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DATA PROCESSING CARD PUNCHING

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Fig. 1.

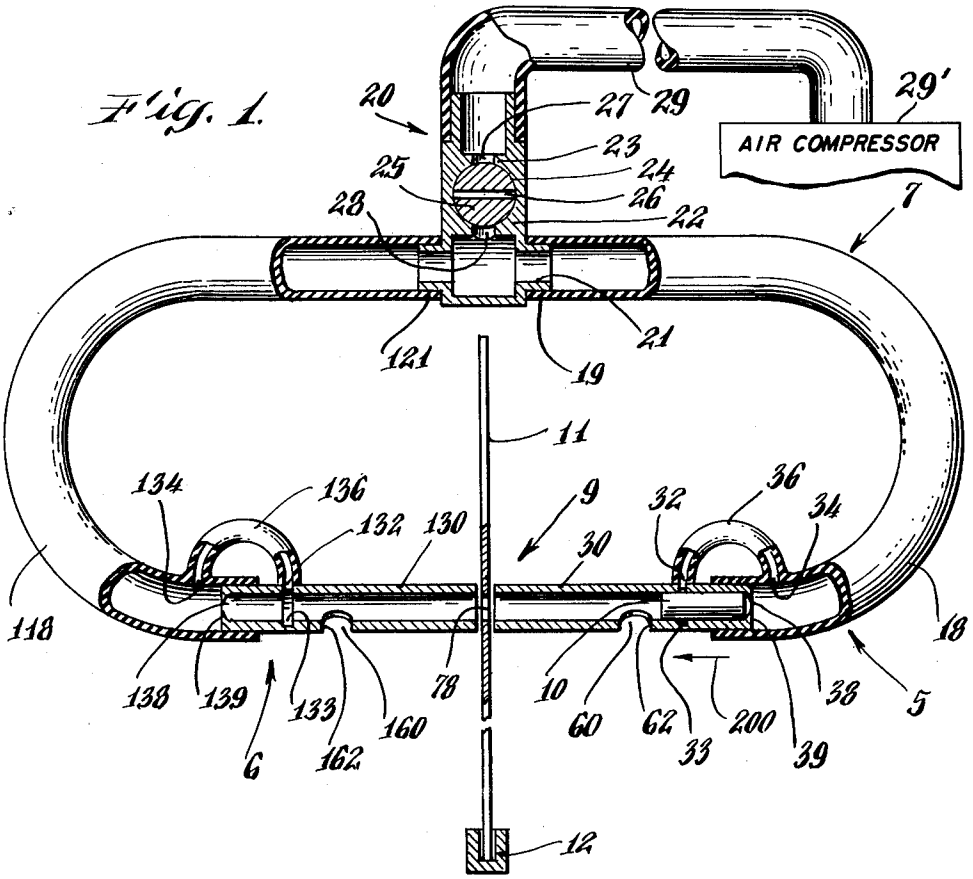
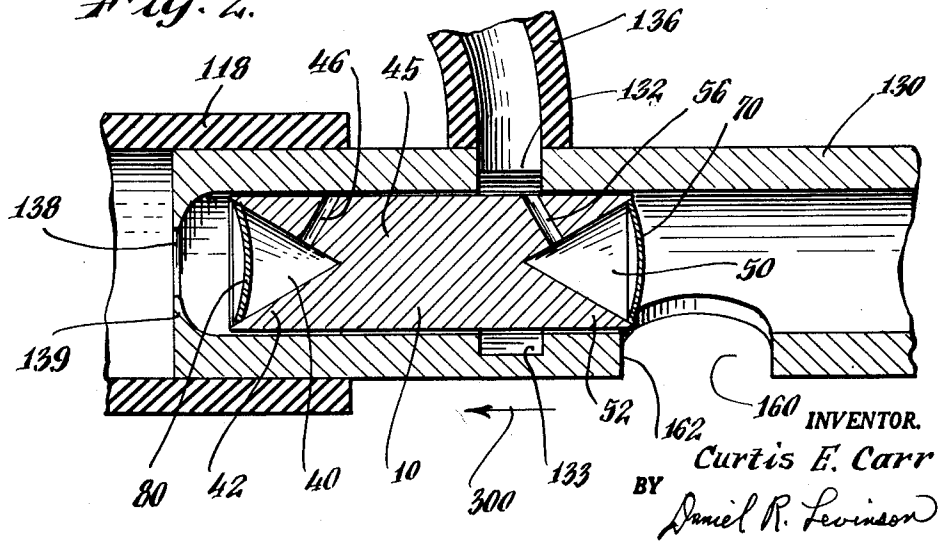


Fig. 2.



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DATA PROCESSING CARD PUNCHING

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This invention relates to an apparatus and method for high speed punching of cards of the data processing type. More specifically, the invention provides a device and method for punching holes in I.B.M.-type cards more rapidly than have previously been available to the data processing art.

With the advent of more efficient electronic computer and sorting devices, the need for increasing the operating speed of the inputs and outputs to these units has become increasingly evident. Although attempts have been made to increase the rate of punching of such cards by various mechanical improvements, nevertheless, at the present state of the art, the placing of data on such I.B.M.-type cards has remained one of the limiting factors in the speed of utilizing such equipment. The invention solves the problem of increasing the punching speed of such cards by means of an entirely new conceptual approach. While previous improvements have never departed in principle from the basic technique of regular paper punching procedures (i.e., the movement into and through the paper of a punching die and then the retraction thereof), the present invention departs completely from this concept.

Generally, the new technique avoids the delay occasioned by the removal of the punching element from the card after the hole has been made thereby. More specifically, the technique utilized is to fire through the data processing card a projectile, so shaped as to cut a clean hole therethrough, and to retrieve this projectile at the other side of the card. Therefore, a single pass of the punching element through the card produces the final hole without requiring any additional time for retrieving the punch. This new technique is accomplished by apparatus which not only fires such a punching projectile through the card but also captures and holds the projectile at the other side thereof so that the projectile may be reused almost immediately after it has been fired. Preferably the apparatus utilized is capable of firing such a projectile alternately through each side of the cards so that no additional mechanical means or wasted time is required before the projectile may be refired.

An object of the invention is therefore the provision of a new technique and apparatus for increasing the rate of punching of data-processing cards.

Another object of the invention is the providing of a data processing card punching arrangement in which the punch is mechanically independent of the means for pushing it through the card thereby conserving the time usually required for retracting the punch.

A further object of the invention is providing a data processing card punching arrangement in which a projectile is utilized which is capable of being fired through the card alternately from either side thereof.

Another object is to provide a projectile-type of data processing card punching arrangement utilizing a minimum number of different manufactured parts.

Further objects and advantages of the invention will become obvious to one skilled in the art upon reading the following specification and upon studying the accompanying drawing of a preferred embodiment, in which:

FIGURE 1 is a vertical section through the apparatus utilized in the invention; and

FIGURE 2 is an enlarged detail showing the punching

projectile and the means for removing a paper disk from this punching element.

Since the entire apparatus is composed of two substantially identical halves 5 and 6, first the right-hand half 5 will be described in detail. This right-hand side comprises generally a propulsion mechanism 7 and a barrel or tube assembly 9 for propelling a projectile through data processing card 11, which is guided by support means 12 and moved into position by any conventional means. The propulsion mechanism may comprise an airtight rubber tube 18 which is connected at one end 19 to a nipple 21 of valve 20. This valve is shown as composed of an outer housing 22 and interior portions 23 forming a cylindrical recess 24, which houses a cylindrical rotatable member 25. This member 25 has a bore 26 drilled therethrough so that, when the member is rotated 90° from the position shown in FIGURE 1, bore 26 will be aligned with apertures 27 and 28 formed in the interior portions 23 of the housing. Thus, in this rotated position, the valve will be opened so that the compressed air bearing tube 29 will communicate with the lower part of the valve and, therefore, the nipple 21 and end 19 of tube 18. The tube 29 is attached by any suitable means to a source of compressed air, such as a conventional air compressor 29'. The end of the tube 18 remote from end 19 is attached in an air-tight manner to the right-hand end of projectile tube 30.

A small aperture 32 in the upper part of tube 30 is connected to a similar aperture 34 in connecting tube 18 by means of small rubber tubing 36. Therefore, the same air pressure is developed at aperture 32 as at the right-hand open end 38 of tube 30. When the projectile 10 is at its extreme right-hand position as shown in FIGURE 1, the flanged left-hand end 42 (see FIGURE 2) closes aperture 32 thereby precluding the escape of air through this aperture. Therefore, upon rotation of the valve member 25, the compressed air within connecting tube 18 may only escape through opening 38, thus pushing projectile 10 to the left in an accelerating manner as suggested by arrow 200 in FIGURE 1. Since the amount of compressed air available is very large in comparison with the diameter of the tube 30, the movement of the projectile does not reduce the pressure at any appreciable rate. Therefore, the projectile is pushed with increasing velocity toward the left at least during its initial movement.

Since, as is well known, work (or energy) is equal to a force multiplied by a distance, the high pressure (i.e., force on the right-hand end of projectile 10) will result in an explosive-like transfer of kinetic energy to the projectile. Therefore, the projectile accelerates at an extremely rapid rate to the left as it proceeds through tube 30. Thus, even though paper escape slot 60 in the lower part of tube 30 (the function of which will be described hereinafter) will allow air to escape after the right-hand end of projectile 10 has passed the right-hand wall 62 of this slot 60, nevertheless, the pressure previously built up is so great that the projectile has already reached a high velocity and therefore is capable of cutting through the data processing card 11 to produce the hole 78 (shown dotted in FIGURE 1).

As previously stated, the left-hand side 6 of the apparatus is substantially identical to the right-hand side 5 so that no detailed description of this part of the apparatus is necessary. In fact, since the system is truly symmetrical, the actual parts used for both halves of the system may be absolutely identical, thereby reducing manufacturing costs. The parts on the left side have therefore been numbered in the same manner as those in the right but for purposes of differentiation have been preceded by a "1."

Since the purpose for small rubber tubing 36 and aperture 32 as well as the paper escape slot 60 will be described hereinafter, the operation of the apparatus will be first explained without reference to these elements. The projectile 10 now traveling at high velocity through the card 11, enters left-hand projectile tube 130, carrying with it a cardboard disc 80 (see FIGURE 2) cut from the card. Since valve 20 admits air pressure to both of tubes 18 and 118, a pressure build-up in left-hand tube 130 as well as within left-hand ruber tube 118 has occurred. Therefore, as the projectile proceeds through the tube 130, it is subjected to increasing back pressure tending to slow down the projectile 10. The effect becomes increasingly important as the projectile eventually closes left-hand paper escape slot 160, thereby trapping all of the air in the left-hand part of the system between itself and the walls of tube 130. Therefore, as the projectile nears the position shown in FIGURE 2, the back pressure against the left-hand end of the projectile through aperture 138 is an extremely powerful, ever-increasing deceleration force so that by the time that the projectile has reached the position of FIGURE 2, it is moving very slowly to the left and comes to rest at a position only slightly to the left of that shown in said figure.

It should be noted that since the valve 20 admits pressurized air to both of tubes 18 and 118 at the same time without requiring any timing mechanisms whatsoever, there is no need to sense in which of the projectile tubes 30, 130 that the projectile is at any given time, since the firing of the solenoids will rapidly accelerate and then decelerate the projectile from the end of the tube in which it may then be to the opposite end of the other tube.

Since constant firing of the projectile back and forth, as intended by the apparatus of the invention, would gather paper discs in the recesses 40, 50 of the cutting edges of the projectile (see FIGURE 2), means must be provided to extract these paper discs before the projectile punching recesses become jammed with these pieces of the data processing cards. The means provided in the illustrated embodiment of the invention comprise (on the right side) the small rubber tubing 36, aperture 32, groove 33 communicating therewith and paper escape slot 60, as well as certain additional elements in the projectile 10 shown in FIGURE 2. The projectile itself is composed of a tubular body member 45 in which a conical recess 40, 50 has been drilled in each end, each of these conical recesses having an apex angle of approximately 60 degrees. These recesses leave a sharp annular flange 42, 52 at each end of the projectile body, and it is these flanges which form the cutting or punching elements of the projectile. The additional elements mentioned above for assisting in removing the discs cut from the card comprise small holes so drilled through the projectile body as to create air passages 46, 56 between the interior of recesses 40 and 50, respectively, and the exterior of the cylindrical body 45 of projectile 10.

In order to visualize how these new elements 46 and 56 (in conjunction with elements 32, 132, 33, 133, 36, 136, and 60, 160) assist in removing the previously punched discs, let it be assumed that the projectile has already been fired from the left to the right (thereby cutting disc 70 from the card) and has been fired back again from the right toward the left, almost reaching the left-hand end of tube 130. This is the situation shown in FIGURE 2 in that the projectile now has the old disc 70 and the recently cut disc 80 still within recesses 50 and 40, respectively. As a projectile is retarded in its travel to the left (see arrow 300), the great pressure developed at its front or left end is communicated by the small connecting rubber tube 136 to aperture 132. Therefore, as the small connecting hole 56 reaches groove 133 communicating with this aperture 132, the air will flow into recess 50 to create a greater pressure therein. Since paper disc 70 is held only by friction within the end of annular flange 52, this increased pressure upon the disc 70 will blow it out to the right so that it may fall through paper escape slot 160 (see FIGURE 2). It should be noted that it is the previously picked-up disc (70) rather than the newly punched one (80) which is disposed of. Obviously, the process of removing paper disc 80 will be accomplished on the deceleration part of the cycle of the next firing of the projectile from the left to the right.

Since it may be thought that the mechanism for removing the punched card discs would cause operational difficulties in other parts of the cycle, the operation of the entire device will now be described including the effects of the small rubber tubing 36, aperture 32, paper escape slot 60 and the two small connecting passages 46 and 56 in the projectile 10. Let it be assumed that the projectile has been fired back and forth previously so that if the projectile is in the "rest" position shown in FIGURE 1, it will have a paper disc such as 70 caught in the right recess thereof but the left paper disc should have been removed on the previous retardation part of the cycle as the projectile came to rest after having been fired from the left side of the apparatus.

When a punching operation is intended to be commenced, valve member 25 will be turned from the position shown in FIGURE 1 through 90° to the position where bore 26 is vertical so that the compressed air is allowed to communicate with both of tubes 18 and 118, thereby producing pressure in both sides of the system. The effects on the projectile of these two pressures, however, is quite different depending on which side of the apparatus the projectile is at the time that the pressure build-up takes place. Thus, (assuming the projectile to be on the right as shown in FIGURE 1), the pressure in the left-hand side of the system merely creates a small pressure on the left-hand side of card 11, whereas most of the pressure will escape through paper escape slot 160. However, as previously explained, the pressure in the right-hand side of the apparatus cannot escape because of the presence of projectile 10 therein, and therefore a great pressure build-up occurs within tubes 18 and 36. The projectile is therefore accelerated to the left by the powerful force therebehind so that the acceleration rate is quite high even after the projectile starts its movement towards the left. It should be noted that as the left-hand small passageway 46 of the projectile passes under aperture 32, some loss of pressure (i.e., escape through aperture 32, groove 33, passageway 46, recess 40 and paper escape slot 60) will occur. However, the small cross-sectional size of passage 46 precludes any substantial drop in pressure during the short time that passageways 46 and 32 are aligned. It might be noted that should a paper disc such as 80 be present (because of failure to be removed at the end of the last firing) this pressure in recess 40 would tend to now drop such a disc through paper slot 60; thus the early part of the firing cycle involves a check on the previous paper disc removal part of the last cycle. Passage 46 soon passes beyond the left-hand extremity of the wall forming groove 33 and aperture 32 thus completely resealing the pressure chamber behind (i.e., to the right of) projectile 10. The pressure continues to accelerate the projectile along tube 30 until the lower part of the right-hand annular flange 52 passes beyond the righthand wall 62 forming paper escape slot 60; at this time, the compressed air behind the projectile begins to escape through the paper escape slot 60 to the outside atmosphere. By this time, however, the projectile is rapidly speeding to the left, since the acceleration thereof has been extremely great until this point. As the right-hand edge of the projectile continues to open an air escape route through paper escape slot 60, the pressure reduces rapidly to approach atmospheric pressure; therefore, the projectile is now a true ballistic missile in that it is no longer being accelerated with any great force towards the left. However, the momentum already gathered is so substantial that the projectile will pierce card 11 without losing substantially all its momentum (or

kinetic energy) so that it enters left-hand projectile tube 130 at a substantial velocity.

It might be noted at this point that the effect of groove 33 and therefore aperture 32 having come into alignment with the right-hand air passage 56 in the projectile 10 has little effect when the projectile is being fired from right to left. The reason for this is that the only effect of such alignment is to tend to equalize the pressure inside recess 50 with that behind (i.e., to the right of) the projectile so that there is no tendency to force out cut paper disc 70 when the projectile is being fired. The deceleration of the projectile in the left-hand tube starts almost immediately upon the projectile entering the tube but in view of the fact that left-hand paper escape slot 160 is open, the back pressure on the front of the projectile is not substantial until the projectile has advanced to the left to such point that it begins to close this slot. Once the left-hand end of the projectile has completely sealed off this slot 160, the pressure in front of (i.e., at the left) of the projectile begins to build up at a very rapid rate. The reason for this pressure build-up is two-fold: first, the projectile itself is acting as a plunger tending to decrease the volume of the air trapped in the left-hand end of tube 130, in tube 118 and in the main pressure chamber 124; secondly, valve member 25 may still be in such position that pressurized air is still being fed to tube 130 through tube 118. Therefore, a great deceleration force begins to act on the front (i.e., left) end of projectile 10, which force is ever-increasing.

It might be noted at this point that during this deceleration the communication of left-hand passage 46 with the left-hand groove 133 (and therefore aperture 132) has no substantial effect other than to tend to equalize the pressure inside recess 40 with that already existing on the left end of the projectile. As the central part of the body 45 of the projectile 10 reaches the groove 133 and aperture 132, much of the deceleration of the projectile has already occurred so that by the time right-hand passage 56 is aligned with aperture 132 (in the position more or less shown in FIGURE 2), the projectile has almost come to rest. During this time the removal of paper disc 70 occurs in the manner previously explained. In the meantime the pressure build-up at the left-hand end of projectile 10 continues even though some air now may escape through passage 56, recess 50 and paper escape slot 160; that is, since the passage 56 is of small cross-section, the combined effect of the plunger action of the larger cross-sectional area of projectile 10 and the pressure in tube 118 continues to maintain pressure in front of the projectile even though some air escapes in the manner just mentioned. However, the dimension of the passage 56 and of the timing of valve member 25 are so chosen that as the projectile slows to the position shown in FIGURE 2 (with the passage 56 still in communication with groove 133 and therefore aperture 132) a substantial part of the pressure has escaped because of the length of time that the now slow moving projectile remains in such position. Stated in other words, the width of groove 133 and its position is so chosen that by the time the projectile has reached the position of FIGURE 2 it is moving very slowly. Nevertheless, the inertia of the projectile is sufficient to carry the projectile somewhat farther to the left than shown in FIGURE 2, so that the projectile comes to rest with passage-way 56 slightly farther to the left than the left-hand wall forming groove 133 and aperture 132. This is then the new starting position for firing the projectile to the right the next time that valve 20 is opened.

The extremities of tubes 30 and 130 are provided with a slight constriction (formed for example by peening) so that the projectile cannot pass therethrough. This constriction prevents overshooting of the projectile during firing should the back pressure of the receiving tube be insufficient to stop it because of some malfunction. The shape of this constriction may also be made sufficiently

gradual that the projectile is slightly wedged therein upon stopping so that there is an additional inertia-like effect upon the next firing thereof. Since the pressure behind the projectile will then tend to build to a greater value before the projectile is dislodged, a greater explosive-like propulsion can be thus obtained, thus decreasing the time of alignment of the leading small passageway 46 (in the right to left firing of FIGURE 1) and aperture 32, thus reducing the pressure lost thereby.

Although the drawing shows only one projectile, one tube and one propulsion unit on each side of the card, preferably a multitude of such units are provided in commercial applications thereof so that a large number of holes may be punched simultaneously. Thus, many tubes 30, 130 are provided, each having its own connecting tubes 18, 118 and small rubber tubing 36, 136 and associated openings, which may be connected to multiple nipples (such as 21, 121) in valve housing 22. Alternatively, additional valves (like 20) may be provided for each of these additional tubes; or a few such valves may be provided, each providing pressurized air to a small number of tubes 30, 130. Similarly, tubes 36, 136 need not be all separate tubes, but rather a few might all join to a larger tube before being connected to a single aperture (similar to but somewhat larger than that shown at 34, 134) in tubes 18, 118. By any of these arrangements a whole series of holes will be punched in the card simultaneously, regardless of which side of the apparatus the various projectiles may be at the time of firing.

Control of the valves is, of course, effected by rotating the various valve members 25, either in an intermittent or continuous manner. Thus, rotary solenoids may be utilized to periodically rotate the valve members when the card is more or less stationary between tubes 30 and 130 so as to supply pressurized air at this time. Alternately, continuously rotating electric or other motors may be utilized to keep the valve members 25 always in rotation, and the size and placement of apertures 27 and 28 are so chosen in relation to the size of bore 26 that the valve is opened while the data processing card is stationary and closed after the punching operation, thus allowing for the movement into the apparatus of the next card. Although this latter arrangement has the apparent advantage of eliminating inertial effects in the control system, it has the disadvantage of requiring additional means to select which of the various valves should not be opened. Such a means could include electromagnetic clutches between the various valve member actuation shafts and the motors or common motor shaft utilized in the driving means. Because of the need for such additional means, the use of intermittently acting solenoids or the like would appear preferable. Any rapidly acting valve operating means may be utilized, however; and, indeed, any valve which is capable of rapid opening and closing may be utilized with any fast actuation means. Although the invention preferably utilizes a single valve for admitting pressurized air both of tubes 18 and 118 simultaneously so that, as previously explained, the punching projectile 10 will be fired through the card 11, regardless of the side of the apparatus from which it originates, nevertheless, this is not absolutely necessary. Thus, a valve could be provided for each of tubes 18 and 118, and only the tube, which communicates with the side of the apparatus in which the projectile is, would be fired. Since this would require some additional means for sensing on which side of the apparatus the projectile was before opening the appropriate valve, the preferred arrangement is the one shown in the drawing, which requires no such sensing and only one valve per punching system.

Other minor modifications of the system are also possible. For example, tubes 30 and 130 have been described as cylindrical so that a cylindrical punching projectile 10, producing a round hole in card 12, is utilized. In fact, there is no objection to utilizing tubes and projec-

tiles of square, rectangular or other cross section in order to produce correspondingly shaped holes in the cards. It might be noted that such alternate cross-sectional shapes would eliminate the need for grooves 33 and 133, since such projectiles could not rotate in tubes 30 and 130 and the purpose of grooves 33, 133 is to assure that the air passages 46, 56 in the projectile communicate with apertures 32, 132 even if the projectile should rotate in these tubes. Furthermore, it is possible to time the actuation means of valves 20 in such manner as to allow the cards to be in motion while the hole-punching operation is being accomplished, thus increasing still further the capacity of the system.

Although the inventive method and arrangement has been illustrated by a single preferred embodiment, the inventive concept is not limited to any particular arrangement; on the contrary, the invention is defined by the following claims and is co-extensive with their scope and their equivalents.

I claim:

1. The method of punching holes in data processing cards which comprises: initially firing at least one ballistic projectile, having at least one punching element on each end thereof, completely through said card so as to produce a hole with the punching element on one end of said projectile; decelerating said projectile so as to stop it at a point on the other side of said card remote therefrom, and in such a manner that said projectile remains generally aligned with its original direction of flight; and subsequently refiring the projectile back along said direction of flight with sufficient force so that the other end of said projectile produces a hole in a card occupying substantially the same position as the card in said initial firing.

2. Apparatus for punching holes in data processing cards comprising: a data card supporting station; at least a first tube assembly positioned with one end adjacent said card station; at least a second tube assembly longitudinally aligned with said first tube assembly and with one end thereof spaced from but proximate to said one end of said first tube assembly so that said card station is between said one ends of said tube assemblies; at least one propulsion mechanism; said propulsion mechanism comprising force-producing means and means operatively connected to said force-producing means and the distal other ends of both said tube assemblies for conveying the force produced by said force-producing means into said other ends of said tube assemblies; a punching projectile in one of said tube assemblies adjacent said distal other end thereof; and means for actuating said force-producing means in such manner that upon actuation a force will be produced in at least one of said other ends of said tube assemblies of sufficient magnitude to propel said punching projectile situated therein along the length of said tube assembly, through a card which may be positioned at said card supporting station and into the other of said tube assemblies.

3. Apparatus for punching holes in data processing cards as recited in claim 2, in which each of said tube assemblies and said force conveying means are substantially identical so as to require the manufacturing of only one type of each unit.

4. Apparatus for punching holes in data processing cards comprising: a data card supporting station; at least a first tube assembly positioned with one end adjacent said card station; at least a second tube assembly longitudinally aligned with said first tube assembly and with one end thereof spaced from but proximate to said one end of said first tube assembly so that said card station is between said one ends of said tube assemblies; at least one propulsion mechanism; said propulsion mechanism comprising force-producing means and means operatively connected to said force-producing means and the distal other ends of both said tube assemblies for conveying the force produced by said force-producing means into said other ends of said tube assemblies; a punching projectile having at least one cutting portion in one of said tube assemblies adjacent said distal other end thereof; means for actuating said force-producing means so that upon actuation a force will be produced in at least one of said other ends of said tube assemblies of sufficient magnitude to propel said punching projectile situated therein along the length of said tube assembly, through a card which may be positioned at said card supporting station, and into the other of said tube assemblies; and means for assisting in removal from said cutting portion of said projectile of the punched card part which may be carried by said punching projectile from one tube assembly into the other.

5. Apparatus for punching holes in data processing cards comprising: a data card supporting station; at least a first tube assembly positioned with one end adjacent said card station; at least a second tube assembly longitudinally aligned with said first tube assembly and with one end thereof spaced from but proximate to said one end of said first tube assembly so that said card station is between said one ends of said tube assemblies; at least one propulsion mechanism; said propulsion mechanism comprising force-producing means and means operatively connected to said force-producing means and the distal other ends of both said tube assemblies for conveying the force produced by said force-producing means into said other ends of said tube assemblies; a punching projectile in one of said tube assemblies adjacent said distal other end thereof; and means for actuating said force-producing means in such manner that a force is produced in each of said other ends of said tube asesmblies of sufficient magnitude to propel said punching projectile situated in said other end of either of said tube assemblies along the length of said tube, so as to pass from said one end of one of said tube assemblies, through a card which may be positioned at said card supporting station and into said one end of the other of said tube assemblies.

6. Apparatus for punching holes in data processing cards according to claim 5, in which said means for actuating said force-producing means is composed of a single actuator causing said force-producing means to introduce a force on both of said conveying means substantially simultaneously, so that said force is created at each of said other ends of said tube assemblies substantially symmetrically.

7. Apparatus for punching holes in data processing cards according to claim 5, in which said force-producing means utilizes a compressed gas, which may be supplied from a pneumatic compressor.

8. Apparatus for punching holes in data processing cards comprising: a data card supporting station; at least a first tube assembly positioned with one end adjacent said card station; at least a second tube assembly longitudinally aligned with said first tube assembly and with one end thereof spaced from but proximate to said one end of said first tube assembly so that said card station is between said one ends of said tube assemblies; at least one propulsion mechanism; said propulsion mechanism comprising pneumatic-pressure means and means operatively connected to said propulsion mechanism and the distal other ends of both said tube assemblies for conveying said pressure produced by said pneumatic means into said other ends of said tubes; a punching projectile in one of said tube assemblies adjacent said distal other end thereof; means for actuating said pneumatic means so that a gaseous pressure is produced in each of said other ends of said tube assemblies of sufficient magnitude to propel a punching projectile situated in said other end of either of said tube assemblies along the length of said tube, so as to pass from said one end of one of said tube assemblies, through a card which may be positioned at said card supporting station and into said one end of the other of said tube assemblies; and a pneumatic escape means positioned between said other end and one end of each of said tube assemblies; so as to allow the escape of said gaseous pres-

sure in the absence of a projectile between said escape means and said other end of either of said tube assemblies.

9. Apparatus for punching holes in data processing cards according to claim 8, in which said pneumatic escape means is formed directly in said tube assemblies by a discontinuity of the walls thereof.

10. Apparatus for punching holes in data processing cards according to claim 9, in which said walls forming said escape means are sufficiently spaced apart to allow a card disc formed by the punching operation to pass therethrough so as to escape from the interior of said tube assemblies.

11. Apparatus for punching holes in data processing cards comprising: a data card supporting station; at least a first tube assembly positioned with one end adjacent said card station; at least a second tube assembly longitudinally aligned with said first tube assembly and with one end thereof spaced from but proximate to said one end of said first tube assembly so that said card station is between said one ends of said tube assemblies; a propulsion mechanism; said propulsion mechanism comprising pneumatic-pressure means and means operatively connected to said propulsion mechanism and the distal other ends of both said tube assemblies for conveying said pressure produced by said pneumatic means into said other ends of said tubes; a punching projectile having at least one cutting portion in one of said tube assemblies adjacent said distal other end thereof; means for actuating said pneumatic means so that a gaseous pressure is produced in each of said other ends of said tube assemblies of sufficient magnitude to propel said punching projectile situated in said other end of either of said tube assemblies along the length of said tube, so as to pass from said one

end of one of said tube assemblies, through a card which may be positioned at said card supporting station and into said one end of the other of said tube assemblies; a pneumatic escape means positioned between said other end and one end of each of said tube assemblies, so as to allow the escape of said gaseous pressure in the absence of said projectile between said escape means and said other end of either of said tube assemblies; said pneumatic escape means being formed directly in said tube assemblies by a discontinuity of the walls thereof; said walls forming said escape means being sufficiently spaced apart to allow a card disc formed by the punching operation to pass therethrough so as to escape from the interior of said tube assemblies; and additional means for assisting in dislodging punched card discs which may adhere to said cutting portion of said punching projectile, at least part of said additional means being positioned adjacent said escape means and operating at times upon a card disc which may be carried by said punching projectile.

12. Apparatus for punching holes in data processing cards according to claim 11, in which at least part of said additional means comprises a pneumatic conduit so positioned as to assist in dislodging said card discs from said punching projectile by pressure when compressed gas flows therethrough.

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