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J. F. LANGAN

3,352,045

APERTURE CARDS AND THEIR MANUFACTURE

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2 Sheets-Sheet 2

FIG. 2.

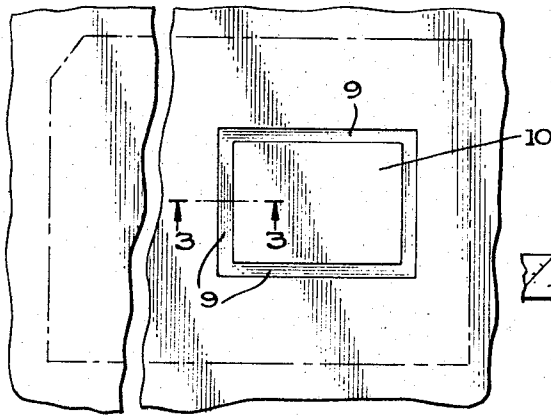


FIG. 3.

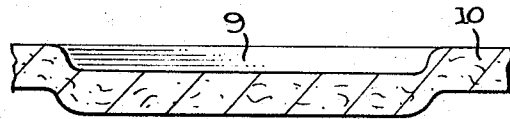


FIG. 4.

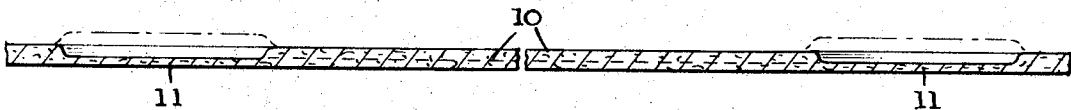


FIG. 5.

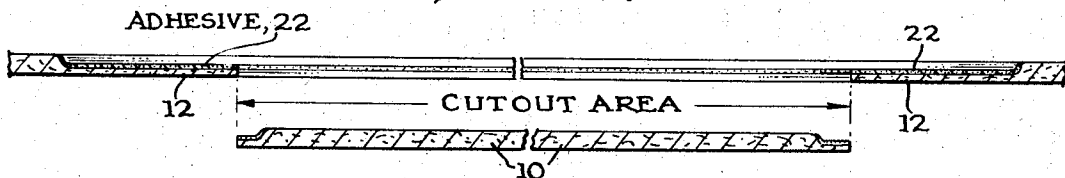
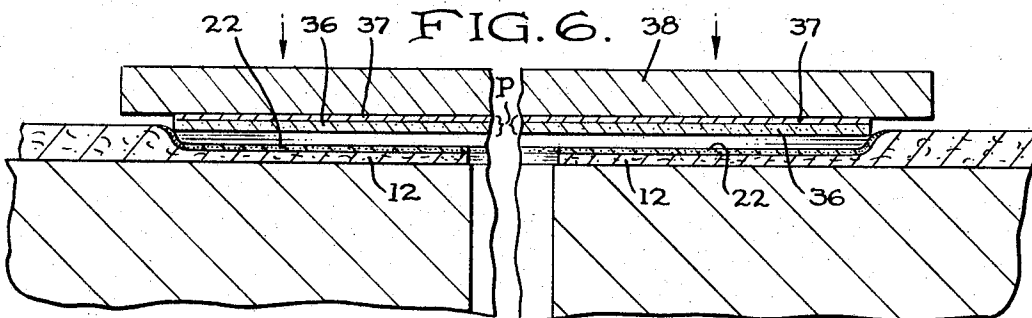


FIG. 6.



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APERTURE CARDS AND THEIR MANUFACTURE
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1 Claim. (Cl. 40—158)

This invention relates to improvements in cards adapted for mounting projectable transparencies such as for example film record cards in which individual microfilm sections are mounted to facilitate the handling, filing and storage of the transparencies, and also the sorting out, projecting and if desired the reproducing of individual transparencies when desired. The invention relates especially to novel blank cards adapted for such uses and to their manufacture.

The invention is particularly useful in mounting microfilm sections in cards that are capable of being sorted mechanically, although it is not limited to this use as explained hereinafter. Various types of mechanical sorting systems are well known. They range from systems in which groups of related cards can be separated and extracted from a stack by inserting a pin or like instrument through aligned holes in the edges of the cards, to the elaborate and well known IBM system in which the cards are perforated according to a code and are sorted by electrically controlled apparatus responsive to the location of the perforation in the individual cards. However, the invention also comprehends the mounting of projectionable transparencies, including all types of photographic film records, in ordinary file cards, catalog cards, and the like.

With reference to machine sorting of the IBM type, the present invention comprises important improvements of the "punch cards" or "aperture cards" disclosed in the prior Langan U.S. Patents Nos. 2,511,859, 2,512,106, and 2,587,022, and in the prior Langan et al. applications Ser. No. 191,117, filed Apr. 30, 1962 and Ser. No. 280,406, filed Apr. 26, 1963, as well as in the preparation and use of such cards. Aperture cards of the type shown in these prior patents (including "copy cards") have been very widely used, especially by the United States Government, for purposes such as the preparation and distribution of engineering data, i.e., drawings, specifications and the like, the duplication of such records at different locations, and so on. In spite of such widespread use, however, these aperture card systems suffered from serious practical defects. As supplied in bulk quantity to the ultimate user, i.e., before the film was mounted therein the cards were generally of the type disclosed in the prior Langan U.S. Patent No. 2,511,859, mentioned above; that is, apertures were already formed and strips of pressure-sensitive adhesive material were secured to the backsides of the cards around the edges of the apertures with narrow section of these strips extending into the apertures with exposed adhesive thereon for subsequent mounting of transparencies in the apertures. This exposed tacky adhesive was usually covered by a temporary sheet of glassine paper or similar material.

A problem arose from frequent sticking together of such cards due either to exposed pressure-sensitive adhesive in the case of imperfect preparation, or to "bleeding" of the pressure-sensitive adhesive material from underneath the edges of the protective glassine cover sheet or the edges of the transparency itself. In such cases the separation of cards for perforation according to a mechanical sorting code, or for the operations of mounting sections of film therein, or during subsequent use of the finished cards for machine sorting, projection, and the

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like, was hindered to an extent which militated seriously against the usefulness of such systems.

Furthermore, any increase in thickness of such cards is very undesirable. Even though the applied strip of adhesive only increased the thickness of the card by, say, $\frac{1}{1000}$ th of an inch, still when a deck of 1000 or more cards were stacked in a file drawer, there was a difference of an inch or more in the length of one side of the stack as compared with the other.

Still further objections to such prior systems arose from the fact that the operations involved in preparing the cards, i.e., punching out the apertures and then applying the adhesive strips and the cover sheets, required objectionably elaborate and expensive apparatus such as illustrated for example in the prior Standish U.S. Patent No. 2,666,543. The general practice followed was to apply a continuous patch of adhesive material to the backside of the card so as to cover the entire aperture, and then to die out the central part of the adhesive only, leaving a border of exposed adhesive around the edges of the card aperture. These operations were wasteful of material and mechanically difficult to accomplish at the high speeds that were desired for quantity production.

Various attempts were made to eliminate the use of such pressure-sensitive adhesives and to remedy the defects mentioned, but without practical success prior to the inventions of the Langan et al. applications mentioned above. By way of example, the prior Langan U.S. Patent No. 2,587,022, suggested heat bonding of a thermoplastic sheet of cellulose acetate to the edges of the card around the aperture. The material of this cover sheet was proposed to be the same as or similar to that of the base of the film itself, with the thought that subsequently the film section and the cover sheet could be united integrally by heat and pressure to form a unitary transparency across the aperture. Usually heat damage to the film resulted, however, such as clouding and/or buckling or warping of the film. Moreover, the bond formed by heating the cellulose acetate cover sheet and pressing it into contact with the card, or by doing the same thing to the edges of the cellulose acetate base of the film itself, as suggested in the prior Langan U.S. Patent No. 2,633,655, was unsatisfactory. If the degree of heat was only enough to soften the cellulose acetate it would not penetrate the fibers of the card and the bond was weak and unsatisfactory. Attempts to increase fluidity by raising the temperature usually caused warping or buckling of the card itself.

Important steps forward were made in the inventions disclosed in the aforesaid copending Langan et al. applications, and the present invention is based on these prior inventions but departs therefrom in respects which provide a substantially improved aperture card system for many purposes.

Preferably the first step in the present invention is to indent one side of the card around the outline of the aperture eventually to be cut therein, in the manner disclosed in said copending application, so as to form a trench-like depression in one face of the card and a corresponding ridge-like projection embossed on the opposite surface of the card. In the case of aperture cards, this trench will usually be made on the printed face of the card, whereas in copy cards the reverse will usually be true.

It will be apparent that this stamping or embossing operation can be performed by any suitable type of reciprocating or rotating die mechanism. While it has been proposed heretofore to pre-dimple such cards by compressing the edges of the aperture, as for example in the prior Patent No. 2,633,655, the extent of such dimpling that can be produced merely by compression, without em-

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bossing the opposite side of the card, is limited by the compressibility of the card material and as a practical matter a depression of say 0.001–0.002 inch is about the maximum that can be realized with the usual card having an initial thickness of approximately 0.0067 inch. Such depressions are not of sufficient depth to accommodate the thickness of the film (varying from about 0.003 to about 0.0055 inch) and accordingly a very large amount of thinning of the margins of the film by plastic flow and deformation is required in order to approach the desired final condition illustrated in said prior patent. According to the present invention, on the other hand, grooving or indentation of the card on one side can easily be made much deeper by permitting the card material to be embossed on (i.e., to proper form) the other side, the stamping or embossing operation producing a sort of bending or folding of the card material instead of compression thereof.

The next step according to the present invention (again as disclosed in said prior application) is to remove the ridge-like embossed projection from the opposite surface of the card in any suitable manner so as to restore the surface on this side of the card to a planar condition. This can be accomplished by any suitable cutting or shaving operation, but most conveniently by high speed grinding or abrasion applied to the cards while moving relatively past the grinding device. This produces a card which is substantially planar over one side, and is planar on the other side as well except that around the outline of the aperture eventually to be cut out, there is a trench-like depression, the bottom of which is formed by a thin web of card material. An inherent result of this grinding in many cases is that the material of the card originally folded during embossing straightens back to its original position so that the planar condition after grinding is found on the side of the card that was embossed, rather than on the side to which the grinding wheel was applied.

When the portion of the card surrounded by this trench is eventually cut out to form the aperture, the combined thickness of the film and of the ledge around the aperture (which ledge previously formed the bottom of the groove) is not materially, if any, more than the thickness of the card. By way of example, a card initially 0.0067 inch thick may be embossed and ground to a web thickness of about 0.015–0.002 inch in the bottom of the trench around the aperture and the added thickness of the usual silver halide film of say 0.0055 inch makes a total of around 0.007 inch. It will be understood that the depth to which the blank cards are stamped or embossed, and the corresponding thickness of the card material at the bottom of the groove, may vary, depending upon the kind of film to be mounted, the web thickness being for example from about 0.004 inch to about 0.002 inch or less for film varying in thickness within the range stated above.

It will be understood that because of the embossing, the grinding or milling effect is limited to the embossed area while at the same time the desired removal of the raised or embossed material is accomplished by unidirectional movement of the card past the grinding or milling tool in a single pass. During such grinding or milling, the embossed area should be supported against the pressure of the tool at a level at which enough material is ground away to provide a ledge of the desired thinness. Therefore, the card should be left on the embossing die, or placed on a similar die-like support, while removal of the card material is taking place. Preferably this die or support for the bottom of the embossed groove should be high enough so that there will be space or clearance during grinding for card areas beyond the top surface of the support to depress or fall away from the tool and thus limit its effect to an area corresponding closely in shape and extent with said top surfaces. For many purposes it may be satisfactory merely to place the card on a support of the type just described without prior embossing since in any event the area of effectiveness of the grind-

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ing or milling tool will be limited essentially to the area of the supporting surfaces.

In its next step, the present invention differs from said prior applications in that the part of the card surrounded by the trench is removed to form the aperture, the cut being made in the thin material of the bottom of the trench so that the resulting aperture is bounded by a ledge substantially thinner than the remainder of the original card.

Any suitable die-cutting apparatus, either hand or power operated, can be employed for cutting out the apertures in the cards. With the aid of suitable registering means, the cards can be fed one by one to a die means in position that such operation of the die cuts the aperture with its edges lying in the thinned web of card material. Any desired type of feeding mechanism can be used, or the cards can be fed by hand. For some purposes a simple reciprocating die may be satisfactory; it can be operated by hand or foot or by any desired power means. For quantity production, however, high speed apparatus is desirable and a suitable type of high speed rotary mechanism is preferred.

The next operation according to the present invention is to apply a suitable permanently tacky adhesive to the ledge mentioned above on its side to which grinding was applied, this side of the ledge lying below the plane of the corresponding card surface while the other side of the ledge is coplanar with the corresponding card surface. As already stated, the coplanar side will usually be the printed face of aperture cards but the opposite face of copy cards; although these arrangements are not always necessary, they have advantages when an aperture card is to be brought together with an unexposed copy card to make a contact print, because the emulsion sides of the two films can be juxtaposed.

The selection of the adhesive to be used may depend to some extent on the conditions to which the cards are likely to be subjected and the like. Generally speaking, however, any of the various known pressure sensitive adhesives can be used that are permanently or normally tacky under the conditions of storage and handling of the cards and that have good adhesive properties under these conditions. For example, such properties are to be found in various known combinations of latex or synthetic rubbers, synthetic resins such as the alkyds, ester gum and the like, and suitable plasticizers. It may be applied to the desired surface of the ledge in any suitable manner, but for high speed production it is preferred to use suitable rotary applicators. If desired, suitable petroleum solvents can be used to assist in the application of the adhesive and then evaporated.

Finally, the exposed tacky-coated ledge surfaces are covered with what for present purposes may be termed a "cover sheet." In the manufacture of blank copy cards, this cover sheet will be a section of unexposed film of the proper size and shape to cover the aperture including the edges of the surrounding ledges. The film may be of the diazo, silver bromide, or Kalfax type, and for quantity production the sections will usually be cut from a roll and brought into registry automatically with the moving card apertures. Light pressure serves to apply the film sections permanently in place.

In the case of aperture cards, on the other hand, the cover sheet will be a disposable temporary patch of suitable material such as glassine paper, wax or silicone coated paper, cellophane, Mylar, or the like. The preferred materials, including the examples named, have relatively low adhesion for the pressure sensitive adhesive and for this reason may be termed "release-paper" sheets because they can be stripped off with comparative ease for replacement by the ultimate microfilm sections. It will be understood, of course, that the release-paper sheets will normally be cut from a supply roll and then automatically fed to, registered with, and adhered to the apertured cards in

the same manner as the unexposed films sections in the case of copy cards.

Finally, while the cards may be cut to size and passed one by one through the successive operations broadly stated above, high speed production requirements will usually dictate the use of a continuous web which may be several cards in width and many cards in length and is cut into individual cards after the above described operations have been performed.

The accompanying drawings illustrate in diagrammatic fashion one series of operations embodying the invention, but it is to be expressly understood that said drawings are for purposes of illustration only and are not to be taken as a definition of the limits of the invention, reference being had to the appended claim for this purpose.

In the drawings,

FIG. 1 is a diagrammatic illustration of a sequence of steps embodying the present invention;

FIG. 1a is a detail view showing one of the embossing dies in perspective;

FIG. 2 is a plan view showing the condition of a card corresponding to the point A in FIG. 1;

FIG. 3 is a section on the line 3—3 of FIG. 2;

FIG. 4 is a sectional view showing the condition of a card corresponding to the point B of FIG. 1;

FIG. 5 is a sectional view showing the condition of a card corresponding to the point C in FIG. 1; and

FIG. 6 shows the operation of bonding a cover sheet to the card.

Referring first to FIG. 1, the process shown illustrates diagrammatically and by way of example the manufacture of aperture cards which are "punch" cards of the usual type employed with the IBM system of tabulating card machines. These well known cards are formed of stock having a specified thickness of 0.0067 inch with a tolerance of plus or minus 0.0004 inch. As already stated, quantity production requirements will usually dictate the use of a continuous web of card material which is not cut into individual cards until the sequence of operations comprising the present invention has been completed. A web supply roll is shown diagrammatically at 1 in FIG. 1. As already stated, the first step according to the present invention comprises an embossing or stamping operation. When the cards are to be printed, this embossing operation can be combined with the printing press if desired so that the web leaves the press bearing a succession of printed cards in embossed condition. As here shown for purposes of illustration, however, no printing operation is shown and the embossing operation is performed by passing the web 2 longitudinally in succession between the lower embossing roller 3 and an upper backing roller 4 of rubber or the like. In passing between these rollers, the web is embossed in the desired pattern by means of dies 5 carried by the roller 3 at peripheral intervals corresponding with the rate of feed of the web 2.

A detailed diagrammatic view of one of these embossing dies is shown in FIG. 1a. It comprises raised ribs 6 extending circumferentially of the roller 3 and parallel to, but spaced from, one another, the ends of these ribs being cross-connected by transverse ribs 7 so that the ribs together form a rectangular outline to be embossed on the web 2. Of course, other shapes may be desirable. The height of the ribs 6 and 7 will obviously be predetermined so as to produce embossing of the desired depth, depending upon the thickness of the film to be mounted and to some extent also on the yieldability of the rubber backing roller 4. Obviously, the number of dies on the roll 3, and the speeds of the roll and of the web, will be correlated to emboss the web at proper intervals. It will be evident further that a similar die arrangement can be provided on a conventional reciprocating stamping die.

Having been embossed, the web passes from the embossing zone between rollers 3, 4 to a zone in which the operation of removing the embossed ridges from the back of the card is accomplished as described above. While this

can be accomplished by a second pair of rollers, it is preferred to cause the web 2 to travel around with the roller 5 to a grinding position and to provide the desired support against the pressure of the grinding wheel 8 simply by allowing the web to remain on the embossing dies 5. The grinding wheel, by way of example, may be an aluminum oxide wheel running at a surface or linear peripheral speed of approximately 2300 feet per minute, having a wheel grit size of 46-60 and wheel hardness in the range of G to J (the letters at the beginning of the alphabet indicating softer grades). Of course, these values are not critical; for example, the linear peripheral speed of the grinding wheel may vary between approximate limits of 1800 feet per minute and 3000 feet per minute.

FIG. 2 is a plan view at point A of a section of the web 2 from which an aperture card is to be cut, the outline of the eventual card being shown in dot and dash lines. This figure and FIG. 3 show the pattern and cross sectional shape of the embossed area which forms a trench-like depression 9 extending around the area 10 of the eventual aperture. The depth of embossing by the dies 5 may be approximately 0.0045 inch, in the case of relatively thick film such as the usual silver halide film which approximates 0.0055 inch.

In passing through the grinding zone, the embossed ridges are removed from the back of the card as explained above, converting it from the condition shown in FIG. 3 to that shown in FIG. 4 and leaving a web 11 having a thickness of about 0.002 inch. A concomitant of the grinding operation as stated above, is that for reasons that are obscure, the bends or folds caused by embossing straighten out with the result that the web 11 is coplanar with that face of the sheet in which the depression 9 was indented. FIG. 4 shows the condition of the web at point B in FIG. 1, i.e., after grinding.

The next operation is to die out the aperture in the card as indicated diagrammatically in FIG. 5 corresponding to point C in FIG. 1. Preferably the cut is made through the thin webs 11 around the section 10, leaving the major portions of these webs projecting into the aperture and forming thin ledges 12 (FIG. 5) around the aperture. Usually it will be desirable to make the cuts bordering the edges of the cut-outs 10 so as to obtain the desired width of the ledges 12 without unduly widening the trench 9. The ledges 12 thus form extensions of the surrounding portions of the card, being integral with these portions, and although thinner having substantially identical fibrous structure therewith, especially in the sense of being uncompressed.

The operation of cutting out the sections 10 can of course be accomplished by any suitable mechanism such as a reciprocating punch and die. However, for quantity production it is preferred to pass the web 2 in continuous movement through rotary cutting mechanism operating at high speed. Such mechanism is known in the art of cutting out windows or apertures in making various paper products and typically comprises a rotor having projecting knife edges or the like which rotate almost in engagement with a cylinder, so that deep scores or impressions are made in paper passing between them along the lines of the knife edges. Such almost complete cuts are sufficient that the use of vacuum on one of the cylinders will tear the patch or cutout from the moving web.

Referring again to FIG. 1, such a rotary mechanism is shown diagrammatically as comprising an upper cutter wheel or roller 13 and a lower cylindrical roller 14, the web 2 passing between the rollers around the guide rolls 15 and 16 which maintain it in engagement with the cutter roll 13. The latter is provided with knife edges 17 projecting from its cylindrical surfaces almost into contact with the cylindrical surface of the lower cylindrical roller 14, the clearance between them amounting to say 0.001-0.002" so that the web material is practically severed. Of course, the knife edges 17 are arranged in sets so that they score the thinned (i.e., ground) web material along lines

corresponding to the shape of the cutout 10 shown in FIGS. 2, 4 and 5.

In order to insure removal of the cutouts from the web, as well as to provide for their disposal (usually to waste), the cylindrical roll 14 may suitably be provided with vacuum means including for example radial passages 18 communicating with an axial passage 19, the vacuum being controlled through suitable valve mechanism (not shown). In the position shown in FIG. 1, vacuum is being applied through the upwardly directed passage 18 to the lower face of the web at one of the areas 10 which is being scored by a set of knife edges 17. As the rollers 13 and 14 continue to rotate and the web moves on, this vacuum holds the cutout 10 against the periphery of the roller 14 and tears it out of the web 2 as the latter passes on over the guide roll 16. The cutouts 10 can be directed one by one to a waste receptacle 21 of any suitable size, shape and locations, being released to this receptacle by cutting off the vacuum at appropriate times.

The next operation is to apply adhesive to the ledge-like borders or edges 12 of the apertures in the web as the latter continues to move longitudinally through the apparatus. The adhesive, as already explained, is one which is of the normally tacky, pressure-sensitive type, and can be applied to the moving web by any suitable means known to the art. If necessary, its fluidity can be increased during application by the use of some volatile thinner such as a petroleum solvent. As shown diagrammatically in FIG. 1, a bath 22 of such an adhesive or adhesive solution is provided in a suitable container 23, and a roller 24 dips into the bath 22 and applies a film of the adhesive 22 to a transfer roller 25 which coats suitable applicators 26 on an applicator roll 27. It will be seen that if the applicators 26 are properly arranged and the speed of the roll 27 is correlated with that of the moving web 2, the adhesive 22 will be applied only to the depressed sides of the ledges 12 as seen in FIG. 5, these being the sides exposed toward the back of an aperture card as previously explained.

It remains to apply a cover sheet to the exposed adhesive on the ledges 12 and then to cut the individual completed cards from the continuously moving web 2. Preferably the cover sheets, whether of release paper or of unexposed copy film, are cut from a roll supply 28 by mechanism similar to that described above in connection with cutting the apertures in the web. Referring again to FIG. 1, the upper cutter roll 29 with its knife edges 30 and the lower cylindrical roll 31 with its vacuum passages 32 are similar to the rolls 13 and 14 already described, and the web 33 of cover sheet material passes from the supply 28 to and between rolls 29 and 31, being maintained in contact with roll 31 by guide rolls 34 and 35. Patches of cover sheet material are removed from the web 33 by the combination of the cutting or scoring action of the knife edges 30 and the vacuum in passages 32, and are carried around by the rotating intermittent-vacuum roll 31 (see patch P in FIG. 1) in such a way that one of these patches is brought into registry with an aperture in the moving web and is applied to the exposed adhesive on the ledges 12 thereof.

Of course, other suitable mechanisms are available for applying the cover patches to the adhesively coated ledges 12. For example, in FIG. 6 a patch is shown which comprises a section of unexposed copy film comprising a layer 36 of suitable backing material such as Mylar and a layer 37 of photo-sensitive emulsion or the like. After being brought into registry with the aperture in the card by any suitable means, or if desired by hand, this patch can be

pressed into engagement with the exposed adhesive 22 by any suitable pressure means such as a plate 38.

Once the patches or cover sheets have been affixed, the web can be divided into individual cards at a suitable card cutting station 39 along the dot and dash lines shown in FIG. 2, and then delivered to any suitable magazine 40.

The resulting cards, whether copy cards or aperture cards, are ready for delivery to ultimate users in large quantities. In the case of copy cards, of course, the cover sheet of unexposed film is permanently mounted for exposure by contact printing or any other desired method. In the case of aperture cards, on the other hand, the cover sheet is only temporary but is readily removed because of its release properties when a film section is to be permanently mounted, machines for this purpose being well known. In either case the card surface is continuous and uninterrupted and there is no increase in card thickness.

While only one embodiment of the invention has been described and illustrated in the drawings, it is to be understood that this embodiment is by way of example only and that the invention is not restricted thereto. Reference should be had to the appended claim for a definition of the limits of the invention.

What is claimed is:

A record card having an aperture for projectably mounting sections of microfilm and like projectable transparencies which comprises a flat relatively thin card of fibrous card stock of uniform thickness except for a thinner narrow elongated ledge extending around and forming the edge of said aperture, said ledge being an integral extension of the card stock surrounding the aperture and having a thickness of less than half that of the surrounding stock, said ledge on one side of the card having an abraded surface with a normally tacky pressure sensitive adhesive thereon, and a cover sheet extending over said aperture and being non-tacky on both sides throughout the area of said aperture with its edges overlying and bonded to the surface of said ledge by said pressure sensitive adhesive therebetween, thereby maintaining continuous, said cover sheet having a uniform thickness which does not exceed the difference between the thicknesses of the card stock and ledge, the combined thickness of the superimposed portions of said cover sheet and ledge being no greater than the thickness of the card stock and said superimposed portions being disposed entirely between the planes of the flat surfaces of the card, non-tacky card surfaces comprising in part the surfaces of said card stock and in part the non-tacky surfaces of said cover sheet during handling and distribution of the card, said cover sheet being removable, if desired, by breaking said adhesive bond and leaving said adhesively coated ledge surface exposed pending the replacement of said cover sheet by a projectable transparency.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,352,045

November 14, 1967

John F. Langan

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, lines 58 and 67, for "reigstry", each occurrence, read -- registry --; column 8, lines 40 and 41, strike out "thereby maintaining continuous," and insert the same after "card," in line 47, same column 8.

Signed and sealed this 7th day of January 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents