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3,479,203 METHOD OF REINFORCING PERFORATIONS IN PAPER

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to a method of making perforated sheets with reinforced perforations by stacking a plurality of paper sheets with the perforations thereof in substantial alignment to form a tubular cavity defined by boundary edges of the aligned perforations, introducing a strengthening agent in liquid form into the tubular cavity whereby at least a portion thereof is absorbed by the boundary edges of the perforations, and draining off any excess of the strengthening agent not absorbed by the boundary edges, and the strengthening agent being of such nature as to form a coating which when dry is not sticky.

This invention is concerned with perforated paper sheets of the kind used in loose-leaf ledgers, files, binders and indexing devices. Such sheets suffer from the disadvantage that the perforations introduce local weakness which makes the sheets liable to tear at the edges of the perforations when in contact with the rings, posts, laces, tongues and the like of the different types of holders. The liability to tearing arises not only when the sheets are inserted or removed from the holder, but may operate when they are being turned or on any movement in relation to the holder, even for example by the jogging which occurs when the holder is merely being carried.

It is well known to strengthen the sheets at the perforations by the use of eyelets of metal, linen, manilla or the like, or by affixing to one or both sides of the sheet small tabs of paper, manilla, linen cellulose film, or the like in the area to be perforated, or by applying strips of such material to the binding edge of the sheet. Such methods, however, have many disadvantages. They are relatively slow and cumbrous, they add considerably to the thickness of the binding edge of the paper, and they are relatively costly; they are therefore usually adopted only where it is imperative to avoid any possibility of tearing and where cost and increased bulk of the binding edge are of secondary importance.

I have now devised a simple, cheap and effective method whereby sheets may be greatly strengthened at the perforations, while adding virtually nothing to the thickness of the paper at any point.

My new method consists in applying to the paper a solution or dispersion of an agent, hereinafter referred to as a strengthening agent, which provides the required protection from the above described damage. The solution or dispersion may be applied to paper in the web form or in the form of an assembly of sheets, and may be applied to the surface of the paper or to the edges of perforations already formed in a web or in an assembly of sheets. When applied to the edges of perforations already formed, the solution or dispersion will impregnate the paper round the perforations to a depth which varies with a number of factors, such as the viscosity of the liquid, the porosity of the paper, the nature of the solvent or dispersion medium, the time of contact, and so on, forming an annulus round each perforation. The width of the annulus will usually be small but the im-

pregnation gives the paper surrounding the perforations considerably increased strength. Where the application is made to the edges of perforations already formed, also, the application strengthens the edges of the perforations by providing a coating which not only protects them against mechanical wear and tear, but also seals them against absorption of atmospheric moisture and thereby maintains the improved strength. The coating also covers the sharpnesses and roughnesses of the edges caused by the operation of perforating, and so provides a rounded edge which lessens friction during use and so further reduces wear and tear.

I use the term "strengthening agent" to mean any material which when deposited from solution or dispersion will form a coating or film which when dry is not sticky. Gums and glues which are sticky when dry or which dry very slowly are unsuitable and are excluded. Thermoplastic resins are generally suitable materials, and these resins or mixtures of resins can be dissolved or dispersed for use in a volatile solvent. Additives may be used to make the coating more flexible and to prevent adhesion between the sheets. Solutions of vinyl derivatives or partly polymerized vinyl derivatives in ketones with silicone additives have given very satisfactory results. Acrylic and methacrylic ester polymers dissolved in toluene give excellent results, and a solution of a mixture of polyethylacrylate and polymethylmethacrylate is especially suitable.

The solution or dispersion of the strengthening agent may be applied to the perforations in single sheets, or to batches or piles of any desired thickness.

When perforations in single sheets are being treated the solution or dispersion may suitably be applied at the time the perforations are made. A small quantity of the liquid may be transferred to the perforating tool by conventional means, e.g., by contact with a saturated felt pad or by momentary immersion of the tip of the tool, and as the tool pierces the sheet the liquid is picked up at the point of contact of the tool with the edge of the hole which the tool has made.

When sheets in the form of pads, blocks or piles are to be treated, the solution or dispersion is poured, squirted or sprayed into the perforations, and any excess not absorbed is drained off. Even if considerable excess has been used, the pressure on the pile and the viscosity of the liquid will either prevent it from penetrating or allow it to penetrate a short distance only beyond the perforations. A suitable distance is $\frac{1}{8}$ " of an inch; this will usually be achieved with a pressure of a few pounds on the pile, depending on the viscosity of the liquid and the porosity of the paper. The liquid is absorbed through the cut edges of the perforations and the fibres or the surrounding annuli, whilst the pile as such remains substantially dry. The sheets do not adhere to one another and the treated pile may be handled in the usual way. The cut edges of the perforations in the individual sheets are found to be effectively sealed and coated and if the strengthening agent has penetrated beyond the edges of the perforations, each perforation is surrounded by a narrow annulus in which the paper is considerably strengthened.

Perforated paper for use in binders, files, ledgers and so on is generally ruled. Ruling is effected in ruling machines through which the paper is passed as a continuous web, before being perforated and cut into sheets. Such machines usually rule one web at a time, but some deal with two webs simultaneously. After the paper has been ruled, it is possible to perforate it on the same machine, and if this is done the method of my invention may be carried out by applying the solution or dispersion of the strengthening agent to the edges of the

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perforations. Alternatively the solution or dispersion may be applied to the surface of the paper in bands or patches before or after the perforations are made.

The solution or dispersion may be applied to the edges of perforations in a web in several ways. I have already described one method, in which the liquid may be applied by the perforating tool at the time the perforations are made. Liquid can also be applied to the edges only of perforations already made by means of a tool the tip of which registers with or enters the perforations.

When the liquid is applied to the surface of an already perforated paper web in patches or bands extending across the perforations it will coat not only the edges of the perforations, but adjacent areas of the paper the extent of which can be varied at will. When the liquid is applied in patches or bands before perforation, the perforations will be made through the patches or bands.

The application of the solution or dispersion of the strengthening agent whilst the paper is still in the web may be made on one side only or on both sides of the web, and has the advantage that it can be carried out on the ruling machines and so saves the cost of a separate operation.

I claim:

1. A method of making perforated paper sheets with reinforced perforations comprising the steps of stacking a plurality of paper sheets with the perforations in substantial alignment to form a tubular cavity defined by boundary edges of the aligned perforations, introducing a strengthening agent in liquid form into the tubular cavity whereby at least a portion thereof is absorbed by

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the boundary edges of the perforations, and draining off any excess of the strengthening agent not absorbed by the boundary edges of the paper sheets, and the strengthening agent being of such nature as to form a coating which when dry is not sticky.

2. The method according to claim 1 wherein the strengthening agent is a synthetic resin.

3. The method according to claim 2 wherein the synthetic resin comprises a polymer of an acrylic ester.

4. The method according to claim 2 wherein the synthetic resin comprises a polymer of methacrylic ester.

5. The method according to claim 2 wherein the synthetic resin is a mixture of polyethylacrylate and polymethylmethacrylate and is applied in solution in toluene.

References Cited

UNITED STATES PATENTS

2,039,752	5/1936	Thomas	117—44
2,260,601	10/1941	Brenn	117—44 X
2,260,602	10/1941	Brenn	282—20
2,346,219	4/1944	Johnson	117—44
2,743,189	4/1956	Speed et al.	107—44 X

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117—4, 48