhesive from the crayon depends upon the hardness differential between the body of the crayon and the film of adhesive at the working tip of the crayon, it is neither essential nor necessarily desirable that the body of the crayon be harder than needed to withstand the pressure and stress of application.

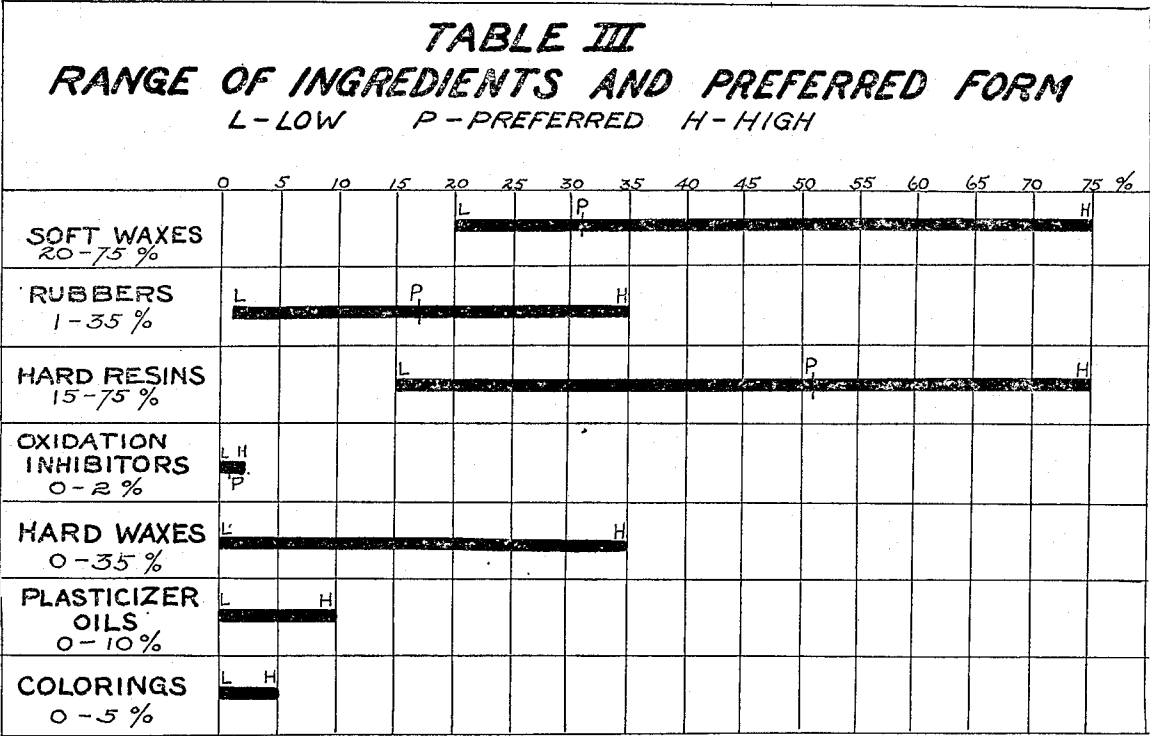


TABLE IV

Formula.....	#39	#715	#971	#921	#931	#985	#998	#999	1000	1035
Ingredient:										
#1.....	51		6				10	10	10	10
2.....		5		3	5	5				
3.....		4					8	10	12	8
4.....			3	1		1				
5.....				2						6
6.....		4	4	2	1	2				
7.....	16	4	4	2	5	x	10	10	10	10
8.....		1/4		1/10		1/2				
9.....	16.5									
10.....	16.5									
11.....		9	9	9	10	9	15	15	15	15
12.....			9				15	15	15	15
13.....		9								
14.....		.01	.5	.01	.1	.1	.5	.5	.5	.5
Strength, grams per sq. in., 2 hours.....	300	2,200	2,150	1,200	950	1,300	3,000	3,000	2,700	2,100

- Key to Ingredients:
- 1. Microcrystalline wax 165° F.
 - 2. Microcrystalline wax 170° F.
 - 3. Japan wax.
 - 4. Stearic acid.
 - 5. Paraffin 128° F.
 - 6. Polyethylene 210° F.
 - 7. Polyisobutylene 10,000 m.w.
 - 8. Butyl rubber 50,000 m.w.
 - 9. Oxidized microcrystalline wax.
 - 10. Phenolic terpene resin 200° F. plus.
 - 11. Glyceryl ester of hydrogenated wood rosin 183° F.
 - 12. Polymerized terpene resin 115° C.
 - 13. Polymerized terpene resin 70° C.
 - 14. Sterically hindered bisphenol.

It has been observed that softer formulations generally have a more prolonged surface tack, and where this quality is desirable, the normal hardness of the cured adhesive should be as low as possible. This prolonged tack is also present in formulations which maintain a good bond on the surface of materials for prolonged periods, in terms of months or years. And this is most true in bonding plastic and metal films. A wax penetrometer reading of from about 15 mm. to 45 mm. at 77° F. in the cured adhesive is thought to be the ideal range. The range of ingredients is illustrated in Table III with low limits being designated as L, the high limits designated as H and the preferred proportions of ingredients being approximated as P in the table.

Table IV illustrates several formulations having one or more distinctive characteristics considered to be useful under various conditions. It will be noted that several of the formulations approximate the preferred balance of the three essential elements, but do not necessarily use the same quantities of each individual ingredient.

As with most wax formulations, it is advisable to start the formulation with the highest melting point ingredients, which are usually the resins. It is also advisable to mill the rubber into the mineral wax and add any plasticizer needed to soften the rubber, before attempting to combine these ingredients into the balance of the formulation. Oxidation inhibitor should be added to both the rubber-wax mixture and to the resins at the start of the mixing and melting down operations to avoid deterioration of these ingredients. A steam jacketed wax kettle with power driven mixing blades is highly desirable for the proper melting and thorough mixing of ingredients. The low melting point waxes, especially vegetable waxes, such as Japan, are most easily damaged by excessive heat, so should be added last, with the kettle heat turned off. The batch should then be poured out in shallow molds or thin slabs, as soon as the mixing is complete, so as to avoid holding the mixture in the molten state any longer than necessary.

It is, of course, possible to pour the freshly formulated adhesive into its final form while still molten. To do this it is suggested that porous molds, such as plaster of Paris, or wood be used, and that the interior surfaces be moistened with glycerine to prevent the adhesive from sticking to the mold.

The stick may be of any convenient cross-sectional diameter and shape, and may be as thin as one quarter inch in diameter, while for various heavy duty applications a stick an inch or more in diameter is useful. Generally it has been found that a cylindrical stick of about $\frac{5}{16}$ inch to $\frac{3}{8}$ inch is desirable. Where the body 10 of the crayon or applicator is cylindrical or rod shaped it is preferably circumferentially enclosed within a sheath 11 of metallic foil or plastic. The body 10 should protrude slightly from the sheath 11 and may be made with a variety of shapes to provide the important working tip. Various shaped working tips are illustrated as 12, 17, 18, 19, 20, and 21. The precise shape is not material so long as there is a convex or pointed area from which to apply the adhesive. Actually the use of the applicator or crayon will constantly change the profile and general shape with wear, but as the successful application always depends to some degree upon frictional heat, a working tip of limited area will provide the concentration of frictional heat needed.

It is practical to pour the molten adhesive directly into the sheath 11 to form a stick of FIG. 1. Tubes of foil are shaped and stood in wooden or plaster forms with the lower end fitting snugly in holes in the material. These recesses should be shaped to mold the working tip 12 and should be treated with a coat of glycerine to prevent the adhesive from sticking. The tubes are then filled with molten adhesive and the cap 14 inserted in the partly cooled body 10 so that the tang 15 will be securely embedded. If the cap 14 is made of hard wood or

plastic it will provide a convenient blade 16 to seal joints with minimum effort.

To avoid holding the adhesive in the molten state for long periods, however, as well as to reduce the cost of production, it is suggested that the material be extruded from a crayon extruding machine. This will normally only require that the adhesive be warmed to a soft state, from which it can be extruded quite rapidly. If this extruded shape is then cooled in a water bath to about 40° F. it may be readily cut into short lengths and wrapped in paper or other material while still cold and moist. Shapes such as shown in FIG. 4 and FIG. 5 are well suited to extrusion.

Shapes such as those shown in FIG. 3, FIG. 6 and FIG. 8 may be molded in wooden or plaster molds coated with glycerine.

While there is no one formulation of these adhesive crayons which can be considered ideal for all purposes, there are numerous characteristics which are generally desirable in an adhesive of this type. It should apply smoothly and with little physical effort, should apply a highly tacky coating which maintains its tack for a prolonged period after application. It should form a firm bond with paper and most other types of material, and its bonding strength should improve rapidly and sustain a high level of bonding strength for a prolonged period.

A formulation of this type, which admits of numerous minor variations, and is suggested for general use with paper, consists of the following parts by weight: 10 parts polyisobutylene 10,000 molecular weight; 10 parts microcrystalline wax melting at 155° F. to 175° F.; 15 parts glycerol ester of hydrogenated wood rosin melting at about 183° F.; 15 parts polymerized terpene resin melting at about 115° C.; 8 parts Japan wax; and .5 part sterically hindered bisphenol antioxidant.

This is designated as Formula 998 in the tables. It may be made firmer by using the higher melting point microcrystalline wax. To make it apply more freely paraffin may be added or substituted for the microcrystalline or for part of it. Additional Japan wax will give a wetter acting adhesive, while the addition of more of the hard resins will harden the adhesive, raise the melting point, and give adhesive films with less tendency to transfer to a second surface.

As with every other adhesive known, it is essential for good results that these adhesives be selected and used with due consideration for their capabilities and limitations.

Because the cohesive strength of these adhesives must be within certain limits if the material is to be separated from the body of the adhesive as a film or coating, their principle uses must be considered to be of a temporary or semi-permanent nature. However, in the field of paper adhesives they are generally as strong as the surface fibers of the paper, so that when properly applied and joined, may be used as a permanent adhesive.

If, for example, it is desired to mount newspaper clippings into an album, this can be readily accomplished without encountering many of the problems often associated with this task.

The clipping should be placed on a smooth table top with the reverse side of the clipping uppermost, and while it has a surplus border of paper beyond the actual material to be mounted. The clipping is then held firmly to the table with the fingers of the left hand near the center. If an adhesive tool of this invention is then held in the right hand with the thumb and fingers grasping it near the exposed tip or applying end, and it is stroked rapidly onto the paper in short strokes which start near the fingers to the left hand and move away towards the edges of the paper, lifting the tip free of the paper before terminating each stroke, the paper may be easily and rapidly coated with a thin tacky film of adhesive.

This coating operation may be accomplished at a leisurely pace, for there is no need for haste, as with wet

adhesives. When the back of the clipping has been largely coated with radial strokes of about one eighth of an inch in width, the clipping will be sufficiently coated to hold securely to most papers. Should greater adhesiveness be desired, it is only necessary to build up a heavier coating of adhesive with additional strokes, or if a less permanent bond is desired, the coating need only be abbreviated. At this point the clipping may be trimmed to the finished size without serious inconvenience from the adhesive coating, and thus bringing the adhesive to the extreme outer edges of the clipping without the slightest possibility of the adhesive smearing over to the face.

When the coating and trimming have been completed, it is only necessary to position the clipping on the page and press it firmly into place. Here again, unlike conventional adhesives, the degree of bond is subject to variation, simply by varying the bonding pressure.

It should also be noted that the clipping may be placed in limitless trial positions without smearing or otherwise defacing the surface on which it is laid, as no appreciable transfer or adhesive will occur, as is common with liquid adhesives. Nor will the adhesive grab or seize to the page, as with various rubber cements, which are applied to both surfaces to be joined.

When the clipping is thought to be properly placed it may be lightly pressed down, in which case it will adhere but lightly, and may easily be removed again without damage.

For maximum mounting strength it is advisable to lay a sheet of protective paper over the clipping and rub over the protective sheet with a hard object, such as the special cap 14 of FIGURE 1.

Should it ever be desired to remove the clipping, it is only necessary to soften the adhesive by exposing it to moderate heat, such as an electric hair dryer, or an electric light bulb, and the softened joint may be readily separated again without damage to either paper.

Where it is desirable to remove traces of the adhesive from paper it is only necessary to rub the spot briskly with a soft rubber eraser of the type referred to as "art gum." This type of eraser creates sufficient frictional heat to soften the film of adhesive and at the same time to work into it crumbs of the eraser. This action soon reaches the point where the adhesive no longer can adhere to the paper and it can be brushed away. On most other types of material the adhesive may be rapidly wiped away with a cloth moistened in a hydrocarbon solvent such as solvent naphtha.

Several other valuable techniques for applying and using these adhesive crayons have been found, such as that of applying and using this material in extra thick and tacky coatings to one or more local areas. This is done by rubbing the adhesive crayon rapidly and repeatedly on a small spot. This action resembles that of erasing a small stubborn ink spot from a piece of paper. If the adhesive crayon is applied in this manner to an area an inch or less in length, the adhesive will quite abruptly become semi-fluid under the crayon tip and will apply in a thick tacky state.

If such tacky spots are applied near the corners on the reverse side of small photographs they will hold the pictures securely enough for most photographic album mounting requirements. The mounting is not visible, does not curl the photograph adheres instantly, yet can be mounted in a leisurely manner, may be repositioned if desired, and may be removed again at any later time without damage to the album or picture.

In many cases it has been found that small lumps of the adhesive form a better bond than the thin films previously described.

A very convenient method of applying small dabs of the activated adhesive directly from the crayon is to press the side of the crayon tip to the surface so that it is held at about a 45° angle to the surface, with the thumb and

fingers grasping the stick close to the contacting end. From this position the wrist is rotated to turn the stick about one eighth of a turn, while at a fixed position on the contacting surface. This movement is concluded by moving the adhesive crayon laterally across the surface to which it is being applied, for a short distance, and finally lifting the tip free of the surface. These combined movements leave a small dab of the activated adhesive about one half inch long, and terminating in a pointed or feathery edge where the applied adhesive separates from the tool. By repeating this movement a number of dabs may be quickly spaced across an area. Such dabs are especially useful in bonding non-flexible materials and objects together where the contacting surfaces would be too limited to form a good bond if the thinner adhesives films were employed.

One use for these adhesive dabs is in temporarily holding small items of hardware for trial placement, or in precise locations for making pilot screw holes or the like. For example, properly positioning the striker plate of a conventional door catch becomes a very simple operation if it is adhered to the door jam with dabs from this adhesive crayon and moved to the proper location. Once the proper position is found it may then be marked on the wood with a pencil or scribe and the proper area cut away. Without this technique such a task can be most exacting and time consuming. Many variations of this useful expedient are possible.

Numerous uses have been found for such an adhesive crayon in the home repair and hobby fields, including the holding of templates, gaskets, and shims in place during assembly. Or such dabs will hold nails, screws or machine nuts to the tool where manual holding would be difficult or impossible. Even sheet abrasives may be held to either a sanding block or even the bare hand by means of adhesive from these crayons.

A piece of paper coated with adhesive stroked on from one of these crayons will remove lint and hair from clothing, rugs or upholstery, or it will provide a much improved grip when turning off tight screw lids and caps from jars or bottles.

The adhesive is useful in sealing down scuffed shoe leather or providing shoe laces with a non-slipping knot. Or, it will quickly and easily join film leaders to camera winding spools.

In the kitchen, these adhesive devices will provide both temporary and permanent food labels, reseal packages with paper, foil or plastic films, mount shelf papers, menus or other papers.

In offices many uses will suggest themselves in connection with the handling of papers, such as temporarily mounting labels for easy typing and handling, sealing poorly gummed envelopes, overmoistened stamps, posting bulletins, joining papers for files, or enclosure to correspondence.

In school, possible uses for these adhesive crayons range from non-spilling adhesives for young art students to installing book covers, holding tracing papers, and making movable charts and graphs or other visual aids.

Among the many uses of these adhesives for play and recreation are the clothing of paper dolls, joining of take-apart toys, construction sets, making decorations, greeting cards and the like, and providing a tacky surface for various game boards to convert them for travel use.

In the industrial field adhesive coatings from these crayons will help prevent shipping cartons from shifting during transit.

One of the most unique uses for these adhesive crayons is to provide an adhesive path for the wheel of a glass cutter so that the wheel will rotate uniformly in its movement across the sheet of glass and thus score the glass with unprecedented uniformity and certainty.

In many of these and other uses it will be seen that highly adhesive, liquid or permanent adhesives would be less desirable or often unsuitable, whereas the moderately

tacky adhesive from these crayons serve the purpose well.

I claim as my invention:

1. An adhesive applicator crayon consisting essentially of a ductile, homogeneous body of a thermoplastic pressure sensitive adhesive having the characteristics of becoming softer and less cohesive at the area of contact and under the influence of the frictional heat generated when a small exposed area of the said body is drawn rapidly in frictional contact with a smooth, dry, paperlike surface, and then being capable of transferring a thin, smooth layer of the softened adhesive to the said dry surface, and the said smooth layer of adhesive remaining in a softened state for a period of time thereafter, the said body being composed essentially of from 20% to 75% of a soft wax, of from 1% to 35% of a soft rubber, and from 15% to 75% of a hard resin.

2. An article of claim 1 in which the said body is composed of a wax from the group consisting of Japan, stearic acid, paraffin, spermaceti, microcrystalline, bees, ozokerite, ceresin, and hard tallow; of a rubber material taken from the group consisting of polyisobutylenes with a mo-

lecular weight of from about 1,000 to 25,000, plasticized natural rubber, plasticized butyl rubber; and a hard resin taken from the group consisting of wood rosin, para-coumarone-indene, dammar, ester gum, hydrogenated terpene, polymerized terpene, phenolic terpene, polymerized rosin ester, hydrogenated rosin, and hydrogenated rosin ester.

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EARL M. BERGERT, *Primary Examiner*.

H. F. EPSTEIN, *Assistant Examiner*.