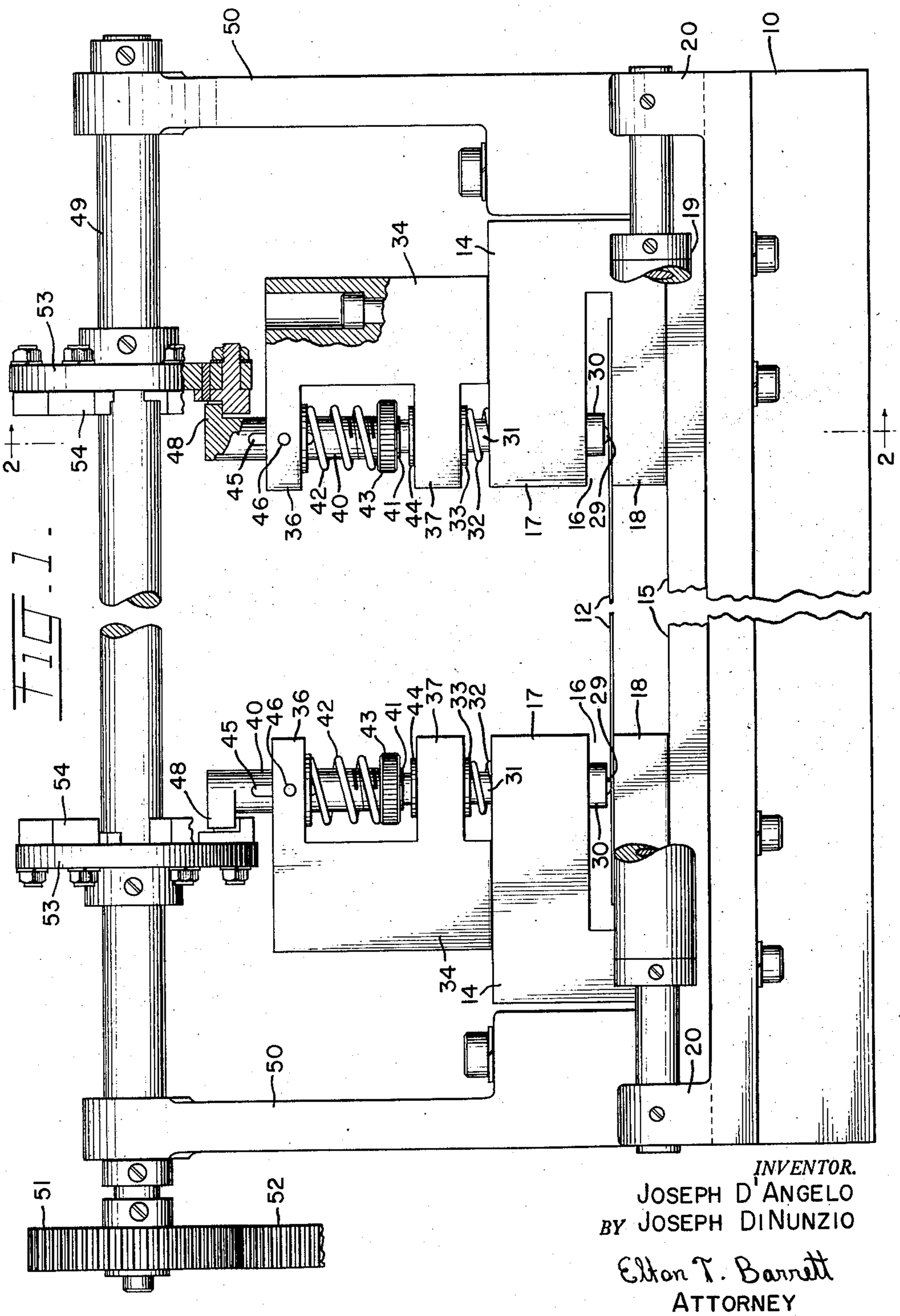
Sept. 2, 1958 J. D'ANGELO ET AL 2,850,093

PERFORATING APPARATUS

Filed Dec. 6, 1955

2 Sheets-Sheet 1

FIG. 1



INVENTOR.
JOSEPH D'ANGELO
BY JOSEPH DINUNZIO

Elton T. Barrett
ATTORNEY

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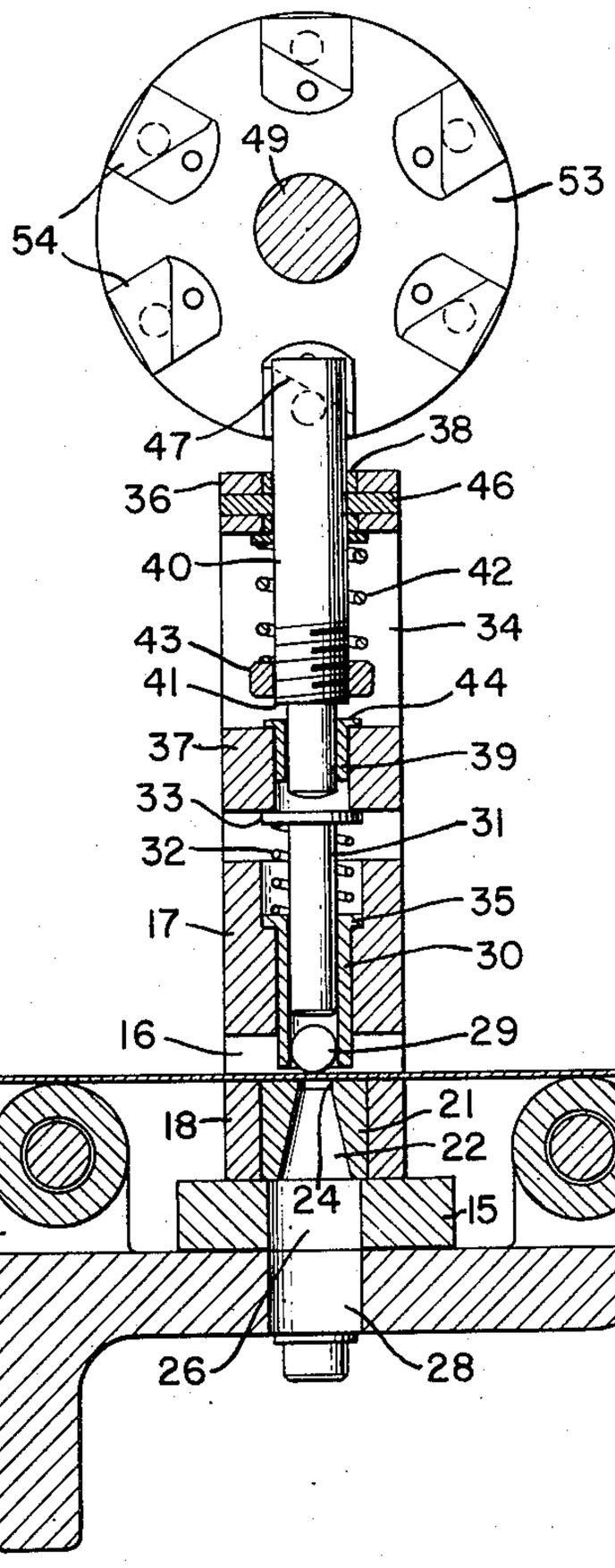

FIG. 2.

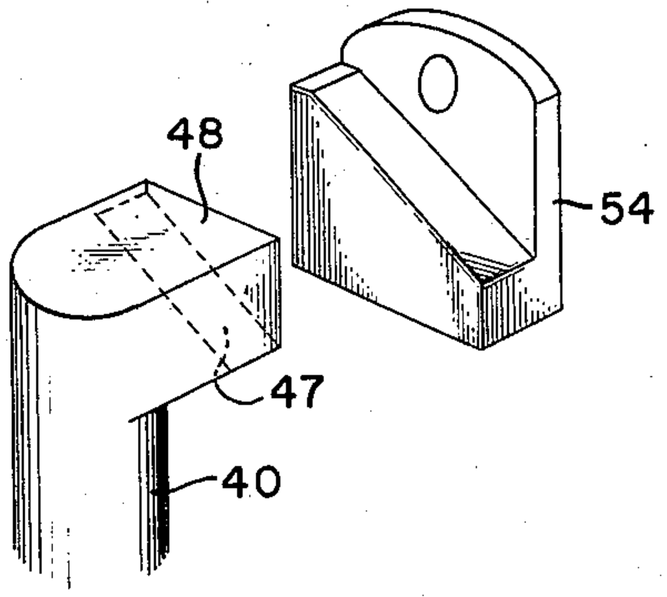

FIG. 3.

INVENTOR.
JOSEPH D'ANGELO
BY JOSEPH DiNUNZIO
Elton T. Barrett.
ATTORNEY

United States Patent Office

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2,850,093

PERFORATING APPARATUS

Joseph D'Angelo, Flushing, and Joseph Di Nunzio, Astoria, N. Y., assignors to Roto Bag Machine Corporation, New York, N. Y.

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9 Claims. (Cl. 164—94)

This invention relates to improvements in perforators, and particularly to an improved perforator for making holes in a moving web of packaging material.

Among the many uses that have been developed for plastic materials, there are a number of instances in the packaging industry and the like where the material must be perforated. For example, in the packaging of certain vegetables, such as potatoes, it is desirable to make provision for air circulation about the packaged articles to prevent spoilage. This is accomplished most readily by making holes in the packaging material, and for economy it is preferable to do the perforating while the material is going through some other necessary fabrication procedure such as the formation of the packages or bags.

It is, of course, common practice to form plastic bags in a "continuous-process" apparatus wherein the packaging material moves continuously from a supply roll or the like to the finished package discharge point. In some instances, the material may leave the supply roll as a flat web which is subsequently folded and heat-sealed longitudinally and laterally to form the package. In other types of machines, an extruded tube of plastic is heat-sealed laterally to form the package. In any case, if the material is to be perforated it is important to do so without tearing the material or otherwise interfering with its normal continuous movement through the machine.

It is a general object of the invention to provide a perforator for use in application such as those referred to above. More specificaly, it is among the objects of the invention to provide a perforator which lends itself to the making of holes in a continuously moving, single or multi-layer web of sheet material without interfering with the movement of the material, which entails the provision of a punching mechanism operating in a simple and reliable manner.

In accordance with a preferred embodiment of the present invention, the foregoing and other related objects and advantages are attained in a perforating mechanism wherein a spherical punch is driven against a sharp-edged circular cutting die to perform the cutting operation. To insure uniformity and reproducibility of results, the punch is driven by a spring-loaded plunger which is withdrawn against the force of the spring by a cam element. Upon disengagement of the cam, the plunger is carried forward by the spring and its forward motion transmitted to the punch to drive the punch against the die. Immediately upon making cutting contact with the die, the punch is released so as not to interfere with the movement of the material, and assumes a position in readiness for the next punching operation.

A more complete understanding of the invention and of further objects and features thereof can be had by reference to the following description of an illustrative embodiment of the invention, when considered in connection with the accompanying drawings, in which:

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Figure 1 is an elevational view, partly in section, of a perforator embodying the present invention;

Figure 2 is a sectional view of the perforator shown in Figure 1, taken on the line 2—2 of Figure 1; and

Figure 3 is an enlarged exploded perspective view of the camming members for actuating the punch driver in the perforator of Figures 1 and 2.

As shown in Figure 1 of the drawings, a perforator embodying the invention comprises a bed plate 10 which extends across the path of travel of the continuously moving material 12 to be perforated. It will be understood that the bed plate may be mounted at any suitable point along the path of material travel in a complete machine for forming bags or the like. The present showing is limited solely to those parts which contribute to an understanding of the invention.

A pair of C-shaped punch-and-die support blocks 14 are mounted on a spacer plate 15 at opposite ends of the bed plate 10. The spaces 16 between the upper and lower portions 17, 18 of the blocks 14 provide slots through which the edge portions of the material 12 can pass.

As best shown in Figure 2, guide rollers 19 preferably are journalled between brackets 20 extending upwardly from the bed plate 10 ahead of and beyond the blocks 14 in the path of material travel. The material is passed over the rollers 19 to insure its being held flat and properly positioned as it passes through the perforator.

The lower portion 18 of each C-block 14 carries a female die insert 21 which is set flush with the surface of the block section 18 over which the material 12 passes. The die 21 has a central hole 22 therein which forms a sharp circular cutting edge 24 in the upper surface of the die. The die hole 22 preferably tapers outwardly somewhat from top to bottom and registers with holes 26, 28 in the spacer 15 and bedplate 10 so that the punched out material can drop freely from the die.

Above the die 21 is mounted a punch comprising a ball 29 fitting slidably in a sleeve 30 which is set into the upper portion 17 of the block 14 in axial alignment with the die aperture 22. When no material is passing through the perforator, the ball 29 will rest on the cutting edge 24 of the die, protruding slightly into the hole 22 as the ball diameter is slightly larger than that of the hole 22. When material is passing through the C-slot 16, the ball 29 normally will ride lightly on the surface of the moving material, as shown in the drawing.

The sleeve 30 in which the ball 29 is located also serves as a guide for an impact transfer member 31. This transfer member 31 comprises a rod which is slidable vertically in the sleeve 30. In order to allow the ball to ride freely on the moving material surface, the rod 31 normally is held in a retracted position, as shown, by a return spring 32. The spring 32 fits around the rod 31 and extends from a flange 35 on the upper end of the sleeve to the underside of an enlarged diameter cap 33 formed on the upper end of the rod 31.

The punch is actuated by a driver which is mounted above the C-block 14 in a bearing support 34. The support 34 has vertically spaced upper and lower sections 36, 37 which project over the transfer memer 31 and carry slide bearings 38, 39 for a vertically reciprocable plunger 40 which is axially aligned with the transfer rod 31. The underside of the lower support section 37 serves as a stop for limiting upward movement of the rod 31, being contacted by the cap 33 when the rod is in its rest position as shown.

The lower end of the plunger 40 is slightly rounded to serve as a hammer head for striking the cap 33, and normally rests on the cap, being urged downwardly to this position by a drive spring 42. The spring 42 extends

between the underside of the upper support section **36** and an adjusting collar **43** which is threaded onto the upper portion of the plunger **40**. The upper portion of the plunger **40** also is enlarged slightly to form a shoulder **41** on the plunger. During operation of the perforator, the shoulder **41** will bottom against a flange **44** formed at the upper end of the lower bearing **39** to limit the downward movement of the plunger. The collar **43** provides a means for adjusting the effective force of the spring **42** so that it can be properly balanced with the opposing force of the return spring **32**, as described hereinafter.

The enlarged upper portion of the plunger **40** also is slotted as indicated at **45** (Figure 1) to accommodate a dowel pin **46** extending laterally through the slot **45**. The pin **46** prevents rotation of the plunger to insure proper orientation of the plunger with respect to the plunger actuator, which will now be described.

The plunger **40** is actuated by raising it against the force of the drive spring **42** and then releasing it to be driven downwardly by the spring **42**. The plunger actuator or lift comprises a rotatable shaft **49** journalled above the punch mechanism in bearing brackets **50** which extend upwardly from the bedplate **10** beside the **C**-blocks **14**. A gear **51** keyed to the end of the shaft **49** is engaged by a drive gear **52** for rotation by any suitable drive mechanism (not shown). A pair of discs **53** are fixed to the shaft **49** immediately adjacent to the plungers **40**. Each disc **53** carries a plurality of cam elements **54** distributed about the periphery of the face of the disc and projecting from the disc surface a sufficient amount to engage the complimentary bevelled undersurface **48** (see also Figure 3) of a projecting lug **48** at the upper end of the associated plunger **40**. Accordingly, upon rotation of the shaft **49**, each cam **47** in turn will engage the lug **48** of its associated plunger **40**, raising the plunger away from its impact transfer rod **31** against the force of the associated drive spring **42**. In the position shown in the drawing, the plunger is partially raised. As the cam slides out from under the lug **48**, the plunger **40** will be released and driven downwardly by the spring **42** to strike the rod cap **33**. In turn, the rod **31** will be driven downwardly against the ball **29**, driving the ball into temporary cutting engagement with the rim **24** of the die aperture **22** and thereby perforating the moving material. Immediately upon completion of this cutting contact, the rod **31** and plunger **40** will be raised by the return spring **32**, freeing the ball **29**. The moving material will slide between the ball and the die, and the ball will ride freely on the moving material surface until the next punching operation.

For simplicity, the foregoing description has been given mainly in terms of a single punch and associated parts, it being understood that the two punch assemblies shown will operate in substantially identical fashion and that holes can be made either simultaneously or alternately in the opposite edges of the moving material depending on the number and relative orientation of the cams **54** on their associated discs.

It may be noted that the momentum developed by the plunger **40** in its downward movement must be sufficient to overcome the resistive force of the return spring **32** in order for the proper cutting impact to be delivered to the ball point **29**. At the same time, the force exerted by the return spring **32** when compressed must be adequate to overcome the downward force of the drive spring **42** when the latter is extended, so as to return the rod **31** and plunger **40** to their rest positions promptly. These forces can readily be balanced by proper initial selection of the plunger mass and spring specifications, with any necessary final adjustment being made by adjusting the collar **43** to vary the force exerted by the drive spring **42**.

It can be seen that the unique perforator assembly described in the foregoing, wherein the actuating force for the punch is dependent solely on the setting of the drive spring **42**, completely eliminates any variation in this actuating force such as might occur if the driving force were supplied by having the cams act as hammers, for example, in which case the drive force would vary with variations in the speed of rotation of the shaft. Thus, it is apparent that the present invention provides a perforator that will operate in a highly precise and reliable manner.

What is claimed is:

1. An improved perforator for making holes in a continuously moving web of packaging material, said perforator comprising a die having a hole therein forming a sharp circular cutting edge in the surface of said die, a punch movable toward and away from said die and having a spherical surface portion engageable with said circular cutting edge, the radius of curvature of said spherical surface portion being larger than the radius of said circular cutting edge, a reciprocable drive element spaced from said punch for actuating said punch and movable toward and away from said punch, a drive spring urging said driver element toward said punch, an impact transfer member positioned between said driver element and said punch and movable toward and away from said punch for transferring driving power from said driver element to said punch, said punch normally being free to move between said circular cutting edge and said transfer member an amount sufficient to allow said continuously moving material to pass between said die surface and said punch, and means engageable with said driver for retracting said driver against the force of said drive spring and then releasing said driver element to be driven by said spring against said transfer member, whereby to cause said transfer member to drive said punch into temporary engagement with said cutting edge.

2. An improved perforator for making holes in heat-sealable material, said perforator comprising a die having a hole therein forming a sharp circular cutting edge in the surface of said die, a punch movable toward and away from said die and having a spherical surface portion engageable with said circular cutting edge, the radius of curvature of said spherical surface portion being larger than the radius of said circular cutting edge, an elongated plunger for actuating said punch and reciprocable toward and away from said punch, a drive spring urging said plunger toward said punch, an impact transfer member positioned between said plunger and said punch and movable toward and away from said punch for transferring driving power from said plunger to said punch, said punch normally being free to move between said circular cutting edge and said transfer member an amount sufficient to allow said material to pass between said die and said punch, and actuator means engageable with said plunger for retracting said plunger against the force of said spring and releasing said plunger to be driven by said drive spring against said transfer member, whereby to cause said transfer member to drive said punch into temporary engagement with said cutting edge, said actuator means comprising rotatable cam means engageable with said plunger and bevelled to retract said plunger upon engagement of said cam and said plunger, said cam means terminating abruptly and abruptly releasing said plunger.

3. An improved perforator for making holes in a continuously moving web of packaging material, said perforator comprising a die having a flat surface over which said material passes, said surface having a hole therein forming a sharp circular cutting edge in said surface, a punch movable toward and away from said die and comprising a sleeve fixed in position in axial alignment with said die hole and spaced from said die surface and a ball slidable in said sleeve and engageable with said circular cutting edge, the radius of said ball being larger than the radius of said circular cutting edge, a reciprocable driver element spaced from said sleeve for actuating said punch and movable toward and away from said sleeve, a drive

spring urging said driver element toward said sleeve, an impact transfer member positioned between said driver element and said ball and movable toward and away from said ball for transferring driving power from said driver element to said ball through said sleeve, said ball normally being free to move within said sleeve between said circular cutting edge and said transfer member an amount sufficient to allow said material to pass between said die surface and said ball, and means engageable with said driver element for retracting said driver against the force of said drive spring and then releasing said driver element to be driven by said drive spring against said transfer member, whereby to cause said transfer member to drive said ball into temporary engagement with said cutting edge.

4. An improved perforator for making holes in a continuously moving web of heat-sealable material, said perforator comprising a die having a hole therein forming a sharp circular cutting edge in the surface of said die, a punch movable toward and away from said die and having a spherical surface portion engageable with said circular cutting edge, the radius of curvature of said spherical surface portion being larger than the radius of said circular cutting edge, a reciprocable driver spaced from said punch for actuating said punch and movable toward and away from said punch, a drive spring urging said driver toward said punch, an impact transfer member positioned between said driver and said punch and movable toward and away from said punch for transferring driving power from said driver to said punch, a return spring urging said transfer member in a direction away from said punch and toward said driver whereby said punch normally is free to move between said circular cutting edge and said transfer member an amount sufficient to allow said material to pass between said die surface and said punch, and actuator means engageable with said driver for retracting said driver against the force of said drive spring and releasing said driver to be driven by said drive spring against said transfer member, whereby to cause said transfer member to drive said punch into temporary engagement with said cutting edge, said actuator means comprising a rotatable disc adjacent to said driver, a cam carried by said disc, and a lug projecting from said driver into the path of rotation of said cam, said cam and said lug having complimentary engageable surfaces bevelled to cause retraction of said driver upon engagement of said cam and said lug, at least one of said engageable surfaces terminating abruptly and abruptly releasing said driver after retraction.

5. An improved perforator for making holes in a continuously moving web of packaging material and comprising a die having a hole therein forming a sharp circular cutting edge in the surface of said die, a punch movable toward and away from said die and having a spherical surface portion engageable with said circular cutting edge, the radius of curvature of said spherical surface portion being larger than the radius of said circular cutting edge, an elongated plunger movable toward and away from said punch for actuating said punch, a drive spring urging said plunger toward said punch, an impact transfer member positioned between said plunger and said punch and comprising a rod movable toward and away from said punch and a sleeve guiding said rod, a return spring urging said rod toward said plunger whereby said punch normally is free to move between said rod and said circular cutting edge an amount sufficient to allow said material to pass between said die surface and said punch, and actuator means engageable with said plunger for retracting said plunger against the force of said drive spring and releasing said plunger to be driven by said drive spring against said rod, whereby to cause said rod to drive said punch into temporary engagement with said cutting edge, said actuator means comprising rotatable cam means engageable with co-operating cam means on said plunger, at least one of said cam means being bevelled to retract said plunger upon engagement of said cam means and said cam and lug abruptly releasing said plunger after retraction.

6. An improved perforator for making holes in a continuously moving web of packaging material, said perforator comprising a stationary die having a flat surface over which to pass the material to be perforated, said flat surface having a circular opening therein forming at the periphery of said opening a sharp circular cutting edge, a punch disposed opposite said opening and comprising a guide sleeve axially aligned with said opening and a ball in said sleeve movable into and out of engagement with said cutting edge, a rod slidable in said sleeve between a first position pressing said ball into engagement with said cutting edge and a second position freeing said ball to move out of contact with said cutting edge, a first spring normally holding said rod in said second position, a plunger for driving said rod against said ball and movable toward and away from said rod, a second spring urging said plunger toward said rod, an actuator for said plunger comprising a rotatable shaft adjacent to said plunger, a disc keyed to said shaft, a plurality of cam means fixed to said disc and individually engageable with said plunger upon rotation of said shaft to retract said plunger against the force of said second spring and then abruptly releasing said plunger to be driven toward said rod by said second spring.

7. An improved perforator for making holes in a continuously moving web of heat-sealable material, said perforator comprising a stationary die member having a flat surface over which to pass the material to be perforated, said flat surface having a circular opening therein extending through said die member and forming at the periphery of said opening a sharp-edged cutting aperture in said surface, a punch element disposed opposite said opening and movable toward and away from said aperture along a line normal to said die surface, said punch element having a spherical surface portion engageable with said periphery of said opening, and means for driving said punch element into contact with said periphery of said opening, said means comprising a retractable element movable toward and away from said punch element along a line which is an extension of said first-named line, a spring normally urging said retractable element toward said punch element, means engageable with said retractable element for retracting said retractable element against the force of said spring and releasing said retractable element to be driven toward said punch element by said drive spring, and means engageable with said punch element for transmitting the driving force of said drive spring from said retractable element to said punch element whereby to drive said punch element into engagement with said periphery of said opening.

8. An improved perforator for making holes in a continuously moving web of packaging material, said perforator comprising a die having a flat surface over which said material passes, said surface having a hole therein forming a sharp circular cutting edge in said surface, a punch movable toward and away from said die and comprising a sleeve fixed in position in axial alignment with said die hole and spaced from said die surface and a ball slidable in said sleeve and engageable with said circular cutting edge, the radius of said ball being larger than the radius of said circular cutting edge, an elongated plunger axially aligned with said sleeve and reciprocable toward and away from said sleeve, a drive spring urging said plunger toward said sleeve, means associated with said spring for varying the effective force of said drive spring acting on said plunger, an impact transfer member positioned between said plunger and said punch and comprising a rod slidable in said sleeve toward and away from said ball for transferring driving power from said plunger to said ball, a return spring urging said rod away from said ball and toward said plunger whereby said ball

normally is free to move in said sleeve between said circular cutting edge and the end of said rod an amount sufficient to allow said continuously moving web of material to pass between said die surface and said punch, and actuator means engageable with said plunger for retracting said plunger against the force of said drive spring and releasing said plunger to be driven by said drive spring against said transfer member, whereby to cause said transfer member to drive said ball into temporary engagement with said cutting edge, said actuator means comprising a rotatable disc adjacent to said plunger, a cam carried by said disc, and a lug projecting from said plunger into the path of rotation of said cam, said cam and said lug having complementary engageable surfaces bevelled to cause retraction of said plunger by said cam upon engagement of said cam and said lug, said cam and lug abruptly releasing said plunger after retraction.

9. An improved spring-actuated perforator for making holes in a continuously moving web of packaging material including a die having a smooth surface adjacent which passes the moving web and having an opening therein forming a sharp cutting edge, guide means directed toward said die opening from the opposite side of said moving web, a punch having a convex working surface larger than said opening and being of relatively small

mass, said punch moving freely along said guide means toward and away from said die opening, an impact transfer member of larger mass than said punch and being movable toward and away from said punch for moving said punch toward said die opening, return spring means urging said impact transfer member away from said punch, a stop engaging said impact transfer member and stopping said transfer member in a position for allowing said web to pass freely between said die opening and said punch, a driver element of larger mass than said impact transfer member, drive spring means urging said driver element toward said impact transfer member, and retracting and quick-release mechanism for engaging said driver element and retracting it against the force of said drive spring means and then releasing said driver element when in retracted position.

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