April 28, 1964 W. J. NESBITT 3,130,623

CAM ACTUATED RECIPROCATING PUNCH WITH MEANS TO COUNTERACT FORCE TENDING TO TILT PUNCH

Filed April 6, 1961

Fig. 1.

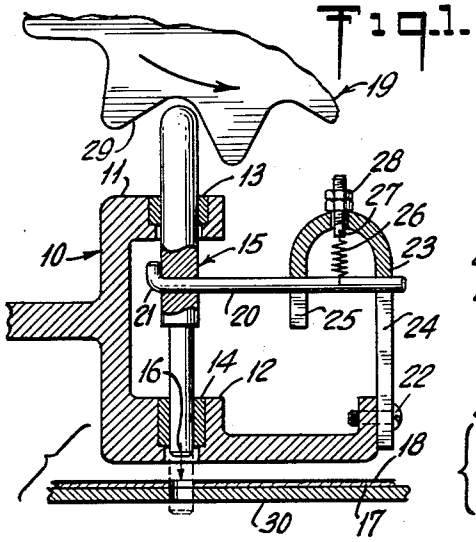


Fig. 2.

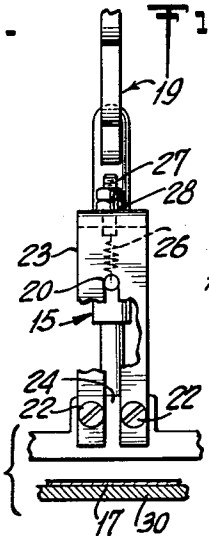


Fig. 6.

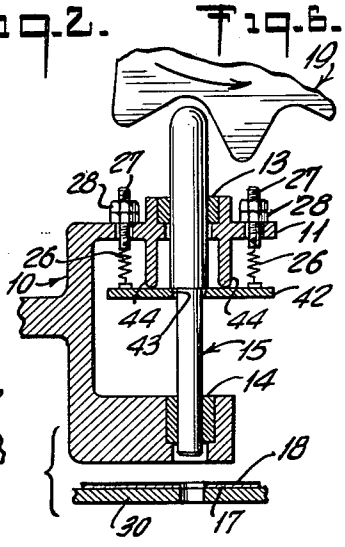


Fig. 3.

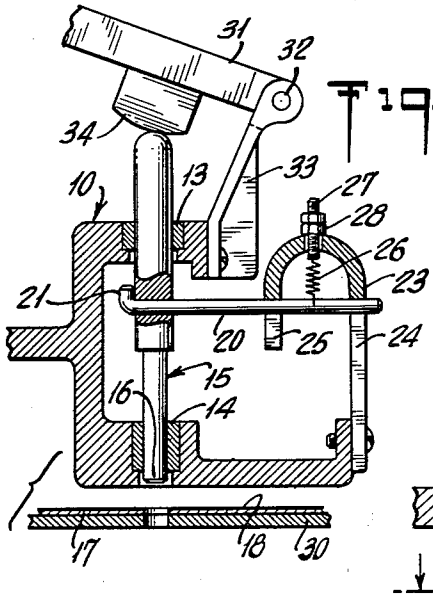


Fig. 4.

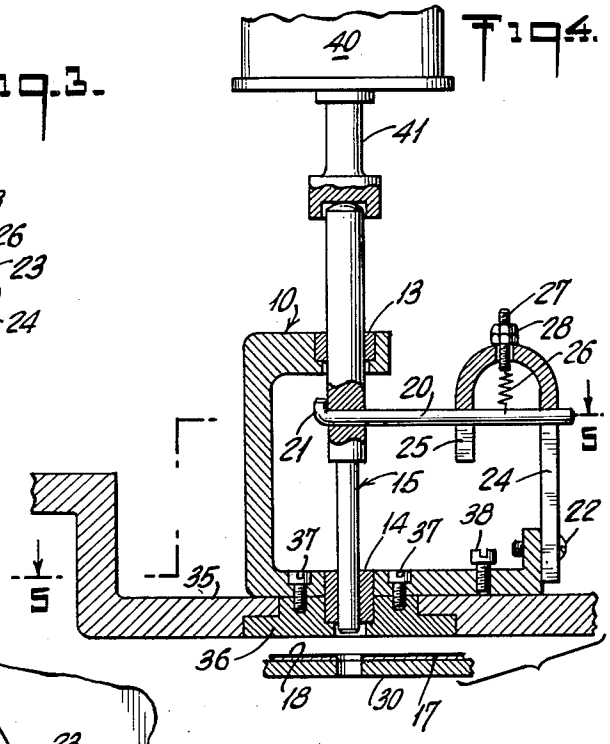
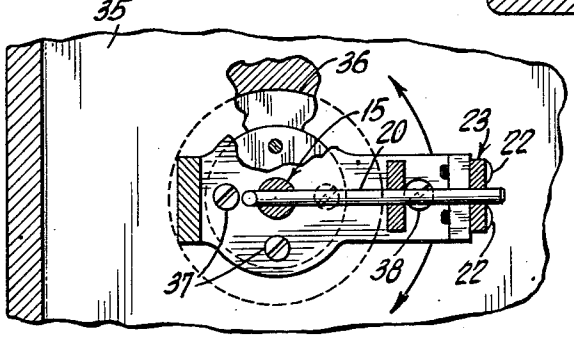


Fig. 5.



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CAM ACTUATED RECIPROCATING PUNCH WITH MEANS TO COUNTERACT FORCE TENDING TO TILT PUNCH

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This invention relates to punch mechanisms and more particularly it relates to such mechanisms which are primarily designed to punch relatively thin sheet material.

A principal object of the invention is to provide a punch mechanism which is specially designed to punch thin sheet stock with a maximum of precisional shape in the punched-out areas.

A feature of the invention relates to a punch mechanism which is capable of operation at high speed with a minimum of wear in the reciprocating punch parts.

Another feature relates to a mechanically operated punch wherein the force operating the punch tends to tilt the punch during the punching movement, in conjunction with a novel equalizing arrangement whereby the said tendency is neutralized.

A further feature relates to the novel organization, arrangement, relative location and interconnection of parts which cooperate to provide an improved punch mechanism.

Other features and advantages not particularly enumerated will be apparent after a consideration of the following detailed descriptions, the appended drawings and the attached claims.

In the drawing, which shows by way of example certain forms of the invention,

FIG. 1 is a cross sectional view, in elevation, of a punch embodying the invention;

FIG. 2 is a right-hand side elevational view of FIG. 1;

FIG. 3 shows a modification of FIG. 1;

FIG. 4 shows a further modification of FIG. 1;

FIG. 5 is a broken sectional view of FIG. 4 taken along the line 5—5 thereof;

FIG. 6 shows a still further modification of FIG. 1.

One of the serious difficulties encountered in the design of mechanical punches, especially those intended to operate at high speed and those intended to perforate thin sheet material, is the excessive wear and the frictional overheating of the punch. For that reason it has been necessary to provide a clearance between the punch per se and the bearing in which it reciprocates. Heretofore the accuracy of punching has required a relatively minute tolerance or tight fit between the reciprocating punch and its bearings. Such close tolerances obviously limit the speed at which the punch can be operated and likewise introduce excessive wear on the punch parts. The problem of accurately punching relatively thin sheet material, such as paper, cardboard, thermoplastic film, and the like, is even further aggravated because the heat developed under such close tolerances is transmitted to the punch tip and tends to burn or distort the sheet at the punched boundary. Furthermore, when the thin sheet is coated with a resin film, or similar relatively low melting point material, the heat at the punched tip may distort the plastic coat and even melt it so that it sticks to and accumulates at the punched tip.

I have found that by designing the punch with a somewhat higher clearance tolerance between the punch and its bearings, it is possible by using a novel equalizing arrangement to obtain the desired degree of punching accuracy without danger of tearing or distorting the punched material around the boundary of the punched area. Thus, there is shown in FIGS. 1 and 2 a punch comprising a rigidly supported frame 10, having spaced arms 11, 12, in which are fitted suitable metal bearing sleeves 13, 14.

Arranged for vertically reciprocatable motion in the bearing is a cylindrical punch member 15. The lower end of the punch member has its tip 16 of the desired punching configuration, for example circular.

The sheet material to be punched may, for example, be a sheet of paper or cardboard 17 which is provided with a coating 18 of resinous film or thermoplastic film. Such sheets are of relatively minute thickness. For example, the paper or cardboard may be approximately .01 inch and the coating 18 may be as small as a few thousandths of an inch. If the punch is operated at relatively high speed, for example one hundred punches per minute, it is important that the temperature of the punch tip be below the melting or distorting temperature of the thermoplastic film 18. In some cases the material to be punched may be entirely of thermoplastic sheets, so that the temperature at the tip of the punch must likewise be kept below the distorting or melting temperature of the film material.

Because of the fact that some clearance must be provided between the punch and its bearings in order to reduce the frictional heat, I have found that the punch, when subjected to the punching force, tends to tilt. That is, it does not follow a truly linear punching motion. This departure from linearity of motion is aggravated in accordance with the degree of clearance between the punch and its bearings. Furthermore, where the punch is operated by an inclined power transmitting surface, such for example as the continuously rotating cam 19, it is not feasible to transmit the punch force solely along the longitudinal axis of the punch. Thus, as the cam 19 rotates, and because of the unavoidable and necessary clearance between the punch 15 and its bearings, there is transmitted to the punch not only a component of force along its longitudinal axis but also a sidewise component which tends to tilt the punch out of vertical alignment. This results in a sliding component of the punch tip 16 on the thermoplastic surface 18 and with the likelihood of the distortion of that surface and an irregular boundary at the punched opening.

In order to overcome this sidewise component, I provide the punch with a laterally extending rod 20 which passes through the punch shank and is provided with a bent-over portion 21 which abuts against the punch shank. Preferably, the portion 21 is welded or brazed to the punch shank. Fastened to the frame 10 by suitable bolts 22 is a metal plate 23 which is curved back upon itself at its upper end. The straight legs of plate 23 are provided with aligned slots 24, 25, through which passes the rod 20. A tension spring 26 has one end fastened to the rod 20 and the opposite end is attached to the adjusting screw 27 which is locked in place by suitable lock nuts 28. Thus, as the cam 19 rotates in the direction of the arrow, each cam face 29 tends to rock the punch and rod 20 clockwise. However, this tendency is overcome by the tension of spring 26 which acts to rock the rod 20 and punch counterclockwise. The spring 26 also serves as the punch restoring spring to raise the punch after it has performed its punching stroke, and the rod 20 also serves to prevent rotation of the punch around its longitudinal axis. It will be understood, of course, that the material to be punched is supported on a suitable flat bed 30 and preferably, although not necessarily, the frame 10 can be mounted in a suitable support for raising or lowering it with respect to the bed 30. I have found that with this combination of parts it is possible to operate the punch at relatively high speeds, for example at speeds of one hundred punches per minute, while insuring that the punched out areas are of precise configuration and without danger of distorting or tearing the sheet at the punched out areas since the punch is automatically maintained in a truly rectilinear motion during punching, and since it is subjected to negligible tilting the frictional heat in the bearing

is greatly reduced with a consequent reduction in the likelihood of the thermoplastic coating 18 being distorted during punching.

FIG. 3 shows the punch of FIG. 1 except that, instead of operating the punch by a continuously rotating cam, there is provided a lever 31 which is pivotally attached at 32 in a bracket 33 fastened to frame 10. The lever 31 has a punch engaging boss 34. Here again the portion of the lever 31 tends not only to impart a longitudinal motion to the punch 15 but also to impart a sidewise component tending to increase the frictional forces between the punch and its bearing and at the same time to prevent the punch tip 16 engaging the sheet material in a truly normal direction. The remaining parts of FIG. 3 are the same as those of FIG. 1 and their function has been already described.

In the foregoing embodiments, the rod 20, which transmits the equalizing or compensating force to the punch under control of the associated spring 26, is substantially coplanar with the plane of rotation of the operating cam 19 or the lever 31. In certain cases it may be desirable to be able to change the normal angular relation of the rod 20 with respect to the longitudinal center line of action of the punch. Thus, as shown in FIGS. 4 and 5, the frame 10, which carries the punch 15 and its bearings 13, 14, is rotatably attached to another rigid frame 35. The frame 10 is rotatably coupled to the frame 35 through the intermediary of a shoulder metal ring 36 which is fastened to the frame 10 by suitable bolts 37. The frame 10, therefore, can be turned around at an angle with respect to the longitudinal axis of the punch, thus likewise turning the rod 20 and its associated frame 23 and spring 26. When these elements have been turned to the appropriate angular setting, as indicated by the arrows in FIG. 5, the set screw 38 can be tightened to lock the parts in their angularly adjusted position. This arrangement is particularly useful where the punch is to be operated for example by a solenoid 40, since it is not feasible to insure that the solenoid armature or plunger 41 always acts in a concentric linear motion through the solenoid core. Thus, the end of the core 41 may be provided with a circular recess into which the upper end of the punch 15 somewhat loosely fits, thus enabling the frame 10 with the punch 15 to be turned through the desired angle without changing the position of the solenoid 40. It will be understood, of course, that this angular adjustment of the punch and its supporting frame may also be applied to the remaining embodiments shown in the drawing if desired.

FIG. 6 shows a further modification wherein the equalization or compensation for the tilting movement of the punch is achieved by a metal disc 42 through which the punch 15 freely passes. The disc 42 abuts against the shouldered portion 43 on the punch to raise the punch from the work after punching thereof. This return motion of the punch, as well as the equalizing against the tilting motion of the punch is achieved by a series of equalizing springs 26 similar to spring 26 of FIG. 1. These springs are attched at their lower ends to the disc 42, and at their upper ends they are attached to the respective adjusting screws 27, as in FIG. 1. The action

of the equalizing springs is the same in the embodiment of FIG. 6 as in FIG. 1. However, in the embodiment of FIG. 6, the punch 15 is free to rotate around its longitudinal axis but nevertheless the equalizing action of the springs 26 is in a substantially coplanar direction with respect to the plane of rotation of the cam 19. Preferably the arm 11 of the frame is provided with downwardly depending integral and downwardly depending stops 44 to limit the upward motion of the disc 42. Here again the springs 26 not only serve as anti-tilt equalizing springs but they also serve to restore the punch to its raised position.

Various changes and modifications may be made in the disclosed embodiments without departing from the spirit and scope of the invention.

What is claimed is:

1. In a punching mechanism, the combination of a reciprocatably mounted punch member, at least one bearing guide through which the punch member passes and of a size which permits the punch member to tilt, means comprising a moving punch-driving element having a cammang face for engaging said punch member to cause reciprocation thereof, said camming face tending to tilt said punch member in one direction by applying thereto a component of force at an angle to the length of said punch member, a rigid rod extending through said punch member and moving as a unit with said punch member, said rod extending laterally away from said punch member, a stationary support, and a spring connected to the laterally extending portion of the said rod and to said support, said spring being connected between said rod and support and acting through said laterally extending rod to provide a punch tilting component of force in a direction opposite to said first mentioned direction to compensate for said component and thereby to constrain said punch member to follow a linear motion during punching.

2. A punching mechanism according to claim 1 in which said stationary support includes a slotted guide to receive the said laterally extending part of said arm to confine the tilting of said punch and arm substantially in a single plane.

3. A punching mechanism according to claim 1 in which said punch member and said rod are rotatably adjustable around the longitudinal axis of the punch member, a rotatable adjustable frame for said punch member and rod, and means to lock said frame in a predetermined rotated setting.

4. A punching mechanism according to claim 1 in which said punch driving element has a series of teeth with inclined faces for successively and directly engaging one end of said punch member, the inclination of said faces tending to tilt said punch member.

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