

March 16, 1948.

F. EDGARTON

2,438,042

SELECTOR SWITCH

Filed April 21, 1945

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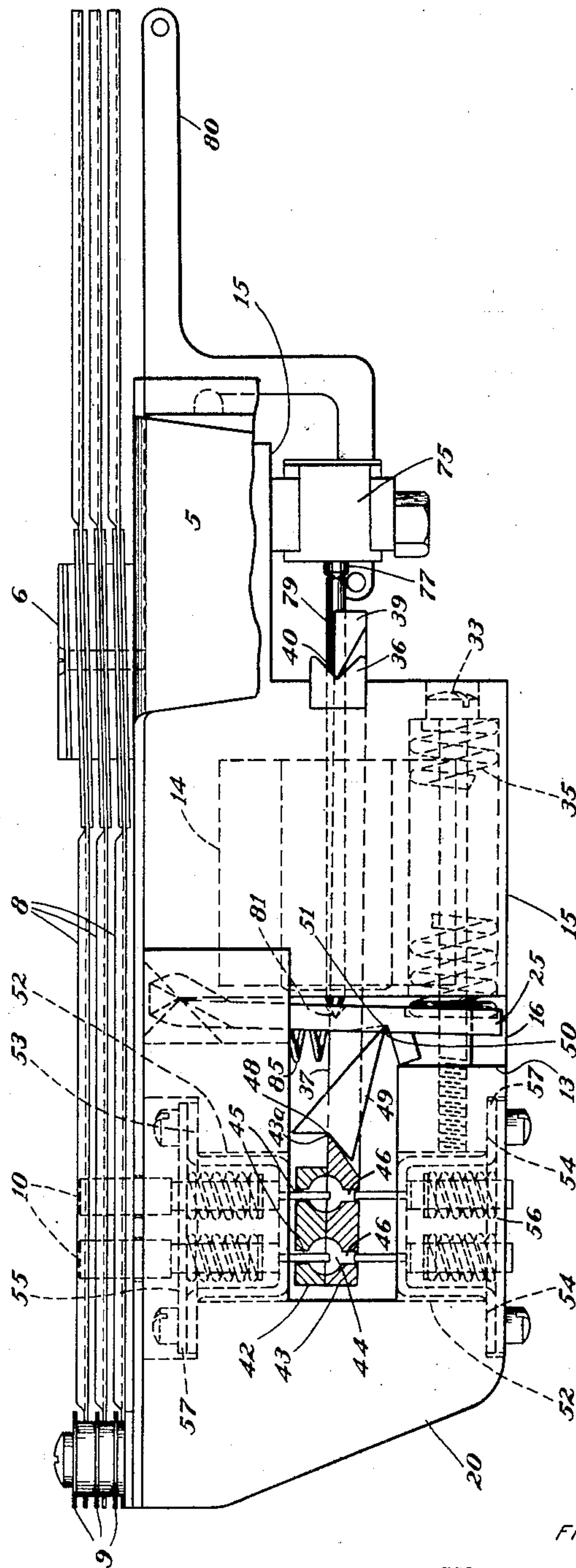


Fig. 1

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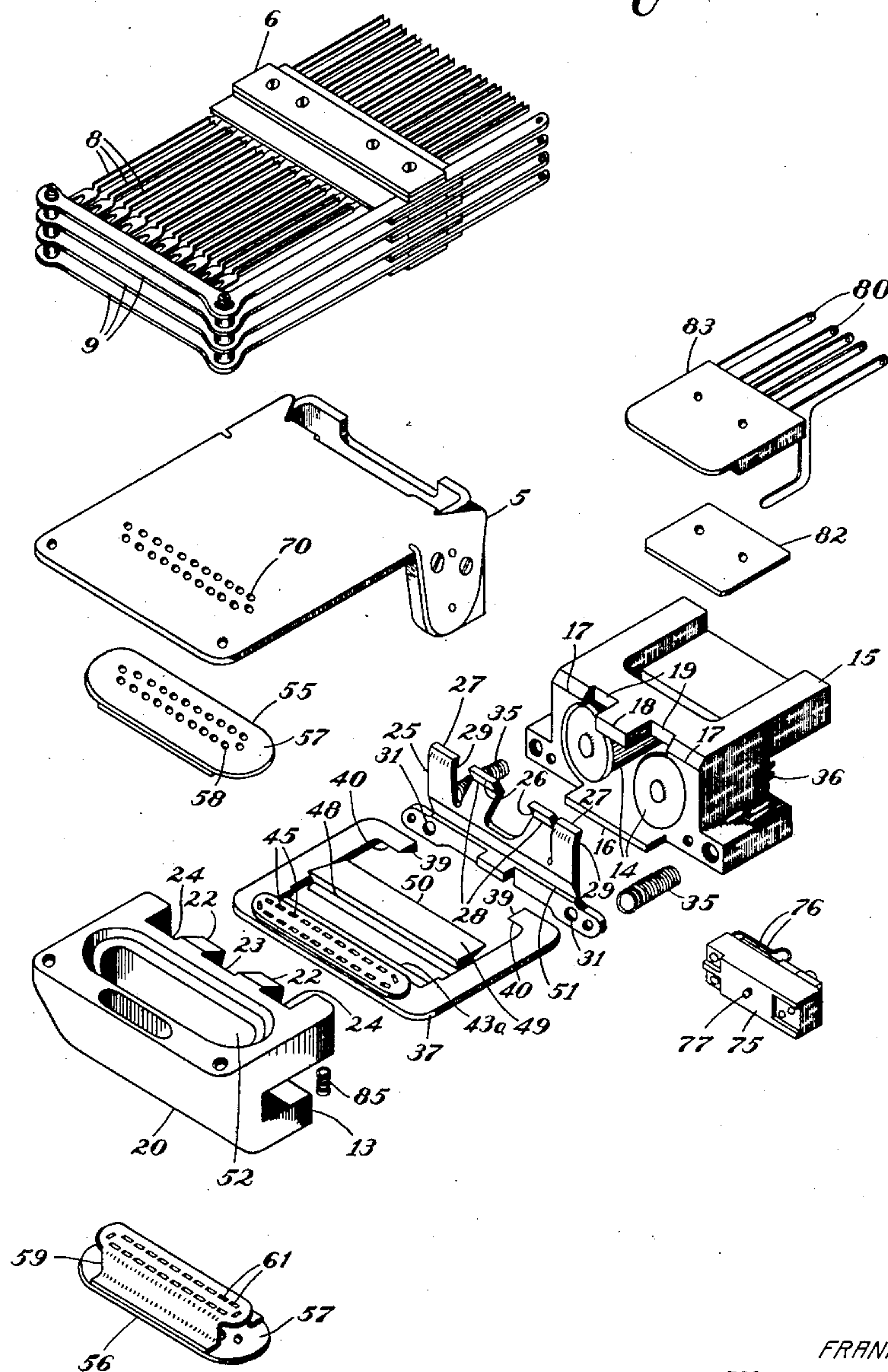
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Fig. 2



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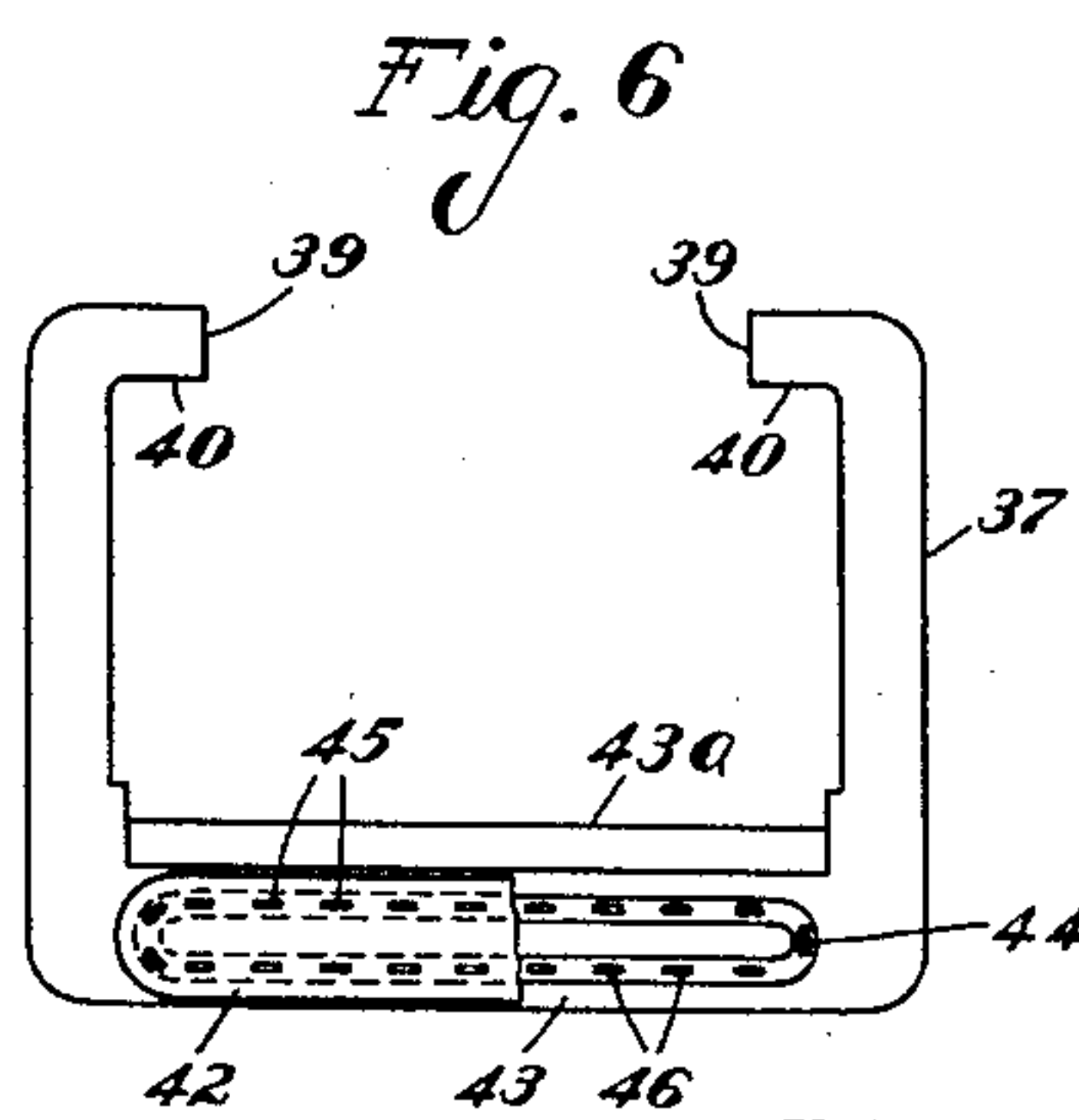
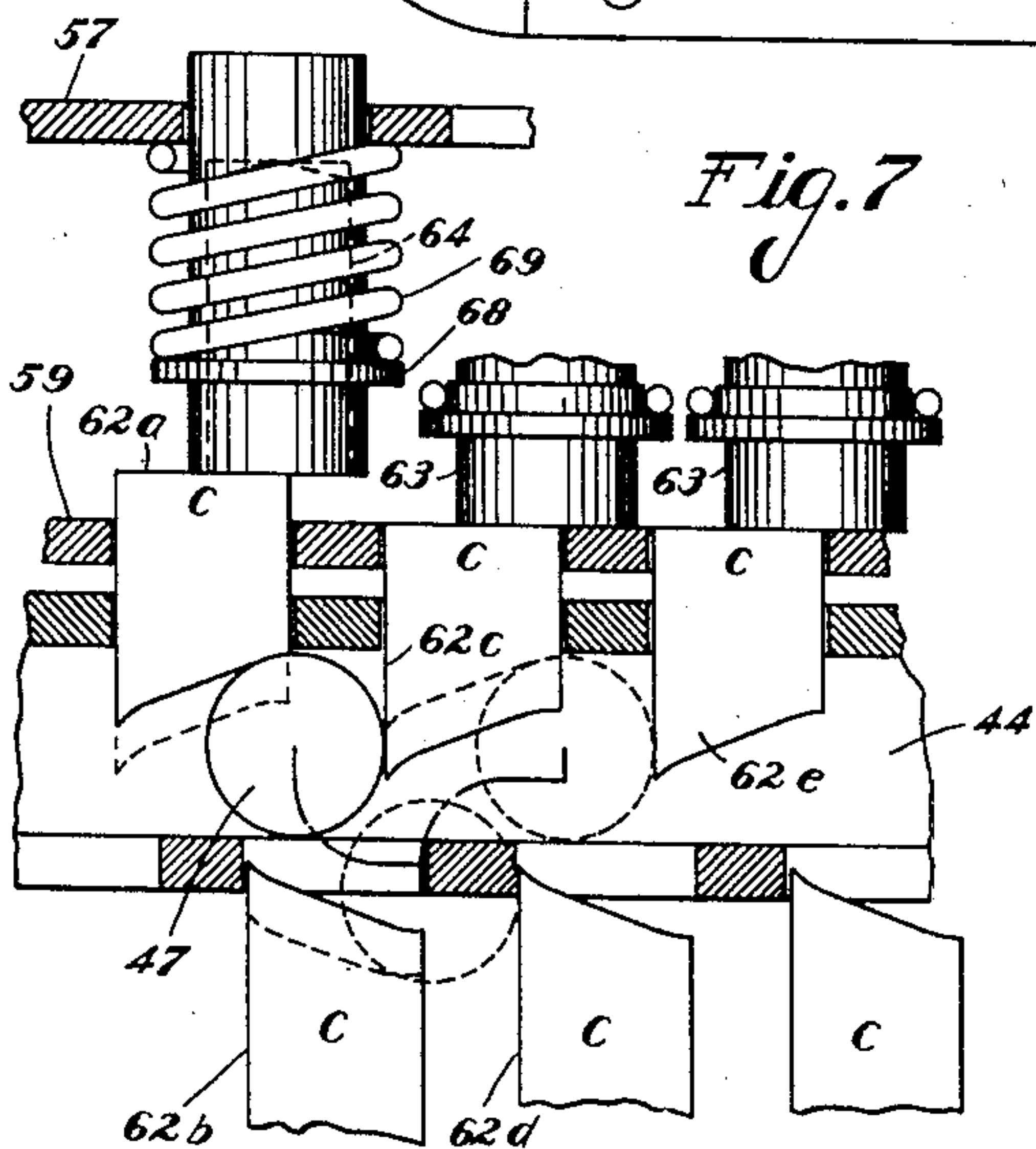
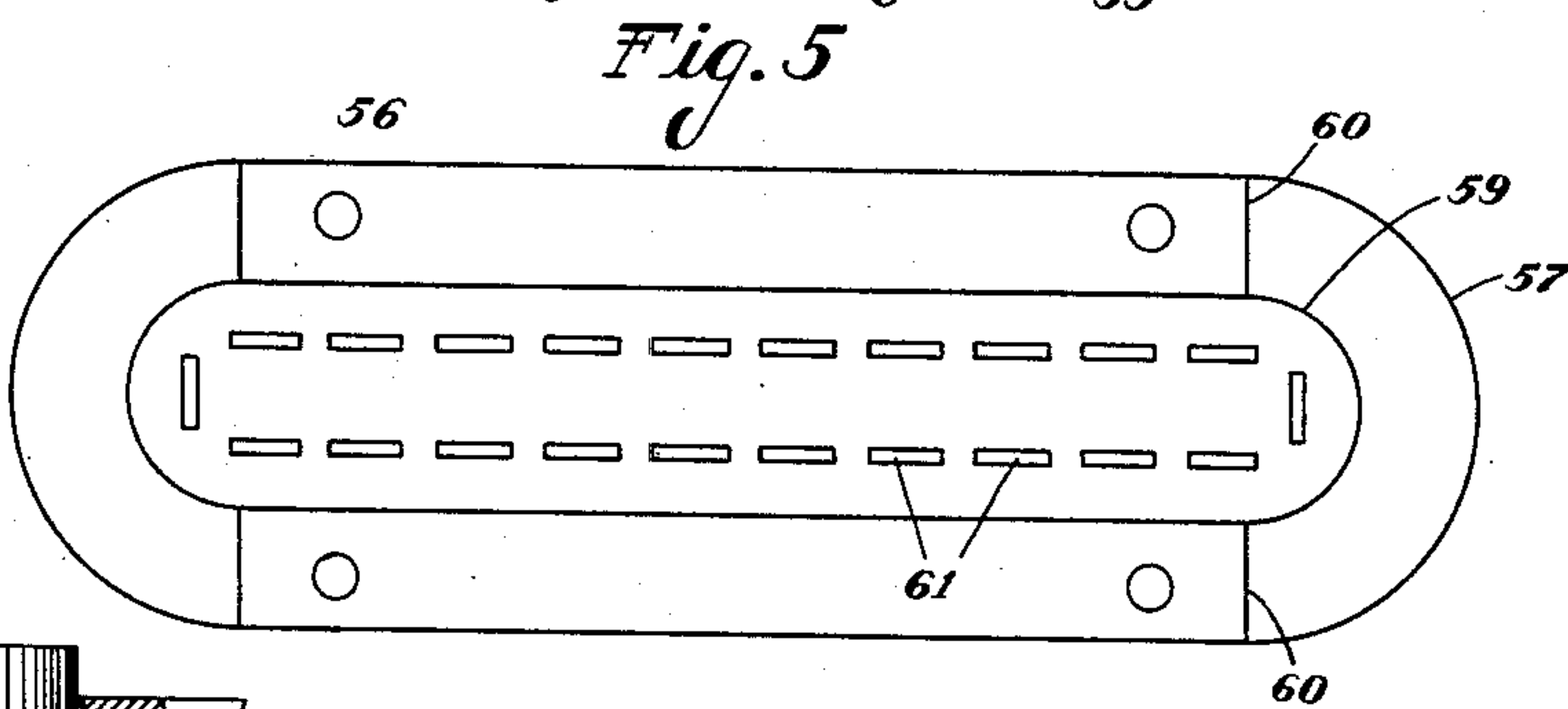
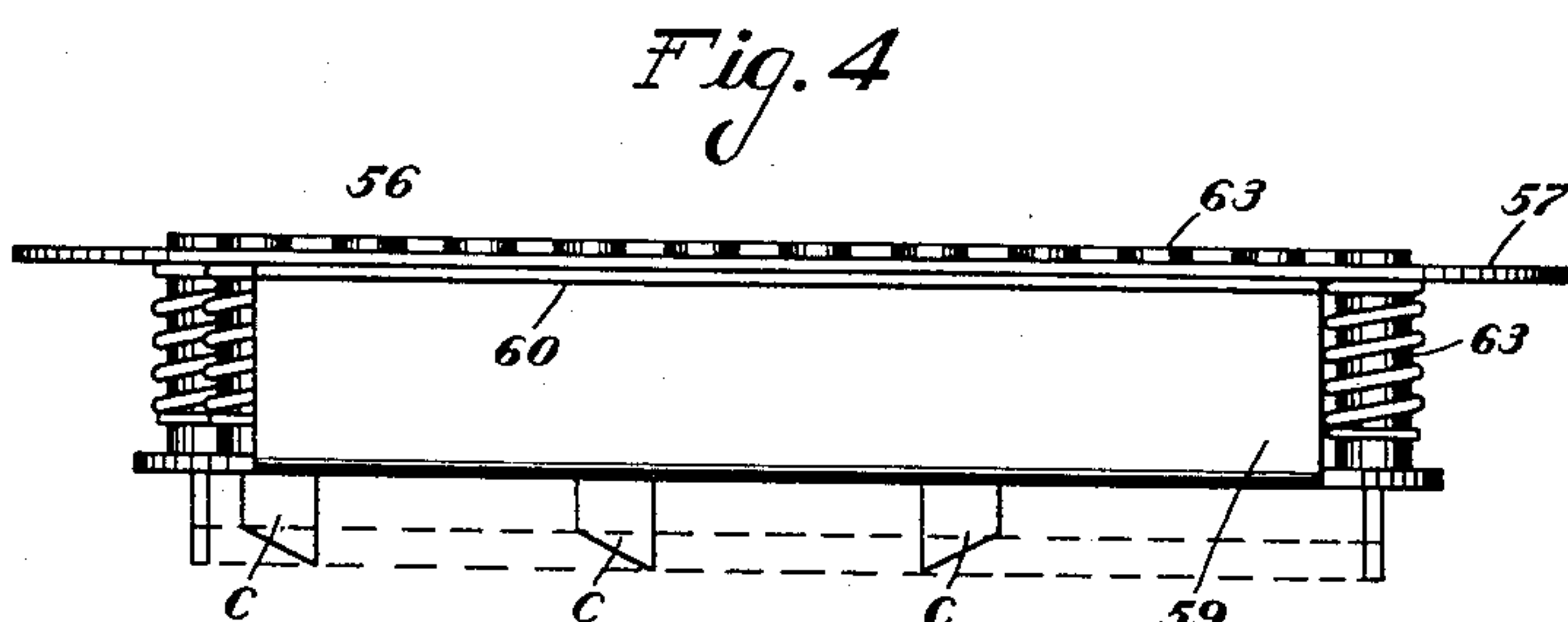
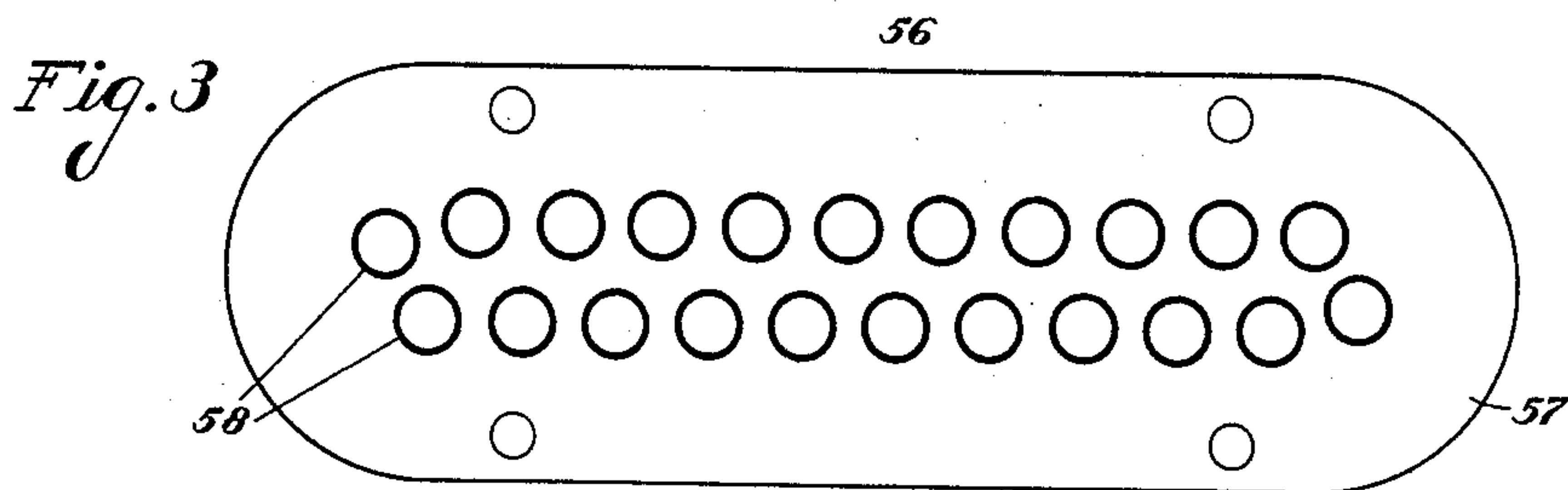
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4 Sheets-Sheet 3



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Fig. 8

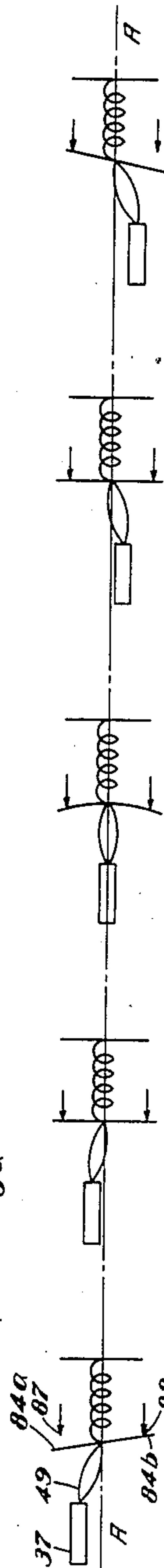
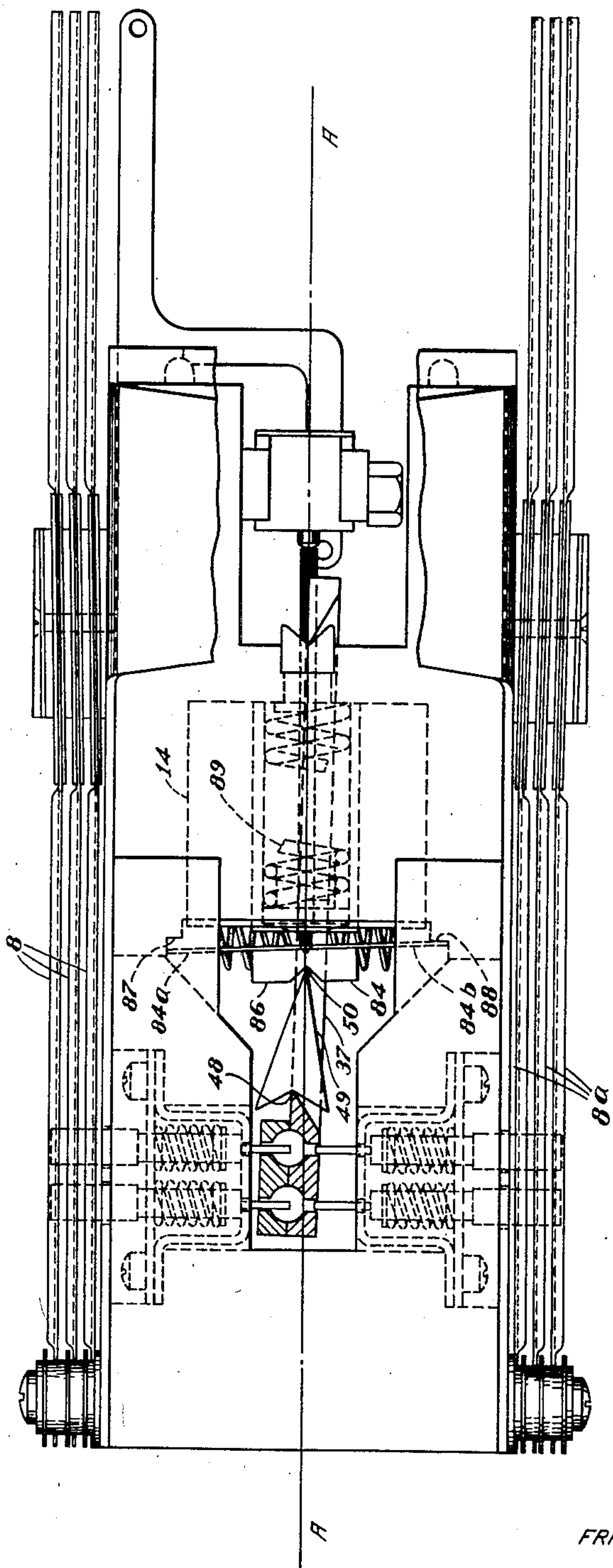


Fig. 13

Fig. 12

Fig. 11

Fig. 10

Fig. 9

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2,438,042

SELECTOR SWITCH

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Application April 21, 1945, Serial No. 589,667

18 Claims. (Cl. 179—27.5)

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This invention relates to selecting mechanisms and particularly to selecting switches.

The present selecting mechanism is of the type referred to in the art as a ball selector. In such a selector, a ball is advanced by a progressive, step-by-step motion, to any desired position along a predetermined path to effect one wanted selection from several possible selections. Such a selector is especially adapted for use in telephone systems and the like, wherein rapidity of selection and reliability of operation over long periods of service, are essential.

The main feature of the invention relates to a ball selector of such construction and having such mode of operation that it affords extreme reliability and rapidity of operation.

Other features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which:

Fig. 1 is a side elevation of a single acting type of ball selector of the present invention;

Fig. 2 is an exploded perspective view of this selector;

Fig. 3 is a bottom view, Fig. 4 is an inverted side elevation and Fig. 5 is a top view, with respect to its assembled condition in Fig. 1, of the lower cam assembly;

Fig. 6 is a view, partially in section, particularly indicating the outline of the ball race;

Fig. 7 is a fragmentary showing of a portion of the ball race assembly with the actuating ball therein and also several of the cam elements projecting into the ball race, this showing being particularly useful in describing the interaction between the cam elements and the ball for advancing the ball along the ball race and for forcing the cam elements outward from the ball race in succession;

Fig. 8 is a side elevation of a modified form of the invention herein referred to as a double acting selector and Figs. 9, 10, 11, 12 and 13 are schematic showings useful in describing one cycle of operation of the ball race assembly of the double acting selector.

The ball selector of the present invention, in one embodiment, comprises a mounting base 5 (Fig. 2) on the upper surface of which there is secured a contact spring assembly 6 comprising stacks of contacts, each stack of contacts including sets of active spring contacts 8 and inactive contacts 9, the several active spring contacts of a stack being movable by a single pusher 10 into contact with their related inactive contacts. The pushers 10 are arranged in two generally parallel

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rows. On the under surface of the mounting plate, there is secured mechanism for selectively operating the pushers of the stacks of contact springs, one at a time in a predetermined order.

In the illustrated form of my invention, the operating mechanism comprises a magnet made up of two parallelly arranged solenoids 14, adapted when energized to attract an armature 25 against the action of a pair of springs 35. The armature, in cooperation with a toggle link 49, moves a swinging operating member having a suitable contact operating member of relatively small mass disposed for movement along a guideway. In the drawings there is shown a ball race unit 37 movable against the action of return springs 85 (Fig. 1) so that the ball race unit oscillates away from and toward the mounting base 5 in response to the energization and deenergization of the magnet. The ball race unit includes an enclosed, flattened elliptical race or guideway 44 (Fig. 6) in which an actuating ball 47 (Fig. 7) is adapted to travel, the ball race being generally parallel to the base and being generally coextensive in length with the width of the contact spring assembly 6. The ball race unit and the contact actuating member or ball 47 therein cooperate with means comprising cam elements C of an upper cam assembly as well as the cam elements C of a lower cam assembly mounted within the cam assembly support 20. The cam surfaces of the several cam elements of the upper cam assembly and of the lower cam assembly project into the ball race in the path of the actuating ball, with the cam surfaces of the upper cam assembly in alternate relation with those of the lower cam assembly. Thus, as the ball race unit is oscillated in the manner above-mentioned, first a cam element C of the lower cam assembly and then a cam element C of the upper cam assembly will be forced outward in a manner to be described. The contours of the cam surfaces, as will be described, are such that as the cam elements of the upper and lower cam assemblies are alternately forced outward in succession, the ball 47 will be progressively advanced along the ball race 44. The cam elements C of the upper cam assembly project through openings 70 in the mounting plate to operate in succession the several pushers 10, one of which is individual to each stack of contact springs in the contact spring assembly.

With this general description of the ball selector, a detailed description thereof is in order. The solenoids 14 comprising the driving magnet, are mounted in parallel relation in a generally

rectangular mounting block 15 with their pole faces extending toward the left side of the block, as viewed in Fig. 2. The left end of the mounting block has the outer portions of its upper corner provided with knife edges 17. The intermediate portion of the upper corner of the block is formed with a rectangular projection 18 which is received in a recess 23 in the cam assembly support 20 as will be further referred to. The intermediate portion of the lower corner of the block is formed with a rectangular projection 16 which will be further referred to. At each side of the rectangular projection 18 there are provided cut-out portions 19 to afford clearance for a portion 26 of the armature, as will be described. The cam assembly support 20 has its right side fastened by screws 33 (Fig. 1) against the left face of the mounting block 15. The right side of the support 20 is provided with projecting aligned knife edges 22 having the recess 23 therebetween. At each side of the knife edges 22 there are provided cut-out portions 24 to afford clearance for a portion 27 of the armature, as will be described. The knife edges 22 are directed toward the cut-out portions 19 in the mounting block when this block and the cam assembly support are bolted together in rigid relation. When thus bolted together, the projection 18 on the mounting block extends into the recess 23 between the knife edges 22 on the cam assembly support, and the projection 16 on the mounting block is held in contact with the lower right surface 13 of the cam assembly support 20.

The armature 25, which is operated by the solenoids 14 and which serves to oscillate the ball race unit, is provided with two upstanding pairs of arms 26 and 27. The two intermediate arms 26 are shaped to afford bearings 28 adapted to receive the knife edges 22 on the cam assembly support. The two outer arms 27 of the armature are shaped to provide bearings 29 to receive the knife edges 17 on the mounting block. It will be understood that the knife edges 17 on the mounting block and the knife edges 22 on the cam assembly support 20 are arranged to be in alinement in the assembled selector. However, the bearings 28 and 29 on the two pairs of upstanding arms 26 and 27 of the armature are slightly out of alinement but these upstanding arms are somewhat flexible so that their bearings can be sprung into alinement when the armature is assembled between the mounting block and the cam assembly support. This arrangement assures that there will be no play in the swinging action of the armature. The lower part of the armature is provided with two openings 31 through which there freely passes the screws 33 threaded into the cam assembly support 20 to join said support rigidly to the mounting block 15. The openings 31 are of sufficient size so that the mentioned bolts can pass therethrough and yet the armature can oscillate without striking these bolts. In the lower corners of the left face of the mounting block there are provided recesses to receive coil springs 35. The outer ends of these springs respectively engage the lower ends of the armature tending to swing the lower portion of the armature away from the mounting block and from the solenoids. The right face of the mounting block, as shown in Fig. 1 is provided with hardened inserts 36 each having a V-notch therein. These V-notches serve as bearings about which the ball race unit 37 oscillates.

The ball race unit 37 comprises a generally

rectangular frame with one of its sides interrupted to define inturned end portions 39. These portions have knife edges 40 adapted to engage the V-shaped notches in the hardened inserts 36. The side of the unit opposite the knife edges is provided with the ball race 44 (Fig. 6). As shown in cross section in Fig. 1, this assembly comprises two plates 42 and 43 secured together with their inner faces in contact. The inner surfaces of these plates are each formed with a depression of generally flattened elliptical outline. The two depressions in these plates when brought into registry define the ball race 44 of generally flattened elliptical outline and of a size in cross section to enable the hardened actuating ball 47 (Fig. 7) to travel freely therealong. Each plate has openings therein, generally rectangular in cross section, extending into the race, the openings 45 in plate 42 being staggered with respect to the openings 46 in plate 43. The lower plate 43 of the ball assembly is provided with a knife edge 43a to cooperate with the V-shaped recess 43 in one side of a toggle link 49. The opposite side of this link is provided with a knife edge 50 to engage a notch 51 in the adjacent surface of the armature 25.

The cam assembly support 20 has a vertical recess 52 therethrough positioned directly above and below the ball race when the device is put together. The support 20 is provided with an internal ledge 53 on the wall of the recess adjacent the top thereof and a similar ledge 54 (Fig. 1) adjacent the bottom of the support. The upper ledge 53 receives and supports an upper cam assembly 55, while the lower ledge 54 supports a lower cam assembly 56. Each cam assembly as shown in Fig. 1 comprises a main plate 57 having a series of circular openings 58 (Fig. 2) therein, positioned in accordance with a pattern having an outline similar to the outline of ball race 44 in the ball race unit. The main plate 57 has secured thereto, in spaced parallel relation, a guide plate 59 of similar outline but of smaller dimensions than said main plate. Thus, the guide plate 59 can extend into the opening 52 in the cam assembly support to a point beyond its related ledge while the margin of the main plate rests on that ledge. As herein shown, the guide plate has legs 60 formed thereon which can be joined to the main plate by welding or the like. The guide plate 59 has a series of rectangular openings 61 therein positioned in a pattern similar to the circular openings 58 in its related main plate with a circular opening in the main plate and a rectangular opening in the guide plate located in slightly off set-relation. It should be pointed out that the rectangular openings 61 in the upper guide plate 59 have the same pattern as that of the ball race support in Fig. 2, while the rectangular openings 61 in the lower guide plate 59 are arranged as indicated at the lower left of this figure and in Fig. 5.

The series of cam elements C, one for each circular opening 58 and for its related rectangular opening 61 are mounted in the two plates 57 and 59. Each cam element, as best shown in Fig. 7, comprises a cylindrical stem 63 of a length to have its inner end contact the guide plate 59 and its outer end to project through the main plate 57. The outer end of the stem, as shown, is solid to engage the pusher 10 but its inner portion is hollow to receive with a force fit, a portion 64 of a flat cam, such as 62a which extends through the guide plate 59. The free end of each cam within the ball race has a generally

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inclined surface, the inclined surfaces of the several cams face in the direction of movement of the ball 47.

It will be noted that stem 63 of the cam element has a shoulder 68 against which one end of a coil spring 69 engages. The other end of this spring engages the main plate 57. The projecting end of each stem 63 of the upper cam assembly registers with a corresponding opening 70 in the mounting base 5 so that each stem when elevated will encounter the pusher 10 of a given stack of contact springs.

It will be noted in Fig. 1 that there is mounted on the right side of the mounting block, a so-called microswitch 75, namely a switch that closes its contacts 76 (Fig. 2) with a snap action. In this switch, when a button 77 thereof is depressed, the switch will snap from one position to the other and when the pressure is removed from the button, the contact springs will snap back to their original position. The button 77 (Fig. 1) of this snap switch is actuated by a push rod 79 adapted to move longitudinally through a guide in the mounting block under the action of armature 25 and a suitable return spring (not shown). This push rod 79 at its left end, is pointed to engage a tapered recess 81 located at an intermediate point on the armature 25. The other end of the push rod contacts button 77.

The upper surface of the mounting block 15, is provided with a recess to receive an insulating plate 82 and the terminal strip 83 of insulating material. The strip 83 has mounted thereon, the terminals 80. These terminals are electrically connected to the windings of the solenoids and to the snap-acting switch 75 in the well-known manner. The exposed ends of the terminals 80 are for the purpose of external circuit connections.

In the operation of the selector switch, it will be understood that a circuit is completed, through the microswitch 75 or not, depending upon circuit considerations, to energize the two solenoids 14 of the magnet. When energized the solenoids attract the armature 25 which oscillates on the knife edges 17 and 22. As the armature is attracted toward the solenoids, the toggle link 49 tends to move toward the right (Fig. 1), but in so doing, knife edge support 48 of the toggle link will always remain higher than knife edge 50, thus insuring that the toggle link will never assume dead center position. The return spring 35 normally urges the ball race unit 37 downward so that when the toggle link 49 moves toward the right, the ball race is moved downward. Also, when the armature 25 is attracted toward the solenoids, the push rod 79 is moved lengthwise toward the right. This movement of the push rod actuates the button 77 of the snap-acting switch to change the relation of its contacts. The operating circuit for the solenoids 14 may be connected through the contacts of the snap-acting switch to provide a self-interrupting circuit, in the well-known manner. The operating circuit of the solenoids will now be interrupted so that they will no longer attract the armature 25. The coil springs 35 tend to return the armature 25 to its normal position and the armature during its return movement acts through the toggle link to force the ball race unit 37 upward against the action of spring 35. The push rod 79 also follows the armature. This push rod releases the pressure on the button 77 of the snap-acting switch permitting its contacts to move to their alternate position. The repeated opening and

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closing of the snap-acting switch will continue to energize and deenergize the solenoids 14 with a consequent oscillation of the armature 25, until a predetermined circuit condition is satisfied.

Each time that the ball race unit moves downward the ball 47 in its ball race 44 is constrained to move downward therewith. During this downward motion the cam 62a follows the ball until this cam reaches its normal position, as indicated by the dotted lines in Fig. 7. However, the ball continues downward after leaving the cam 62a so that it promptly encounters and starts to depress the cam 62b. Cam 62b, while thus under pressure from the ball, imparts a sidewise thrust on the ball with the result that as soon as the ball has descended far enough to clear the bottom of the cam 62c, the ball will be propelled along the ball race until it is in contact with the side of the cam 62d. The ball then continues downward until it reaches the lower limit of its motion. By this time, the ball has depressed the cam 62b to the position shown in dotted lines. As the ball race then moves upward carrying with it the ball, the ball is followed by the cam 62b until this cam reaches its normal position. The ball then leaves contact with the cam 62b and at once encounters cam 62c which it then starts to raise. Cam 62c under pressure reacts to impart a sidewise thrust on the ball with the result that as soon as the ball has been lifted high enough to clear the top of cam 62d it will be propelled along the ball race until it comes into contact with the side of cam 62e. The ball then continues its upward movement until the ball race has reached the upper limit of its motion. At this point, the ball has succeeded in raising cam 62c to the position shown in dotted lines. In a similar manner repeated lowering and raising of the ball race assembly in response to further operation of the solenoids will cause the ball to be propelled along the ball race and lowering and raising succeeding cams until a desired set of contact springs 8 has been operated. On the release of the switch, the ball race will continue to lower and raise with the consequent advance of the ball and the successive operation of the cams until the ball has completed its entire elliptical course around the ball race to a so-called normal or home position, which may be any one of the stacks of contact springs 8, or a special stack designated for this purpose. At this position the operating circuit for the solenoids will be open. The path of the ball, as it progressively moves along the ball race, in response to the downward and upward movement of the ball race unit, is indicated in dot and dash lines in Fig. 7 wherein this line represents the locus of the center of the ball in the course of its travel during one complete down-and-up cycle of the ball race assembly. From consideration of this path of travel of the ball, it will be noted that the motion of the ball along the ball race occurs at a time when the ball is very lightly loaded due to the spring action against the several cams. However, when the ball is depressing or raising a cam far enough to build up or pick up a large vertical spring load, only vertical motion is required of the ball.

It should be pointed out that no useful work in actuating a stack of springs is performed by any depressed cam while the ball race assembly is held in its lower position. In the foregoing arrangement, it is not intended to actuate a given stack of springs during the actual duration of the impulses applied to the solenoids. The duration of the impulse is, of course, momentary and

for this reason the stacks of springs are all associated with the upper cams only. At the termination of each impulse the solenoids deenergize. The armature springs 35 which have been under maximum compression during the impulse act with sufficient force to push the armature away from the magnet poles. It will be noted that the point 43 of the toggle link is higher than the edge 50 thereof. Therefore, the force of the armature spring on the armature is transmitted through the toggle link to cause the ball race assembly to rise against the action of the spring 35. The ball race unit travel is large compared with the required armature travel. When the ball race unit rises, it lifts the ball 47 into contact with a selected upper cam, which cam is raised and in turn actuates the selected stack of springs 8. The ball race assembly continues to rise until the armature has been pushed to the limit of its travel or until the back pressure of the load of the contact spring stack has equalized the force of the armature spring. The mechanism remains in this position until the next impulse is received. Thus impulses applied to the driver unit are translated into actuation of successive stacks of springs 8. For each energization and deenergization of the solenoids, a spring stack is restored to normal and the next spring stack in succession is actuated. The foregoing selector may be referred to as the single action type since only its upper cams can be utilized for actuating a stack of contact springs since each complete impulse causes the ball race unit to be lowered only momentarily during the impulse of the solenoids and then to be raised again where it remains until the next impulse is received. In this arrangement, the lower set of cams which are required to cooperate with the upper cams in propelling the actuating ball are not used to actuate contact spring stacks.

In the modified form of the invention shown in Fig. 8, the selector switch has been changed so that not only the upper series of cams but also the lower series of cams are each effective in operating a stack of contact springs. The parts of this construction which are identical with those already described are designated by the same reference characters and will not be further described. In this construction, the armature 34 consists of an approximately rectangular plate which is slightly flexible. This armature is reinforced at an intermediate point by a block 26 having a notch therein to receive the knife edge 50 of the toggle link the knife edge 50 being located generally at the center line A—A of Fig. 8. The edge 34a of the armature rests against an upper ledge 37 while the lower edge 34b of the armature rests against the lower ledge 38. This armature is free to rock on either of the ledges 37 and 38 as a fulcrum if the forces acting on this armature permit such movement. The armature springs 39 exert their force along the center line A—A. The ball race unit and the toggle link are so coupled to the armature that if the ball race is held at the mid-point of its travel, the edges 43 and 50 of the toggle link as well as the rotational axis of the ball race unit will all lie along the center line A—A. The magnet pull is also exerted along this center line. The distance from 43 to 50 of the toggle link is such that when the ball race unit is held on the center line, namely on dead center, the armature 34 is caused to bow slightly, as shown in exaggerated form in the diagram of Fig. 11. In the operation of the selector, the normal position of the parts thereof will be either as indi-

cated in Fig. 9 or in Fig. 13 since the position illustrated in Fig. 11 is an unstable one.

Let it be assumed that the mechanism is awaiting an impulse with the ball race assembly in the upper position in Fig. 9. The armature spring 39 is then exerting a force on the armature which, opposed by the downward load on the ball race unit, transmitted through the toggle link, has caused the armature to assume the position shown in Fig. 9. In this position, the upper edge 34a of the armature has been rocked outward from the ledge 37 by using the ledge 38 as a fulcrum. The pressure of the strong armature spring 39 serves to hold the ball race assembly at the top of its travel with a stack of contact springs 8 actuated by the selected upper cam. At the beginning of the next impulse the solenoids are energized. This causes the armature to rock back to its vertical position with the armature edges 34a and 34b respectively in contact with the ledges 37 and 38, as indicated in Fig. 10. This permits the ball race assembly to start downward. The pull of the magnet is insufficient to bow the armature, but the moving ball race assembly has sufficient momentum in its travel downward, so that it is enabled to reach and pass through the dead center point, namely the center line A—A thereby bowing the armature slightly in order to pass through dead center, as indicated in Fig. 11. As soon as the ball race assembly has passed through dead center the armature 34 in relieving itself of the bowing action will thrust and hold the ball race assembly in the lower position shown in Fig. 12. The ball race will remain in this position until the solenoids are deenergized at the end of the impulse. When the solenoids are deenergized the pressure of the armature spring 39 forces the armature outward from the solenoids. Since the ball race unit is already below the center line A—A it will oppose the armature spring in such a way as to cause the armature edge 34a to rock on the ledge 37 as a fulcrum, while the armature swings its edge 34b outward. The ball race unit can now be swung to the lower limit of its travel where it will remain, holding the selected cam and the stack of contact springs 8a actuated thereby until the next impulse takes place. This condition is indicated in Fig. 13. When the next impulse starts and the solenoids are again energized the armature 34 will again assume its vertical position and the ball race unit will rise passing through the phases indicated in Figs. 12 and 11 and eventually assuming the position indicated in Fig. 10 where it will await the end of the impulse.

When the solenoids are deenergized at the end of the impulse, the armature 34 will be rocked outward on the ledge 38 as a fulcrum, the armature driving the ball race unit to the upper limit of its travel as indicated in Fig. 9. Thus, the modified selector of Fig. 8 selects in sequence the various contact spring stacks associated with its several cams making alternate selections from its upper and lower cam groups.

What I claim is:

1. In a selector switch having sets of contacts to be operated, a magnet provided with an armature arranged to move toward and away from said magnet in response to the energization thereof, a member movable back and forth under the control of said armature, said member having a ball race therein, a ball contained in said race, elements projecting into said race for progressively moving said ball along said race as said member moves back and forth, and means including cer-

tain of said elements for actuating said sets of contacts in succession under the control of said ball.

2. In a selector switch having sets of contacts to be operated, a magnet provided with an armature arranged to move toward and away from said magnet in response to the energization thereof, a member movable back and forth under the control of said armature, said member having a ball race therein, a ball contained in said race, independently movable elements projecting into said ball race for progressively advancing said ball along said race as said member moves back and forth, and means including certain of said elements for actuating said sets of contacts in succession under the control of said ball as it advances.

3. In a selector switch having sets of contacts to be operated, a magnet provided with an armature arranged to move toward and away from said magnet in response to the energization thereof, a member movable back and forth under the control of said armature, said member having a guideway therein, a contact actuating member of relatively small mass disposed for movement along said guideway, independently movable elements projecting into said guideway from opposite sides thereof for progressively moving said ball along said guideway as said member moves back and forth, and means including certain of said elements for actuating said sets of contacts in succession under the control of said actuating member.

4. In a selector switch, sets of contacts arranged in two spaced rows, a magnet provided with an armature arranged to move toward and away from said magnet in response to the energization thereof, a member movable back and forth between said rows under the control of said armature, said member having a guideway therein extending in a plane substantially parallel to said rows, a contact actuating member of relatively small mass disposed for movement along said guideway, individually movable elements projecting into said guideway from opposite sides thereof for progressively moving said actuating member along said guideway as said member moves back and forth, and means including said elements for actuating said sets of contacts in succession under the control of said actuating member.

5. In a selecting device, a block provided with a pair of knife edges adjacent one surface thereof, a support adapted to have one of its faces secured in spaced relation to the surface of said block, said support having a pair of knife edges in alinement with the knife edges on said block and in side by side relation therewith, an armature provided with two pairs of somewhat flexible arms provided with bearings to engage said knife edges, said bearings prior to assembling being misaligned but being adapted to be sprung into alinement with each other by engagement with said knife edges, contact springs, and means including said armature for actuating said contact springs.

6. In a ball selector, a series of elements to be operated in succession, a ball race mounted to move back and forth in a given path extending generally at right angles to the principal axis of said race, a ball in said race, means for moving said ball race in said path, said series of elements projecting into said ball race where they terminate in cam surfaces which are all inclined with respect to the plane of said race, and in the

same direction with respect to the path of said ball in said race, and means including said cam surfaces for advancing said ball along said ball race during the back and forth movement thereof, said ball as it advances actuating said elements in succession.

7. In a selector switch, sets of contacts arranged in two spaced rows, a magnet provided with an armature arranged to move toward and away from said magnet in response to the energization thereof, a member movable back and forth between said rows under the control of said armature, said member having a ball race therein extending along said rows, a ball contained in said race, individually movable elements projecting into said race from opposite sides thereof for progressively moving said ball along said race as said member moves back and forth, said elements terminating in said race in cam surfaces which are all inclined with respect to the plane of said race, and in the same direction with respect to the path of said ball in said race, and means including said elements for actuating said sets of contacts in succession under the control of said ball.

8. In a selecting device, a block provided with a pair of knife edges adjacent one surface of said block, a support adapted to have one of its faces secured in spaced relation to the surface of said block, said support having a pair of knife edges in alinement with the knife edges on said support and in side by side relation therewith, an armature provided with two pairs of somewhat flexible arms provided with bearings to engage said knife edges, said bearings prior to assembling being misaligned but being adapted to be sprung into alinement with each other by engagement with said knife edges, two spaced series of elements to be operated in succession, a guideway mounted to move back and forth in a given path extending generally at right angles to the principal axis of said guideway, a contact actuating member of relatively small mass disposed for movement along said guideway, means for moving said guideway in said path, the two series of elements projecting into said guideway from opposite sides thereof where they terminate in cam surfaces which are all inclined with respect to the plane of said guideway, and in the same direction with respect to the path of said actuating member in said guideway, means including said cam surfaces for advancing said actuating member along said guideway during the back and forth movement thereof, said actuating member as it advances alternatively actuating an element in one series and then an element in the second series in succession.

9. In a selecting device, a block member, a support member having a face secured in spaced relation to a face of said block member, one of said members having a pair of knife edges at its face and the other member having at its face at least one knife edge in alinement with the knife edges on said other member and in side by side relation therewith, an armature provided with somewhat flexible arms provided with bearings to engage said knife edges, said bearings prior to assembling being misaligned but being adapted to be sprung into alinement with each other by engagement with said knife edges, contact springs and means including said armature for actuating said contact springs.

10. In a selector switch, sets of contacts arranged in two spaced rows, a magnet provided with an armature arranged to move toward and

away from said magnet in response to the energization and deenergization thereof, a member movable back and forth in a path between and substantially at right angles to said rows, means including a toggle link for translating the movement of said armature into the movement of said member in said path, said link having two stable terminal positions respectively related to the two rows of contact sets and having an unstable intermediate position, said member having a guideway therein extending along said rows, a contact actuating member of relatively small mass disposed for movement along said guideway, individually movable elements projecting into said guideway from opposite sides thereof for progressively moving said actuating member along said guideway as said member moves back and forth, and means including said elements for actuating said sets of contacts in succession under the control of said ball.

11. In a ball selector, a series of elements to be operated in succession, an element operating member mounted to move back and forth in a given path extending generally at right angles to the principal axis of said operating member, said operating member having a guideway therein, a contact actuating member of relatively small mass disposed for movement along said guideway, means for moving said operating member in said path, said series of elements projecting into said guideway where they terminate in cam surfaces presenting a saw-tooth array along the principal axis of said race, means including said cam surfaces for advancing said actuating member along said guideway during the back and forth movement thereof, said actuating member as it advances actuating said elements in succession.

12. In a selector, a block having knife edges at one surface thereof, a magnet mounted on said block, a support having knife edges projecting therefrom, said support being mounted in spaced relation to the surface of said block with said knife edges aligned with each other in side by side relation, an armature having pairs of arms provided with bearings respectively engaging said knife edges whereby said armature can swing toward and away from said magnet, a unit having a ball race therein, and mounted to move back and forth in a path generally at right angles to the direction of movement of said armature, means including said armature for moving said unit, a ball in said race, and a plurality of elements to be selected, individually movable in the general direction of said path, each element having a pointed end biased to project into said race in the path of said ball, said ball as it moves with said unit displacing said elements in succession, each element as a result of displacement serving to propel said ball along the ball race.

13. In a selector switch, sets of contacts arranged in two spaced rows, a magnet provided with a somewhat flexible armature, arranged to be moved toward and away from said magnet, in response to the energization and deenergization thereof, said armature being mounted to rock on either of its opposite edges, a contact operating assembly mounted to swing in a path generally parallel to the plane of said armature, a toggle link having one end engaging an intermediate portion of said armature and its other end engaging a part of said contact operating assembly, said link being somewhat longer than the distance between an intermediate portion

of the armature and said part when the contact operating assembly is in its nearest position to said armature whereby said link will snap from one position of stability to another through a position of instability, said contact operating assembly having a guideway therein, a contact actuating member of relatively small mass disposed for movement along said guideway, individually movable elements projecting into said guideway from opposite sides thereof for progressively moving said actuating member along said guideway as said assembly moves back and forth in said path, and means including said elements for actuating said sets of contacts in succession under the control of said actuating member.

14. In a selector switch, a ball race mounted for movement back and forth in a given path substantially at right angles to the principal axis of said race, oppositely disposed walls of said race having openings therethrough, the openings in one of said walls being staggered with respect to the openings in the opposite wall, a plurality of elements to be operated in succession, said elements being disposed in two sets on opposite sides of said race in the direction of movement of said race, one set being associated with said one wall and the second set being associated with said opposite wall and said elements extending through said openings into said race, the inner end of each element having a cam surface, all of the cam surfaces being inclined with respect to the principal axis of said race and in the same direction, a ball in said race, and means for imparting movement to said race whereby said elements successively cooperate with said race to urge said ball along said race.

15. In a selector switch, a ball race mounted for movement back and forth in a given path substantially at right angles to the principal axis of said race, oppositely disposed walls of said race having openings therethrough, the openings in one wall being staggered with respect to the openings in the opposite wall, a plurality of elements to be operated in succession, said elements being disposed in two sets on opposite sides of said race in the direction of movement of said race, one set being associated with said one wall and the second set being associated with said opposite wall and said elements extending through said openings into said race, the inner end of each element having a cam surface, all of the cam surfaces being inclined with respect to the principal axis of said race and in the same direction, a ball in said race, and means for imparting movement to said race whereby said elements successively cooperate with said race to urge said ball along said race, each of said elements being resiliently urged toward said race.

16. In a selector switch having sets of contacts to be operated, a ball race mounted for movement back and forth in a given path substantially at right angles to the principal axis of said race, oppositely disposed walls of said race having openings therethrough, the openings in one wall being staggered with respect to the openings in the opposite wall, a plurality of elements to be operated in succession, said elements being disposed in two sets on opposite sides of said race in the direction of movement of said race, one set being associated with said one wall and the second set being associated with said opposite wall and said elements extending through said openings into said race, the inner end of each element having a cam surface, all of the cam surfaces

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being inclined with respect to the principal axis of said race and in the same direction, a ball in said race, and means for imparting movement to said race whereby said elements successively cooperate with said race to urge said ball along said race, and means including certain of said elements for actuating said sets of contacts in succession as said ball advances along said race.

17. In a selector mechanism having contacts to be operated, a movable operating member having a guideway, means for causing movement of said operating member toward and away from said contacts whereby said guideway is moved toward and away from said contacts, a contact actuating member of relatively small mass disposed for movement along said guideway, means projecting into said guideway for causing movement of said actuating member along said guideway as said operating member moves back and forth in order to operate said contacts.

18. In a selector switch having sets of con-

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tacts to be operated, a movable operating member having a guideway, means for causing movement of said operating member toward and away from said contacts whereby said guideway is moved toward and away from said contacts, a contact actuating member of relatively small mass disposed for movement along said guideway, a plurality of elements projecting into said guideway for progressively moving said actuating member along said guideway as said operating member moves back and forth in order to operate successively said sets of contacts.

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REFERENCES CITED

The following references are of record in the file of this patent:

FOREIGN PATENTS

20	Number	Country	Date
	643,700	Germany	July 6, 1935