

Nov. 29, 1966

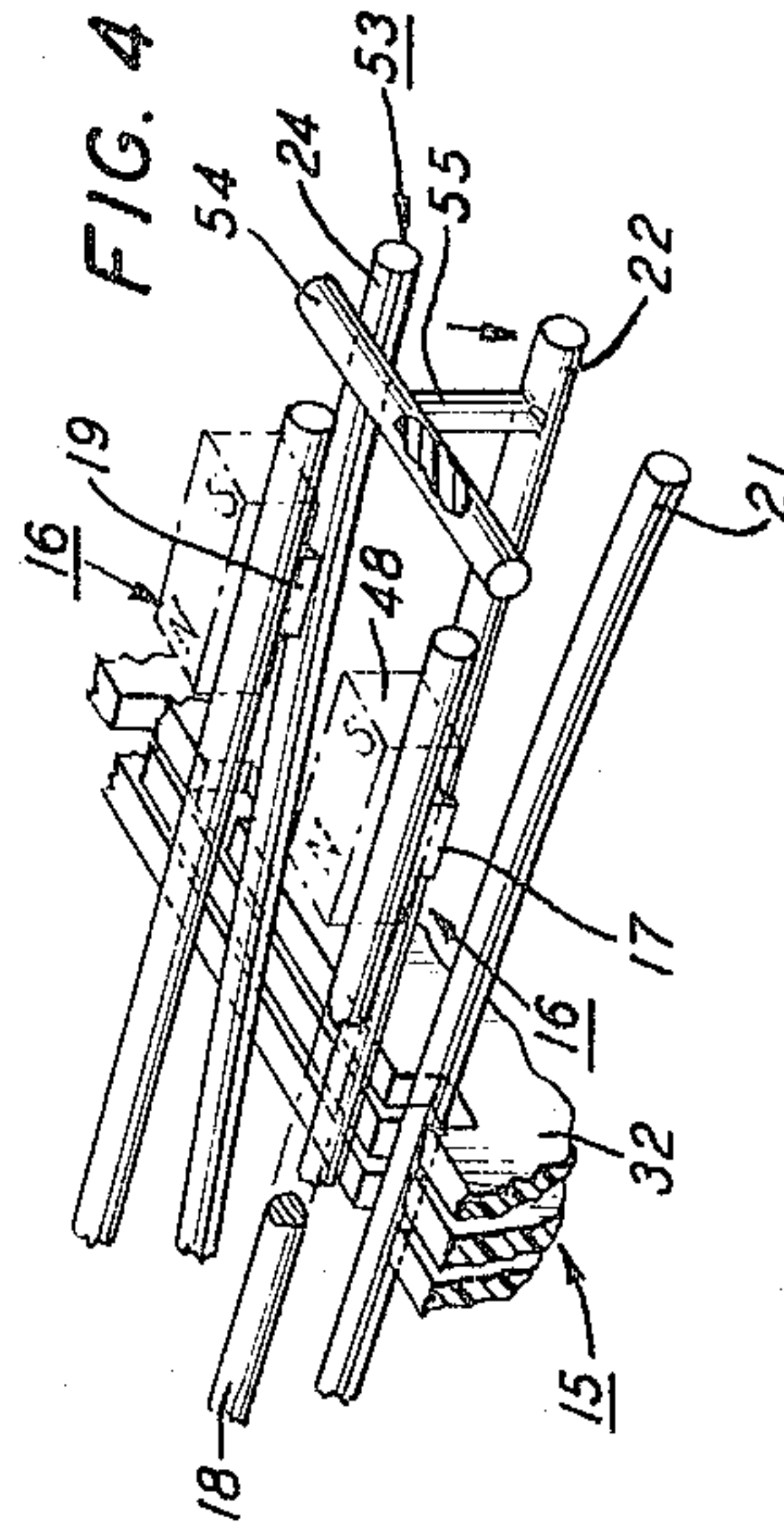
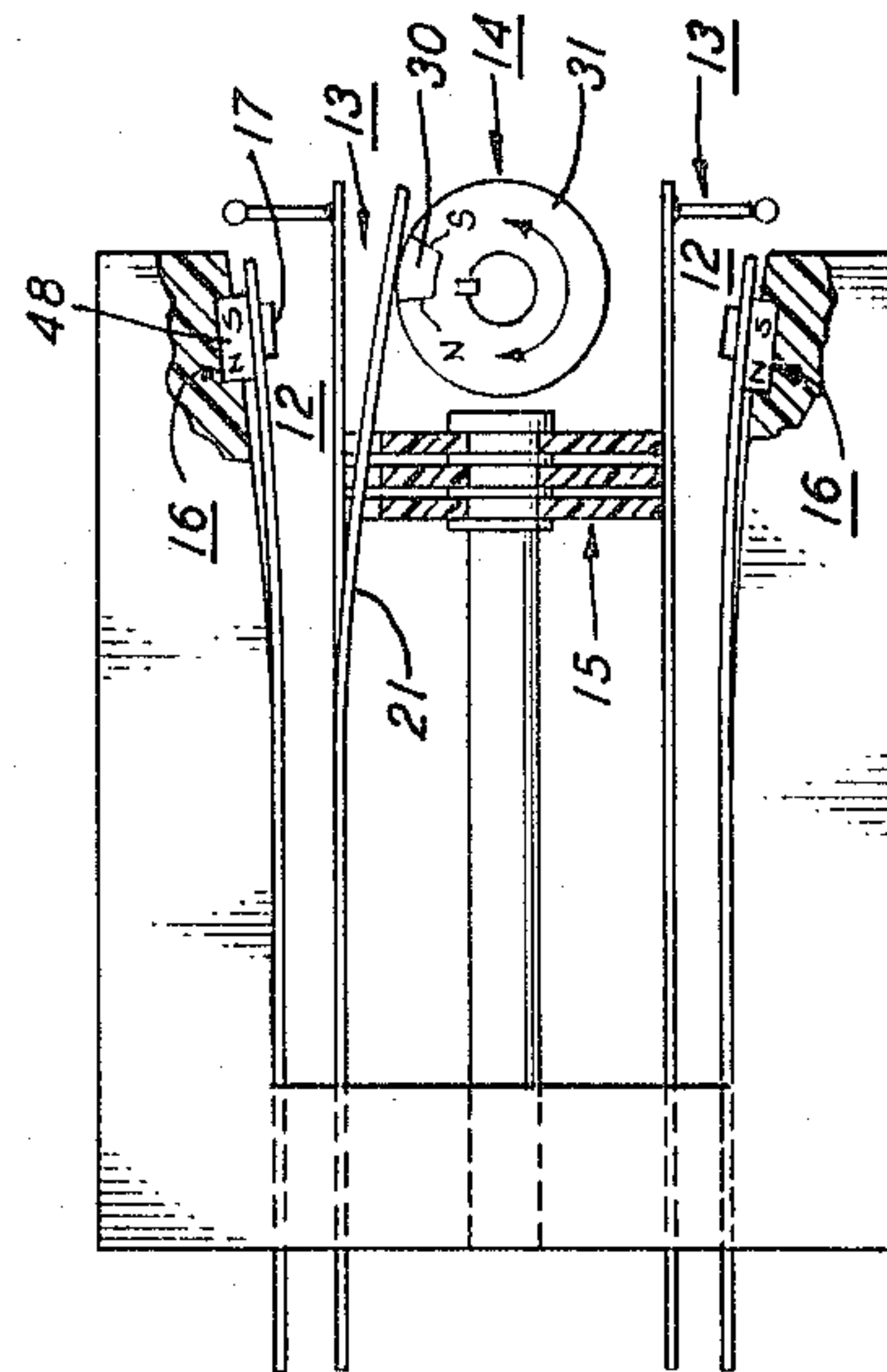
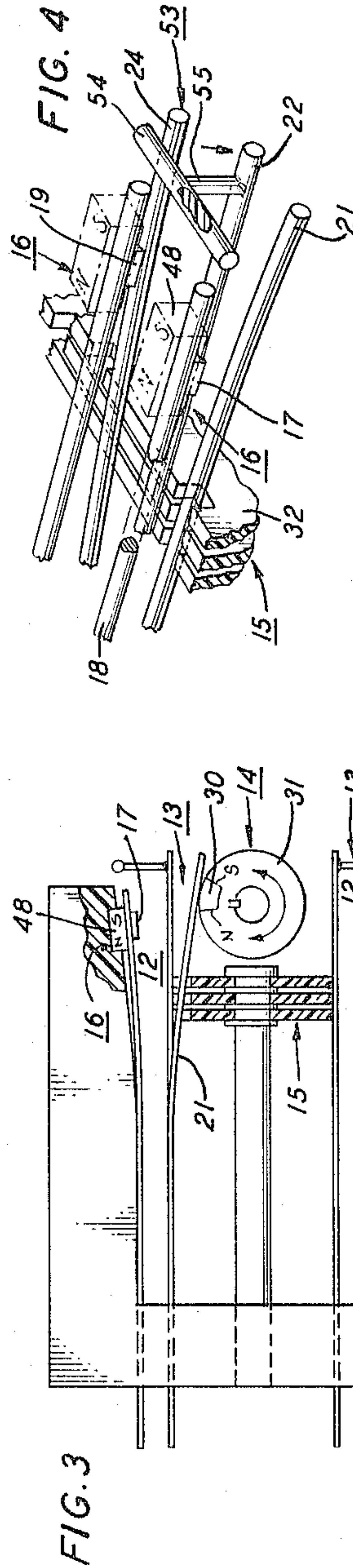
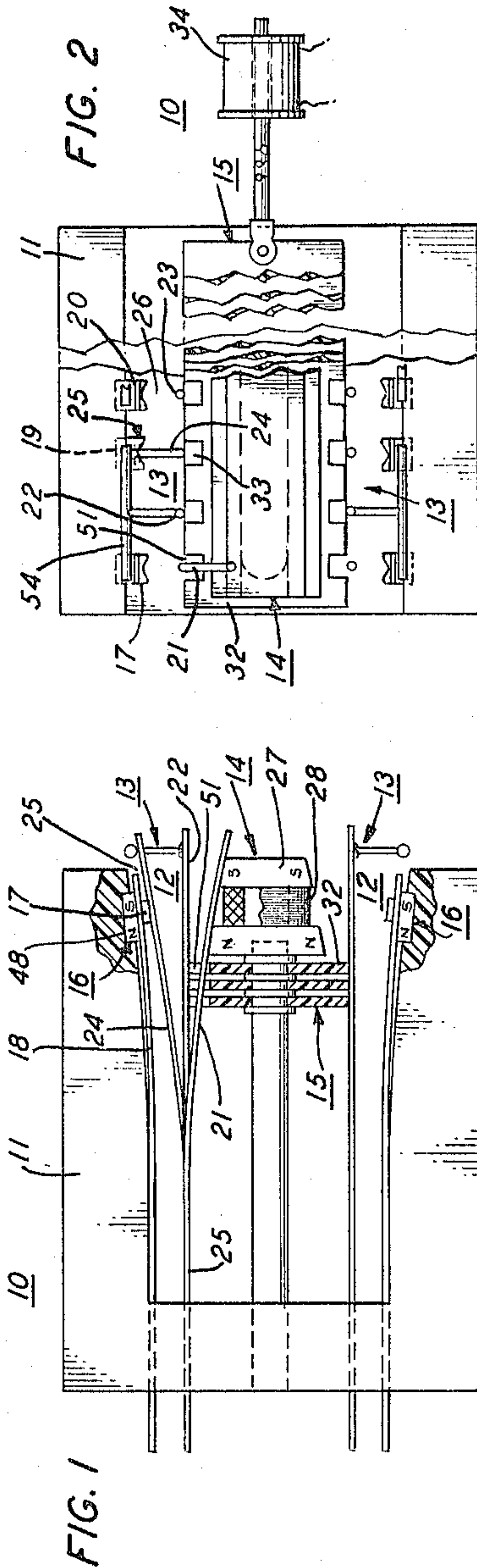
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3,289,127

CODE-BAR CONTROLLED COORDINATE SWITCH

Filed Jan. 19, 1965

2 Sheets-Sheet 1



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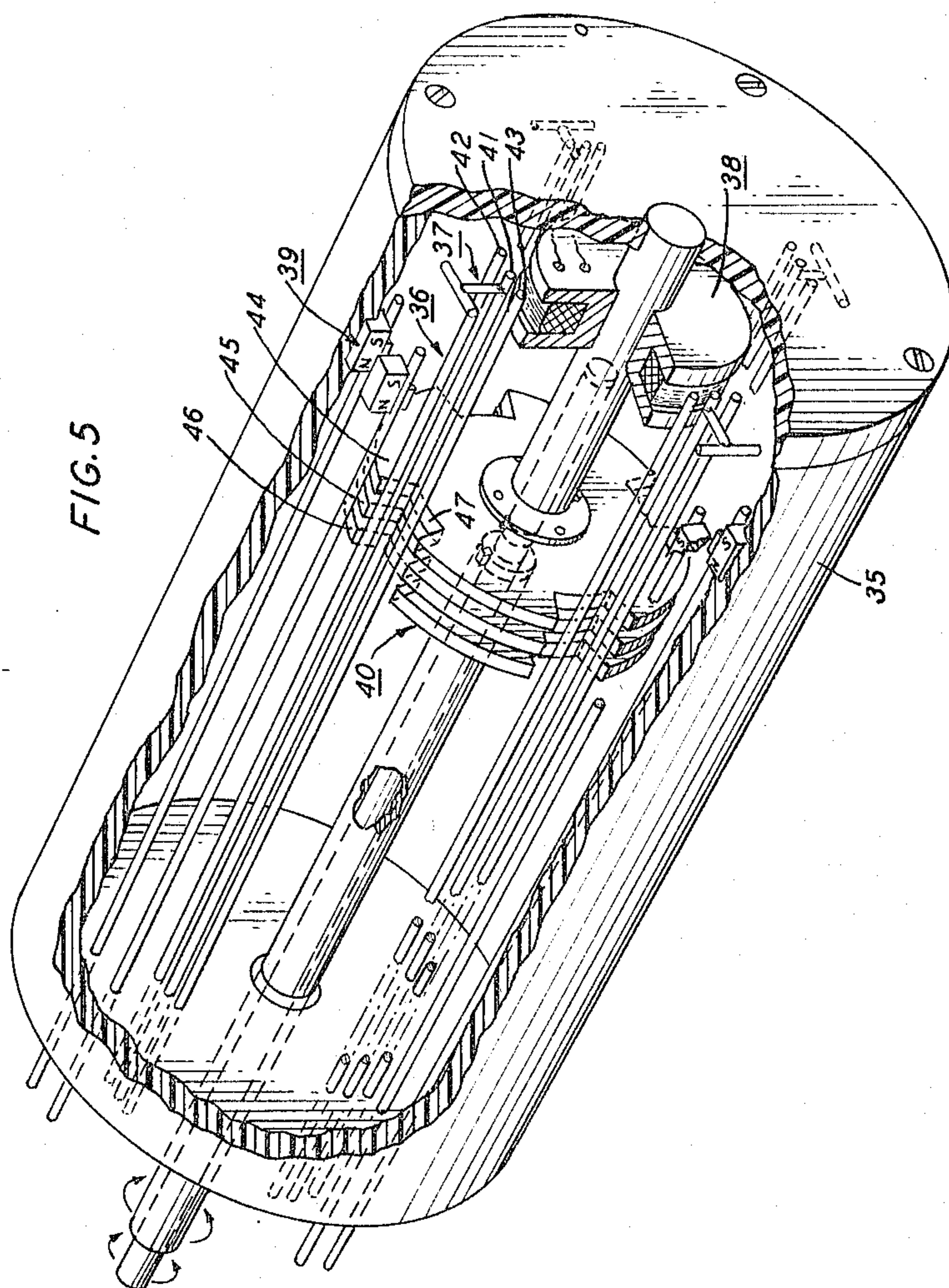
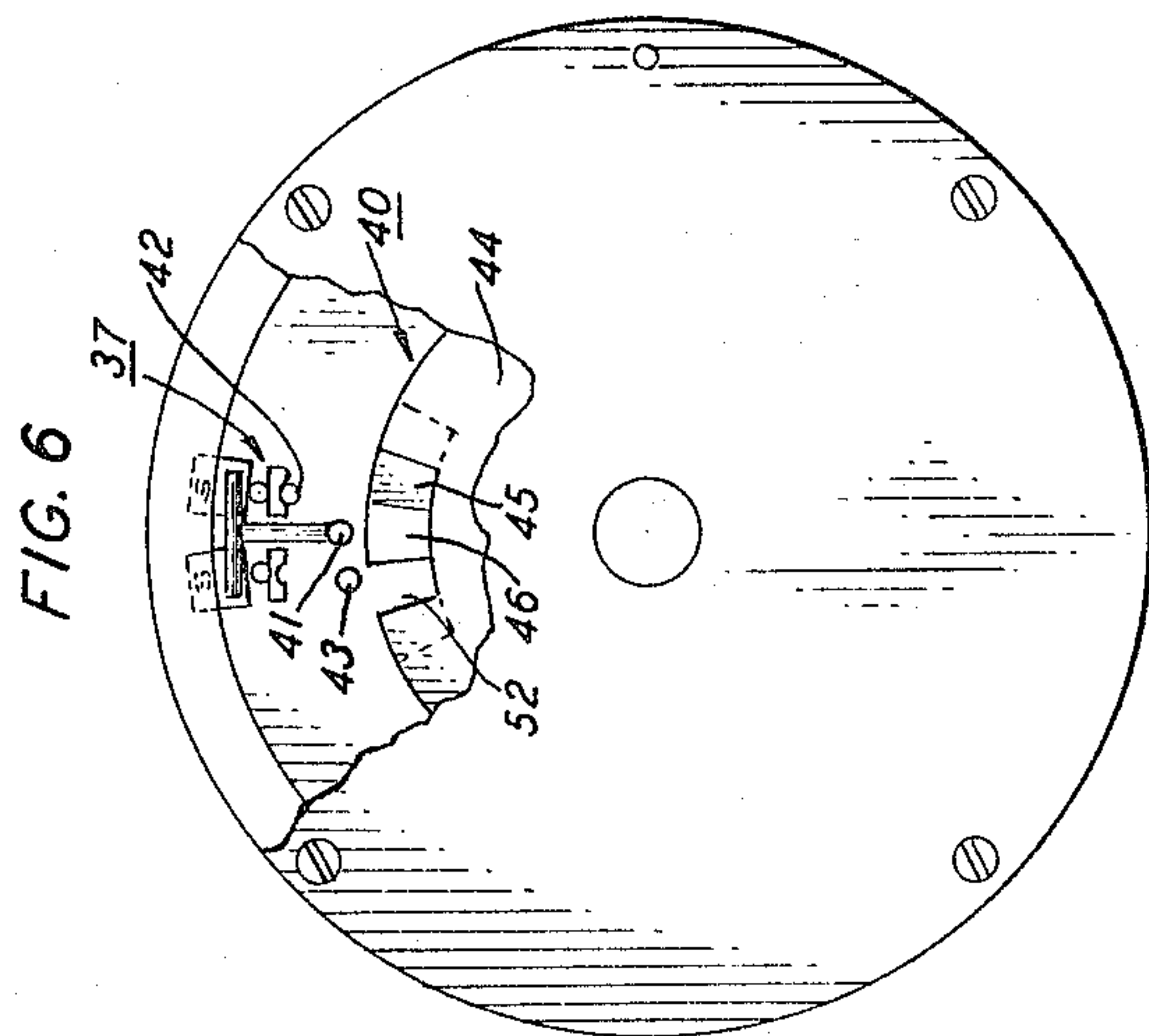
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2 Sheets-Sheet 2



1

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CODE-BAR CONTROLLED COORDINATED SWITCH

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Filed Jan. 19, 1965, Ser. No. 426,569

11 Claims. (Cl. 335-118)

This invention relates generally to multiple contact relays and particularly to relays containing contacts arranged for selective operation by a selecting mechanism which is common to all of the contacts.

Relays containing contacts selectively operated by a common selecting mechanism are well known. Heretofore, however, the selecting mechanism functioned in a manner such that contacts initially operated and had to be released before subsequent contacts could be operated.

In relays which are of interest here, the selecting mechanism is of the type which uses notched code bars. Generally, the code bars are disposed between the contacts or crosspoints which are to be opened or closed and contact operators which open or close the contacts.

In operation, the code bars are manipulated in the relay until alignment of the notches establishes a channel beneath a selected contact operator. Accordingly, when all of the contact operators are urged against the code bars, all except the selected one are stopped. Thus, the selected operator proceeds into the channel and operates the contacts or crosspoint with which it is associated.

While the foregoing arrangement is satisfactory for many purposes, the code bars must remain idle until the selected contact operator is removed from the channel. Thus, selection of contact operators is dependent upon operator condition and the action of the common selecting mechanism is inefficient.

It is, therefore, one object of this invention to free operator selection from operator condition.

Another object of this invention is to increase the number of contacts or crosspoints which can be concurrently operated in multiple contact relays.

Another object of this invention is to make efficient use of the common selecting mechanism in multiple contact relays.

According to this invention, a selecting mechanism is associated with a plurality of contact operators to intercept movement of all operators except a selected one. As in the prior art, the selecting mechanism allows a contact operator to enter a preformed channel in a code bar assembly. However, the contact operator, instead of operating a crosspoint when entering the channel, bends and then springs back to operate a crosspoint on the rebound.

Since crosspoint operation occurs on the rebound, crosspoint operation is made on one side of a neutral or normal position of the contact operator and selection is made on the other side thereof. As a result, the selecting mechanism operates without regard to the condition of the crosspoints.

According to a preferred embodiment of this invention, a plurality of contacts, a plurality of magnetically responsive flexible contact operators, a plurality of magnets for holding operated contacts closed, an electromagnet for activating contact operators, and a plurality of notched code bars for selecting contact operators are combined in an arrangement wherein the contacts and the magnets are disposed on one side of the contact operators, and the code bars and the electromagnet are disposed on the other side thereof.

The contacts are arranged in pairs wherein one contact is stationary and the other is controlled by a contact operator in such a manner that, in the normal or neutral

2

condition, it is separated from the stationary contact by an air gap. All of the contact operators are flexible wires and each is cantilevered to bend in such a manner that the contact associated therewith moves away from its associated stationary contact as the contact operator bends. The material from which the contact operator is made is sufficiently flexible so that after the contact operator has been bent a predetermined distance and then released, it will rebound and carry its contact into engagement with its associated stationary contact.

In operation, the code bars are manipulated until a channel appears adjacent to the selected contact operator. Thereafter, the electromagnet attracts all of the contact operators toward the code bars where all except the selected one stop. The selected one bends into the slot.

When the selected contact operator is in the slot, the electromagnet is released. As a result, the selected contact operator rebounds. As it rebounds, the contact operator carries its contact into engagement with a stationary contact.

After the contacts engage, one of the holding magnets holds the contacts together, thereby completing a crosspoint closure. Thereafter, other contact operators can be chosen by the code bars and other crosspoints can be closed without waiting for the first to be opened.

One feature of this invention is a plurality of code bars arranged to intercept all moving contacts except a selected one as they move away from associated stationary contacts.

According to another feature of this invention, one set of contacts which are magnetically responsive and one set of contacts which are stationary are associated in an arrangement wherein the magnetically responsive contacts are attracted away from the stationary contacts and toward a set of code bars by a magnet.

Still another feature of this invention is a plurality of release members fastened to certain movable contacts and arranged to disengage adjacent movable contacts from associated stationary contacts in response to selection by code bars.

According to a feature of one embodiment of this invention, the code bars comprise at least one rotatable disk having notches cut in its periphery.

According to a feature of a second embodiment of this invention, the magnet for attracting all the magnetically responsive contacts comprises a segment of a rotating member.

Other objects and features of this invention will become readily apparent from the following detailed description of the invention when taken in connection with the drawing wherein:

FIG. 1 is a side elevation of the switch with portions thereof shown in section;

FIG. 2 is a front elevation of FIG. 1 with a portion thereof broken to indicate a multiplicity of contacts;

FIG. 3 is a side elevation of a modified form of the switch shown in FIG. 1;

FIG. 4 is a fragmentary view in perspective showing the means for opening a crosspoint;

FIG. 5 is a perspective view of another modified form of the switch; and

FIG. 6 is a front view of FIG. 5 with a portion thereof broken away to show the arrangement of the code disks for permitting the operation of a release wire.

Referring now to FIG. 1, the relay 10 shown therein comprises a housing 11, a contact assembly 12, a contact operator assembly 13, a motor assembly 14, a selecting mechanism 15, and a latching mechanism 16.

The contact assembly 12 comprises a plurality of electrically conducting active and passive contacts arranged to operate in a plurality of crosspoints. As used herein, the term "passive contacts" refers to contacts which are

stationary in nature, while the term "active contacts" refers to contacts which move into and out of engagement with the passive contacts to make or break electrical connections.

In the embodiment shown in FIG. 1, the passive contacts are on conductors extending along the housing 11 as, for example, the contact 17 on the conductor 18. Other passive contacts are shown in FIG. 2 as, for example, the contacts 19 and 20.

The active contacts, on the other hand, comprise the free ends of certain flexible wires such as the wire 21 shown in FIG. 1. Other flexible wires are shown in FIG. 2 as, for example, the wires 22, 23 and 24 wherein only the free ends of the wires 23 and 24 serve as active contacts. In the embodiment shown in FIG. 2, the contact 19 and the free end of the wire 24 have come together to form a crosspoint 25. All of the flexible wires are disposed so that, in the neutral or normal condition, the active and passive contacts are separated by an air gap, as for example, the air gap 26 shown in FIG. 2 between the wire 23 and the contact 20. The normal or neutral position of the wires is demonstrated by the position of the wire 23 as shown in FIG. 2.

The contact operator assembly 13 operates crosspoints by causing the active and passive contacts to engage and disengage. As shown in FIG. 1, the contact operator assembly 13 comprises a plurality of flexible wires arranged in sets. Each set conveniently includes three wires. For example, one set, as illustrated in FIG. 2, comprises the wires 21, 22 and 24. The wires 21 and 24 are contact wires and the wire 22 is a release wire. All of the wires are conveniently made from a material which is magnetically responsive as well as electrically conducting. Moreover, all of the wires are secured to the housing 11 by one end in the manner illustrated in FIG. 1 by the fixed end on the wire 21. As a result, all of the wires are cantilevers.

The motor assembly 14 supplies the moving force by which the contact operator assembly 13 engages and disengages active and passive contacts. As shown in FIG. 1, the motor assembly 14 is electromagnetic and comprises a pole piece 27 and a coil 28.

Another advantageous arrangement of the motor assembly 14 is shown in FIG. 3. There, all of the components of the relay 10 are the same as in FIG. 1, except that the motor assembly 14 comprises a magnet 30 arranged as a segment of a rotating member 31. In both foregoing embodiments of the motor assembly 14, the magnets are disposed so as to exert an equal influence on all of the wires in the contact operator assembly 13.

The selecting mechanism 15 control crosspoint operation by allowing only selected portions of the contact operator assembly 13 to operate. As illustrated in FIG. 2, the selecting mechanism 15 and the contact group comprising all of the passive contacts are arranged so that they straddle the active contacts. The selecting mechanism 15 includes a plurality of code bars wherein each is substantially identical to the code bar 32. All of the code bars have notches cut in both edges. Moreover, all of the notches are substantially identical to those shown cut in the upper edge of the code bar 32. Furthermore, all of the notches are substantially identical to the notch 33.

The code bars are disposed side by side in slidable relation with each other. As illustrated in FIG. 2, the notched portions of the code bars are positioned between the contact operator assembly 13 and the motor assembly 14. Furthermore, the code bars are associated with an actuator 34. The actuator 34 preferably comprises a plurality of solenoids (only one is shown) and is arranged to selectively reciprocate the code bars with respect to each other.

The latching mechanism 16 maintains electrical connections which have been established between active and passive contacts. In the embodiment shown in FIG. 1, the latching mechanism 16 comprises a plurality of mag-

nets wherein each magnet is associated with a passive contact. For example, the magnet 48 and the contact 17 are associated in the embodiment shown in FIG. 1. All of the magnets in the latching mechanism 16 are substantially identical to the magnet 48. All of the magnets, moreover, are arranged to generate a magnetic flux which will pass through those wires which have engaged passive contacts so as to hold the wires and the contacts together in closed crosspoints. As illustrated in FIG. 2, the contact 19 and the wire 24 are being held together in a crosspoint 25 by a magnet in the latching mechanism 16.

In operation, a crosspoint, as for example, the one comprising the wire 21 and the contact 17, is closed by a sequence beginning when the selecting mechanism 15 is energized by the actuator 34. The actuator 34 manipulates the selecting mechanism 15 until notches in adjacent code bars are aligned to form a channel adjacent to the crosspoint to be operated. Since the operation of the crosspoint associated with the wire 21 and the contact 17 is being described, a channel 51 has been aligned adjacent to the wire 21.

Next, the motor assembly is operated. As shown in FIG. 1, the motor assembly 14 has been energized and has urged all of the wires in the contact operator assembly 13 towards the selecting mechanism 15. In the embodiment illustrated, all of the wires are magnetically responsive as well as flexible. Thus, the motor assembly 14 is conveniently magnetic and the urging force is electromotive. Any other kind of force, however, will serve equally as well.

Next, one wire is selected for operation. As shown in FIG. 2, all of the wires in the contact operator assembly 13 except the contact wire 24 have been bent away from the passive contacts and toward the selecting mechanism 15. The wire 24 is shown in engagement with the contact 19 and has already progressed through the procedure being described.

As further shown in FIG. 2, all of the wires except the contact wire 21 have been stopped after moving an insignificant distance by the code bars. The contact wire 21, however, was unimpeded by the code bars and has entered the channel 51 where it has been bent or cocked.

Next, the motor assembly 14 will be de-energized. In the embodiment shown in FIG. 1, one convenient method of de-energizing the motor assembly 14 is to discontinue the current flowing in the coil 28. As a result, the magnetic forces acting on the wires are interrupted and all of the wires are released.

When released, all of the wires except the contact wire 21 will return to the neutral or starting position. Releasing the contact wire 21, however, will trigger it so that it will rebound from the cocked position back beyond the neutral position and into engagement with the passive contact 17.

Next, the latching mechanism locks the triggered wire and its associated passive contact together to form a crosspoint. As can be seen from FIG. 2, the contact wire 21 will become subject to the influence of a magnet in the latching mechanism 16 as it engages the contact 17. As a result, the contact wire 21 will be held against the contact 17 similarly to the manner in which the contact wire 24 is held against the contact 19 as shown in FIG. 2.

While the latching mechanism 16 in the embodiment described relies upon magnetic forces to hold active and passive contacts together, it is clear that any other convenient latching forces can be used. In addition, it is clear that the wires can be made of non-homogenous materials. For example, any of the wires described herein can readily be made in at least two parts wherein one part is flexible but magnetically non-conducting and the other part is magnetic but not flexible. With such an arrangement, the non-magnetic flexible part would join the wire to the housing while the magnetic part would be arranged to respond to the motor assembly and the latching mechanism.

5

Moreover, it is clear that the wires themselves can serve as contacts directly or they can serve as carriers for a plurality of contacts. In the latter case, a single wire can readily be used to control a crosspoint containing multiple contacts.

Another advantageous form of the selecting mechanism 15 is embodied in a counter part to the relay 10 which is illustrated in FIG. 5. The relay embodied therein comprises a housing 35, a contact assembly 36, a contact operator assembly 37, a motor assembly 38, a latching mechanism 39, and a selecting mechanism 40.

As shown, the housing 35 is cylindrical; the contact assembly 36 comprises a plurality of active and passive contacts wherein the active contacts are mounted on the ends of flexible wires and the passive contacts are mounted on conductors extending along the housing 35; the contact operator assembly 37 comprises a plurality of flexible wire sets disposed around the perimeter of the housing 35 wherein each flexible wire set comprises contact and release wires substantially the same as the release wire 41 and the contact wires 42 and 43; the motor assembly 38 is an electromagnet; and the latching mechanism 39 comprises a plurality of magnets disposed on the housing 35. Each of the foregoing components functions similarly to counterparts identified in detail in previously described embodiments.

The selecting mechanism 40, however, comprises a plurality of disks 44, 45 and 46 and means for supporting the disks. In the embodiment shown, the disk 44 is supported by a stationary shaft and the disks 45 and 46 are supported by shafts which are adapted to rotate separately in either direction. Moreover, all of the disks include notches similar to the notch 47 in the disk 44.

As can be seen from the embodiments disclosed herein, the selecting mechanism is free to select wires from a contact operator assembly without being affected by the condition of either operated or unoperated wires. As a result, any desired number of crosspoints, up to and including all that are available, can be operated concurrently.

Operation of a crosspoint in the embodiment of the relay shown in FIG. 5 is similar to that of the embodiments previously described. In the embodiment shown in FIG. 5, however, selection of a crosspoint for operation is made by rotating the disks 45 and 46. As illustrated in FIG. 6, the disks have been so rotated that a channel 52 has been established below the contact wire 43. As a result, the crosspoint associated with the wire 43 is ready for operation.

Crosspoints are opened in response to movement of release wires. As previously described, selected wires in the contact operator assembly are release wires as, for example, the wire 22 in the contact assembly 13 shown in FIG. 2.

As shown in detail in FIG. 4, the release wire 22 is equipped with a T-shaped hook 53. The hook 53 includes a cap 54 and is attached to the release wire 22 by an end 55. The hook 53 is arranged so that the cap 54 is disposed behind the two adjacent contact wires 21 and 24 at a spatial level intermediate the wires and their associated contacts 17 and 19. The cap 54 is preferably made from an electrically non-conducting material and is arranged to disconnect the contact wires 21 and 24 from their respective contacts 17 and 19 in response to movement of the release wire 22.

Operation of release wires, as in the case of contact wires, is selective. Operation occurs when, in the manner described for contact wires, a channel is established into which a release wire can bend. For example, when the contact wires 21 and 24 and the contacts 17 and 19 are engaged and the release wire 22 is bent into a channel, the hook 53 will pull the wires 21 and 24 away from the contacts 17 and 19. When the contact wires 21 and 24 are moved away from the contacts 17 and 19, they move out of the influence of the latching mechanism 16.

6

Thus, the associated crosspoints open and remain open.

While a T-shape is a preferred form for the hook 53, it will be recognized that other configurations can be used. Again, as in the case of the contact wires, additional release wires can be selected and operated without regard to the condition of any of the crosspoints in the relay 10.

It is understood that the above-described arrangements are merely illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A switching device comprising:

a contact;

a flexible member including a contact portion arranged to cooperate with said contact to form an electrical connection, said contact portion normally separated from said contact;

means for bending said flexible member to move said contact portion away from said contact a predetermined distance and for releasing said flexible member after said contact portion has moved away from said contact said predetermined distance, said flexible member arranged to rebound and transport said contact portion towards said contact and into engagement therewith after it has been released; and

means for holding said contacting portion and said contact together after engagement.

2. In a switching device, the combination comprising:

a housing;

a contact assembly mounted on said housing, said contact assembly including a plurality of active and passive contacts arranged to cooperate with each other in order to open and close electrical connections;

a selecting mechanism for selecting active contacts, said selecting mechanism mounted on said housing adjacent to said passive contacts in a manner such that said selecting mechanism and said passive contacts straddle said active contacts;

a motor assembly mounted on said housing;

a contact operators assembly mounted on said housing, said contact operator assembly including means responsive to the energization of said motor assembly for transporting a selected active contact a predetermined distance away from said passive contacts and responsive to the de-energization of said motor assembly for transporting said selected active contact into engagement with one of said passive contacts after said selected active contact has traversed said predetermined distance; and

a latching mechanism mounted on said housing, said latching mechanism including means for holding active and passive contacts together after they have engaged each other.

3. A switching device comprising:

a plurality of flexible first members;

a plurality of second members wherein each second member is adapted to cooperate with a first member to form an electrical connection;

means for selecting a first member, said selecting means and said second members disposed to straddle said first members;

means for bending a selected first member in a direction away from said second member and for releasing said selected first member after it has been bent, said selected first member being adapted to move after it has been released in a direction toward said second member until it makes electrical contact with a second member; and

means for keeping said first and second members in engagement with each other.

4. A switching device in accordance with claim 3 wherein some of said first members include make contacts for electrically engaging second members and some of said

7

first members include means for disengaging make contacts from said second members.

5. A switching device in accordance with claim 4 wherein said disengaging means comprises a release member having one end fastened to a first member and the other end hooked to engage the end of another first member.

6. A switching device comprising:

a plurality of magnetically responsive first wires;

a plurality of contacts for engaging selected first wires in current-carrying connections;

means for magnetically urging all of said first wires away from said contacts, deflecting a selected first wire a predetermined distance away from said contacts, and for releasing said selected and deflected first wire after said predetermined distance has been traversed, said selected and deflected first wire arranged to swing into engagement with one of said contacts when released;

means for magnetically latching contacts and released first wires together in electrical connection; and

a plurality of notched code bars for intercepting said first wires as they move away from said contacts and for selecting said selected wire whereby wire selection is made on one side and electrical contact is made on the other side of said wires.

7. A switching device in accordance with claim 6 further including a plurality of magnetically responsive second wires disposed among said first wires, each of said second wires being operatively similar to said first wires and including means for disengaging a first wire from a contact.

8. A switching device comprising:

a plurality of stationary contacts;

a plurality of flexible contacts having a neutral position, said flexible contacts arranged to engage said stationary contacts in current-carrying connections on a first side of said neutral position;

8

a plurality of code bars for aligning a channel adjacent to a selected flexible contact, said code bars disposed on a second side of said neutral position;

means for urging all of said flexible contacts toward said code bars, for moving said selected flexible contact into said channel, and for releasing said selected flexible contact from said channel, said selected flexible contact being adapted to spring into engagement with one of said stationary contacts when released from said channel;

means for holding engaged contacts together; and

means responsive to said code bars for disengaging said engaged contacts.

9. A switching device in accordance with claim 8 wherein said flexible contacts are magnetically responsive and said moving means is a source of magnetic flux.

10. A switching device in accordance with claim 8 wherein said source of magnetic flux comprises a rotating magnet.

11. A switching device in accordance with claim 8 wherein said code bars comprise a plurality of disks having notches cut in their peripheries.

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