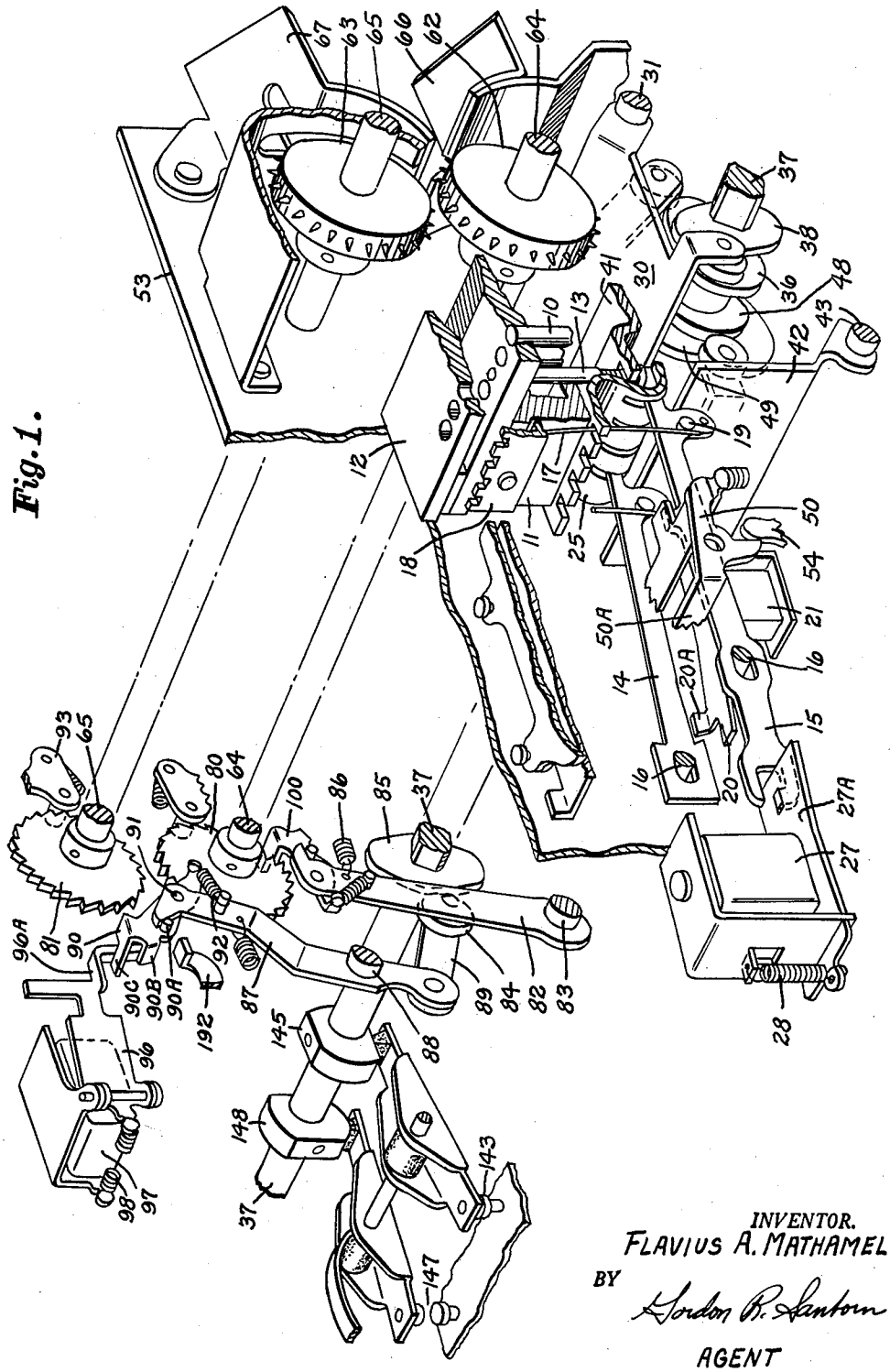
Dec. 25, 1962 F. A. MATHAMEL 3,070,292

RECORD PERFORATOR

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Fig. 1.



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RECORD PERFORATOR

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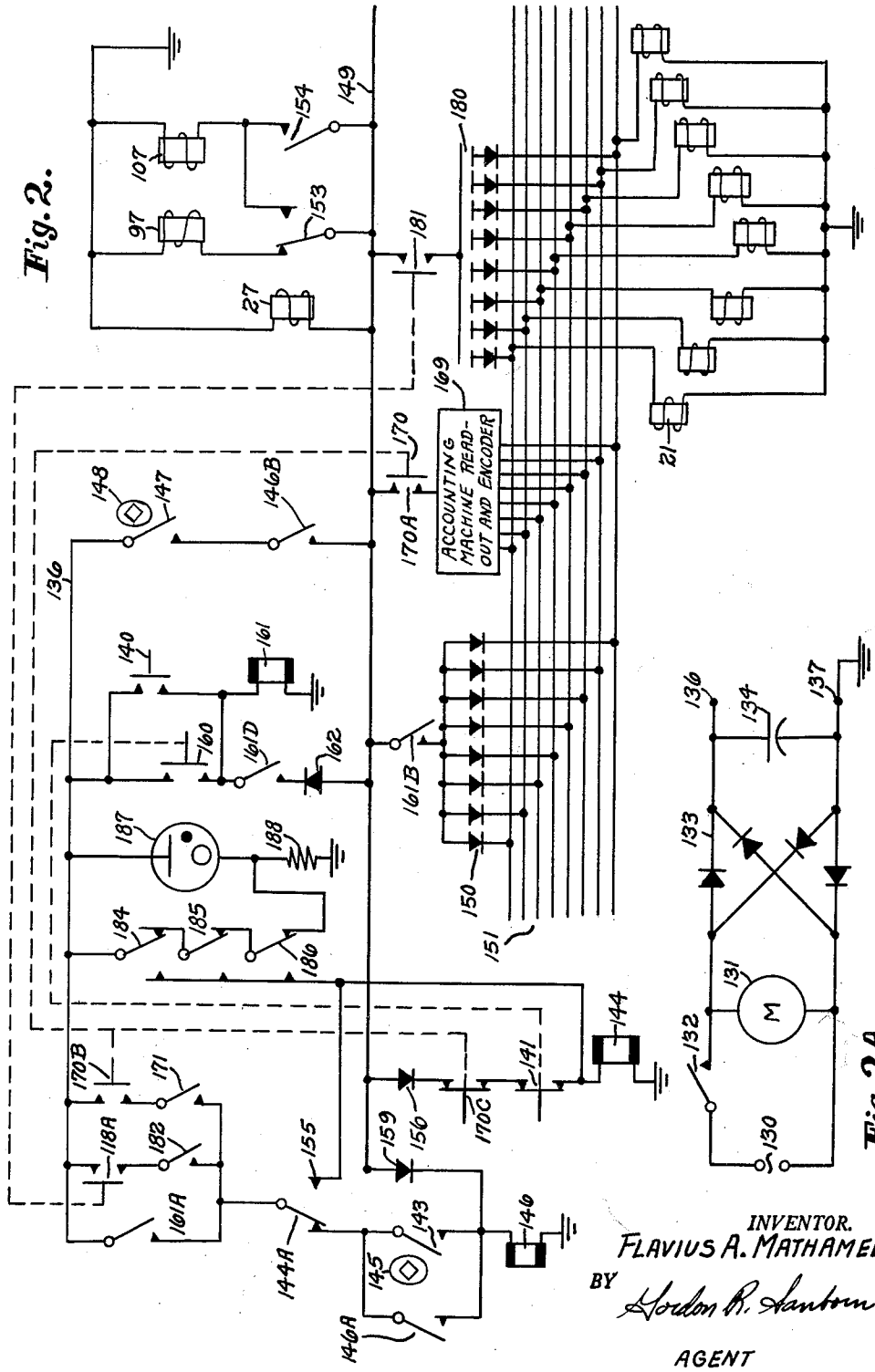


Fig. 2.

Fig. 2A.

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RECORD PERFORATOR

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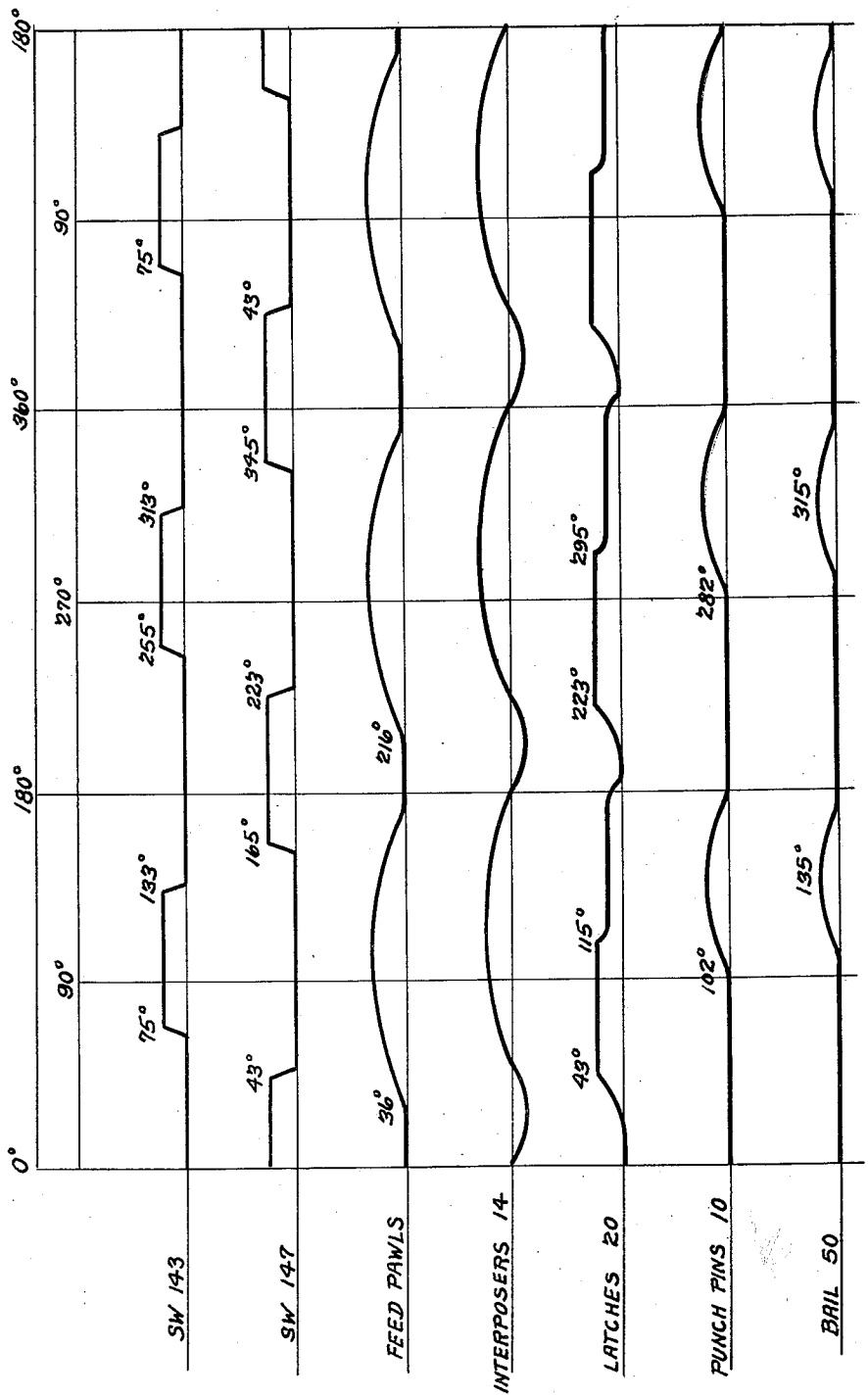


Fig.3.

United States Patent Office 3,070,292 Patented Dec. 25, 1962

3,070,292
RECORD PERFORATOR

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Filed Apr. 3, 1961, Ser. No. 100,222
9 Claims. (Cl. 234—114)

The present invention relates to a perforating apparatus and more particularly to a perforator having a continuously rotating driveshaft in combination with an improved control circuit for controlling the perforating cycles of operation.

Record producing devices such as tape perforators are well known in the art, and in general such devices are adapted to be operated intermittently through the use of a single cycle clutch to record a unit of information. This requires the use of an accurate single cycle clutch device which adds to the cost of the perforator and may impose restrictions on the speed at which the perforator can be operated. In those perforators in which the camshaft is constantly rotating a relatively complicated control circuit has been required for controlling the signals applied to the various solenoids contained in the perforator. In addition, some prior art perforators in which the driveshaft is continuously rotating are not capable of utilizing each rotation of the main driveshaft to accomplish a perforating cycle of operation since resetting of the various components in the control circuitry requires at least one rotation of the main shaft following the perforating cycle of operation.

Therefore it is an object of the present invention to provide an improved tape perforator having a continuously rotating driveshaft and including the control circuitry therefor. A further object of the present invention is to provide an improved control circuit for a tape perforator having a continuously rotating driveshaft. Another object of the present invention is to provide an improved control circuit for a perforator having a continuously driven shaft which permits each rotation of the shaft to accomplish perforating cycles of operation.

These objects are achieved in the present invention through the use of a control circuit in which the application of control signals to various solenoids in the perforator is controlled by cam means secured to the driveshaft and operable to control the condition of a plurality of switch means in the circuit. The perforator includes a plurality of punch pins movable from first to second positions to perforate a strip of record material disposed in the path thereof. A punch pin driving member is continuously reciprocated by the main driveshaft to provide the necessary drive for the perforating motion of the punch pins. Each of the punch pins is disposed on the upper rear surface of a movable solenoid controlled interposer element which serves to selectively couple the associated punch pin with the punch pin driving bail. The movement of the interposer elements to their coupling positions of engagement with the punch pin driving bail is controlled by an interposer bail which is reciprocated by the main driveshaft. This interposer control bail serves to control the movement of the interposers to said coupling position and also to restore the interposer elements to their home positions where they are latched by the clappers of the control solenoids which serve as interposer latches.

The perforator includes a sprocket wheel for advancing the perforated tape, said sprocket wheel having a ratchet wheel secured thereto. A driving pawl for the ratchet wheel is constantly reciprocated between first and second positions for advancing the tape, and is so positioned during said reciprocatory motion as to normally engage

the ratchet wheel. The clapper of a feed control solenoid has a portion disposed in the path of the feed pawl so that the feed pawl is normally prevented from engaging the ratchet wheel. When the feed control solenoid is energized the clapper is pulled away from the feed pawl and therefore a feed operation can occur. Thus the release of the interposers and the feed pawl is controlled by solenoids while the actual movement of the parts is controlled by the common driveshaft. Therefore the control signals can be generated by means of timing switches operated by cams on the driveshaft.

The circuit for the solenoids includes first and second pairs of contacts serially connected between the solenoids and a source of potential in a manner such that both sets of contacts must be closed in order for the solenoids to be energized. One set of contacts is controlled by a cam on the shaft while the other set is controlled by a relay adapted to be energized when a third set of contacts is closed by a second cam on the main driveshaft. Thus the operation of the interposer solenoids and the feed solenoid is dependent upon the closing of the cam controlled contacts and energization of the relay.

These and other objects of the present invention will be more clearly understood from the following description when read with reference to the accompanying drawings wherein,

FIG. 1 is a perspective view from the right front corner of the perforator with sections thereof broken away to illustrate the operation of the perforator and with the tape feed mechanism being displaced from the main supporting frame of the perforator to more clearly illustrate the operation thereof,

FIG. 2 is a diagram of the control circuit for the perforator,

FIG. 2A is a circuit diagram of a power source for the circuit of FIG. 2, and

FIG. 3 is a timing chart showing the time during which the various parts of the perforator and control circuit operate.

The perforator illustrated in FIG. 1 is the same as that illustrated and claimed in the copending application of Louis J. Gavasso, Serial No. 100,229 entitled "Recording Method and Means" filed on the same day as the present application and assigned to the present assignee. As set forth in said co-pending application the perforator can be used to selectively record information on one, the other, or both of two tapes and hence is provided with individual selectively operable tape feed devices. Further details of the operation of the perforator to selectively record information on a plurality of tapes is set forth in said co-pending application, such details forming no part of the present invention.

Referring now to the drawings and in particular to FIG. 1, the perforator is seen to have a plurality of punch pins **10** disposed within openings provided in a punch guide block **11** in a manner such that they are aligned with openings in a punch die **12**. A single feed punch pin **13** which is of smaller diameter than the punch pins **10** is provided for punching the necessary tape feed holes. Each of the punch pins **10** is disposed on the upper rear surface of an interposer member **14** while the feed pin **13** is disposed on top of the feed interposer **15**. The interposers are supported at their front ends by a common shaft **16** secured to the frame **53** and at their rear ends by a slotted guide plate **25**. Each of the interposers is urged rearwardly by individual spring members **17** held in place by a small plate **18** screwed to the front surface of the punch guide block **11**. Each spring member **17** engages a rightwardly extending stud **19** provided on the interposers. The interposers **14** are normally held in their forward positions through the engagement of a lug **20A**

on the individual clappers which serve as interposer latches **20** controlled by the solenoids **21**. Each clapper is spring urged into latching engagement with the associated interposer **14** and therefore prevents rearward movement of the interposer unless the associated solenoid **21** is energized. The feed solenoid **27** which controls the feed interposer **15** is disposed forwardly of the solenoids **21** to facilitate arrangement of the solenoids in the perforator, but operates in substantially the same manner as do the solenoids **21**. That is, the clapper **27A** associated with solenoid **27** is spring urged into latching engagement with the interposer **15** by a spring **28** and hence holds the interposer **15** against rearward movement unless solenoid **27** is energized.

The rear ends of the interposers are disposed forwardly of the front edge of a punch pin driving bail **30** pivoted at **31** and adapted for reciprocatory motion. A set of complemental driving cams **36** and **38** secured to the main driveshaft **37** serve to reciprocate the bail **30** as the shaft **37** rotates. A slotted plate **41** secured to the top of bail **30** engages the cut-away portions of the punch pins and hence serves to permit movement of the punch bail **30** in an upward direction without affecting the punch pins unless the interposers have been moved rearwardly and yet serves to restore each punch pin to its lowered position when the interposer bail moves downwardly. The above-described mechanism is similar to that described in U.S. Patent 2,775,300 issued to P. R. Hoffman on December 25, 1956.

The movement of the interposers into their rearward positions of engagement by the bail **30** is controlled by interposer bail **42**, pivoted at **43** and reciprocated in a forwardly and rearwardly direction by means of complemental cams **48** and **49** on the shaft **37**. The bail **42** not only controls the rearward travel of the interposers which have been released by their associated solenoids but also serves to restore each interposer to its forward position where it is relatched by the associated latch **20** or **27A**. The upward travel of the rear end of feed interposer **15** serves to rock a pair of clapper restoring bails **50** and **54** to release any solenoid clapper which might tend to remain in its operated position because of residual magnetism. The perforator illustrated is adapted to simultaneously punch two tapes and therefore is provided with first and second tape feed sprocket wheels **62** and **63** supported for independent rotation by the shafts **64** and **65**. Individual tape guide plates **66** and **67** are associated with the sprocket wheels for maintaining the tapes engaged with the feed pins on the wheels. Separate ratchet wheels **80** and **81** are respectively secured to shafts **64** and **65** and hence when driven serve to advance the associated tape. A first driving lever **82** pivoted at **83** on the left side of frame **53** has a roller **84** secured thereto for engagement with a cam **85** on driveshaft **37**. A spring **86** serves to hold the roller **84** in engagement with cam **85**, the shape of cam **85** being such that the upper end of driving arm **82** is reciprocated forwardly and rearwardly twice during each rotation of the main drive shaft **37**. A second driving lever **87** pivoted on a stationary shaft **88** is coupled with the first lever **82** by means of a short pitman **89** pinned to the lower end of lever **87** and to lever **82**. Thus it is seen that each complete rotation of shaft **37** causes the upper end of lever **87** to reciprocate rearwardly and forwardly twice at the same time that the upper end of lever **82** is reciprocated forwardly and rearwardly twice.

A first tape feed pawl **90** is pivoted at **91** on the upper end of lever **87** and is urged in a clockwise direction thereon by means of a small coil spring **92**. Pawl **90** has a rightwardly extending stud **90A** which is engageable with the upper end of lever **87** and therefore serves to position the pawl on the lever. With the stud **90A** engaged with the upper end of lever **87** the pawl **90** is so positioned with respect to the ratchet wheel **81** that the downward and rearward drive of the upper end of lever **87** brings the driving surface of pawl **90** into engagement with the ratchet wheel **81** and advances ratchet **81** by one tooth. Near the end of such a driving movement of pawl **90** a leftwardly extending lug **90B** on the pawl becomes engaged with a rigid stationary abutment member **192** secured to the left side of frame **53**. This engagement of the lug **90B** with the bent-over portion of the abutment member **192** serves to hold the pawl against the ratchet wheel and prevent overthrow thereof. A detent arm **93** is spring urged into engagement with the ratchet wheel to positively position the ratchet wheel.

From the above it will be seen that the repeated reciprocation of drive lever **87** would normally repeatedly step the upper feed sprocket **63** in a counterclockwise direction. The engagement of pawl **90** with ratchet wheel **81** is controlled by a clapper latch **96** associated with a solenoid **97** positioned on the left side of frame **53**. Clapper **96** has an arcuate lug **96A** engageable with the leftwardly extending lug **90C** on pawl **90**, the shape of said lug **96A** being such that if it is maintained behind lug **90C** the pawl will be prevented from engaging the ratchet wheel **81** as the lever **87** is reciprocated. A coil spring **98** serves to normally hold the clapper **96** in its most clockwise position so that lug **96A** normally holds pawl **90** ineffective to drive the ratchet wheel **81**. Thus if solenoid **97** is not energized pawl **90** will rotate in a counterclockwise direction on its pivot point on the driving lever **87** as the lever rotates clockwise and therefore will not engage ratchet wheel **81**. If solenoid **97** is energized at the proper time clapper **96** is pulled away from pawl **90** and therefore the pawl maintains its same relative position on the arm **87** during the driving movement thereof. Accordingly, pawl **90** engages the ratchet wheel **81** to advance it by one tooth. During the occurrence of the rearward drive of the pawl the solenoid **97** is de-energized and therefore the arcuate lug **96A** is spring urged in a clockwise direction for engagement with the lug **90C**. The parts are so positioned that such clockwise urge on the clapper **96** brings the right surface of the arcuate lug **96A** into engagement with the left end of lug **90C** on the pawl. Therefore upon return of the driving arm **97** to the position shown in FIG. 1 following a tape feed operation, the lug **90C** will be positioned forward of lug **96A** and hence the clapper will complete its clockwise movement into latching engagement with lug **90C** under the urge of spring **98**.

A similar drive arrangement for the lower ratchet wheel **80** including a feed pawl **100** pivoted on the upper end of lever **82** is provided. The details of this drive arrangement are shown in greater detail in the above referred to Gavasso application, and form no part of the present invention. In the circuit diagram of FIG. 2 a second feed control solenoid **107** is illustrated. This second feed control solenoid **107** operates a clapper having an arcuate lug thereon for controlling pawl **100** in a manner substantially identical to the manner in which solenoid **97** operates clapper **96** to control the upper feed pawl **90**.

Each of the cams on shaft **37** is provided with dual lobes and therefore when the shaft **37** rotates through 360° two complete perforating cycles of operation can be performed including two operations of the two tape feed pawls. Therefore as seen in the timing chart of FIG. 3 180° represents a complete perforating cycle of operation. Each of the interposers are moved by bail **42** to a position where they can be relatched by their associated solenoid controlled latches **20**. Similarly, the tape feed pawls are driven to positions where they can be relatched by their associated solenoid controlled latches following a feed operation. Hence the shaft **37** can be continuously rotated if the signals controlling the various solenoids are applied thereto at the proper times. The circuit of FIG. 2 is adapted to control such timing of the signals. The circuit prevents erroneous repetition and yet allows separate perforating cycles of operation to be performed during each 180° of rotation of shaft **37**.

The power supply circuit of FIG. 2A is utilized to provide current to the operating circuit of FIG. 2 and includes a source of A.C. potential 130 having a motor 131 connected thereacross. A manually operable switch 132 serves to control the aplication of the A.C. potential to the motor. A conventional bridge rectifier circuit including diodes 133 and the filter capacitor 134 provides a D.C. potential between the output terminal 136 and ground terminal 137. The shaft of motor 131 can be connected directly to shaft 37 in any of a number of well known manners. Thus the shaft 37 will continuously rotate as long as motor 131 is energized.

In the circuit of FIG. 2 the closing of feed switch 140 serves to initiate a tape feed operation in which each of the interposer control solenoids 21 and 27 will be energized as well as one, the other, or both of the tape feed control solenoids 97 and 107. The closing of switch 140 applies the positive potential of terminal 136 to relay 161 which operates to close contacts 161A. Therefore the potential of terminal 136 is applied to a first cam controlled switch means in the form of contacts 143 over the relay contacts 144A. When cam 145 secured to shaft 37 closes the contacts 143 relay 146 having two sets of contacts 146A and 146B controlled thereby will be energized. Contacts 146A serve to provide a holding circuit for relay 146 even though cam 145 allows the contacts 143 to open. The second set of contacts 146B of relay 146 are connected in series arrangement with a second set of cam controlled contacts 147 controlled by a cam 148 secured to the main driveshaft 37 (FIG. 1). Accordingly, when the second set of cam controlled contacts 147 are closed positive potential will be applied to the common buss 149. Since contacts 161B controlled by relay 161 were closed by the operation of relay 161 positive potential from buss 149 will be applied across diodes 150 to the common terminal strips 151 to which the individual interposer control solenoids 21 are connected. Accordingly the interposers will be released for movement in the manner above described. Therefore the punch bail will move the punch pins through the tapes. Also it will be seen that the solenoid 27 which controls the feed punch interposer is directly connected between buss 149 and ground potential so that each time buss 149 is provided with the positive potential of terminal 136 the feed interposer will be released.

First and second tape feed control switches 153 and 154 are respectively connected in series arrangement with the feed control solenoids 97 and 107 between the buss 149 and ground. The switches 153 and 154 can be manually set so that one, the other, or both of the solenoids 97 and 107 will be energized in response to the positive potential being applied to buss 149. It should be noted that the switch arrangement is such that one of the feed control solenoids will always be energized in response to buss 149 being energized. The switches 153 and 154 may be advantageously closed in response to the operation of selected operation control keys on an accounting or similar type machine used as a source of input information to the perforator.

To prevent the repeated punching of the tape feed or end-of-word code in the event that the switch 140 is held closed, a relay 144 is energized to move its contacts 144A into engagement with the line 155. The circuit for energizing relay 144 extends from buss 149 over diode 156, switch 170C, and switch 141. When the relay 144 is energized and the contacts 144A are switched it will be seen that a holding circuit for relay 144 is established over contacts 161A and hence relay 144 remains energized until relay 161 is de-energized. Relay 161 is in turn held energized as long as buss 149 is energized because of the diode 162 and relay contacts 161D. The transfer of contacts 144A opens the original circuit for relay 146, and therefore an additional holding circuit for relay 146 is provided from buss 149 over diode 159 to prevent de-energization of relay 146 in response to the transfer of contacts 144A. Accordingly relay 146 will remain energized as long as the cam controlled contacts 147 remain closed to maintain buss 149 energized. As soon as the cam controlled contacts 147 open the positive potential applied to buss 149 is removed and the circuit returns to its original condition if the switch 140 has been released. If the switch 140 has not been released relay 161 remains energized and thus contacts 161A remain closed. Relay 144 thus remains energized and prevents the application of a second pulse to relay 146 until switch 140 is opened to permit contacts 144A to return to normal. It is thus seen that a single tape feed or end-of-word code comprising the punching of all the holes across the tape will be punched in response to the operation of switch 140 even though the switch is held closed. The timing of the various operations taking place will be described hereinafter in connection with the timing diagram of FIG. 3.

When the tapes are initially positioned in the throat of the punch it is advantageous to provide means for punching and feeding an initial strip of the two tapes therethrough. Accordingly a continuous tape feed key or switch 160 is provided. When switch 160 is closed relay 161 will be energized and therefore its first set of contacts 161A will be transferred so that the positive potential of terminal 136 will be applied to relay 146 over contacts 144A when cam 145 closes contacts 143. Accordingly as set forth above when relay 146 is energized, the buss 149 will be supplied with positive potential when cam 148 closes contacts 147. The contacts 161B will have been transferred in response to the energization of relay 161 so that the positive potential of buss 149 will be applied over diodes 150 to the interposer control solenoids and hence each of the punch pins will be operable.

Prior to the operation of the continuous tape feed switch 160, the operator would position the feed control switches 153 and 154 so that both of the solenoids 97 and 107 would be energized to release each of the tape feed pawls for operation in the manner previously described (the timing of which is described hereinafter). It is of course evident that the switches 153 and 154 could also be closed by the operation of the switch 160. Since the relay 144 would normally transfer the contacts 144A and hence cause de-energization of relay 146 when cam 148 releases contacts 147 (relay 146 at such time being energized from buss 149 through diode 159) it is necessary to prevent the energization of relay 144. Accordingly a switch 141 is ganged with switch 160 so that the contacts 141 will be opened at the same time that contacts 160 are closed.

Therefore relay 144 does not become energized. Since contacts 161A are held closed and contacts 144A are not transferred, relay 146 will be de-energized when cam 148 opens contacts 147 but will be again energized as soon as cam 145 closes contacts 143. Therefore it is seen that the buss 149 will be repeatedly pulsed with the positive potential of terminal 136 as contacts 147 open and close. The tape feed or end-of-word code which for purpose of illustration consists of the punching of eight holes (plus the feed hole) will thus occur repeatedly as long as switch 160 is held closed. As will be seen hereinafter, due to the asynchronous manner of operation of the punch it is possible that the operator might release switch 160 at any time during the cycling of the punch. The contacts 161D which are closed to provide a holding circuit for relay 161 from buss 149 over diode 162 make certain that the perforator will complete the existing perforating cycle of operation regardless of when switch 160 (and 141) is released. Upon the completion of the cycle cam 148 will open contacts 147 to cause the de-energization of relay 161 and place the circuit in its original condition.

The perforator is well suited for use with an accounting or similar-type machine as the source of input informa-

tion. Accounting machines adapted for controlling a tape perforator and including coded electrical readout means are well known in the art and therefore the details of such a machine are not included herein. As seen in FIG. 2 an accounting machine having a readout and encoding mechanism is shown in block form at **169**. To render the accounting machine operable to control the perforator of the present invention, manual switch **170** is closed. Therefore contacts **170A** complete the circuit from buss **149** to the accounting machine, contacts **170B** in the circuit from terminal **136** to solenoid **146** are closed, and contacts **170C** in the circuit extending from buss **149** to solenoid **144** are opened. The switches **153** and **154** which control the operability of the two tape feed devices are advantageously controlled by separate operation control keys on the accounting machine so that the switches **153** and **154** are set in accordance with the recording program desired.

When an amount has been set in the accounting machine readout mechanism, the switch **171** is closed by mechanism in the accounting machine and held closed till the end of the perforating operation. Therefore potential will be applied from terminal **136** over switch **171**, contacts **170B**, contacts **144A**, and the cam-controlled contacts **143** to relay **146**. Thereafter the operation of the perforator will be substantially the same as described above in connection with the operation of the tape feed key **169**. That is, since contacts **170C** are opened relay **144** will not be energized and contacts **144A** will not be transferred to break the circuit to relay **146**. Accordingly each time cam **148** closes contacts **147** a pulse will be applied through the accounting machine readout and encoder mechanism to the interposer control solenoids **21** as well as to the selected feed control solenoids **97** and **107**. As is common in the art the readout mechanism used with the accounting machine **169** may include a stepper switch and therefore the pulse applied from the terminal **136** may be used to advance the stepper switch. The readout mechanism is programmed so that when the contact of the stepper has completed its movement through each of the orders to be read out it will be advanced to a tape feed contact. This contact is connected to the terminal strips **151** through a plurality of diodes such as **150** to cause the tape feed code to be punched. Following the punching of the end-of-word or tape feed code the stepper in the readout mechanism of the accounting machine returns to its rest position and the switch **171** is opened.

The circuit illustrated in FIG. 2 is also adapted for use with a typewriter. As is well known in the art the operation of the keys on a typewriter can be used to close combinations of switches to provide an electrical readout of the typewriter to a recording mechanism such as a tape perforator. Since such readout devices are well known in the art a description thereof is not included herein, but the switches which are closed in combinations to represent a given character are illustrated in FIG. 2 as the readout switches **180**. A manual switch **181** is closed to render the typewriter operable for controlling the perforator, and such operation of switch **181** not only connects buss **149** to the typewriter readout switches **180** but also closes contacts **181A** in the circuit from terminal **136** to relay **146**. Thereafter the operation of a key on the typewriter will cause the contacts of switch **182** to be closed (such contacts **182** being held closed by the typewriter till the end of the punching operation). Accordingly the potential of terminal **136** will be applied over switch **182** and contacts **181A** to the relay **146** in the manner previously described. Thereafter the closing of contacts **147** in response to the rotation of the perforator shaft **37** will apply the potential of terminal **136** to the interposer solenoids **21** over the selected switches **180**. Since the circuit from buss **149** to relay **144** is not broken, relay **144** will be energized and contacts **144A** will be transferred. Therefore a single unit of information will be punched even though the typewriter key is held depressed. When the switch **182** is opened by release of the key relay **144** will be de-energized, and contacts **144A** will return to their initial condition. Thus another punching cycle of operation can be performed since relay **146** can again be energized.

Also seen in FIG. 2 is a "full" switch **184**, a switch **185** controlled by the tape supply reel, and a "broken tape" switch **186**. Normally these three switches are in the positions indicated in FIG. 2, and therefore the gas glow tube **187** is shunted. However if the takeup reel becomes full switch **184** closes, or if the supply of tape is depleted switch **185** closes, and hence the circuit extending from terminal **136** over switches **184**, **185** and **186** to resistor **188** and ground is opened so that tube **187** will be ignited. Similarly if switch **186** is transferrd in response to a tape break tube **187** will be ignited to provide an indication to the operator. Also as seen in FIG. 2, if any one of the three switches **184**, **185** or **186** is operated the potential of terminal **136** will be applied to relay **144** and therefore contacts **144A** will be transferred to prevent any further punching until the operated switch **184**, **185** or **186** has been reset.

Referring now to the timing chart of FIG. 3 it will be seen that contacts **143** are closed by cam **145** from 75° to 133° and from 255° to 313° as the main shaft **37** completes one rotation. Similarly the contacts **147** are closed from 0° to 43°, from 165° to 223°, and from 345° to 360° (there being an overlap of the closed condition of contacts **147** existing from 345° of one revolution to 43° of the next revolution). Since the potential of terminal **136** is applied to buss **149** only if the relay **146** in series circuit with contacts **143** is energized it will be seen that the repeated opening and closing of contacts **143** and **147** will have no effect on the apparatus unless one of the sets of contacts between terminal **136** and contacts **143** are closed during the time that the contacts **143** are closed.

Assuming for example that the switch **140** is operated during the interval from 75° to 133° and held closed until 165°, the relay **146** will remain energized at 165° so that contacts **146B** are closed. Thus it will be seen that at 165° the closing of contacts **147** will provide the positive potential of terminal **136** to buss **149** and hence relay **146** will be held energized over diode **159**. At 180° the interposer control bail starts to drive the interposers **14** and **15** forwardly and the solenoids **21** are effective to pull their associated latches **20** away from the interposers. Since the contacts **147** are closed until 223° the solenoids **21** remain energized until 223°. At this time the interposer bail allows the interposers **14** and **15** to move rearwardly under the urge of the springs **17**. Since the closing of tape feed switch **140** caused relay **161** to be energized, contacts **161B** were closed and each of the interposers (including the tape feed interposer **15**) will move rearwardly to a position of engagement with the punch driving bail **30** In the diagram of FIG. 3 the latches **20** are shown as being held in their operated positions after 223° even though contacts **147** open at 223°. This is due to the residual magnetism in the solenoid cores. However it should be noted that even though such latch **20** is not held by residual magnetism it cannot return to latching position since the interposers **14** move rearward at 223° and the solenoids require a short time to become de-energized.

At 216° the feed pawls start their drive motion, and since the selected solenoids **97** and/or **107** for the feed pawls are energized until 223° the selected feed pawls will move beyond their latching engagement with the clapper latches. Therefore the selected feed pawls will be effective to advance the selected tapes prior to approximately 270°. Therefore at 282° as the punch pins start their upward travel the tapes will have completed their feeding motion and hence be in position to receive the feed code. As the punch pins are driven upwardly a lug on the feed interposer **15** operates the knock-off bail **50** by approximately 295° and hence the latches

controlled by solenoids **21** are driven away from the solenoids. Since the interposers at this time are in their rearward positions the latches cannot move to latching positions but merely move into engagement with the interposers at points which are forward of their latching surfaces which engage lugs **20A**. The interposer control bail starts to restore the interposers to their forward positions slightly before the punch pins reach their points of maximum displacement and such forward movement of the interposers brings them back to their initial positons at 360°. At that time the interposer latches are spring urged to their home positions of latching engagement with the interposers.

From the above it will be seen that the tape feed code will be punched in response to the closing of contacts **140** and **141**. As seen from FIG. 2 the relay **144** was energized in response to buss **149** being energized and therefore contacts **144A** were transferred at 165°. Therefore from 165° on the only holding circuit for relay **146** is through contacts **147**. Accordingly at 223° when contacts **147** are opened relay **146** is de-energized. Relay **144** remains energized if switch **140** is held closed since contacts **144A** were transferred to line **155** and therefore even though contacts **143** are again closed at 255° relay **146** will not be re-energized. Since buss **149** can only be energized when contacts **146B** controlled by relay **146** are closed, no further punching can occur until contacts **140** are opened. Accordingly a single tape feed code is punched.

From the above it will be seen that if the relay **144** is not energized (as for example when the continuous tape feed switch **160** is closed) the contacts **144A** are not transferred. Accordingly the relay **146** remains energized over its self-holding contacts **146A**, the contacts **144A**, and contacts **161A**. Therefore contacts **146B** remain closed and buss **149** is repeatedly pulsed with the positive potential of terminal **136** as the contacts **147** open and close. A punching cycle of operation will therefore be performed during each 180° of rotation of shaft **37**.

Since contacts **147** are closed from 345° to 43° (and from 165° to 223°) it will be seen that if an interposer latch **20** operated for the operation occurring between 180° and 360° is to be again released for the next punching operation occurring between 360° and 180°, then said latch would be operated at 345° when contacts **147** re-close rather than first moving to latching position as indicated by the solid curve for latches **20** in FIG. 3. This is indicated by the dotted lines. Thus the perforator will repeatedly punch the selected information into the tape or tapes. It should be noted that the timing of the drive of the feed pawls with respect to the movement of the punch pins in connection with the closing of contacts **147** is such that the feed operation is completed prior to the time that the punch pins are driven through the tapes. Therefore the closing of the tape selection switches **153** and **154** can be made during the cycle of operation in which a unit of information is being punched.

Since the various elements in the perforator as well as the timing contacts **143** and **147** are under the positive control of the main shaft **37** and the cams thereon, the perforator can be operated at a relatively high speed. Therefore the length of time which the switch or switches such as **140** or **182** must be held closed is very short. For example when the shaft **37** is rotating at a constant speed of 1800 r.p.m. (corresponding to a punching speed of 60 per second) each degree on the timing diagram of FIG. 3 is equal to slightly less than 0.1 milliseconds. The longest time that the switch **140** would have to be held would occur in the case where the switch is closed immediately after 133°. In such a case the switch would have to be held until 345° or a maximum of 212°. This corresponds to slightly less than 20 milliseconds. This time would of course be decreased as the speed of the shaft **37** is increased. When the perforator is used with an accounting machine readout having a stepper switch arrangement for controlling the application of code combinations to the terminal strips **151**, the stepper solenoid can advantageously be controlled directly by the potential on buss **149**. Therefore the perforator and the stepper switch will be certain to be in synchronization as the various orders of the accounting machine are read out.

From the timing chart of FIG. 3 it will be seen that following the punching of a first unit of information provided by the accounting machine **169**, each subsequent 180° of rotation of shaft **37** will be a perforating cycle of operation until all of the units of information have been read out. That is, if the first unit of information is punched between 180° and 360° the signals applied to the control solenoids can be released any time after 223° since at that time the interposers **14** which must be moved rearwardly for the perforating cycle of operation have already been released and are beyond control of the solenoid latches **20**. Thus a new code combination can be established for the next unit of information. Accordingly when switch **147** closes at 345° the next unit of information corresponding to the code established by the encoder will be applied to solenoids **21** and the feed control solenoids will be energized. Therefore a punching cycle of operation will occur between 360° and 180°. The last step on the readout and encoder mechanism is preferably an end-of-word or tape feed code. Since each of the interposers and the feed pawls are restored to their latched positions at the end of a perforating cycle (that is at the end of each 180° rotation of shaft **37**) the continued rotation of shaft **37** following the punching of the last unit of information has no effect on the tape or tapes.

There has thus been described an improved perforating apparatus having a continuously rotating driveshaft and including an improved control circuit therefor. The control circuit not only allows continuous rotation of the driveshaft but also permits high speed operation since each 180° of rotation of the driveshaft can be utilized as a perforating cycle of operation without requiring wasted rotation of the driveshaft to reset the circuit. The disclosed arrangement merely represents a preferred embodiment of the invention, and thus the following claims are intended to include those modifications which will readily appear to one skilled in the art.

What is claimed is:

1. A tape perforator comprising in combination: a main driveshaft, a plurality of punch pins movable from first to second positions to perforate record material; a plurality of interposer elements; an interposer control bail coupled with said shaft and movable between first and second positions; a plurality of spring elements engaged with said interposer elements adapted to urge each interposer element into engagement with said bail, whereby each interposer element will be urged to move from a first to a second position as said bail moves from its first to its second position; a plurality of interposer control solenoids each associated with one of said interposer elements and adapted to normally prevent movement of the associated interposer element to its said second position; a sprocket wheel supported for rotation and engageable with the perforated tape; a ratchet wheel secured to said sprocket wheel; a tape feed pawl; a feed pawl control solenoid adapted to control the engagement of said pawl with said ratchet wheel; means establishing first and second points of reference potential; first and second switch means connected in series circuit with each of said solenoids between said points of reference potential; first cam means driven by said shaft for controlling the condition of said first switch means; a relay and third switch means connected in series circuit between said points of reference potential, said relay being adapted to control said second switch means; second cam means secured to said shaft adapted to control the

conditon of said third switch means, and circuit means connecting said relay in series circuit with said first and second switch means between said points of reference potential.

2. A tape perforater as defined in claim 1 and including a second relay connected in series circuit with said first and second switch means between said points of reference potential, and fourth switch means controlled by said second relay connected in series circuit with said first relay and said third switch means.

3. A tape perforator as defined in claim 2 and including a holding circuit for said second relay which includes said fourth switch means.

4. A tape perforator comprising in combination: a drive shaft, a plurality of punch pins, punch pin driving means operated by said shaft, a plurality of interposers having first and second positions and operative when in said second positions to couple said pins with said pin driving means, a plurality of latches adapted to hold said interposers in their said first positions, means urging said interposers toward their said second positions, interposer control means coupled with said shaft adapted to move each interposer from its second to its first position, a plurality of interposer control solenoids each adapted upon energization to operate one of said latches, record feed means, a feed control solenoid adapted to control said feed means, first and second switch means connected in series circuit between each of said solenoids and a source of operating potential, a first relay, circuit means including third switch means connecting said relay to a source of operating potential, said relay being adapted to control said second switch means, means operated by said shaft for controlling said first and third switch means, and a diode connecting said relay in series circuit with said first and second switch means.

5. A tape perforater and control circuit therefor comprising in combination: a driveshaft, power means adapted to continuously rotate said shaft, a plurality of record perforating elements adapted to be selectively coupled with said shaft for reciprocation between first and second positions, a plurality of solenoids connected in parallel circuit arrangement and each adapted to control an element in said perforator, first and second switch means connected in series circuit between said solenoids and a source of operating potential, a first relay controlling said second switch means, third switch means connected to said relay, selectively operable means adapted upon operation to connect said third switch means to said source of operating potential, mechanical means operated by said shaft for controlling the condition of said first and said third switch means, and circuit means establishing a holding circuit for said relay over said first and second switch means.

6. A control circiut as defined in claim 5 including fourth switch means connected in parallel with said third switch means and controlled by said relay, and wherein said first and third switch means are closed during mutually exclusive time intervals during the rotation of said shaft.

7. A control circuit as defined in claim 6 and including a second relay connected in series circuit with said first and second switch means, and fifth switch means connected in series circuit with said third switch means and controlled by said second relay.

8. A control circuit as defined in claim 7 including sixth selectively operable switch means connected in series circuit with said third and fifth switch means, and circuit means defining a holding circuit for said second relay over said fifth and sixth switch means when said second relay is energized.

9. A control circuit as defined in claim 8 and including seventh switch means connected between said second relay and said first and second switch means, said seventh switch means being simultaneously operable with said sixth switch means.

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