This invention relates to die structure generally, and more specifically to dies for forming carton blanks.

One of the objects of the invention is the provision of a die for use on a flat bed press, which die is adapted for forming carton blanks having separate spliced cut and creased portions that must be in accurate registration with each other when the blank is folded to form the carton in order to produce the carton.

Heretofore the conventional practice has been to hold the cutting and creasing rules in their desired positions for forming a carton blank (including intricate portions that must be in registration when the blank is folded to form the carton) by use of wooden blocks that are cut to the desired shapes by jig saws. The rules are present to form cuts or creases and the blocks are positioned at opposite sides of the rules and have the same surface contours as the rules held thereby.

This method and structure is very old, and is quite satisfactory where the problem of accurate registration between separate parts of the blanks that are formed by the dies is not involved. However, where, as in many present day cartons used for frozen foods and other products in which automatic machinery folds the blanks to carton form and where certain flaps and walls have relatively intricate interlocking tabs that must be in accurate registration with each other to properly form the cartons, the old die structure and method of making it, are not satisfactory. No matter how carefully the wooden supporting blocks are formed and fitted in the die, they will not hold the relatively intricately arranged rules rigid or fixed, in those portions of the die that are to form the parts of the blank that later must be in accurate registration with each other. The present day losses resulting from rejected cartons formed by cutting and creasing rules that have shifted relative to each other is enormous.

With the present invention, the production of a durable, light weight die, and one in which the rules are frictionally held by the blocks separating them so that individual rules may be replaced if nicked or worn without injury to the die and without requiring any necessary mechanisms.

Other objects and advantages will appear in the description and in the drawings.

In the drawings:

FIG. 1 is a perspective view showing a conventional die in a frame as the initial step in forming a mold for a die of this invention.

FIG. 2 is a reduced size top plan view of the die of FIG. 1, including the frame, supported by ordinary quinns in a conventional chase.

FIG. 3 is a cross sectional view taken along line 3--3 of FIG. 2.

FIG. 4 is an enlarged top plan view of the die of FIG. 3. The next step in the method, in which a block is on plastic in the mold and knock-out ejector pins and openings or bores are in the block.

FIG. 5 is a sectional view taken along line 5--5 of FIG. 4 showing plastic material in the structure of FIG. 4 in the step of forming a mold.

FIG. 6 is a view similar to that of FIG. 5 showing the plastic material around the block that is shown in FIG. 5.

FIG. 7 shows the top block or mold that is formed by the step illustrated in FIG. 6.

FIG. 8 is a top plan view of the mold of FIG. 7 in a frame preparatory to forming a die.

FIG. 9 is a sectional view taken along line 9--9 of FIG. 8.

FIG. 10 is a sectional view similar to that of FIG. 9 but with the addition of plastic for forming the die.

FIG. 11 is a sectional view similar to that of FIG. 10 showing the next step in forming the die.

FIG. 12 shows the finished die in a frame with the rules therein.

In detail the initial step in making the mold for dies of the present structure comprises making a conventional die from steel rules 1 that have been cut and formed to have the desired and necessary contours for cutting and creasing a carton blank. Wooden blocks 2 are cut to have contours corresponding to that of the rules that are between the blocks and certain rules 3 may, if desired, be supported at one of their sides by one of the side members of the frame 4 that encloses the die and that functions to hold the rules and blocks in their desired relationship to each other.

The frame 4 differs from the ordinary frame in that its sides extend to a level above that of the upper edges of the rules and which edges are the cutting and creasing or scoring edges. The distance to which such side members may extend is preferably about three quarters of an inch.

In the die herein illustrated are two groups of rules 5, 6 (FIG. 2) that are rather intricately arranged and close together, and which groups are adapted to form different portions of a carton blank that, ultimately, must coat with each other when the carton is formed. This connection requires very accurate registration between said portions, or parts thereof. Otherwise, the carton will be inoperative for accomplishing the desired results, which results extend to the actual formation of the carton itself.

The members of frame 4, and the rules, are supported on a flat base 7 so that the cutting and creasing rules will be at the correct height for performing their functions if the die were used on a flat bed press to form a carton, and if the side frame members were of less height than that of the rules. However, base 7 supports the frame members so they are higher at their upper edges than the upper edges of the rules, as has been explained.

After the die is formed within frame 4, it is positioned within an ordinary chase 8 on the base of the latter, and is locked therein by use of the usual blocks or shims 9 and quins 10. The cutting and creasing edges of rules 1, 3 are upwardly directed, the same as in FIG. 1 and the rules, blocks 2, and frame 4 are all supported on the flat base.

The next step in the method is to fill the spaces between the rules and the space between the block and the frame, with an epoxy plastic 12 that preferably may be in the proportion of approximately 5 ounces of what is known in the trade as "Epoxy Resin G," which in itself may be an epoxy modified with a polyamide resin and a filler of metal powder, such as aluminum. To this is added approximately one ounce of an epoxy hardener and then 10% by weight of a flexiclor, which is preferably a balanced thioctol base material. The hardener is well known in the trade as "Epoxy L 930 A," and the flexiclor as "Epoxy L 940."

The above materials are mixed together for approximately five minutes time and are then poured into the mold in a consistency that is similar to heavy syrup.

The frame 4, as seen in FIG. 2 is rectangular, and while the invention is not necessarily restricted to a rectangular die or frame, such dies and frames are preferably...
since they are readily locked in the usual chase 8 and are readily locked on the bed of a press.

After the level of the plastic is slightly higher than the upper edges of the rules 1, 3, and said upper edges may vary slightly as between the cutting rules and the creasing rules, the latter being slightly below the upper level of the cutting rules, a rectangular block 13 is positioned within frame 4 and on the plastic body 12. This block 13 is preferably made of plywood and is formed around its outer peripheral edge with an outwardly opening groove or channel 14. Block 13 corresponds in shape and proportions (in plan view) to the frame 4, but is smaller by approximately a quarter of an inch on each side, so that a space of approximately one-eighth of an inch, as indicated at 15 in FIG. 5, will be between each side of the block and the side of the frame 4 opposed thereto, when the block is centered within the frame.

The block 13 is formed with plurality of vertical open ended bores or passageways 16 therethrough at right angles to the parallel flat upper and lower horizontal faces 17, 18 of the block and counterbores 19 are at the upper ends of each bore 16.

It is particularly pertinent to note that the lower ends of these bores 16, for the most part, terminate close to rules 1 and at or closely adjacent to intersecting points of rules in groups 5, 6, and several are positioned within the larger areas 20 in which there are no rules.

Other bores 21 similar in shape to bores 16 extend through the block, but these do not have counterbores. Knock-out pins 23 are positioned within bores 21, which pins have circular heads 24 that project below the lower surface of the block 13.

The upper surfaces of the die blocks 2 and the upwardly projecting portions of rules 1, 3, including the inner surfaces of the frame 4 may be suitably waxed to preclude the plastic sticking to them.

It should be noted that the bores 23 are positioned between adjacent pairs of the relatively long central rules of the frame and are positioned within each group of rules 5, 6, with the heads 24 spaced from the rules.

The block 13 may now be forced downwardly by any suitable press (FIG. 6) until the block is stopped by its engagement with the uppermost edges of cutting rules. Thus a relatively thin amount of the plastic may be between the cutting rules and the block.

This action in forcing block 13 downwardly results in the plastic material rising around the outer peripheral sides of the block 13 filling the grooves 14, and also in filling bores 16 and counterbores 19. The heads 24 on the knock-out pins 23 will be surrounded by the plastic.

The thickness of these heads may be substantially equal to the height that the rules project from the lower die. After the block 13 is in the position seen in FIG. 6 in which the plastic extends almost to the top level of the block in the space 15 and substantially fills the counterbores 19, the assembly, exclusive of the press and chase, is preferably held at substantially room temperature of 72–77° for about twelve hours after which the plastic is sufficiently hard to enable removal of the block 13, with the plastic carried thereby, from the frame 4 and the rules 1, 3. The separation of the mold from the die may be facilitated by tapping the exposed upper ends of the knock-out pins while lifting the block 13 by any suitable means that may engage the exposed sides of the block adjacent to its upper surface.

The block 13 and the plastic are very tightly locked together as a unit by the plastic 27 that extends between the outer sides of the block and frame 4, and that fills grooves 14, and by the plastic 28 in bores 16 and 29 and in counterbores 19; and also the plastic in space 15 between block 13 and the frame 4 provides an accurate peripheral outer surface of exactly the size of the frame so that the mold, which comprises the block 13 and the plastic carried thereby as a unit therewith, will fit the frame in precisely the same manner as the die that is made up of rules 1 and blocks 2, hence the mold may be substituted for said die in the frame and will be of exactly the same size, in plan view, as the die.

The plastic of the mold, above described, will progressively harden to the point where it is, for practical purposes, substantially indestructible. The plastic does not shrink and the mold is very light, being substantially of wood. These molds may be made economically and an indefinite number of dies can be made therefrom.

The layer of plastic 28 that is between the rules 1, 3 and that is over the areas 20 is, of course, exactly equal in thickness to the distance from the cutting edge 17 of the frame from the blocks 2 of the die, and the bases of the grooves 31 (FIG. 7) that are formed in the mold 26 conform to the cross sectional contours of the projecting portions of the rules.

The next step in forming a die from mold 26 is to preferably mold in a frame 33 (FIG. 9) that may be identical with the frame 4, since the mold contour will be identical with the die of FIGS. 1, 2. The frame may be supported on a base 34 that is similar to base 7. The grooves 31 open upwardly, hence block 13 is supported on base 34.

A conventional parting wax may be applied to the upper surface of the mold and rules 36 are positioned in the recesses 31, said rules and the sides of the frame 33 being waxed to prevent plastic from adhering thereto. The rules are pre-formed to correspond to the rules 1, 3 except that the longer rules 37 have aligned U-shaped recesses 38 formed therein, which recesses open outwardly of the upper edges of the rules as seen in FIG. 9, but which edges will ultimately be the lower edges of the rules, since the cutting and creasing edges are in the mold. Also along the areas 39 (FIG. 8) that correspond to areas 20 in FIG. 4, the long rules 40 that are perpendicular to rules 37 are formed with U-shaped recesses 41 of substantially greater depth than recesses 38, although the latter could be of the same depth as the recesses in rules 40.

Within the aligned recesses 41 is a metal dowel 42, preferably of aluminum, and metal dowels 43 are positioned in the aligned recesses 38 (FIGS. 8, 9). When these dowels are so positioned, the uppermost dowels 43 do not project above the upper level of the edges of the rules.

Following the positioning of the rules and dowels, as above described, plastic material 45 of the same kind as plastic 12, except with the addition of ground walnut shells, is poured into frame 33 and between and around the rules to a level slightly above the level of the upper edges of the rules, as seen in FIG. 10. This material may be tamped to insure against the entrance of air.

One suitable formula for the plastic 45 is 100 parts epoxy G resin, 15 parts epoxy hardener, 8% to 10% by weight of epoxy flexibilizer, which is a balanced thiolic base material, and 25% to 30% by weight of ground walnut shells. These ingredients are thoroughly mixed together and form a relatively thick but flowable plastic mass.

The same formula as given for the mold plastic 12 may be used, except that approximately 7 to 10 ounces of walnut shells is added.

This produces a strong die that is light in weight, and one in which the cast material does not affect the temper of the rules, nor does it shrink away from the rules.

After the plastic material 45 is poured as above mentioned, a centrally apertured block 46 adapted to closely (but slidably) fit within frame 33 is positioned over the plastic 45. This block carries a layer 47 of uniform thickness of yieldable, rubber-like material, such as polymerized chloroprene, known under the trade name of "Neoprene."

The frame may be locked in the chase in the same manner as described for making the mold.
The block 46 is forcefully pressed downwardly by any suitable press 48 until the upper edges of the rules are impressed into the layer 47. Surplus plastic will pass through the central opening 49 of the block and layer 47 into a free space within the press 48 above the block. Since the rules may have small gaps where they intersect, the plastic between the various rules can readily find escape to the central opening 49.

The above step assures against there being any plastic matter on the upper edges of the rules, as seen in FIG. 11, and which upper edges will be the bottom edges of the plastic die in which the rules are held. Also, the level of the plastic 45 between and at opposite sides of the rules will usually be slightly lower than the plane in which said edges are positioned. The distance that the edges of the rules sink into the layer 47 is preferably approximately one sixty-fourth of an inch.

After approximately two hours at 72-77°F, the plastic 45 is sufficiently hardened that the die may be removed from the mold and frame 33. The knock-out pins 23 facilitate such removal. The die may then stand at atmospheric temperature for approximately 8 hours at the end of which time it is completely hardened.

FIG. 12 shows the completed die in a frame 50 in which the die is ready for use.

The starting temperatures of approximately 77°F for the mold and the die are preferably employed to start the development of the best of reaction that occurs.

In the mold, the layer of plastic is relatively thin, being approximately three-sixteenths of an inch thick, except for the lateral sides which are one-eighth of an inch in thickness, and the die is approximately three-quarters of an inch in thickness. This is pertinent, since the thickness is limited to approximately 1/4 inches by the heat generated by the chemical hardener.

The positioning of the dowels 42, 43 may be somewhat arbitrary, but it is highly desirable and even essential to use them where there are large areas in the die that are not crossed by rules. While the plastic material will continue to harden with age, the die is removable from the frame 33 and is usable immediately after such removal without injury, but there is a tendency of the large ones to break, before they are fully hardened, unless they are reinforced by the dowels.

In the above described, the individual rules are so firmly held in place that the die can be handled as a unit with the rules remaining in place. However, the rules are only frictionally held, and may be separately removed and replaced, which enables the user to replace a nicked or worn rule instead of replacing the entire die.

A plurality of molds may be formed in one block, if desired, so that the die produced therefrom may be a multiple die, such as a four-on or eight-on die, etc. Dies produced by the above process may be used as master dies for forming molds that, in turn, are identical with each other, and may be used to make other dies.

In the carton making art the lack of uniformity in the wooden block type dies has been one of the most disturbing elements in the industry, since there could be no uniformity when the blocks used were formed by hand.

In the die, it will be seen that cast blocks take the place of the wooden blocks in the conventional die, except that the dowels in the present structure would prevent the blocks in which they are embedded from being removed from the mold, and there is sufficient frictional resistance between the blocks and the rules in the present die to prevent the blocks from being removed except by use of considerable force. There is no occasion to remove the blocks, and the rules themselves are replaced with very little work except in case of an accident, when one or more may be nicked. Hence, while the rules may be removed and replaced, they fit so perfectly that a rawhide hammer usually must be used to tap a replace-

ment rule in place, after which it normally stays in place by frictional resistance between it and the plastic blocks.

The formation of the mold as described is quite important. The locking of the plastic to the block 13 as described produces a durable, light weight mold that can be shipped and handled and used an indefinite number of times to produce dies that are absolutely uniform and identical with the original die.

The particular die that is illustrated is merely by way of one example, it being obvious that many other molds and dies may be formed in the same way.

We claim:

1. A die for forming a carton blank from a sheet of cardboard comprising: a plurality of cutting and creasing rules disposed along lines defining the outline of the blank to be cut from said sheet and the creases to be formed in said blank along which said blank is to be folded to form a carton, said rules having coplanar base edges extending longitudinally thereof for direct engagement with the flat planar bed of a press, the edges of said rules opposite to said base edges being the cutting and creasing edges of said rules, a hardened, plastic material between said rules in cast, tight, frictional, but releasable engagement with said cutting and creasing rules for supporting the latter rigid relative to each other and perpendicular to such bed when said base edges are supported thereon, rigid rods extending between and across certain of said rules wholly imbedded within said plastic material, recesses opening outwardly of the base edges of the rules across which said rods extend and within which said rods are positioned to enable removal of said last mentioned rules from the side of said plastic material opposite to said base edges.

2. A die for forming a carton blank from a sheet of cardboard comprising: a plurality of cutting and creasing rules disposed along lines defining the outline of the blank to be cut from said sheet and the creases to be formed in said blank along which said blank is to be folded to form a carton, said rules having coplanar base edges extending longitudinally thereof for direct engagement with the flat planar bed of a press, the edges of said rules opposite to said base edges being the cutting and creasing edges of said rules, a hardened, plastic material between said rules in cast, tight, frictional, but releasable engagement with said cutting and creasing rules for supporting the latter rigid relative to each other and perpendicular to such bed when said base edges are supported thereon, rigid rods extending between and across certain of said rules wholly imbedded within said plastic material, recesses opening outwardly of the base edges of the rules across which said rods extend and within which said dowel rods are positioned to enable removal of said last mentioned rules from the side of said plastic material opposite to said base edges.

3. A die for forming a carton blank from a sheet of cardboard comprising; a plurality of cutting and creasing rules disposed along lines defining the cuts and creases to be formed in said sheet for forming the carton blank, said rules having coplanar base edges opposite to said cutting and creasing edges extending longitudinally of said rules for supporting them directly on the planar surface of a rigid bed during the application of pressure against said cutting and creasing edges extending in a cutting and creasing operation; certain of said rules being in spaced side by side relation and others of said rules being disposed along lines extending transversely relative to said certain of said rules; a body of hard, plastic material between and enclosing said certain of said rules and said
others thereof in tight, cast, frictional, but releasable engagement with opposite sides thereof leaving their said base edges, cutting and creasing edges, and relatively narrow marginal portions along said cutting and creasing edges, exposed; rigid rods respectively extending across said certain of said rules and the areas therebetween and across said others of said rules and across each other, enclosed within said body in tight holding relation to said body for holding the portions of said body between and at opposite sides of said certain of said rules, and said others of said rules, stationary relative to each other when said rules are removed and upon compressive pressure being placed upon said body in the plane of the die when the die is locked in a chase, said certain of said rules and said others of said rules being formed with recesses opening outwardly of said base edges and through which receives said rods extend to enable removal of said rules from said body and to enable said rods to be enclosed within said body.

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