Oct. 14, 1941. B. A. SCHWARZ ET AL 2,258,814

MECHANICAL DRIVE

Filed Dec. 16, 1939 2 Sheets-Sheet 1

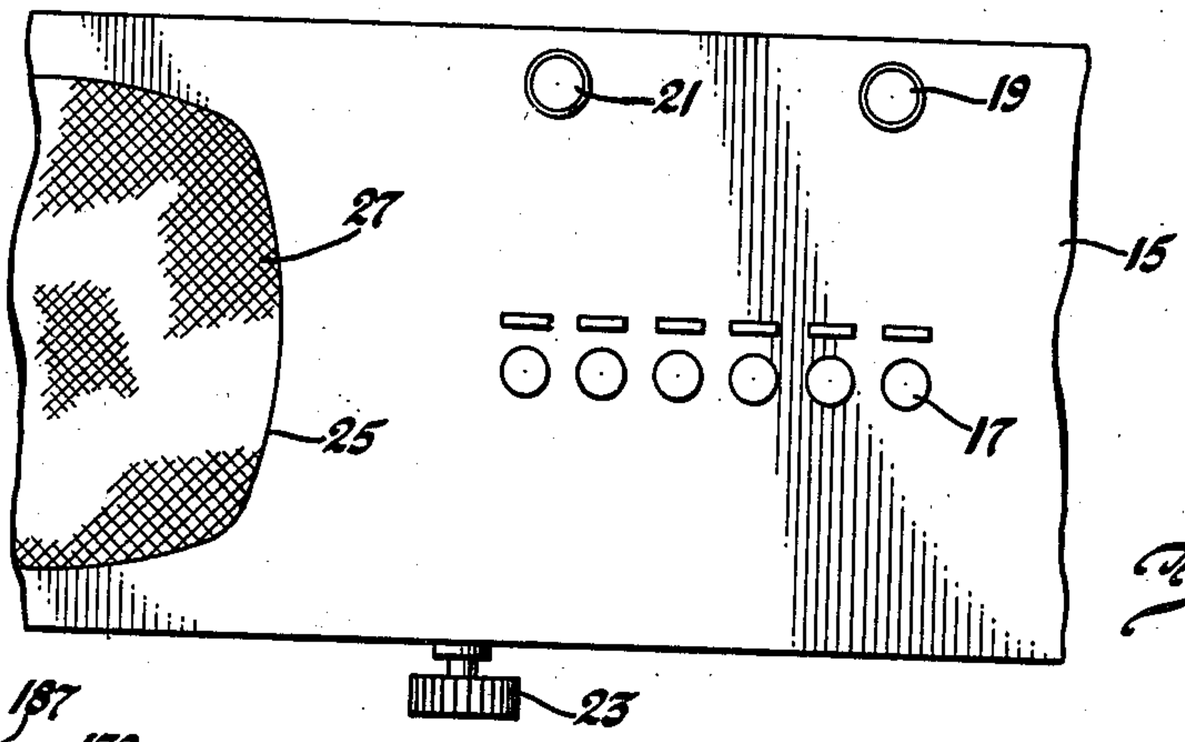

Fig. 1

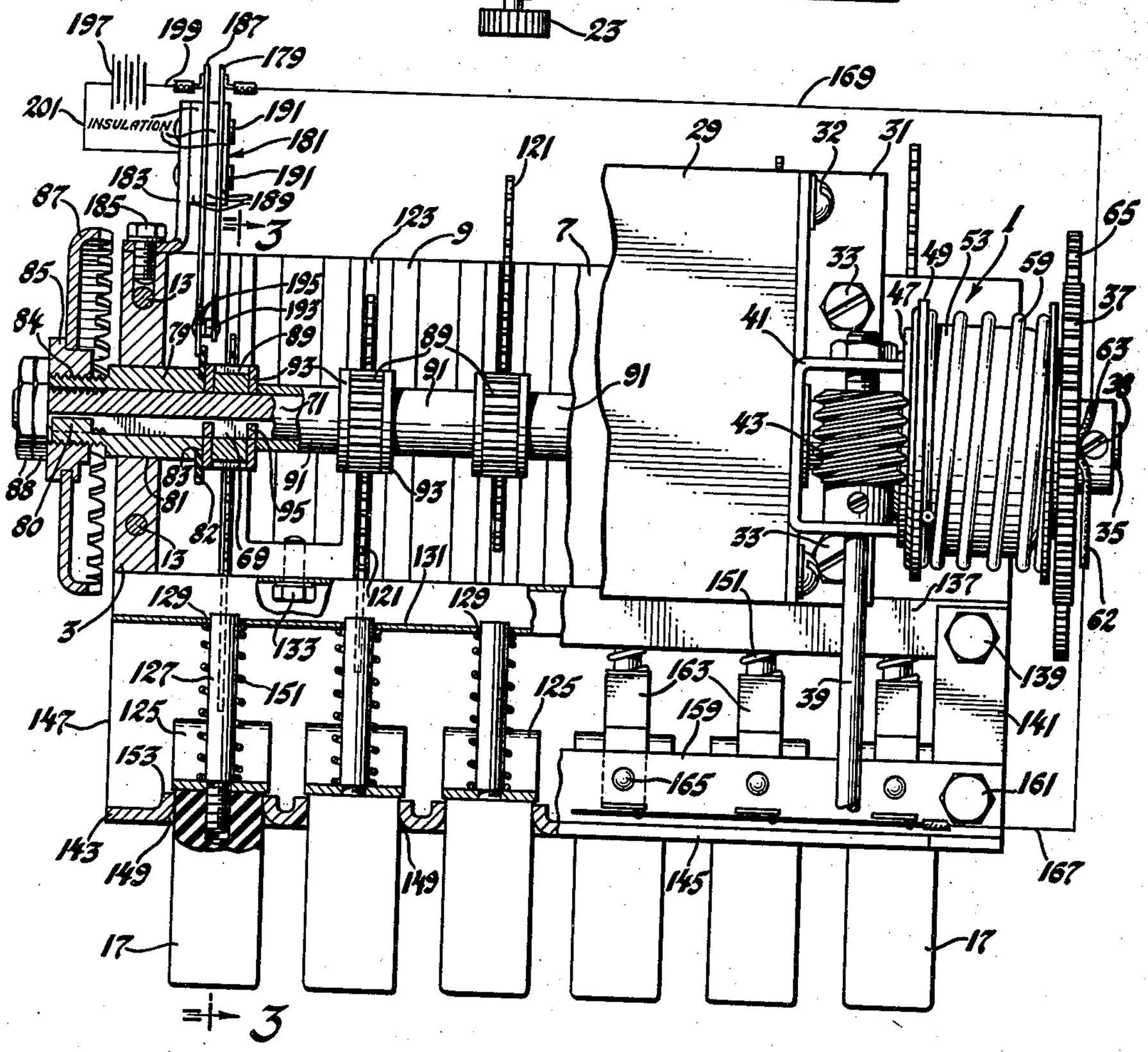

Fig. 2

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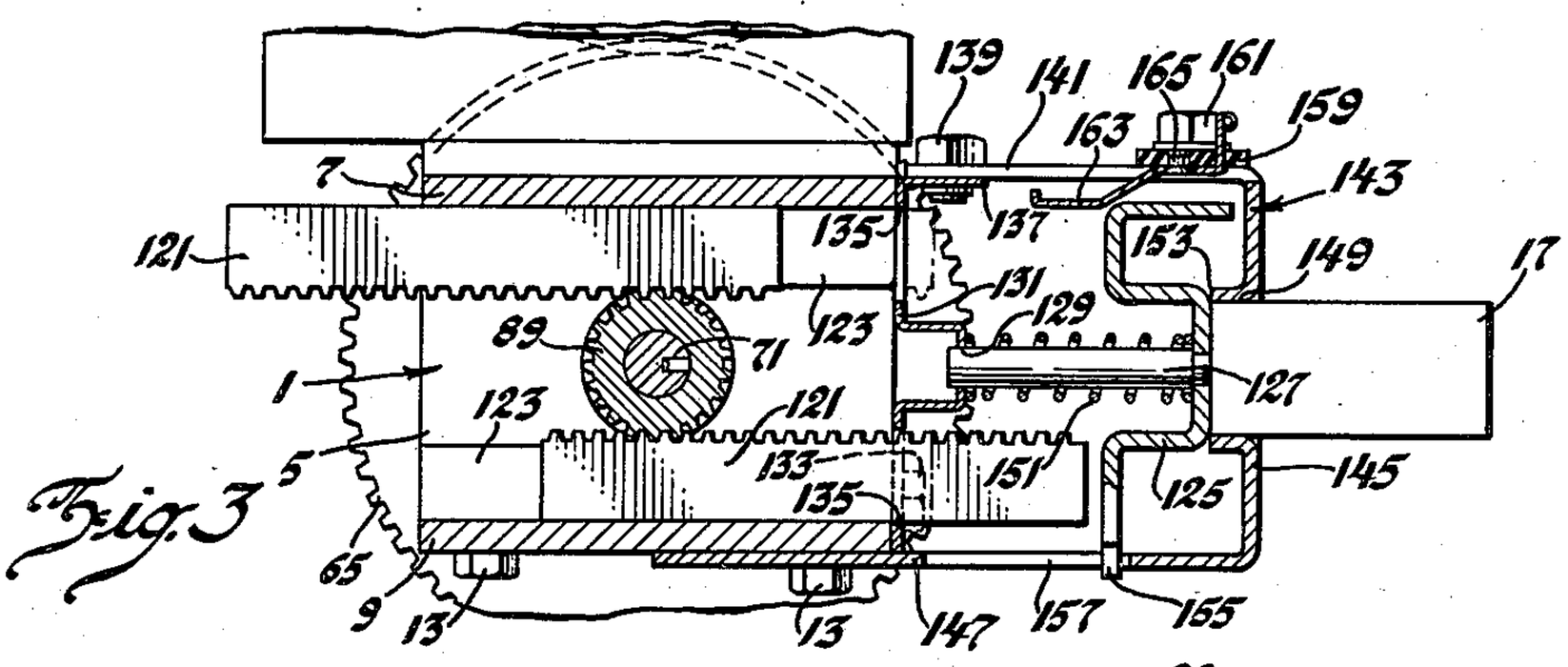

Fig. 3

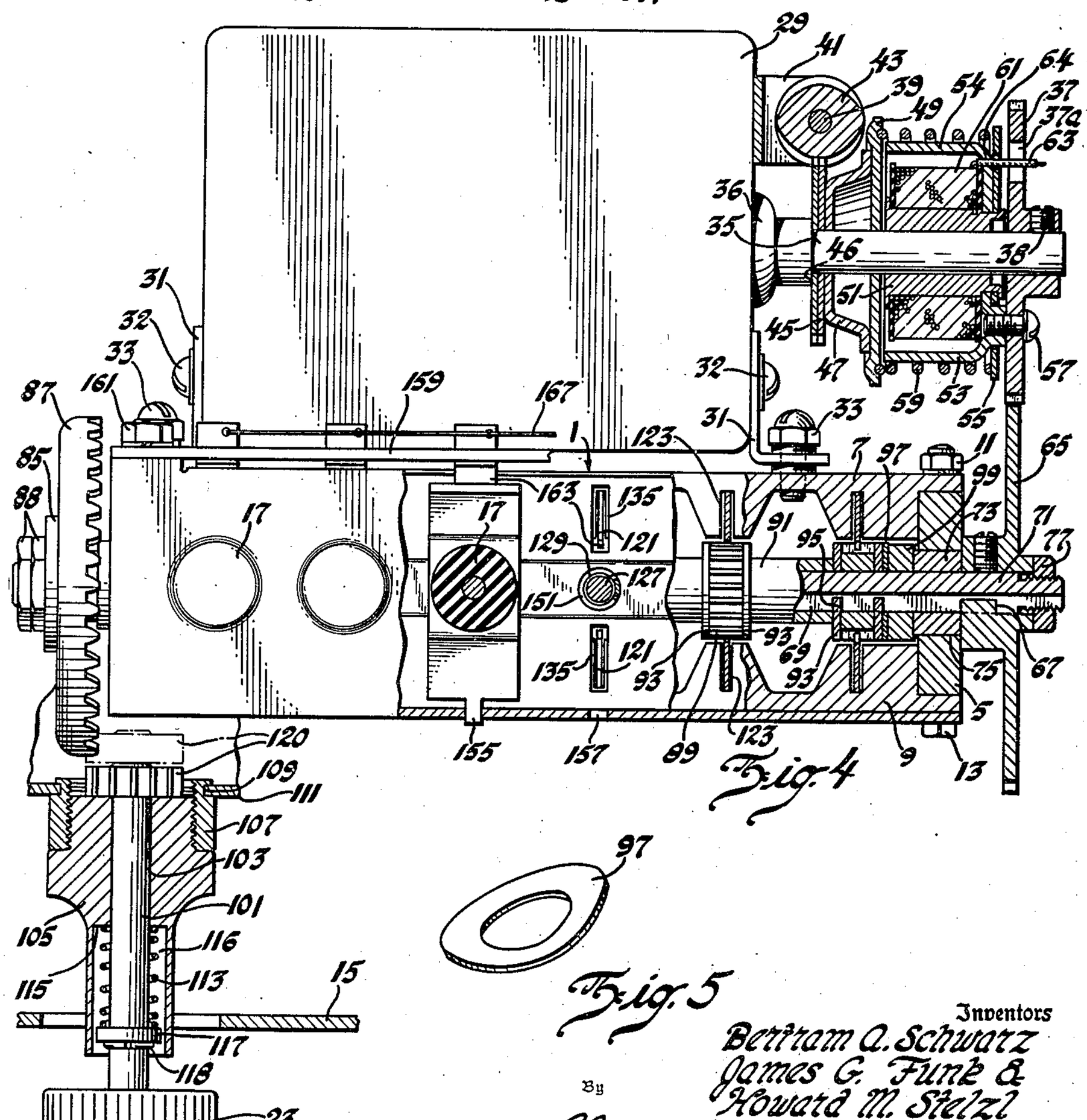

Fig. 4

Fig. 5

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MECHANICAL DRIVE

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7 Claims. (Cl. 74—10)

The present invention relates to a mechanical drive and more specifically to mechanical means for converting straight line movement into rotary movement to index a rotary member.

Mechanical drive and indexing mechanisms of the above type are particularly adaptable for rotating and indexing the tuning device of radio receivers in order to tune the receiver rapidly to a predetermined broadcast station. The combination of the mechanical drive and indexing mechanism when connected to actuate the tuning device of a radio receiver is usually known as an automatic tuning mechanism.

On small receivers such as those used on automobiles, where this type of tuning mechanism is particularly desirable, the mechanism must be small so that it may be included in the receiver housing. The parts of the mechanism must be sufficiently strong to prevent bending or misalignment in order to obtain accurate tuning. There must also be provided means whereby the indexing mechanism may be conveniently adjusted so that the tuning device may be indexed to different positions to vary the selection of broadcast stations to suit the location in which the receiver is operated.

An object of the present invention is to provide a compact, sturdy and inexpensive mechanical drive mechanism which may be included as part of a radio receiver assembly, whereby the receiver may be tuned to any one of a plurality of preselected broadcast stations by merely depressing a push button.

Another object is to provide convenient means associated with the tuning mechanism whereby the tuning mechanism may be adjusted by means of one hand only to change the selection of broadcast stations.

The means by which the above and associated objects are accomplished are described in the following specification and illustrated in the accompanying drawings, in which:

Figure 1 is a front elevation of the control panel of a radio receiver provided with controls for the tuning mechanism as well as other controls therefor.

Figure 2 is a top plan view of the tuning mechanism with some of the parts broken away to show details thereof.

Figure 3 is a vertical sectional view taken on line 3—3 of Figure 2.

Figure 4 is a front elevation of the tuning mechanism with the control panel broken away and some of the parts of the tuning mechanism broken away and others shown in section to show further details of the mechanism.

Figure 5 is a perspective view of one of the parts of the mechanism.

As shown in Figures 2 to 4, the tuning mechanism is supported in a frame indicated at 1 comprising end plates 3 and 5 and upper and lower plates 7 and 9, rigidly bolted together by nuts 11 threaded on the ends of bolts 13 which extend through the ends of the upper and lower plates and through the end plates. The frame 1 may be supported on a radio receiver chassis, not shown, the receiver and frame being suitably mounted behind a control panel shown at 15 which is provided with openings through which control elements extend for manual operation. These elements consist of a plurality of push buttons 17 for actuating individual mechanical drive and indexing mechanisms associated with the tuning device of the receiving set, a manually rotatable tuning knob 19 for the tuning device in the conventional manner, a volume control knob 21, and a control knob 23 by which any or all of the mechanical indexing means are adjusted so that any desired broadcasting frequency may be tuned in accurately upon depressing any one push button. A large opening 25 is shown in the panel 15 in which a grill 27 is shown which covers the opening in the radio speaker, not shown, which is associated with the receiver.

The tuning device associated with the receiving set is enclosed in a housing 29 provided with end brackets 31 by which it is fixed to the upper plate 7 of the frame 1 by means of the screws 32 and 33 and bolts 13 extending through these brackets. A tuning shaft 35 by which the tuning device is adjusted is rotatably supported in a bearing 36 located in the housing. The tuning shaft is limited to a definite angle of rotary movement by conventional stop means, not shown, associated with the tuning mechanism. A gear 37, fixed by means of a set screw 38 on the end of the shaft 35, is driven by a gear 65 of larger pitch diameter meshing therewith and fixed to a shaft 71 which is rotated in either direction by mechanical drive and indexing mechanism, to be described later. The tuning shaft 35 may also be rotated by the manually rotatable control knob 19 fixed on the outer end of a shaft 39, the inner end of which is rotatably supported in a U-shaped bracket 41 fixed to the housing 29. A worm 43 is fixed on the shaft portion between the legs of the bracket 41 and meshes with a worm wheel 45 supported adjacent an annular surface 46 of the tuning shaft 35.

A clutch mechanism is supported on the tuning shaft **35** between the worm wheel **45** and the gear **37** and includes two clutch discs **47** and **49** rotatably mounted on the shaft adjacent the worm wheel and a hub **51** to which is fixed a cup member **53** and a disc **55**. The cup member **53** has an annular surface portion **54** adjacent the disc **47** and is fixed to the gear **37** by screws **57**. A helical compression spring **59** placed between the discs **49** and **55** normally urges the discs **49** and **47** toward the worm wheel **43**, thereby urging it into frictional driving and holding engagement with the annular surface **46** on the tuning shaft **35** so that rotation of the worm **43** by the manual tuning knob **19** causes rotation of the tuning shaft by the worm wheel. The clutch mechanism, when so engaged with the worm wheel **45**, also acts as a holding means to prevent rotation of the tuning shaft **35** and the shaft **71** operatively connected thereto by the gears **65** and **37** on account of the irreversibility of the worm gearing. It will be apparent that any form of gearing having irreversible characteristics may be substituted for the worm gearing shown. The clutch mechanism may be disengaged, however, to allow rotation of the tuning shaft **35** by the shaft **71** by an annular electromagnetic winding **61** located in the space between the hub **51** and cup **53** which is provided with flexible end connections **62** and **63** extending outward through aligned openings indicated at **64** in the cup **53** and disc **55** in an opening **37***a* in the gear **37**. The end connections **62** and **63** are connected to a source of electrical energy by means to be described later to energize the winding **61** which sets up a magnetic field in the air gap between the disc **49** and the annular end surfaces of the hub **51** and cup **53** adiacent thereto which causes the disc to be attracted and moved into contact with these surfaces, thus compressing the spring **59** and releasing the force exerted by the spring **59** normally tending to hold the worm wheel **45** in engagement with the annular surface **46** of the tuning shaft **35**. Disengagement of the worm wheel from the tuning shaft allows the tuning shaft **35** to be rotated with respect to the worm wheel **45** by the shaft **71** which is operatively connected thereto by the gears **65** and **37** previously mentioned.

The gear **65** is provided with a tongue portion **67** extending into a slot **69** of the shaft **71** which is supported in a bushing **73** rotatable in an opening **75** in the end plate **5**. A nut **77** threaded on the end of the shaft prevents outward movement of the gear with respect to the shaft. The other end of the shaft **71** is supported by a bushing **79** having a tongue **80** also extending into the slot **69** of the shaft which prevents it from rotating with respect thereto. The bushing **79** is rotatably mounted in an opening **81** in the end plate **3** and is also capable of moving axially in this opening. An insulating washer **82** is pressed on the inner end **83** of the bushing which is turned to a smaller diameter. This washer controls an electric switch located adiacent thereto which will be referred to later. The outer end of the bushing is threaded at **84** on which is screwed an internally threaded hub **85** to which is fixed a gear **87** by which the bushing is screwed axially in either direction when the gear is rotated and the shaft is prevented from rotating. Nuts **88** are threaded on the outer end of the shaft **71** to limit outward movement of the gear **87** with respect to the shaft. A plurality of pinions **89** and sleeves **91** are rotatably mounted on the shaft **71** between the bushings **73** and **79**, the sleeves being located between the pinions in order to space them axially with respect to each other. Pinion washers **93** having tongues **95** extending into the slot **69** of the shaft are placed on either side of each pinion between the ends of the sleeves and also between the bushing **79** supporting one end of the shaft and between a spring washer **97** and a collar **99** located on the shaft adjacent the bushing **73** supporting the other end of the shaft. The spring washer **97** is shown compressed in Figure 4, but is bowed as shown in Figure 5 when not compressed. With the structure described above, movement of the bushing axially inward on the shaft increases the endwise frictional force on the parts carried on the shaft to connect the pinions, which are rotatably mounted on the shaft, to the pinion washers which are non-rotatably mounted on the shaft. With the above mentioned parts in this position, the pinions are thus operatively connected to rotate with the shaft. Movement of the bushing axially outward on the shaft decreases the endwise frictional force between these parts to a small value, determined only by the axial force exerted by the spring washer **99**, and allows the pinions to be rotated with respect to the pinion washers and the shaft. Axial movement of the bushing **79** in either direction with respect to the shaft is accomplished by the gear **87** threaded thereon when the shaft **71** and bushing **79** non-rotatably connected thereto are prevented from rotating and the gear is rotated in either direction which screws the bushing inward or outward with respect to the shaft **71**.

The control knob **23** previously mentioned, together with the following means operatively connected thereto, provides convenient means by which the gear **37** may be rotated in either direction to operatively connect the pinions to the shaft or allow them to be disconnected from the shaft. As best shown in Figure 4, the control knob **23** is fixed to a shaft **101** rotatably supported about an axis at right angles to the shaft **71** in the bore **103** of a housing **105** which is screwed into a bushing **107** fixed in an opening **109** in the lower flange **111** of the panel **15**. A spring **113** located on the shaft has one end in contact with the end **115** of the counterbore **116** of the housing and its opposite end in contact with a collar **117** fixed axially with respect to the shaft **101** by a spring ring **118** and therefore serves to project the shaft and control knob outwardly for manual operation and to maintain a pinion **120** fixed on the upper end of the shaft **103** out of mesh with the gear **87**. Inward movement of the control knob meshes the pinion **120** with the gear **87** and when the knob is rotated in one direction or the other the gear **87** will be rotated in one direction or the other with respect to the bushing **79** to screw it inwardly or outwardly axially with respect to the shaft **71** to operatively connect or disconnect the pinions with the shaft **71** as described above.

Each of the individual mechanical indexing mechanisms is operatively connected to one of the pinions **89** to cause it to be rotated in either direction to a given angular position when the push button actuating this mechanism is depressed. Each of these mechanisms comprises pairs of racks **121**, each of which is slidably mounted in vertically aligned transverse grooves **123** in the upper and lower plates **7** and **9** of the frame. Each rack of a pair meshes with a pinion at opposite sides thereof and accordingly the racks move linearly in the grooves **123** in opposite directions when the pinion **89** is rotated.

Actuating means for each pair of racks comprises a push plate 125 and one of the push buttons 17 fixed on the outer end of a shaft 127 movable axially with respect to a pair of racks. The inner end of each of these shafts 127 is slidably mounted in openings 129 in a plate 131 extending vertically between the front faces of the upper and lower plates and fixed thereto by cap screws 133. Vertically aligned slots 135 are provided in the plate 131 above and below the shaft openings 129 so that the ends of the racks 121 may move therethrough and be contacted and moved linearly by the push plates when they are moved inwardly by the push buttons. The plate 131 has a horizontal flange 137 at its upper extremity to which is fixed by screws 139 the horizontal end projections 141 of a member 143 having a vertical flange 145 spaced from the plate 131. The member 143 is also provided with a lower horizontal flange 147 which extends inwardly and is attached by means of the bolts 13 to the ends of the lower plate 9 of the frame 1. The vertical flange 145 of the member 143 has openings 149 in axial alignment with the shaft openings 129 in which the push buttons are slidably mounted. Helical compression springs 151 are located on each shaft 127 between the plate 131 and the push plates 125 to normally hold the shafts, push plates and push buttons outwardly away from the racks 121 and in the position shown in Figures 2 and 3 in which the push plates are shown in contact with the peripheral inturned flanges 153 of the openings 149 in the vertical flange 145 of the member 143. The lower ends of the push plates are provided with integral lugs 155 which project downward into transverse slots 157 in the lower flange 147 of the member 143 to prevent rotation of the push plates and shafts 125.

Electrical control means actuated by each push button and by the control knob 23 are provided to allow or prevent rotation of the tuning shaft 35 and shaft 71 by connecting or disconnecting the electromagnetic winding to a source of energy. This means comprises an insulating strip 159 extending horizontally between and fixed to both of the upper horizontal projections 141 of the member 143 by screws 161. Spring contacts 163 are fixed to the strip 159 by rivets 165 so that each is in a position to be contacted by a respective push plate when it is moved inwardly a slight distance. Each of the contacts is connected to the conductor 167 which is connected to the connector 62 of the electromagnetic winding 61; the other connector 63 is connected by a conductor 169 to a blade 179 of a switch indicated at 181. This switch comprises a bracket 183 fixed to the end plate 3 by a screw 185 which supports the switch blade 179 and another blade 187 arranged parallel thereto. Adjacent ends of these blades are clamped between insulating members 189 which are fixed to the bracket 183 by rivets 191 as best shown in Figure 2. The free ends of these blades extend inwardly toward the insulating washer 82 fixed to the bushing 79, the end of the blade 187 normally bearing on the outer annular surface of the washer. These blades are provided with contacts 193 and 195 which are held in electric contact with each other when the bushing is moved axially inward on the shaft to connect the pinions 89 to the shaft 71 and are separated when the bushing is moved axially outward on the shaft to disconnect the pinions from the shaft. The blade 187 is connected to one terminal of a battery 197 by a conductor 199, and the other terminal of the battery is connected to the bracket 183 by a conductor 201.

Operation

With the parts in their normal position as shown and described, the tuning shaft is rotated by a given angular position by depressing one of the push buttons 17. Initial inward movement of the push button and its respective push plate 125 causes the push plate to establish an electrical contact with the spring contact 163 located adjacent thereto whereby a circuit is completed between the battery 197 and the electromagnetic winding 61 to disconnect the worm wheel 45 from the tuning shaft 35 to allow the shaft to rotate with respect to the worm wheel. Current flows in this circuit from the battery 197 to the frame 1 and push plate 125 by the conductor 201, thence through the spring contact 163 to the winding 61 and from the winding to the switch 181 by the conductor 169. The switch contacts 193 and 195 are closed as shown, and the current flows through these contacts and back to the battery through the conductor 199. Further inward movement of the push plate causes it to come into contact and move one or the other of a pair of racks inwardly which rotates the pinion 89, shaft 71 and therefore rotates the tuning shaft 35 in the opposite direction at greater speed on account of its geared connection with the shaft 71 consisting of the large gear 65 fixed to the shaft 71 and the small gear 37 fixed to the tuning shaft 35. Rotation of the pinion likewise causes the other rack to move outward toward the inwardly moving push plate coming into contact therewith which stops movement of all the above named parts in a definite position, the tuning shaft position being such that the radio receiver is tuned to a certain broadcast station. Upon release of the push button the spring 151 returns the push plate and push button to its normal projected position and breaks the circuit connection to the winding 61 which allows the worm wheel to be reengaged with the tuning shaft, thus holding it in the position to which it was moved.

Adjusting of any or all of the indexing means to change the broadcast station selection is accomplished in the following manner by the use of one hand only. The control knob 23 is first pushed inward and rotated in the proper direction whereby the gear 87 is rotated to cause the bushing 79 to be screwed outwardly with respect to the shaft 71 and the opening 81 in the end plate 3. The shaft 71 is prevented from rotating by the worm wheel which is engaged to the tuning shaft. As the bushing moves outward the blade 187 of the switch 181 is moved out of contact with the blade 179 which opens the circuit to the winding 61 and prevents energization thereof, which maintains the worm wheel in holding engagement with the tuning shaft. Outward movement of the bushing at the same time decreases the endwise compression between the pinions 89 and pinion washers 93 so that the only endwise force therebetween is that due to the spring washer 97. The tuning shaft 35 is then rotated to a new angular position by the manually rotatable knob 19 and worm gearing until the particular radio frequency desired is tuned in, which likewise causes the shaft 71 to be rotated to a new position. Rotation of the shaft 71 causes the pinions 89 to rotate therewith and move all the rack bars to a different position. The spring washer 97 exerts just sufficient endwise force