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A. M. TAILLEUR

2,999,632

HIGH SPEED PUNCH MECHANISM

Filed Dec. 26, 1958

2 Sheets-Sheet 1

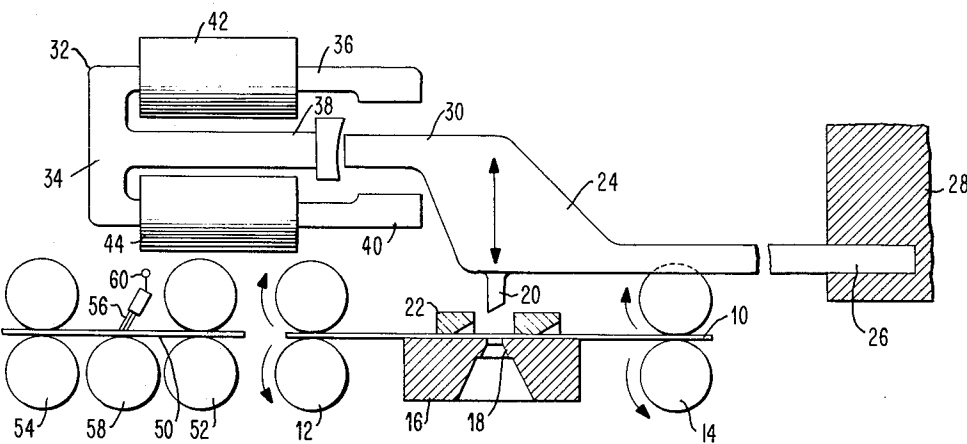


FIG. 1

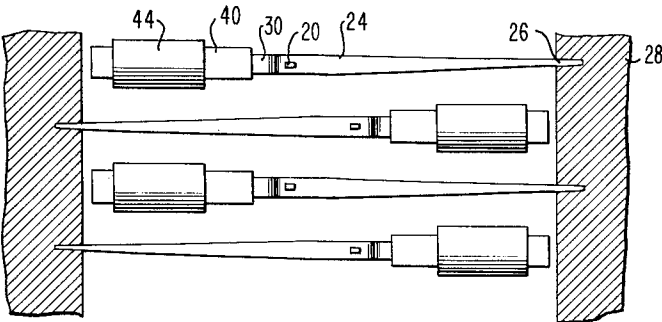


FIG. 2

INVENTOR
ANDRÉ M. TAILLEUR
BY *Maurice H. Kitzman*
ATTORNEY

A. M. TAILLEUR
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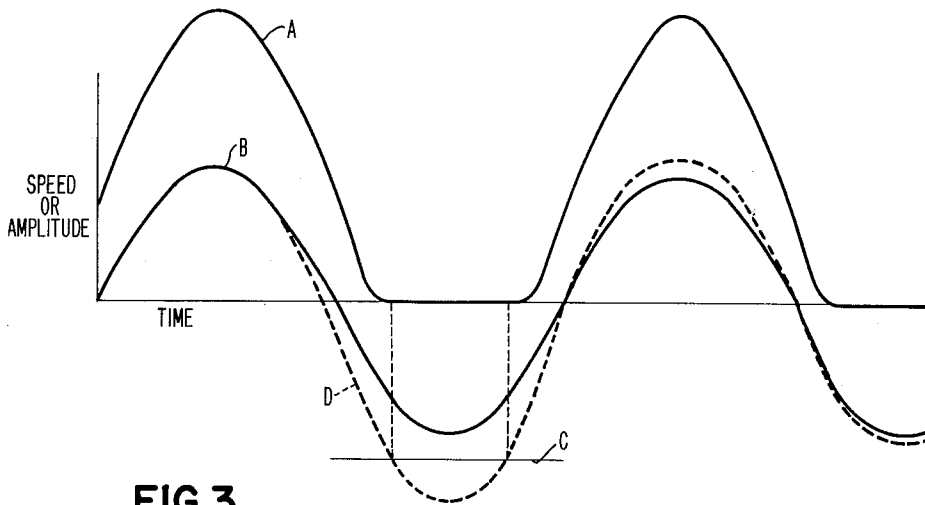


FIG.3

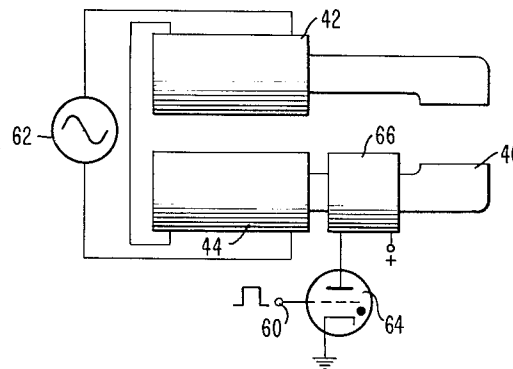


FIG.4

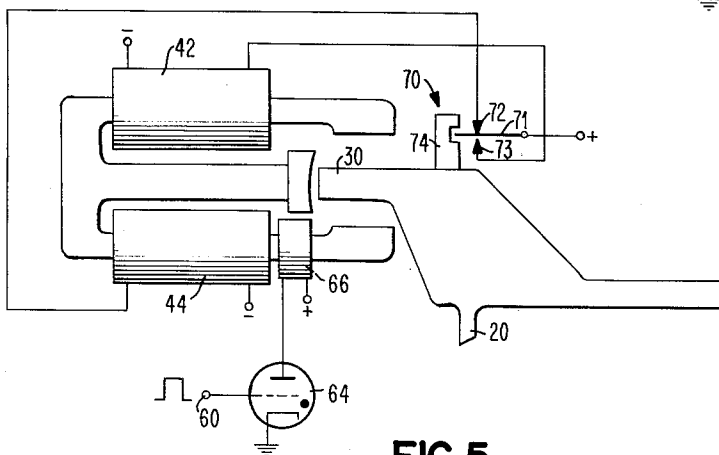


FIG. 5

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HIGH SPEED PUNCH MECHANISM

André Marcel Tailleux, Paris, France, assignor to International Business Machines Corporation, New York, N.Y., a corporation of New York

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5 Claims. (Cl. 234—109)

This invention relates to a high speed punch mechanism, and, in particular, to a high speed punch for punching record cards for use in business machines, which punch mechanism has a minimum amount of parts that are subject to wear.

For purposes of this invention, it is intended that the term "card" be used generically to cover cards, sheets or tape.

In present day business machines, for example, collators, sorters, etc., cards are used many times and ultimately become mutilated. Therefore, they must be reproduced. This is accomplished by passing a master card through a reproducing machine and reading the information from these cards back into a punch mechanism for punching the new card. The rapidity with which the punching is effected is limited by the mechanical stresses on the punch element and stripping die, which cannot exceed the acceleration force limits without risking damage or premature wear of the parts. The punch mechanism receives such a large shock at high speeds during each cycle that it is becoming difficult to avoid damage. The impact imparted from the cycling drive members onto an interposer which then actuates the punch, creates large acceleration forces which becomes incompatible with the increase in demand of higher speeds for punching record cards.

This invention is primarily aimed at a new quick selective punching device for punching record cards such as those daily used in statistical and accounting business machines, wherein no impact forces are transmitted to the punch from the driving member, thereby presenting no limiting acceleration or impact force on the parts and no other wear other than that of the punching element and die itself.

It is another object of this invention to provide a new punching device wherein the punch element itself is constantly oscillating at its own sustained frequency, and when a signal is received during one of the oscillations, the punch element is urged towards the record card to be punched, which occurs during the downward movement caused by the normal oscillation.

It is still another object of this invention to provide an oscillating element for use in punching record cards, which punch element is not actuated by a mechanical interposer, or the like, but relies upon an electrical interposing means for energizing the punch element to punch the record card.

It is still another object of this invention to provide a new punch which is more reliable, less cumbersome, and less expensive than the mechanical punch mechanisms and still capable of obtaining identical results.

Briefly stated and in accordance with one aspect of this invention, I provide a card punching mechanism in which the punch element constantly vibrates without contact with the cards and is at its own frequency sustained under the control of magnets, which when selected in response to an appropriate signal, amplifies one of the downward moving oscillations of the vibrating punch element to increase the amplitude so as to produce a perforation in the card to be punched.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of

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example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

FIG. 1 shows a punch and die arrangement in accordance with my invention.

FIG. 2 shows a series of punches as viewed from beneath the punch rather than in an elevation, which are adapted to punch in parallel so as to gang punch when desirable.

FIG. 3 diagrammatically represents the movement of the record card, and movements of the punch element with respect to a fixed die and also the card.

FIG. 4 is an electrical diagram for energizing the magnets to operate the punch element.

FIG. 5 is a schematic view showing a means for vibrating the punch element at its natural frequency.

Referring to FIG. 1, a record card 10 is shown being fed by feed rolls 12 and 14. In accordance with prior practice, the feed rolls are driven intermittently through the use of a Geneva or cam mechanism (not shown) so that the selective perforation of the cards can occur when the cards are at zero velocity. A punching die is shown at 16 provided with a mating opening 18 through which a punch element 20 can enter so as to perforate the card 10. A stripper die is shown at 22 which not only acts as the guide for the punch 20 but also strips the card from the punch when the punch is on its return stroke after having perforated the card.

The punch element 20 terminates into a main body portion 24 and has one of its ends 26 cantilevered in a rigid fixed support 28. This permits the punch element and punch body to vibrate in response to its natural frequency. The other end of the punch is provided with a freely moving armature portion 30 which is adapted to freely move within the gaps of a magnet generally designated as 32. The magnet 32 comprises a yoke 34 with three legs 36, 38 and 40. The legs 36 and 40 are provided with coils 42 and 44. The magnet 32 controls the movement as concerns the amplitude and phase of the punch element 20 which has an inertia mass and which is maintained fixed at its end 26 so as to vibrate at its own frequency.

The intermittent advance of the cards 10 through the feed rolls 12 and 14 is so designed by use of its Geneva cam or cams to occur at the frequency of the current flowing through the coils 42 and 44. The current flowing through the coils 42 and 44 insures the synchronism between the movement of the punch element and the feeding of the cards. The intermittent feeding of feed rolls 12 and 14 can be provided with an electrical circuit in synchronized response to the frequency of the coils 42 and 44. The electrical circuit could energize a motor for driving a Geneva cam which in turn intermittently drives the feed rolls 12 and 14.

Whenever card 10 stops at the punching station, the frequency of the punch element is synchronized with the coils 42 and 44 so that it is at its lower position during this instant. Thereafter, while the card is still in its punching station at a stopped position, the punch moves upward as a result of its natural frequency and timed relation with the coils 42 and 44. If perforation is to be effected during the time that the card is still in its stationary position at the punch station, coil 44 is energized when the punch reaches its higher position by a strong current so as to pull the armature 30 and the punch element 20 down to its lowest point by a circuit arrangement preferably comprising a thyatron and arranged to provide a low response time.

Such an arrangement may take the form shown in FIG. 1 and FIG. 4, where a reproducing punch arrangement is shown merely as an example of how the inven-

tion may be carried out. For this purpose, a master card or card that contains information which is to be punched into the card 10 is shown at 50. The feed rolls 52 and 54 are also synchronized in the same manner as feed rolls 12 and 14 so as to intermittently drive the card 50 past the reading station while the same point on card 10 is intermittently passing the punch station. The reading station comprises reading brushes 56 as a sensing means and contact roll 58 so as to deliver a pulse to the hub at 60. Referring now to FIG. 4, a generator is shown at 62 connected to the coils 42 and 44 which is set to match the natural frequency of the punch 20. Now, when the pulse is received at the hub 60 from the sensing brushes 56 reading a hole in the card 50 which is to be reproduced in the card 10, the pulse is transmitted to the thyatron 64 which energizes the coil 66 of a magnet which extends about the core leg 40. The pulse received from the sensing brushes 56 is timed so that it is received when the punch element 20 is at its high position. Therefore, when the coil 66 receives the pulse from the hub 60, the vibrating armature 30 will be pulled downwardly due to the additional current in the coil 66.

The coil 66 is energized during half a period to accelerate punch element 20 to move to its lower than normal low point so as to perforate the card. The card 10 is punched when it is at the punch station and during the interval when it is under the punch 20, which punching occurs at a result of the inertia during the downward movement of the punch 20 supplemented by the action of the magnet 32.

Punch 20 then returns to its normal high position due to the natural frequency of the cantilevered arm 26, and due to the attraction force of magnet 32 caused by the coil 42 and opposite to that produced previously by the coil 44. This makes for an eventual slight phase shift.

In the event that a self-synchronous system is desired, such an arrangement can be provided as shown in FIG. 5. In the arrangement shown, it is not necessary to match the natural frequency of the punch with the frequency of the generator. Again, this is merely intended as an example of a self-synchronous system. It is recognized that other similar arrangements could also be used. In the self-synchronous system, a circuit breaker is shown at 70 which provides an on and off arrangement for operating the coils 42 and 44 of the magnet 32. In this arrangement, the normal position would be one where one of the fixed contacts is in engagement with the movable contact 71. For example, contact 72 is shown in this condition. Therefore, when current is supplied, a circuit is closed to energize the coil 44 so as to pull the armature 30 and punch 20 down. This starts the punch element 20 operating at its natural frequency. Therefore, when the punch element 20 and insulated operating member 74 move down, the contact at 72 is broken and contact is then made with fixed contact 73. Therefore, when the punch element 20 reaches its bottom-most position, another circuit is made with the coil 42 which then tends to pull the armature 30 upwardly. Repeated cycles of operation are then continued in the manner described above. When it is desired to punch the record card 10, as explained in connection with FIG. 1, the operation is the same as described in connection with FIG. 4, in that a signal or pulse received at hub 60 energizes the thyatron 64 to energize the magnet coil 66 so that the magnet 32 and coil 66 actuates or attracts the armature 30 so as to pull the punch down 20 sufficiently to perforate the card 10. The thyatron circuits of FIGS. 4 and 5, when energized by direct current, will of course require suitable quenching means, not shown, which will extinguish the thyatron after each operation. On the other hand, no such means is required for alternating current operation.

FIG. 2 shows several punches, such as those shown in FIG. 1, disposed in alternate rows to minimize the area taken up by the punches. Also, it is obvious that

other arrangements of these punch devices such as that represented in FIG. 1 would also be within the scope of the invention.

Referring now to FIG. 3, curve A represents the variations in card speed relative to time, the speed values being along the ordinate axis and the time values along the abscissa axis. Curve B shows the movement of punch element 20 vibrating at its own frequency with relation to a fixed reference such as the top of the die 16. The top of the die is represented by the line C, which is parallel to the abscissa axis.

Dotted curve D shows the movement of punch element 20 during a perforation operation. Perforation takes place at the point where the dotted curve D crosses line C.

In curves B, C and D, the amplitude of the movements are measured along the ordinate. The time duration of the movements are measured along the abscissa.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A punch mechanism for perforating business cards comprising a punching die, a punch element cantilevered in a support, which punch element is adapted to cooperate with the punch die to perforate a card placed therebetween, a magnet co-operating with the punch element to vibrate the punch at its natural frequency, the magnet being in resonant relationship with the natural frequency of the punch element which provides a means for constantly vibrating the punch without contact with the cards, means for energizing the magnet to amplify one of the oscillations on its downward movement so that the punch extends below the punching die to thereby perforate the card.

2. A punching arrangement of the character described, comprising a punch station, a vibrating cantilevered punch element, means for vibrating the punch element, means for moving a card through the punch station, the frequency of the vibrations being in timed relation with the movement of the card passing through the punch station, and means acting on the punch element for increasing the amplitude of one of the vibrations so as to cause the punch element to perforate the card.

3. In a punching arrangement having a punch station, the combination of means for intermittently feeding a card through the punch station so as to have a dwell period, a punch element for perforating the card normally oscillating according to its natural frequency, a magnet for oscillating the punch at an amplitude according to its natural frequency, the oscillations and the operation of the magnet being in synchronization with the operation of the intermittent feeding means, a means for sending a signal to a magnet when the punch is in its upwardly position, so as to pull the punch down through a larger amplitude so that the punch perforates a card during the dwell period of the intermittent motion.

4. A mechanism for marking an element, comprising an oscillatable marking member cantilevered in a support, magnet means oscillating the member at a preselected frequency and normally within an amplitude at which it is ineffective to contact the element, and means responsive to a signal to augment the normal action of said magnet means for increasing the amplitude of such oscillation to cause the member to mark the element.

5. A mechanism for marking an element, comprising an oscillatable marking member cantilevered in a support, means for moving the element relative to said member in increments separated by stationary dwell periods, magnet

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means oscillating the member at a preselected frequency and normally within an amplitude at which it is ineffective to contact the element, means responsive to a signal to augment the normal action of said magnet means for increasing the amplitude of such oscillation to cause the member to mark the element, and means synchronizing the operation of the element-moving means and magnet means and signal-responsive means to cause the increased

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amplitude to be effected only during one of the dwell periods.

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