Oct. 15, 1940. M. J. KIRK 2,217,984

OPERATING MEANS FOR PERMEABILITY-TUNED DEVICES

Filed Oct. 2, 1939 2 Sheets-Sheet 1

Fig. 1

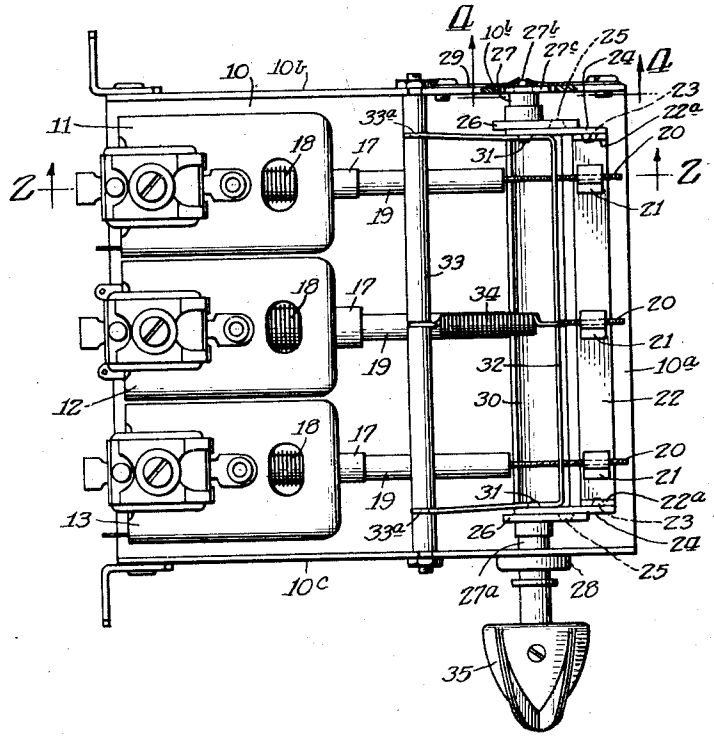


Fig. 2

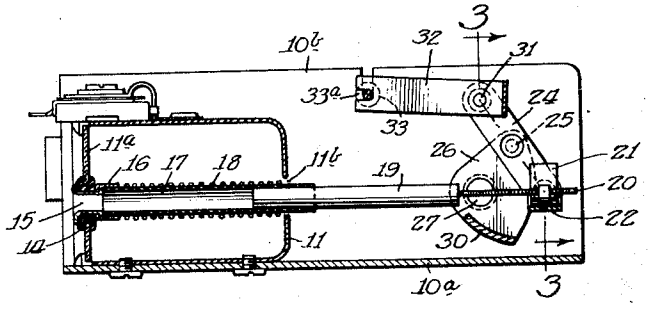


Fig. 3

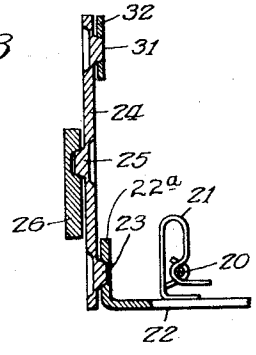
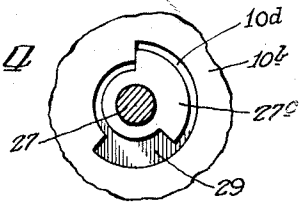


Fig. 4



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Filed Oct. 2, 1939 2 Sheets-Sheet 2

Fig. 6

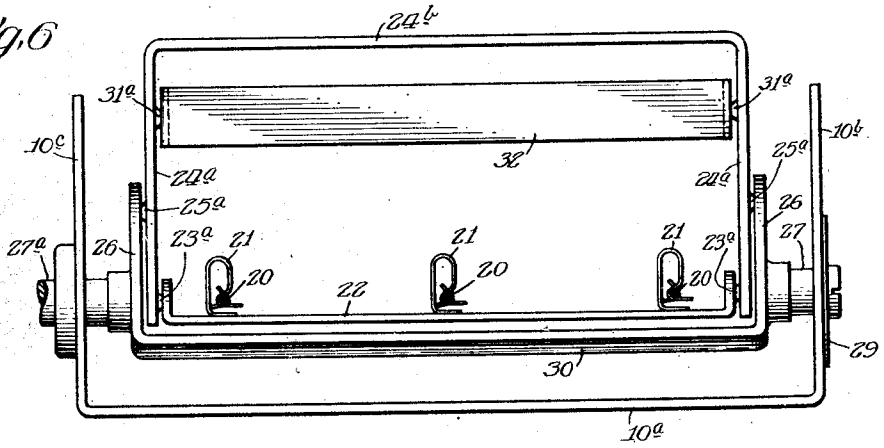


Fig. 7

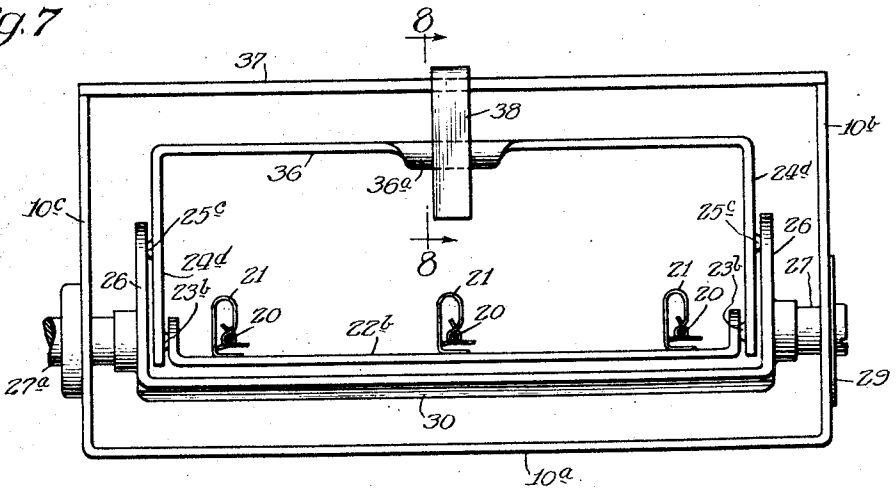


Fig. 5

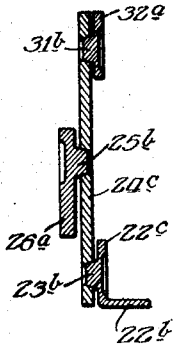


Fig. 8

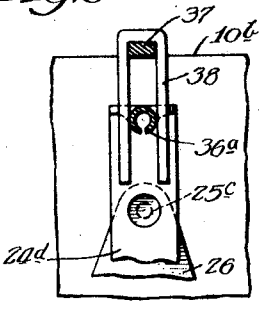
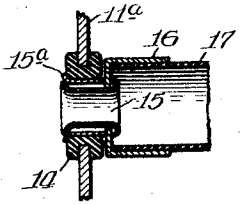


Fig. 9



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Patented Oct. 15, 1940 2,217,984

UNITED STATES PATENT OFFICE

2,217,984

OPERATING MEANS FOR PERMEABILITY-TUNED DEVICES

Martin J. Kirk, Chicago, Ill., assignor to Johnson Laboratories, Inc., Chicago, Ill., a corporation of Illinois

Application October 2, 1939, Serial No. 297,442

10 Claims. (Cl. 74—10)

The invention relates to improved operating means for permeability tuned devices including movable cores by which the inductances of coils may be changed as required for tuning purposes when said coils are parts of resonant circuits, for example in radio receivers which are required to be tuned over a substantial band of frequencies, so that desired stations, for example of the broadcast band, may be selected and tuned.

The invention is particularly characterized by improved devices by which a plurality of ferromagnetic cores may be simultaneously moved relative to corresponding inductance coils, to simultaneously effect proper tuning of the coils, so that their cooperating action will select and tune the apparatus to desired frequencies. The operating mechanism specifically includes a yoke for connection with the several cores to be operated by the mechanism, supported at both of its ends and operated by links and levers so that a straight line movement is imparted to the yoke in the direction of the axes of the cores, the levers being operated by a shaft which may be turned in any suitable manner to select a desired frequency. In accordance with the invention, the links and levers referred to are connected by extruded tapered pivots so arranged that the resilience of the parts holds the pivots snugly in their seats or sockets, thereby eliminating lost motion in the pivots and automatically compensating for wear, the arrangement further being such that no separate parts are required to connect the yoke, links and levers in cooperative relation, and that the mechanism may be quickly and easily assembled and dismantled as desired. The invention further includes novel means for mounting the inductance coils by which binding between the cores and sleeves supporting them and also supporting the inductance coils, is avoided.

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

Fig. 1 shows the assembled mechanism in plan view,

Fig. 2 is a vertical, sectional view of the construction shown in Fig. 1 taken along the line 2—2 in Fig. 1,

Fig. 3 is a vertical, sectional view to an enlarged scale through a part of the construction shown in Fig. 2, taken along the line 3—3 in Fig. 2,

Fig. 4 is a vertical, sectional view to an enlarged scale of a part of the structure shown in Fig. 1, taken along the line 4—4 in Fig. 1,

Fig. 5 shows in a view similar to Fig. 3, a modified arrangement of the tapered pivots and pivot seats employed to connect the members of the operating mechanism,

Fig. 6 shows in end elevation and to an enlarged scale, a modified construction of the motion-multiplying levers employed,

Fig. 7 shows in end elevation and substantially to the same scale as Fig. 6, modified means for restraining the end portions of the motion-multiplying levers from movement in the direction of the straight-line movement produced by the mechanism,

Fig. 8 is a vertical, sectional view of a part of the structure shown in Fig. 7, taken along the line 8—8 in Fig. 7, and

Fig. 9 shows in vertical, central, sectional view and to an enlarged scale, a modified and preferred means for securing each of the coil tubes to its supporting plate.

Similar numerals refer to similar parts throughout the several views.

As shown in Fig. 1, the device includes a casing 10 having a bottom wall 10*a* and side walls 10*b* and 10*c* extending upwards substantially perpendicularly to the bottom wall 10*a*. The bottom wall 10*a* supports shield cans 11, 12 and 13 which are secured thereto in any suitable manner, for example by screws as illustrated for the shield can 11 in Fig. 2. As shown in Fig. 2, the shield can 11 is provided with an end wall 11*a* of suitable sheet insulating material, which is provided with a central bore in which a washer or grommet 14 of soft resilient and readily flexible material, for example, rubber compound, is disposed and held in place by a tubular rivet 15 engaging a cup 16 of insulating material secured to the adjacent end of the insulating sleeve 17 employed to support the inductance coil 18 centrally in the shield can 11 and longitudinally thereof, a clearance opening 11*b* being provided in the end of said can remote from the end wall 11*a*, which clearance opening is substantially larger than the outer diameter of sleeve 17, so that the adjacent end of the sleeve 17 may have a substantial amount of lateral movement without restraint by the shield can, which lateral movement is readily permitted by the soft and resilient nature of the washer 14. The sleeve 17 contains a ferromagnetic core 19 with a free sliding fit, so that the core may be freely moved into and from the coil 18 to change the inductance thereof as may be required for tuning purposes. Each of the cans 12 and 13 is provided with an inductance coil 18 mounted on an insulating sleeve 17 supported by the correspond-

ing shield can in the manner described for the shield can 11 shown in Fig. 2, each of the sleeves 17 containing a ferromagnetic core 19 for longitudinal movement therein in the manner described for the core 19 in connection with Fig. 2.

As shown in Fig. 1, the cores 19 have rigidly secured to their outer ends respectively, slender adjusting screws 20 which are preferably secured to the cores by having their ends embedded therein. The outer end portions of the screws 20 extend through spring clips 21, for example of the Fahnestock type, which are secured to a yoke 22 disposed substantially parallel with the base plate 10a and extending transversely of the screws 20, said yoke having upwardly extending bent ends 22a engaging tapered pivots 23 carried by the lower end portions of motion-multiplying levers 24, which levers have central supporting pivots 25 of tapered construction extending outwardly therefrom to engage the end portions of levers 26 rigidly secured to short shaft sections 27 and 27a in alignment with each other and extending horizontally through the side walls 10b and 10c. The shaft sections are supported for free turning movement in any convenient manner by the side walls 10b and 10c, for example, the shaft section 27a may be supported by a ball-bearing 28 carried by the side wall 10c, and of a type to resist outward axial thrusts on the shaft section 27a, and the shaft section 27 may be supported by providing its outer end with a bearing ball 27b engaged by an apertured spring plate 29 secured to the side plate 10b, to press the shaft structure in a direction to hold the shaft section 27a as far outwardly as the bearing 28 will permit. The levers 26 are connected by a rigid cross member 30 to constitute a rigid unitary structure having sufficient stiffness to withstand the forces exerted upon it in the direction of the shaft sections 27 and 27a, without appreciable deformation of the lever structure 26, 30. The upper end portions of the levers 24 are provided with tapered pivots 31 engaging suitable seats in the leg portions of a U-shaped member 32, the ends of which leg portions are slotted as illustrated in Fig. 2 to engage grooves 33a formed in a rod 33 extending horizontally between the side walls 10b and 10c and rigidly secured at its ends to said side walls. The member 32 is preferably made of resilient sheet metal and by its size and shape relatively to the spacing of the grooves 33a, accomplishes two distinct functions: First, the spacing of the grooves 33a is such that the leg portions of the member 32 are sprung outwardly sufficiently to hold the pivot seats in its leg portions firmly against the tapered pivots 31 on the levers 24, so that lost motion is completely eliminated at said pivots and also at the pivots 25 and 23, and, second, the leg portions of said member 32, are disposed for slight movement above and below horizontal positions, which, together with the proportions and disposition of the other parts of the structure, results in the yoke 22 having substantially straight line movement in the direction of the axes of the cores 19, the tapered pivots 23 and 31 of each of the levers 24 being equidistant from the central tapered pivot 25 of said lever, which spacing is the same as the distance of the socket for each of the tapered pivots 25 from the axis of the shaft sections 27 and 27a. The parts are preferably so related and proportioned that when the shaft sections 27 and 27a are turned to place the pivots 25 directly over the axis of said shaft sections, the levers 24 will be vertical and will occupy a position such that the pivots 31 are slightly above the axis of the rod 33. The operating mechanism described imparts full range movement to the cores 19 for substantially 90° of rotary movement of the shaft sections 27 and 27a, and rotary movement of said shaft sections may be so limited by suitable stops of any desired kind cooperating with either of said shaft sections, for example, by the stop 27c rigidly secured to the shaft section 27 for rotary movement in a shouldered opening 10d in the side wall 10b, as shown in Fig. 4.

To facilitate assembling the parts and to hold the member 32 in the position described, a tension spring 34 is provided which engages the mid-portion of the member 32 at one of its ends, and at its other end is in engagement with the mid-portion of the rod 33 so that the slotted ends of the leg portions of the member 32 are pressed firmly against the bottoms of the grooves 33a at all times. The shaft sections 27 and 27a may be rotated in any desired manner, for example by means of a knob 35 secured to the shaft section 27a, although any other form of operating means whether directly or indirectly connected with either of the shaft sections 27 and 27a may be employed if preferred.

As a result of the construction described, the levers 24 are not permanently secured to the yoke 22, or to the levers 26, or to the member 32, but on the other hand are held in cooperative relation to said parts by the spring action of the member 32, since the forces exerted by said member on the upper ends of the levers 24 not only press the tapered pivots 31 and their sockets firmly into engagement, but also press the tapered pivots 25 firmly into their sockets and thereby press the tapered pivots 23 firmly into engagement with their sockets, there being sufficient clearance between the parts so that when they are assembled as described, they engage each other only at the tapered pivots referred to. As a result, lost motion is entirely eliminated at the pivot points, compensation for wear at said pivot points is automatically attained, and the operation of the mechanism is smooth and even throughout. The spring clips 21 afford a convenient means for adjusting the cores 19 relatively to each other for aligning and tracking purposes, for by turning any one of the cores in its sleeve 17, said core may be moved axially of the sleeve to any desired position of adjustment, without corresponding axial movement of the other cores. The spring clips are a convenient and inexpensive means for attaching the screws 20 to the yoke 22, since lost motion is thereby eliminated, and because of the burrs or edge projections left on the clips by the tools used in making them, it is not necessary to specially thread them, the threads of the screws 20 having sufficient engagement of a threaded nature with the burrs on the clips, to effectively serve the purposes set forth.

When it is desired to dismantle the operating mechanism described, all that is necessary is to disconnect the spring 34 at one of its ends, slide the slotted ends of the leg portions of the member 32 from engagement with the rod 33, spring the end portions sufficiently together to disengage the pivots 31, and then remove the levers 24. The assembly of the parts is readily effected by a reverse procedure.

Figure 3 illustrates the manner in which the pivots 23, 25 and 31 are preferably constructed. As indicated in Fig. 3, each of said pivots is

formed by extruding or forcing from the body portion of the lever **24**, by suitable punches and dies, sufficient metal to form the projecting tapered pivot; suitable seats in the yoke **22**, in levers **26** and the leg portions of the member **32** are similarly formed to fit said tapered pivots in a manner to leave a slight clearance between the connected parts so that free and smooth turning movement of the parts on said tapered pivots will result, and that the taper of the pivots will eliminate all lost motion between the parts. It will be noted that the wearing qualities of the bearing surfaces of the tapered pivots and their seats is materially improved by the extruding or swaging operations involved in making them, by the hardening of the metal resulting from such operations. It will also be noted that for the construction shown in Figs. 1–3, all three of the pivots at either end of the operating mechanism, are formed on one of the levers **24**, which greatly facilitates the forming of the tapered pivots, inasmuch as the lever is otherwise a straight, plain piece of metal and easily handled.

The link and lever arrangement above described for supporting and operating the yoke **22** is the same at each end of said yoke and similarly disposed angularly, so that all parts of the yoke **22** have imparted to them the same horizontal movement in the direction of the axes of the cores **19**, as other parts of said yoke.

In Fig. 5, I illustrate a construction similar to that shown in Fig. 3, the difference being that the lever **24c** shown in Fig. 5 is provided with seats or sockets for the tapered pivots **31***b*, **25***b* and **23***b* formed on the member **32***a*, on the lever **26***a* and on yoke end **22***c*, instead of the opposite arrangement shown in Fig. 3, the member **32***a*, the lever **26***a* and the yoke **22***b* of Fig. 5 being otherwise the same as the member **32**, the lever **26** and the yoke **22** of Fig. 3. It will be understood that it is immaterial which of the parts are provided with tapered pivots, and which of the parts are provided with seats or sockets therefor, as long as the results described are secured.

In Fig. 6 I illustrate a modified construction by which the levers **24** above described are replaced by similar levers **24***a* which extend substantially above the tapered pivots **31***a* and are secured together at their upper ends by a yoke **24***b*, so that the levers **24***a* are parts of a unitary structure for convenient handling, instead of being separate parts as shown in Figs. 1 and 2. The other parts of the structure are the same and operate in the same manner as the similar parts above described in connection with Figs. 1, 2 and 3.

In Fig. 7 I illustrate a modified construction in which levers **24***d* similar to the levers **24** are employed, excepting that no pivotal connections are employed corresponding to the tapered pivots **31***a* or **31***b*, the levers **24***d* being connected to form a unitary structure by a yoke **36** having a mid-portion **36***a* of circular cross-section as more clearly shown in Fig. 8. A cross bar **37** is rigidly secured to the side walls **10***b* and **10***c*, and carries at its mid-portion a depending guide **38** which, as more clearly shown in Fig. 8 has parallel and vertical guide walls engaging the circular portion **36***a* to so restrain said portion **36***a* that it may move only in a vertical direction. The distance of the axis of the portion **36***a* from the axis of the tapered pivots **25***c* is the same as the distance of the latter axis from the axis of the tapered pivots **23***b*, and the said axes are all in the same plane. As a result, straight-line horizontal movement is imparted to the yoke **22***b* and to the screws **20** connected therewith, when the shaft sections **27**, **27***a* are rotated. With this construction the member **32** is omitted and the yoke **22***b* exerts the pressures on the tapered pivots of the structure, required to firmly hold the pivots in their seats or sockets.

In Fig. 9 I illustrate a means for mounting each of the sleeves **17** which is preferred because it affords a positive support for the sleeve without unduly compressing the washer or grommet **14**. In this construction I employ a first tubular rivet **15***a* extending through the washer **14** with its head outermost and resting at its inner end against the end wall of the cup **16**; a second tubular rivet **15** is inserted with its head innermost, through the cup **16** and through the rivet **15***a*, and is then expanded at its outer end to firmly engage the rivet **15***a*, thus securely holding the end wall of the cup between the two rivets, the rivet **15***a* serving to protect the washer **14** from undesired compression that might interfere with its resilience in supporting the sleeve **17**.

While the construction illustrated shows shield cans around the coils, the coil supporting sleeves **17** may be similarly mounted whether shield cans are used or not. Furthermore, the devices described for effecting substantially straight-line movement of the cores, are equally effective for that purpose, whether the sleeves **17** are supported as illustrated, or in any other suitable manner, the only requisite in this connection being that the cores shall have adequate support for substantially straight-line movement.

The core operating mechanisms described, possess the marked advantage of eliminating backlash or lost motion from the pivotal connections by the manner in which said pivotal connections are constructed from the necessary members themselves, and without the use of extra parts of any kind. No special take-up springs are required or used, and there is a complete absence of close machine fits and minute tolerances in the pivotal connections. Accurately and closely fitted pivotal connections of the usual kind, are expensive to make and expensive to maintain; the pivot structure of the present invention by avoiding accurately machined fits, is inexpensive to construct and inexpensive to maintain, and at the same time, it provides a construction that positively eliminates backlash or lost motion, that has a smooth, easy and uniform action, that automatically compensates for wear, and that can readily and quickly be assembled and dismantled by means of the hands and fingers of the workman, and without the use of tools or accessories of any kind.

It will be understood that if preferred, the formed pivots above described, may be replaced by pivot studs that are separate parts secured to the several members of the structure in the relation above described in any suitable manner, for example, by pressing the shanks of said studs into apertures therefor in said members in a manner well known in the art, the only requisites being that said pivots shall be rigidly related to the members carrying them and that said pivots shall have projecting portions for pivotal connection with cooperating members of the structure.

In view of the above it will be noted that the operating mechanism is of simple and inexpensive construction and efficient in operation for the contemplated purposes.

While I have shown my invention in the par-

ticular embodiment above described, it will be understood I do not limit myself thereto as I may employ equivalents without departing from the scope of the appended claims.

Having thus described my invention, what I claim is:

1. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections.

2. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said pivotal connections comprising tapered pivots and cooperating sockets punched from said levers and said links.

3. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said links comprising the leg portions of a U-shaped resilient metal member the resilience of which holds said pivotal connections together.

4. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said pivotal connections comprising tapered pivots and cooperating sockets punched from said levers and said links, all of said pivots of said pivotal connections being formed and extending from said first levers.

5. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said pivotal connections comprising tapered pivots and cooperating sockets punched from said levers and said links, all of said pivots of said pivotal connections being formed and extending from said first levers, the central pivot of each of said first levers extending therefrom in a direction opposite to that of the end pivots thereof.

6. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke

extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, a link extending in the direction of said core movement and having pivotal support at one of its end portions and pivotally connected at its other end portion with the other end portion of each of said first levers, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, and a member rigidly connecting said second levers.

7. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and devices restraining the other end portions of said first levers to movement transversely of said core movement, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections.

8. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, devices restraining the other end portions of said first levers to movement transversely of said core movement, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, and a member rigidly connecting said second levers.

9. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and devices restraining the other end portions of said first levers to movement transversely of said core movement, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said pivotal connections comprising tapered pivots and cooperating sockets punched from said levers.

10. Operating mechanism for a plurality of axially movable ferromagnetic cores in parallel relation and constituting parts of permeability tuning devices, including in combination a yoke extending transversely of said core movement and for connection with said cores, first and angularly aligned levers having pivotal connection each at one of its end portions with the ends of said yoke, second and angularly aligned levers having pivotal connection at their end portions respectively with the mid-portions of said first levers, spaced and aligned shaft sections secured to said second levers to support and operate said second levers, and devices restraining the other end portions of said first levers to movement transversely of said core movement, said first and said second levers being free from other connections and being proportioned and related to said yoke to support said yoke and to restrain said yoke to substantially rectilinear movement in the direction of said core movement for angular movement of said shaft sections, said first levers comprising a U-shaped metal frame engaging said restraining devices.

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