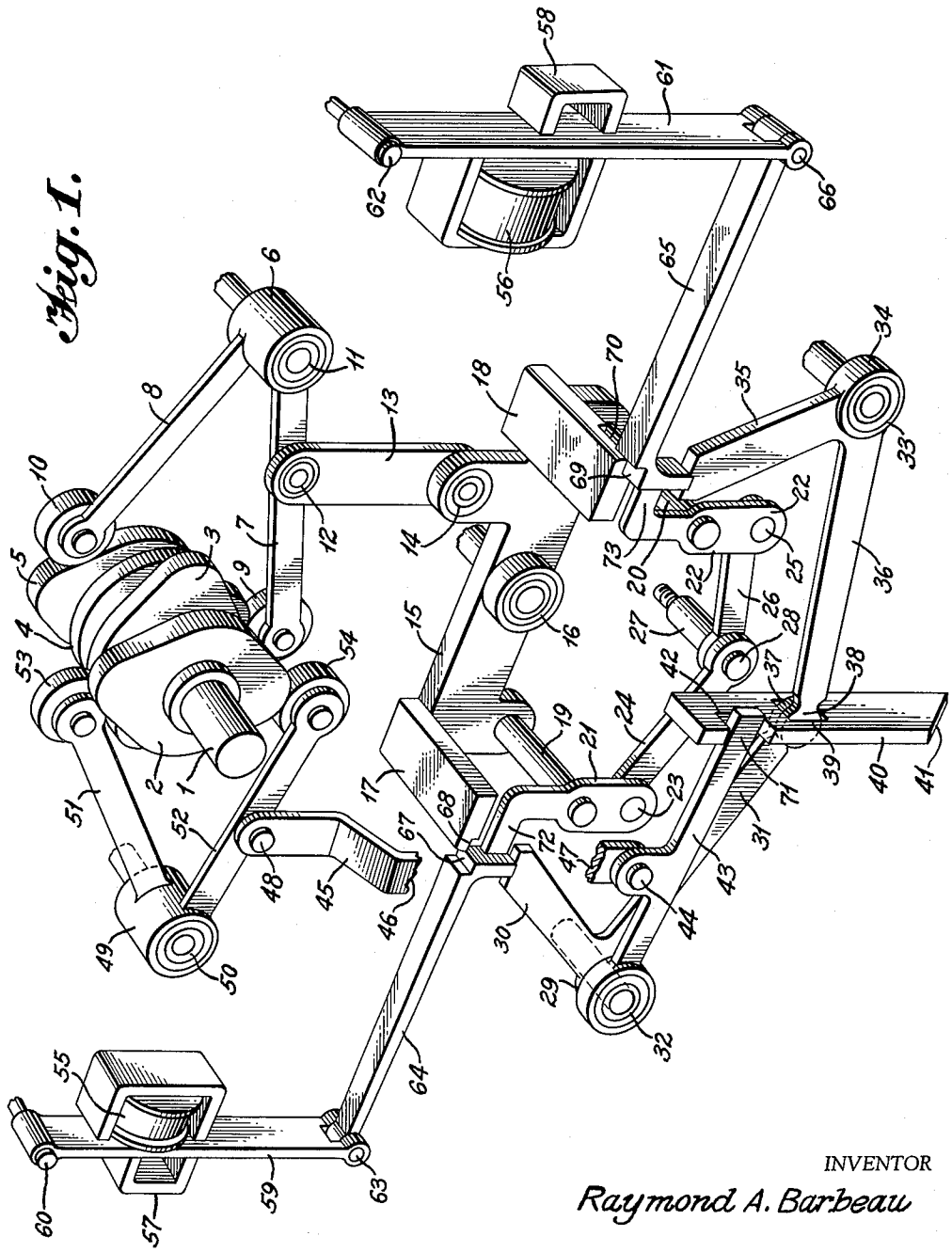
June 20, 1961 R. A. BARBEAU 2,989,229

DOUBLE ACTION HIGH SPEED PUNCH

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Fig. 1.



INVENTOR
Raymond A. Barbeau

BY Geoffrey Knight
ATTORNEY

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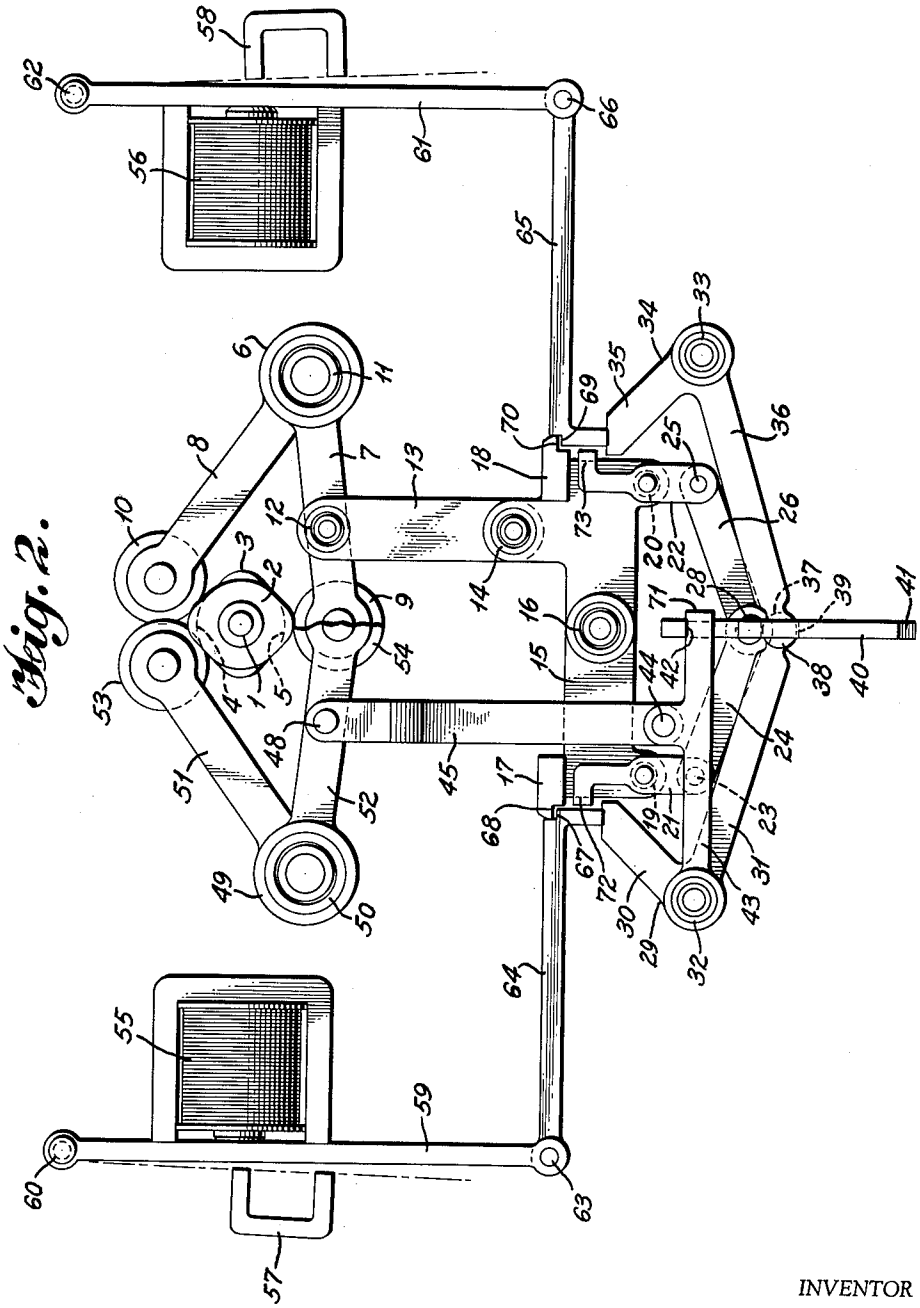


Fig. 2.

INVENTOR

Raymond A. Barbeau

BY Geoffrey Knight

ATTORNEY

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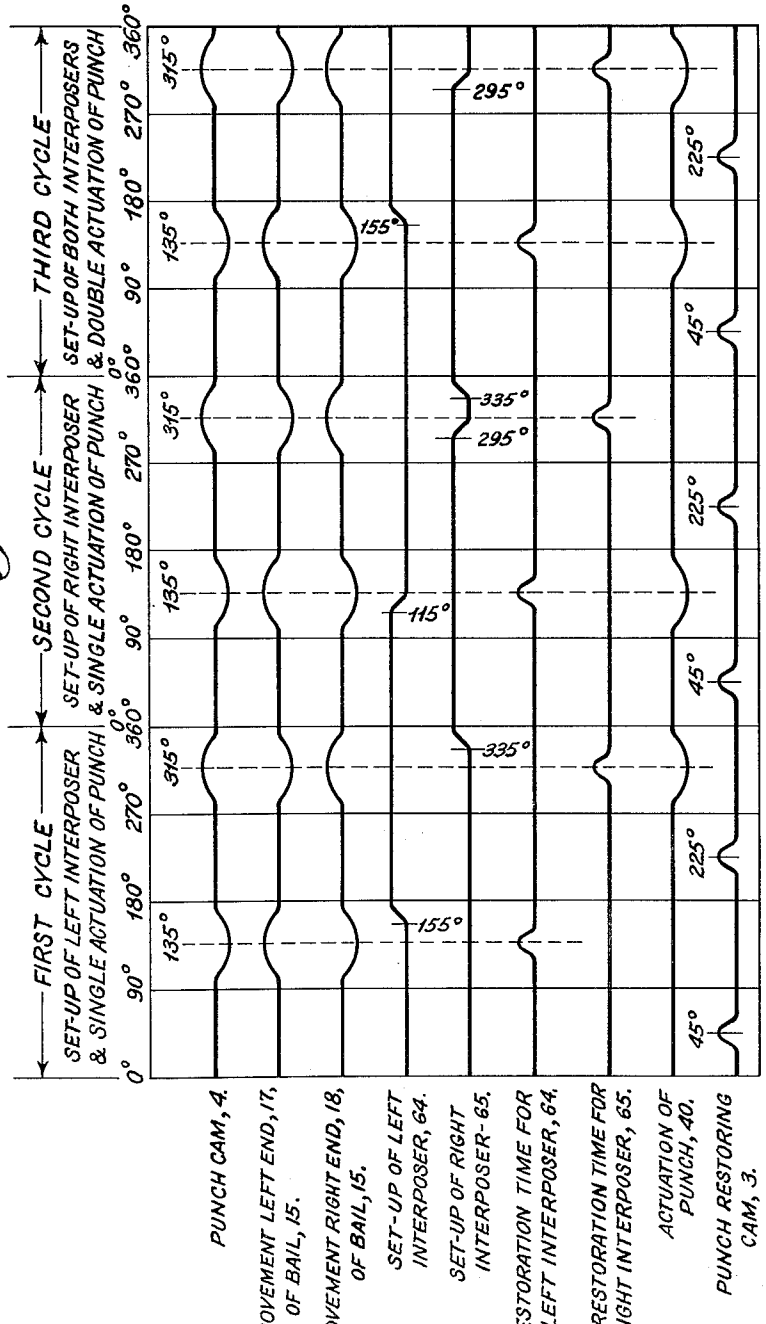


Fig. 3.

INVENTOR

Raymond A. Barbeau

BY Geoffrey Knight ATTORNEY

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DOUBLE ACTION HIGH SPEED PUNCH

Raymond A. Barbeau, Poughkeepsie, N.Y., assignor to International Business Machines Corporation, New York, N.Y., a corporation of New York

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9 Claims. (Cl. 234—115)

This invention relates to punching mechanisms, and more particularly to very high speed punching mechanisms.

Generally in the prior art, punches have operated on the principle of driving each punch through a single linkage from a driving means. In such a mechanism the entire linkage connected to an individual punch goes through one complete cycle for each actuation of the punch and the speed is limited by the rate at which the entire linkage between the individual punch and the driving means can be operated and restored.

This principle of operation has proven to be satisfactory, since these devices operate at moderate speeds and no particular problems are encountered with respect to adequate actuation and restoration of the punches.

For example, certain paper tape and card perforating devices in the prior art have operated in the range of 1200 to 3500 cycles per minute. This operating range has permitted the use of spring elements for restoration purposes, and has permitted satisfactory operation with commercially available bearings. Bearings currently available have an upper limit of operations of around 4500 cycles per minute.

With the advent of electronic computers, which are capable of pouring out data at a tremendous rate, punches of the type heretofore available have become a limiting factor in the operation of these machines.

The present invention is primarily intended for use in high speed tape preparation devices which may operate at speeds of 9000 cycles per minute or higher, but the principle of operation disclosed is equally applicable to slow speed devices.

The principal object of the invention is, therefore, to provide a punching mechanism that is capable of operation at extremely high speeds.

An additional object is to provide a punching mechanism capable of the high speed referred to, characterized by positive drive of the punch on both the punching and restoring strokes.

Another object of the invention is to provide a punching mechanism that operates with a minimum amount of noise.

Another object of the invention is to provide a punching mechanism that is simple in design and efficient in operation.

Another object of the invention is to eliminate the problem of harmonic vibration that is sometimes encountered in punching mechanisms.

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

In the drawings:

FIG. 1 is a perspective view of the punching mechanism.

FIG. 2 is a simplified drawing of the punching mechanism showing the relationship of the elements used.

FIG. 3 is a timing chart for three cycles of operation of the punching mechanism which shows the relative movements of the major elements employed in the punching mechanism.

The preferred embodiment of the invention can be

understood by referring to FIG. 1 in conjunction with FIG. 2.

The invention utilizes, for each individual punch, two alternately operating setup mechanisms, respectively coacting with two differently phased driving linkages actuated by common drive means, as will be fully described.

In FIG. 1, a shaft 1 has cams 2, 3, 4 and 5 rigidly mounted on it and is driven at high speed, for example 4500 cycles per minute.

The shaft may be coupled to any suitable driving means, such as a motor, through a cyclically operable clutch mechanism as disclosed in Patent No. 2,784,785 to C. R. Doty, assigned to the same assignee as the present application.

Cams 2 and 3 are double lobe cams, while cams 4 and 5 are single lobe cams, each having a slight dwell diametrically opposite the lobe. The cams are shown in exaggerated form in FIG. 1 for purposes of illustration and description.

Cams 4 and 5, through associated linkages, cause punching to take place through the setup mechanism on one side of the device and concurrently cause restoration of the setup mechanism on the opposite of the device. Cams 2 and 3, through associated linkages, cause restoration of the punch element 40 employed.

A complementary cam follower 6 has two arms 7 and 8 with associated rollers 9 and 10 which follow cams 4 and 5 respectively. The cam follower 6 is pivoted at 11. Attached to arm 7 of the complementary cam follower 6 at point 12 is a link 13, one end of which is pivotally mounted at 14 on a bail 15, which in turn is free to rock about bearing 16. Bail 15 has extensions 17 and 18 formed at each of its end at right angles to the bail itself.

A bell crank 29 which has a long arm 31 and a short arm 30 is pivotally mounted on bearing 32. Freely mounted on bearing 33 diametrically opposed to bell crank 29 is bell crank 34 which likewise has a short arm 35 and a long arm 36. The rounded ends 37 and 38 of bell crank arms 31 and 36 rest in an aperture 39 and thus are in continual engagement with a punch 40 which would normally reciprocate upwardly and downwardly within a stripper. The cutting end 41 of punch 40 would normally move into and out of a matching die as is well known in the art.

A card or tape passing between the die and stripper would be perforated by the punch 40 each time the punch 40 was actuated.

Also engageable with the punch 40 in a cutout portion 42 is a punch restoring link 43 mounted on bearing 32 along with bell crank 29. The cutout opening 42 is sufficiently large to permit the end 71 of the punch restoring link 43 to move a short distance within the opening without actually engaging the punch 40. Thus, the link 42 will act on the punch 40 only if the punch 40 has been previously actuated downwardly to perforate a record or tape passing underneath. Movement of the restoring link 43 upwardly caused by the restoring cams and linkages, as presently described, will result in punch 40 being returned to its upper or home position.

Attached to link 43 at point 44 is another link 45 which is angularly formed to clear the bell crank 29 and bail 15 and which for purposes of clarification is shown cut away at points 46 and 47 in FIG. 1. The upper end of link 45 is attached by means of a stud 48 to a cam follower 49 which is pivoted at point 50. The cam follower 49 has a configuration similar to that of cam follower 6 in that it also has two arms 51 and 52, each of which has a roller (53 and 54 respectively) mounted thereon. The roller 53 rides on cam 3 and the roller 54 rides on cam 2.

Identical electromagnetically operable setup magnets 55 and 56 are arranged opposite each other and are used

to selectively control the operation of the punch 40 through interposers 64 and 65. A permanent horseshoe type magnet 57 is fixedly mounted with the open end of the horseshoe facing setup magnet 55 while an identical permanent magnet 58 is fixedly mounted in like manner facing setup magnet 56.

An armature 59 pivoted at point 60 is free to move in a small arc between setup magnet 55 and permanent magnet 57. An identical armature 61 pivoted at point 62 is in a like manner free to move in a small arc between setup magnet 56 and permanent magnet 58.

The armatures 59 and 61 are normally attracted to their respective horseshoe magnets 57 and 58 when in a restored condition. Each armature thus remains against its related permanent magnet until the associated setup magnet is energized and overcomes the magnetic attraction of the permanent magnet when the armature will swing over to the setup magnet.

Hinged at the lower extremity 63 of armature 59 is an interposer 64 which would normally be retained in a guide member, not shown, and which is free to move inwardly and outwardly toward and away from the extension 17 of bail 15 as the armature 59 is attracted to setup magnet 55 and is subsequently restored. Likewise, an interposer 65 is hinged at the lower extremity 66 of armature 61 and may be guided similarly to interposer 64 inwardly and outwardly toward and away from the extension 18 on bail 15.

Interposer 64 has a step 67 which is engageable with a cutout portion 68 on extension 17 of bail 15 and interposer 65 has a step 69 engageable with a cutout portion 70 on extension 18 of bail 15. The interposers 64 and 65 must be positioned properly with respect to the bail 15 and the bell cranks 30 and 35 to obtain operation of the punch 40.

The restored position of the interposers 64 and 65 exists when the respective armatures 59 and 61 to which they are attached are attracted to their individual permanent magnets 57 and 58. In this condition, the extensions 17 and 18 of bail 15 cannot engage the steps 67 and 69 on their associated interposers 64 and 65 and the punch 40 will not be actuated even if the shaft 1 and associated cams 2, 3, 4 and 5 are rotated.

Rigidly attached to the bail 15 under each extension are elongated studs 19 and 20. Interposer knockoffs 21 and 22 are pivotally mounted on studs 19 and 20 respectively. Pivotally attached to the bottom extremity of knockoff 21 at point 23 is a link 24 and pivotally attached to the bottom extremity of knockoff 22 at point 25 is a link 26. The other ends of links 24 and 26 are commonly connected to a fixed elongated stud 27 at point 28.

The operation of the punch interposers 64 and 65 and their subsequent restoration by the interposer knockoffs 21 and 22 will be explained in detail shortly.

It is desirable that the actuating and restoring mechanisms of the device move through extremely small distances for high speed operations. This is to minimize vibrations set up in the device as well as to achieve quieter operation. The particular configuration shown and described accomplishes these objectives.

In order to cause punch 40 to move a sufficient distance and thus insure complete and satisfactory punching of a record, the arms 31 and 36 of bell cranks 29 and 34 are made relatively longer than the arms 30 and 35 of the same bell cranks, so that a small downward movement of the bail 15 from horizontal (for example .020") will cause a considerably greater movement of the punch 40 (for example .054") when either interposer is positioned for punching.

In addition, the cams 4 and 5 are preferably shaped so that the bail 15 is moving at a slower rate at the instant of engagement with a particular interposer and this will result in relatively quiet operation of the device even though it may be operating at very high speeds.

Referring to FIG. 3, a sequence chart may be observed which represents three cycles of operation of the punch mechanism. Each cycle extends from 0° to 360°. The timings and sequence of operations shown in FIG. 3 have been selected arbitrarily and for purposes of illustration of the mode of operation of the invention. Movements of the various elements noted at the left of the charts are represented by the horizontal lines on the sequence chart opposite the respective elements.

For example, the left end of bail 15 reaches a maximum upward limit of travel about 135° of each cycle and a maximum downward limit of travel about 315° of each cycle. The left interposer is set up for punching about 155° of each cycle and restored at 115° of the next cycle, while the right interposer is set up for punching in a particular cycle at 335° of the preceding cycle and restored about 295° of the cycle when punching occurs.

For ease of explaining the operation of the device, it is assumed that the device is in a completely restored condition at the beginning of cycle No. 1 in FIG. 3. In the typical sequence depicted, one actuation of the punch 40 occurs during cycle No. 1, utilizing the left interposer 64, one actuation of the punch 40 occurs in cycle No. 2 utilizing the right interposer 65 and two actuations of the punch 40 occur in cycle No. 3 when both interposers 64 and 65 are utilized.

At the beginning of cycle No. 1 shaft 1 and its associated cams 2, 3, 4 and 5 are rotating. The high lobe on cam 4 will be around at its extreme downward position at about 135° of cycle No. 1. As a result, movement of cam follower arm 7 and link 13 will cause the right end of bail 15 to move to its extreme downward position. The right interposer 65 was not positioned under extension 18 at this time so no punching occurs.

At the same time that the right end of bail 15 moves down, the left end of the bail moves up. Since the interposer knockoff 21 is pivoted on stud 19 and since the other end of link 24 (to which the interposer knockoff 21 is attached) is pivoted on fixed stud 27, the interposer knockoff 21 and link 24 will act as a toggle link about point 23. Movement of the bail 15 upward will cause the interposer knockoff 21 to pivot in a counterclockwise direction so that the knockoff portion 72 will move toward interposer 64.

Interposer 64 had not been in punching position at this time, so no restoration was necessary. However, the action of the interposer knockoff 21 takes place as described at about 135° of every cycle. Shortly after 135° the bail is started back toward a horizontal position and the interposer knockoff 21 is rocked in a clockwise direction away from the interposer 64. At this time, an impulse can be directed by the punch control mechanism as is well known in the art, to energize setup magnet 55.

Normally, in a record perforating machine, a plurality of individual punching mechanisms would be arranged side by side so that a complete row of holes or only certain holes in a row would be selectively punched in the record. These would represent data in coded form, and examples of this are the five-hole telegraphic code and the eight-hole IBM code. Thus, the impulse directed to magnet 55 might represent one bit of a complete code combination.

The energization of magnet 55 will cause its armature 59 to be attracted and the step 67 of attached interposer 64 will be positioned underneath the extension 17 on bail 15. Continued rotation of shaft 1 and cams 2, 3, 4 and 5 will result in the dwell on cam 4 being positioned around 315° of the cycle so that the cam follower arm 7 will be in its uppermost position. The link 13 will pull the right end of bail 15 up, and the left end of bail 15 will go down.

Since interposer 64 is in punching position, its engagement by extension 17 of bail 15 will cause bell crank 30

to pivot clockwise. The arm 31 of bell crank 29 will impart a downward actuation of punch 40 and a hole can be punched in a record positioned under the punch.

At the same time that punching takes place at the left side of the mechanism, the right interposer knockoff 20 is pivoted toward and away from interposer 65 in a manner similar to the action of the left interposer knockoff 21 previously described. If the interposer 65 had been in punching position at this time, it would have been restored.

Thus, in cycle No. 1, a single punch actuation was achieved at 315°.

Early in cycle No. 2, restoration of the punch 40 takes place at 45° as a result of the rotation of cam 3 and the movement of cam follower 51, link 45, and knockoff link 43. The link 43 will engage the punch 40 in the cutout portion 42 and pull it back up to home or restored condition.

It is desired to utilize the right interposer for punching during the second cycle and the right setup magnet 56 is energized at about 335° of cycle No. 1 as the arm 73 of right interposer knockoff 22 moves in a counterclockwise direction away from the interposer 65.

Interposer 65 is then in position at 135° of the second cycle so that the extension 18 of bail 15 can engage it and cause actuation of the punch 40. This is accomplished through the interposer 65 and the bell crank 34. Arm 36 of bell crank 34 moves counterclockwise at this time and since the end 38 of the arm 36 is positioned in recess 39 of the punch 40, the punch will move downward for punching a record positioned underneath.

At the same time that punching occurs from the right side of bail 15, the left interposer 64 is being restored by knockoff 21. Restoration of right interposer 65 takes place in the second cycle around 315° when the right end of bail 15 is toward its upper limit of travel. No punching will take place from the left side of the bail at this time since the left interposer 64 was not positioned for punching.

In cycle No. 2, a single actuation of the punch was achieved at 135° utilizing the right interposer.

It is desired to actuate the punch twice in the third cycle, so right setup magnet 56 will be energized in the second cycle shortly after 335° which is knockoff time for the right interposer. The right interposer is restored by 315° of the second cycle, but shortly thereafter it is repositioned for punching during the third cycle. The first punch operation in the third cycle will occur about 135° as it did in the second cycle utilizing the right interposer 65.

Since two punching operations are required this cycle, the left interposer is positioned shortly after 135° or at about 155° of the cycle by energization of the left setup magnet 55. Left interposer 64 is thus in position to cause actuation of the punch 40 through the bell crank 29 when the left extension 17 of bail 15 is moved downwardly at 315° of the cycle.

Two actuations of the punch 40 thus occur in the third cycle, one at 135° and the other at 315°, or 180° later.

Due to the novel mode of operation disclosed in the foregoing discussion, punching at extremely high speeds is possible. For example, if 9000 actuations of the punch 40 per minute were desired, the time available for actuation and restoration of the punch is only 6 milliseconds.

By employing the principles disclosed in the present invention, twice as much time, or 12 milliseconds at the rate cited, is available for energization of each setup magnet, positioning of its associated interposer and restoration of the interposer.

This is advantageous, since enough time is assured for proper electrical operation of each of the setup magnets and for proper mechanical operation and restoration of the associated armature and interposer.

Each interposer need be set up only once in each full cycle of 12 milliseconds duration, but because the two interposers are successively engaged by the rocking bail during the cycle, two operations of the punch may be achieved or one operation of the punch every 6 milliseconds.

While the fundamental novel features of the invention have been shown, described and pointed out as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in form and details may be made in the device illustrated and in its operation 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 multiple action punching device comprising in combination, cyclically operable driving means, a punch, a plurality of connecting means each having a driving connection with said punch, a bail driven by said driving means through a cycle of movement for each cycle of said driving means, said bail having different portions respectively associated with said connecting means, said different portions executing punch drive strokes at different times in the cycle of movement of said bail, a plurality of interposers respectively associated with said connecting means and adapted to be inserted between the respective connecting means and the related portions of said bail, and means for selectively controlling said interposers, whereby said punch may be actuated repeatedly in a single cycle of said bail.

2. A cyclically operable punching device, comprising in combination, a punch, a pair of bell cranks each having an arm engaged with said punch, a centrally pivoted bail each of the respective ends of which is in proximity to a second arm of a respective one of said bell cranks, a pair of interposers respectively associated with said bell cranks, each of said interposers being movable into and out of a coupling position between the related bell crank arm and the appertaining end of said bail, setup means for selectively moving said interposers into said coupling position, and drive means connected to said bail for rocking said bail once each cycle so that the punch may be actuated through either of said bell cranks when its associated interposer has been moved to the coupling position.

3. A punching device, comprising cyclically operable drive shaft means, a plurality of cams on said shaft means, a rocking bail, linking means including a cam follower connecting said bail and said cams for rocking said bail once during each cycle of said drive shaft means, a pair of bell cranks each having an operating arm and a punch driving arm, said operating arms of said bell cranks being respectively positioned under opposite ends of said bail, a pair of interposers respectively associated with said bell cranks, each of said interposers being movable into and out of a coupling position between the operating arms of the respective bell cranks and the appertaining ends of said bail, and a punch engaged with both of said punch driving arms, so as to be actuated by either of said bell cranks when the related interposer is in the coupling position.

4. A punching device comprising in combination, a punch, a pair of bell crank members each having an arm engaged with said punch, a rocking bail positioned so as to have one of its operating ends in proximity with the second arm of one of said bell cranks and the other operating end in proximity with the second arm of the other of said bell cranks, a pair of interposers, one of which is movably positioned on the second arm of one of said bell cranks and the other of which is movably positioned on the second arm of the other of said bell cranks, setup means for selectively positioning each interposer in engageable position between an operating end of said bail and the associated second arm of the respective bell crank, cyclical drive means for rocking said bail so that it may engage a first interposer if selected and drive the said

punch through the associated bell crank at a first time in a particular cycle and so that it may engage the other interposer if selected and drive the said punch through the associated bell crank at a second time in the said cycle thus permitting two actuations of the said punch during a cycle of the said driving means.

5. A punching device comprising cyclical driving means, a plurality of cams operated by said driving means, a centrally pivoted bail, a first complementary cam follower driven from a first set of said cams for positively moving said bail about said pivot once during each cycle of said driving means, a punch, a pair of bell cranks each having an arm engaged with said punch, and each of said bell cranks having a second arm positioned under a respective end of said bail, interposers respectively associated with each of said second bell crank arms near the ends of said bail and normally in a non-engageable condition with respect to said bail as it is moved about its pivot by said driving means, setup means for selectively positioning each interposer so that the bail may engage it and actuate said punch through the said interposer and said associated bell crank, the ends of said bail operating at different times in the cycle on the respective interposers, so that two actuations of the said punch may be achieved during any one cycle of the driving means.

6. A driving mechanism, comprising in combination, a driven member, a pair of bell crank members each having an arm engaged with said driven member, a rocking bail positioned so as to have one of its operating ends in proximity with the second arm of one of said bell cranks and another operating end in proximity with the second arm of the other of said bell cranks, a pair of interposers, one of which is movably positioned on the second arm of one of said bell cranks and the other of which is movably positioned on the second arm of the other of said bell cranks, setup means for selectively positioning each interposer in engageable position between an operating end of said bail and the associated second arm of the respective bell crank, cyclical drive means for rocking said bail so that it may engage a first interposer, if selected, and drive the said driven member through the associated bell crank at a first time in a particular cycle and so that it may engage the other interposer, if selected, and drive the said driven member through the associated bell crank at a second time in the said cycle, thus permitting two actuations of the said driven member during a cycle of the said driving means.

7. A cyclically operable driving mechanism, comprising in combination, a driven member, a pair of bell cranks each having an arm engaged with said driven member, a centrally pivoted bail each of the respective ends of which is in proximity to a second arm of a respective one of said bell cranks, a pair of interposers respectively associated with said bell cranks, each of said interposers being movable into and out of a coupling position between the related bell crank arm and the appertaining end of said bell, setup means for selectively moving said interposers into said coupling position, and drive means connected to said bail for rocking said bail once each cycle so that the driven member may be actuated through either of said bell cranks when its associated interposer has been moved to the coupling position.

8. A high speed punching device comprising in combination: a punch; a plurality of linkages, each of said linkages having associated interposer means, and each of said linkages further having an element in driving engagement with said punch; means for selectively operating each of said interposer means; and cyclically operating common driving means positioned to operate successively, in a cycle of said driving means, on all of said linkages, whereby a plurality of actuations of said punch may be achieved during said cycle of operation of the said driving means.

9. A driving mechanism comprising: a driven member; a plurality of linkages, each of said linkages having associated interposer means and each of said linkages further having an element in driving engagement with said driven member; means for selectively operating each of said interposer means; and cyclically operating common driving means positioned to operate successively in a cycle of said driving means, on all of said linkages, whereby a plurality of actuations of said driven member may be achieved during said cycle of operation of said driving means.

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