

July 2, 1957

W. BORNEMANN
APPARATUS FOR BROACHING DIE APERTURES IN
A ROTARY FILM PERFORATOR

2,797,754

Filed July 26, 1955

3 Sheets-Sheet 1

Fig. 1

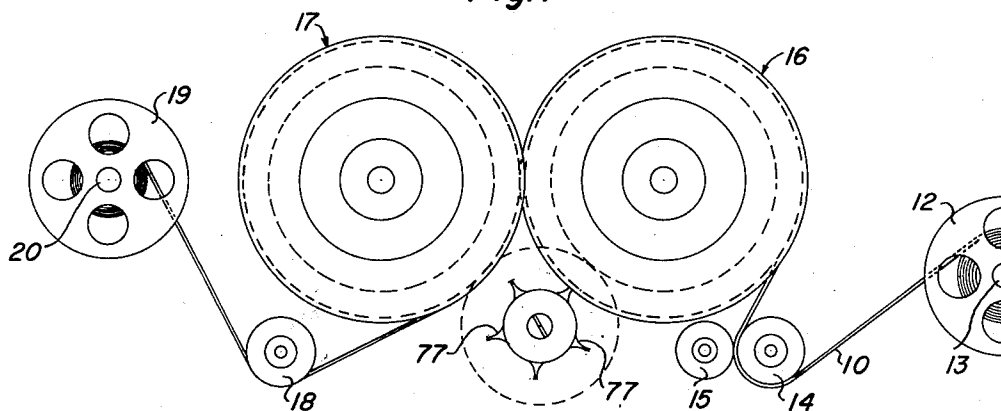


Fig. 3

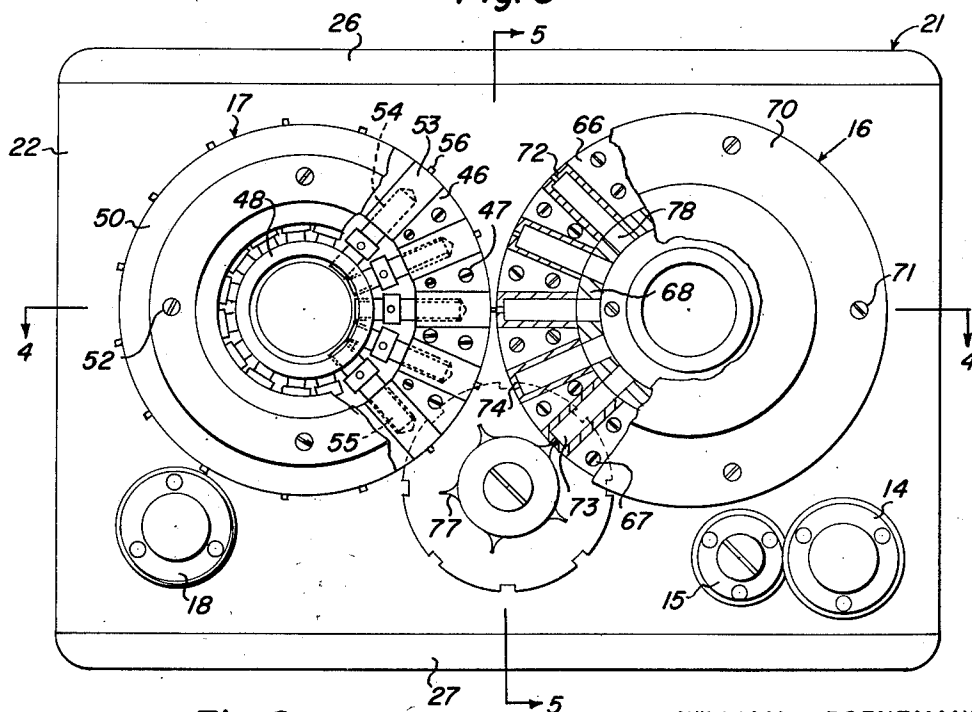
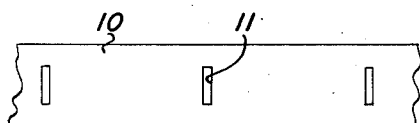


Fig. 2



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Fig. 4

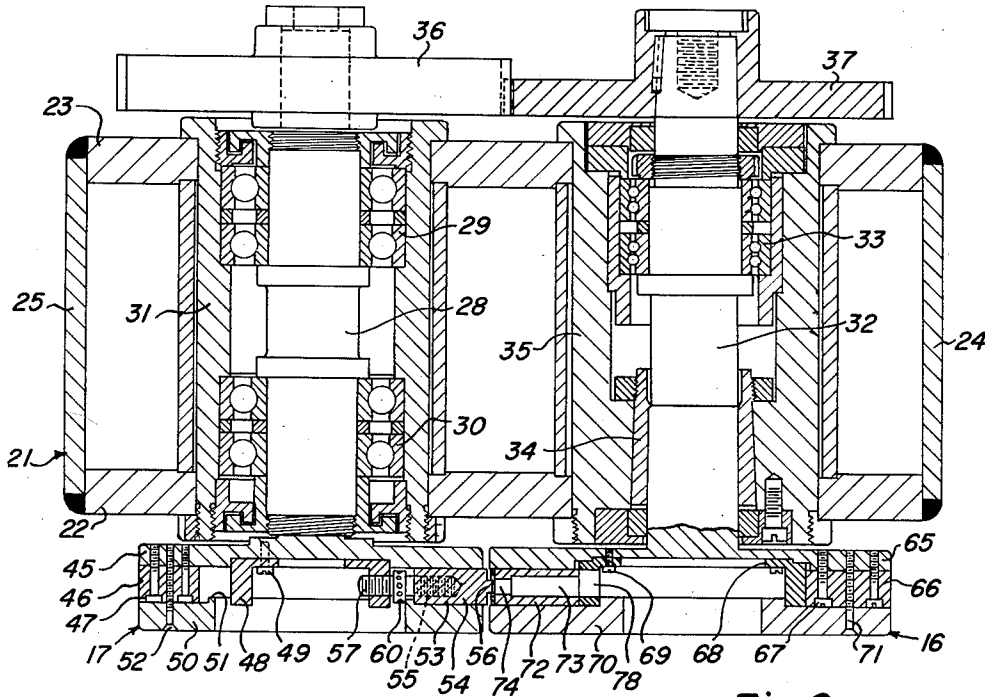


Fig. 6

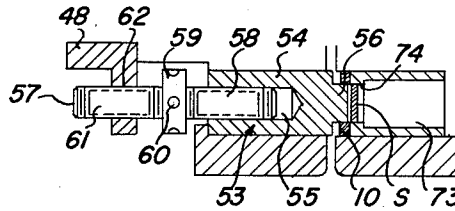
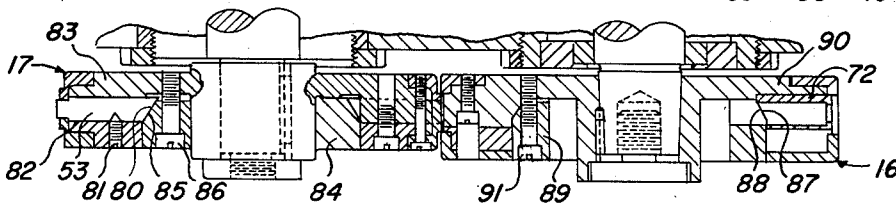


Fig. 7



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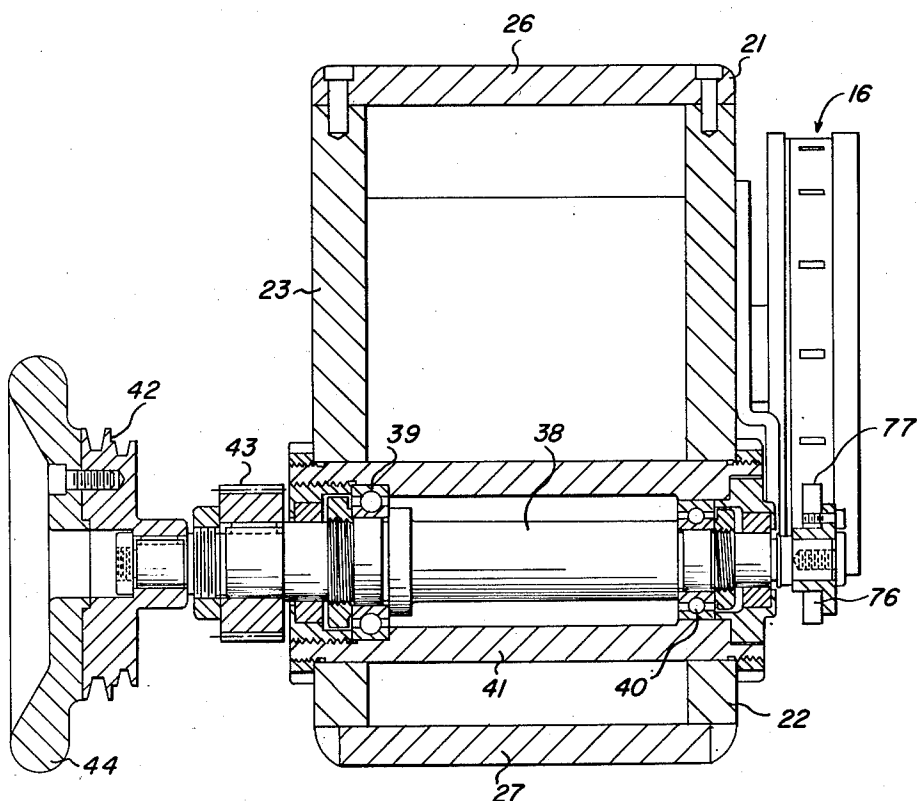
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Fig. 5



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APPARATUS FOR BROACHING DIE APERTURES IN A ROTARY FILM PERFORATOR

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Application July 26, 1955, Serial No. 524,426

1 Claim. (Cl. 164—99)

The invention relates to a rotary perforator for film and more particularly to an arrangement of the punches and dies whereby the punches are utilized to broach the apertures in the dies to obtain very accurate die apertures and, hence, film perforations within very close tolerances.

In U. S. Patent No. 2,206,138 a rotary perforator for motion picture film is described in which the film is moved continuously through a fixed path and the perforations are pressed from the moving film and stripped therefrom by passing the film and slugs through different paths. This perforator utilizes two rotary members or drums, one of the drums carrying a plurality of radially arranged punches and the other drum carrying a plurality of radially arranged dies. The punches are mounted so that their tip approaches but does not contact the die members. In this way, the punches pass substantially through the film and force the slug into the die aperture. Since the film and slugs are moved through different paths, the slug is stripped from the film, leaving clean, sharply formed perforations.

While the accuracy of the perforations obtained by the apparatus described in the above patent is within the tolerable limits, it has been found that perforations exceeding the tolerable limits prescribed for the perforations per se and the spacing between perforations can easily be obtained. In the above patent, the tolerances of the punch could be held to very exacting limits. The die aperture, however, because of its relatively small size and shape, is not capable of being held within the same tolerances as the punch. As a result, any discrepancies in the perforations were due primarily to the variations in the die aperture.

The present invention eliminates the above difficulty by insuring a die aperture which will conform exactly to the size of the punch. This is accomplished by making the die apertures slightly undersize with respect to the punch and assembling the apparatus with such dies in their normal position with respect to the punches. Since the punches and dies are mounted radially on rotary members, there is only one point at which a punch and a die aperture are in alignment. In assembly, therefore, the drums are intermittently rotated to position a punch and die aperture in alignment. At this point, the punch, which is hardened and ground, is moved radially into and through the die aperture so that, in effect, the punch broaches the undersize die aperture to exactly the same size as the punch. The punch is then retracted to its normal position with respect to the die aperture and the succeeding punch and die aperture are then moved into an aligned position. In this way, every punch and die are mated and the die apertures correspond exactly to their respective punch. It has been found that when perforations are made in film by a rotary perforator in which this procedure of broaching the die aperture by the punch has been utilized, the tolerable limits can be

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decreased considerably in comparison with the limits imposed by the previous arrangement.

The primary object of the invention is, therefore, to provide a rotary film perforator in which each die aperture is finally broached by its respective punch to obtain perforations within the very exacting limits.

Another object of the invention is to provide means associated with the rotary film perforator for moving each punch into and through the undersize die aperture when said die and aperture are in an aligned position.

Other objects and advantages will be readily apparent to those skilled in the art by the description which follows.

Reference is now made to the accompanying drawings wherein like reference numerals designate like parts and wherein:

Fig. 1 is a diagrammatic front elevation of a rotary film perforator embodying the invention;

Fig. 2 is a fragmentary plan view of a typical film perforated with transverse apertures in accordance with the invention;

Fig. 3 is an enlarged front elevation, partially in section, showing the radial arrangement of the punches and dies in each of the rotary members;

Fig. 4 is a sectional view taken substantially along line 4—4 in Fig. 3;

Fig. 5 is a sectional view taken substantially along line 5—5 in Fig. 3;

Fig. 6 is a detail view of the means shown in Fig. 4 for moving the punches radially into the die apertures and showing the related parts in their normal perforating position; and

Fig. 7 is a detail view of another embodiment of the invention showing means for moving the punches radially.

While the invention is disclosed with respect to apparatus for perforating film, it is to be understood that the invention can be applied equally well to apparatus for perforating other strip materials which readily lend themselves to a continuous operation; such as paper tape, magnetic tape, etc. A typical film 10 is shown in Fig. 2, wherein apertures 11 which are transverse to the film are perforated in the film by the apparatus to be described. Since apertures 11 are utilized in apparatus for both registration and advancement of the film strip, it is of utmost importance that apertures 11 be held within very close limits and that the spacing of said apertures also be within such limits.

Referring to Fig. 1, film 10 is moved continuously from supply reel 12 on spindle 13, around and between fixed roll 14 and tension roll 15, around rotary member 16 and onto rotary member 17, around idler roll 18 and thence to take-up reel 19 on spindle 20. Rolls 14, 15 and 18 can be supported on the housing or support 21 for rotary members 16 and 17 shown in Fig. 3.

Housing 21 comprises a front plate 22, a back plate 23, side plates 24 and 25, top plate 26 and bottom plate 27. Between plates 22 and 23, shaft 28 is journaled in bearings 29 and 30 which are mounted in sleeve 31. In spaced and parallel relation to shaft 28, shaft 32 is also journaled in bearings 33 and 34 which are mounted in sleeve 35 arranged between plates 22 and 23, see Fig. 4. Gear 36 is keyed to shaft 28 on the end extending through plate 23 and meshes with gear 37 which is keyed to a similarly extending end of shaft 32, gears 36 and 37 being of the same pitch diameter and rotatable at the same speed. Below and between shafts 28 and 32, see Fig. 5, a third shaft 38 is mounted in bearings 39 and 40 which are mounted in sleeve 41 also arranged between plates 22 and 23. Shaft 38 has keyed thereto on the end extending beyond plate 23, a double pulley 42 and a gear 43 which meshes with gear 36, handwheel 44 being

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fixed to pulley 42. A suitable drive means, such as a motor not shown, can be operatively connected to either of pulleys 42 for rotating gear 43 and driving gear 36 which, in turn, drives gear 37, shafts 28 and 32 thus being rotated in opposed directions at the same speed. For a purpose to be described hereinafter, handwheel 44 can also be used to rotate shafts 28 and 32 since it is connected directly to pulley 42.

Rotary member 17 is keyed to the end of shaft 28 extending beyond plate 22. Member 17 comprises a flange 45 to which spacers 46 are secured by screws 47, a ring 48 secured to flange 45 by screws 49 and a cover plate 50 having an internal shoulder 51 and which is retained by screws 52. Punches 53 are arranged between spacers 46 and, with reference to Fig. 3, it is evident that said punches can be moved radially. Each of punches 53 has a substantially square body portion 54 which is provided with a blind threaded hole 55 and a perforating portion 56 which is of a shape in accordance with the aperture to be perforated and which in the disclosure is rectangular, as shown in Fig. 2. With reference to Figs. 3 and 6, it will be noted that each of punches 53 is maintained in position by screw studs 57 having a threaded portion 58, an intermediate collar 59 provided with a plurality of spaced apertures 60 and a threaded portion 61, threaded portions 58 and 61 being of opposed hands. Portion 58 threadably engages hole 55 in punch 53 and portion 61 threadably engages a corresponding tapped hole 62 in ring 48 aligned with punch 53. By this means, each of punches 53 can be adjusted radially for a purpose to be described hereinafter.

Rotary member 16 is keyed to the end of shaft 32 extending beyond plate 22. Member 16 comprises a flange 65 to which spacers 66 are secured by screws 67, a ring 68 secured to flange 65 by screws 69, and a cover plate 70 which is fastened to flange 65 by screws 71. The side walls of spacers 66 together with flange 65 and cover plate 70 form a series of radially extending recesses in which dies 72 are mounted. Each of dies 72 is provided with a central hole 73 and a die aperture 74 which is slightly undersize with respect to the dimensions of the perforating portion 56 of punches 53. When assembled between spacers 66, the inner ends abut the outer surface of ring 68 which positions the outer end of dies 72 with respect to punches 53 and particularly portion 56 thereof.

As taught in the above-mentioned patent, punches 53 are adjusted by studs 57 so that perforating portion 56 moves into film 10 but does not penetrate it, see Fig. 6. In other words, punches 53 are set up to approach but do not enter dies 72. Since die apertures 74 are undersize when in assembled relation on flange 65, it becomes necessary to broach the apertures in order that they conform to the portion 56 and will receive the slug pressed out of the film thereby. For this purpose, handwheel 44 is turned slowly, thereby rotating gear 43 and gears 36 and 37. When flanges 45 and 65 are positioned so that the portion 56 of one of punches 53 is aligned with the aperture 74 in one of dies 72, then collar 59 is turned by a suitable tool placed in one of apertures 60 and turned in a direction to move punch 53 toward die 72. Punch 53 is moved radially until portion 56 thereof has been moved completely through aperture 74 which then conforms exactly with portion 56. Collar 59 is then rotated in the opposite direction to withdraw or retract portion 56 from aperture 74. This movement of collar 59 and punch 53 is continued until the end of punch 53 abuts shoulder 51 on cover plate 50. In this position punch 53 will be correctly positioned with respect to its mating die aperture. Handwheel 44 is then rotated to position the next punch and die in proper alignment for the same operation and the procedure is repeated until each of the punches has been utilized to broach its respective die on member 16.

When it becomes necessary to sharpen the punches 53, cover plate 50 is replaced with a similar plate on which the locating periphery of shoulder 51 is increased in ac-

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cordance with the amount of material removed from portion 56. For example, if five-thousandths of an inch is removed from the end of portions 56, then the outer diameter of shoulder 51, that is, the locating surface which abuts the inner ends of punches 53, is increased by ten thousandths of an inch. In the same manner, if it should be necessary to grind the outer surface of dies 72, ring 68 can be replaced by a similar ring having a corresponding larger outer diameter.

The slugs S are pressed out of film 10 and into aperture 74 by portion 56 and are completely removed from the film thereby due to the speed of members 16 and 17 and the resultant impact of the punches with respect to the film. As a result, the slug S is stripped from the film leaving a clean, sharply formed perforation. Since the film passes in a comparatively smooth path which is free of sharp turns, the film can be moved at relatively high speed without damage thereto during the perforating operation. As the film is moved between rotary members 16 and 17, the film is very accurately perforated and until the film leaves rotary member 17, the portions 56 remain in contact with the perforations to serve as teeth and retain the film in registry on the periphery of member 17. In order to insure removal of slugs S from dies 72, a plate 76 is secured to the end of shaft 38 extending beyond front wall 22 for rotation therewith. Plate 76 is provided with spaced and radial extensions 77 which are smaller dimension-wise than die apertures 74 and are utilized to enter the apertures for forcing the slugs into holes 73. Ring 68 is also provided with apertures 78 which are aligned with the central holes 73 in dies 72. By providing a suitable connection to cover plate 70, a vacuum pump or suction device can be fixed thereto for removing the film slugs forced into holes 73 by extensions 77.

In Fig. 7 another arrangement is disclosed for moving the punches 53 and dies 72 radially and for maintaining them in their proper operating relationship. Punches 53 are provided with an inclined surface 80 and are retained in position by lock screws 81 in plate 82, the spacing between punches 53 being provided by milling radial slots in flange 83. A plurality of sectors 84 having an inclined surface 85 for abutting surface 80 are secured to flange 83 by screws 86. In a similar manner, dies 72 are provided with an inclined surface 87 which is abutted by an inclined surface 88 on ring 89 which is fastened to flange 90 by screws 91. When one of punches 53 is aligned with its respective die 72, as described hereinbefore, screw 81 is backed off to free punch 53 for radial movement in its slot. Screw 86 is then turned in a direction to move sector 84 toward flange 83 whereby surface 85 thereof which is in contact with surface 80 on the punch cams said punch radially into and through the undersize aperture in die 72. Screw 86 is then turned in the opposite direction to release surfaces 80 and 85 to permit punch 53 to be withdrawn from the die aperture. The punch is then aligned with screw 81 and secured in position and sector 84 is returned to a position in which surfaces 80 and 85 are again in abutting relation. The succeeding punch and die are then moved into an aligned position and the above procedure is repeated for each set of punches and dies.

By the above described mountings of the punches and dies, the die aperture can be successfully broached by the punch, thereby resulting in a perforation in the film which is accurate within limits not heretofore attainable. While the arrangement of the punch and die has been disclosed with respect to providing a transverse perforation in the film, such a structure is also feasible for providing marginal perforations, such as are used in movie film, with the same order of accuracy. Since many other modifications of the invention will be apparent to those skilled in the art, the invention is not to be limited to the apparatus and method disclosed but is defined by the appended claim.

Having now particularly described my invention, what

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I desire to secure by Letters Patent of the United States and what I claim is:

A film perforator comprising a pair of spaced rotary members, means for rotating said members in opposite directions, one of said rotary members including a plurality of radially arranged punches extending therefrom and the other of said rotary members including a plurality of radially arranged dies equal in number to said punches and provided with a radially extending aperture which is undersize with respect to said punches, means 10 fixed to said one rotary member and engaging said punches for fixing the position of said punches with respect to said dies at a distance such that said punches approach but cannot enter said dies, a stationary ring fixed to said one rotary member and movable therewith 15 and provided with a plurality of threaded apertures, a screw member arranged between each of said punches and said ring and having a collar intermediate the ends thereof for imparting rotary motion thereto, said screws being provided with threads of different hand in each 20

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side of said collar for threadably engaging said punches and the threaded apertures in said ring for moving each punch radially into and through the aperture aligned therewith to broach said aperture in accordance with said punch and for retracting said punch to position it with respect to said engaging means.

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