Aug. 19, 1941. P. K. McGALL 2,253,304

PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

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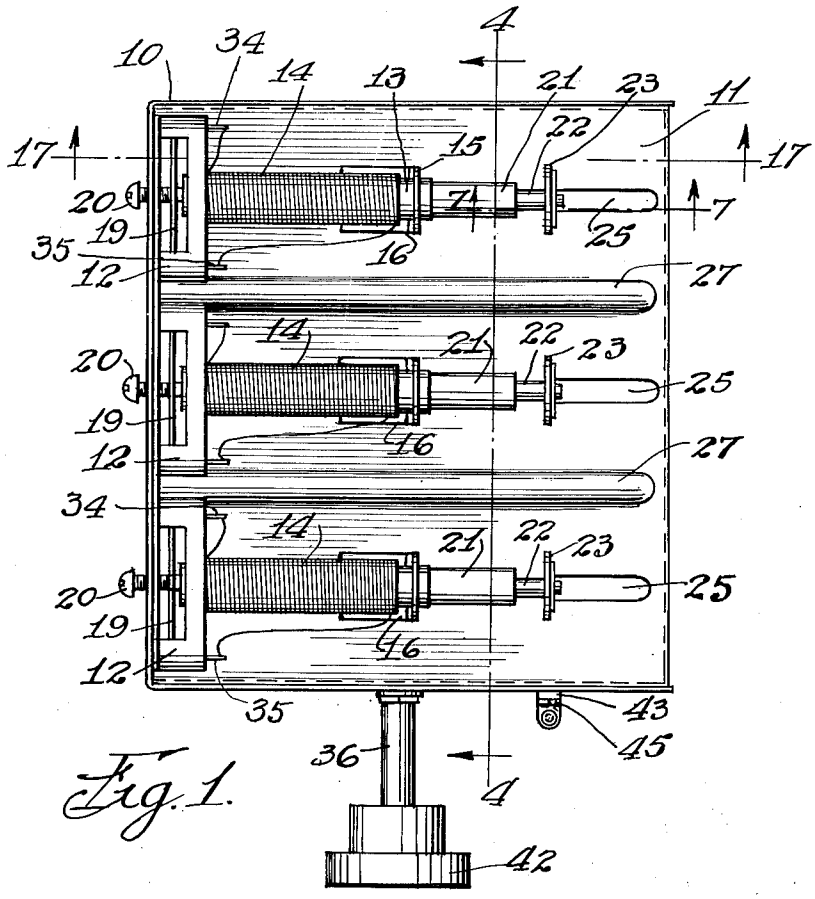


Fig. 1.

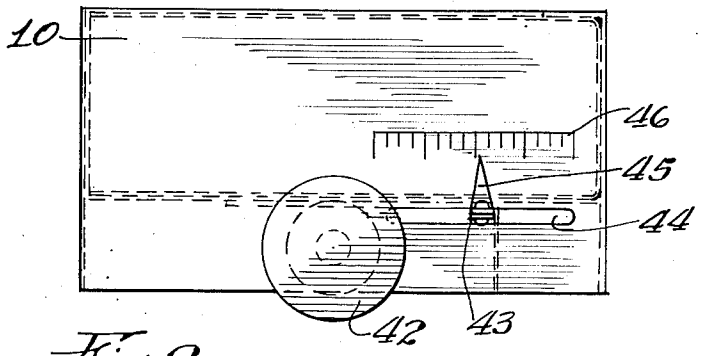


Fig. 2.

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

Filed Dec. 24, 1937 7 Sheets-Sheet 2

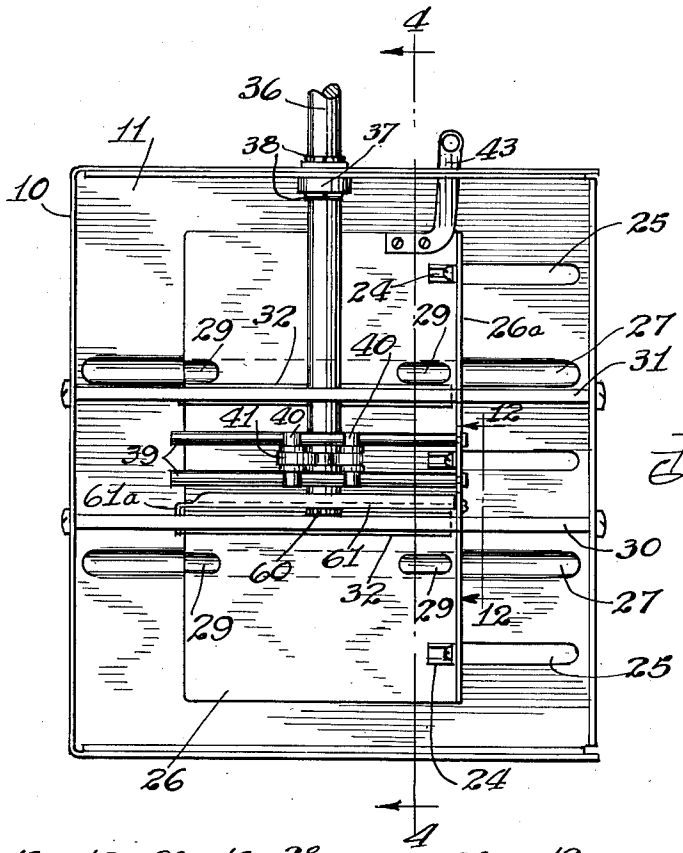


Fig. 3

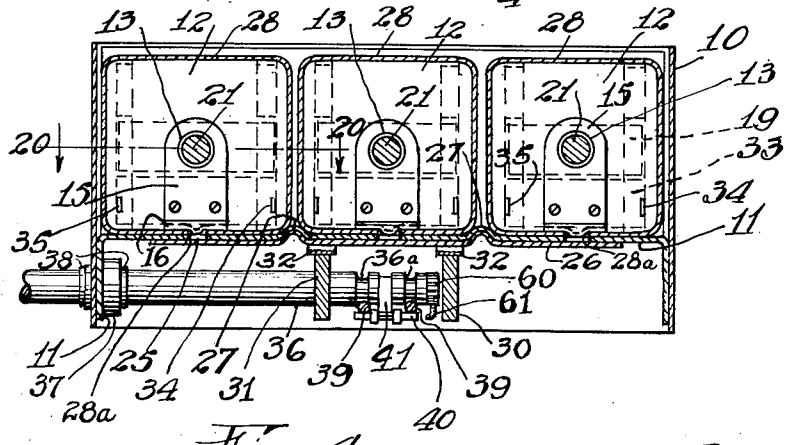


Fig 4

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

Filed Dec. 24, 1937 7 Sheets-Sheet 3

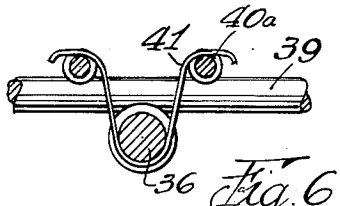


Fig. 6

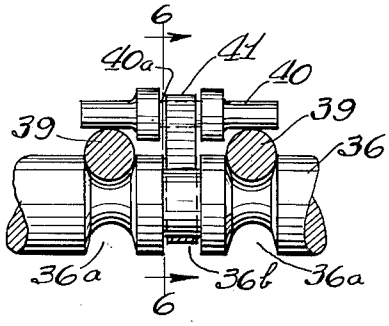


Fig. 5

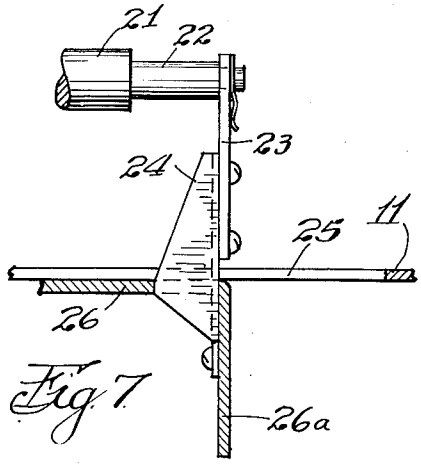


Fig. 7

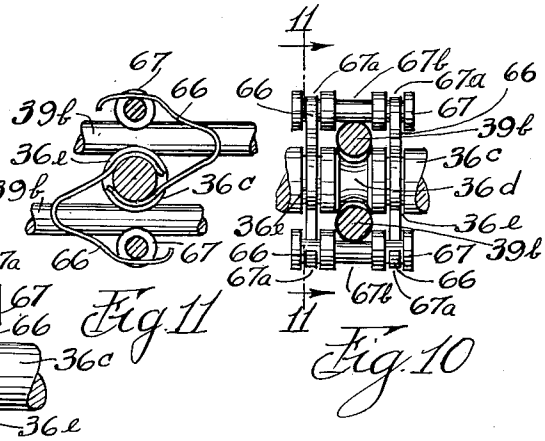


Fig. 10

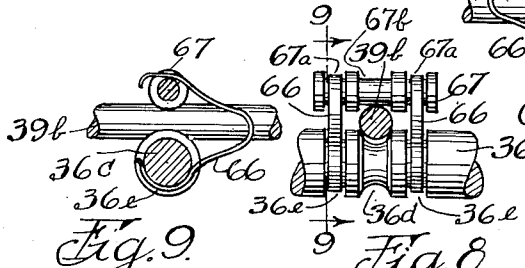


Fig. 9 Fig. 8

Fig. 11

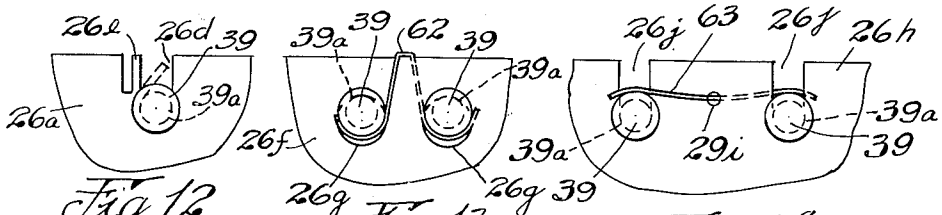


Fig. 12 Fig. 13 Fig. 14

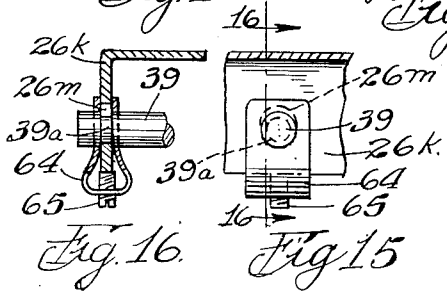


Fig. 16 Fig. 15

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

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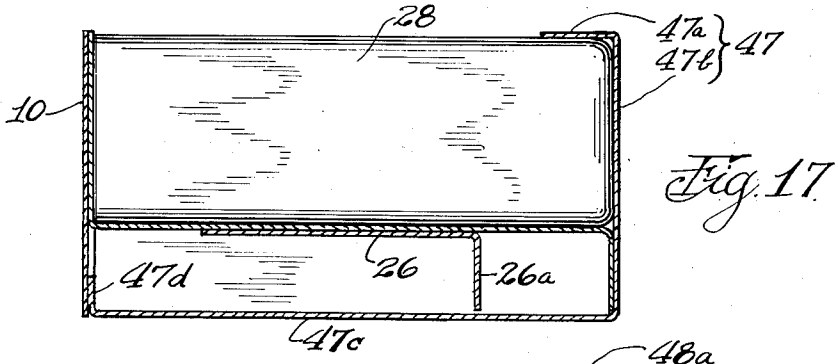


Fig. 17

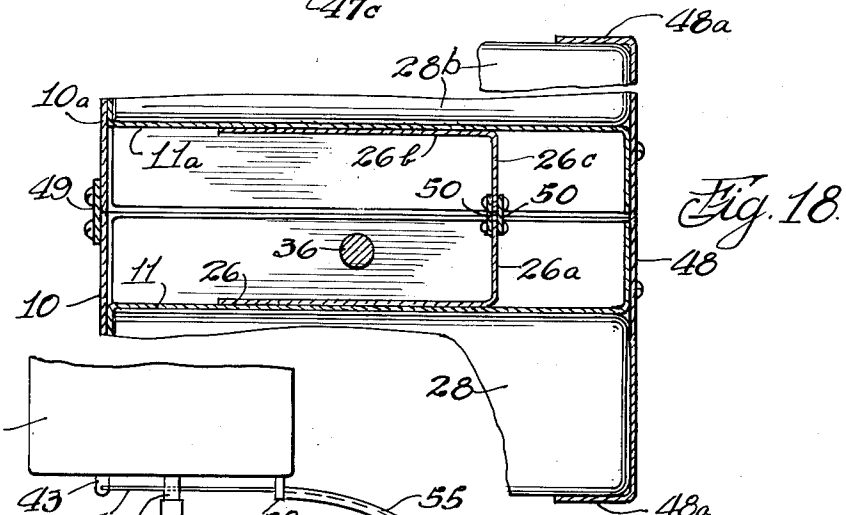


Fig. 18

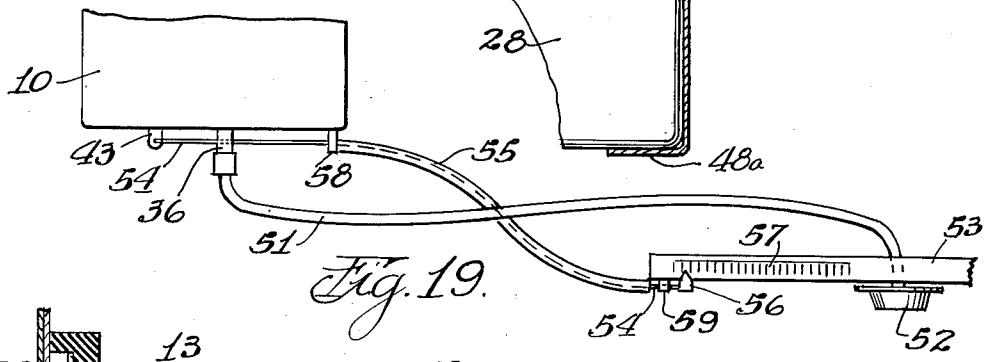


Fig. 19

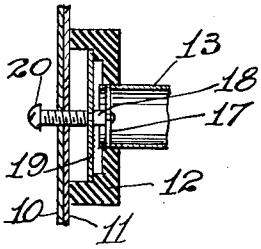


Fig. 20

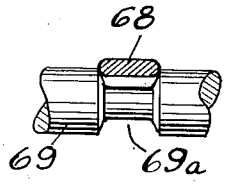


Fig. 21

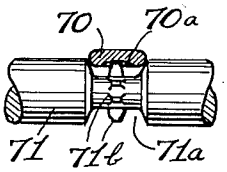


Fig. 22

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

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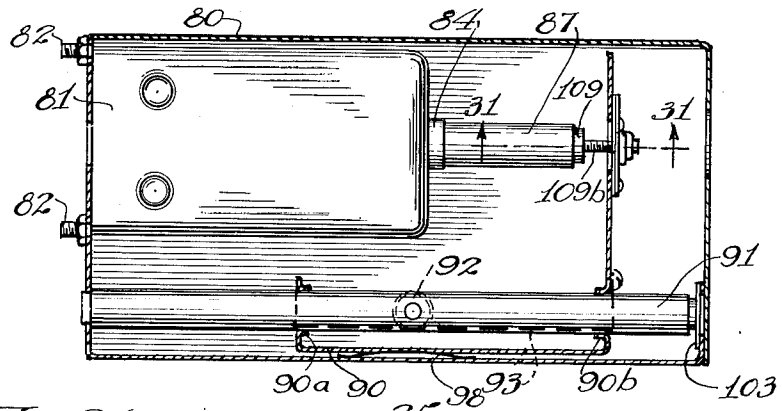


Fig. 24

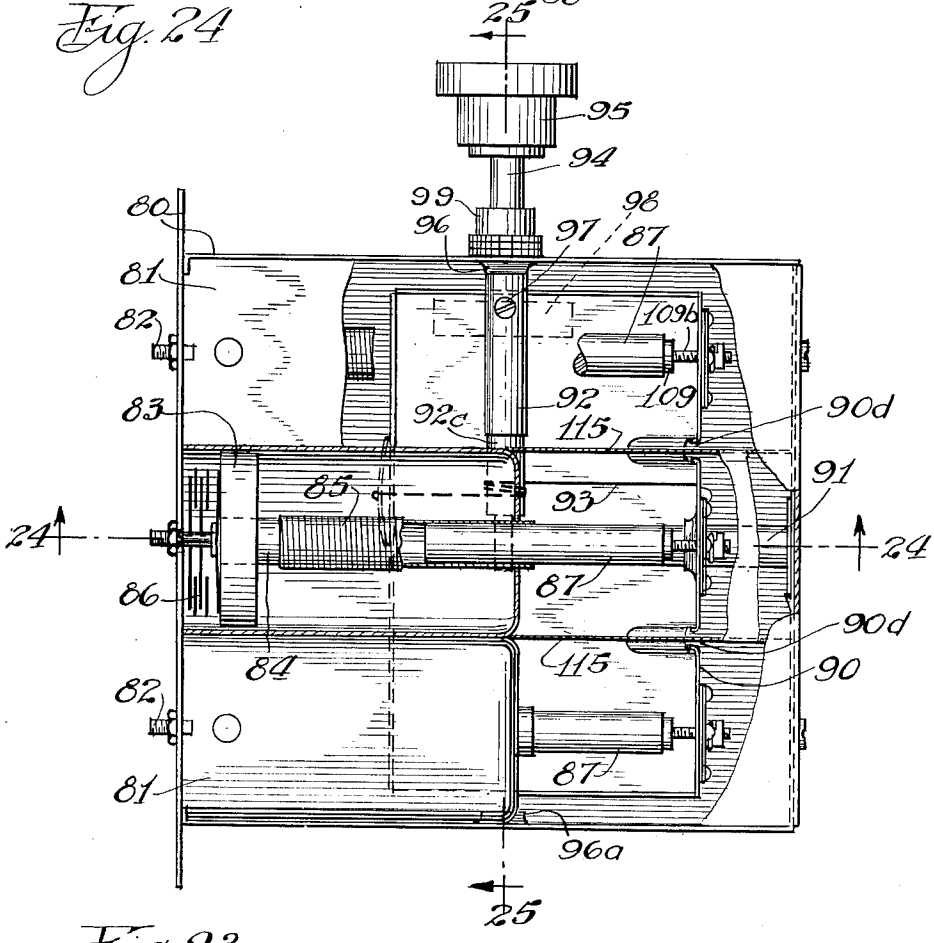


Fig. 23

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

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Fig. 25

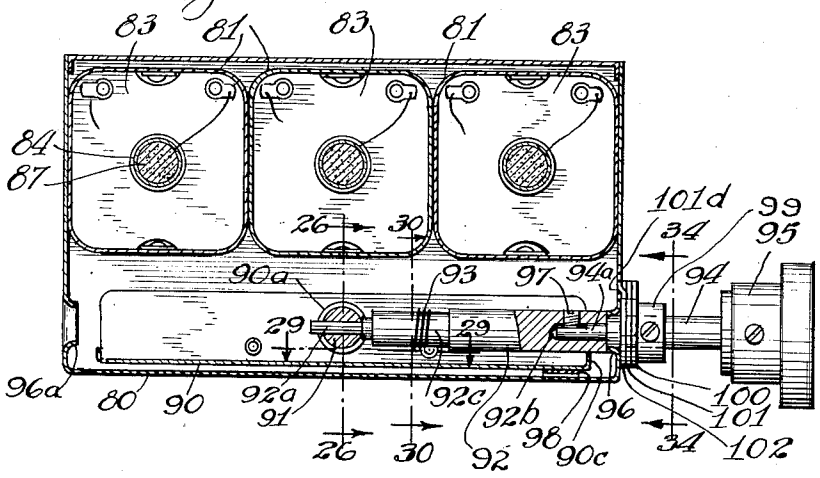


Fig. 26

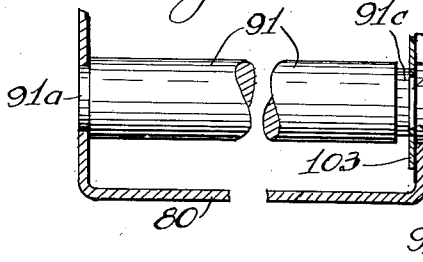
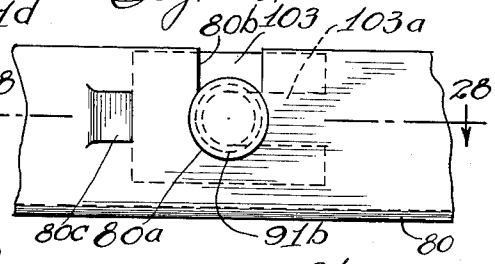


Fig. 27



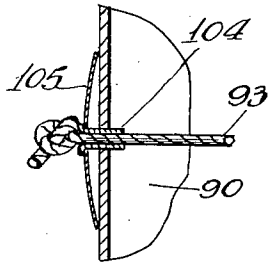


Fig. 29

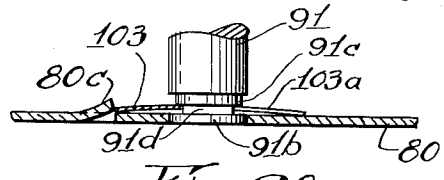


Fig. 28

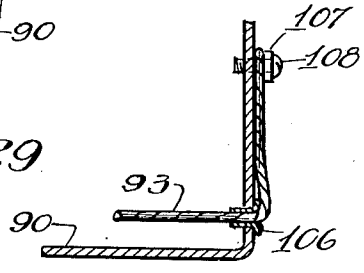


Fig. 30

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PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

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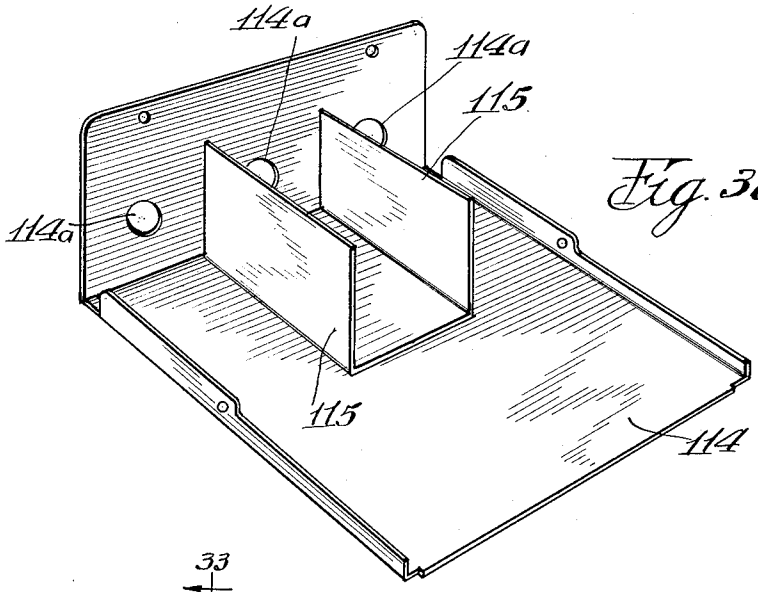


Fig. 38

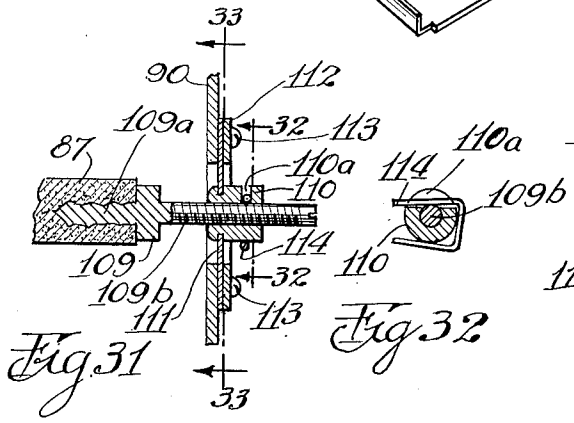


Fig. 31

Fig. 32

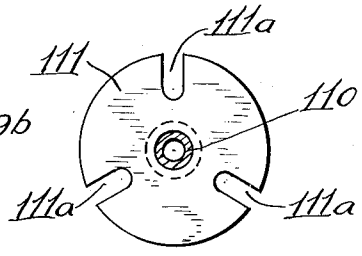


Fig. 33.

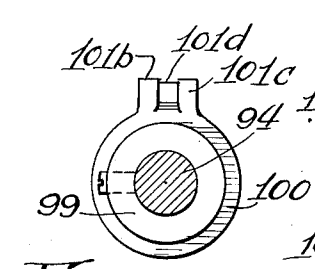


Fig. 34

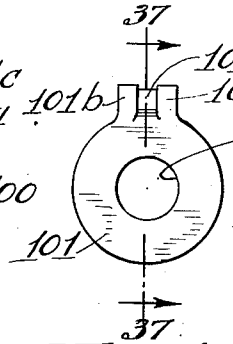


Fig. 35.

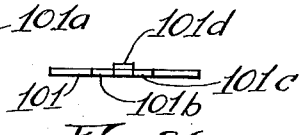


Fig. 36.

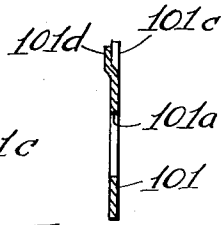


Fig. 37.

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Patented Aug. 19, 1941 2,253,304

UNITED STATES PATENT OFFICE

2,253,304

PERMEABILITY TUNER AND OPERATING MECHANISM THEREFOR

Philip K. McGall, Chicago, Ill., assignor to Johnson Laboratories, Inc., Chicago, Ill., a corporation of Illinois

Application December 24, 1937, Serial No. 181,674

16 Claims. (Cl. 74—95)

My invention relates to an improved construction of permeability tuner for radio receiving sets and similar purposes, comprising a plurality of combined capacitance and inductance units susceptible of being tuned to resonance at different frequencies, by changing the effective inductance of the inductance coils of said units. A tuner of the kind referred to may consist of as many stages as desired, and it has the advantage of small bulk per stage, adapting the tuner for use in receivers where the larger bulk of variable condensers would be undesirable, if not prohibitive.

My invention also includes improved operating means for simultaneously and similarly varying the effective inductance of the inductance coils of said tuner, to the end that the several tuner units or stages may be simultaneously tuned to resonance at any desired frequency of alternating current impulses, within the range of the tuner. Said operating mechanism thus constitutes a gang control for tuning said units, and it is characterized by smoothness of action, absence of lost motion, positive operation, and micrometric effect, at the same time being simple and inexpensive to manufacture. Said operating mechanism is also adapted for use for other purposes, as will more fully appear below.

My invention will be best understood by reference to the accompanying drawings illustrating a preferred embodiment thereof in which

Fig. 1 shows my improved tuner in plan view;

Fig. 2 is a side elevation of the construction shown in Fig. 1;

Fig. 3 is a bottom view of the construction shown in Fig. 1;

Fig. 4 is a vertical, sectional view of the parts illustrated in Figs. 1 and 3, taken along the line 4—4 in the latter figures;

Fig. 5 shows in a view similar to Fig. 4 and to an enlarged scale, a part of the operating mechanism of the tuner, consisting of the devices used to hold the operating rod in operative relation to the operated rods of said operating mechanism, said operated rods being above said operating rod instead of below the latter as illustrated in Fig. 4;

Fig. 6 is a vertical, sectional view of the parts shown in Fig. 5, taken along the line 6—6 in that figure;

Fig. 7 is a horizontal, sectional view to an enlarged scale, of a part of the construction shown in Fig. 1, taken along the line 7—7 in that figure;

Fig. 8 shows in a view similar to Fig. 5, a modified construction of operating mechanism, in which one operated rod is employed instead of two of said rods as shown in Fig. 5;

Fig. 9 is a vertical, sectional view of the parts shown in Fig. 8, taken along the line 9—9 in that figure;

Fig. 10 shows in a view similar to Fig. 5, a further modified construction of operating mechanism, in which two operated rods are moved simultaneously in opposite directions by the operating rod, instead of in the same direction as illustrated in Fig. 5;

Fig. 11 is a vertical, sectional view of the parts shown in Fig. 10, taken along the line 11—11 in that figure;

Fig. 12 is a right hand end view to an enlarged scale, of one of the operated rods shown in Fig. 3, and illustrates the manner of connecting said rods with the movable plate connected in turn with the cores of magnetic material to operate the same;

Figs. 13, 14 and 15 show respectively, modified means for connecting said operated rods with said movable plate;

Fig. 16 is a vertical, sectional view of the parts shown in Fig. 15, taken along the line 16—16 in that figure;

Fig. 17 is a horizontal, sectional view of the construction shown in Fig. 1, taken along the line 17—17, excepting that in this view the shield of the sectioned tuner unit is shown in side elevation, and the cover of the tuner is shown in place;

Fig. 18 illustrates in a view similar to Fig. 17, the combination of two tuners of the construction illustrated in Figs. 1 to 4 inclusive, to illustrate the tuning of two multi-stage tuners, by means of a single operating rod;

Fig. 19 illustrates diagrammatically, the adaptation of my improved tuner to a remote control system;

Fig. 20 is a horizontal, sectional view of a part of the structure shown in Fig. 4, taken along the line 20—20 in that figure;

Figs. 21 and 22 illustrate respectively in views similar to Fig. 5, modified forms of operated rods for actuation by the operating rod;

Fig. 23 shows in plan view and partially in horizontal sectional view, a modified form of operating mechanism for my improved tuner construction;

Fig. 24 is a horizontal, sectional view of the structure shown in Fig. 23, taken along the line 24—24 in that figure;

Fig. 25 is a vertical, sectional view of the

structure shown in Fig. 23, taken along the line 25—25 in that figure;

Fig. 26 is a vertical, sectional view to an enlarged scale, of the carriage mounting rod and its manner of support, taken along the line 26—26 in Fig. 25;

Fig. 27 is a right-hand elevation of the parts shown in Fig. 26;

Fig. 28 is a horizontal, sectional view of the structure shown in Fig. 27, taken along the line 28—28 in that figure;

Fig. 29 is a horizontal, sectional view of fastening and tensioning devices employed in connection with the operating cable illustrated in Figs. 23 and 25, this view being taken along the line 29—29 in Fig. 25;

Fig. 30 is a vertical, sectional view showing the manner of securing the other end of the operating cable to the carriage, this view being taken along the line 30—30 in Fig. 25;

Fig. 31 is a horizontal, sectional view to an enlarged scale, through the mounting devices employed to support one of the tuning cores of the device, this view being taken along the line 31—31 in Fig. 24;

Fig. 32 is a vertical, sectional view through a part of the construction shown in Fig. 31, taken along the line 32—32 in that figure;

Fig. 33 shows in elevation, the diaphragm forming a part of the core supporting structure shown in Fig. 31, this view being taken along the line 33—33 in that figure;

Fig. 34 shows in elevation to an enlarged scale, the stop mechanism employed to limit rotation of the operating shaft of the device, this view being taken along the line 34—34 in Fig. 25;

Fig. 35 shows in elevation to an enlarged scale, one of the discs employed in the stop mechanism illustrated in Fig. 34;

Fig. 36 is a top view of the disc shown in Fig. 35;

Fig. 37 is a vertical, sectional view of the disc shown in Fig. 35, taken along the line 37—37 in that figure; and

Fig. 38 shows in perspective view, the underside of the cover of the tuning device, to show certain shields secured thereto.

Similar numerals refer to similar parts throughout the several views.

As shown in Figs. 1 to 4 inclusive, my improved tuner consists of a housing comprising a bent sheet metal plate 10 forming the front and side walls of said housing, and a sheet metal shelf 11 having front and side flanges secured respectively to the front and side walls of the plate 10, the front flange of said shelf extending upwardly and its side flanges extending downwardly. Said shelf 11 is also provided with a downwardly extending flange at its rear edge. Above the shelf 11, the front wall of the housing has secured to it a plurality of blocks 12 of insulating material, each of which blocks supports with a sliding fit, the front end of a tubular support 13 of insulating material on which the inductance coil 14 of the corresponding unit of the tuner, is wound. The rear end of each insulating tube 13 is supported with a sliding fit, in a small plate 15 of insulating material which is in turn supported from the shelf 11 by a metal angle bracket 16. As shown in Fig. 20, the front end of the tube 13 contains a cross member 17 connected at its ends with said tube, which cross member is connected by a stud 18 with the central portion of a flat spring 19 resting at its ends against the corresponding block 12. A screw 20 threaded through the front wall of the tuner housing, rests at its inner end against the mid-portion of the spring 19, said spring having a conformation moving the tube 13 to its extreme forward position when the screw 20 is turned to move it forwardly away from the block 12. The spring 19 and the parts described as cooperating therewith, constitute a means for moving axially the tube 13 and the coil 14 carried thereby, to align said coils relatively to each other for effective and accurate gang operation of the inductance changing devices respectively associated with said coils, by the common operating mechanism below described.

Each of the tubes 13 contains a core 21 of magnetic material, preferably comminuted magnetic material compressed into solid form, which core may move freely axially in the tube 13 to change as desired, the effective permeability of the magnetic path through and around the corresponding coil 14, and correspondingly changes the inductance of said coil. The rear end of each core 21 is connected with a short rod 22, the rear end of which is connected with and supported by a small plate of insulating material 23, which, as shown in Fig. 7, is rigidly connected with the upper portion of metal bracket 24 extending through a slot 25 therefor in the shelf 11, shown in Figs. 1 and 3. As shown in Figs. 3 and 7, the lower portion of each bracket 24 extends through an opening therefor in an operating plate 26, and is rigidly secured below said plate to a flange 26a extending downwardly from the rear edge of said operating plate.

As shown in Figs. 1, 3 and 4, the shelf 11 has formed therefrom upwardly projecting ribs 27 extending from front to rear of said shelf between the coils 14, forming corresponding grooves in the lower surface of said shelf. As shown in Fig. 4, each of the ribs 27 engages the lower portions of adjacent shields 28 provided to enclose the coils 14 and their cores 21, to hold said shields against lateral movement, and centrally around said coils 14. Each of said shields 28 is provided with a longitudinal slot 28a in its bottom wall, to clear the corresponding bracket 24 and to also clear the connection between the corresponding bracket 16 and the shelf 11. The opposite side edges of the horizontal portion of each of the brackets 16, are off-set upwardly from the shelf 11, to clear the portions of the corresponding shield 28 adjacent its slot 28a, whereby the bracket 16 serves as a guide in moving the shield around the coil 14, and holds the shield adjacent the shelf 11. Each of the blocks 12 fits in the open end of the corresponding shield 28, as a result of which the shields when in place, are held at their front ends against lateral movement in any direction. The rear ends of said shields are held against movement, as below described.

The operating plate 26 as shown in Fig. 3, is shorter from front to rear, than the shelf 11, so that its operating movement is equal to the tuning movement to be imparted axially to the cores 21. The plate 26 is provided with upwardly extending ribs 29 fitting the grooves in the ribs 27, to guide the plate 26 in its movement under the shelf 11. As shown in Figs. 3 and 4, bars 30 and 31 extend horizontally from the front wall of the tuner housing to the rear flange on the shelf 11, to which their ends are rigidly secured, the upper edges of said bars being spaced slightly from the operating plate 26, the flange 26a of which is provided with apertures through which said bars

extend with sliding fits. In the spaces between the bars 30 and 31 and the plate 26, flat springs 32 carried by said plate are disposed which press the plate against the shelf 11 and hold the ribs 29 in sliding engagement with the grooves in the ribs 27. The lower edges of the bars 30 and 31 are somewhat above the bottom of the housing 10, to clear the cover of the latter, as below described. The plate 26 thus constitutes a means for imparting simultaneous and equal movement to the cores 21, making gang tuning of the several inductances possible for different frequencies within the range of the tuner.

As indicated diagrammatically in Fig. 4, each of the blocks 12 carries a flat capacitor 33 having terminals 34 and 35, for connection with the terminals of the corresponding coil 14, which terminals 34 and 35 are also the terminals of the corresponding unit of the tuner for connection as desired, according to the requirements of the circuit or hook-up with which the tuner is used, whether superheterodyne, tuned radio frequency, or otherwise. The capacitors 33 are of any kind well known in the art and preferably provided with sufficient adjustment for aligning purposes, but are otherwise fixed.

In constructing the tuner, the coils 14 are wound to have as nearly as possible, identical electrical characteristics, and the cores 21 are made as closely as possible, duplicates as to dimensions and permeability. The coils and cores are then mounted as described, and by aligning the coils by the screws 20, the same inductance relation is established between each coil and its core, as between each other coil and its core. Then, preferably with the cores drawn to the limit of their movement from within the coils, each unit of the tuner is tuned to resonance by aligning adjustment of its capacitor 33, and the tuner as to all of its units or stages, is in tune or resonance for the highest frequency of the range of the tuner. Movement of the cores 21 into the coils 14 by the operating plate 26, equally increases the permeability of the magnetic paths of the several coils for any particular position of said cores, correspondingly and equally increasing the inductance of said coils and establishing a tuned or resonant condition of all of the units or stages of the tuner for any desired frequency within the range of the tuner, which is lower than the limiting high frequency of said range.

The means I employ to operate the plate 26, consists as shown in Figs. 3 and 4, of an operating rod 36 having rotary movement, which rod extends perpendicularly through one of the side walls of the housing 10 and through the bar 31, a bushing 37 being mounted in said side wall to constitute a bearing for said rod, which rod is prevented from moving axially in said bearing by split rings 38 carried by said rod at the ends of said bushing. Two operated rods 39 are mounted below the rod 36, between and parallel with the bars 30 and 31, with their rear ends attached to the flange 26a. The rod 36 is provided with grooves 36a in line with the rods 39, in which grooves the rods 39 are held in frictional engagement by rollers 40 below said rods 39, said rollers 40 being pressed upwardly against said rods 39 and in turn pressing said rods upwardly into the grooves 36a, by a spring 41 extending at its mid-portion over and pressing downwardly against the rod 36, and at its ends extending under and pressing upwardly against the mid-portions of the rollers 40. In Figs. 5 and 6, the relation between the rod 36 and the rods 39 is more clearly shown. In these figures the rods 39 are above the rod 36 instead of below the latter rod as shown in Fig. 4, but the relation between said rods operatively, is the same in both cases. As shown in Fig. 5, the grooves 36a are provided with inclined side surfaces diverging outwardly, said grooves being deep enough to clear the surfaces of the rods 39 which are nearest the axis of the rod 36, so that the rods 39 engage only said side surfaces. Between the grooves 36a, the rod 36 is provided with a groove 36b containing the mid-portion of the spring 41, and the rollers 40 are provided at their mid-portions with grooves 40a containing the end portions of said spring. The ends of the spring 41 are extended sufficiently around the rollers 40, so that in use, rotation of the rod 36 and the resultant longitudinal movement of the rods 39, will rotate the rollers and cause them to slip at their points of engagement with said spring, without changing the general relation of the spring to the rollers 40. By engaging the surfaces of the rod 36 and of the rollers 40 which are remote from the surfaces of engagement between the rod 36 and the rods 39, the tendency of the spring 41 to elongate or straighten, presses the rollers 40 towards the rod 36, and maintains the frictional engagement between the rod 36 and the rods 39. This produces a smooth and even longitudinal movement of the rods 39 by rotation of the rod 36, without any irregularity of action, which makes possible exact and smooth operation of the movable parts of the tuner, even in imperceptible amounts, a condition greatly to be desired in effecting exact tuning. As shown in Figs. 1 and 2, the rod 36 has secured to its outer end, an operating knob 42, and the much greater diameter of the knob than the diameter of the surfaces of the rod 36 engaging the rods 39, gives the operating mechanism a micrometric action, which also facilitates exact tuning. It will be noted in Fig. 6 that the radius of curvature of the curved end portions of the spring 41 engaging the rollers 40, is substantially greater than the radius of curvature of the surfaces of said rollers 40 engaged by said spring. As a result, when the tuner is substantially in tune for a desired frequency, and exact tuning is required, a small amount of rolling action of the rollers 40 on the spring 41 occurs without slippage of said parts on each other, which further facilitates effecting exact tuning, by lessening the drag on the operating rod 36.

With the operating mechanism described, several complete rotations of the rod 36 are required to move the plate 26 through its tuning range, and to afford an indication of the frequency for which the tuner is adjusted at any time, the plate 26 is provided with an arm 43 (Figs. 1, 2 and 3), extending through a slot 44 in a side wall of the housing 10 (Fig. 2), which arm is connected with an indicating pointer 45 adjacent a scale 46 on the housing, calibrated in any desired units. Obviously, any equivalent indicating means operated by the arm 43 may be employed as desired, depending upon the location of the tuner and the parts associated therewith in any case.

To enclose the operating mechanism, a cover plate 47 (Fig. 17) is employed. With the unit shields 28 in place as above described, the upper rear flange 47a of the cover plate is located on

top of the rear ends of said shields, the rear wall 47b of said cover plate extends adjacent the rear end walls of the shields 28, and the bottom wall 47c of said cover plate extends horizontally in the bottom plane of the tuner housing 10, a front flange 47d on said cover plate extending upwardly just inside of the front wall of the plate 10 of the tuner housing. The cover plate is of a width equal to the distance between the side walls of the plate 10, and rests between said side walls and on the lower edges of the downwardly extending side flanges of the shelf 11, the flange 47d being between the front ends of said side flanges, and the front wall of the plate 10. This completely encloses the tuner, and produces a self-contained structure that is much more compact than is possible by the use of conventional interleaved variable capacitors, which structure is a complete multi-stage tuner that is thoroughly shielded and entirely enclosed, and requires in addition, only suitable radio tubes, a suitable current source, and wiring therefor, connected with the tuner in accordance with a desired hook-up or circuit, to make an operative tuning system.

It will be understood that I do not limit myself in constructing the tuners described, to the particular number of units illustrated, since each tuner may consist of as many units or stages as desired. In Fig. 18 I illustrate means that may be employed to operate and tune two complete tuners of the kind described, by a single operating rod. Part of a first tuner as above described, is shown, having a housing 10, a shelf 11, shields 28, an operating plate 26 and an operating rod 36. A second similar tuner is shown, having a housing 10a, a shelf 11a, shields 28b and an operating plate 26b, but no operating rod. The bottom edges of the housing 10 are held against the bottom edges of the housing 10a, by a cover plate 48 secured to the rear flanges of the shelves 11 and 11a, which cover plate has upper and lower flanges 48a extending over the end portions of the shields 28 and 28b. The front walls of the housings 10 and 10a are held together by a connecting plate 49 secured to said front walls. The flanges 26a and 26c of the operating plates 26 and 26b respectively, are connected by plates 50 secured to said flanges as indicated. The operating devices connecting the operating rod 36 with the operating plate 26, are the same as above described, and are omitted in Fig. 18 for the sake of clearness. As a result of the construction shown in Fig. 18, rotation of the rod 36 operates the plate 26 with the results above described, and at the same time operates the operating plate 26b of the second tuner with similar results as to the second tuner, and all of the units or stages of both tuners are thus simultaneously operated and tuned by means of a single operating rod. Thus a plurality of tuners, each complete for its intended purpose and consisting of as many stages as desired, may be simultaneously tuned by a single operating rod, and said complete tuners may be severally used for any purposes desired and either simultaneously or alternately, for example, as tuning means for different frequency bands.

As illustrated in Fig. 19, my tuner described, is adapted for use in any case where the tuning units must have one location and the operating means or controlling devices must have a second location which may be remote from said first location. In this figure my tuner is shown diagrammatically at 10, its operating rod 36 being connected by a flexible shaft 51 with an operating knob 52 on a control board 53 remote from the tuner 10. The arm 43 of the tuner, is connected with a wire 54 extending through a tube 55 to the control board 53, where said wire is connected with a pointer 56 movable by said wire along a scale 57 carried by said control board. The ends of the tube 55 are supported by brackets 58 and 59 carried respectively by the turner 10 and the control board 53.

The manner of operating the frequency indicating pointer 56 as described, gives a correct indication at any time of the frequency to which the units of the tuner are tuned, in the system of units used in laying out the scale 57, regardless of whether there is slippage in the friction mechanism above described between the operating rod 36 and the cores 21, since the knob 52 is not relied upon to indicate by its angular position, the frequency for which the tuner is set at any time. Although there is little probability of slippage between the operating rod 36 and the operated rods 39 described in connection with Figs. 3 to 6 inclusive, such slippage is possible unless prevented. I eliminate the possibility of such slippage to an appreciable extent, by securing to the inner end of the rod 36, a pinion 60 (Figs. 3 and 4), meshing with a rack 61 disposed parallel with the operated rods 39 which rack is rigidly secured at one end to the flange 26a. The other end 61a of the rack 61 is in sliding engagement with the upper surface of the bar 30, thereby holding the rack in mesh with the pinion 60. The pitch diameter of the pinion 60 should equal the diameter of the contact circles in the grooves 36a with the rods 39 to insure against slippage between the operating rod 36 and the operated rods 39, due to the action of said pinion.

The operated rods 39 may be connected with the flange 26a of the operating plate 26, in any one of a number of ways, several of which are shown in Figs. 12 to 16 inclusive. In each of these cases, each of the rods 39 is provided with a circumferential groove 39a near its end to facilitate said connection. In Fig. 12 the flange 26a is provided with an edge slot 26d fitting the groove 39a, and after the rod 39 is pressed to the bottom of said slot, an edge tongue 26e of the flange 26a adjacent said slot, is forced over and into the slot 26d and into the groove 39a, locking the rod 39 in said slot. In Fig. 13 the flange 26f is provided with clearance holes 26g for the rods 39, and after they are inserted in said holes with the adjacent parts of the flange 26f in the grooves 39a, the rods 39 are held in the position shown in Fig. 13 by a spring 62 bent at its mid-portion to go over the edge of the flange 26f with the ends of said spring on opposite sides of said flange and extending under and partly around and pressing upwardly on the rods 39 respectively. In Fig. 14, the flange 26h is provided with edge slots 26j fitting the grooves 39a in the rods 39, and when said rods are pressed to the bottoms of said slots, they are held in the position shown in Fig. 14 by a spring 63 bent at its mid-portion to go through a hole 29i in the flange, with the ends of said spring extending on opposite sides of said flange and over and pressing downwardly on said rods 39 respectively. As shown in Figs. 15 and 16, the flange 26k is provided with a clearance aperture 26m for each of the rods 39, and a U-shaped metal clip 64

having similar clearance apertures through its legs, is employed. The clip is placed on the flange with the clip apertures in line with the flange aperture 26*m*, the grooved end of a rod 39 is inserted through said apertures with the groove 39*a* in line with the flange 26*k*, and a set screw 65 threaded through the mid-portion of the clip 64 and resting against the edge of the flange 26*k*, is tightened, drawing the clip 64 and the rod 39 downwardly until the groove 39*a* is tightly against the bottom of the aperture 26*m*, in which position the parts are held by the set screw.

In constructing the operating mechanism above described, I do not limit myself to the form and detail shown, since said mechanism may be made in many equivalent ways as far as operation and results are concerned, without departing from my invention in its generic aspect. Essentially my improved operating mechanism includes a rotary operating rod, an operated rod to which movement is imparted axially by angular movement of said operating rod, there being frictional engagement between said rods resulting preferably from substantially opposed surfaces of or carried by one of said rods engaging correspondingly opposed side surfaces of a groove in or carried by the other of said rods, said surfaces being held in frictional engagement with each other by pressure of an amount determined by the degree of said frictional engagement required by the purpose for which said operating mechanism is used. It will be understood that said operating mechanism may be used for any purpose requiring the changing of angular motion into translatory or axial motion of an operated member or rod, as long as the force so transferred is within the limits of the frictional engagement referred to.

In Figs. 8 and 9 I show a modified form of operating mechanism in which but one pressure roller and one operated rod are use, instead of two of said rollers and two of said rods, as illustrated in Figs. 3, 4, 5 and 6. As shown in Fig. 8, the operating rod 36*c* is provided with a groove 36*d* having outwardly diverging side walls and engaging an operated rod 39*b* in said groove, in the same manner that each of the grooves 36*a* engages a corresponding rod 39 as above described in connection with Figs. 5 and 6. On each side of the groove 36*d*, the rod 36*c* is provided with a groove 36*e* containing one end portion of a spring 66, the other end portion of which is in a groove 67*a* in a roller 67, which roller is provided with a central groove 67*b* receiving the operated rod 39*b*. The form of the springs 66 which press the roller 67 against the operated rod 39*b* and so press the operated rod into the groove 36*d*, is shown in Fig. 9, which also shows the position of the roller 67 immediately over the operating rod 36*c*, this view further illustrating the shape of the end portions of each of the springs 66, which permits a small amount of rolling movement of the roller 67 on said springs, in making accurate adjustments of the rod 39*b*. This construction is adapted to move not only rigid operated rods, but also operated rods that are more or less flexible, whereas the construction shown in Figs. 5 and 6 is adapted particularly for use with operated rods that are rigid and have little flexibility. A further advantage of the construction shown in Figs. 8 and 9, is that greater pressure of the operated rod against the operating rod may readily be obtained, as a result of using two springs per roller and per operated rod, instead of one spring as shown in Figs. 5 and 6.

In Figs. 10 and 11 I show a modification of the operating mechanism last described, in which two operated rods 39*b* are in frictional engagement with the inclined side walls of the groove 36*d* in the operating rod 36*c*, one of the said rods 39*b* being above and the other being below the operating rod, and each of said operated rods 39*b* being held in engagement with the operating rod 36*c* by a pair of springs 66 in the manner described in connection with Figs. 8 and 9. The two grooves 36*e* in the operating rod 36*c*, receive the end portions of both sets of springs, the parts being of the same construction and operating in the same manner as described in connection with Figs. 8 and 9, and the only difference being that two operated rods 39*b* are employed. This construction provides for moving operated mechanisms in different directions from each other, by a single angular movement of an operating rod.

While I have so far illustrated the operated rods as having circular cross-sections, it will be understood that they may be of any form of cross-sections, that will effect frictional engagement of the kind described, with an operating rod. For example, in Fig. 21 I illustrate a flat operated rod 68 having frictional engagement at its edge portions, with the outwardly diverging side walls of a groove 69*a* in an operating rod 69, it being understood that the rod 68 may be held in said frictional engagement, by any of the means above described and not shown in Fig. 21, to avoid needless duplication. In Fig. 22 I show a modification of the construction shown in Fig. 21, in which a flat operated rod 70 and an operating rod 71 are employed, which have the same frictional relation to each other as the rods 68 and 69 shown in Fig. 21, and in addition, the groove 71*a* in the rod 71, which frictionally engages the edge portions of the rod 70, carries at its mid-portion, outwardly extending gear teeth 71*b* meshing with corresponding rack teeth 70*a* in the lower surface of the rod 70, to prevent relative displacement between the rods 70 and 71 due to slippage at their surfaces of frictional engagement, thereby avoiding the need for an additional gear and a separate rack for that purpose.

In the tuner construction illustrated in Figs. 23 and 24, a sheet metal casing 80 has secured to one of its end walls and in parallel, horizontal arrangement, a plurality of shield cans 81 by means of bolts 82, each of said shield cans having mounted therein, and at the end of said can adjacent the mounting wall of the casing 80, a head 83 of insulating material which supports a tube 84 of insulating material carrying an inductance coil 85. The end of each of the shield cans remote from the mounting wall of the casing, is closed and provided with a central bore fitting the end of the tube 84 remote from the head 83, said tube 84 extending through the said shield end wall to support the tube and inductance coil centrally in the shield can. The head 83 also supports between said head and the mounting wall of the casing, an adjustable capacitor 86 for tuning the corresponding inductance coil 85 to a desired frequency, so as to align the resonant frequencies of the coil and capacitor combinations at any desired frequency of a range of frequencies. Each of the tubes 84 has mounted therein a cylindrical core 87 of powdered iron, which is an easy sliding fit in said tube, so that by movement of the core into and from the inductance coil 85 on the tube, the inductance of

the coil may be changed to tune the coil and capacitor combination, to any desired frequency in a given range of frequencies. The cores 87 are secured at their outer ends to a horizontally movable carriage 90 supported for movement parallel with the tubes 84 and under the shield cans 81, by a rod 91 supported by the end walls of the casing 80, on which rod said carriage is a sliding fit. A cross-shaft 92 is mounted horizontally in the casing in line with the rod 91, said shaft being supported by the casing and by said rod 91 for rotary movement, in a manner to be described. The shaft 92 is engaged by an operating cable 93 which encircles said shaft in such a manner that there will be no slippage between the shaft and the cable, and the ends of the cable are secured to the end walls of the carriage 90 in a manner to be described. An operating rod 94 having secured thereto an operating knob 95, extends through a bearing 96 in one of the side walls of the casing, and into the corresponding end of the shaft 92, to which it is secured in any desired manner, for example, by a set-screw 97. The opposite side wall of the casing is provided with a similar bearing 96*a* for the operating rod 94, so that the shaft 92 may be placed on the other side of the carriage supporting rod 91, and the operating rod 94 may extend from the opposite side of the tuning device, where it is desired to assemble the tuning device for operation from its side which is opposite to that which is indicated as the operating side in Fig. 23.

As shown in Fig. 24, the end walls of the carriage 90 are flanged towards each other at 90*a* and 90*b* to form bearings engaging the supporting rod 91 with an easy sliding fit.

As shown in Fig. 25, the shaft 92 is provided at one end with a portion 92*a* of reduced diameter, and is supported for turning movement in a corresponding horizontal bore in the supporting rod 91, the oither end of said shaft being provided with a bore 92*b* to receive the end portion 94*a* of the operating rod 94, which is of reduced diameter to fit said bore. The shaft 92 is in rolling engagement with the upper edge of a flange 90*c* extending upwardly from the side edge of the carriage 90, in which position said flange is held by a flat spring 98 between said carriage and the bottom of the casing 80, said spring being held in any suitable manner against movement with the carriage 90 and under the shaft 92. The spring 98 by maintaining the engagement referred to between the flange 90*c* and the shaft 92, prevents rocking movement of the carriage 90 on its supporting rod 91. It will be noted that the bore in the supporting rod 91 for the end 92*a* of the shaft 92, extends horizontally through said supporting rod, as a result of which the shaft 92 may be mounted between said supporting rod 91 and either side wall of the casing, as desired. Outside of the casing, the operating rod 94 has secured thereto a collar 99 holding discs 100, 101 and 102 in contact with each other between said collar 99 and the adjacent side wall of the casing, said discs serving as below described to constitute a stop mechanism limiting rotation of the operating rod 94.

As shown in Fig. 26, the supporting rod 91 is provided at one end with a portion 91*a* of reduced diameter fitting a corresponding bore in the end wall of the casing. The other end 91*b* of said supporting rod is not reduced in diameter and fits a bore 80*a* in the end wall of the casing, which bore is connected with a slot 80*b* extending through the upper edge of said casing end wall, said slot being narrower than the diameter of said bore. Adjacent the end 91*b* of the rod 91, the said rod is grooved at 91*c* to a diameter substantially equal to the width of the slot 80*b*, so that when said groove 91*c* is in alignment with said slot, the corresponding end of the supporting rod 91 may be raised through said slot and from engagement with the corresponding end wall of the casing 80. Adjacent the end 91*b* of the rod 91, the groove 91*c* is further reduced in diameter to form a second groove 91*b* to receive a locking plate 103.

As shown in Fig. 27, the plate 103 is slotted through one of its ends at 103*a*, the width of the slot being substantially equal to the diameter of the groove 91*d*, so that when the groove 91*d* is inside of the corresponding end wall of the casing 80, the locking plate 103 may be moved longitudinally into engagement with said groove 91*d*, in which position it may be held by a lug 80*c* extending from the corresponding end wall of the casing 80, as shown in Fig. 28. As a result of this construction, when the locking plate 103 is in engagement with the groove 91*d* and with the lug 80*c*, the supporting rod 91 is held immovable longitudinally, in the casing 80, and when for any reason it is desired to remove the supporting rod from the casing, all that is required is to first disengage the locking plate from the lug 80*c*, to then move the locking plate 103 endwise from engagement with the groove 91*d*, and to then move the supporting rod 91 longitudinally sufficiently to bring the groove 91*c* into alignment with the slot 80*b*, for which relation of the parts the grooved end of the supporting rod may be readily lifted from engagement with the corresponding end wall of the casing 80, and the rod may then be disengaged from the other end of the casing. The locking plate 103 is preferably made of spring metal and bent sufficiently so that it will exert a desired amount of pressure on the rod 91 when in place, to hold the shouldered portion 91*a* of said rod tightly against the corresponding end wall of the casing.

As shown in Fig. 29, the left-hand end of the cable 93 illustrated in Figs. 23 and 24, is secured to the corresponding end wall of the carriage 90 by means of an eyelet 104 which extends through a flat spring 105 and with a free fit through the corresponding end wall of the carriage 90, the end of the cable being knotted outside of the head of the eyelet 104, to flatten the spring 105 to a desired degree from its condition of normal curvature, so that the desired tension may be continually exerted on the cable 93. The eyelet 104 besides holding the spring 105 in alignment with the cable opening through the end wall of the carriage 90, also provides a rounded opening for engagement by the knot of the cable which prevents damaging the cable and its knot. The other end of the cable 93, as shown in Fig. 30, extends through a similar eyelet 106 from which the cable is led upwardly along the outer surface of the corresponding end wall of the carriage 90 and clamped in desired position by washer 107 by means of a screw 108 extending into the end wall of the carriage. By proper initial adjustment, the cable may be subjected to sufficient initial tension to take up its stretching tendency, and the spring 105 insures the taking up of any further stretch that may occur in the cable, so that it is maintained in tight condition at all times, with the result that the operation of the carriage by rotation of the operating rod 94 positively drives the carriage without lost motion

and without appreciable friction. The cable employed may be of any material that will accomplish the purpose, and as an illustration of the material that may be used, I find that braided silk cord is well adapted to the purpose.

As indicated in Fig. 25, the portion 92c of the shaft 92, around which the cable 93 is wrapped, is of somewhat smaller diameter than the diameter of the body portion of said shaft, the difference in diameter being preferably equal to the diameter of the cable, so that the effective diameter of the cable wrapped around the said shaft portion 92c will produce longitudinal movement of the carriage 90 precisely at the same rate as the frictional engagement between the shaft 92 and the edge of the flange 90c, thereby avoiding any slipping of the shaft on the flange, and making use of the frictional engagement between the shaft and the flange, to assist in moving the carriage 90.

In Figs. 31, 32 and 33, I illustrate the manner of securing each of the cores 87 to the end wall of the carriage 90. As shown in Fig. 31, the core 87 has extended into it, one end portion 109a of a shouldered stud 109, the other slotted end portion of which is threaded at 109b and in threaded engagement with a metal collar 110 rigidly secured to the central portion of a thin diaphragm 111. The outer edge portion of the diaphragm 111 is clamped to the end wall of the carriage 90 by a clamping ring 112 and clamping screws 113, the inner diameter of the clamping ring 112 being in line with a corresponding aperture through the end wall of the carriage 90, said diameter being sufficiently larger than the external diameter of the collar 110 so that the central portion of the diaphragm 111 is relatively free to bend to a limited extent. The collar 110 is provided through one of its sides with a slot 110a extending somewhat into the threaded bore through said collar, and in said slot a bent wire spring 114 is disposed in such a manner as to press against the threaded portion 109b and also against the collar 110, with sufficient force to prevent the accidental turning of the threaded portion 109b in the collar 110. The outer edge of the diaphragm 111, as shown in Fig. 33, is preferably provided with clearance notches 111a in line with the clamping screws 113, to facilitate assembling the parts, and adjusting the diaphragm in exact alignment with the axis of the corresponding core 87. The flexibility of the diaphragm 111, permits the collar 110 to adjust itself axially with the axis of the corresponding core and coil mounting tube, if for any reason they are slightly out of alignment, so that the carriage may be operated freely without resultant binding of the cores in the coil mounting tubes, which might be the case if the cores did not have the flexible mounting referred to. The threaded portion 109b connected with each of the cores permits each core to be moved longitudinally relatively to the carriage 90, by turning the stud 109 relatively to its collar 110, so that a desired amount of inductance of the corresponding inductance coil 85 may be secured at any desired frequency of a tuned band, and this feature of adjustment further provides that the inductances may be aligned with each other to facilitate gang operation of the inductance variation for the several resonant circuits controlled by the tuning device.

In Figs. 34–37 inclusive, I illustrate the structure provided to limit rotative movement of the operating rod 94. This stop mechanism consists of a plurality of discs of the same construction as that illustrated in Figs. 35, 36 and 37 for the disc 101. As shown in these figures, the disc is provided with a bore 101a which is a free fit on the operating rod 94, and from the outer edge of the disc and at one side thereof, two lugs 101b and 101c project, between which lugs a third lug 101d is located, said lug 101d being offset from the plane of the disc by an amount substantially equal to the thickness of the disc, while the lugs 101b and 101c are in the plane of said disc. The discs 100, 101 and 102 shown in Fig. 25, being all of the same construction, are mounted on the operating rod 94 with their lugs 101d extending in the same direction, and the disc 100 is rigidly secured to the collar 99 in any convenient manner not shown, and the lug 101d of the disc 102 engages a corresponding opening in the side wall of the casing 80 which prevents rotary movement of the disc 102. Since the discs are held in engagement with each other by the collar 99, the lug 101d on the disc 100 is in the plane of lugs 101b and 101c of the disc 101, and the lug 101d of the disc 101 is in the plane of the lugs 101b and 101c of the disc 102. It will be observed that the disc 101 is not connected with the operating rod 94 and that it is not connected with either of the adjacent discs, or in other words, that it floats angularly on the operating rod between the discs 100 and 102. As a result of this construction, rotation of the operating rod 94 in either direction rotates the disc 100 at the same rate and this rotation first results in engagement between lugs of the discs 100 and 101, after which the disc 101 is rotated with the operating rod 94 until engagement between the lugs of the discs 101 and 102 results, which prevents further rotation of the operating rod in that direction; beginning with that condition, rotation of the operating rod 94 in the reverse direction, may continue freely until engagement in the reverse direction between the lugs of each disc and its adjacent disc is effected, which prevents further movement of the operating rod in that direction. It is obvious of course that as many floating discs may be employed as desired, depending upon the amount of rotary movement that is to be permitted in either direction.

In Fig. 38 I illustrate in perspective, the construction of the cover 114 used to close the casing 80, which cover is provided with a U-shaped shield member 115 of sheet metal, the side walls of which are located to lie midway between the cores 87 respectively when the cover is in place on the casing, the ends of said shield entering slightly between the ends of the shield cans 81, as illustrated in Fig. 23. The end wall of the cover is provided with apertures 114a in line with the studs 109, so that core adjustment relatively to the carriage 90 may be effected with the cover in place on the casing. The end wall of the carriage 90 supporting the cores 87, is slotted at 90d to clear the side walls of the shielding member 115.

In connection with the diaphragms employed to connect the carriage with the cores, said diaphragms may preferably be of thin flexible sheet metal where there is no need to electrically insulate said diaphragms, and where for any reason the said cores must be insulated from the supporting mechanism, said diaphragms may

conveniently be of thin sheet insulating material such as Bakelite or the equivalent.

In connection with the construction of operating mechanism illustrated in Figs. 23–38 inclusive, it will be noted that the cable 93 is not secured to the shaft 92, but that the movement of the carriage 90 results from the friction of the cable on the shaft. It will further be observed that the cable is subjected to a substantial initial tension and that the ends of the cable extending to the carriage are substantially in line with each other; also, that the forces exerted by the cable upon the carriage are equal and opposite and as a result balance each other without any extraneous or resulting force that must be compensated for in any other way, and that the forces exerted upon the shaft by the cable are equal and balanced, so that considering the operating mechanism as a whole, although the initial forces are substantial, there are no extraneous unbalanced forces of any kind which require counteracting with the resultant possibility of introducing opposition to the movement of the operating mechanism. The result is that the operating mechanism has a smooth, uniform and reliable movement throughout. With the type of operating mechanism shown in Figs. 1–22 inclusive, substantial forces are initially exerted between each operated rod and the operating rod by the springs and rollers described, and in this case the lateral pressures developed by the small inclination of the side walls of the groove or grooves in the operating rod, produce forces which are balanced and self-contained in the operating rod, and also produce balanced lateral forces which are self-contained in the operated rod or rods, the spring pressure exerted in holding the rods together being balanced against the operating and operated rods so that the said forces are balanced within the operating mechanism considered as a whole. With this construction the only force required to move the operating mechanism, is that required to overcome the friction between the operated rod and the side walls of the groove of the operating rod. Although this friction is of small amount, the entire similar load on the operating rod, represented by the force required to bend the cable 93 around the shaft 92, is even less, so that the latter construction is somewhat easier to operate, and is correspondingly smoother in operation.

As a result of the substantial initial pressures employed in connection with the operating mechanism of either type disclosed, it will be observed that the drive forces imparted to the operated member or rod may readily be considerably greater than is actually required to move the same, as a result of which I designate the operating mechanism in each case as a positive-drive friction mechanism, the operating rod and the operated member being connected in either case by positive-drive friction gearing.

While I have shown my invention in the particular embodiment above described, it will be understood that I do not limit myself thereto, as I may employ equivalents thereof known to the art at the time of the filing of this application, without departing from the scope of the appended claims.

Having thus described my invention, what I claim is:

1. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, and a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage.

2. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said carriage having a flange extending towards and engaging said operating rod, and a spring holding said flange in engagement with said operating rod.

3. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said carriage having a flange extending towards and engaging said operating rod, and a spring holding said flange in engagement with said operating rod, the portion of said operating rod engaged by said cable being of smaller diameter than the portion of said operating rod engaged by said flange to compensate for the thickness of said cable, whereby the carriage movement per rotation of said operating rod produced by said cable is substantially equal to the circumference of the portion of said operating rod engaging said flange.

4. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, and a spring connected with said cable and exerting tension thereon.

5. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with

a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, and a flat spring on one of said carriage end walls and connected with the corresponding cable portion and maintaining said cable under tension.

6. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, a flat spring on one of said carriage end walls in line with said cable, and a headed tube extending through said spring and with a free fit through said end wall, the head of said tube resting against said spring and said cable extending through said tube and secured adjacent the head thereof.

7. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, and a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said supporting rod having a transverse bore therein constituting a first bearing for the inner end of said operating rod, and one of said housing side walls having a second bearing for said operating rod.

8. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, and a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said operating rod being substantially parallel with the bottom wall of said housing and in line with said supporting rod, and said supporting rod being centrally disposed between the side walls of said housing, said supporting rod having a transverse bore therethrough constituting a bearing for the inner end of said operating rod, and each of said housing side walls having a bearing for said operating rod in line with said transverse bore, whereby said operating rod may be assembled in said operating mechanism to project from either of the housing side walls as desired.

9. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, and stop devices for limiting rotary movement of said operating rod including a series of apertured discs each having a first lug extending radially therefrom in the plane of the disc and also a second lug extending radially therefrom and displaced from the plane of the disc, said discs loosely fitting said operating rod and being mounted thereon adjacent each other and with said second lugs displaced in the same direction axially of said rod, the first disc of said series being secured to said operating rod and the last disc of said series being secured to said housing with the second lug of each disc in the plane of the first lug of the next disc, whereby rotation of said operating rod may be limited to a desired number of rotations determined by the number of discs in said series and the angular extent of said lugs.

10. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, and a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said supporting rod having a transverse bore therein constituting a first bearing for the inner end of said operating rod, and one of said housing side walls having a second bearing for said operating rod, said operating rod including an inner shaft portion extending from said supporting rod to said second bearing and an outer portion extending through said second bearing and secured to said shaft portion.

11. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, said supporting rod having a transverse bore therein constituting a first bearing for the inner end of said operating rod, and one of said housing side walls having a second bearing for said operating rod, said operating rod including an inner shaft portion extending from said supporting rod to said second bearing and an outer portion extending through said second bearing and secured to said shaft portion,

said shaft portion having a shouldered portion of reduced diameter at its inner end to fit said first bearing and having an axial bore at its outer end, the outer portion of said operating rod being of reduced diameter at its inner end to fit said shaft bore, and fastening means securing said shaft portion to the outer portion of said operating rod, the outer end of said shaft portion being of larger diameter than the bore of said second bearing, whereby said operating rod is restrained from longitudinal movement.

12. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, a first one of said housing end walls having a first bore receiving and fitting a first end portion of said supporting rod, and the second of said housing end walls having a second bore receiving and fitting the second end portion of said supporting rod, said second bore opening into a slot of less width than the diameter of said second bore, said slot extending through the upper edge of said second end wall, said second end portion of said supporting rod having a groove inside of said second end wall of a bottom diameter for free movement in said slot, said groove having an axial width at least at large as the thickness of said second end wall, and locking means restraining said supporting rod from longitudinal movement when in said bores.

13. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, a first one of said housing end walls having a first bore receiving and fitting a first end portion of said supporting rod, and the second of said housing end walls having a second bore receiving and fitting the second end portion of said supporting rod, said second bore opening into a slot of less width than the diameter of said second bore, said slot extending through the upper edge of said second end wall, said second end portion of said supporting rod having a groove inside of said second end wall of a bottom diameter for free movement in said slot, said groove having an axial width at least as large as the thickness of said second end wall, said groove containing a second groove of still smaller bottom diameter, said first end portion of said supporting rod being of reduced diameter and shouldered, and a flat spring locking plate slotted to engage said second groove to hold said supporting rod against longitudinal movement relatively to said housing.

14. Operating mechanism for a device of the class described, including in combination a housing having side, bottom and end walls, a supporting rod having connection at its end portions with the end walls of said housing, a longitudinally movable carriage having end walls provided with bearings engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, a flexible cable tightly wrapped around said operating rod and extending in opposite directions therefrom and connected with the end walls of said carriage, a first one of said housing end walls having a first bore receiving and fitting a first end portion of said supporting rod, and the second of said housing end walls having a second bore receiving and fitting the second end portion of said supporting rod, said second bore opening into a slot of less width than the diameter of said second bore, said slot extending through the upper edge of said second end wall, said second end portion of said supporting rod having a groove inside of said second end wall of a bottom diameter for free movement in said slot, said groove having an axial width at least as large as the thickness of said second end wall, said groove containing a second groove of still smaller bottom diameter, said first end portion of said supporting rod being of reduced diameter and shouldered, and a flat spring locking plate slotted to engage said second groove to hold said supporting rod against longitudinal movement relatively to said housing, said second end wall having an extending lug engaging said locking plate and holding it in said second groove.

15. Operating mechanism for a device of the class described, including in combination a housing, a supporting rod having connection at its end portions with said housing, a longitudinally movable carriage engaging said supporting rod with a sliding fit, a rotary operating rod extending transversely of said supporting rod adjacent said carriage and supported by said housing, and a flexible cable around and driven by said operating rod and extending in opposite directions therefrom and connected with said carriage.

16. Operating mechanism for a device of the class described, including in combination a housing, two elements having relative rectilinear movement and comprising a guide rod and a bearing member in sliding engagement with said guide rod, a first one of said elements having fixed support from said housing, a rotary operating rod extending transversely of said guide rod and supported by said housing, and a flexible cable around and driven by said operating rod and extending in opposite directions therefrom and connected at its end portions with the second one of said elements.

PHILIP K. McGALL.

CERTIFICATE OF CORRECTION.

Patent No. 2,253,304. August 19, 1941.

PHILIP K. McGALL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 24-25, for "cross-sections" read --cross-section--; page 6, second column, line 11, for "91b" read --91d--; line 65, before "washer" insert --a--; page 10, first column, line 37, claim 12, for "at large" read --as large--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of October, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)