July 12, 1938. E. A. FORD 2,123,237

SORTING MACHINE

Filed Aug. 17, 1935 5 Sheets-Sheet 1

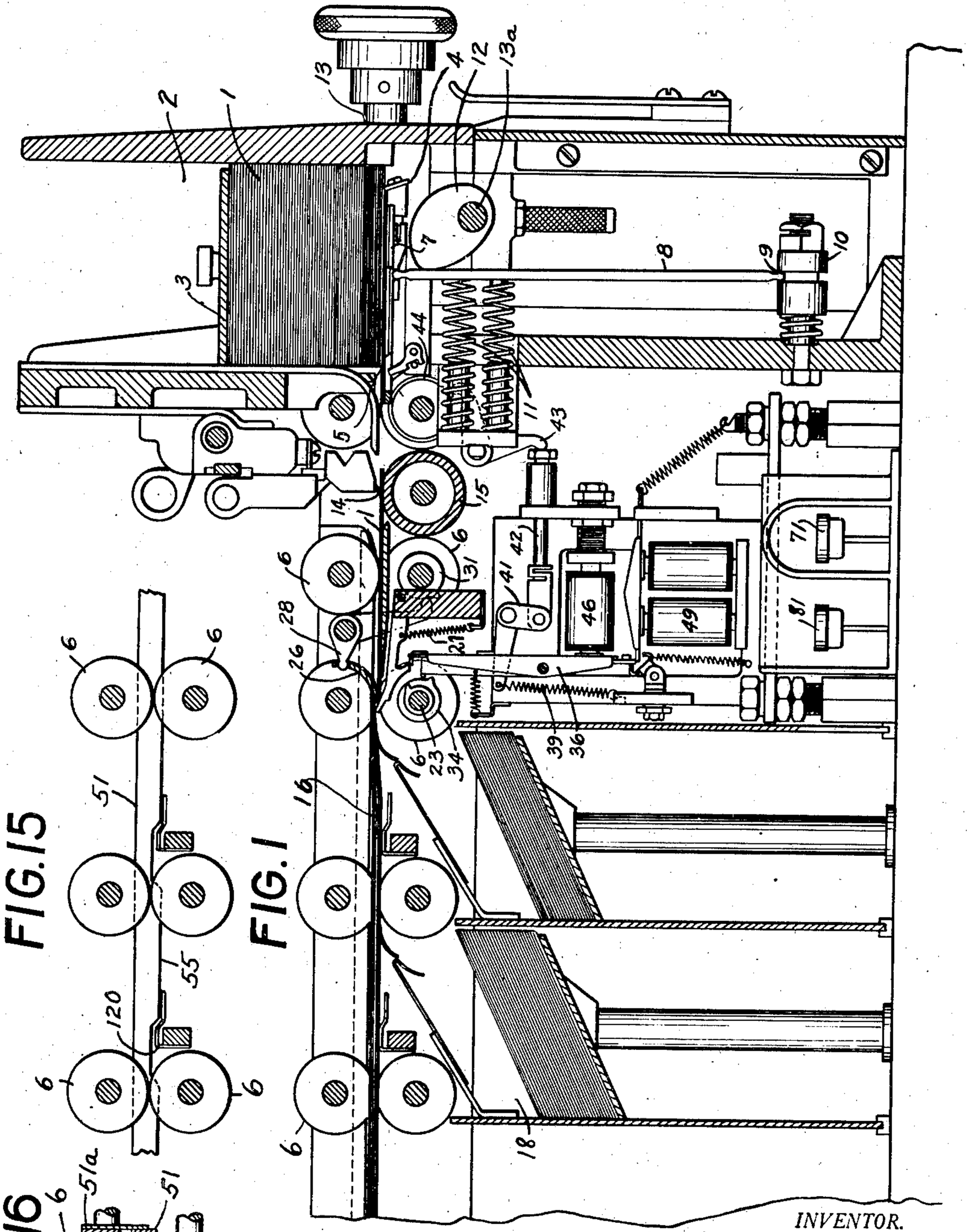

FIG. 1

FIG. 15

FIG. 16

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SORTING MACHINE

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FIG. 2

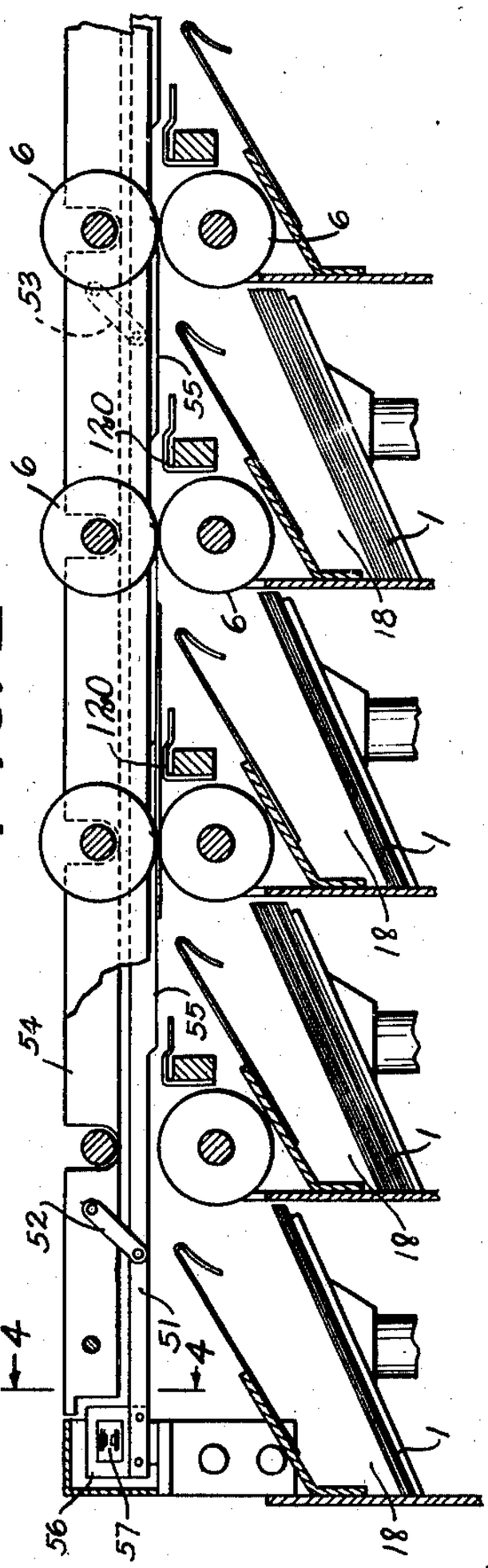


FIG. 4

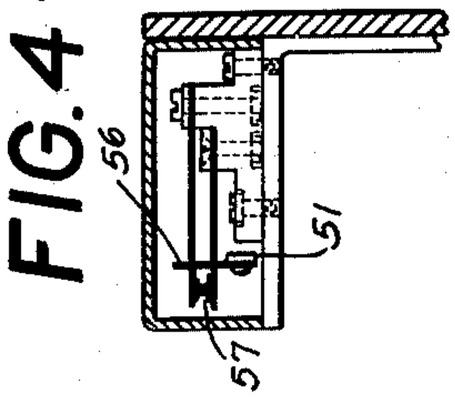
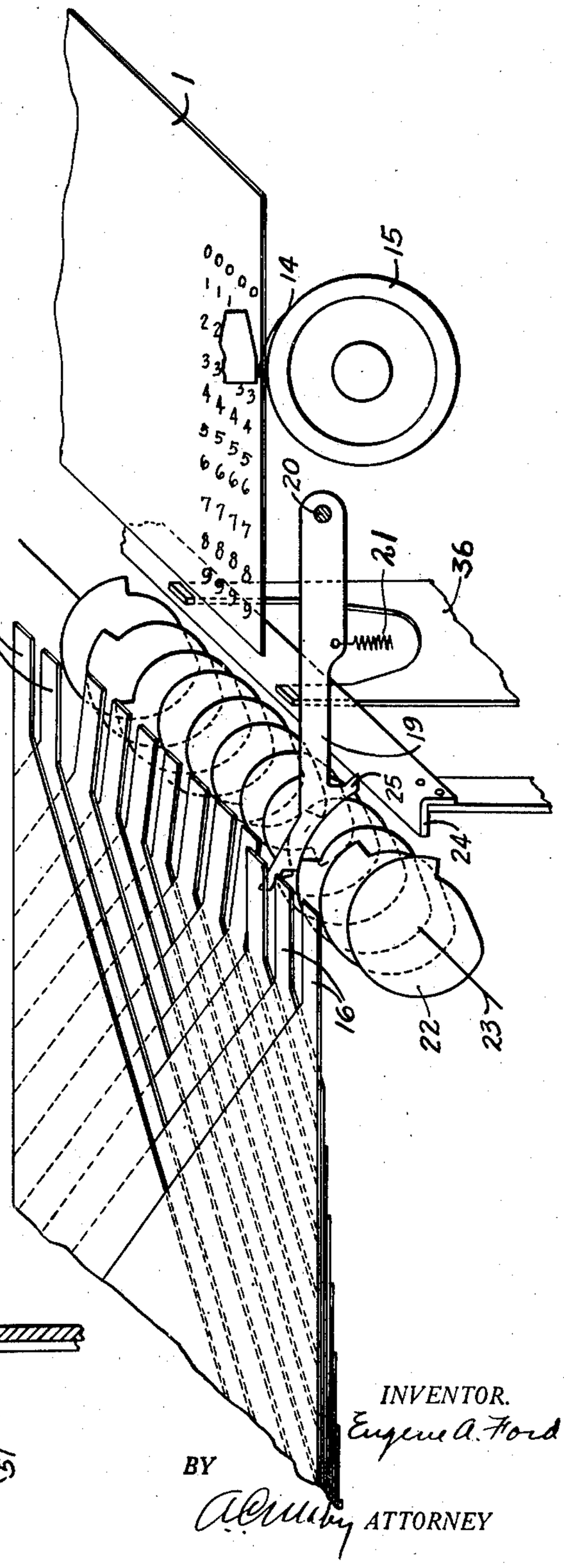


FIG. 3



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SORTING MACHINE

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FIG. 5

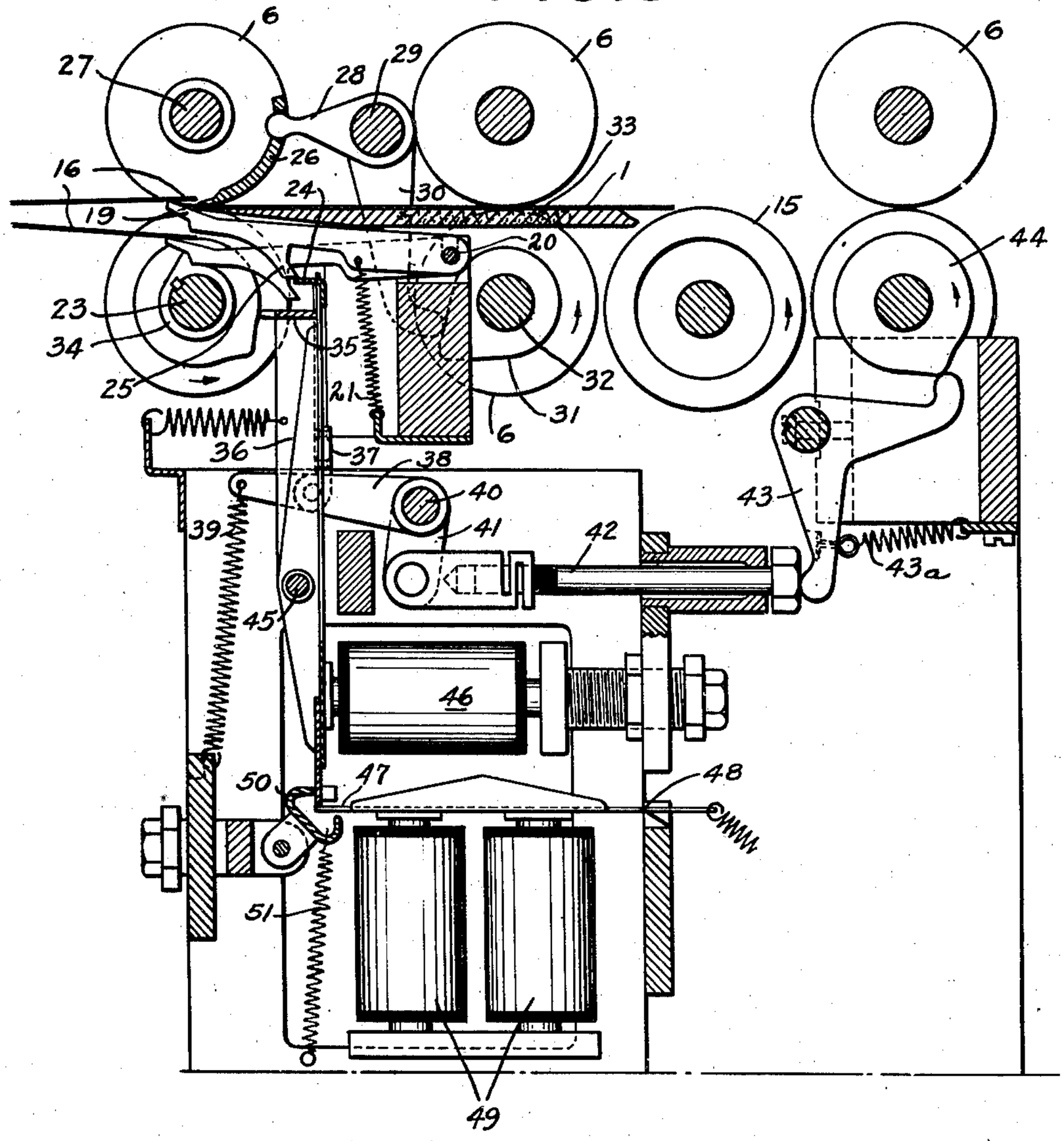

FIG. 12

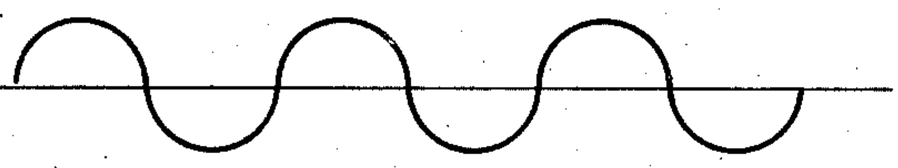

FIG. 13

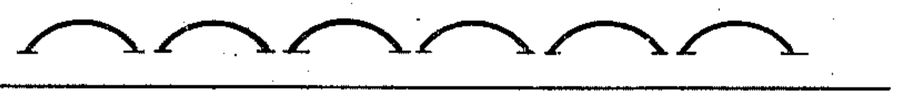

FIG. 14

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FIG. 6

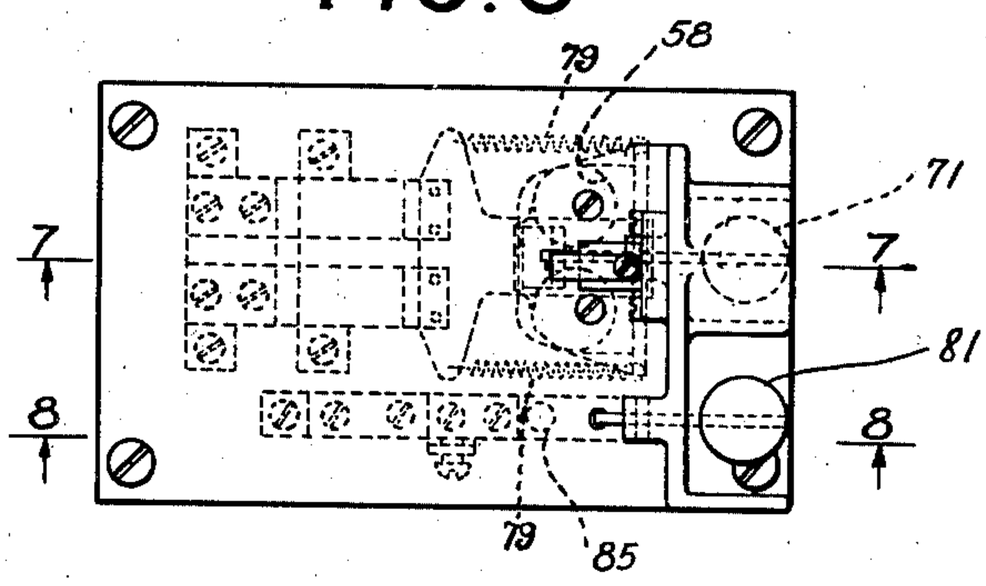


FIG. 7

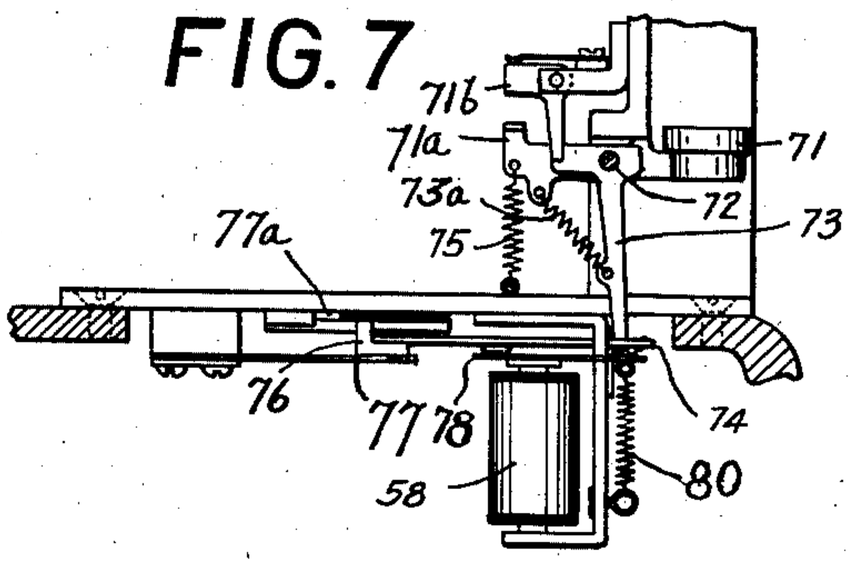


FIG. 8

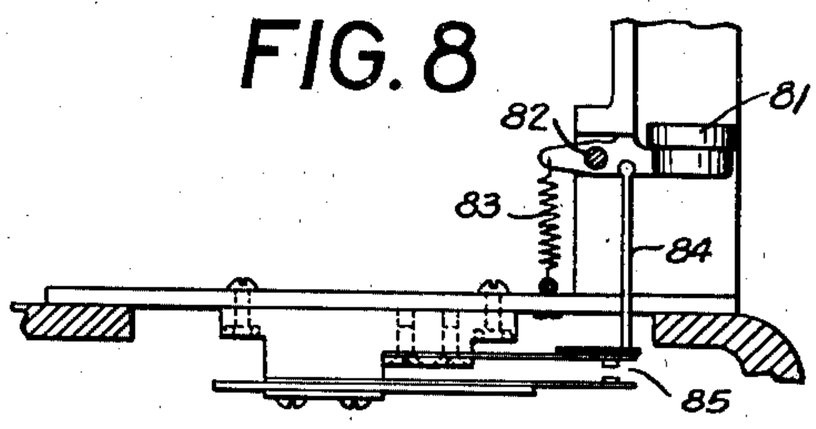


FIG. 9

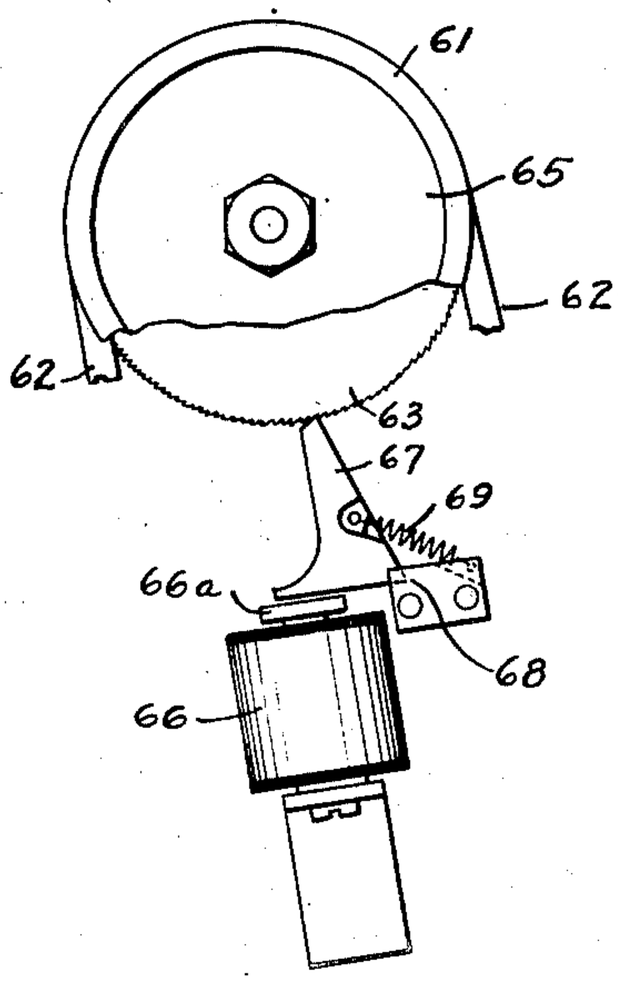
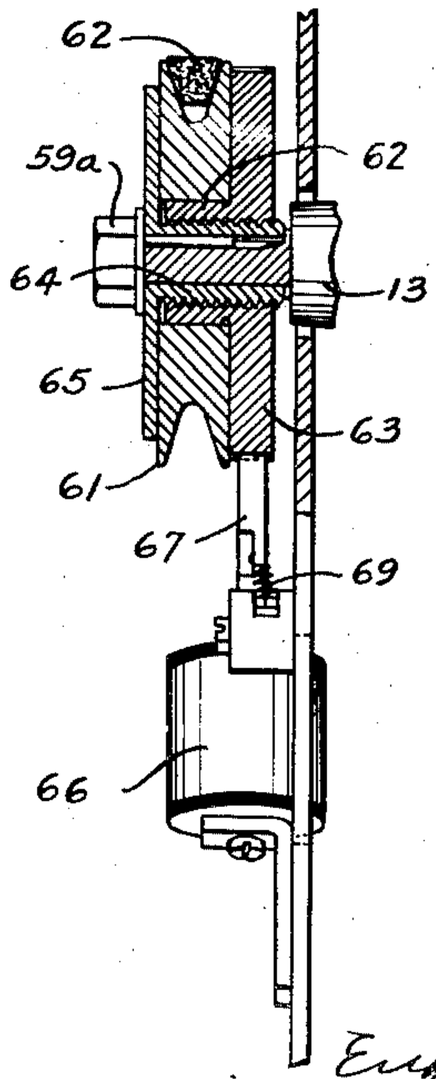


FIG. 10



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SORTING MACHINE

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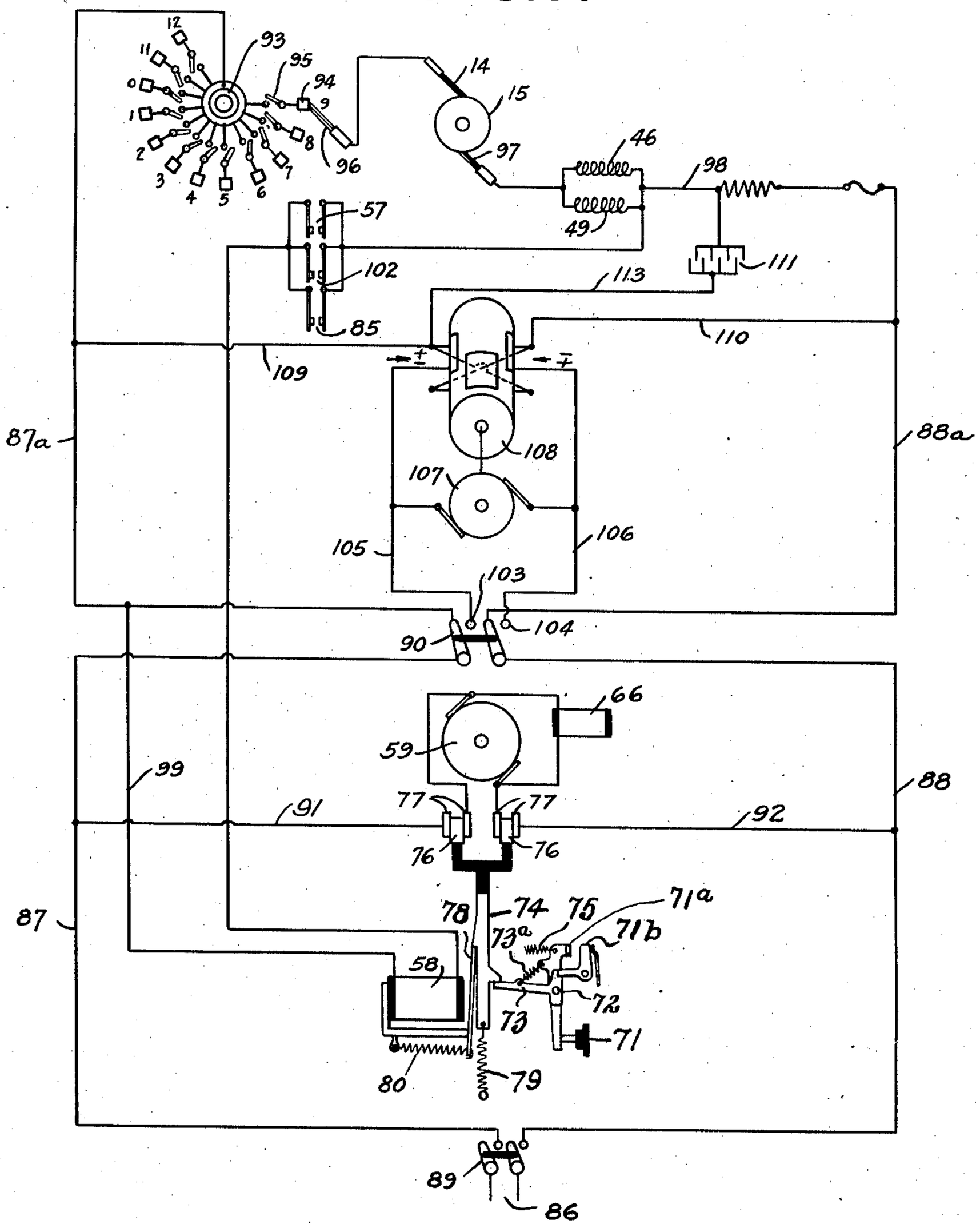
FIG. 11



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Patented July 12, 1938 2,123,237

UNITED STATES PATENT OFFICE

2,123,237

SORTING MACHINE

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Application August 17, 1935, Serial No. 36,643

8 Claims. (Cl. 209—110)

This invention relates to sorting machines and more particularly to perforated-record sorting machines in which the perforations are arranged in particular positions in separate columns and the position of the perforation determines the value represented. In these machines, the record cards are fed one at a time past a brush which serves as part of a control circuit. The card is so fed that a selected column passes under the brush, the different index positions passing in succession under the brush so that where a perforation appears in one of the positions, the brush will reach through and engage a metallic plate or roller on the opposite side and close an electric circuit which includes a control magnet. The closing of the circuit thus energizes the magnet which, in turn, controls the operation of sorting mechanisms to effect the proper disposition of the card.

In my United States Patent #1,969,362, I disclosed a sorting machine of this type which is adapted to effect sorting of record cards at a very high speed. In the present invention, I disclose this high speed sorting mechanism.

The object of the present invention is to devise a machine of this character in which alternating as well as direct current may be employed to sense the perforations in the record cards. When using direct current for this purpose, it makes no difference when the sensing brush senses a perforation at one of the index positions, but in employing alternating current, if the perforation is sensed when the current value is at or near zero the control magnets are not energized and the machine does not operate. This difficulty has been met in some machines by so synchronizing the passage of the separate index positions on the card with respect to the brush that each index point passes under the brush when the current is at its maximum.

In a very high speed machine, however, it is desired to feed the record cards so that the index positions pass the sensing brush more rapidly than there are wave peaks or cycles to the current so that the index positions will frequently reach the brush at times when the current value would be at or near zero and could not energize a magnet. I remedy this by rectifying the alternate current waves to produce pulsating direct current and by placing a condenser across the sensing circuit so that during each current cycle or pulse, the condenser will be charged, and as the current wave dips down toward the zero point or between the current pulses the condenser will discharge and in this way supply current to operate the sorting magnet if a perforation is sensed at this particular moment. In this way, there is always sufficient current in the sensing circuit to operate the sorting magnet regardless of when the perforation is sensed.

Another object of the invention is to provide means which will prevent the cards from rubbing over the ends of the separating sorter blades. It has been found that constant friction between the cards and the thin and narrow ends of the sorting blades soon wears the blades down so that they break. I have therefore provided means which will lift the blades which have not been lowered so that they will be above the plane of the passing card as the card enters the ends of the blades.

Another object is to provide a clutch between the operating motor and the card feeding mechanism which will permit quick stoppage of the machine.

Another object is to provide means for causing the machine to stop whenever cards are misfed, so that they will not pile up and cause destruction of a large number of cards before the operator can stop the machine.

Another object is to develop a machine of this nature which will successfully sort thin record sheets as well as the standard cards.

Other objects will appear in the following description of the invention.

Referring to the drawings in which I have shown what I now consider to be the preferred form of the invention:

Fig. 1 is a side elevation shown in section of a portion of a sorting machine;

Fig. 2 is a detail of part of the mechanism shown in Fig. 1, illustrating the device for preventing jamming when cards are misfed;

Fig. 3 is a diagrammatic view illustrating the operation of the sorting blades;

Fig. 4 is a sectional detail taken on line 4—4 of Fig. 2, showing electric contact operated by the non-jam mechanism;

Fig. 5 is an enlarged detail view of the sorting mechanism shown in Fig. 1;

Fig. 6 is a plan view of the switch mechanism for starting and stopping the machine;

Fig. 7 is a section taken on line 7—7 of Fig. 6 showing the start key mechanism;

Fig. 8 is a section taken on line 8—8 of Fig. 6 showing the stop key mechanism;

Fig. 9 is a detail view of the clutch mechanism for controlling the card feeding;

Fig. 10 is a section taken on line 10—10 of Fig. 9;

Fig. 11 is an electric wiring diagram;

Fig. 12 represents ordinary alternating current waves;

Fig. 13 represents rectified alternating current so as to produce pulsating direct current;

Fig. 14 represents the current where a condenser is employed to discharge between the current pulses to produce a smoother wave which is at all times sufficiently strong to operate the sorting magnet.

Fig. 15 is a detail of a nonjam device with its supporting frame omitted;

Fig. 16 is an end detail of the device mounted in its supporting guard frame.

Referring to the drawings:

The records 1 to be sorted are shown in a supply hopper 2 with a weight 3 to press them down in position to be fed to the sensing mechanism. A card picker 4 is adapted to engage the rear edge of the lowermost card or record of the stack and to push the record forward, i. e. to the left through the feeding throat 5 whose opening is slightly wider in a vertical direction than the thickness of one of the records being fed so that but one record can pass through the throat at a time. The record will then be gripped by the first set of feed rollers 6 and fed thereby to the second set which, in turn, feeds it to the third set and so on. The card picker 4 is carried by a plate 7 which is connected to an arm 8 pivoted at 9 to a supporting member 10. Springs 11 move the arm 8 and the picker to the right into position to engage the rear edge of the record. A cam 12 on shaft 13*a* is constantly driven in a manner well known by the main shaft 13. The cam thus repeatedly moves the picker to the left to feed a record through the throat 5 and the springs 11 then restore the picker to position to feed the next record.

As the record is fed to the left, it passes under a sensing brush 14 which is normally adapted to engage the contact roller 15. The record separates the brush from the roller 15 so that if current is now supplied to the brush it will not close the circuit through the sorting magnet. A commutator device supplies current to the brush for a short duration of time as each succeeding index position passes under the brush so that if the brush senses a perforation and engages the roller 15, it will close the circuit through the sorting magnet.

After the record card leaves the sensing brush, it passes between the ends of the sorting blades 16. These blades as is well known guide the record into the pockets 18 according to the position of the perforation in the column being sensed. Each of the ends of the blades 16 is held in raised position by a finger 19 which is pivoted at 20. Each of these fingers is provided with a spring 21 tending to pull it downwardly so as to permit its particular blade end to follow. Associated with each finger 19 is a cam 22 all of which are mounted on a common shaft 23 which is constantly rotating. The cams are differentially set so that they will release their respective fingers 19 one after the other and synchronously with the sensing of the successive index positions by the brush 14. Common to all of the fingers 19 is a bar 24 adapted to cooperate with a projection 25 on each of the fingers. The bar when moved to the left as in Figs. 3 and 5 will be below the projections 25 of those fingers which have not dropped and above the projections of those fingers which have dropped. As the cams 22 turn, releasing their respective fingers 19, those fingers which have not dropped before the bar 24 moves to its operative position will not be permitted to drop.

The time at which the bar 24 moves to its operative position depends upon the time in the card cycle that the brush 14 encounters a perforation in the column being sensed. This time, in turn, depends upon the position of the perforation. Thus, if the perforation appears at the index position representing "2" the separation of the blades will take place at a point opening a passage to the "2" pocket.

Formerly when some of the fingers 19 had dropped, followed by the ends of blades 16 and others of said fingers had been locked in their raised position by the bar 24, the card then passing into the opening thus made between the blades would rub against the lower surface of the upper blades and the upper surface of the fingers 19 supporting the blades. In the present case, I provide means for further lifting all of the ends of the chute blades 16 that are in raised position, so that when the card enters between the blades, it will not touch the ends of the blades nor slide over the tops of the fingers 19. To this end, the ends of the blades may be normally slightly below the plane of the card after the separation of the blades has taken place by the dropping of some of the fingers 19 and the rest have been latched in their upper position by the action of the bar 24. A member 26 pivotally mounted on the axis 27 is adapted to be rocked clockwise (Fig. 5) by an arm 28 fixed on the shaft 29 on which is also fixed an arm 30 cooperating with a cam 31 on shaft 32 which also carries feeding rollers 6 and is therefore constantly rotating. The cam 31 serves to positively remove the member 26 from cooperation with the ends of the blades while the spring 33 acting on arm 30 rocks the member 26 under the ends of the blades.

After the ends of the sorting blades have been separated, some of them having dropped and others being held in the upper position by the fingers 19 whose projections 25 rest upon the top of the bar 24, the bar 24 will be slightly raised to lift the blades which it is holding above the plane of the approaching card. The operation of the member 26 from the position of Fig. 5 to that of Fig. 1 will then place the member 26 under the ends of the blades 16 to hold them in this raised position. The fingers 19 may then be lowered below the plane of the card so that the latter may now enter a sorting path between the raised and lowered sorting blades without rubbing against the ends of the blades or against the fingers 19. After the card has passed in between the blades sufficiently far so as not to rub against the ends of the blades, the member 26 is restored and a cam 34 engages a bail 35 rocking the latter against the bar 24 and restoring the bar to its normal position releasing the fingers 19 in position for the beginning of the next sorting cycle.

In order that the bar 24 may be raised, it i slidably mounted on the armature frame 36 and is attached to a hinged member 37 carried by arm 38 normally held in lowered position by a spring 39. Arm 38 is fixed on shaft 40 on which is also fixed an arm 41 connected to an adjustable link 42. A bell crank 43 is adapted to be rocked by a cam 44 which is constantly rotating. Movement of the link 42 to the left will raise the bar 24 and all of the fingers 19 resting thereon, and then under the action of spring 43*a*, permits the fingers 19 to quickly drop again out of the path of the card.

The armature frame 36 is pivoted at 45 and is

adapted to be rocked counterclockwise to the position shown in Fig. 5 by magnet **46**. The armature is normally locked by a latching member **47** fulcrumed at **48** and constituting the armature of magnet **49**. When a perforation in the card is sensed a circuit is closed through both magnets **46** and **49**. As we have seen in Patent #1,969,362, as the current is building up in these magnets and before the full effect of magnet **46** is exerted upon its armature, magnet **49** lowers the latching armature **47** to release the armature **36**. Armature **47** then engages the member **50** and assists the spring **51** in rocking member **50** about its pivot and this, in turn, assists the magnet **46** in turning the armature **36** about its pivot, moving bar **24** into its operative position. This operation as we have seen in connection with the aforesaid patent, causes the sorting elements to operate at a very high speed.

Nonjam device

In order that misfed records may quickly bring about stoppage of the machine before several records have been jammed together and damaged, I have provided a device which will cause the opening of the electric circuit which controls the operation of the feeding mechanism so as to stop the record feeding. This device includes a very light rod or bar **51** (Fig. 2) which is suspended near its opposite ends by links **52**, **53** pivotally attached to a fixed frame member **54**. Projections **55** on the bar **51** are adapted to reach slightly below the plane of the passing records so that the records will lift the bar **51** and hold it in a slightly raised position as long as records are passing between the feeding rollers **6** toward the various pockets **18**.

The bar **51** may be mounted to one side of the machine in a protecting guard **51***a* near the feeding rollers on that side (Fig. 16) so that the record which is held rather taut between the feed rollers will hold the bar in raised position even though the records are of very soft paper. Also, the record passes over the tops of fixed members **120** which help to prevent it from sagging. The distance between the members **120** is less than the width of a record so that the record passes onto the next member before it leaves the previous one. If the records become jammed between the feed rollers and tend to buckle or if two or more records run together and tend to pile up, the bar **51** will be raised. The end of the bar **51** carries a yoke **56** through which reach a pair of spring contacts **57** (see Fig. 4). Slight raising of the bar **51** will lift the lower one of the spring contacts **57** and close the contacts. Also if there are no records between the feed rollers, the bar **51** will be lowered to its normal position and this will cause closure of contacts **57** by lowering the upper one of the spring contacts. The closure of these contacts will cause energization of magnet **58** (Fig. 11) and this will deenergize the drive motor **59** and open up the clutch **59***a* which connects the driving motor to the record feeding drive shaft **13**.

The motor is connected to the pulley **61** by a belt **62**. Pulley **61** is loosely mounted on a hub portion **62** of a clutch plate **63**. This hub and plate are threaded on the hub portion **64** of a clutching plate **65** which is fixed to the drive shaft **13**. Turning of the pulley **61** tends to turn the hub **62** and plate **63** and this, in turn, causes the plate **63** to press against the pulley **61**, pressing the latter against the plate **65**. This causes the pulley to rotate the plates **65**, **63** and also the drive shaft **13**. The armature **66***a* of a magnet **66** is connected to an arm **67** fulcrumed at **68** and actuated by a spring **69** tending to rock the arm **67** into cooperation with the periphery of disk **63** which when operating turns in a counterclockwise direction in Fig. 9.

Magnet **66** is connected in parallel with the operating motor **59** and thus holds the arm **67** out of contact with the disk **63** while the motor is energized and operating. But when the motor circuit is broken the magnet **66** also becomes deenergized and the arm **67** engages the disk **63**, producing a binding effect and thus immediately stopping the disk **63** from rotating while the motor continues to turn the pulley **61** until it comes to a dead stop. This further movement of the pulley **61** will cause a slight further rotation of clutch disk **65**. This eases the pressure of the disks **63**, **65** upon the pulley **61** so that the latter may turn freely between the disks until it stops without causing any further operation of the driving shaft **13**.

Start and stop switch

As shown in Figs. 6, 7 and 11 a start key for closing the circuit through the driving motor **59** is shown at **71** and pivoted at **72**. Also pivoted at **72** is a depending arm **73** cooperating with a slide **74** to move the latter to the left as viewed in Fig. 7. A spring **73***a* connected between arm **73** and the rear end **71***a* of the start key normally tends to move arm **73** with the slide **74** to the left. A latch **71***b* locks arm **73** in its normal position. The slide **74** carries contact closing members **76** resting on contact spring **77**. When the bar **74** with members **76** is moved to the left, these members slide along the contact spring **77** and into contact with contact members **77***a* to close the circuit through the operating motor **59**. When the start key **71** is depressed it tensions spring **73***a* to operate the arm **73**. Then when the rear end **71***a* engages the latch **71***b*, the arm **73** is released and snaps quickly to the left so that the contact members **76** close the circuit through members **77**, **77***a* with a snap.

A latch member **78** then holds the slide **74** against the action of spring **79**, the latch being actuated by spring **80**. Latch **78** also constitutes the armature of magnet **58** so that when the latter is energized, the slide **74** will be released and spring **79** will move it with contact member **76** to effect a quick breaking of the circuit through switch members **77**, **77***a* to the operating motor **59**. This quick breaking of the motor circuit is preferred to the usual method of energizing a relay to open the motor circuit because the lag or residue in the relay causes the breaking of the circuit to be sluggish and the motor continues to run and thus continues to feed records for a number of operating cycles of the machine after the current is supposed to be shut off. When the motor stops slowly due to jamming of records in the machine, a tendency to feed records for several cycles causes damage to the records being fed into a jammed position in the machine. By breaking the circuit to the motor quickly when a jam occurs, the motor stops without feeding a large number of additional cards into a jam.

The stop key **81** is pivoted at **82** and held in normal position by spring **83**. The key is connected by a link **84** to stop contacts **85** which when closed energize magnet **58**.

Wiring diagram

Referring to Fig. 11, the current supply is shown at **86** and may be connected to the ma-

chine lines 87, 88 by switch 89. This supply may be either direct current or alternating current. If it is direct current, then switch 90 will be set in the position shown. Operation of the start key 71 will close the circuit through the driving motor from the line 87, through wire 91, motor 59 and magnet 66, wire 92 back to the other side of the line 88.

Current will also be supplied through switch 90 to lines 87*a*, 88*a*. The sorting circuit is from line 87*a* to the timing device 93 which has twelve segment contacts 94 corresponding to the twelve index positions in the columns of the record. Each of these segments 94 may be connected or disconnected by its individual switch 95. The purpose of these switches 95 is well known and need not be described here. Assuming that all of the switches are closed and that normal sorting is being effected then all of the segments 94 will be connected to the line 87*a* and as the device 93 is turned synchronously with the feeding of the cards, the segments 94 will successively engage brush 96 synchronously with the passage of each successive index point in the column on the record with respect to the sorting brush 14. Thus, when a perforation in a column registers with the brush 14 a circuit will be closed from the line 87*a* through a segment 94 corresponding with the position of the perforation in the record, through brush 96, brush 14, through the perforation in the record to the roller 15, common brush 97, sorting magnets 46, 49, wire 98 to the other side of the line 88*a*.

Deenergization of the sorting magnets will effect a selective setting of the sorting blades so that the record will pass between the blades and be carried to a pocket corresponding to the position of the perforation through which the circuit to the sorting magnets was closed.

In the operation of the machine, when the start key is depressed, it will be held until the records being analyzed are fed far enough to engage the non-jam bar 51 to raise the latter so as to open the contacts 57. The start key may then be released and feeding of the records will continue until the machine is stopped by depression of the stop key or by the operation of the bar 51. The stop key will close contacts 85 and the bar 51 when not supported by a record or when the records are lifted too high will cause closure of contacts 57. Closure of either of these contacts will close the circuit through the magnet 58 to cause the driving motor to be deenergized and also to cause the driving clutch 59*a* to be released. The circuit through the magnet 58 is from line 87*a*, through wire 99, magnet 58, wire 100, contacts 57 or 85, wire 101, wire 98 to the other side of the line 88*a*.

Associated with the magnet 58 there is also a third set of contacts 102 adapted to be closed whenever one of the sorting pockets becomes filled to cause the machine to stop.

If alternating current is supplied by the source 86 then the switch 90 will be moved into cooperation with contact points 103, 104 to supply current to the lines 105, 106. This will energize a motor 107, the circuit being from line 87 through switch 90 to line 105, motor 107, line 106, through switch 90 back to the other side of the line 88.

Motor 107 operates a rectifying commutator 108 which is adapted to change the curve of the current from that shown in Fig. 12 to that shown in Fig. 13 in the well known manner. The current from the rectifier 108 is carried by line 109 to the line 87*a* and by line 110 to the line 88*a*. A condenser 111 is shunted across lines 87*a*, 88*a*. With this device when a perforation is sensed in a record the circuit will be from line 87 to line 105, rectifier 108, wire 109, line 87*a*, one of the commutator segments 94, brush 96, brush 14, contact roll 15, brush 97, sorting magnets 46, 49, wire 98, line 88, wire 110 to the rectifier 108, wire 106 and through switch 90 back to the line 88.

During the high point of the current wave of Fig. 13, the condenser 111 will be charged. Then as the wave approaches its zero point 112, current will surge from the condenser 111 so that if a perforation is being sensed at this moment, there will be sufficient current in the line to energize the sorting magnets 46, 49. This condenser discharge circuit is from the condenser 111 through wire 113, wire 109, line 87*a*, contact segment 94, brush 96, brush 14, contact roller 15, brush 97, sorting magnets 46, 49, wire 98 to the condenser 111.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a record sorting machine, a plurality of pockets, guide blades associated with the pockets for selectively guiding records thereto, means for feeding records through the blades to the pockets, means controlled by the records being fed for lowering the ends of some of the blades below the path of the records being fed, and means for raising the ends of the blades not lowered while the lowered blades remain in lowered position, to provide a path between the blades for the records to enter.

2. In a record sorting machine, a series of sorting pockets, record controlled means for distributing records to said pockets including feeding means, a rigid member extending along the path of feed of the records and adjacent the entrances of all the pockets whereby the records may engage said member throughout their travel to the entrances of the pockets, parallel motion links for movably mounting said member for displacement transversely of the path of the records from a non-record-engaging position to either of two record-engaging positions to one of which record-engaging positions the member may be moved by a normally fed record and to the other of which record-engaging positions said member is moved by a buckled or otherwise abnormally fed record, and a machine control device controlled in accordance with movement of said member.

3. In a record controlled machine, sorting mechanism including a series of sorting blades; record controlled means for separating the blades into two groups in accordance with data designations in a record, including means to displace one of the groups in one direction to partly open a passage for the record; and means for moving the remaining group of blades in the opposite direction while the first named group are in displaced position whereby to enlarge the passage for the record.

4. In a record controlled machine, sorting

mechanism including a series of sorting blades, means to progressively displace the blades in one direction, means controlled by a designation in a record for determining the number of blades to be displaced by the first named means and operative to prevent displacement of the remaining blades whereby to initially partly open a passage for the record containing the designation, and means for displacing the remaining blades in the opposite direction while the first displaced blades are in displaced position whereby to widen the passage for the record containing the designation.

5. In a record controlled sorting machine, sorting mechanism including a series of guide blades, cam actuated means for moving a group of said blades in one direction and additional cam actuated means for moving the remaining blades in the opposite direction whereby to provide a passage for a record to enter, and means controlled by a designation in the record for determining the number of blades moved by the first named cam actuated means.

6. In a record controlled machine, sorting mechanism including a series of guide blades normally occupying a medial position, means controlled by a designation in a record for moving a group of said blades in a predetermined direction away from the medial position to preliminarily open a passage for said record, and means operative before said record enters said passage for moving the remaining blades away from the medial position and away from the group initially moved whereby to enlarge the passage for the record before said record enters such passage.

7. In a record controlled machine, sorting mechanism including a series of record guiding elements normally occupying a medial position, means to move a group of said elements in one direction away from the medial position to partly form a passage for a record, means to move the remainder of the elements in a different direction away from the medial position to complete the opening of a passage for the records, and means controlled by designations in the records for controlling the number of elements moved away from the medial position by each of the moving means.

8. In a record controlled machine, a series of sorting guides normally occupying a medial position, record controlled means for initially moving a plurality of the guides in one direction away from the medial position whereby to partly open passage for a record and subsequently operative to restore the guides so moved to the medial position after a record has entered said passage, and means operative before said initially moved guides are restored to move the remaining blades in the opposite direction away from the medial position to widen the passage for the record, said last named means being operative, after the record has entered said passage to cause the guides moved thereby to return to the medial position to close said passage in cooperation with the first named moving means.

EUGENE A. FORD.