

Aug. 9, 1955

I. ROTKIN ET AL
SELECTIVELY OPERATED PUNCHES MOUNTED
IN AN AIRTIGHT COMPARTMENT
Filed Jan. 30, 1952

2,714,928

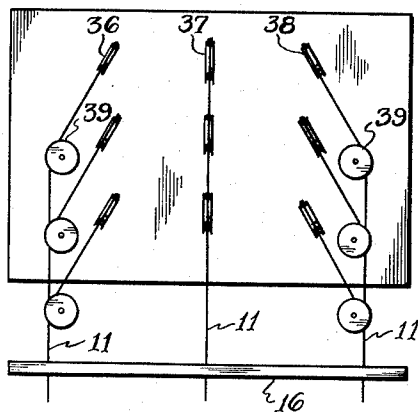


Fig. 3

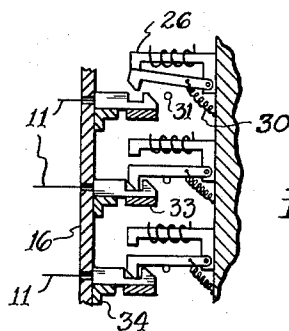


Fig. 2

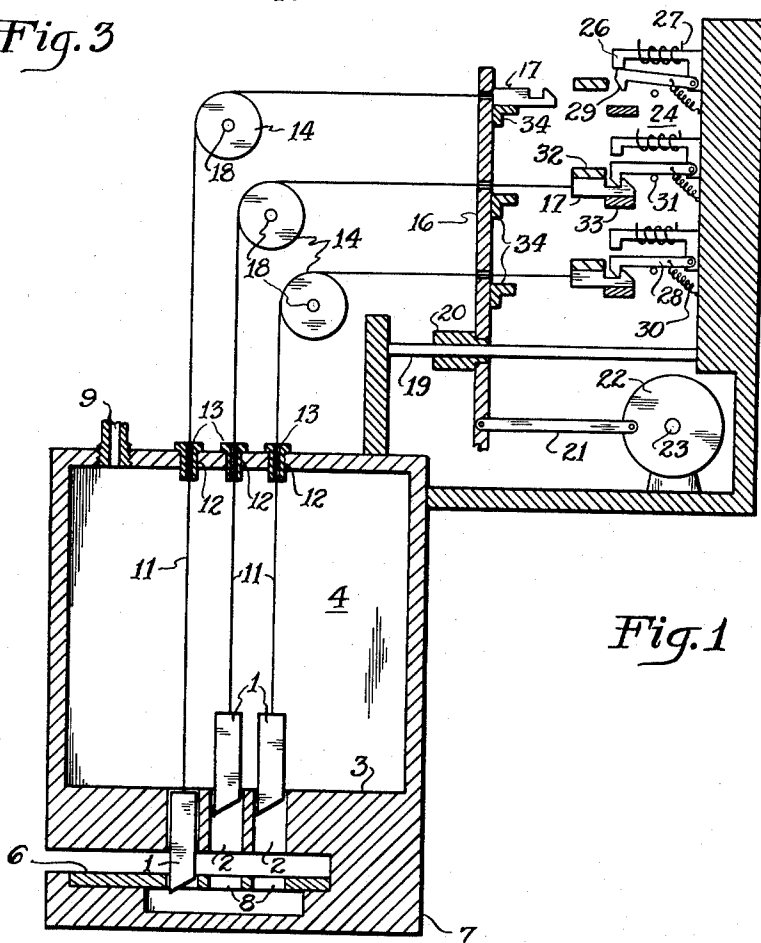


Fig. 1

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SELECTIVELY OPERATED PUNCHES MOUNTED IN AN AIRTIGHT COMPARTMENT

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Application January 30, 1952, Serial No. 269,102

7 Claims. (Cl. 164—111)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to us of any royalty thereon in accordance with the provisions of the Act of March 3, 1883, as amended (45 Stat. 467; 35 U. S. C. 45).

The present invention relates to a selective multiple punch in which any desired number of punches can be actuated simultaneously to obtain any desired pattern of punches.

There exists today a great need for punching machines in which any desired number of punches can be actuated simultaneously. This need is particularly apparent in multiple punches used for perforating cards such as IBM cards. At present there are available machines capable of reading these cards at the rate of 600 cards per minute. However, the fastest punching machines known to us are capable of punching only 600 lines per minute. It can be seen from this that when information is to be gathered from a number of cards and then recorded on other cards, the reading machines must be operated at reduced speeds. Aside from this special problem, it is in general highly desirable to have punching machines that can be operated at far greater speeds than the machines presently available.

It is an object of this invention to provide a selective multiple punch in which any desired number of punches can be actuated simultaneously to obtain any desired pattern of punches.

It is another object of the invention to provide a selective multiple punch which can punch an array of holes on an area in a single punching operation.

Another object of the invention is to provide card-punching apparatus that can operate as fast as card-reading apparatus.

Still another object is to provide a selective multiple punch in which there is a continuously acting actuating force on the punches.

Another object of the invention is to provide a system in which no energy is required to hold the punches in an inactive position.

Another object of the invention is to separate the punching mechanism from the punch-control mechanism, thereby permitting the control mechanism to be spread out for ease of control while the punching mechanism remains the prescribed compact size.

In accordance with the preferred form of the invention a die plate is provided with a number of apertures corresponding to all of the possible punch positions on the card, with a separately movable punch for each aperture. The punches ride in close-fitting guide holes that are formed in one side of an airtight chamber containing air under pressure supplied by a suitable source. The pressure on the punches tends to force them out into the corresponding holes in the die plate. A wire attached to the back of the punch controls its motion. The wire is brought out of the airtight chamber through small

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holes which are packed to prevent leakage of air. The wires extend over pulleys and through an oscillating plate which is in a plane normal to the axis of the wires. The plate oscillates in a plane parallel to the axis of the wires.

Each wire is terminated in a hook which is arranged to cooperate with a hook on the armature of a solenoid. When the solenoid is not energized the armature is held in a latching position. When the solenoid is energized, the hook is released and air pressure forces the corresponding punch towards the die plate until the hook on the end of the wire contacts the oscillating plate. The plate then returns the hook to its original position where it is relatched. Any number of solenoids may be actuated simultaneously, thereby actuating the corresponding punches.

Other uses and advantages of the invention will become apparent upon reference to the specification and drawings.

Figure 1 is a cross-sectional view of the apparatus of the present invention.

Figure 2 is a view of the control mechanism shown at a different time from that shown in Figure 1.

Figure 3 is a top view of the machine showing the means employed to spread out the control mechanism.

Referring to Figure 1, the punches 1 ride in the close-fitting guide holes 2 which are formed in the bottom 3 of the airtight compartment 4. A die-plate 6 is fastened in the base 7 of the machine and the holes 8 in the die-plate are lined up with the punches 1. Air pressure is maintained in the compartment 4 by some outside source which pumps air into the compartment through the input opening 9. A wire 11 is attached to the top of each punch and is brought out of the top of the compartment 4 through the holes 12 which are provided with air seals 13. The air seals fit tightly around the wires 11 and hold air leakage past the wires to a minimum. The wires extend over the pulleys 14 through an oscillating plate 16 and terminate in a hook 17. The pulleys rotate on shafts 18 which are supported by the side panels (not shown) of the machine. The oscillating plate 16 is supported on the shaft 19 which is mounted between parts of the frame of the machine. The plate 16 is caused to oscillate on the shaft 19 by means of the link 21 and the rotating disk 22. The disk is driven by the shaft 23 of a motor which is not shown. The bushing 20, mounted on the front face of the oscillating plate, prevents tilting of the plate. This showing of the means for supporting and oscillating the plate 16 is merely schematic, and it is quite obvious that in a machine of any size more sophisticated means must be provided for maintaining the position of the plate and transmitting motion to it.

The latching solenoids 24 extend horizontally from a vertical portion of the frame. The solenoids are composed of the field pieces 26, coils 27, and the armatures 28. The ends of the armatures are formed into hooks 29 which cooperate with the hooks 17 on the ends of the wires 11. When the solenoids are not energized, the armatures are held in a downward or latching position by the springs 30. The downward travel of the armatures is limited by the stops 31. The hooks 17 are constrained against vertical motion while in the latched position by means of the guides 32 and 33, and are constrained while in the unlatched position by the guides 34.

The operation of the machine is as follows: The air pressure in the chamber 4 tends to push the punches 1 down into the holes 8 in the die plate 6. However, the punches are restrained against downward motion because of the engagement of the hooks 17 on the ends of the wires 11 by the hooks 29. When all of the solenoids are de-energized and the armatures 28 are pulled down by the springs 30 the oscillating plate slides back

and forth along the wires without affecting the punches.

When the oscillating plate 16 is in the retracted position, as shown in Figure 2, the solenoid of the punch to be actuated is energized pulling up the armature and unlatching the corresponding hook 17. As the oscillating plate moves away from the retracted position, the force on the punch, which is transmitted to the hook through the wire 11, causes the hook to move forward with the plate, allowing the punch to move downward into the corresponding hole in the die-plate. With the punch in this extended position some air will leak past the punch. This leakage will help in removing the punched material. When the plate has moved its maximum amount to the right, the punch and plate are in the position shown in Figure 1 and the punching operation is complete. By the time the plate returns to the position shown in Figure 2, the solenoid has been deenergized, releasing the armature 28; and the hook 17 is related by the hook 29, thereby constraining the punch against further motion.

The drawings of Figures 1 and 2 are cross sections showing only one column of three punches. The number of punches in a column and the number of columns are unlimited from an operational point of view, the only limiting factor being the overall size of the machine. It is quite obvious from the description of the operation of the machine that any punch or number of punches in any column or row may be actuated at the same time thereby making it possible to put all the information on the card in a single punching operation. The machine is not limited to the punching of cards and can be used for punching any type of material for any purpose. Also the machine might be used for deforming or marking surfaces rather than for punching holes through some material.

The air pressure constitutes a common actuating force that is continuously acting on all of the punches. No energy is expended in holding the punches and only a brief expenditure of energy is necessary to release the punches. Once a punch is released the continuously acting force actuates it. This system of operation provides for a complete separation of the punching and the punch control mechanisms. The speed can be very great because the moving parts can be made to have very low inertia in comparison to the forces available to cause motion.

The punch actuating force has been stated to be pneumatic. However, a number of different actuating means might be used. These could include hydraulic, elastic (springs), magnetic (attraction or repulsion of the punch which in this case would contain magnetic material) and electrical (that is, the punches containing dielectric material and subjected to an electrostatic field).

The latching mechanism could also have a number of different unlatching means besides the magnetic means shown and described. These means could be electrical, the hook arm containing some dielectric material; pneumatic or hydraulic, the hook arm being subjected to pneumatic or hydraulic pressure; thermal, the hook arm being caused to move by thermal expansion or contraction; or mechanical, the hook arm being directly actuated by some associated apparatus.

The oscillating plate may be moved by a similar variety of forces.

As the device is shown in Figure 1, the number of rows of punches per unit thickness may be limited by the size of the unlatching means (that is, the solenoids) rather than by the size of the punches. Since the punching and control mechanisms are completely independent of one another, it is possible to spread out the control mechanism horizontally as well as vertically without affecting the spacing of the punches. By doing this the number of rows of punches per unit thickness becomes essentially unlimited.

One arrangement for spreading out the control mechanism is shown in Figure 3. The center row of punches

37 and related parts would be as shown in Figure 1. However, the rows to the right and left of the center are affected. Each pulley 14 in the row 36 is rotated clockwise about a vertical axis through the axis of the vertical portion of wire coming up from the punch to a position shown in Figure 3. The wires 11 in row 36 are thereby fanned out from the wires 11 in row 37. The wires in row 36 are then brought back into line and made parallel with respect to those in row 37 by passing them around the pulleys 39.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of our invention as defined in the appended claims.

We claim:

1. A selective multiple punch comprising an airtight compartment, a plurality of punches slidably mounted in and extending through at least one side of said compartment, air pressure in said compartment for urging said punches outward, a separate latching means for each of said punches for holding said punches in an unactuated position against the force of said air pressure, and means for selectively unlatching said punches.

2. A selective multiple punch comprising a compartment, a plurality of holes in one side of said compartment, a punch for each of said holes, said punches fitting tightly in said holes, air pressure in said compartment for urging said punches outward from said compartment, a separate latching means for each of said punches for holding said punches in an unactuated position, means for selectively unlatching said punches and allowing the air pressure to move the selected punches outward, means for limiting the outward motion of said punches and means including said last-mentioned means for returning said punches to their latched positions.

3. The invention according to claim 2 in which said latching means comprises a wire connected to one end of the punch, a first hook on the end of said wire, and a second hook supported on the frame of said selective multiple punch for engaging said first hook.

4. The invention according to claim 3 in which the means for unlatching said punches is a solenoid which raises said second hook thereby releasing said first hook.

5. The invention according to claim 4 in which said motion-limiting means is an oscillating plate through which said wires pass, the punch being on one side of said plate and the first hook on the other side of said plate.

6. A selective multiple punch comprising a die-plate having a plurality of rows of closely spaced perforations, a punch for each perforation constrained to travel into and out of its perforation, a compartment having a plurality of holes in one side thereof, there being one hole for each of said punches, the walls of said holes fitting tightly around said punches and thereby forming guides for said punches, air pressure in said compartment for urging said punches toward their corresponding perforation in said die-plate, a wire attached to the back of each of said punches, said wires passing through tightly fitting holes in the side of said compartment that is opposite to the side containing the first-mentioned holes, a pulley lying outside of said compartment for each of said wires, each of said wires passing over one of said pulleys, an oscillating plate lying in a plane perpendicular to the plane normal to the axis of the wires, said oscillating plate having a hole for each of said wires, each wire passing through a hole in said oscillating plate, a first hook on the end of each of said wires, a solenoid comprising an armature and a field for each of said wires, a second hook formed on the end of each of said armatures for engaging the corresponding said first hook on the end of said wires when said solenoids are deenergized, said second hook being disengaged from said first hook when said solenoid is energized thereby allowing the air pressure to actuate the punch.

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7. A selective multiple punch comprising a die-plate having a plurality of rows of closely spaced perforations, a punch for each perforation constrained to travel into and out of its perforation, a compartment having a plurality of holes in one side thereof, there being one hole for each of said punches, the walls of said holes fitting tightly around said punches and thereby forming guides for said punches, air pressure in said compartment for urging said punches toward their corresponding perforation in said die-plate, a wire attached to the back of each of said punches, said wires passing through tightly fitting holes in one side of said compartment, an oscillating plate, each of said wires passing through a hole in said oscillating plate, a first hook on the end of each of said wires, a second hook for engaging said first hook and a solenoid means for releasing said first hook when said solenoid is energized.

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