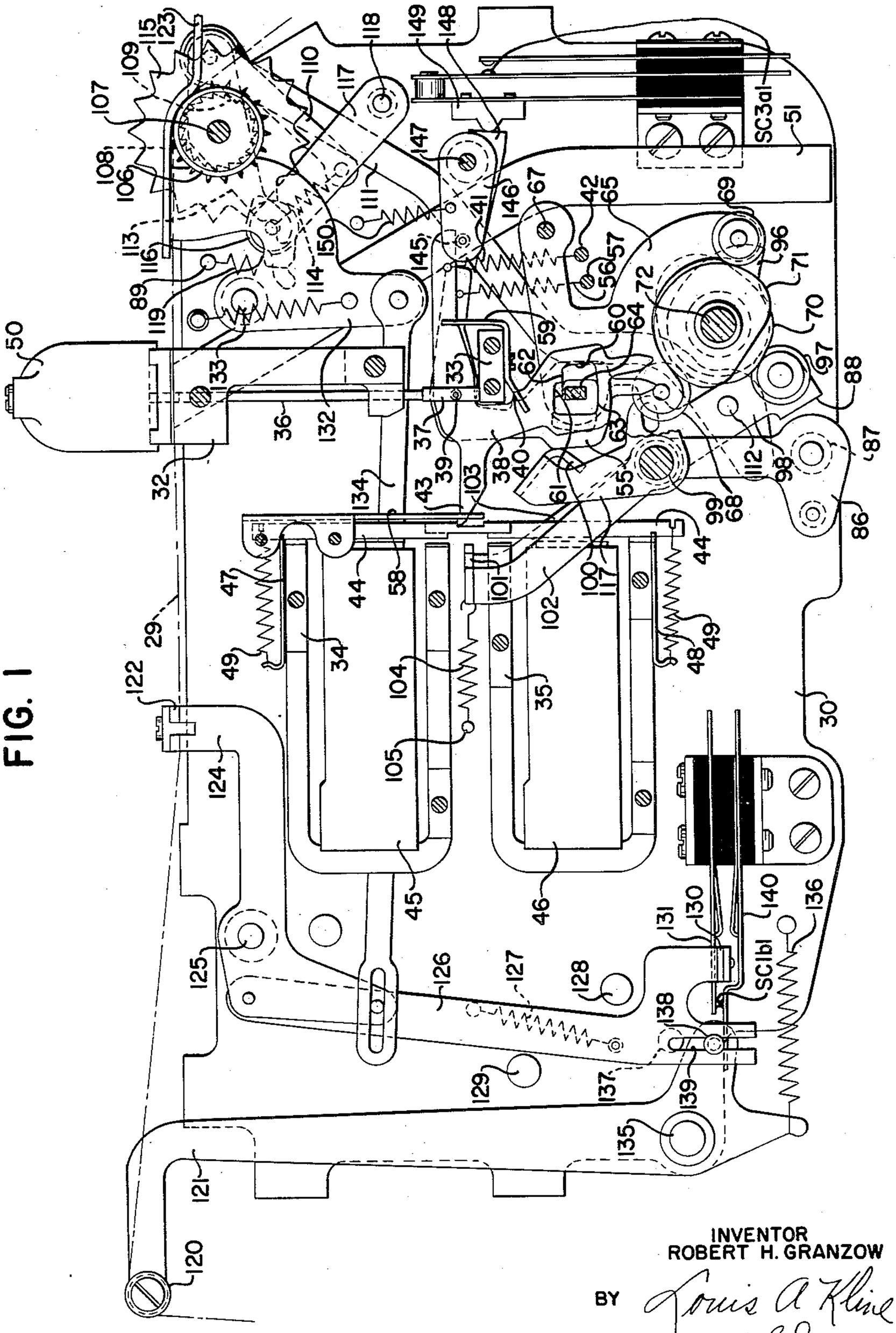
Sept. 20, 1960 R. H. GRANZOW 2,953,203

PERFORATING APPARATUS

Filed Feb. 6, 1957 4 Sheets-Sheet 1

FIG. 1



INVENTOR
ROBERT H. GRANZOW

BY Louis A Kline
Albert L. Sessler, Jr

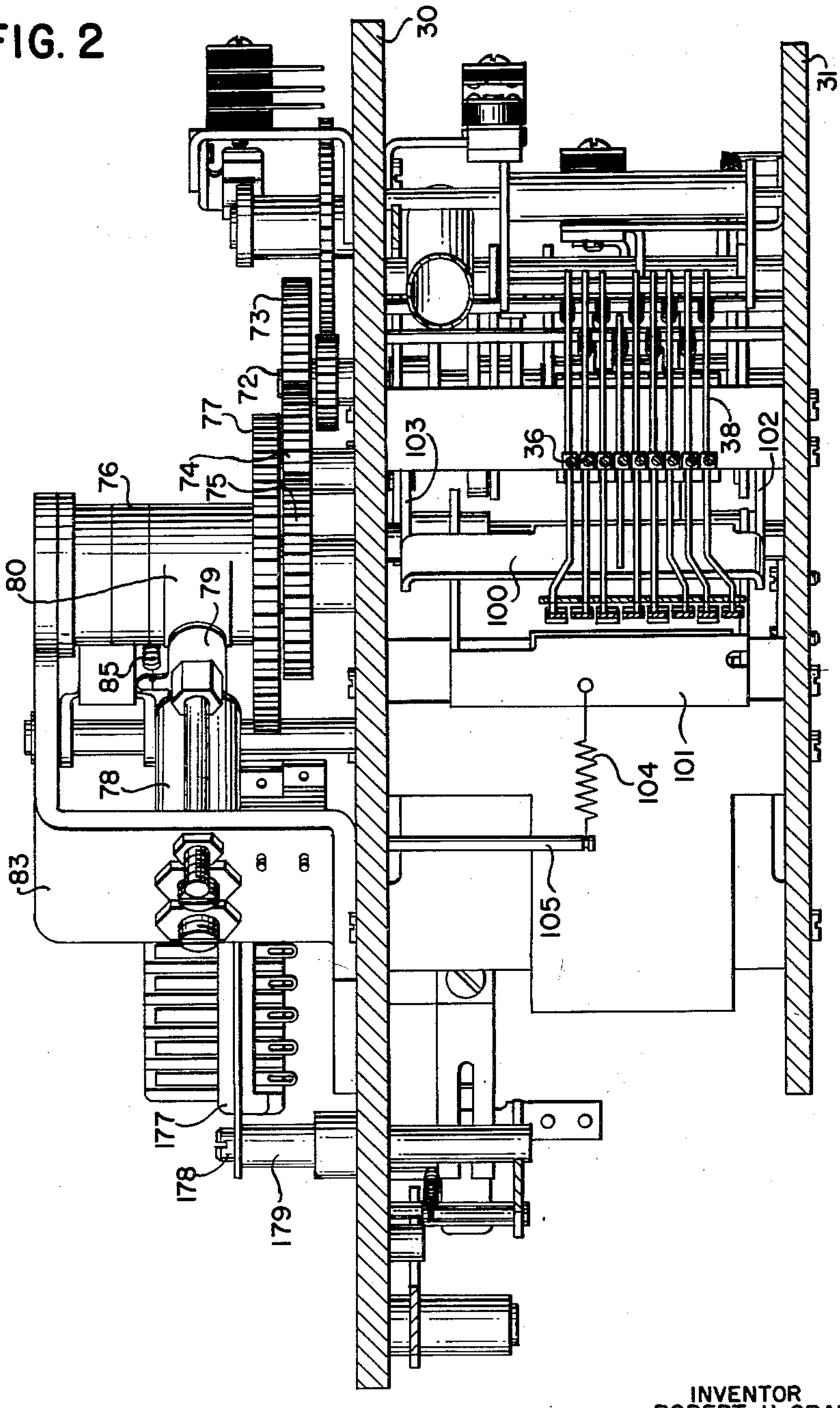
HIS ATTORNEYS

Sept. 20, 1960 R. H. GRANZOW 2,953,203

PERFORATING APPARATUS

Filed Feb. 6, 1957 4 Sheets-Sheet 2

FIG. 2



INVENTOR
ROBERT H. GRANZOW
BY Louis A Kline
Albert L. Sessler, Jr
HIS ATTORNEYS

Sept. 20, 1960 R. H. GRANZOW 2,953,203

PERFORATING APPARATUS

Filed Feb. 6, 1957 4 Sheets-Sheet 3

FIG. 3

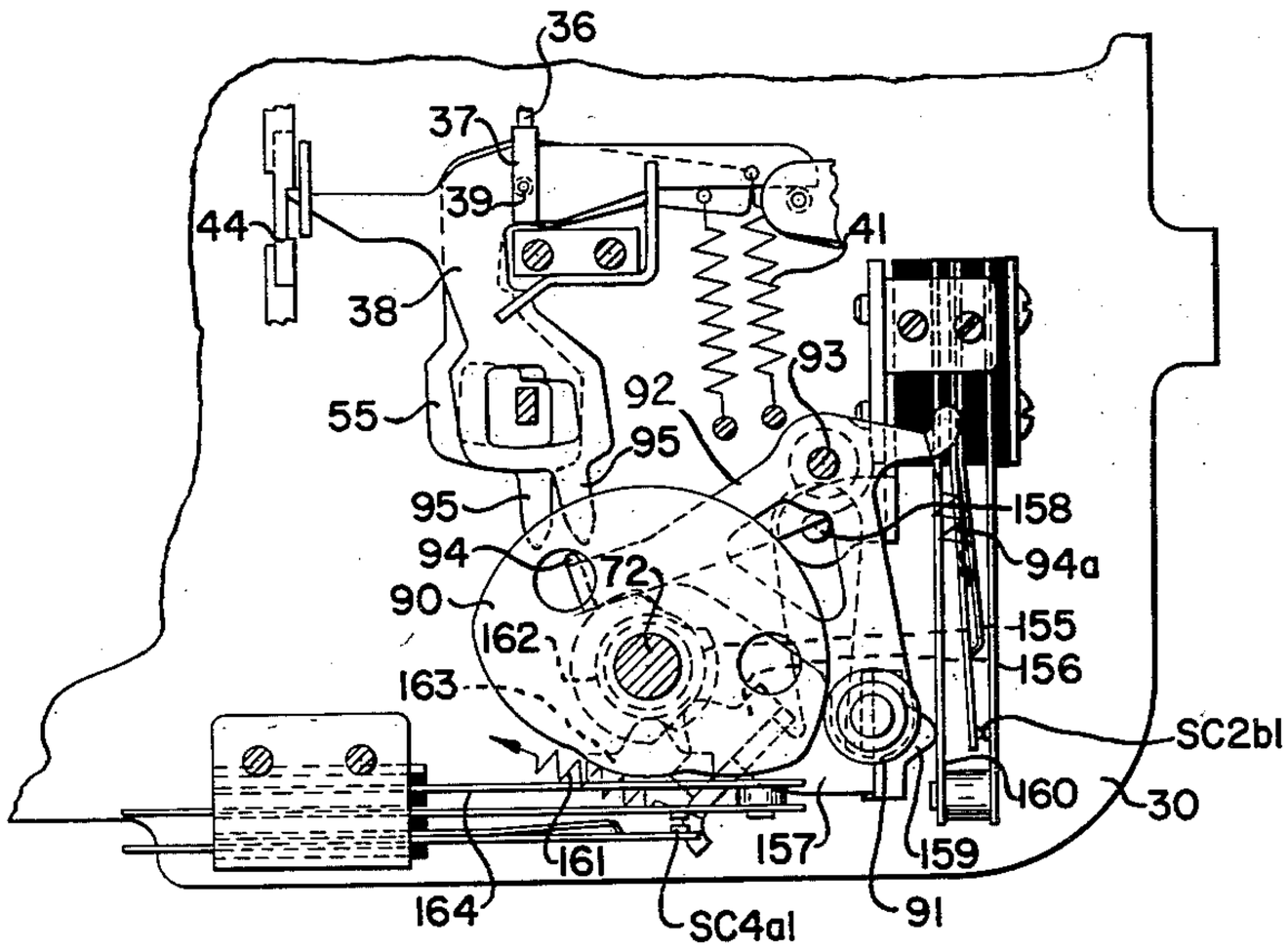
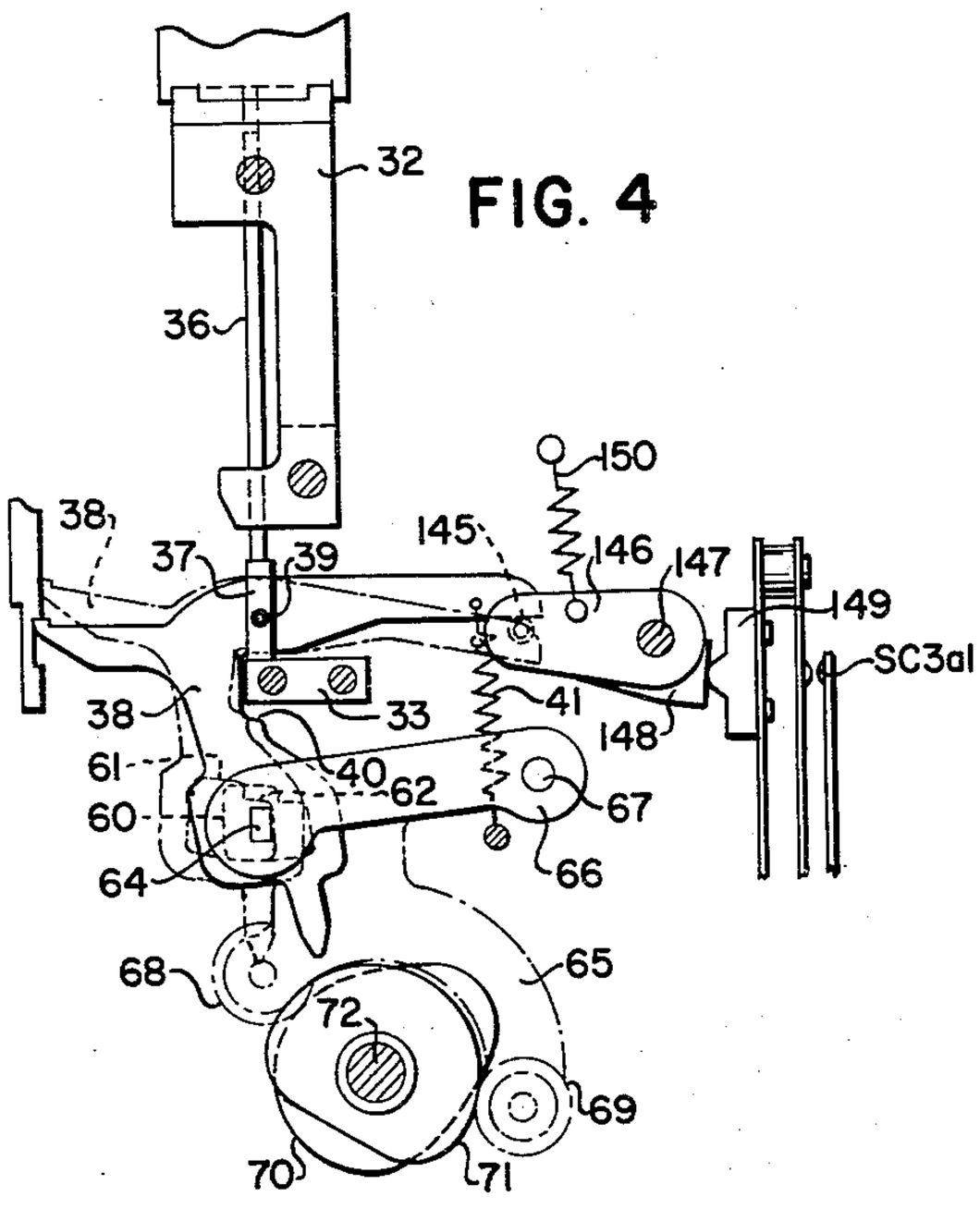


FIG. 4



INVENTOR
ROBERT H. GRANZOW

BY Louis A Klein
Albert L. Sessler, Jr.

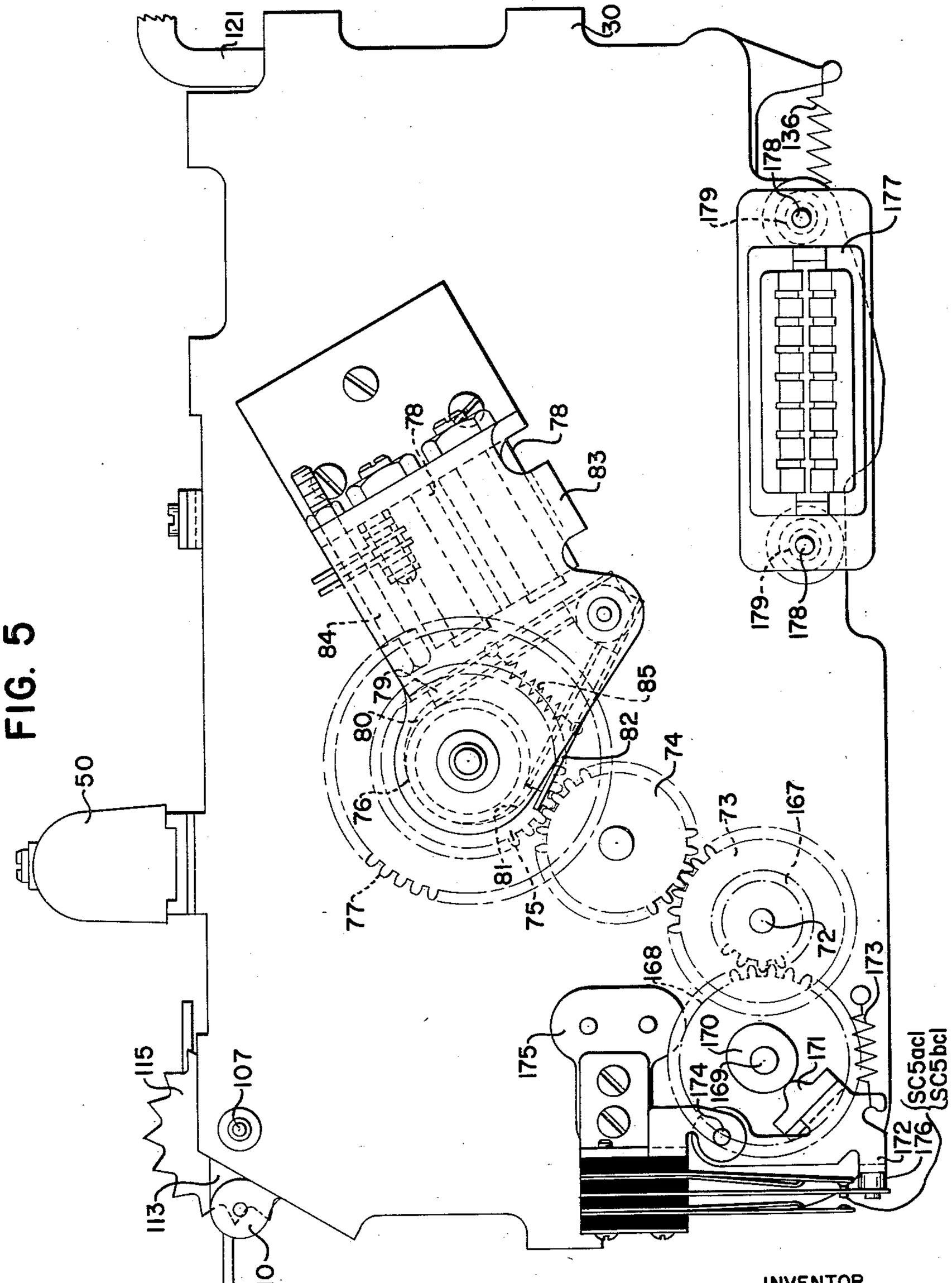
HIS ATTORNEYS

Sept. 20, 1960 R. H. GRANZOW 2,953,203

PERFORATING APPARATUS

Filed Feb. 6, 1957 4 Sheets-Sheet 4

FIG. 5



INVENTOR
ROBERT H. GRANZOW

BY Louis A Kline
Albert L. Sessler, Jr.

HIS ATTORNEYS

United States Patent Office

2,953,203

Patented Sept. 20, 1960

2,953,203

PERFORATING APPARATUS

Robert H. Granzow, Miamisburg, Ohio, assignor to The National Cash Register Company, Dayton, Ohio, a corporation of Maryland

Filed Feb. 6, 1957, Ser. No. 638,558

11 Claims. (Cl. 164—111)

This invention relates to an improved type of punching mechanism for use in data-recording devices.

The punch mechanism of the present invention may be used in many different types of recording devices, such as commonly form a part of business systems for the recording and integration of large volumes of data.

In its illustrated embodiment, the punch mechanism is controlled by electromagnetic means which are responsive to data entered into the recording device, of which the punch mechanism forms a part, by a data input machine such as a cash register, an adding machine, an accounting machine, and/or a media reader. For a detailed description of a representative data-recording system in which the punch mechanism of the instant invention might be used, reference may be had to the United States patent application Serial No. 550,728, of Elmer A. Gerdemann, inventor, filed December 2, 1955, now United States Patent No. 2,896,713, issued July 28, 1959. Driving means for the punch mechanism consists of a normally-operating electric motor to which the punch mechanism is selectively connected by a single-revolution clutch. The record material normally employed is a paper tape on which the punch mechanism operates to punch data according to a predetermined code. The electromagnetic control means selectively release punch drive pitmans for movement into a position in which they will be positively driven by driving means to cause the corresponding punch to perforate the paper tape. Said driving means are driven by cam means which in turn are driven by the electric motor through the single-revolution clutch.

It is an object of this invention to provide a simple and efficient punch mechanism.

Another object of the invention is to provide a punch mechanism in which the punch drive pitmans are selectively moved from a first position, in which they will not be driven by a cyclically-operable punch-driving means, to a second position, in which they will be driven by said driving means to effect punch operation.

A further object of the invention is to provide a punch mechanism in which alining means are provided to hold the punch drive pitmans in their respective positions during a punching cycle.

An additional object is to provide positive means for preventing movement of those punch drive pitmans which are not selected for operation during a punching cycle.

Still a further object is to provide a punching mechanism in which the minimum number of parts consistent with efficient, dependable operation is provided.

Still another object is to provide positive means for the return of the operated punches and punch drive pitmans to normal, or initial, position after punching during each punch cycle.

With these and incidental objects in view, the invention includes certain novel features of construction and combinations of parts, a preferred form or embodiment of which will hereinafter be described with reference to the

drawings which accompany and form a part of this specification.

In the drawings:

Fig. 1 is a side elevation of the novel punching mechanism.

Fig. 2 is a top detail view of the punch mechanism.

Fig. 3 is a detail view showing the cam-controlled alining means for the drive pitmans and also showing certain cam-operated switches.

Fig. 4 is a detail view showing the drive pitmans and associated mechanism.

Fig. 5 is a side elevation showing the single-revolution clutch and driving gear train for the punching mechanism.

Two side frames **30** and **31** (Fig. 2) form the main supporting means for the novel punching mechanism of the instant invention. The frames **30** and **31** are held in fixed spaced-apart relationship by a number of cross members, including a punch support block **32** (Fig. 1), a pitman-retaining block **33**, and magnet supporting members **34** and **35**.

Slidably mounted for vertical reciprocating movement in the support block **32** are a plurality of punches **36**. In the illustrated embodiment, nine punches **36** (Figs. 1 and 2) are shown alined in a vertical plane perpendicular to the frame members **30** and **31**, one punch for punching sprocket holes in the recording tape **29**, and eight others corresponding to the eight channels of the form of recording tape which it is contemplated will be used with the embodiment shown of the punching mechanism. It will, however, be obvious that any desired number of punches could be provided, according to the code and the width of the tape employed.

The chaff resulting from perforation of the tape **29** is caught in a housing **50** and subsequently is carried through a chaff chute **51** to a suitable receptacle (not shown).

Each punch **36** terminates at its lower end in a bifurcated member **37**, which embraces a pitman **38**. The member **37** and the pitman **38** are pivotally connected by a pin **39**.

The lower edges of the bifurcated members **37** for each of the punches **36** normally rest upon the upper surface of the retaining block **33** to support the connected punch **36** and pitman **38**. A shoulder **40** on each pitman **38** coacts with the lower surface of the block **33** to prevent upward movement of the pitmans **38** when said pitmans are in the position in which they are shown in Fig. 1. A spring **41**, secured between each pitman **38** and a rod **42**, which extends between the frame members **30** and **31**, urges the pitman **38** clockwise about the pin **39**, as viewed in Fig. 1. The pitmans **38** are normally retained in the position in which they are shown in Fig. 1 against the force of the springs **41** by means of fingers **43** on said pitmans, which cooperate with notches in armatures **44** of punch-selecting magnets such as **45** and **46**.

The armatures **44** are fulcrumed on the edges of plates **47** and **48**, secured to the members **34** and **35**, and are urged into engagement with the fingers **43** by means of springs **49**, extending between the armatures and corresponding hooks on the plates **47** and **48**. It will be seen that energization of any of the punch-selecting magnets such as **45** or **46** will cause the corresponding armature **44** to be shifted to the left, as viewed in Fig. 1, out of engagement with its related finger **43** of the pitman **38**, thus freeing said pitman for clockwise movement, as viewed in Fig. 1, under the influence of the spring **41**.

An additional pitman **55**, which controls the punch for punching sprocket holes in the tape, is similar to the pitmans **38**, except that it is not provided with a finger **43** and normally is held in the position in which it is shown in Fig. 1 by a spring **56** extending between the pitman **55** and a rod **57**.

All of the pitmans **38** and the pitman **55** are retained

in their proper side-by-side, spaced-apart relationship by means of two comb plates **58** and **59**. The comb plate **58** is mounted on and extends between the frames **30** and **31** and coacts with the fingers **43** of the pitmans **38**, while the comb plate **59** is secured to the block **33** and is slotted along its upper and lower edges to cooperate with corresponding portions of the pitmans **38** and the pitman **55**.

Each of the pitmans **38** and **55** has an enlarged lower portions to accommodate a cut-out **60**, which forms an idling space **61**, an upper driving surface **62**, and a lower driving surface **63**. A driving bar **64** extends through all of the cut-outs **60** and is secured at its ends to two companion plates, one of which is shown at **65** in Fig. 1, and the other of which is shown at **66** in Fig. 4, rotatably mounted on a shaft **67**, which is journaled in the side frames **30** and **31**.

A pair of rollers **68** and **69** are rotatably mounted on the plate **65** and are arranged to coact with a pair of cams **70** and **71**, respectively, fixed to a cam shaft **72**, journaled in the frames **30** and **31**. Rotation of the cam shaft **72** causes rocking of the plates **65** and **66** and the driving bar **64**, to effect shifting of the pitman **55** and selected ones of the pitmans **38**, as will be described subsequently.

At one end, the cam shaft **72** extends through the frame **30** (Figs. 2 and 5) and has fixed thereto a gear **73**, which is driven through an idling gear **74** by a gear **75**, fixed to the output of a single-revolution-type clutch **76**. A gear **77**, secured to the input of the clutch **76**, is driven through a gear train (not shown) by a motor (not shown), which is constantly in operation whenever the recording system, with which the punching mechanism is associated, is operating. When the clutch **76** is tripped, the motor will be connected, through the above-described gear train, to the cam shaft **72** of the punching mechanism to cause the cam shaft to make one complete rotation. Two punch clutch trip magnets **78** are provided and, when energized, will remove a block **79** from engagement with a projection **80** on the clutch to allow the clutch to operate to drive the punching mechanism. A stop **84** is provided to limit the clockwise movement (Fig. 5) of the block **79**. A second projection **81** on the clutch **76** cooperates with a second block **82** to prevent retrograde movement of the clutch. The blocks **79** and **82** are interconnected by means of a spring **85**. At one end, the clutch is journaled in the frame **30**, and at its other end it is journaled in a bracket **83**, secured to the frame **30**. The bracket **83** also serves as mounting means for the clutch magnets **78** and the associated clutch-operating mechanism.

The punch clutch trip magnets **78** are energized each time one or more of the pitmans **38** is released. A bail **145** (Fig. 1) extends across the pitmans **38** and is carried by a pair of arms **146** pivoted on a rod **147** mounted in the frames **30** and **31**. One of the arms is formed with an extension **148**, which coacts with a block **149** to operate contacts SC3*al*. When any one of the pitmans **38** is rocked, upon its release by its related armature **44**, it will rock the bail **145** counter-clockwise, against the force of a spring **150**, secured thereto, to close the contacts SC3*al*, which are in an operating circuit for the punch clutch trip magnets **78**. This will energize the magnets **78** to render the clutch effective to connect the motor to the cam shaft **72** to drive it through one complete rotation. The contacts SC3*al* remain closed from 0 degrees to 190 degrees of the rotation of the cam shaft **72**.

Means are provided for positively alining and holding the pitmans **38** and **55** in the positions in which they have been disposed while the actual tape-punching operation takes place. As shown in Fig. 3, a cam **90** on the cam shaft **72** cooperates with a roller **91** on an alining member **92** to rock said member in regularly-excursioned movement during each cycle of operation of the punching mechanism. The member **92** is rotatably mounted on a shaft **93**, journaled in the frames **30** and **31**, and includes an aliner **94**, positioned to coact with fingers **95**, formed at the lower end of each of the pitmans **38** and **55** and

urged clockwise, as viewed in Fig. 3, by a spring **94***a*, connected between the aliner **94** and a stud (not shown) on the frame **31**. The configuration of the cam **90** is such that the aliner **94** is out of the path of movement of the fingers **95** during the time that some of the pitmans **38** are being released by the armatures **44** and rocked by the springs **41** to the dotted-line position of Fig. 4. The cam **90**, however, permits the aliner **94** to be shifted upwardly by the spring **94***a* to be positioned in the path of movement of the fingers **95** during the time that the selected pitmans **38** and their related punches **36** are being shifted upwardly by the driving bar **64** to punch the tape with the desired information.

A cam **96** (Fig. 1), fixed to the cam shaft **72**, coacts with a roller **97** on an arm **98** rotatably mounted on a shaft **99** journaled in the frames **30** and **31**. Integral with the arm **98** and a second arm **117**, rotatably mounted on the shaft **99**, is a restoring plate **100**. Near the end of each cycle of operation of the punch mechanism, the cam **96** coacts with the roller **97** to rock the arm **98**, its companion arm **117**, and the plate **100** clockwise, as viewed in Fig. 1. The plate **100** coacts at this time with the pitman **55** and with those pitmans **38** which have been released by their related armatures **44** and rocked clockwise by the springs **41**, to shift said pitmans counter-clockwise. The fingers **43** of the pitmans **38** so rocked are thereby caused to re-engage the notches of their related armatures to retain said pitmans in the position in which they are shown in Fig. 1. Since the sprocket hole pitman **55** has no finger **43**, its movement under the influence of the restoring plate **100** will be merely an idle one, and the pitman **55** will be returned by the spring **56** to the posititon in which it is shown in Fig. 1 when the plate **100** moves back to its normal position.

Means operable near the end of each cycle of operation are provided to insure that the armatures **44** for the punch-selecting magnets are returned to the positions in which they are shown in Fig. 1 for engagement of the notches therein with the fingers **43** of the pitmans **38**. Normally, the springs **49** accomplish this function, but it is desirable to have a return mechanism for the armatures **44** in the event that one or more should remain stuck to a magnet after deenergization of said magnet due to residual magnetism, or the failure of one of the springs **49**.

A restoring bail **101**, positioned to coact with the armatures **44** to restore them to the position in which they are shown in Fig. 1 at the conclusion of each cycle of operation, is formed integral with two arms **102** and **103** rotatably mounted on the shaft **99**. The bail **101** and the arms **102** and **103** are normally held in the position in which they are shown in Fig. 1 by a spring **104**, connected between the bail **101** and a rod **105**, fixed to the frame **30**. An extension **86** of the arm **102** is provided with a pin **87**, positioned in the path of movement of a surface **88** on the arm **98**. As the arm **98** is shifted by the cam **96** during each cycle of punch operation, the surface **88** coacts with the pin **87** to shift the arms **102** and **103** and the bail **101** clockwise, as viewed in Fig. 1, about the shaft **99**. During this movement, the bail **101** contacts any armatures **44** which are stuck in their operated position and returns them to the position in which they are shown in Fig. 1.

A tape-feeding pinwheel **106** (Fig. 1) is fixed on a shaft **107** journaled in the frames **30** and **31** and has, in its periphery, pins which engage the feed holes in the tape to advance the tape after it is punched. A ratchet wheel **108**, also fixed on the shaft **107**, is advanced step by step by means of a tooth **109** on an arm **110** pivotally attached to the upper end of a feed link **111** pivotally secured at its lower end to the arm **98** by a pin **112**. Also pivotally secured to the upper end of the link **111** at the point of attachment of the arm **110** to said link is an arm **113** rotatably mounted on the shaft **107**. A spring **114** connects the free ends of the arms **110** and **113**.

During each cycle of operation of the punching mecha-

nism, as the arm **98** is rocked by the cam **96**, this movement is transmitted by the link **111** to the arms **110** and **113**, causing the arm **113** to be rocked clockwise about the shaft **107** and causing the arm **110** to be shifted downwardly. The tooth **109** on the arm **110** coacts with the adjacent tooth on the ratchet wheel **108** to carry said wheel one step in a clockwise direction, as viewed in Fig. 1, thus advancing the pinwheel **106**, and the paper tape with which it is normally engaged, one increment. During subsequent return movement of the arm **98**, the arm **110** is returned upwardly to the position in which it is shown in Fig. 1, the tooth **109** on said arm ratcheting past the adjacent tooth on the ratchet wheel **108**.

A detent wheel **115**, also fixed on the shaft **107**, cooperates with a roller **116** on an arm **117** to accurately position the pinwheel **106** and to prevent retrograde movement of said pinwheel and the ratchet wheel **108** during the upward return movement of the arm **110**, having the tooth **109** thereon. The arm **117** is pivotally mounted on a shaft **118**, fixed in the frame **30**, and is urged clockwise, as viewed in Fig. 1, by a spring **119**, connected between the arm **117** and a rod **89**, fixed in the frame **30**, to maintain the roller **116** in engagement with the detent wheel **115**.

Switch means associated with a punching mechanism are provided to effect the halting of punch operation in the event that tension on the tape becomes so great as to cause improper punching, or in the event of breakage of the tape. The operating mechanism for said switch will now be described.

In the recording apparatus, the tape will be guided from a supply roll (not shown) through various guiding elements (not shown) over a roller **120** (Fig. 1) on a tension control arm **121**, under a tape feeler **122**, through the punching section of the punching mechanism, over the pinwheel **106**, and under a cooperating pressure plate **123**, around additional guide means (not shown) to a take-up reel (not shown).

The tension control arm **121**, the tape feeler **122**, and the pressure plate **123** cooperate to open contacts SC1*bl* in an operating circuit for the punch clutch trip magnets **78** to prevent an operation of the punching mechanism under the following conditions, which would contribute to an improper punching of the tape.

The tape feeler **122** is carried by an arm **124**, which is pivoted on a stud **125**. With a supply of tape in the punching mechanism, the feeler **122** will be supported by the tape; but, as soon as the tape breaks or the end of the tape passes the feeler, the feeler will drop downwardly and rock the arm **124** clockwise (Fig. 1) about the stud **125**. The arm **124** is pivotally connected to a link **126**. A spring **127**, connected between the link **126** and the frame **30**, urges said link upwardly, as viewed in Fig. 1, and urges the arm **124** clockwise. Movement of the link **126** and the arm **124** under the influence of the spring **127** is limited by a stop member **128**, which coacts with a surface on said link. At its lower end, the link **126** is provided with an operating finger **130**, of insulating material, which is positioned to coact with the upper blade **131** of the contacts SC1*bl*. When the arm **124** rocks clockwise, it will pull the link **126** upwardly, thereby causing the finger **130** to carry the blade **131** upwardly to open the contacts SC1*bl*.

The contacts SC1*bl* are also opened when the pressure plate **123** is moved away from the pinwheel **106**. The pressure plate **123** is mounted on a lever **132** pivoted on a stud **133**, fixed on the side frame **30**. A link **134** is connected to the lever **132** and has a pin-and-slot connection with the arm **124**, so that, whenever the lever **132** is rocked to move the pressure plate **123** away from the pinwheel **106**, the link **134** will rock the arm **124** counter-clockwise to raise the feeler **122** above the tape. The counter-clockwise rocking of the arm **124** will shift the link **126** downwardly and cause the insulated finger **130** thereon to coact with the lower blade **140** of the contacts SC1*bl* to shift said lower blade downwardly, thereby opening the contacts SC1*bl*.

A further control of the contacts SC1*bl* prevents punching if there is too much tension on the tape and improper punching would result. The roller **120** is supported at the upper end of the arm **121**, which is pivoted on a stud **135**, fixed in the frame **30**, and is normally urged counter-clockwise, as viewed in Fig. 1, by a spring **136**, connected between the arm **121** and the frame **30**, to maintain a surface on the arm **121** in contact with a stop **137**, fixed in the frame **30**. A stud **138** is fixed in the lower portion of the arm **121** in such a position as to coact with the lower blade **140** of the contacts SC1*bl*. The stud **138** extends through a guide slot **139** in the link **126** and serves to limit sidewise movement of said link. If the feeding of the tape from the supply reel becomes blocked and the feeding of the tape by the pinwheel **106** continues, the tension on the tape will be increased and will shift the roller **120** to the right, as shown in Fig. 1, rocking the arm **121** clockwise. A stud **129**, fixed to the frame **30**, limits clockwise movement of the arm **121**. The stud **138**, in such an event, coacts with the extended lower blade **140** of the contacts SC1*bl* to open said contacts. As soon as the tension has been relieved, the spring **136** will return the arm **121** to its normal position and will allow the contacts SC1*bl* to reclose.

Additional mechanical switching means are provided on the punch mechanism for operation of switches used to perform various functions in the recording system.

A cam **155** (Fig. 3), fixed to the camshaft **72**, cooperates with a cam follower **156**, mounted on an arm **157**, which is pivoted on a stud **158**, fixed to the frame **30**, to operate a set of normally-closed contacts SC2*bl*. The arm **157** is normally urged clockwise, as viewed in Fig. 3, by a spring **161**, connected thereto, to maintain the follower **156** in engagement with the cam **155**. An operator **159**, fixed to the arm **157**, coacts with a blade **160** to cause the contacts SC2*bl* to open at approximately 36 degrees of the rotation of the camshaft **72** and to remain open until said shaft has completed approximately 192 degrees of its rotation. The contacts SC2*bl* are in the operating circuit for the punch clutch trip magnets **78** and serve to deenergize these magnets after rotation of the camshaft **72** has been initiated.

Another cam, **162** (Fig. 3), fixed to the camshaft **72**, coacts with an operator **163** to effect operation of the contacts SC4*al*. The operator **163** is fixed to a blade **164**, operatively connected to the contacts SC4*al*. These contacts are normally open and will be closed from 215 degrees to 310 degrees of rotation of the camshaft **72**. When a media reader or other means for reading perforated tags is employed in a recording system embodying the instant punching mechanism, the contacts SC4*al* serve to synchronize the operation of the media reader with the operation of the recorder. The contacts SC4*al* are located in the circuit to the media reader clutch trip magnet and serve to prevent a further operation of the media reader until the recording operation corresponding to the current operation of the media reader has commenced. One example of the manner in which the contacts SC4*al* might function would be in a situation where the punch clutch trip magnets **78** have been burned out or otherwise rendered ineffective. In this case, a rotation of the camshaft **72** could not be commenced, and the contacts SC4*al* would thereby prevent another operation of the media reader from taking place until the defective magnets **78** had been replaced.

If desired, the novel punch mechanism of the present invention may also be provided with a set of contacts SC5*acl* and SC5*bcl* (Fig. 5) for use in a sequential timing and checking circuit of the type disclosed in United States patent application, Serial No. 561, 866, of Edgar H. Sonnanstine, Jr., and Robert H. Granzow, inventors, filed January 27, 1956, now United States Patent No. 2,789,644, issued April 23, 1957. Such a device is employed to keep

a sequential stepping switch in a recorder in its correct phase relationship with the punching mechanism.

Secured to the camshaft **72** (Fig. 5) of the punching mechanism is a pinion **167**, which meshes with a gear **168**, secured on a shaft **169**, journaled in the frame **30**. Also secured on the shaft **169** is a cam **170**. Since the pitch diameter of the gear **168** is twice that of the pinion **167**, the cam **170** makes one half of a complete rotation each time the punching mechanism cycles. A cam follower **171**, fixed to an arm **172**, is positioned to coact with the periphery of the cam **170** and is retained in engagement with said cam by a spring **173**, secured to the arm **172** and to the frame **30**. The arm **172** is pivotally mounted by a stud **174** on a bracket **175**, secured to the frame **30**. Also fixed on the bracket **175** are the contacts SC5*acl* and SC5*bcl*, which are positioned to be controlled by an operator **176**, fixed to one end of the arm **172**. The configuration of the cam **170** is such that, during each cycle of the punching mechanism, one of the sets of contacts SC5*acl* and SC5*bcl* will open and the other will close, and, during the next succeeding cycle of the punching mechanism, the contacts which were closed in the previous cycle will be opened, and the contacts which were opened will be closed. For a detailed description of the manner in which the contacts SC5*acl* and SC5*bcl* perform a timing function, reference may be had to the previously-cited Patent No. 2,789,644.

A plug unit **177** (Figs. 2 and 5), connected to the frame **30** by means of studs **178**, and spaced therefrom by means of sleeves **179** on said studs, is normally used to connect the electrical circuit components of the punching mechanism of the present invention to the circuitry of the remainder of the recording system.

Operation

A brief description of the operation of the novel punching mechanism will now be made. As has been stated, a representative data-recording system in which this punching mechanism might be employed is shown in the previously-cited United States Patent No. 2,896,713. Therefore it will be assumed, for purposes of this explanation, that the system shown therein is used to control the punching mechanism described, and, for a detailed description of the manner in which the punching mechanism is controlled to perform its various functions, reference may be had to that application.

Assuming that power to the system has been turned on, and that said system is completely prepared for operation, the entry of data to the system, through a cash register or other data input device, according to a predetermined program, will cause a circuit to be completed to one or more of the punch-selecting magnets, such as **45** and **46** (Fig. 1). These magnets are thereby energized, causing the corresponding armatures **44** to be shifted to the left, as viewed in Fig. 1, releasing their related pitmans **38** for movement under the influence of the springs **41** to the dotted-line position in which they are shown in Fig. 4.

This movement of any of the pitmans **38** causes the bail **145** to be rocked counter-clockwise in the manner previously described, to close the contacts SC3*al*. The closing of the contacts SC3*al* completes a circuit for the energization of the punch clutch trip magnet **78** (Figs. 2 and 5), thereby coupling the camshaft **72** to the operating motor for the recorder for one complete rotation.

Soon after commencement of the cycle of punching operation, the aliner **94** is shifted by the spring **94***a* upwardly into operative position, in which it retains the selected pitmans **38** and the sprocket hole pitman **55** in a position in which they, together with their corresponding punches **36**, will be operated by the drive bar **64** in an upward direction.

Subsequently to the previously-described movement of the aliner **94**, the cams **70** and **71** coact with the corresponding rollers **68** and **69** to shift the drive bar **64** upwardly. Those pitmans **38** which have not been shifted from the position in which they are shown in Fig. 1 are not moved upwardly by the drive bar **64**, since the cut-out **60** of these pitmans has the idle space **61** positioned in the path of movement of the drive bar **64**, and the drive bar is, therefore, ineffective to move these pitmans. However, the selected pitmans which have been shifted to the dotted-line position of Fig. 4, as well as the sprocket hole pitman **55**, present their upper driving surfaces **62** in the path of movement of the drive bar **64**. As said drive bar moves upwardly in its regularly-excursioned movement, it contacts these surfaces **62** and carries the selected pitmans and their corresponding punches **36** upwardly with it. This upward movement of the selected punches **36** causes the paper tape to be perforated by them in the corresponding channels at the point at which it is positioned on the upper surface of the punch support block **32** directly over the line of punches **36**.

The pitmans **38** which have not been selected by energization of their punch-selecting magnets are positively prevented from being dragged upwardly through friction or some other cause, which might result in an erroneous punching, by their shoulders **40**, which are positioned to engage the lower edge of the pitman-retaining block **33**. On the other hand, the shoulder **40** of any pitman **38** which has been shifted to the dotted-line position shown in Fig. 4 is moved so that it will not engage the block **33** during the upward movement of said pitman and its associated punch **36**.

Continued rotation of the camshaft **72** causes the drive bar **64** to be returned downwardly and to carry the operated pitmans **38** and **55** down with it by contact of the lower edge of the drive bar **64** with the lower driving surface **63** of the cut-out **60** of each of the operated pitmans. A positive means is thus provided to return all of the pitmans and their associated punches to their lower position.

During continued revolution of the camshaft **72**, and after return of the drive bar **64** to its original position, the cam **90** (Fig. 3) rocks the arm **92** to cause the aliner **94** to move out of the position in which it retains the fingers **95** of the pitmans **38** and **55** against movement. With the aliner **94** out of the path of movement of the fingers **95**, the restoring plate **100** is caused to move clockwise to the right (Fig. 1) to coact with adjacent surfaces of the operated pitmans **38** and **55** to shift these pitmans from the dotted-line position shown in Fig. 4 to the solid-line position shown in Figs. 1 and 4. This return of the pitmans to their original unoperated position is effected by the cam **96** on the camshaft **72**, in cooperation with the roller **97** on the arm **98**, to which the restoring plate **100** is fixed.

Clockwise movement of the arm **98**, as viewed in Fig. 1, is also effective to cause the armatures **44** to be positively returned to their original positions by contact of the surface **88** on the arm **98** with the pin **87** on the extension **86**. This rocks the extension **86**, the arm **103**, with which it is integral, the arm **102**, and the restoring bail **101** clockwise about the shaft **99** and causes the restoring bail **101** to coact with the armatures **44** to positively return any of the operated armatures **44** to their original unoperated position, as shown in Fig. 1. Since the pitmans **38** have also been returned to their original unoperated position, as described above, the notches of the armatures **44** engage the fingers **43** on said pitmans and retain the pitmans **38** in the position in which they are shown in Fig. 1.

During this time, the paper tape is also advanced one increment by the tape-feeding means previously described. The clockwise movement of the arm **98** under the influence of the cam **96** shifts the link **111** and the arms **110** and **113**, in the manner previously described, to cause the pinwheel **106**, the ratchet wheel **108**, and the detent wheel **115**, all of which are fixed to the shaft **107**, to be advanced one step in a clockwise direction, as viewed in Fig. 1, to position a new section of paper tape opposite the ends of the punches **36** for perforation according to

the determined code and the data entered into the recording system.

During each punching cycle, the contacts SC2*bl*, SC4*al*, and SC5*acl* and SC5*bcl* are also caused to operate at a predetermined time in the manner previously described, to perform their respective functions in the operation of the data-recording system.

Since the punch clutch trip magnets **78** have been de-energized by the opening of the contacts SC2*bl* in the operating circuit for said magnets during the punching cycle, the block **79** (Fig. 5) will be returned by the spring **85** into the path of movement of the projection **80** on the clutch **76**. This will uncouple the recorder motor from the camshaft **72** to halt the punching mechanism after completion of a single cycle, unless another signal has been received from the data input means prior to the end of the cycle.

During normal operation of the recording system, in the recording of a program of information comprising more than one character, signals relating to each successive character are received from the data input means prior to the end of the punching cycle for the immediately-preceding character. This causes the contacts SC3*al* to be closed to reenergize the magnets **78** before the end of the cycle, thereby shifting the block **79** out of the path of movement of the projection **80** on the clutch **76**, so that the recorder motor and the camshaft **72** remain uninterruptedly coupled for another cycle of punch operation. The continuous coupling of the recorder motor and the camshaft **72** results in higher operating speed of the system and less wear on the punch mechanism, since no starting and stopping, with their attendant inertia effects, take place until punching of all of the information in a program has been completed.

While the form of the invention shown and described herein is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the one form or embodiment disclosed herein, for it is susceptible of embodiment in various other forms.

What is claimed is:

1. Punching apparatus comprising, in combination, a plurality of punch elements; a plurality of drive pitmans operatively connected to the punch elements; a cut-out portion in the pitmans including a driving surface and an idling space; control fingers on the pitmans; spring means urging the pitmans in one direction; shiftable retaining means normally engaged with the control fingers of the pitmans for holding said pitmans in a first position; means for controlling the shiftable retaining means, and operable to move selected ones of the shiftable retaining means out of engagement with the pitmans, thereby enabling the spring means to move the released pitmans from said first position to a second position; and cyclically operable operating means having a driving member extending through the cut-out portions of the pitmans and coacting during each punching cycle with the driving surface of those pitmans which have been shifted to said second position to drive those pitmans and their corresponding punch elements in a punch-operating movement to an operated position, said member at the same time moving in the idling space of the pitmans which remain in said first position and being therefore ineffective to drive the latter pitmans.

2. The punching apparatus of claim 1 in which the cut-out portion of the pitmans also includes a second driving surface located opposite the first-mentioned driving surface, the driving member coacting during a portion of each cycle with the second driving surface of those pitmans which have previously during the cycle been driven in a punch-operating movement to drive said pitmans in a return movement from their operated position.

3. The punching apparatus of claim 2 including a cyclically-operable pitman-positioning means for shifting the operated pitmans from said second position to said first position after they have been returned from their operated position.

4. The punching apparatus of claim 3 including means for advancing the record material to be punched past the punch elements.

5. The punching apparatus of claim 4 in which the record-material-advancing means is operated in unison with the pitman-positioning means.

6. The punching apparatus of claim 3 including means operable in unison with the pitman-positioning means for returning the shifted retaining means into engagement with their corresponding pitman control fingers.

7. The punching apparatus of claim 1 including a fixed retaining member; and complementary retaining surfaces on the retaining member and the drive pitmans cooperating so that, when the drive pitmans are in said first position, they are positively restrained against punch-operating movement, the movement of the pitmans from said first position to said second position being effective to move the retaining surfaces of the pitmans out of cooperative relationship to the corresponding surfaces on the retaining member to free said pitmans for subsequent punch-operating movement.

8. The punching apparatus of claim 1 including alining means operable during a punching cycle to hold the pitmans against movement from said first position to said second position and vice versa.

9. The punching apparatus of claim 1 in which the means for controlling the shiftable retaining means comprises a plurality of magnets.

10. Punching apparatus comprising, in combination, a plurality of punch elements; a plurality of operators positively connected to the punch elements, each of said operators having a driving surface thereon; spring means urging the operators in one direction; shiftable retaining means normally engaged with the operators for holding said operators in a first position; means for controlling the shiftable retaining means, and operable to move selected ones of the shiftable retaining means out of engagement with the operators, thereby enabling the spring means to move the released operators from said first position to a second position; actuating means partaking of regularly-excursioned movement for coaction with the driving surfaces of any of the operators which have been shifted from said first position to said second position for operation of the corresponding punch elements, the driving surfaces of those operators remaining in said first position being located out of the path of movement of the actuating means; a stop member; and surfaces on the operators arranged to coact with said stop member when the operators are in said first position to positively retain them against movement for operating their respective punch elements.

11. Punching apparatus comprising, in combination, a plurality of punch elements; a plurality of operators positively connected to the punch elements, each of said operators having a driving surface thereon; spring means urging the operators in one direction; shiftable retaining means normally engaged with the operators for holding said operators in a first position; means for controlling the shiftable retaining means, and operable to move selected ones of the shiftable retaining means out of engagement with the operators, thereby enabling the spring means to move the released operators from said first position to a second position; actuating means partaking of regularly-excursioned movement for coaction with the driving surfaces of any of the operators which have been shifted from said first position to said second position for operation of the corresponding punch elements, the driving surfaces of those operators remaining in said first position being located out of the path of movement of the actuating means; and alining means which are operative during a punching operation to hold the operators

against movement from said first position to said second position and vice versa.

References Cited in the file of this patent

UNITED STATES PATENTS

458,990	Lewis	Sept. 1, 1891
734,496	Ames	July 28, 1903
763,038	Ball	June 21, 1904
770,655	Reynders	Sept. 20, 1904
1,650,411	Yates	Nov. 22, 1927
1,963,313	Richardson	June 19, 1934
2,131,601	Taub	Sept. 27, 1938
2,204,405	Dunlap	June 11, 1940
2,737,241	Doty	Mar. 6, 1956
2,775,300	Hoffman	Dec. 25, 1956

FOREIGN PATENTS

297,466	Germany	Apr. 21, 1917