United States Patent [19]

Loose et al.

[11] **3,890,892**

[45] **June 24, 1975**

[54] **ULTRASONIC MARKING**

[75] Inventors: **Guenter H. Loose; William J. Diesel; Thadeus S. Graczyk**, all of Rochester, N.Y.

[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.

[22] Filed: **Nov. 9, 1972**

[21] Appl. No.: **305,050**

Related U.S. Application Data

[63] Continuation of Ser. No. 85,595, Oct. 30, 1970, abandoned.

[52] **U.S. Cl.** .... **101/32;** 101/DIG. 5; 274/42 P; 346/77 E

[51] **Int. Cl.** **B44c 1/24**

[58] **Field of Search** .... 101/1, 3, 93 C, DIG. 5, 101/28, 32, 407, 368, 369, 19; 40/136; 346/69, 77 R, 77 E, 141, 136; 352/225; 310/813; 274/42 P

[56] **References Cited**

UNITED STATES PATENTS

2,792,779	5/1957	Toeppen et al.	101/936
1,889,179	11/1932	Lobl	40/136
2,027,637	1/1936	Eaton	101/297
2,522,078	9/1950	Walker	346/77 R
2,651,148	9/1953	Carwile	101/DIG. 5
2,748,298	5/1956	Calosi et al.	101/DIG. 5
2,891,178	6/1959	Elmore	101/DIG. 5
2,939,958	7/1960	Andersson	101/369 X
2,942,928	6/1960	Levin	101/DIG. 5
3,055,294	9/1962	Amyx	101/DIG. 5
3,089,411	5/1963	Sollberger et al.	101/3 R
3,112,693	12/1963	Williams	101/DIG. 5
3,151,521	10/1964	Atkin et al.	352/225 X
3,175,383	3/1965	Levine	101/32 X
3,409,904	11/1968	Maiershofer	101/1 X
3,626,843	12/1971	Willing	101/3 R
3,749,006	7/1973	Loose	101/32

Primary Examiner—E. H. Eickholt
Attorney, Agent, or Firm—S. W. Gremban

[57] **ABSTRACT**

A method for embossing indicia such as numbers, letters, or other symbols into an article of malleable material such as a thin sheet or web by providing an anvil which has the appropriate indicia defined by a plurality of individual protuberant dots, positioning the article against the anvil in contact with the protuberant dots, and applying an ultrasonically vibrating horn to the article and forcing it against the dots to form indentations. Relative translational movement can be effected between the horn and the article when the indicia cover a greater area than the surface of the horn. The horn can be non-rotating, or can rotate along the surface of the article. The method is particularly applicable to the marking of photographic film and paper.

2 Claims, 5 Drawing Figures

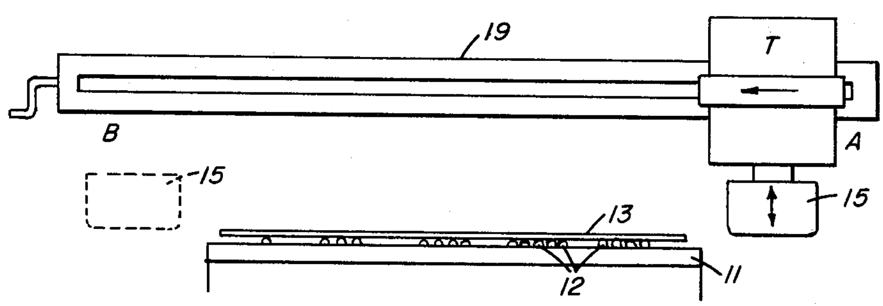


FIG. 1

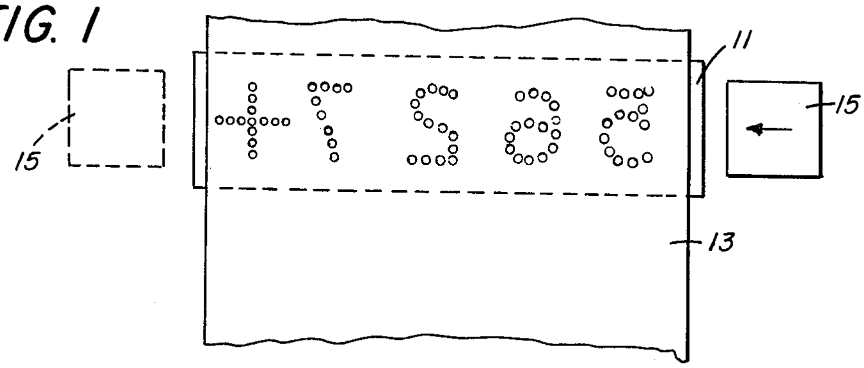


FIG. 2

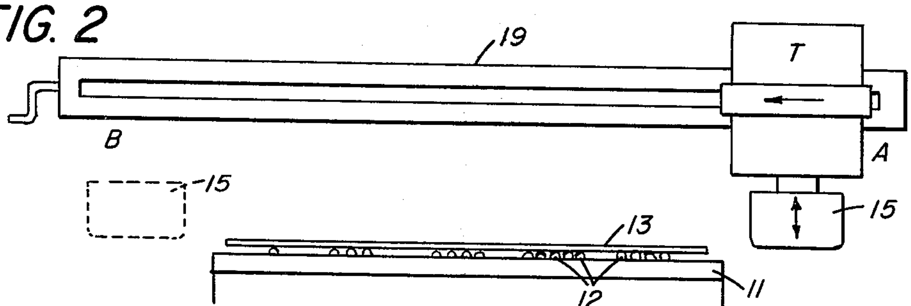


FIG. 4

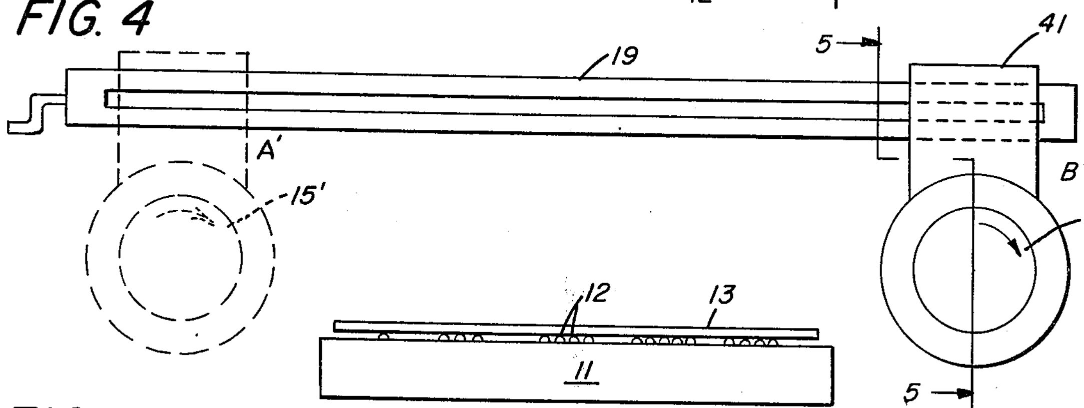


FIG. 5

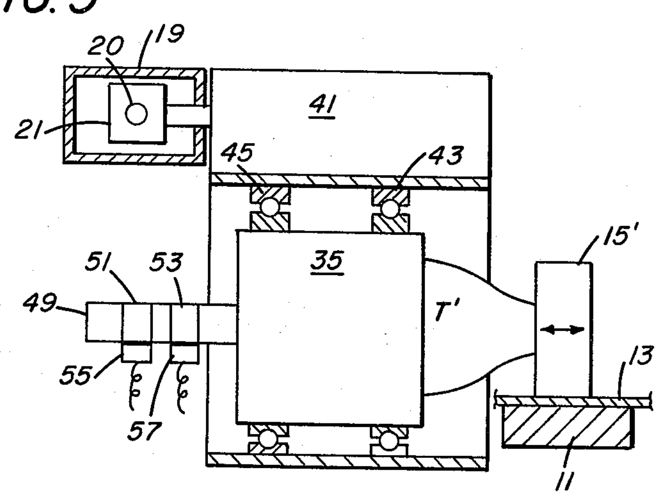
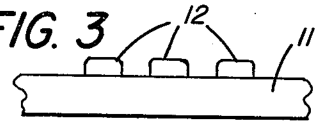


FIG. 3



GUENTER H. LOOSE
WILLIAM J. DIESEL
THADEUS S. GRACZYK
INVENTORS

BY Walter O. Hodsdon
Henry M. Chapin

ULTRASONIC MARKING

This is a continuation of application Ser. No. 85,595, filed Oct. 30, 1970, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a novel method for ultrasonically marking indicia in an article of malleable material such as a sheet or web of photograpic film or paper, aluminum or other metal foils, and various synthetic plastics such as polyethylene or polypropylene.

2. The Prior Art

In the photographic products industry it has been customary to mark photographic film and paper by perforating indicia (such as numbers or letters) through the web, using a die set with many punches. Such a die set is very costly to produce and to maintain. Also, when perforating the web, problems are encountered as a result of the dust and chips that are produced, which may seriously interfere with subsequent procedures.

In U.S. Ser. No. 858,428, which was filed on Sept. 16, 1969, by Guenter H. Loose (one of the present inventors) and which is assigned to Eastman Kodak Company like the present application, there is described the ultrasonic embossing of a number or other indicia in a sheet by positioning a raised fully defined number in contact with one side of the web while an ultrasonic horn is applied to the opposite side of the web. This operation has proved to be very successful for embossing small numbers in webs, but when large-sized numbers greater than about one-sixteenth inch in the longest direction are to be embossed, undesirably great ultrasonic energy is required, it is not always possible to secure a complete impression, the numbers tend to be distorted and smeared, and light transmission is so poor that they cannot easily be read in a darkened room where photographic operations are conducted. Furthermore, numbering dies required for this operation are quite expensive to produce and maintain.

SUMMARY OF THE INVENTION

In accordance with the present invention, we have provided a novel method for embossing indicia such as numbers, letters, and other symbols into a thin sheet or other article of malleable material such as webs of photographic film (e.g., polyester or cellulose acetate) or paper, aluminum or other metal foils, and various synthetic plastics such as polyethylene and polypropylene, which overcomes the disadvantages of the prior art. We provide an anvil template of hard material such as steel which has the appropriate indicia delineated on the surface thereof by a plurality of individual tiny protuberant dots which are spaced apart and project above the surface of the anvil. We then position the sheet against this anvil with one side of the sheet in contact with the protuberant dots, and apply pressure impulses from an ultrasonically vibrating horn to the opposite side of the web, thus heating and forcing the web against the dots to form the indicia in the web as a series of small cavities or indentations.

With this technique, material is only displaced rather than removed from the web as in prior art punching operations so that the problem of dust and chips is eliminated. In a thermoplastic material, melting and resolidification occur simultaneously during displacement.

Furthermore, the cost of producing and maintaining an anvil with protuberant dots is much less than when using a die set for perforation, or when employing fully formed numbers as the embossing means. This is in large part because well-known etching techniques can be used for etching away the surface of the anvil except at the localities of the individual dots where the anvil is protected by a resistant covering. Such an etching technique is well known and is described in the publication, "Chemical Milling with Kodak Photosensitive Resists" (Kodak Publication P-131), copyrighted in 1968 by Eastman Kodak Company.

The operation described above can be performed without effecting relative translational movement between the horn and the anvil when the indicia to be embossed cover a relatively small area no greater than the area of the end of the ultrasonic horn. However, it so happens that indicia frequently must be embossed over an area substantially greater than the area of the horn end, for example when numbers must be embossed at intervals across the entire width of a roll of photographic film or paper which may be as wide as **54** inches. Our novel method can be used under such circumstances by effecting relative movement between the ultrasonic horn and the web so that the end surface of the horn passes successively over the numbers. In one type of operation the web and anvil are held stationary while the horn is traversed across the web and the anvil by any suitable mechanism. In another type of operation the horn is held stationary while the anvil and the web are moved across the end surface of the horn.

Embossing can be accomplished by a non-rotating horn, or by a cylindrical horn having its cylindrical surface in contact with the web above the indicia, and rotating along the web during the embossing operation. Provision is made in the latter design for maintaining electrical connections to the ultrasonic transducer as it rotates. A suitable construction is described in U.S. Pat. No. 3,201,864 to J. B. Jones et al, for "Method and Apparatus for Ultrasonic Welding."

THE DRAWINGS

FIG. **1** is a schematic plan view showing a web positioned on an anvil template for ultrasonic embossing in accordance with the invention;

FIG. **2** is a schematic front elevational view showing apparatus in position for ultransonically embossing a web with a non-rotating horn;

FIG. **3** is a side elevational view on a greatly enlarged scale showing an anvil template with protuberant dots for outlining indicia;

FIG. **4** is a front elevational view showing an alternative apparatus for ultrasonically embossing a web, using a rotating cylindrical horn; and

FIG. **5** is a sectional view, partly in elevation, taken along line **5—5** in FIG. **4**.

THE PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2** there is shown an anvil template **11** comprised of a hard material such as steel or other metal whose top surface is provided with appropriate indicia formed by series of protuberant generally cylindrical dots **12,** which in the example shown form a plus symbol and a series of mirror image numbers. Thus, the anvil operates as a template having the appropriate indicia thereon for embossing onto a sheet such as the web **13** of photographic film or paper lying on top of the anvil **11.** Anvil **11** is shown as a plate which is bolted or otherwise secured to a heavy backup plate, but it can as well be a thinner strip, or a unitary structure.

An ultrasonic transducer T comprising a horn **15** is positioned with a bottom surface **17** in position to vibrate vertically down against the web **13** and force it down over the protuberant dots so as to cause them to penetrate part way or all the way through the web and form the indicia therein. Even with complete penetration, there is no release of dust and fragments because material is only displaced rather than removed. The bottom surface of horn **15** can be planar or curved slightly, or planar with curved edges.

When the indicia cover a relatively small area, movement of the horn **15** across the work is not necessary. However, when a series of indicia such as numbers extend over a substantial area greater than that of the horn surface **17**, then embossing is accomplished by moving the transducer T with its horn **15** across the work in any desired way, as by rotating a lead screw (FIG. **4**) within a support **19** to cause a travelling nut (FIG. **4**) which carries transducer T to move across the support **19** from an initial position A to a final position B.

Similar results can be obtained by holding the horn **15** stationary and causing the anvil **11** to move under the horn in a straight line, or in a circle if the indicia are provided on the surface of a rotatable cylindrical anvil over which the web is continuously moving, as in U.S. application Ser. No. 858,428.

FIG. **3** shows the general shape of the dots or protuberances **12**, which generally project a distance slightly greater than the thickness of the sheet to be embossed. The depth of penetration is then controlled by properly adjusting the downward force exerted by the horn, and the power supplied to the transducer. In some cases, complete penetration through the sheet is desired; in other cases, only partial penetration. Individual dot diameters of 0.017 inch, plus or minus 0.005 inch, have been employed, but much smaller diameters can be employed, such as 0.003 inch.

Referring to FIGS. **4** and **5**, the ultrasonic horn **15'** has the shape of a wheel or cylinder with its cylindrical surface in contact with the web **13** on anvil **11**. Starting from the positionA', the horn is moved across the work to position B' by any suitable traversing mechanism such as a lead screw **20** and a travelling nut **21** within support **19**, as described in connection with FIG. **2**. During such movement the cylindrical horn **15'** rotates freely along the surface of web **13** on an axis which is perpendicular to the length of the web, and vibrates longitudinally to exert a wiping action on the web.

FIG. **5** shows the construction of the ultrasonic transducer T' which permits rotation of the horn **15'** without interrupting the flow of electric current to the transducer. Transducer T' is mounted rigidly within a cylindrical housing **35** which in turn is rotatably supported within a cylindrical support **41** by means of a pair of spaced ball bearings **43** and **45** which are wedged between the two.

With the described construction, the entire transducer T' rotates as horn **15'** is moved across the work. This necessitates suitable means for assuring continuity of the electrical supply to the transducer as it rotates. A tube **49** projects from the rear end of transducer T' and rotates therewith. The outside of tube **49** carries a pair of longitudinally spaced circular electrical conductors **51** and **53** which rotate in contact with stationary electrical conductors such as brushes **55** and **57**. The conductors **51** and **53** are individually connected by insulated wires within the tube **49** (not shown) to the transducer.

The ultransonic transducer can be constructed in any well-known way such as in Calosi et al, U.S. Pat. No. 2,748,298, which describes a magnetostrictive transducer, or in Jacke et al, U.S. Pat. No. 3,328,610, describing a piezoelectric transducer, both designed to vibrate the horn back and forth in a lengthwise direction. Vibrations ranging from 20 to 80 kilohertz (1 KHZ equals 1,000 periods or cycles per second) can be employed successfully.

The method described in detail above overcomes the disadvantages of the prior art discussed previously herein. Moreover, another important advantage is secured in that when a coated film or paper is embossed in the described way, the coatings at the points of indentation become stretched and fragmented with the result that even through the major portion of the web may be opaque to light, it becomes transparent or translucent at the indentations so that the indicia may be read even in the presence of the weak red or green lights that are customary in photographic operations. This is indeed a great advantage.

Indicia as large as ⅜ by ¼ inch have been successfully formed with indentations about 0.017 inch in diameter, but much smaller indicia such as 1/16 inch square can be formed with indentations as small as 0.003 inch in diameter. A punch and die set could not be made to create such small indentations.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. A method for embossing indicia into a thin sheet of malleable thermoplastic material which comprises:

providing an anvil having an indicia defined thereon by a plurality of individual spaced dot-like protuberances projecting from the surface of said anvil;

positioning a thermoplastic material over the anvil with one side of said material resting upon and in engagement with the dot-like protuberances; and

applying ultrasonically vibrating pressure impulses generated by an ultrasonic vibrating device comprising a transducer and horn to the opposite side of said thermoplastic material for applying heat and pressure to said material causing said material in register with and resting on the protuberances to melt, be displaced and to resolidify forming a plurality of clear, undistorted, indentations extending partially through said material and which due to the reduced thickness at said indentations are substantially transparent and clearly visible in the presence of a weak light.

2. The invention according to claim **1** comprising the step of effecting relative translational movement between the vibrating device and the article and anvil as a unit substantially simultaneously with the step of applying the ultrasonically vibrating pressure impulses.

* * * * *