Dec. 8, 1953 G. H. WALLACE 2,661,841

COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

Filed June 30, 1948 5 Sheets-Sheet 1

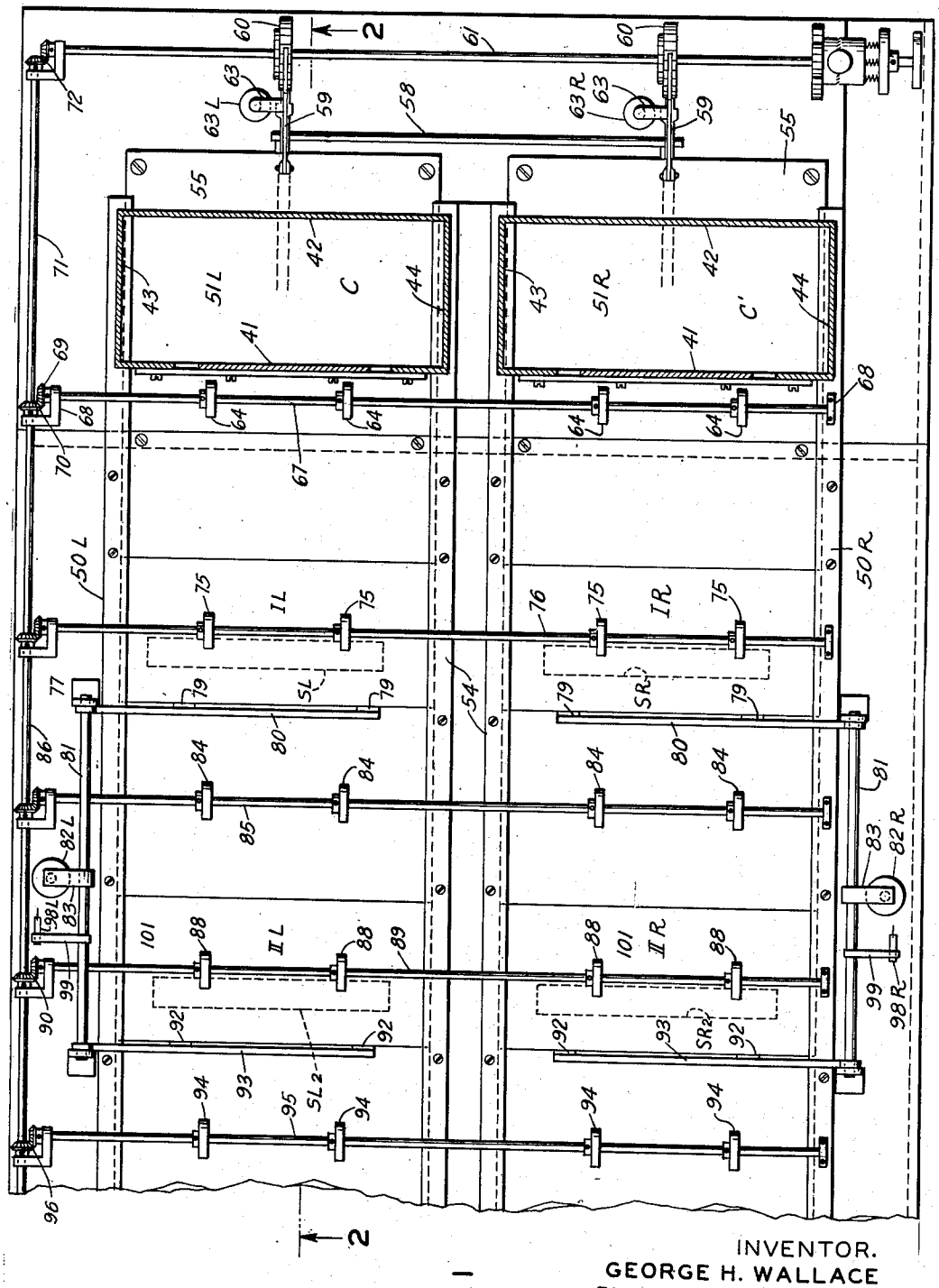


FIG. 1

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COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

Filed June 30, 1948 5 Sheets-Sheet 2

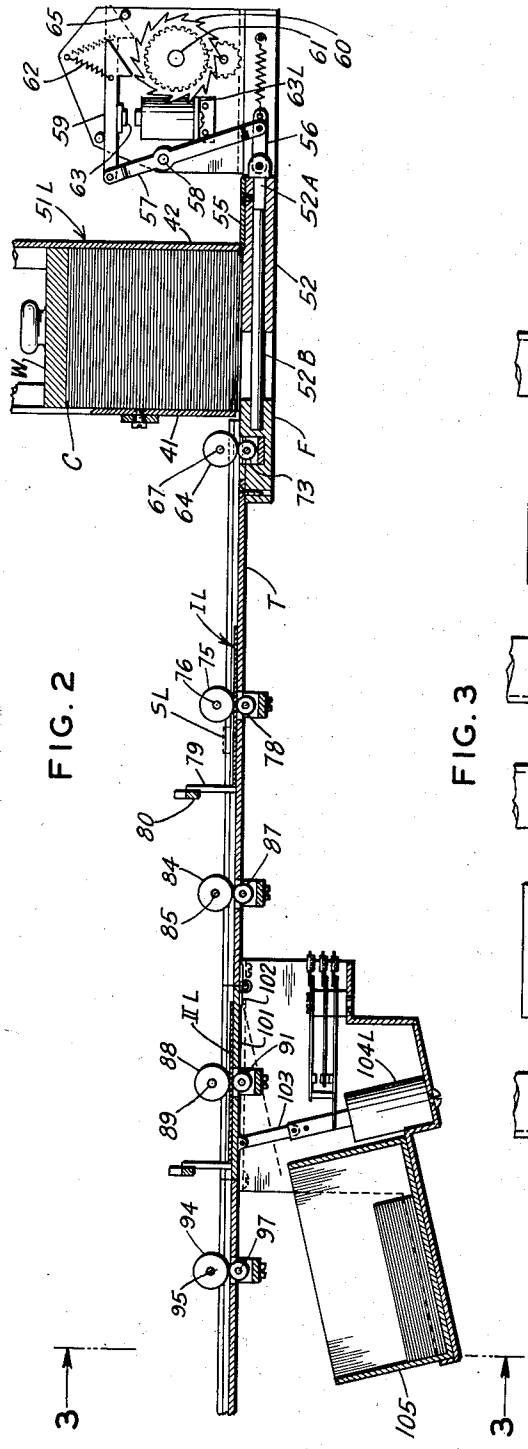


FIG. 2

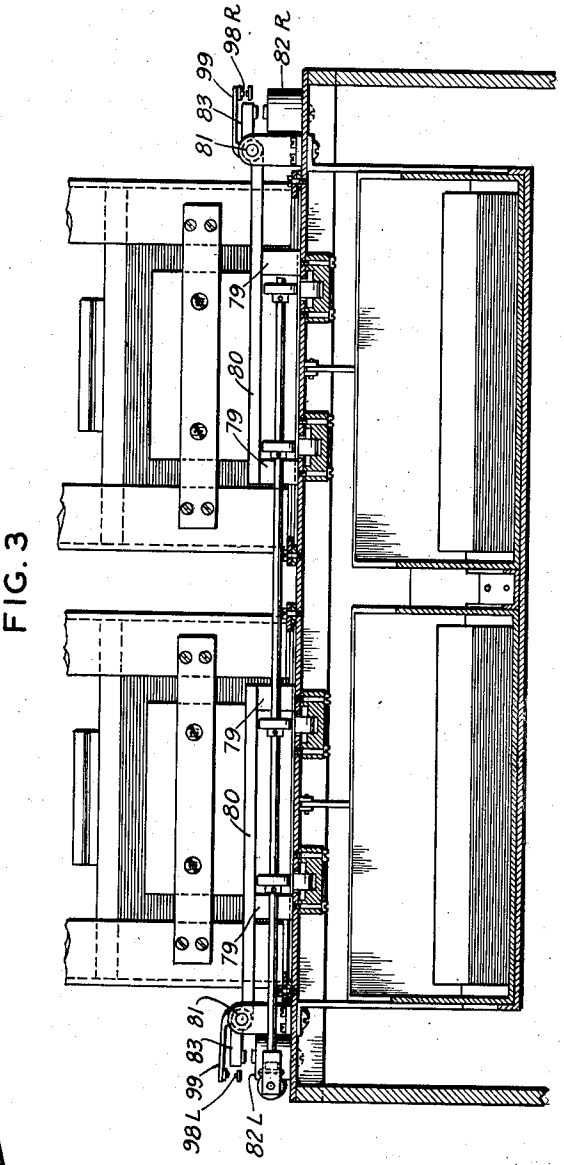


FIG. 3

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COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

Filed June 30, 1948 5 Sheets-Sheet 3

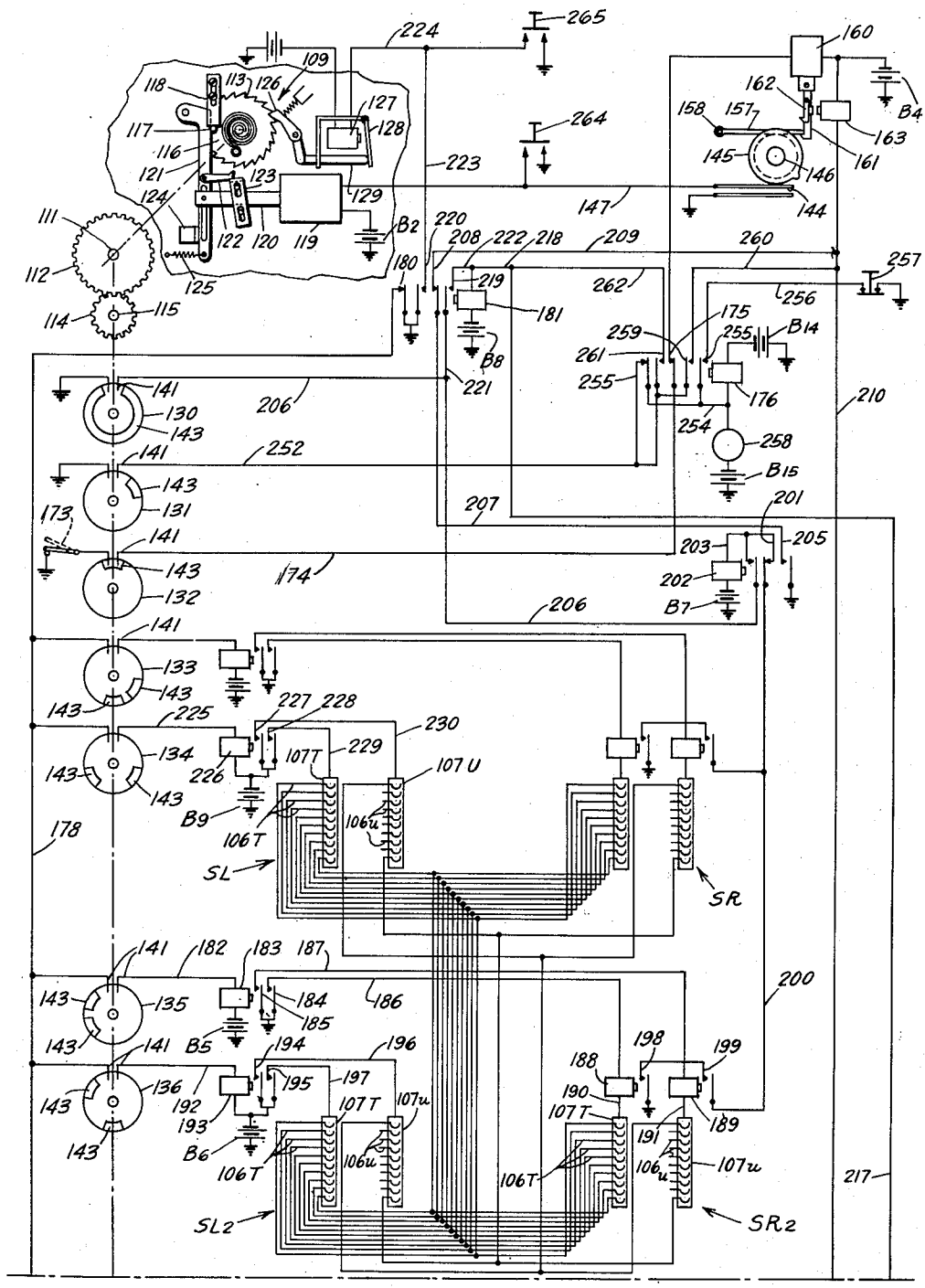


FIG. 4

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COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

Filed June 30, 1948 5 Sheets-Sheet 4

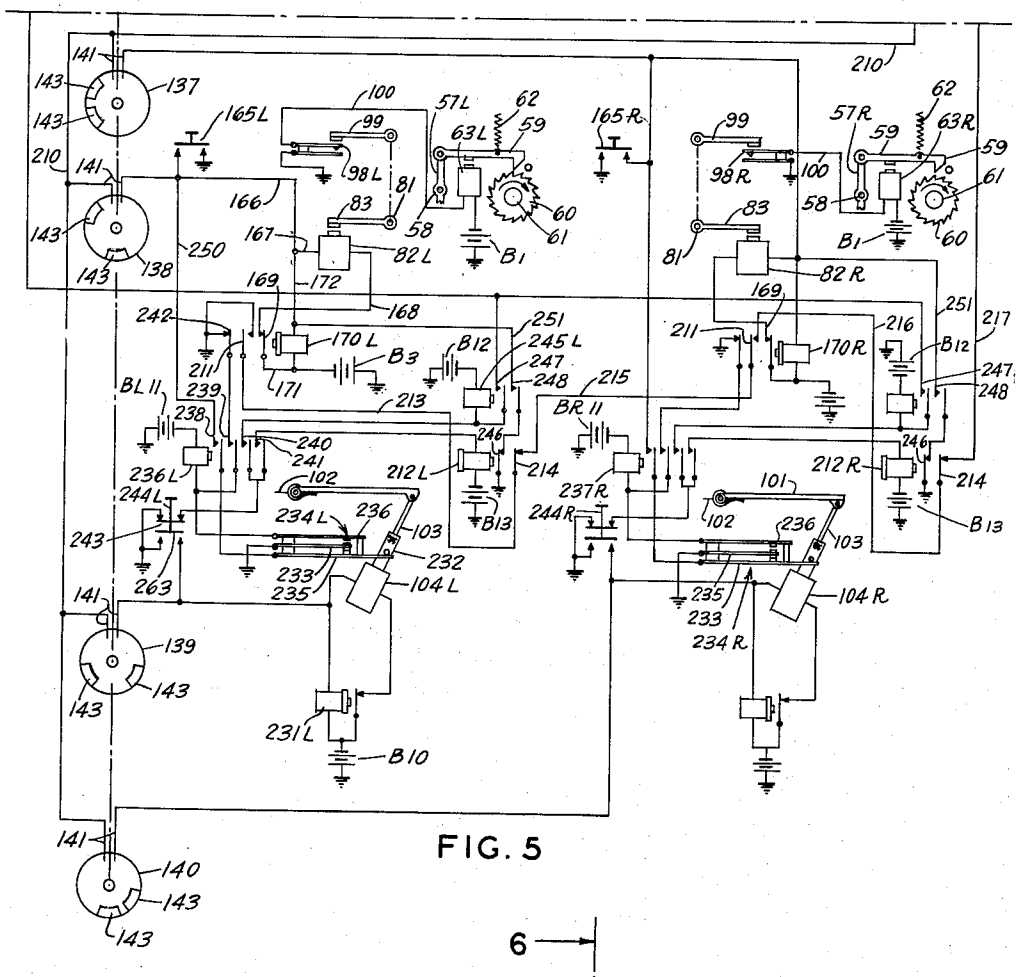


FIG. 5

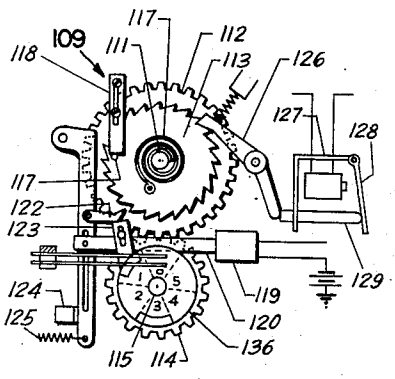


FIG. 6

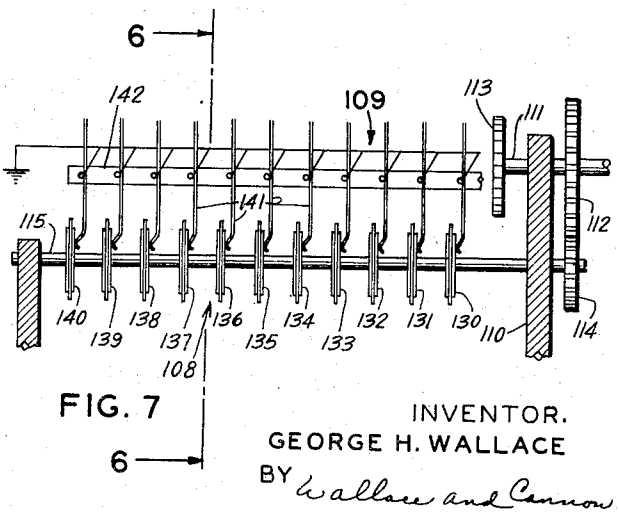


FIG. 7

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COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

Filed June 30, 1948

5 Sheets-Sheet 5

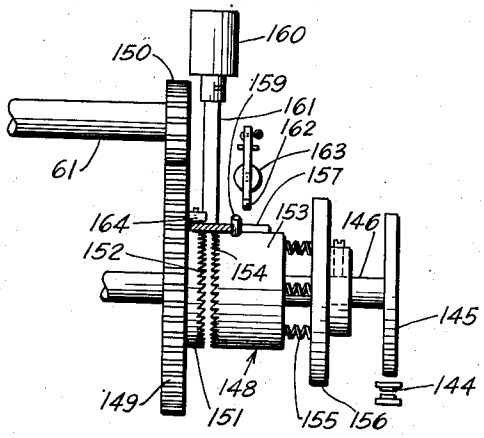


FIG. 8

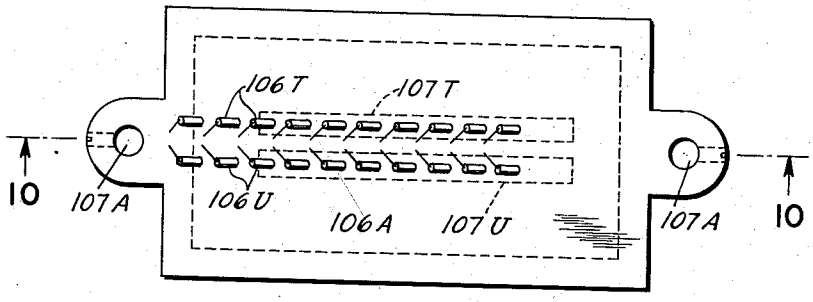


FIG. 9

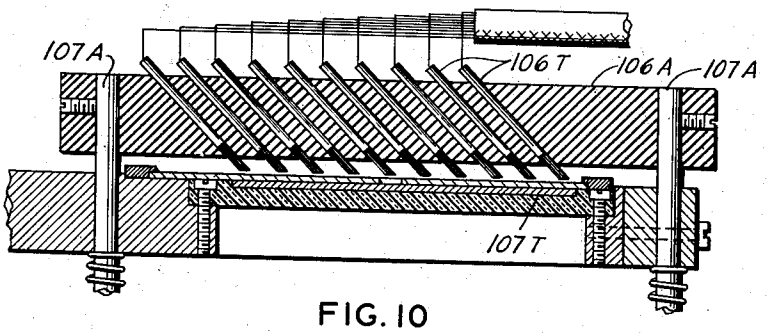


FIG. 10

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Patented Dec. 8, 1953

2,661,841

UNITED STATES PATENT OFFICE

2,661,841

COMPARING AND ASSORTING DEVICE FOR PAIRS OF PUNCH CARDS

George H. Wallace, Oak Park, Ill., assignor to Addressograph-Multigraph Corporation, Wilmington, Del., a corporation of Delaware

Application June 30, 1948, Serial No. 36,217

15 Claims. (Cl. 209—110)

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This invention relates to feeding apparatus of the kind employed to feed a plurality of sheets, cards or the like simultaneously to printing, calculating and similar machines.

It is ofttimes desirable to feed two related sheets, cards or the like simultaneously through a mechanism which performs operations on or under control of such sheets, cards or the like that are hereinafter sometimes referred to as articles. In many such instances it is necessary that a predetermined relation be maintained between two such simultaneously fed articles and to enable this to be realized in a novel and efficient manner is the primary object of this invention.

One instance where a predetermined relation is to be maintained between simultaneously fed articles is disclosed in Gollwitzer Patent No. 2,296,277. In the apparatus to which this patent pertains printing devices bearing coded indicia are passed sequentially through a printing machine in timed relation with perforated cards which also bear coded indicia and printing and calculating operations are performed on or under control of such devices and cards. In this machine, each printing device corresponds to a particular card, the data borne by the two being related so that it is important that the corresponding printing device and card pass through the machine in a predetermined relation, for otherwise the data borne by the printing device does not have proper relation with that borne by the card, and vice versa, and since the data respectively borne by the two, in the aforesaid machine, are to be printed on a common sheet, it is important that the corresponding printing device and card pass through the machine together, for otherwise related data will not be printed on a particular sheet.

As described in the aforesaid patent, the printing machine therein disclosed is equipped with sensing means for, as it is called, reading data respectively borne in coded representations thereof by the printing device and the card. The machine is also equipped with comparing means so that the relationship of a particular card to a particular printing device, and vice versa, is automatically ascertained. As long as properly related printing devices and cards are fed simultaneously through the aforesaid sensing means, the machine continues to function. When, however, the data borne by a particular printing device and card moved into association with the aforesaid sensing means do not correspond, operation of the machine is automatically

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interrupted. In such circumstances the intended operation of the machine cannot be resumed until a related card and printing device are associated with the aforesaid sensing means. A machine of the character disclosed in the aforesaid Gollwitzer patent, as well as other machines wherein a comparing operation somewhat like that described above is effected, customarily operates at high speed so that an interruption in the operation of the machine occasioned as aforesaid materially interferes with the intended production of the machine.

It has been found in machines of the aforesaid character that the failure to feed properly related articles is frequently due to displacement in one or the other of the two sequences of articles of a single article. Of course, when this occurs the entire series is out of step with respect to the other series, and it is therefore another important object of this invention to enable a machine of the aforesaid character to remain in continuous operation, notwithstanding the improper positioning in one or the other of the two series of articles of a particular article, and an ancillary object is to enable continuous operation of a machine of the aforesaid character to be intended even when an article is improperly positioned in one or the other of two series of articles intended to be advanced in such a manner that related devices in the two series will advance simultaneously and in predetermined relation one with the other.

A further object of this invention is to eject from one or the other of the two series of articles being advanced simultaneously, as aforesaid, one or the other of two articles in each of the two series when there is not a predetermined relation between two particular articles in the respective series.

Still another object is to so arrange a sensing arrangement of the nature included in the machine disclosed in the aforesaid Gollwitzer patent that the sensing operation may not only be effected upon two purportedly corresponding articles in each of the two series, but also upon other articles in the two series, particularly when two articles in a particular series do not have the desired predetermined relation therebetween or are out of phase one with the other.

A yet further object is to first effect a sensing operation between purportedly related articles in two series thereof passing into or to a machine and to thereafter, when necessary, compare one article in one series with an article in the other series immediately behind the pur-

portedly corresponding article in the other series and to subsequently, if necessary, effect comparison between the purportedly related article in one series with the article in the other series immediately behind the purportedly corresponding article in such other series, and an object ancillary to the foregoing is to eject from one or the other or both of such series the article of a purportedly related pair which is not related to the other article of the pair in a predetermined manner.

A still further object of my invention is to sense separate series of related articles in various phases and to eliminate selected articles from another of said series in order to bring said respective series into proper phase, so that matched or complementary articles in the respective series may be fed substantially simultaneously to mechanism wherein use is made of the matched or complementary aspects of such articles.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, shows preferred embodiments of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a plan view of an apparatus embodying my invention, certain elements being shown diagrammatically;

Fig. 2 is a vertical sectional view taken substantially on the line 2—2, Fig. 1;

Fig. 3 is a vertical sectional view taken substantially along the line 3—3, Fig. 2;

Fig. 4 is an electrical wiring diagram showing certain mechanical parts somewhat diagrammatically;

Fig. 5 is a continuation of Fig. 4, the top part of Fig. 5 being joined to the bottom of Fig. 4;

Fig. 6 is a detail sectional view showing the mechanical arrangement of certain elements indicated in the wiring diagram of Fig. 4 and taken substantially along the line 6—6, Fig. 7;

Fig. 7 is a plan view of the commutator mechanism which is partly shown in Fig. 6;

Fig. 8 is a detail view, considerably enlarged, showing certain mechanism which is indicated diagrammatically in Fig. 1, this view being taken substantially along the line 8—8, Fig. 1;

Fig. 9 is a plan view of certain sensing mechanism that is indicated only diagrammatically in Figs. 1 and 2; and

Fig. 10 is a vertical sectional view, taken substantially on the line 10—10, Fig. 9, of such sensing mechanism.

Before proceeding with a detailed description of the specific mechanism which embodies my invention, a brief discussion of the problem involved and the principles upon which its solution may be based may be given, after which the detailed description may be more readily apprehended.

Referring to Fig. 1 there are shown a pair of side frames 50L and 50R which support respectively two parallel tables along which series of related articles may be passed in sequence. For purposes of illustration, the articles may be considered to be perforated cards bearing complementary indicia in pairs so that in order to utilize the indicia, or to interpret and apply data represented by such indicia, it is essential that related pairs of articles, such as cards, be moved to their respective and effective positions either simultaneously or in some other specific and predetermined timed relation. Thus each pair of articles, one from each series, are to be passed along a path of travel to mechanism which reads out the indicia on each and combines such indicia to perform some indicated function. For example, one of the cards or articles may carry indicia to control the setting up of recording or printing elements for recording a name, address and other data pertaining to an individual. The complementary card or article may bear data, for example, to show a sum of money or other numerical data to be charged or credited to the individual whose name is carried by the first card mentioned.

Obviously, if two related cards are not properly phased, certain data properly chargeable or creditable to one individual might be charged or credited to another. Means must be provided, therefore, for ascertaining, before data is read out, that the two cards or other articles are properly related. In the apparatus mentioned above as being disclosed in the aforesaid Gollwitzer Patent No. 2,296,277, both members are provided, in code, with an identical account number and both are sensed to insure that they are properly matched. If not properly matched the entire machine is stopped until the series of articles are rearranged to be fed in proper sequence and phase.

Consider the two magazines 51L and 51R, Fig. 1, as containing series of related cards, supposedly arranged in the same order so that as a first card A is fed from magazine 51L, a complementary or related card A' will be fed from magazine 51R. These cards will be fed step by step through several consecutive positions, as will hereinafter be more fully described. Following, a card *b* from the first magazine or stack should be matched by a complementary card *b'* from the second, and subsequent pairs *c, c'*; *d, d'*; *e, e'*; and so on should be fed in the same phase relationship. If the cards are all fed in proper order, each matched pair will perform its proper function. The units of each pair need not necessarily be advanced simultaneously, it being obvious that only a definite phase relationship is required. However, for simplicity in explaining the operation, it will be assumed, except where otherwise noted, that complementary cards, or cards forming a matched pair, are fed substantially simultaneously.

In the machine described in the aforesaid patent, the displacement of a single unit, such as a card, in either magazine, causes the machine to be shut down, as has been mentioned above. It very frequently happens that two cards are interchanged, or one card or printing device is inadvertently omitted from a stack, or one is intentionally withdrawn without removing its related or complementary article from the other stack. Under any of these conditions, the machine would shut down automatically, and remain inactive until an attendant can find and remedy the cause, although it is obvious that, at most, the bulk of the articles in both magazines are either in proper phase or only one step out of phase.

Thus, in the example given above, where related or complementary pairs of articles *a, a'*; *b, b'*; *c,*

c'; etc., are to be fed sequentially, if articles b and c happen to be interchanged, articles a and a' would pass through their normal cycle and execute their intended function. According to my invention, when the next pair, c and b' are sensed, operation of the machine where their function is performed would not be interfered with, but one of these articles, for example c, would next be compared with an opposing article in the next phase or feed step. In this example, the compared article would be c', which matches with c. Article b' would thereupon be rejected as superfluous. Articles c and c' would pass on to perform their usual and intended functions.

At the next feed cycle or step, articles b and d' would be compared, the primed articles in magazine 51R now being one step ahead, in relative phase. After establishing the dissimiliarity or lack of proper relationship between these two articles, the former would next be compared with next in series in the other magazine, namely e'. Here again the comparison is unsuccessful and the sensing means further compares the first article in the second series (from magazine 51R) namely c', with the next ensuing article in the first series (from magazine 51L) namely c. This comparison is successful, the odd member b is discharged or ejected, articles c and c' pass through their normal cycles, and thereafter the ensuing articles in both series are in proper phase.

It will be noted from the above that there have been ejected articles b and b'. Later these may be dropped in their respective magazines, or if their order in the series is important, they may be properly inserted in place between articles a, c, and a', c', respectively. The fact that they are discharged calls definite attention to the fact that they have not performed their functions. They may be utilized later if desirable.

The specific mechanism by which the foregoing principle of operation is carried out will next be described. It is emphasized that the articles may be cards, plates, printing devices, or other articles, and they may bear perforations, notches, protuberances, tabs or any other control or data representing elements known to the prior art.

CARD FEED

Reference has been made hereinabove to the side rails 50L and 50R. These rails are provided with overhanging flanges which serve to guide the advancing cards c and c' as they are fed through the machine. Hence they will be referred to hereinafter as guideways.

Magazines 51L and 51R, also referred to above, are each comprised of front and rear walls 41 and 42, respectively, and left and right end walls 43 and 44, respectively. The front or left wall 41, as seen in Figs. 1 and 2, is spaced above the table top T a distance just sufficient to permit the feeding of one card c thereunder. The rear wall 42 is raised or slotted to accommodate a reciprocating feed plate to be described more fully presently.

The stack of cards c and c' in each of the magazines is supported on a reciprocable bottom plate 52. Cards fed out of the magazine advance along the table top T, being held thereon by the overlying flange elements 53 of the side frames, and of mid-frame members 54 which cooperate with the previously noted, card guideways 50L and 50R.

Each magazine is provided with a feeder consisting of a plate 55 secured to bottom plate 52 so as to project thereabove by a distance substantially equal to or very slightly less than the thickness of a card c. The plate 52 is drilled longitudinally, as indicated at 52A to slide on guide rods 52B projecting from a rigid transverse frame member F, Fig. 2.

At its rear end, plate 52 is connected by a link 56 to the lower end of a vertically extending lever 57 pivoted to a fixed transverse shaft 58. The upper end of lever 57 connects to a horizontally extending pawl 59 adapted to engage teeth on a ratchet wheel 60 secured to a main drive shaft 61. Shaft 61 is continuously driven in a clockwise direction, as seen in Figs. 2 and 5, by suitable power drive means not shown.

A spring 62 normally holds the pawl 59 up so that its nose does not engage the teeth on wheel 60. An armature 63, however, is secured to pawl 59 and an electromagnet 63L or 63R, which is periodically and temporarily energized, draws the armature 63 and hence pawl 59 downwardly so that the pawl engages the wheel 60. Wheel 60 thus draws the pawl to the rear, or to the right as seen in Fig. 2, and drives the feed plate 55 to the left to feed the bottom card c from the stack into the bite of feed rollers 64. A pin 65 is arranged to contact the cam shaped rear end of pawl 59 and disengage the pawl from drive wheel 60 when its stroke has been completed. By this time the solenoid or electromagnet 63L or 63R has been deenergized by means to be described hereinafter.

Feed rollers 64 are mounted on a shaft 67 which rotates in suitable bearings 68 secured to the main frame members of the machine. Bevel gears 69 and 70 interconnect shaft 67 with a longitudinal shaft 71 which is connected to main drive shaft 61 by bevel gearing 72. Rollers 73, Fig. 2, are mounted beneath feed rollers 64 and project slightly through openings 74 in the table top or bed plate T, to cooperate with rollers 64. Hence as the bottom card c is advanced from either of the magazines 51L or 51R into the bite of rollers 64 and 67, these rollers grip the card and forward it to another set of feed rollers 75 which are mounted on another transverse shaft 76 geared by bevel gearing 77 to longitudinal shaft 71. Cooperating rollers 78 are mounted to project through the bed plate T and the rollers 75, 78 grip the card frictionally to advance it against stop fingers 79.

Stop fingers 79 depend from a bar 80 secured to a longitudinally extending rock shaft 81 mounted at either side of the machine, one unit being provided for each feed channel. When stop fingers 79 are lowered, the card c is stopped in a first sensing position, the frictional grip of rollers 75 and 78 not being sufficient to buckle or otherwise injure the card.

Electromagnets 82L and 82R, respectively are positioned at the right and left sides of the machine to act upon armatures 83 secured to and extending laterally from rock shafts 81. See Figs. 1, 3 and 5. Whenever a magnet 82L or 82R is energized it is effective to raise the stop fingers 79 associated therewith and permit the stopped card c to advance.

The positions at which cards c are stopped by fingers 79 are respectively designated 1L and 1R, representing first sensing stations. Sensing means at such stations are respectively designated SL and SR, being shown only diagrammatically in Figs. 1 and 2. The sensing means employed are quire similar to those described in the aforesaid patent to Gollwitzer No. 2,296,277.

One unit is illustrated in Figs. 9 and 10 and will be described in some detail hereinafter.

Assuming that a card has been released from the first sensing station, IL or IR, by the operation of solenoids 82L or 82R, the feed rollers 75 and 78, which rotate continuously, next advance the card to another set of feed rollers 84 mounted on a transverse shaft 85 and driven by bevel gearing 86 from shaft 71. Cooperating rollers 87 under the table surface T assist to advance the card c to another set of rollers 88 mounted on another transverse shaft 89 driven by bevel gearing 90 from shaft 71. Cooperating rollers 91 beneath rollers 89 assist in advancing the card c to a second set of stop fingers 92 projecting downwardly from a bar 93 secured to the same rock shaft 81 to which fingers 79 are secured.

The second sensing stations at the left and right, shown at the rear and front, respectively, in Fig. 1, are designated IIL and IIR sensing means SL2 and SR2 are provided at these stations. Whenever a solenoid 82L or 82R is energized, both sets of fingers 79 and 92 controlled thereby are raised. Hence the card which was at station IL or IR advances to the second station IIL or IIR, and a card at one of the second stations, provided it is not rejected, as will be more fully explained hereinafter, is advanced into the bite of another set of feed rollers 94. Rollers 94 are mounted on a transverse shaft 95 driven by bevel gears 96 from drive shaft 71. Cooperating rollers 97 mounted beneath rollers 94 assist in advancing a card further into apparatus, not shown, wherein the pair of matched or complementary cards are utilized for their ultimate purpose. As indicated above, such purpose may be, for example, to control the setting up of printing members, accumulating mechanism, calculating machine elements, and the like, but the present invention is not concerned with the particular purpose of which the cards are matched and forwarded.

When the card stop fingers 79 and 92 are elevated, the card pusher mechanism operates to feed a card from the related magazine 50L or 50R into the bite of the feed rollers 84. This is effected under the control of a switch 98L or 98R, Fig. 5, which is closed by an arm 99 on the corresponding rock shaft 81 whenever a magnet 82L or 82R is energized. See also Fig. 3. Considering the switch 98L, for example, closure of this switch causes ground to be applied to a conductor 100, Fig. 5, leading to a terminal of the winding of magnet 63L, the other terminal of this winding being permanently connected to battery B. Magnet 63L, when energized, attracts the pawl 59 into engagement with a tooth on its driving wheel 60, thereby causing the feed plate 55, Figs. 2 and 5, to be actuated for feeding the bottom card from the magazine 51L in the manner described hereinabove. Similarly, the switch 98R, Figs. 1 and 9, controls energization of the magnet 63R to feed a card from the magazine 51R each time the magnet 82R is energized.

CARD REJECT

Under certain circumstances it is desired to divert cards from the guideways 50L and 50R at the second sensing stations IIL and IIR. This may occur, for example, when the card at station IIL matches the card at station IR but not the card at station IIR in which event the card at station IIR should be rejected. The cards are supported upon hinged plates 101, Figs. 1, 2 and 5, at the sensing stations IIL and IIR. Springs 102 normally maintain the plates 101 in raised position. The free rear edge of each plate 101 (adjacent the stop fingers 92) is connected by a link 103 to the core of a solenoid 104L or 104R positioned beneath the plate 101. When the solenoid 104R, for example, is energized, it retracts its core and the plate 101 is swung downwardly. The card at station IIR then slides off the plate 101 into a reject box 105, Fig. 2, after which the solenoid 104R is deenergized and the spring 102 restores the plate 101 into its normal horizontal position. The solenoid 104L functions in a similar manner to actuate the plate 101 at the station IIL whenever this is necessary.

CARD SENSING

The identification indicia (perforations) in the cards disposed at the sensing stations IL, IR, IIL and IIR are analyzed by sensing devices illustrated only diagrammatically in Fig. 1 for sake of clarity. Such sensing devices, as noted above, are generally similar to those shown in Gollwitzer Patent No. 2,296,277. As best shown in Figs. 9 and 10 they comprise, for each card column to be analyzed, a set of contact fingers or brushes cooperating with a single contact bar. Thus, for analyzing the units denomination of the identifying or serial number represented on a card, there are provided at each sensing station ten contact fingers 106U positioned to correspond with the ten index positions in the card column. The entire assembly of brushes is mounted in a block 106A slideably mounted on vertical guide pins 107A and adapted to be raised and lowered by means not shown but actuated by shaft 71 as each card is fed into sensing positions. These contact fingers engage the upper surface of the card, and depending upon where the perforation is located in the column, one of the contact fingers will pass through the card and engage the contact bar 107U disposed in the card guideway beneath that card column. Similarly, at each sensing station, a set of ten contact fingers 106T and contact bar 107T are arranged to sense the tens order card columns. Additional contact fingers and bars may be arranged to analyze higher orders, if any, of the mutually identifying code elements or numbers on the cards.

The contact bars 107U and 107T at the sensing stations IL and IR are mounted in the bed plate 54 in insulated relation thereto. The contact bars 107U and 107T at the sensing stations IIL and IIR are mounted in but insulated from the hinged plates 101. The contact fingers 106U at each sensing station are respectively connected electrically to the contact fingers 106U at every other sensing station, so that the contact fingers pertaining to like digits are connected electrically to the contact 106T at every other station.

SEQUENCE CONTROL

Assuming that four cards are respectively positioned at the stations IL, IR, IIL and IIR, the sequence in which the cards are compared and disposed of is as follows:

1. Cards at IIL and IIR are first compared. If their serial numbers agree, the stop fingers 92 on both sides are raised and both cards advance along the guideways 50L and 50R.

2. If the cards at IIL and IIR do not match, then the cards at IL and IIR are compared. If their serial numbers agree, the card at IIL is

rejected and the matching cards are then fed along the guideways past the stop fingers 92.

3. If the cards at IL and IIR do not match, the cards at IIL and IR are compared. If their serial numbers agree, the card at IIR is rejected and the matching cards are fed.

4. If none of the cards are found to be in agreement after four successive comparing operations, the machine stops.

In order to carry out the above described operations a suitable sequence control means is utilized, such means comprising, in the present instance, a series of rotary switches generally designated 108, Fig. 7, which are controlled by a stepping relay 109, Figs. 4, 6 and 7. The stepping relay 109 is mounted upon a bracket 110 which is attached in any suitable manner to the frame of the machine. A shaft 111 journaled in the bracket 110 carries a gear 112 and a ratchet wheel 113. This shaft 111 is shown in diagrammatical extension in Fig. 4 for the sake of clarity. The gear 112 meshes with a pinion 114 on a shaft 115 on which the rotatable parts of the sequence switches 108 are mounted. A spiral spring 116, Fig. 4, acting on the ratchet wheel 113 tends to rotate the ratchet wheel clockwise, as viewed in Fig. 4, until a pin 117 on the face of the ratchet wheel strikes an adjustable stop 118.

Advancing movement is imparted to the ratchet wheel 113 against the action of the spring 116 by a solenoid 119. The core 120 of the solenoid 119 has a pin-and-slot connection with a lever 121 carrying a pivoted dog 122 which rests upon and is guided by a lug 123 adjustably secured to the bracket 110, Fig. 4. When the solenoid 119 is in a deenergized condition, the lever 121 is maintained against a stop 124 by a spring 125, and the dog 122 is then out of engagement with the ratchet wheel 113. Upon energization of the solenoid 119, the core 120 is retracted and swings lever 121. The dog 122 is guided diagonally upwardly by the lug 123 into engagement with a tooth on the ratchet wheel 113 and advances the ratchet wheel a step. A spring-urged pawl 126 cooperating with the ratchet wheel 113 prevents the spiral spring 116 from returning the wheel 113 after it has been advanced by the dog 122. Repeated energization of the solenoid 119 progressively advances the ratchet wheel in a step by step manner counterclockwise, as viewed in Fig. 4, provided the pawl 126 remains effective upon the wheel to prevent retraction thereof by the spring 116.

An electro-magnet 127 mounted upon the bracket 110 has an armature 128 which bears against one end of a plunger rod 129, the other end of this plunger abutting the tail of the pawl 126. When the magnet 127 is energized, the armature 128 is actuated and pushes the plunger 129 to thereby swing the pawl 126 to an ineffective position. The ratchet wheel 113 is thus released and is retracted clockwise, as viewed in Fig. 4, until the pin 117 strikes the stop 118. Such energization of the magnet 127 is timed to occur while the solenoid 119 is in a deenergized condition, so that the dog 122 will not interfere with this reverse movement of the ratchet wheel.

The sequence switches 108, Fig. 7, which control the operations of the machine consist of the disks 130 to 140, inclusive, Figs. 4, 6 and 7, and cooperating spring contacts 141, Figs. 6 and 7. The disks 130 to 140, inclusive, are made of insulating material and are mounted upon the shaft 115 to rotate therewith. A pair of spring contacts 141 is associated with each disk. The contacts 141 are secured to and supported by a comb block 142 of insulating material. Metallic contact segments 143 on the disks 130 to 140 are adapted to establish electrical connections between the contacts 141 in the respective pairs thereof when brought into engagement therewith. A typical sequence switch has its disk 136 marked off into six equal sectors which may be respectively designated 0 and 1 to 5, inclusive. See Fig. 6. In the case of the disk 136 there are two contact segments 143 respectively located in the sectors 1 and 3. In the normal rest position of the shaft 115, the spring contacts 141 bear against the sector designated 0 on the disk 136.

The ratio between the gears 112 and 114, Figs. 4 and 6, is such that each time the ratchet wheel 113 is advanced a step by the solenoid 119, each of the disks 130 to 140 is rotated in an amount equal to the width of one sector thereof, that is, one sixth of a revolution. In the case of the disk 130, Fig. 6, this brings the contact segment 143 in sector No. 1 into engagement with the spring contacts 141, thereby bridging these contacts. Then, as the shaft 115 is advanced another step, the electrical connection between the contacts 141 is broken. If the shaft 115 is given a third step of advancing movement, the contacts 141 are again bridged by a contact segment 143 in the third sector on the disk 136. There are various arrangements of contact segments 143 on the disks 130 to 140 depending upon the functions performed by these disks, as will be explained.

Energization of the stepping relay solenoid 119 is effected automatically by a switch 144, Figs. 4 and 8, which is operated by a cam 145 on a shaft 146. Each time the shaft 146 makes a revolution, a lobe on the cam 145 momentarily closes the switch 144 to apply ground on a conductor 147 leading to one terminal of the winding of the solenoid 119, the other terminal of this winding being connected to battery B2. The solenoid 119 is thus energized upon each closure of the switch 144, that is to say, once for each revolution of the shaft 146.

The shaft 146 is connected through the medium of a clutch generally designated 148, Fig. 8 and gears 149 and 150 to the main drive shaft 61. The gear 149 is rotatably but nonslidably mounted on the shaft 146 and has a hub 151 provided with clutch teeth 152. A collar 153 splined to the shaft 146 has clutch teeth 154 opposing the teeth 152. Compression springs 155 interposed between the collar 153 and a collar 156 secured to the shaft 146 tend to urge the clutch teeth 154 into mesh with the clutch teeth 152. A plate 157 pivotally mounted at 158, Fig. 4, on the machine frame overlies the hub 151 and collar 153. This plate has a cam surface adapted to cooperate with a pin 159 on the collar 153 to maintain the clutch teeth 152 and 154 disengaged. A clutch of this general character is disclosed in Gollwitzer Patent No. 2,265,134 issued December 9, 1941.

A solenoid 160 stationarily positioned above the clutch 148 has a core to which is pivotally connected a depending bar 161 having a hooked lower end, not shown, which engages beneath the free end of the plate 157. When the solenoid 160 is energized it retracts the bar 161 upwardly and swings the plate 157 free of the pin 159. A spring-urged latch 162 then hooks the end of the plate 157 and maintains it elevated while the bar 161 drops back to its lower position, the energization of the solenoid 160 being only momentary. As the plate 157 is disengaged from the pin 159, the collar 153 is urged axially by the springs 155 to

bring the clutch teeth 152 and 154 into mesh. Thereupon the shaft 146 is coupled to the drive shaft 61 and the cam 145 commences rotating. The operation of the clutch is substantially identical with that described in the aforesaid patent, No. 2,265,134, except that in the patented clutch, the drive is uncoupled mechanically at the end of a single revolution.

When the shaft 146 is to be uncoupled from the drive shaft 61, an electromagnet 163 adjacent the latch 162 is energized. The latch 162 is attracted toward the core of the magnet 163 and is thus disengaged from the plate 159. Upon being released in this manner the plate 157 drops down onto the hub 151 and collar 153. As the pin 159 on the collar 153 comes around, it rides against the cam surface on the plate 157 and the collar 153 is cammed in an axial direction until the clutch teeth 154 and 152 are out of mesh, whereupon the shaft 146 comes to rest. A roller 164 mounted on the plate 157 rides in contact with the face of the gear 149 at all times to brace the plate 157 against any axial thrust imparted to it by the pin 159.

CIRCUIT DIAGRAM AND OPERATION

Before initiating automatic operation of the machine, the operator manually operates the card handling means to feed cards from the two supply magazines to the sensing stations IL, IIL, IR and IIR. This is done by depressing the push-buttons 165L and 165R, Fig. 5. These are not shown in Fig. 1 but may be located at any convenient place in the machine. Considering the push-button 165L, for example, depression thereof closes circuit from ground to a conductor 166 which is connected to a conductor 167 leading to the winding of the magnet 82L. Circuit from ground continues through this magnet winding and a conductor 168 to a normally closed contact 169 of a slow-to-energize relay 170L, thence through this relay contact and a conductor 171 to battery B3. A conductor 172 connects one terminal of the winding of the relay 170L to the conductor 166, the other terminal of this winding being connected to battery B3. Current therefore starts to flow simultaneously through the windings of the magnet 82L and relay 170L. The magnet 82L energizes and attracts its armature 83, causing the shaft 81, Fig. 1, to be rocked. Arm 99 on the shaft 81 closes the switch 98L, energizing the magnet 63L, Fig. 5, and causing the pawl 59 to engage its driving wheel 60. The pusher 55 is thereby actuated to feed a card from the magazine 51L, Fig. 2, into the card guideway 50L, where it is advanced by the feed rollers 64 and 75, Fig. 1, toward station IL. Shortly prior to the time this card attains the station IL, and about the time pawl 59 is raised by pin 65, Fig. 2, the relay 170L, Fig. 5, completes its energization and opens its contact 169, thereby breaking the circuit through the winding of magnet 82L. The magnet deenergizes, releasing the armature 83 and allowing the card stop finger 79 to drop and arrest the card at station IL. The switch 98L opens and breaks the circuit to the magnet 63L, releasing the pawl 59.

To advance the card from station IL to station IIL and feed another card to station IL, the push button 165L, is released, thereby deenergizing the relay 170L, and is again depressed. Magnet 82L again energizes, elevating the stop fingers 79 and 92 and bringing about the energization of the magnet 63L. The card at station IL is advanced toward station IIL by the feed rollers 75, 84 and 88, and a new card is ejected from the magazine 51L, Fig. 2, by the pusher 55 and is advanced toward station IL by the feed rollers 64 and 75, Fig. 1. The relay 170L, Fig. 5, upon completing its energization, deenergizes the magnet 82L, releasing the stop fingers 79 and 92 in time to arrest the cards at stations IL and IIL. The push button 165L may then be released.

In a similar manner, cards are fed from the magazine 51R and positioned at stations IR and IIR by two successive actuations of the push button 165R.

Referring to Fig. 4, automatic operation of the machine is initiated by closing a switch 173 (left side of Fig. 4) thereby applying ground to one of the spring contacts 141 cooperating with the disk 132. A contact segment 143 in the "0" sector on the disk 132 bridges the associated contact springs 141 when the disk 132 is in its home position. Ground is therefore extended to a conductor 174 leading to a normally closed contact 175 of a relay 176. The circuit from ground continues through this relay and conductor 177 leading therefrom to the winding of the clutch solenoid 160, and thence to battery B4. Solenoid 160 energizes and raises the cam plate 157, causing the clutch 148 to operate and thereby initiating rotation of the cam 145.

The subsequent operation of the machine will be considered under four separate headings, in accordance with the four different conditions that may prevail, as indicated hereinabove.

1. *Cards at stations IIL and IIR match*

The cam 145 closes the switch 144, energizing the solenoid 119 and advancing the ratchet wheel 113 one step. The switch disks 130 to 140 are thereby advanced so that their No. 1 sectors cooperate with their spring contacts 141. The contact segment on the disk 132 is disengaged from the spring contacts 141, deenergizing the clutch solenoid 160. However, the cam plate 157 is held in its upper position for the time being by the latch 162, so that the clutch 148 remains engaged.

As the switch disks 135 and 136 move into their No. 1 positions, the contact segments 143 in the No. 1 sectors of these disks bridge the respective contacts 141. One contact 141 of each of the pairs thereof associated with these disks is connected to a conductor 178 leading to a contact 180 of a relay 181, this relay contact being normally closed to ground when the relay is deenergized. Circuit from ground is thus established from the relay contact 180 through the switch disk 135 and a conductor 182 to the winding of a relay 183, thence through this winding to battery B5. Relay 183 energizes and closes its contacts 184 and 185, applying ground on the conductors 186 and 187, respectively, which are connected to the windings of relays 188 and 189. These relay windings are connected on their other sides by conductors 190 and 191 to the contact bars 197T and 197U, respectively, at the sensing station IIR. The No. 1 contact 143 on the switch disk 136 closes circuit from the grounded conductor 178 to a conductor 192 leading to the winding of a relay 193, this winding being connected to battery B6. The relay 193 energizes and closes its contacts 194 and 195, thereby extending current through conductors 196 and 197, respectively, to the contact bars 197U and 197T at the sensing station IIL.

Assuming that the two cards at the stations IIL and IIR have the same serial numbers, or have other identifying indicia, that is to say,

that there are perforations at the same index positions in corresponding card columns, circuits are completed from battery B6 at the relay contacts 194 and 195 through the conductors 196 and 197, contact bars 107U and 107T, perforations in the card at station IIL, contact fingers 106U and 106T at the station IIL, contact fingers 106U and 106T at the station IIR, perforations in the card at station IIR, contact bars 107U and 107T, conductors 191 and 190, windings of relays 189 and 188, and conductors 187 and 186 to ground at the relay contacts 185 and 184, respectively. Relays 188 and 189 then energize and close their respective contacts 19 and 199. These relay contacts are so interconnected that when both of the relays 188 and 189 are energized, a circuit is established from ground through the contacts 198 and 199 in series to a conductor 200 leading to a contact 201 of a relay 202. The contact 201 is normally closed when the relay 202 is in a deenergized condition, and is connected by a conductor 203 to an end of the winding of relay 202, the other end of this winding being connected to battery B7.

Application of ground to the conductor 200 therefore causes the relay 202 to energize, opening its contact 201 and closing its contacts 204 and 206. The contact 204, in closing, completes a stick circuit for the relay 202 as follows: from ground at one of the contacts 141 of the switch disk 138, through the contact segment 143 on this disk to the other contact 141 (the segment 143 extending continuously through the sectors 1 to 5 of the disk 138), thence through a conductor 206, relay contact 204, conductor 203, and winding of relay 202 to battery B7, thus maintaining the relay 202 energized. Preferably the relay contacts 201 and 204 are so arranged that the contact 204 closes at or prior to the time the contact 201 opens, so that the stick circuit for the relay 202 is established before the initial energizing circuit therefor is broken.

Relay contact 205, which is closed when relay 202 is energized, extends ground through a conductor 207 to a contact 208 of the relay 181, which contact is normally closed when the relay 181 is deenergized, thence through a conductor 209 to a conductor 210, Figs. 4 and 5. The winding of the latch releasing solenoid 163, Figs. 4 and 8, for the clutch 148 is connected on one side to the conductor 210 and on the other side to battery B8. Solenoid 163 therefore energizes when ground is applied to the conductor 210, and in so doing it retracts the latch 162, enabling the cam plate 157 to drop into the path of the pin 159, Figs. 4 and 8, on the clutch collar 153. This brings about the separation of the clutch teeth 152 and 153, thereby arresting the cam 145 at the end of the first revolution thereof so that it cannot close the switch 144 to send a second impulse to the stepping relay 109.

One of the spring contacts 141 associated with each of the switch disks 137 and 138, Fig. 5, is connected to the conductor 210. The other contact 141 of the disk 138 is connected to the conductor 166 which leads to the windings of the card finger control magnet 82L and the slow-to-energize relay 170L. In a similar manner the other contact of the disk 137 is electrically connected in parallel to the card finger control magnet 82R and the slow-to-energize relay 170R. The spring contacts 141 associated with the disks 137 and 138 are bridged by the No. 1 contact segments 143 on these disks in the present instance inasmuch as the stepping relay 109 has been actuated only once. Hence, when the conductor 210 is grounded as just explained, these switch contacts establish circuits for energizing the magnets 82L and 82R and the relays 170L and 170R. The relays 170L and 170R require a certain amount of time to fully energize and actuate their contacts, and during this interval the magnets 82L and 82R energize and operate the stop fingers 70 and 92, Fig. 1, whereby the cards at stations IIL and IIR are advanced out of these stations through the guideways 50L and 50R, and the cards at stations IL and IR advance to the stations IIL and IIR, respectively. It should be noted that the relay 202, Fig. 4, is held energized through its stick circuit irrespective of the conditions of energization or deenergization of the relays 188 and 189 as the cards are moved. The cards which are moved away from stations IL and IR are replaced by other cards which are fed from the magazines 51L and 51R, as explained hereinabove.

When the relays 170L and 170R energize, they open their contacts 169 to interrupt the circuits through the windings of the magnets 82L and 82R, and they also close other contacts 211, thereby establishing a series circuit as follows: from ground through the contact 211 of relay 170L, conductor 213, contact 214 of a relay 212L, conductor 215, contact 211 of relay 170R, conductor 216, contact 214 of a relay 212R, conductor 217, Figs. 5 and 4, conductor 218 and winding of relay 181 to battery B8.

The relay contacts 214 are normally closed when the relays 212L and 212R are deenergized. Relay 181 energizes, closing its contacts 219 and 220 and opening its contacts 180 and 208. Opening of contact 180 deprives the conductor 178 of ground and effects the release of relays 183, 193, 188 and 189. Closure of contact 219 establishes a stick circuit from the conductor through a conductor 221, relay contact 219 and conductor 222 to the winding of relay 181, thereby placing the relay 181 under control of the switch disk 138. Opening of relay contact 208 frees the conductor 210 of ground, thereby deenergizing the magnet 163 and releasing the clutch latching member 162, and also deenergizing the relays 170L and 170R. As these relays deenergize, they release their contacts 211 and deprive the conductor 217 of ground. The contacts 219 and 208 of the relay 181 are arranged to respectively close and open in the sequence named when this relay is energized, in order that the stick circuit will be established before the initial energizing circuit for the relay is broken.

Contact 220 of relay 181, in closing, extends ground through conductors 223 and 224 to the winding of magnet 127, Figs. 4 and 6, which magnet thereupon energizes and trips the pawl 126, releasing the ratchet wheel 113 of the stepping relay 109. The spiral spring 116 returns the ratchet wheel 112 to its initial inactive position, thus moving the cam disks 130 to 140, inclusive, back into the positions wherein the 0 sectors thereof are engaged by the spring contacts 141. As the disk 138 is restored to such position, its contacts ride off the contact segment, and the stick circuits for the relays 181 and 202 are interrupted, whereupon these relays deenergize. Relay 181 opens its contact 220, deenergizing the magnet 127 and causing the pawl 126 to re-engage the ratchet wheel 113. In this way the pawl 126 is held out of engagement with the ratchet wheel until the latter has completed its return to its home position.

As the switch disk 132 moves into its home position, the contact segment 143 thereof bridges the spring contacts 141 and extends ground from the closed switch 173 through the conductor 174, closed relay contact 175 and conductor 177 to the winding of the clutch solenoid 160. The solenoid 160 energizes, setting the clutch 148 in operation, and the cam 145 commences to rotate. Thus, a new card comparing operation is initiated.

2. *Cards at stations IL and IIR match*

Assuming that the serial numbers of the cards at the stations IIL and IIR do not agree, but that the serial numbers or other control indicia of the cards at the stations IL and IIR do agree, the operation is as follows:

The cam 145 closes the switch 144, sending an impulse to the solenoid 119 of the stepping relay 109. The solenoid 119 energizes and actuates the ratchet wheel 113, placing the switch disks 130 to 140 in their No. 1 positions. Relays 183 and 193 energize as before, but inasmuch as it has been assumed that the numbers of the cards at stations IIL and IIR do not match, either one or both of the relays 188 and 189 will remain deenergized and hence the relay 202 is not energized. Consequently, the magnet remains latched up. This enables the cam 145 to continue its rotation and close the switch 144 a second time, sending a second impulse to the solenoid 119. Thus, the stepping relay 109 is actuated to place the switch disks 130 to 140 in their No. 2 positions. See Fig. 6.

The switch disk 135 has a contact segment 143 in its No. 2 sector for closing circuit from the grounded conductor 178 to the winding of the relay 183, which relay then energizes and closes its contacts 184 and 185 to connect ground on the windings of the relays 188 and 189. The switch disk 134, having a contact segment 143 in its No. 2 sector, closes circuit from the conductor 173 through a conductor 225 and winding of a relay 226 to battery B9. The relay 226 energizes and closes its contacts 227 and 228, which extend current from battery B9 through conductors 229 and 239 to the contact bars 107T and 107U at the station IL. Assuming that the serial numbers or other identifying indicia of the cards at the stations IL and IIR are properly related, circuits are established for sensing means SL from the contact bars 107T and 107U through perforations in the card at station IL to the aligned contact fingers 106T and 106U, thence through contact fingers 106T and 106U, perforations in the card at station IIR and contact bars 107T and 107U to the windings of the relays 188 and 189. Relays 188 and 189 thereupon energize and close circuit from ground to the conductor 229, causing relay 202 to energize and extend ground to the conductor 210, in the manner explained in greater detail in connection with the preceding operation. Magnet 163 is energized when conductor 210 is grounded, and operates to release the cam plate 157, thereby bringing about the uncoupling of the cam 145 from the driving member of the clutch 148. In this manner, sensing means SL compare a card with another sensed at SR2.

Grounding of the conductor 210 also extends a circuit through the No. 2 segment of the switch disk 137, Fig. 5, to the windings of the magnet 82R and slow-to-energize relay 170R. Magnet 82R energizes, causing the right-hand stop fingers 92 to be elevated. The card at station IIR advances along the guideway 50R and is replaced by a card from station IR, while another card is fed from the magazine 51R to station IR in the manner described above. Energization of relay 170R after a measured time interval deenergizes the magnet 82R and releases the card stop fingers 92.

The switch disk 139, Fig. 5, has a contact segment 143 in its No. 2 sector. This segment bridges its associated spring contacts 141 in the present instance, causing ground to be extended from the conductor 210 to the winding of the solenoid 104L and also to the winding of a slow-to-energize relay 231L. The winding of solenoid 104L derives its current from a battery B10 through a normally closed contact of the relay 231L. Solenoid 104L energizes and pulls its link 103 downwardly. This causes the drop section 101 at station IIL to swing down, and the card at station IIL slides off into a bin such as 105, Fig. 1, beneath the card guideway.

The core of the solenoid 104L is provided with a pin 232 which engages a blade 233 of a switch 234L as the solenoid 104L is energized, causing the blade 233 to separate from the switch blade 235 and bringing a blade 236 into engagement with the blade 235. Ground is extended from the blade 235 through the blade 236 to the winding of a relay 237L. This relay then energizes and closes its contacts 238, 239, 240 and 241. Contact 239, in closing, completes a holding circuit from ground at the normally closed contact 242 of relay 170L to the winding of relay 237L, maintaining the latter relay locked up. Battery BL11 supplies current for the latter relay, a similar battery BR11 being provided for relay 237R.

Relay contacts 240 and 241, in closing, establish circuits as follows: from ground through the normally closed contact 243 of a push button switch 244L and relay contacts 240 and 241, respectively, to the windings of a relay 245L and the slow-to-release relay 212L. The latter two relays promptly energize, batteries B12 and B13 being connected thereto. Relay 212L opens its normally closed contacts 214 and 246. Relay 245L closes a contact 247 to establish a stick circuit for itself from the conductor 178, Figs. 9 and 8, which leads to the normally closed and grounded contact 130 of the relay 181. Relay 245L also closes a contact 248, but this is without effect at present.

As the slow-to-energize relay 231L completes its energization, it opens its contact and deenergizes the solenoid 104L. The spring 102 thereupon restores the drop section 101 and the core of solenoid 104L to the illustrated positions, Fig. 2. As the pin 232 rises, the switch blades 236 and 235 separate and the blades 233 and 235 re-engage. Ground is extended from blade 235 through blade 233, a conductor 249, closed contact 238 of relay 237L and conductor 250 to the conductor 166 leading to the windings of magnet 82L and slow-to-release relay 170L. The magnet 82L then operates in the usual manner to elevate the left hand stop fingers 92, enabling the card at station II to advance to station IIL, replacing the card which was dropped into the bin 105. Also, a new card is fed to station IL.

The relay 170L energizes and brings about the release of the stop fingers 92 to arrest the first-mentioned card when it attains station IIL. However, it will be recalled that the card which was at station IL matches the card that has just been fed out of station IIR, hence it is necessary that the stop fingers 92 be again elevated so that

the card now in position IIL may continue its advance along with the card from station IIR. This occurs in the following manner:

As the relay 170L energizes, it opens its contact 242, thereby breaking the stick circuit for the relay 231L. The latter relay deenergizes and opens its contacts 238 to 241. Contact 238, in opening, deprives the conductor 250 of ground and thus effects the release of relay 170L. Contact 240 opens without effect, since relay 245L is held energized through its stick circuit. Opening of contact 241 breaks circuit to the winding of the slow-to-release relay 212L. This relay is delayed sufficiently in its deenergization to enable the relay 170L to release; then it closes its contacts 246 and 214. Contact 246 applies ground to the contact 248 of relay 245L. The contact 248, being closed, extends ground through a conductor 251 to the windings of the magnet 82L and slow-to-energize relay 170L. Magnet 82L is thus energized a second time, causing each card in the guideway 50L to advance. Hence, the card at station IIL is fed out of sensing position into the machine to join the matching card which was earlier fed out of station IIR.

Relay 170L energizes after a time interval to deenergize the magnet 82L in the usual manner, and in so doing it closes its contact 211. Circuit from ground is established through contact 211, conductor 213, contact 214 of relay 212L, conductor 215, contact 241 of relay 170R, conductor 216, contact 214 of relay 212R, and conductor 217 to the winding of relay 181, Fig. 4, which energizes. Relay contact 180 opens, depriving the conductor 178 of ground, thereby causing the relays 183, 188, 189, 226, 245L and 170L to deenergize. Contact 219 of relay 181 establishes a stick circuit for this relay under control of the switch disk 130. Contact 208 opens, depriving the conductor 210 of ground, and thus effecting the release of magnet 163 and slow-to-energize relays 231L and 170R.

Contact 220 of relay 181, in closing effects the energization of the magnet 127 which trips the pawl 126, causing the ratchet wheel 113 to snap back to home position, restoring the switch disks 130 to 140 to their zero positions. Switch disk 130 breaks the stick circuits for the relays 181 and 202, releasing these relays.

As the switch disk 132 attains zero position, it reestablishes a circuit from ground to the clutch solenoid 160, thereby initiating the ensuing card-comparing operation.

3. *Cards at stations IIL and IR match*

This operation is merely the reverse of that described above and will not be explained in detail.

The stepping relay 109 is stepped around to its No. 3 position before an agreement in serial numbers or other indicia is detected. Then, the magnet 82L is energized, raising the left-hand stop fingers 92 and enabling the card at station IIL to be fed out through the guideway 40L. The solenoid 104R is energized, causing the card at station IIR to be dropped into the bin 105. Following this, the magnet 82R is energized twice so that the card at station IR will advance first to the station IIR and then out into the guideway 50R toward the machine, to join the matching card which was advanced out of station IIL.

New cards are positioned at the four sensing stations, and the stepping relay 109 is returned to normal, initiating a new comparing operation.

4. *Cards at station IL and IR match*

In addition to the three comparing operations enumerated above, a fourth may be performed if desired.

Stepping relay 109 is stepped around to its No. 4 position. The solenoids 104L and 104R are both energized, causing the cards at stations IIL and IIR to drop into the bin 105. Each of the magnets 82L and 82R is then energized twice to advance the cards at stations IL and IR first to the stations IIL and IIR and then into the guideways 50L and 50R. Following this, the stepping relay 109 is normalized.

It will be understood that the processing of operations described above would eventually bring cards from stations IL and IR to stations IIL and IIR, where they would be compared as described under (1) above. Hence step (4) may be omitted by arranging for restoration of the stepping relay mechanism 113, etc., to zero position after the third test for another test like the first, cards originally at IIL and IIR having been discarded. However, it is preferable to test cards at IL and IR as just described and as shown in the wiring diagram.

5. *None of the cards agree*

Stepping relay 109 is stepped into its No. 5 position. A contact segment 143 on the switch disk 131 closes circuit from ground through a conductor 252 and a normally closed contact 253 of the relay 176, referred to hereinabove, to a conductor 254 leading to the winding of relay 176. Relay 176 is energized by battery B14 and closes a contact 255 prior to opening the contact 253. Contact 255, in closing, completes a stick circuit from the conductor 254 through this contact and a conductor 256 to a push button switch 257 which is normally closed to ground, thereby maintaining the relay 176 energized.

An alarm 258 is connected in parallel with the relay 176 to be energized concurrently therewith by a battery B15, and is held energized through the stick circuit for the relay 176.

The relay 176, in energizing, also closes a contact 259 to extend ground from the conductor 252 through conductors 260 and 210 to the magnet 163, which energizes and brings about the release of the clutch 148 in the manner described above. Another contact 261 of the relay 176 closes when this relay is energized and extends ground from the conductor 252 through conductors 262 and 218 to the winding of the relay 181. The latter relay energizes and closes its contact 219 to complete the stick circuit controlled by the switch disk 130. Contact 220 of relay 181 closes circuit to the tripping magnet 127 and causes the stepping relay to return to normal. Ast the switch disks 130 and 131 attain their 0 positions, the relay 181 and magnets 127 and 163 are released. Relay 176, however, is held energized through its stick circuit.

Relay 176 also has a normally closed contact 175 through which circuit is ordinarily established to the winding of the clutch solenoid 160 when the switch disk 132 returns to its 0 position. This relay contact 175, however, opens when the relay 176 is energized and prevents energization of the clutch solenoid 160. Thus, the entire apparatus is disabled and no further comparing operations can be performed until the condition is remedied.

The operator, upon learning of the fact that the apparatus is no longer functioning, first opens the switch 173 and then depresses the push but-

ton 257 to release the relay 176. The machine is then operated manually to correct the condition of non-agreement.

MANUAL CONTROLS

Mention has been made of the push buttons 165L and 165R, Fig. 5, and their use in actuating the magnets 82L and 82R for momentarily elevating the card stop fingers 92. This is advantageous where it is desired merely to advance the cards along the guideways.

There may be instances, however, where it is desired to eject a card from a station IIL or IIR and move the succeeding cards up a single station each. For example, assuming that the card at station IIL is to be ejected and the card at station IL moved into station IIL and retained there, the procedure is to depress the push button 244L, Fig. 5. A contact piece 263 on the plunger of this switch closes circuit from ground to the windings of the solenoid 104L and slow-to-energize relay 231L. Solenoid 104L energizes and swings the drop section 101 downwardly to eject the card at station IIL into the bin 105. Concurrently therewith the relay 237L is energized, in the manner explained above, but the relays 212L and 245L are prevented from energizing in this instance inasmuch as the contact 243 of the switch 244L is open.

Relay 231L energizes in due course and releases the solenoid 104L. Relay 237L being energized, the stop finger magnet 82L and associated relay 170L are energized as the drop section 101 is restored to its upper position, so that the card at station IL is advanced to station IIL and a new card fed to station IL. As relay 170L energizes it releases the relay 237L, which in turn brings about the release of the relay 170L. Whereupon the push button 244L may be released.

The push button 244R controls the right-hand side of the apparatus in the same manner as the push button 244L does with respect to the left-hand side.

A push button 264, Fig. 4, is provided for the purpose of enabling the solenoid 119 of the stepping relay 109 to be operated under manual control whenever desired. Another push button 265 controls operation of the tripping magnet 127.

It will be understood that where I have referred to batteries B1, B2, etc., for operating the various solenoids, these may all consist of a single battery with multiple connections, or may consist of any other suitable source of electrical energy. The various grounds may all be connected severally or in groups as may be most convenient.

While I have above referred to a certain sequence of operations, and to specific electrical connections, it will be understood that other arrangements may be had and that mechanical elements may be substituted for electrical relays or other elements and vice versa. It will also be understood that by reference to cards above, it is not intended that the invention be so limited. It is equally applicable to other articles bearing indicia of any character, such as notches, perforations, protuberances, conductive or insulating areas, or any form of intelligence capable of mechanical and/or electrical sensing.

Hence, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In an apparatus for pairing related articles that function when paired to control operation of a cyclic operable machine to which the paired articles are to be fed, means for advancing said articles in pairs, comparing means for comparing data representations borne by the articles of the first pair thereof, means for feeding said first pair of articles to the machine when the comparing means is effective to ascertain that such articles bear related data representations, other comparing means including sensing means adapted to cooperate with the articles in the second pair thereof, means operable to render said other comparing means effective only when the articles associated with the first comparing means are not related, means for rejecting one of the articles of the first pair thereof when said other comparing means is effective to determine that one of the articles associated with the first comparing means is related to one of the articles associated with said other comparing means, and means for associating the related article of the second pair with the related article of the first pair whereby the feeding means may be effective to feed such associated articles to the machine.

2. In apparatus for pairing related articles that function when properly paired and correlated to control operation of a cyclic operable machine to which paired articles are to be fed, means for feeding and comparing articles to group them in correlated pairs, including a first pair of comparing means for comparing two related articles first fed, another pair of comparing means for comparing one of said first two articles with a related article of another pair, and means operable to render said other comparing means effective only when the articles associated with the first comparing means are not properly paired and correlated one with the other, means for feeding properly paired and correlated articles to the machine, and means for rejecting articles which are not properly paired and correlated after repeated comparisons.

3. In apparatus of the character described, means for feeding articles to be compared and paired along two separate comparing paths, electrical sensing means at a first pair of stations along said paths for comparing a first pair of articles in said stations to determine whether they are properly paired, additional electrical sensing means at a second pair of stations for comparing one of said articles of said first pair with one article of another pair, means operable to render said additional sensing means effective only when the sensing means at the first station is effective to determine that the articles thereat are not related for pairing, and means for rejecting unpaired articles which give repeated negative results on such comparison, said last-named means being effective to withdraw said unpaired articles from said comparing paths.

4. In apparatus of the character described and for comparing related articles such as cards or the like which are fed together in pairs along a guideway in the apparatus and which function to control the apparatus when properly related, a first pair of comparing means for comparing a pair of articles first fed to determine if they are properly related, a second pair of comparing means for comparing a pair of articles next fed to see if they are properly related, means for comparing each of the articles in said first pair of

comparing means with the related one of the articles in said second pair of comparing means, means operable to render said second pair of comparing means effective only when the articles associated with said first pair of comparing means are determined not to be related, and means operable to reject unrelated articles from the guideway.

5. In apparatus of the character described, first and second pairs of comparing means, spaced-apart sensing stations in said apparatus and whereat said comparing means are respectively located for comparing data carried by different sets of articles feedable through the apparatus, a guideway in said apparatus along which said article may be fed to said sensing stations and through and past said pairs of comparing means, means responsive to the sensing of identical data on a pair of related articles at one of said stations for advancing said articles together in properly related pairs to a point of use in the apparatus, means responsive to failure to so sense identical data to reject one of said articles from the guideway, comparing means for comparing the unrejected article with another related article thereto at the other of said stations, means operable to render said comparing means effective only when identical data are not sensed by the first named means, and means operable to advance said other related article from said other station to said one station when said other comparing means determine that said unrejected article and said other article are properly related to be advanced together to said point of use.

6. In apparatus of the character described, a first pair of sensing stations for comparing indicia-bearing articles, a second pair of sensing stations for comparing indicia-bearing articles, means operable to first compare a pair of articles in said first stations and to forward them to a point of use when they are found to bear properly related indicia, comparing means for comparing an article located in the second pair of stations with the related one of the articles in said first station, means operable to render said comparing means effective only when the means operable to first compare a pair of articles in said first stations are effective to determine that the data on said articles are not related, and means to reject unrelated articles from the apparatus.

7. In apparatus for pairing related articles, a first pair of comparing stations including electrical sensing means for comparing a first pair of articles to ascertain whether they are properly related one with the other, a second pair of comparing stations including additional electrical sensing means to compare each of said articles with a related one of a second pair of articles at the second pair of stations, means operable to render said additional comparing means effective only when the means for comparing the first pair of articles at the first stations ascertain that such articles are not properly related, and means to advance articles from said first stations in pairs only when the articles thereat are determined to be properly related.

8. In a machine of the character described including a guideway for articles to be paired and related as pairs to subsequently control operation of the machine, two pairs of sensing stations in said guideway, feed control means responsive to the sensing of identical data borne by a pair of articles at one of the pairs of stations to advance such articles bearing identical data as a pair therefrom to a point of use in the machine, means responsive to failure to so sense identical data to reject one of said articles from the guideway at said one of the pairs of stations and to compare the remaining article at said forward station with a related article located at the other of the pairs of stations, and means operable to render said last-named means effective upon said rejection of said one of said articles.

9. In a machine of the character described including a guideway for articles to be paired and properly related one with the other to control operation of the machine, a first pair of sensing stations for comparing data borne by said articles to determine if the data borne by a pair of said articles are properly related whereby the articles may control the machine, a second pair of sensing stations, means operable to first compare a pair of articles in said first pair of stations to see if said articles are properly related, means to forward such articles at said first pair of stations to a point of use in the machine when such articles are found to bear related data, other comparing means for comparing one of the articles at said first pair of stations with a related article at said second pair of stations, means operable to render said other comparing means effective only when the said one article is determined to bear data unrelated to the other article at said first pair of stations, means to reject said other article from the guideway, and means to advance said related article at said second pair of stations to said first pair of stations when said related article is determined by said other comparing means to be properly related to said one article.

10. In apparatus of the character described including means for advancing different data-bearing articles along respective paths of travel to be arranged in properly related pairs, means at a first station along said path for comparing said articles to group them in properly related pairs, the articles in each properly related pair to bear identical data, second comparing means at a second station along said path of travel responsive to a first failure to find a properly related data relationship between articles in juxtaposed positions at the first station, for comparing at least one of said articles at the first station with at least one other related article not included in the first-named comparing operation, means operable to render said second comparing means effective only when the first-named means are effective to determine that the articles associated therewith bear unrelated data, third comparing means for comparing the second of said articles at the first station with a second other related article not included in the first-named comparing operation, means to render said third comparing means effective only when the said second comparing means determine that said second article and said second related article bear unrelated data, and means responsive to failure to relate one article with another to reject such unrelated article from the path of travel and to advance another article from the second station to the first station to take the place of the rejected article.

11. In electrical sensing apparatus for testing articles bearing indicia to group such articles as bear related indicia, and in which apparatus there are means for advancing such articles in pairs along separate paths from one sensing station in said paths to a spaced-apart other sensing station and for advancing such articles in properly related pairs from said other station, the combination of sensing means for first compar-

ing a plurality of articles located at said other station, other sensing means including elements of said first sensing means for comparing an article tested by said first means with an article at said one sensing station not tested by said first means, means operable to render said other sensing means effective only when the means for first comparing a plurality of articles is effective to determine that the articles sensed thereby are unrelated, and means to advance said article at said one station to said other station when said other sensing means determine that such one article is properly related to one of said unrelated articles.

12. In apparatus of the character described, two parallel feed channels, a series of feed rollers in each of said channels for advancing control articles along said channels, a reciprocating feeder for taking an article in each channel from a stack of articles and introducing said article into said feed channel, means for controlling the operation of said feeder, stop means along said channels for stopping articles in two different sensing positions in each channel, means for controlling said stop means, a sensing means in each sensing position in each channel, means connecting said sensing means to identify related articles located at each sensing position, means responsive to the identification of properly related articles for initiating operation of said control means for one of said stops at one of said sensing positions, means responsive to failure to identify related articles for rejecting one of such non-identifying articles from its channel, sensing means for sensing each of said non-identifying articles with the articles at the other sensing position that may be related thereto, and means to advance articles from the second to the first sensing position that may be determined as being properly related to the non-identifying articles at the first sensing position.

13. In an apparatus for pairing related articles that function when paired to control operation of a cyclic operable machine to which the paired articles are to be fed, means for advancing said articles in pairs, comparing means for comparing data representations borne by the articles of the first pair thereof, means for feeding said first pair of articles to the machine only when the comparing means is effective to ascertain that such articles bear related data representations, other comparing means including sensing means adapted to cooperate with the articles in the second pair thereof, means operable to render said other comparing means effective only when the articles associated with the first comparing means are not related, means for rejecting articles which do not match after repeated comparisons, and means for interrupting operation of the apparatus and the machine when the comparing means and said other comparing means are effective to determine that all the articles associated therewith are unrelated.

14. In apparatus of the character described, means for feeding related articles to be compared and paired along two separate comparing paths, a first pair of comparing stations along said paths and including a first pair of comparing means for comparing a first pair of articles to determine whether they are matched, a second pair of comparing stations along said paths and including other comparing means for comparing one of the articles in said first pair of articles with a related one of another pair at said second pair of stations, means operable to render said other comparing means effective when the articles associated with the first comparing means are not matched, and means within the comparing paths for rejecting from said path articles which are not properly paired after repeated comparisons.

15. In apparatus for pairing related articles to be advanced along a guideway and which function when properly paired and related to control operation of a cyclic operable machine, means for feeding and comparing articles in pairs to group them in properly related pairs, including, comparing means for comparing two articles first fed as a pair, other comparing means for comparing one of said articles first fed with another of a pair of articles next fed, means operable to render said other comparing means effective only when the articles associated with the first comparing means are determined as not related, means for feeding properly paired articles to the machine, and means for rejecting from the guideway articles which are not properly paired after repeated comparisons.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,591,005	Stuivenberg	June 29, 1926
1,989,049	Youngberg	Jan. 22, 1935
2,066,783	Kolm	Jan. 5, 1937
2,172,328	Bryce	Sept. 5, 1939
2,359,670	Page	Oct. 3, 1944
2,379,828	Rubidge	July 3, 1945
2,434,512	Page	Jan. 13, 1948
2,445,636	Rubidge	July 20, 1948