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Borello

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[54] **STRIP PERFORATING APPARATUS**

[76] Inventor: **Domenic Borello,** 142 Nyack Ave., Pelham, N.Y. 10803

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[52] **U.S. Cl.** **83/322;** 83/337

[51] **Int. Cl.²** **B26F 1/08**

[58] **Field of Search** 83/337, 322

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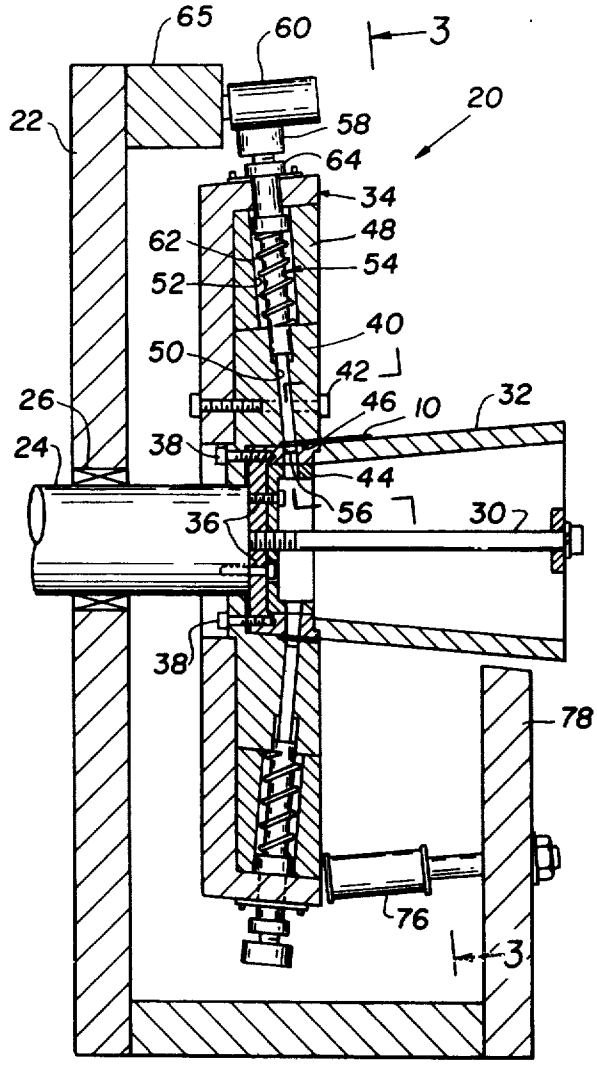
Primary Examiner—Frank T. Yost

Attorney, Agent, or Firm—Bauer & Amer

[57] **ABSTRACT**

An apparatus for continuously perforating strip material, i.e. for applying the sprocket perforations along the edge of a film strip. To achieve uniform spacing of these perforations, a work station is established in relation to a rotating circumferential arrangement of punch or perforating devices wherein each punch, in turn, is projected through the strip to cause said perforation. Said punch is held in its projected position through the strip during its subsequent rotative traverse, thereby pulling a selected length of the strip through the work station and locating accurately the next point on the strip where the next perforation is to be made.

1 Claim, 4 Drawing Figures



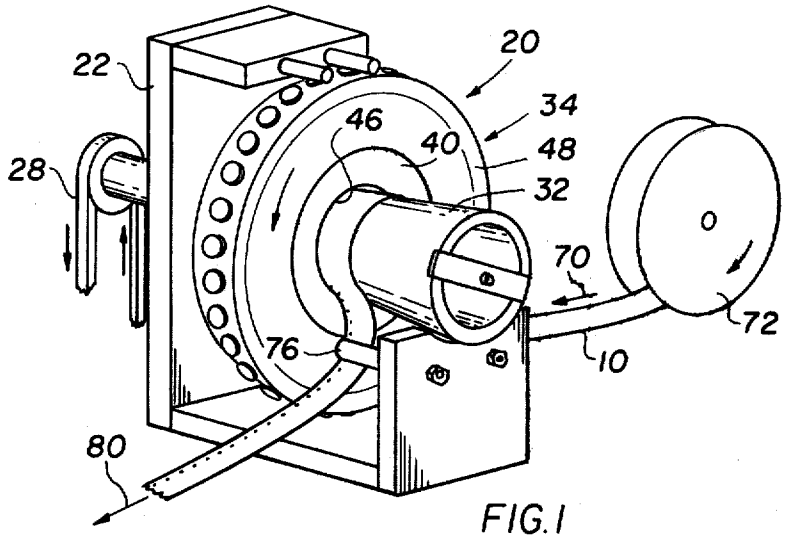


FIG.1

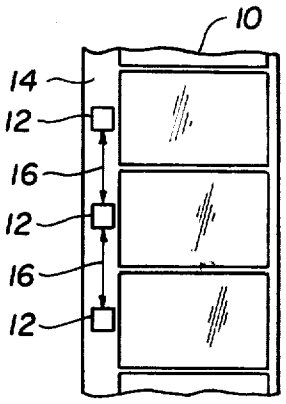


FIG.4

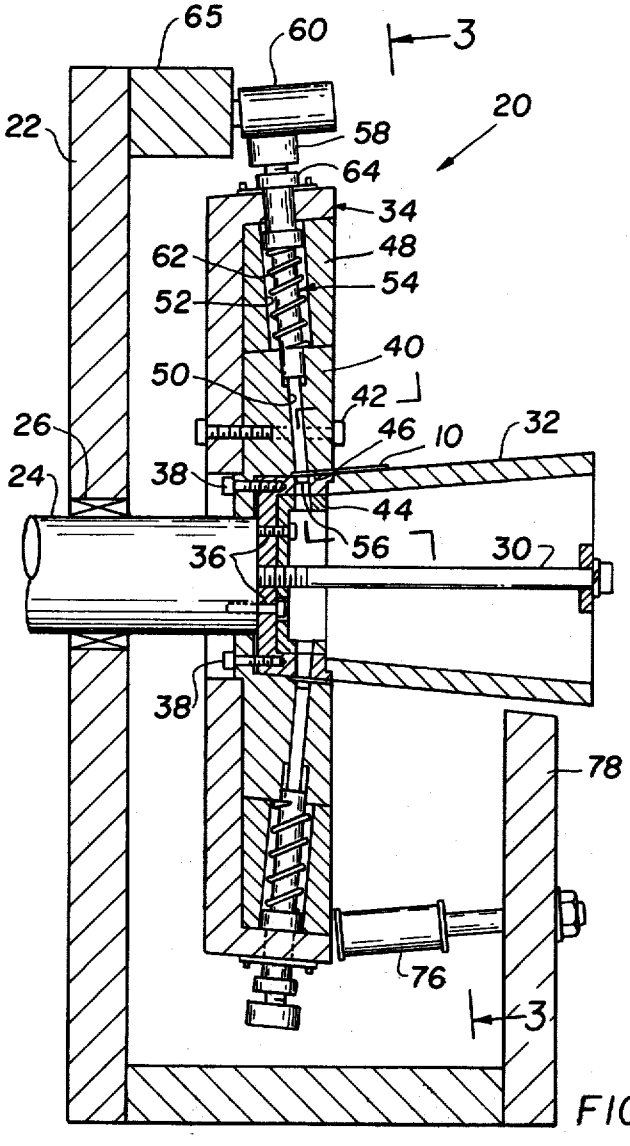


FIG.2

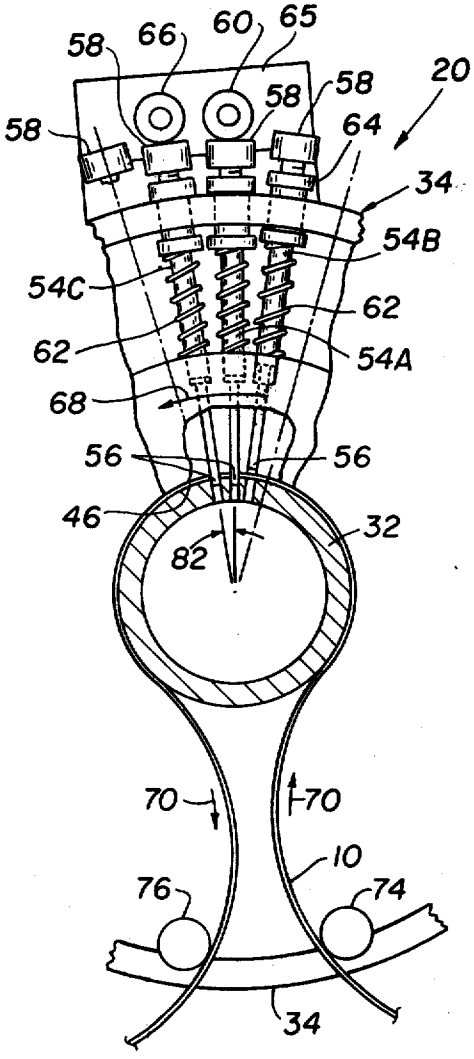


FIG.3

STRIP PERFORATING APPARATUS

The present invention relates generally to perforating apparatus, and more particularly to improved apparatus for accurately providing perforations at uniform spacing along an elongated plastic strip. An exemplary product produced by the within apparatus is a film strip with marginal edge feed movement sprocket openings or perforations that are precisely located so as to provide the desired meshing engagement with the teeth of the sprocket.

The prior art practice of producing a series of perforations along a plastic strip contemplates the simultaneous production of perhaps ten perforations, all uniformly spaced from each other, and then the movement of an adjacent length portion of the strip into the perforating or work station. While, as noted, each group of ten perforations are uniformly spaced, the spacing between adjacent groups may not be as precise as is required. The accuracy thereof would be a function of the accuracy of the mechanism feeding the strip into and out of the work station. Also, the technique described contemplates incremental, rather than a continuous and smooth, feed movement in the strip, and thus is undesirably slow, as well as being subject to malfunctioning in the strip-handling mechanisms that must be employed to provide this incremental movement.

Broadly, it is an object of the present invention to provide a rotary perforating apparatus, characterized by continuous, efficient perforating operation, overcoming the foregoing and other shortcomings of the prior art. Specifically, it is an object to achieve uniform spacing of perforations as a function of the uniform spacing of punch devices producing said perforations, and to further achieve a continuous mode of operation in the apparatus by a circumferential arrangement of said punch devices.

An apparatus demonstrating objects and advantages of the present invention includes a circumferential arrangement of punches, all normally in a raised or ready position, and means in the rotary path of said punches for camming each, in turn, through a stroke producing a perforation. Additional means maintain the punch in its projected condition through the strip so that the rotational traverse thereof pulls the adjacent area of the strip into the work station incident to the application in this area, at a precisly located point, of the next perforation.

The above brief description, as well as further objects, features and advantages of the present invention, will be more fully appreciated by reference to the following detailed description of a presently preferred, but nonetheless illustrative embodiment in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a perspective view of a strip perforating apparatus demonstrating objects and advantages of the present invention;

FIG. **2** is a partial side elevational view, in section, illustrating further structural features of the apparatus;

FIG. **3** is a partial front view, taken along lines **3—3** of FIG. **2**, illustrating additional structural features; and

FIG. **4** illustrates a perforated strip that is produced by the apparatus hereof.

Illustrated in FIG. **4** is a typical film strip **10** having sprocket perforations **12** along a marginal edge **14**. Proper movement of the film strip **10** by the feeding

sprocket gear of the projector, camera, etc., require a uniform spacing **16** between the perforations **12**, as well as accurate uniform sizes in each of the perforations **12**. The foregoing and other desirable criteria are readily achieved by the strip perforating apparatus, generally designated **20**, which constitutes the present invention.

As illustrated in FIGS. **1–3**, apparatus **20** includes a stationary housing having an upstanding member **22** in which shaft **24** is appropriately journalled for rotation, as at **26**. One extending end of shaft **24** is driven in rotation by a pulley connection **28** to a motor. At its other end, as best illustrated in FIG. **2**, shaft **24** has connected to it, as by bolt **30**, a conical rotor **32**, the function of which will soon be apparent. It suffices at this point to note that the conical or cone rotor **32** rotates in unison with shaft **24**.

Also rotating in unison with shaft **24** is a housing **34** which is bolted as by bolts **36, 38**, so as to constitute an attachment to the construction consisting of the shaft **24** and cone rotor **32**. An important part of the housing **34** is a ring-like segment **40** which is bolted by circumferentially spaced bolts **42** in overhanging relation to an inwardly located portion **44** of the cone rotor **32**. As a consequence, the rotor portion **44** and the segment **40** bound a cylindrical punch compartment **46**. In other words, as is best illustrated in FIGS. **1** and **3**, the punch compartment **46** is in the nature of a cylindrically shaped clearance which exists between the rotor end **44** and the housing segment **40** which overhangs said rotor end **44**.

In addition to segment **40**, housing **34** includes an outer segment **48**. As is best illustrated in FIG. **2**, the segments **40** and **48** cooperate to provide a housing structure for a plurality of radially oriented openings, each consisting of a through bore **50** and a counter bore **52**. Disposed for vertically reciprocating movement in the interconnected bores **50, 52** is a punch device **54**, having a bottom perforating tip **56**. At its opposite end, the punch device **54** has a threadably engaged cam block **58**. In practice, block **58** is engaged by a rotary cam member **60** with the result that each punch device **54**, in turn, is projected from a raised ready position through a punching stroke, during which its perforating tip **56** is urged through the strip **10** into the projected position shown in FIG. **2**. This, of course, produces a perforation **12** in the strip **10**. The aforesaid punching stroke of each punch device **54** is produced against the urgency of a helical spring **62** which normally holds the same in its raised, ready position. The depth of the punching stroke is adjusted by threaded adjustment of a collar **54** on the upper end of each punch device **54**.

The significance, in terms of function, of the foregoing can perhaps best be appreciated by reference to FIGS. **2, 3**. As illustrated therein, the noted camming means **60** consists of a cylinder rotatably mounted to extend from block **65** transversely of the circumferential path of rotation of the housing **34**, and thus of the punch device **54** circumferentially located about the housing **34**. As a consequence, each punch device **54**, in turn, during counter-clockwise rotation of the housing **34** must contact the camming cylinder **60**. This contact between the cylinder **60** and the cam block **58** of each punch device results in each said punch device, in turn, being depressed from its raised, ready position to its forwardly projected position in which it is pro-

jected through the body of the strip **10**, and produces the perforation **12** in the marginal edge **14** thereof. In FIG. **3** this punch stroke which is caused sequentially by the circumferentially arranged punches **54** can best be understood by noting the punch identified as **54A** which is already under the camming influence of cam **60** and the next punch to encounter said cam **60** which is identified by the designation **54B**.

In addition to actual production of the perforation **12**, it is an important aspect of the present invention that the punch devices **54** also provide feed movement of the strip **10** into and through the punch compartment **46**. To this end, situated adjacent the first cam cylinder **60** is a second encountered cam cylinder **66**. The function of cylinder **66** is to maintain the punch which is in its projected position through the strip **10**, as just described, in said projected position during the rotative traverse of the housing **34** from cam cylinder **60** and until the punch cam block **58** clears said second encountered cylinder **66**.

The foregoing may be better understood from FIG. **3** by noting how the depressed or projected position of punch **54A**, which is created by the first encountered cam **60**, is preserved by the second encountered cam **66** in the punch designated **54C**. Thus, during the rotative traverse **68**, the perforating end **56** of a punch device is projected through a perforation **12** in the strip **10** and thus carries the strip along with it causing a feed movement **70** in the strip.

The manner in which the strip **10** is properly located in the punch compartment **46** in position to be perforated by the circumferentially arranged punch devices **54** may best be understood from FIGS. **1** and **2**. Rotor **32** is conically shaped so that, as illustrated in FIG. **1**, strip **10** is unwound from a supply spool **72** or the like and is threaded within the compartment **46**, as illustrated in FIG. **2**, for only for a portion, but not for an entire, rotational traverse of the cone rotor **32** and housing **34**. Assisting in guiding strip **10** through this path is an initial guide roller **74** oriented at approximately the same angle as the upper angular surface of cone rotor **32** as illustrated in its FIG. **2** position of rotation. At the exit side of compartment **46** there is a similarly angularly oriented roller **76**. Rollers **74** and **76** extend from the vertical mounting block **78**. Proper tracking of the strip **10** is also assisted by a take-up spool (not shown) which applies a slight tensioning force **80** to the perforated length portion of the strip exiting from the punch compartment **46**.

The material perforated out of the body of the strip **10** is collected in the hollow interior of the cone rotor **32** which is appropriately designed that said collected material passes out of it by the rotating action of the unit.

It should be readily appreciated that there has been described herein an apparatus **20** for continuously producing perforations **12** in the marginal edge **14** of an elongated strip **10**. This continuous mode of operation is noteworthy in that it assures uniform spacing **16** between adjacent perforations **12**. That is, any selected uniform spacing **16** which is desired between adjacent perforations **12** is readily achieved merely by proper circumferential uniform spacing of the punch devices **54** about the housing **34**. This is illustrated in FIG. **3** wherein by proper selection of a uniform angle **82** subtended by adjacent punch devices **54** there will be a corresponding uniform spacing in the adjacently produced perforations **12**.

A latitude of modification, change and substitution is intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

What is claimed is:

1. A strip perforating apparatus comprising a motor operated conically shaped rotor, an overhanging housing on said rotor bounding a cylindrical punch compartment in surrounding relation about said rotor, plural punch devices circumferentially arranged about said housing and means for mounting each for movement through a punch stroke from a ready position into said punch compartment to a projected position, a cooperating spring for each punch device which normally holds the same in said ready position, a first encountered rotatably mounted cylindrically shaped cam strategically located in the path of rotative movement of said punch devices effective to urge each punch in turn through said punching stroke, means for positioning a length portion of an elongated strip in said punch compartment so as to be perforated by each said punch during its movement into said projected position, and a second encountered rotatably mounted cam adjacent said first cam effective to hold each punch in turn in said projected position in which it extends through a perforation in said strip during rotative movement from said first cam and until past said second cam, whereby each punch in turn causes a perforation in said strip and also pulls the same in feed movement through said punch compartment.

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