Oct. 31, 1961 T. GASSINO ET AL 3,006,537

TAPE PUNCHING APPARATUS FOR ACCOUNTING MACHINES AND THE LIKE

Filed April 4, 1958 3 Sheets-Sheet 1

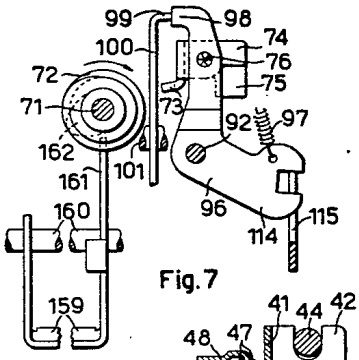


Fig. 7

Fig. 1

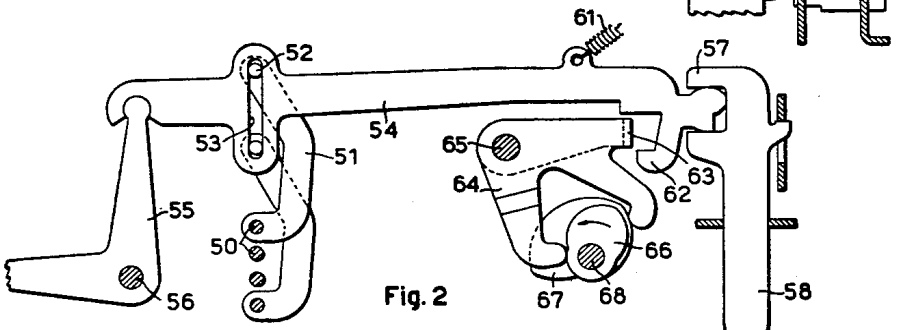


Fig. 2

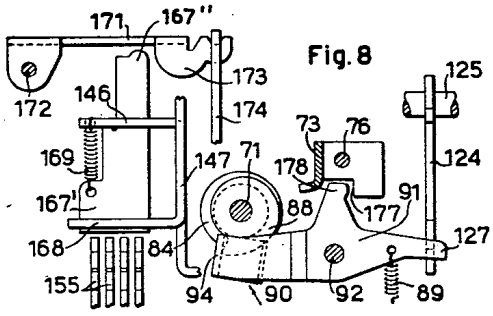
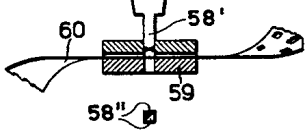


Fig. 8



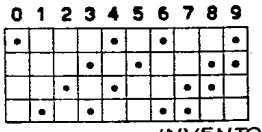


Fig. 3

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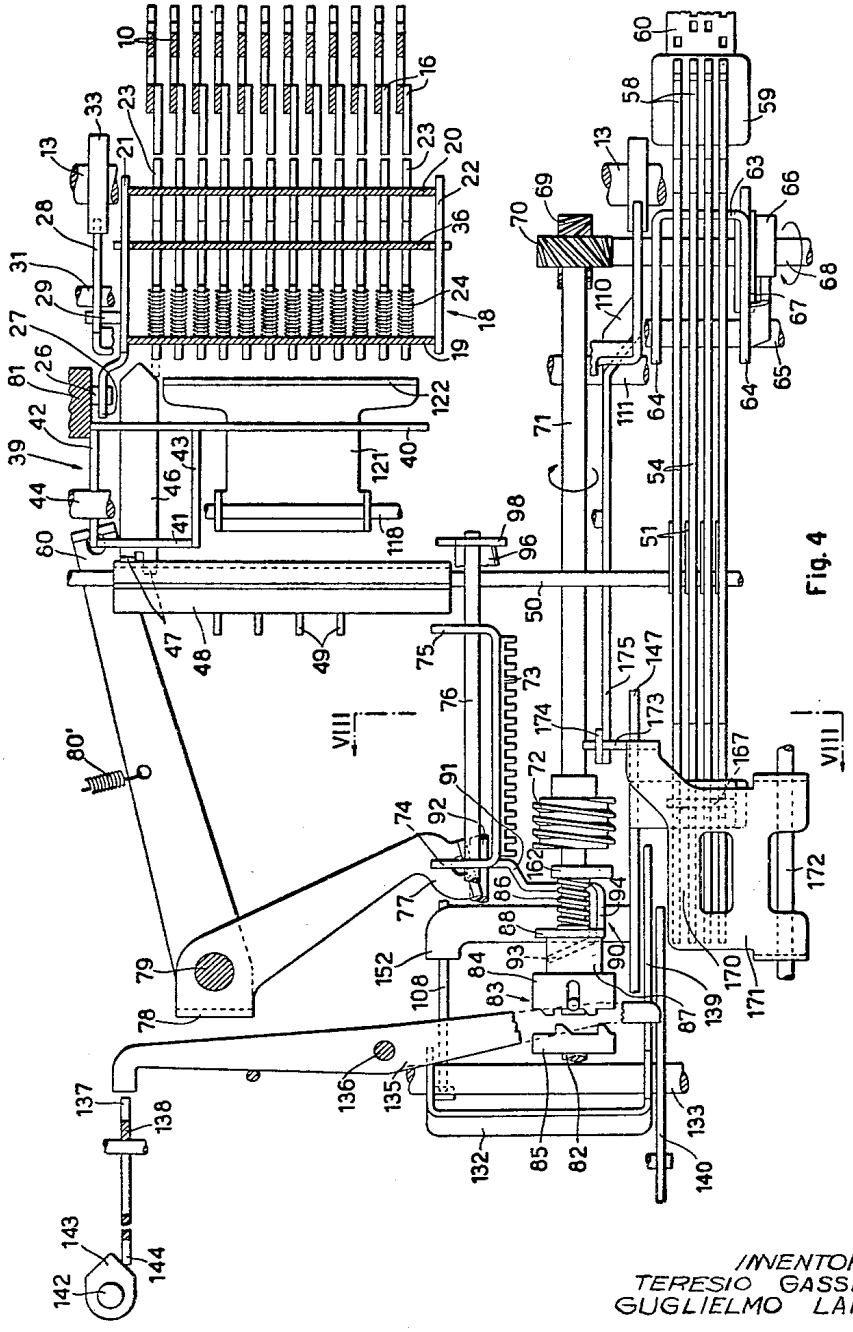

Fig. 4

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TAPE PUNCHING APPARATUS FOR ACCOUNTING MACHINES AND THE LIKE

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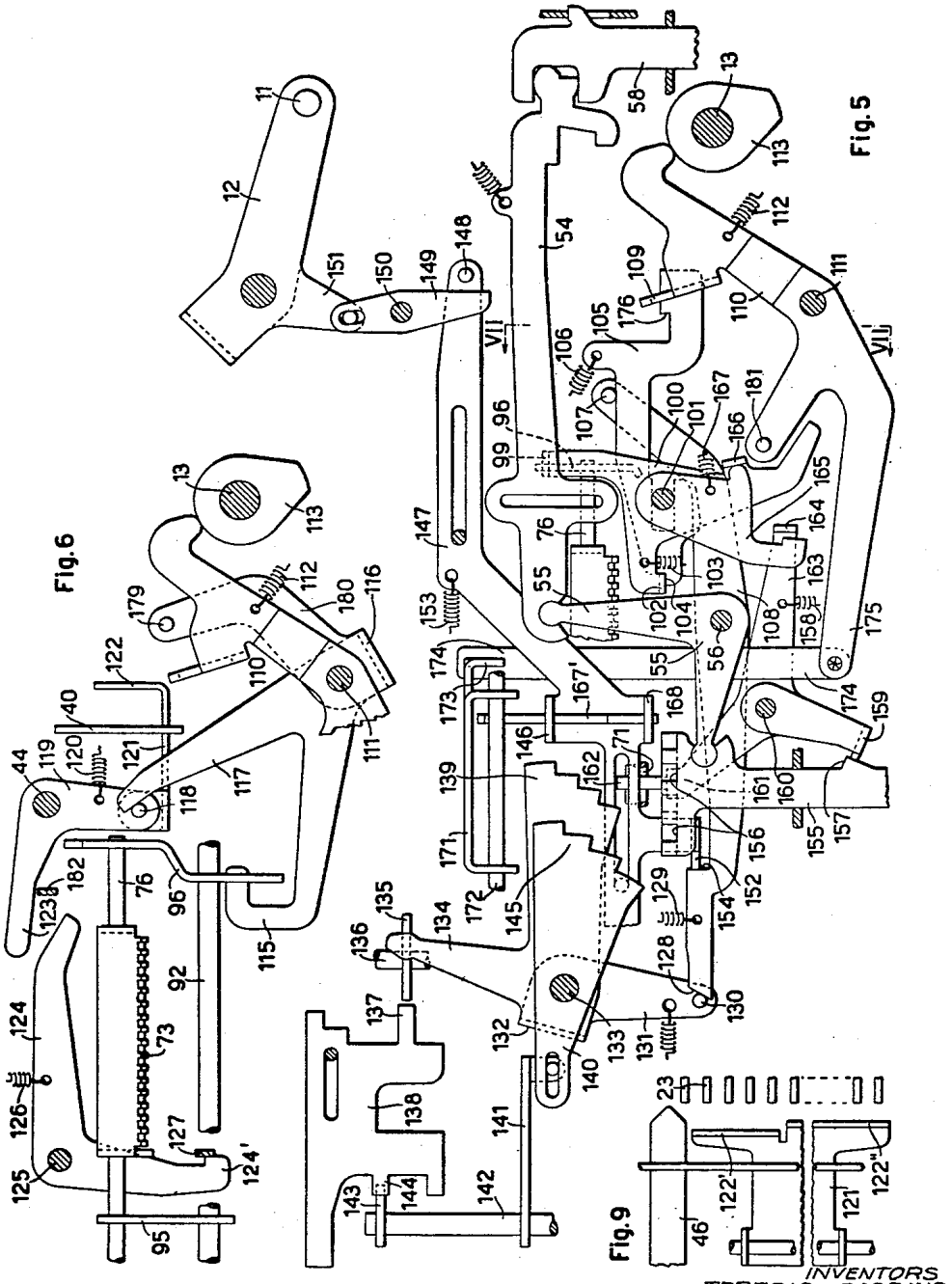

Fig. 5

Fig. 6

Fig. 9

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United States Patent Office 3,006,537 Patented Oct. 31, 1961

3,006,537

TAPE PUNCHING APPARATUS FOR ACCOUNTING MACHINES AND THE LIKE

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9 Claims. (Cl. 234—24)

The present invention relates to accounting and calculating machines and data processing apparatus in general, having a set of actuators arranged in denominational orders and differentially movable to represent a multiorder amount, and concerns a tape punching apparatus for sequentially punching each denomination of said amount according to a predetermined multiunit code.

It is the primary object of the invention to provide a punching apparatus adapted to punch a tape to be used for automatically controlling other business machines for integrated data processing.

It is a further object of the invention to provide a tape punching apparatus wherein the amount represented by the actuators is translated and transferred to the punch pins by mechanical means only.

It is a further object of the invention to avoid the perforation of the non-significant zeroes of the amount represented by the actuators.

Another object of the invention is to provide in connection with an accounting machine an improved punching apparatus capable to effect the perforation of a machine function code combination followed by a train of perforations corresponding to the digits of the amount operated by the accounting machine.

Still another object of the invention is to provide punch pins having an improved cutting surface capable to ensure the cut of the paper.

According to the invention we provide a punching apparatus comprising a code member associated with each one of the actuators of the accounting machine and movable therewith, said code member having code elements arranged according to said predetermined code and being adapted to translate the differential positions of the associated actuator into corresponding effective code combinations of said elements, and a multiorder storing device settable by said elements according to said code combinations for storing the represented amount so translated.

According to another feature of the invention we provide in each order of said storing device a plurality of settable interponents equal in number to the number of units of said code, said storing device being movable with respect to said code members when said actuators represent said amount to enable the code elements of each code member to set the interponents of the corresponding order according to said code combinations, whereby upon said movement said represented amount is translated and stored in said device.

Further objects, features and advantages of the invention will become apparent from the following detailed description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 shows a left-hand longitudinal sectional view of the punching apparatus according to the invention embodied in a ten-key accounting machine of the type described in the U.S. Patent No. 2,849,179;

FIG. 2 is another longitudinal sectional view of the punching apparatus showing a punch pin;

FIG. 3 shows schematically the four-unit code used by the punching apparatus according to the present embodiment;

FIG. 4 shows a plan view of the punching apparatus;

FIG. 5 shows a third longitudinal sectional view of the punching apparatus;

FIG. 6 shows a view of the perforation stopping device;

FIG. 7 shows a partial cross-sectional view taken on line VII—VII of FIG. 5;

FIG. 8 shows a partial cross-sectional view taken on line VIII—VIII of FIG. 4;

FIG. 9 shows a plan view of a detail of FIG. 4 according to a modified embodiment of the invention.

Referring now to FIG. 1, the numeral **10** indicates one of the conventional differential actuators of the accounting machine embodying the punching apparatus. These actuators are arranged in denominational orders and are normally locked at rest in their lowest position by a universal bar **11** secured to a bail **12**. The accounting machine also comprises a cyclically rotatable main operating shaft **13** adapted to oscillate the bail **12** first counterclockwise and then clockwise. During each cycle of the shaft **13** the bail **12** releases the actuators **10** which are thus differentially moved upwards by their individual springs until each one assumes a position representing the digit of the corresponding order of a multiorder amount set up in the pin carriage **14** or stored in the register **15**.

Connected to each actuator **10** by being secured thereon is a code member **16** having four code elements or projections **17** arranged according to a predetermined code. Located rearwards of the code members **16** (leftwards in FIGS. 1 and 4) is a multiorder storing device **18** mounted in a frame made of a pair of transverse plates **19** and **20** secured to a pair of longitudinal plates **21** and **22** (see also FIG. 4). The storing device **18** comprises in each order a column of four settable interponents **23** juxtaposed to a corresponding code member **16**. The interponents **23** are horizontally slidable in the plates **19** and **20**, and are, as will be described hereinafter, each one settable in the position shown with broken lines in FIGS. 1 and 4 with reference to the upper interponent **23** of the unit column. Normally a compression spring **24** urges the corresponding interponent **23** to contact the plate **20** by means of an abutment **25**. A second abutment **38** formed on each interponent **23** is normally located before a transverse plate **36**.

The storing device **18** is mounted for longitudinal movement towards the code members **16** by means of a forked end **27** of the plate **21** which is slidable on a stationary stud **26**.

Linked to a pin **29** secured to the plate **21** is an arm **28** of a lever **30** pivoted on a stationary shaft **31** and urged by a spring **32** to cooperate with a power means are cam **33** secured to the main shaft **13** whereby the storing device **18** is moved during each cycle to and fro with respect to the code members **16**. Another arm **34** of the lever **30** cooperates with a projection **35** of the transverse plate **36** which is vertically slidable on the plates **21** and **22** and normally urged upwards by a spring **37**.

Upon **180** degrees of rotation of the main shaft **13**, the actuators **10** reach the upper position representing a multiorder amount, while the code members **16** upon being moved with the actuators translate the differential positions of the latter into corresponding effective code combinations of the code elements **17** in front of the storing device **18**. The cam **33** now rotates the lever **30** clockwise, whereby the arm **34** moves the plate **36** downwards and the arm **28** moves the storing device **18** towards the code members **16**. The interponents **23** abutting against the projections **17** are arrested, being thus moved rearwards with respect to the plates **19**, **20** and **36**, while the corresponding abutments **38** are located behind the plate **36**.

It will thus be apparent that if the storing device **18** is moved forwards when the actuators **10** have been dif-

ferentially moved upwards so each one represents a digit of an amount, then the code elements 17 of each code member 16 will set the juxtaposed interponents 23 according to the code combinations representing the corresponding digit, whereby said amount is coded and stored in the storing device 18.

Following its rotation the cam 33 allows the lever 30 to be restored by the spring 32. The arm 34 thus allows the plate 36 to return to its upper position, locking the interponents 23 in the assumed position, while the arm 28 removes the storing device 18 from the code members 16. Each column of interponents 23 remains so set to store a digit of the amount according to the four-unit code schematically shown in FIG. 3. The storing device 18 stores the amount until the next cycle of the shaft 13, while the actuators 10 are immediately restored by the universal bar 11.

Located rearwards of the storing device 18 is a sensing mechanism 39 mounted in a carriage formed of a pair of transverse plates 40 and 41 secured to a pair of longitudinal plates 42 and 43 (see also FIG. 4). The sensing mechanism 39 is transversely slidable on two stationary shafts 44 and 45 and is provided with four sensing elements 46 arranged in a single vertical column and individually slidable in the plates 40 and 41. Each sensing element 46 is provided with a pair of bent lugs 47 engaging the forward edge of a corresponding bail 48 and transversely slidable along said edge. Each one of the four bails 48 is carried by an arm 49 secured to a shaft 50. Also secured to each shaft 50 is another arm 51 (FIGS. 2 and 4) provided with a pin 52 cooperating with a slot 53 of a corresponding interposer formed of a horizontal slide 54. The rear end of each slide 54 is connected with a lever 55 pivoted and a stationary shaft 56, while the forward end engages the upper forked end 57 of a punch pin member 58. All the punch pin members 58 cooperate with a stationary die member 59 having a longitudinal slot leading the tape to be perforated. A spring 61 attached to each slide 54 normally urges the slide 54 rightwards and the corresponding punch pin member 58 upwards.

Each horizontal slide 54 is provided with a projection 62 engageable by a cross bar 63 of a bail 64 (see also FIG. 4) pivoted on a shaft 65. The bail 64 is controlled by a pair of complementary cams 66 and 67 (FIG. 2) secured to a cyclically rotatable shaft 68 which represents the main operating shaft of the punching apparatus. During a cycle of the shaft 68 the bail 64 is thus positively oscillated first clockwise and then counterclockwise.

The shaft 68 is connected to a shaft 71 by means of two worm wheels 69 and 70 (FIG. 4) having a transmission ratio of 1:1. Secured to the shaft 71 is a worm gear 72 engageable by a rack bar 73 which by means of two bent lugs 74 and 75 is slidably mounted on a shaft 76. The bent lug 74 is engaged by the forked end 77 of a lever 78 pivoted on a vertical shaft 79 and pivoted with a second forked end 80 engaging the lower end of the plate 42 of the sensing mechanism 39 (see also FIG. 1). A spring 80' attached to the lever 78 (FIG. 4) normally urges the sensing mechanism 39 to its right-hand position (upwards in the drawing) against the machine frame 81. The sensing elements 46 are thus in position adapted to sense the interponents 23 of the unit order.

The shaft 71 may be coupled to a motor shaft 82 by means of a toothed clutch 83 comprising a driven element 84 slidably but not rotatably mounted on the shaft 71 and a driving element 85 secured to a continuously rotating shaft 82. Normally the driven element 84 is latched in a disengaged position from the driving element 85.

As will be hereinafter described, after the amount represented by the actuators has been translated and stored in the storing device 18 the main shaft 13 enables both the rack bar 73 to engage the worm gear 72 and the driven element 84 to engage the driving element 85 of the clutch 83. The shaft 71 is now rotated by the shaft 82 together with the main shaft 68 of the punching apparatus. The worm gear 72 moves the rack bar 73 rearwards (leftwards in FIG. 4), whereby the lever 78 moves the sensing mechanism 39 towards the higher orders through the extent of one order during each cycle of the shaft 71. The sensing elements 46 thus sequentially sense the columns of interponents 23 from the lower orders to the higher orders.

Upon sensing a column of interponents 23 the sensing elements 46 will assume a configuration corresponding to the code combination to be punched. More specifically, the interponents 23 located in the position shown with broken lines (FIGS. 1 and 4), upon the transverse movement of the sensing mechanism 39 will shift the corresponding sensing elements 46 rearwards. Each sensing element 46 so shifted, through the corresponding bail 48 and the arm 49, rocks the shaft 50 counterclockwise, whereby the arm 51 (FIG. 2) will move the slide 54 rearwards to engage the projection 62 with the cross bar 63.

The cam 66 of the shaft 68 will now oscillate the bail 64 clockwise, whereby the cross bar 63 urges the engaged slides 54 downwards together with the corresponding punch pin members 58 which by means of their punch pins 58' will thus punch into the tape 60 the code combination sensed by the sensing elements 46.

It will thus be apparent that the sensing mechanism 39 upon sequentially sensing the orders of the storing device 18 is adapted to select corresponding combinations of the punch pins 58' in order to punch a code combination for each order of the amount stored in the storing device 18.

The punch pins 58' have a rectangular or substantially square section, thus punching substantially square holes into the tape, and the cutting surface 58'' of each punch pin is formed of a pair of opposed inclined triangular planes having a common side coincident with one diagonal line of the square (see lower upward view of the punch pin 58' in FIG. 2). The cutting action will thus begin from two opposed corners of the square and will continue toward the two remaining corners making a sure cut of the paper.

Upon being punched as above the tape 60 is fed in a known manner to be ready for the next perforation during the following cycle of the shaft 68. The perforation cycles, each one corresponding to a sensed order of the storing device, will thus follow until significant digits are sensed in said device; thereupon the clutch 83 is declutched as will be hereinafter described.

The driven element 84 of the clutch 83 is secured to a hub 87 (FIG. 4) provided with a cam disk 88 (FIG. 8) cooperating with a bent lug 90 of a lever 91 pivoted on a stationary shaft 92 and urged by a spring 89. The lug 90 comprises an inclined portion 93 (FIG. 4) and a frontal portion 94. The inclined portion 93 normally latches the driven element 84 out of engagement with the driving element 85, against the urge of a compression spring 86. The frontal portion 94 normally latches the cam disk 88 (FIG. 8) thereby preventing the clockwise rotation of the shaft 71 and thus of the main shaft 68 of the punching apparatus.

The shaft 76 carrying the rack bar 73 is secured to a pair of levers 95 and 96 (FIGS. 6 and 7) pivoted on the stationary shaft 92. A spring 97 (FIG. 7) urges the lever 96 counterclockwise to move the rack bar 73 towards the worm gear 72. The lever 96 is provided with an upper projection 98 contacting a bent lug 99 of a lever 100 pivoted on a stationary shaft 101 (FIG. 5). The lever 100 is provided with another lug 102 contacting a step 104 of a starting means such as a slide 105 by the urge of a spring 103. The slide 105 is slidable on the shaft 101 and by the urge of a spring 106 contacts a stud

107 secured to a lever 108 pivoted on the shaft 56. Moreover, the slide 105 is guided by a slot provided in a bent lug 109 of a lever 110 pivoted on a stationary shaft 111. The lever 110 cooperates by the urge of a spring 112 with a cam 113 secured to the main shaft 13 of the accounting machine.

The lever 96 (FIG. 7) is provided with a forked end 114 engaging an arm 115 of a bail 116 (FIG. 6) pivoted on the shaft 111. A second arm 117 of said bail normally contacts a shaft 118 secured to a lever 119 pivoted on the shaft 44 and urged counterclockwise by a spring 120.

The sensing mechanism 39 is provided with a sensing plate 121 (FIGS. 1 and 4) transversely slidable on the shaft 118 (FIGS. 4 and 6) in order to be movable with the sensing mechanism 39 and also longitudinal slidable in a slot of the plate 40 in order to be capable of sensing the storing device 18. To this end the plate 121 is formed with a vertical bent lug 122 located rearwards the three lower rows of interponents 23 of all the orders higher than the order actually sensed by the sensing elements 46 (FIG. 4).

An arm 123 of the lever 119 (FIG. 6) is adapted to cooperate with a lever 124 pivoted on a stationary shaft 125 and provided with a hooked arm 124' contacting a projection 127 of the lever 91 by the urge of a spring 126 (see also FIG. 8).

The rear end of the lever 108 (FIG. 5) is provided with a tapered edge 128 which by the urge of a spring 129 cooperates with a stud 130 secured to an arm 131 of a bail 132 pivoted on a stationary shaft 133. Another arm 134 of the bail 132 (FIGS. 4 and 5) contacts the left-hand end of a horizontal lever 135 pivoted on a vertical shaft 136. The other end of the lever 135 may cooperate with a projection 137 of a stop plate 138 carried by the conventional paper carriage for automatically controlling the functions of the accounting machine. The paper carriage is not shown in the drawings, it being described in the cited U.S. Patent No. 2,849,179, wherein a stop plate such as the stop plate 138 is adapted to be moved forwards through a first extent in order to arrest the carriage and through a second extent before the beginning of the machine cycle in order to automatically control the machine functions.

The projection 137 of the stop plate 138 may be of four different lengths, each one corresponding to a particular machine function. More specifically, beginning from the lower to the higher lengths, the four lengths correspond to total taking, adding, subtracting, and non-adding. The projection 137 shown in FIG. 5 corresponds to non-adding. The bail 132 is provided with a stepped member such as an arm 139 having four steps each one corresponding to one length of the projection 137.

Pivoted on the shaft 133 is also a lever 140 which is pin-and-slot connected to an arm 141 secured to a vertical shaft 142 carrying an arm 143 (see also FIG. 4) having two opposed tapered edges. When during the travel of the paper carriage a projection 144 of the stop plate 138 reaches the arm 143 the stop plate 138 is moved forwards through the first extent and the paper carriage is arrested by the means described in the cited U.S. Patent No. 2,849,179. The projection 144 may be arranged on the stop plate 138 in selected ones of four different vertical positions corresponding to four different programs of accounting work. In FIG. 5 the stop plate 138 carries two projections 144 arranged in the first and the fourth vertical position. The shaft 142 is vertically movable to position the arm 143 in the horizontal plane of any position of the projections 144, in order to select the stop plate 138 relating to a predetermined program.

The lever 140 is provided with a stepped arm 145 similar to the arm 139, but arranged rearwards with respect to the latter. The stepped arms 139 and 145 may be sensed by a common sensing element such as a bent lug 146 of a slide 147. This slide is provided with a pin 148

adapted to cooperate with a lever 149 pivoted on a stationary shaft 150 and pin-and-slot connected to an arm 151 of the bail 12. Another bent lug 152 of the slide 147 normally contacts a shoulder 154 of the lever 108 by the urge of a spring 153.

Each one of the four levers 55 is connected to a code shaped member such as a vertically slidable plate 155. The upper edge of each plate 155 is provided with a set of recesses 156 variably arranged from plate to plate to represent in each one of the several transverse planes a different code combination according to the various functions of the accounting machine which may be represented by the projections 137 and to the various programs which may be determined by the positions of the arm 143.

Since it has been assumed to use four punch members 58 (FIG. 4), which may perforate fifteen different code combinations, ten code combinations are reserved to the digits (see FIG. 3), while five code combinations may be used for representing machine functions.

Each one of the plates 155 is provided with a shoulder 157 cooperating with a locking bail 159 pivoted on a stationary shaft 160 and urged clockwise by a spring 158. Said locking bail is provided with an arm 161 cooperating with a cam 162 (FIG. 7) secured to the shaft 71 and is also provided with a second arm 163 formed with a bent lug 164 cooperating with a hook 165 pivoted at 101. Normally a bent lug 166 of the lever 100 locks the hook 165 out of engagement with the lug 164, against the urge of a spring 167.

A transverse plate 167' (FIGS. 5 and 8) vertically slidable in a slot of the sensing lug 146 and of a further bent lug 168 of the slide 147 and thus movable into variable vertical transverse planes together with said slide is adapted to engage the plates 155, but is normally held in its upper position by the urge of a spring 169. A plate 170 (FIG. 4) of a bail 171 (FIG. 8) may cooperate with the upper end 167'' (FIG. 8) of the plate 167'. The bail 171 is pivoted on a stationary shaft 172 and is provided with a projection 173 engaging a link 174 (FIG. 5) connected to an arm 175 of the lever 110.

The punching apparatus operates as follows:

It will be assumed that a predetermined accounting work program has been selected by vertically positioning the shaft 142 (FIG. 5). The lever 140 is rocked according to said selected program, placing a step of the stepped arm 145 into the path of the sensing element 146. It will also be assumed that the accounting machine is being cycled and that the machine functions are controlled by the stop plate 138 (FIGS. 4 and 5).

When before the beginning of the machine cycle the stop plate 138 is moved forwards through its second extent, the projection 137 rocks the lever 135 clockwise (FIG. 4) through an angle corresponding to the length of the projection 137. The lever 135 in turn rocks the bail 132 (FIG. 5) counterclockwise, placing a step of the stepped arm 139 into the path of the sensing element 146. However, just at the beginning of the rotation of the bail 132 the stud 130 engages the tapered edge 128, rocking thus the lever 108 counterclockwise, whereby the shoulder 154 releases the lug 152 of the slide 147. The spring 153 moves the slide 147 until its pin 148 contacts the lever 149, whereby the slide 147 is now put under the control of the bail 12 which in turn is moved by the main operating shaft 13. In rocking counterclockwise with the lever 108 the stud 107 releases the slide 105 which under the urge of the spring 106 will contact the upper edge of the slot of the lug 109, shown with a dot in FIG. 5.

During the counterclockwise movement of the bail 12 the lever 149 is rotated clockwise, enabling the slide 147 to be moved rearwards until the sensing element 146 contacts the stepped edge of the arm 139 previously placed in its path. The vertical transverse plate 167' is thus shifted rearwards from the position shown in FIG. 5 into a ver-

tical transverse plane corresponding to the individual step sensed by the sensing element **146** and thus to the function predetermined by the projection **137** of the stop plate **138** which is determined by the particular length of the projection **137**.

When the bail **12** terminates its counterclockwise movement the cam **113** of the main shaft **13** oscillates the lever **110** counterclockwise enabling its lug **109** to latch the shoulder **176** of the slide **105**. Moreover, the arm **175** of the lever **110** pulls the link **174** downwards, enabling the plate **170** of the bail **171** (FIGS. 4 and 8) to push the transverse plate **167'** downwards, whereby according to the recesses **156** (FIG. 5) found by the plate **167'** in its actual vertical plane a particular combination of plates **155** is selected, the plates **155** having no recess **156** in the path of the plate **167'** being depressed. By means of the levers **55** the corresponding horizontal slides **54** will thus be shifted forwards as if the associated arms **51** (FIG. 2) were rocked clockwise, thereby selecting the punch pins **58'** to punch the code combination corresponding to the machine function controlled by the projection **137**. The plates **155** so depressed are locked in their lower position by the locking bail **159**.

In the case of a projection **137** having the maximum length, as that shown in FIG. 5, the arm **139** is rocked out of the path of the sensing element **146** which now reaches the stepped arm **145**, whereby the plate **167'** will select the punch pins **58'** according to the code combination corresponding to an accounting work program instead of a particular machine function.

The cam **113** of the main shaft **13** now enables the lever **110** to be returned to rest. Since the spring **112** is stronger than the spring **106**, the lug **109** latching the shoulder **176** pulls the slide **105** forwards, whereby the shoulder **104** releases the lug **102** of the lever **100**. The spring **103** now urges the lever **100** counterclockwise, enabling the hook **165** to contact the lug **164** and releasing the projection **98** of the lever **96** (FIG. 7) from the lug **99**. The spring **97** will thus rotate the lever **96** counterclockwise around the shaft **92**, enabling the rack bar **73** to be engaged with the worm gear **72**.

Thereupon the rack bar **73** by means of the shoulder **177** (FIG. 8) engages the arm **178** and rocks the lever **91** clockwise, enabling the arm **127** to be engaged by the latch **124'** (FIG. 6) and further enabling the lug **90** (FIG. 8) to release the cam **88**. The spring **86** (FIG. 4) now urges the hub **87** rearwards to mesh the driven element **84** with the driving element **85** of the clutch **83**, whereby the shafts **71** and **68** are cycled synchronously. The cams **66** and **67** of the shaft **68** will now oscillate the bail **64** (FIG. 2), whereby the cross bar **63** during the first cycle of the shaft **68** operates the punch pins **58'** previously selected by the plates **155** (FIG. 4).

It will thus be seen that the punching of the code combinations of an amount represented by the actuators **10** is first preceded by the punching of the code combination either of the function effected by the accounting machine in connection with said amount, said function being determined by the projection **137** of the stop plate **138**, or of a particular program, said program being predetermined by the positioning of the shaft **142**.

At the end of the first punching cycle the cam **162** (FIG. 7) of the shaft **71** pushes down the upper edge of the arm **161** whereby the bail **159** is rocked counterclockwise (FIG. 5), releasing the plates **155**. Furthermore, the arm **163** of the bail **159** is now latched in its rocked position by the latch **165**.

As has been described hereinbefore, toward the middle portion of the cycle of the main shaft **13** the interponents **23** of the storing device **18** are set according to the amount represented by the actuators **10**. As soon as the rack bar **73** (FIG. 4) has been meshed with the worm gear **72**, the sensing mechanism **39** begins to be moved towards the higher orders whereby for each revolution of the shaft **71** the sensing elements **46** will sequentially sense the various columns of interponents **23**. In the punching cycle following the described first cycle the punch pins **58'** (FIG. 2) are selected by the sensing elements **46** according to the configuration of each column of interponents **23**, whereby the first function or program code combination perforated in the tape is followed by the perforation of a train of code combinations representing the digits of the amount stored in the storing device **18**.

During the ensuing train of punching cycles the accounting cycle of the shaft **13** is accomplished and the bail **12** (FIG. 5) by means of the lever **149** restores the slide **147**. Furthermore, the stop plate **138** is restored, whereby the bail **132** is restored as well, releasing the lever **108**. The latter on one hand relatches the lug **152** of the slide **147** and on the other hand moves downwards the slide **105**, which is released from the lug **109** and by the urge of the spring **106** contacts the lug **102** of the lever **100**.

As has been described hereinbefore, the lever **96** (FIG. 7) has been rotated counterclockwise upon being released by the lever **100** in order to enable the rack bar **73** to mesh with the worm gear **72**. The forked end **114** of the lever **96** has rocked the bail **116** clockwise (FIG. 6), releasing the shaft **118** from the arm **117**. The spring **120** rocks the lever **119** counterclockwise and the sensing plate **121** is moved forwards. Thus the bent lug **122** simultaneously senses the three lower rows (FIG. 1) of all the interponents **23** of the orders higher than the order sensed by the sensing elements **46** (FIG. 4).

FIG. 3 shows that the code combinaiton representing the "zero" digit is formed of a single mark or hole located in the upper one of a number of possible positions which is equal to four according to the four-unit code. Therefore, if an actuator **10** remains in its lower or "zero" position, upon the forward movement of the storing device **18** the corresponding code member **16** will only set the interponent **23** of the highest row. On the contrary, if an actuator **10** assumes any other position, the code member **16** will set at least one interponent **23** of the three lower rows. Therefore, as long as at least one order higher than the order actually sensed by the sensing elements **46** (FIG. 4) presents a set interponent **23** in any one of the three lower rows, the bent lug **122** of the sensing plate **121** will be arrested thereby and the arm **123** of the lever **119** (FIG. 6) will not reach the lever **124**.

When the sensing elements **46** reach the highest significant order of the amount stored in the storing device **18**, no interponent **23** of the higher orders arrests the bent lug **122**, whereby the lever **119** is rotated counterclockwise and the arm **123** rocks the lever **124** clockwise, the spring **120** being stronger than the spring **126**. The lever **124** releases now the projection **127** (FIG. 8) whereby, since the shoulder **177** of the rack bar **73** is out of the path of the lug **74** (FIG. 7) as a result of the leftward movement of the rack bar **73** (FIG. 6), the spring **89** will rotate the lever **91** clockwise (FIG. 8). The inclined portion **93** (FIG. 4) of the bent lug **90** moves thus the cam **88** rightwards together with the hub **87**, declutching the driven element **84** from the driving element **85**, while the shaft **71** is arrested by the frontal portion **94** of the lug **90**.

It will be apparent that the sensing plate **121** is thus adapted to cause the cycling mechanism of the punching apparatus to be stopped, whereby the punching apparatus is arrested without having punched the non-significant zeroes of the amount stored in the storing device **18**.

It will be obvious to those skilled in the art that the motor keys of the accounting machine should be locked during the perforation of the tape and should be released upon arresting the punching apparatus. To this end the lever **119** when rocking counterclockwise is adapted to disable a locking member **182** for said motor

keys, such locking member being, for instance, of the type described in the U.S. Patent 2,644,637 as indicated by the numeral 329 in FIG. 16.

Upon completion of the last punching cycle, the rack bar **73** remains meshed with the worm gear **72**, out of its rest position and displaced along the shaft **76**, the bail **116** (FIG. 6) remains rocked clockwise contacting the lever **110** by means of a pin **179** secured to its arm **180**, the lever **100** (FIG. 5) remains rocked counterclockwise, and the locking bail **159** remains latched by the latch **165**.

If the next following cycle of the accounting machine is still controlled by a stop plate **138** having a projection **137**, the sensing element **146** is again arrested either by the stepped arm **139** or by the stepped arm **145**, whereby the plates **155** are selectively depressed by the transverse plate **167'** as in the case described above.

When the lever **110** (FIG. 6) is now rocked counterclockwise by means of the pin **179** it rocks the bail **116**, whose arm **117** restores the plate **121**, releasing the lever **124**, and whose arm **115** rocks the arm **96** (FIG. 7) to disengage the rack bar **73** from the worm gear **72**. The rack bar **73** and the sensing mechanism **39** are now restored by the urge of the spring **80'** (FIG. 4). Furthermore, the stud **181** (FIG. 5) of the lever **110** rotates the lever **100** clockwise. The lug **99** of the lever **100** will now relatch the upper end **98** of the lever **96**, whereby the rack bar **73** remains disengaged from the worm gear **72**, whereas the plug **102** relatches the shoulder **104** of the slide **105**. The lug **166** of the lever **100**, restores the latch **165**, releasing the lug **164** of the bail **159**, which will now lock the plates **155** in their new configuration. The punching apparatus is thus in the same condition as in the case described above, whereby the lever **110** upon being restored enables the shaft **71** to be rotated for a new train of perforation cycles.

After a cycle of the accounting machine controlled by a stop plate **138** having a projection **137**, the accounting machine may be operated for a cycle controlled by either a motor key or a stop plate **138** having no projection **137**. In this case the bail **132** (FIG. 5) does not rock the lever **108**, consequently the slide **147** is not released by the shoulder **154**, whereby the plates **155** are not selected by the slide **167'** and the stud **107** does not enable the slide **105** to be latched by the lug **109**. The lever **100**, when rocked clockwise by the pin **181** of the lever **110**, is relatched by the shoulder **104** in its position of rest. The lug **99** thus locks at rest the lever **96** carrying the rack bar **73**, which is disengaged from the worm gear **72** by the lever **110** as well through the arm **115** of the bail **116**. In this case upon the ensuing clockwise oscillation of the lever **110**, the slide **105** is not moved forwards, the lever **96** is not released and the punching apparatus is not started for operation. Said apparatus has thus been restored in its position of rest.

It has been described hereinbefore the mode of operation of the bent lug **122** of the plate **121**. According to a modified embodiment of the invention shown in FIG. 9, the plate **121** comprises a stepped lug having two steps **122'** and **122''** differentially distanced from the interponents **23** of the storing device **18**, the left step **122''** being less distanced, the right step **122'** being more distanced. The step **122''** thus reaches the interponents **23** storing the non-significant zeroes some perforating cycles before the last cycle, enabling the plate **121** to move forwards through a first extent until the step **122'** is arrested by the set interponents **23**. Upon this first movement of the plate **121** the lever **119** (FIG. 6) operates the locking member **182**, releasing the keyboard of the accounting machine. When the step **122'** reaches the first column of interponents **23** storing a non-significant zero, the plate **121** will be moved through a second extent, enabling the lever **119** to declutch the shaft **71**.

The time between the first and the second extents of movement of the plate **121** may be used to start the accounting machine for the next cycle and to effect the upward movement of the actuators **10**, whereby the speed of operation will be increased.

It will be noted that the shaft **71** rotates faster than the main shaft **13**, for example according to a ratio of 4:1. The train of perforating cycles initiated during the cycle of the main shaft **13** may thus terminate in short time with respect to the time requested by said cycle.

From the foregoing description it will be understood that many changes may be made in the above construction, and different embodiments of the invention could be made without departing from the scope thereof. It is, therefore, intended that all matter contained in the above description, or shown in the accompanying drawing, shall be interpreted as illustrative, and not in a limiting sense.

What we claim is:

1. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuator, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, means for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, and power means cyclically engageable with each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin.

2. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of

the same order, said projections setting said interponents by engaging one end thereof, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, means for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the opposite end of each one of said set interponents of said pluralities to sequentially engage the corresponding sensing element of said set, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, and power means cyclically engageable with each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin.

3. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, a carriage for mounting said sensing mechanism, a cycling mechanism, a member rotating in synchronism with said cycling mechanism for moving said carriage order by order at substantially uniform speed in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, and means actuated by said cycling mechanism to engage each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin.

4. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, a cycling mechanism, means operable for stopping said cycling mechanism, means controlled by said cycling mechanism for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, means actuated by said cycling mechanism to engage each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, and a sensing plate movably mounted on said sensing mechanism for simultaneously sensing the interponents of all the orders of said storing device higher than the order actually sensed by said sensing elements, said plate being adapted to operate said stopping means upon sensing non-significant digits only.

5. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, means for starting the machine for operation, and a normally ineffective locking member conditionable for disabling said starting means, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, a cycling mechanism, means operable for stopping said cycling mechanism, means controlled by said cycling mechanism for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, means actuated by said cycling mechanism to engage each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, a sensing plate movably mounted on said sensing mechanism for simultaneously sensing the interponents of all the orders of said storing device higher than the order actually sensed by said sensing elements, and means on said plate for conditioning said locking member upon sensing at least one order storing a significant digit, said plate comprising a pair of stepped portions differentially distanced from said storing device, one portion being adapted to disable said locking member, the other portion being adapted to operate said stopping means.

6. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position rep-

resenting a significant digit to represent a multidigit amount, and a main operating shaft, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, a cycling mechanism, means controlled by said cycling mechanism for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, means actuated by said cycling mechanism to engage each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, starting means operable to start said cycling mechanism, and means for enabling said starting means to operated by said main shaft.

7. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, means for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, power means cyclically engageable with each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, a stepped member mounted on the machine and movable toward a position corresponding to a predetermined machine function, said punch pins being conditionable to punch the code combination of said function, a sensing means adapted to sense said stepped member, and a plurality of code shaped members each one connected with one of said interposers, said code shaped members being selectable by said sensing means according to the position of said stepped member for shifting the connected interposer to condition said punch pins to punch the code combination of said function.

8. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, means for predetermining a program of machine functions, traveling means for selecting a machine function of a predetermined program, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, means for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, power means cyclically engageable with each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, a stepped member mounted on the machine and movable towards a position corresponding to said selected function, said punch pins being normally conditionable to punch the code combination of said selected function, a sensing means adapted to sense said stepped member to condition said punch pins to punch the code combination of said selected function, said stepped member being adapted to assume another position enabling said sensing means to sense said predetermining means, and a plurality of code shaped members each one connected with one of said interposers, said code shaped members being selectable by said sensing means under the control of said predetermining means for shifting the connected interposers to condition said punch pins to punch the code combination of said predetermining program instead of said selected function.

9. In an accounting machine having a set of actuators arranged in denominational orders, each of said actuators being movable from a normal position to a position representing a significant digit to represent a multidigit amount, a tape punching apparatus for sequentially punching a code combination for each digit of said amount according to a predetermined multiunit code, said apparatus comprising a coding device including a code member connected to each of said actuators, said code member being formed with code projections arranged according to said multiunit code to represent a different code combination in each of the positions of the actuator

to which the code member is connected, a multiorder storing device including in each order a plurality of interponents equal in number to the number of units of said code and selectively settable by the projections of the code member of the same order according to the represented code combination, means for moving one of said devices toward the other device thereby causing the projections of each code member according to the represented code combination to set the interponents of the plurality of the same order, a sensing mechanism having a set of sensing elements equal in number to the number of units of said code and each one engageable by a predetermined one of the set interponents of each plurality, a cycling mechanism, means controlled by said cycling mechanism for moving said sensing mechanism order by order in a transverse path with respect to said storing device for causing the set interponents of said pluralities to sequentially engage said sensing elements, an interposer connected to each sensing element and shiftable thereby upon engagement of said sensing element by one of said interponents, a punch pin connected to each interposer, means actuated by said cycling mechanism to engage each shifted interposer in timed relationship with the movement of said sensing mechanism to operate the connected punch pin, a stepped member mounted on the machine and movable from a home position toward a position corresponding to a predetermined machine function,

said punch pins being conditionable to punch the code combination of said function, a sensing means adapted to sense said stepped member, a plurality of code shaped members each one connected with one of said interposers, said code shaped members being selectable by said sensing means according to the position of said stepped member for shifting the connected interposers to condition said punch pins to punch the code combination of said function, starting means conditionable to start said cycling mechanism, and an element on said stepped member adapted to condition said starting means when the stepped member is moved out of its home position.

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