Sept. 20, 1949. K. L. HENDERSON 2,482,181

TUNING MECHANISM

Filed Jan. 7, 1947

2 Sheets-Sheet 1

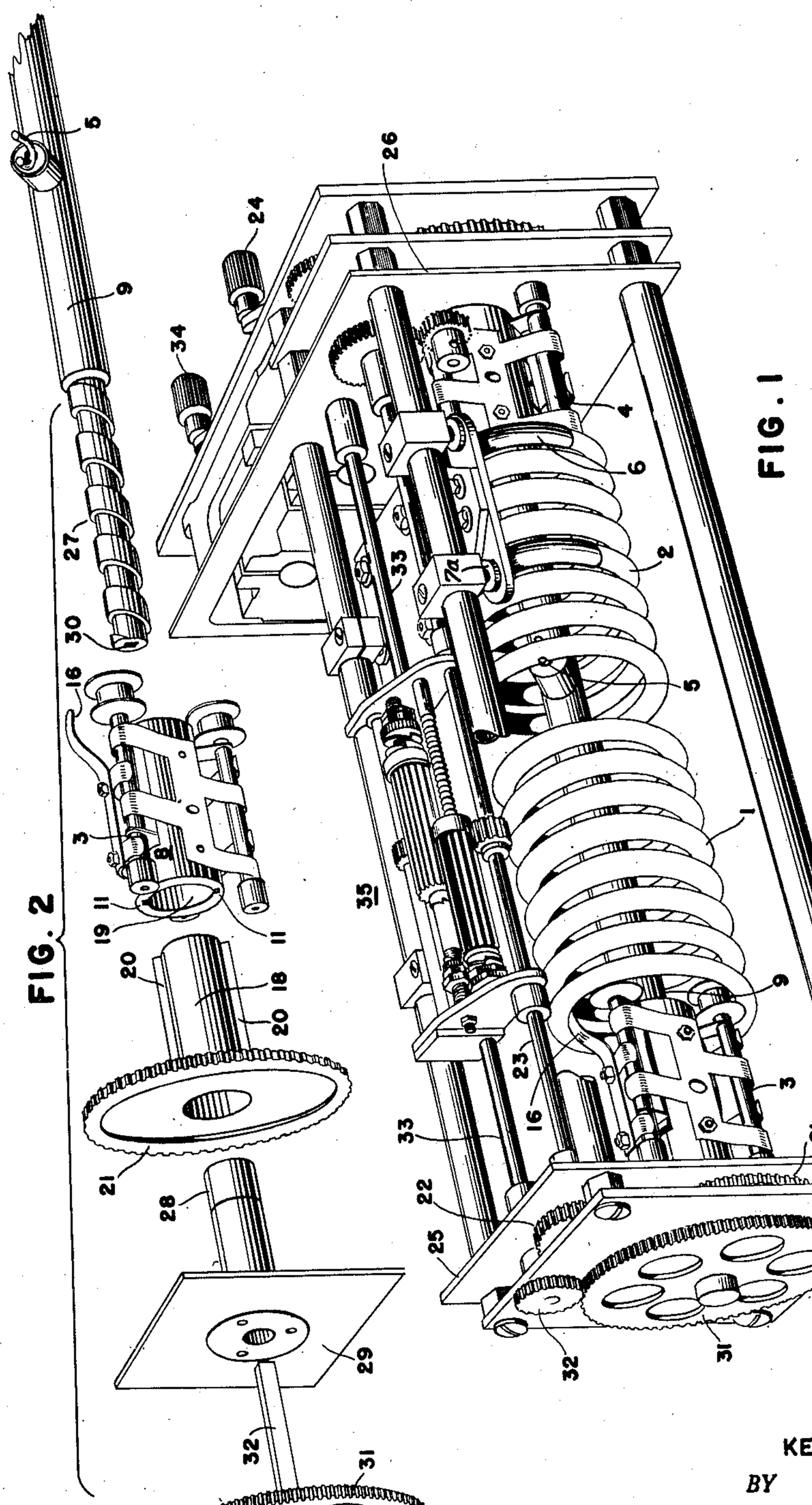

FIG. 2

FIG. 1

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2 Sheets-Sheet 2

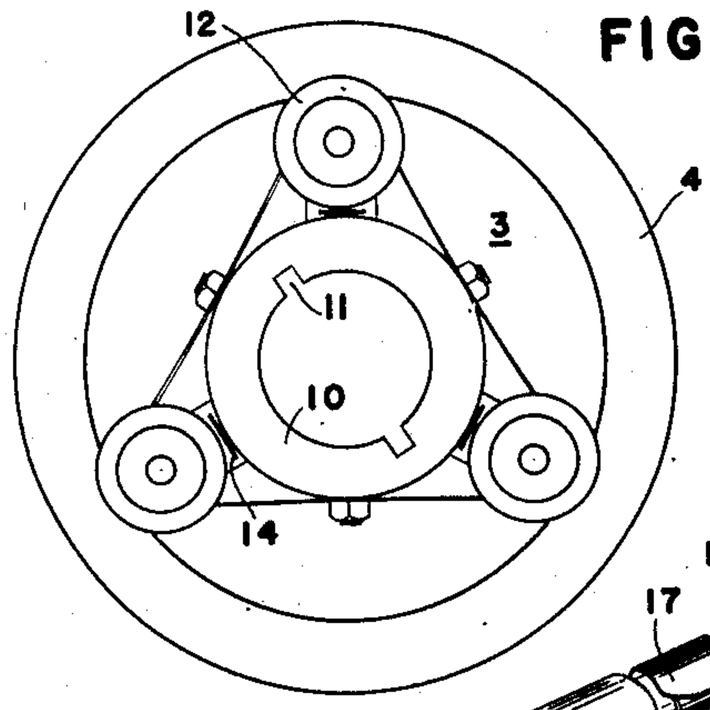

FIG 4

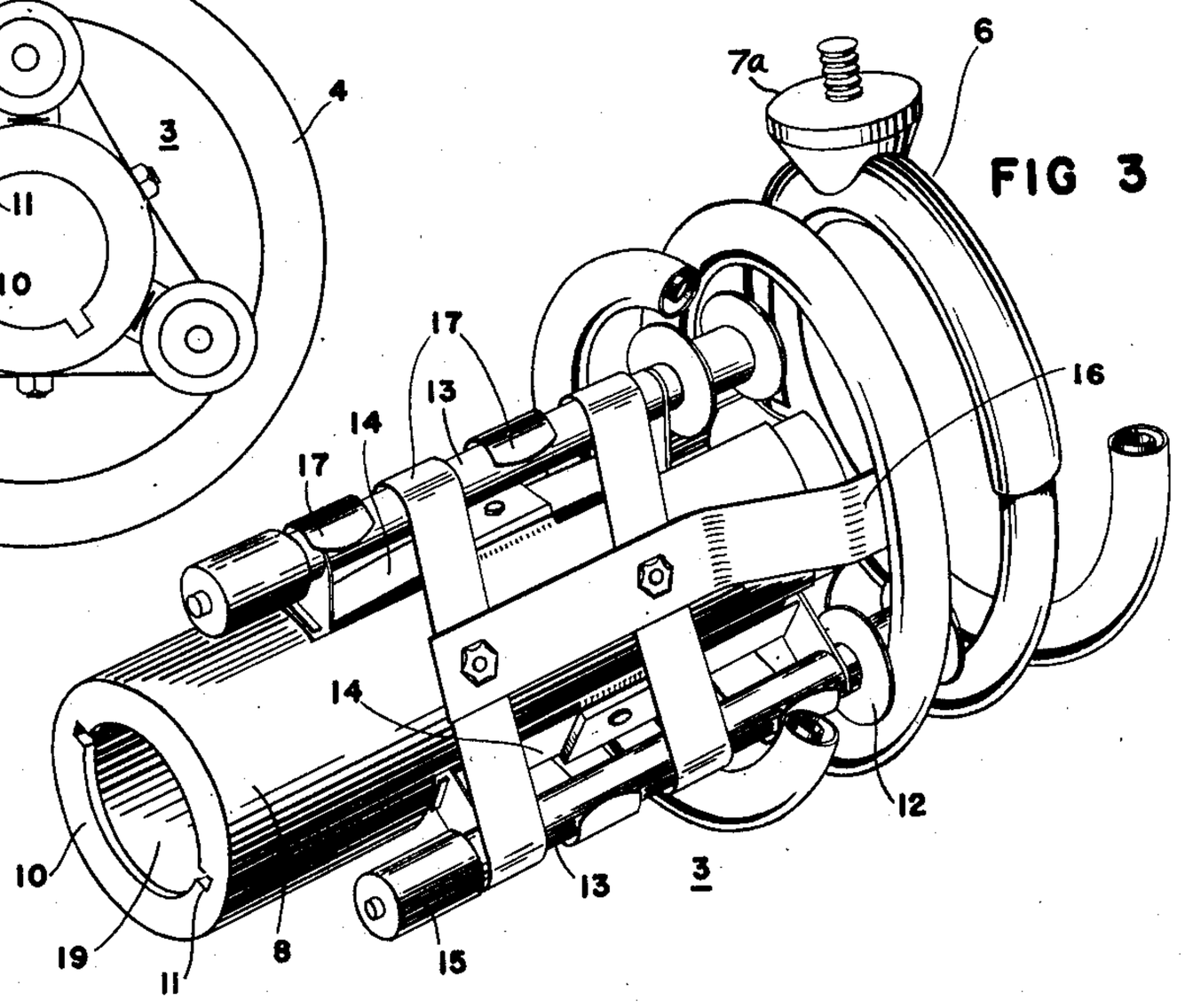

FIG 3

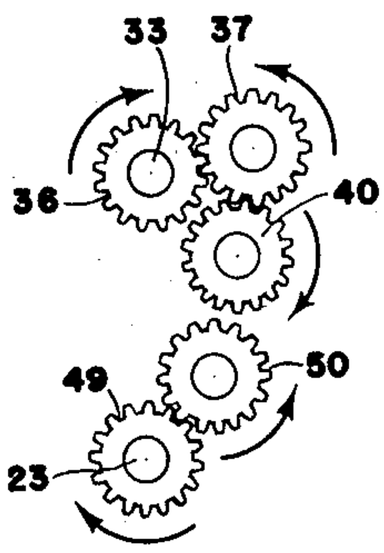

FIG 7

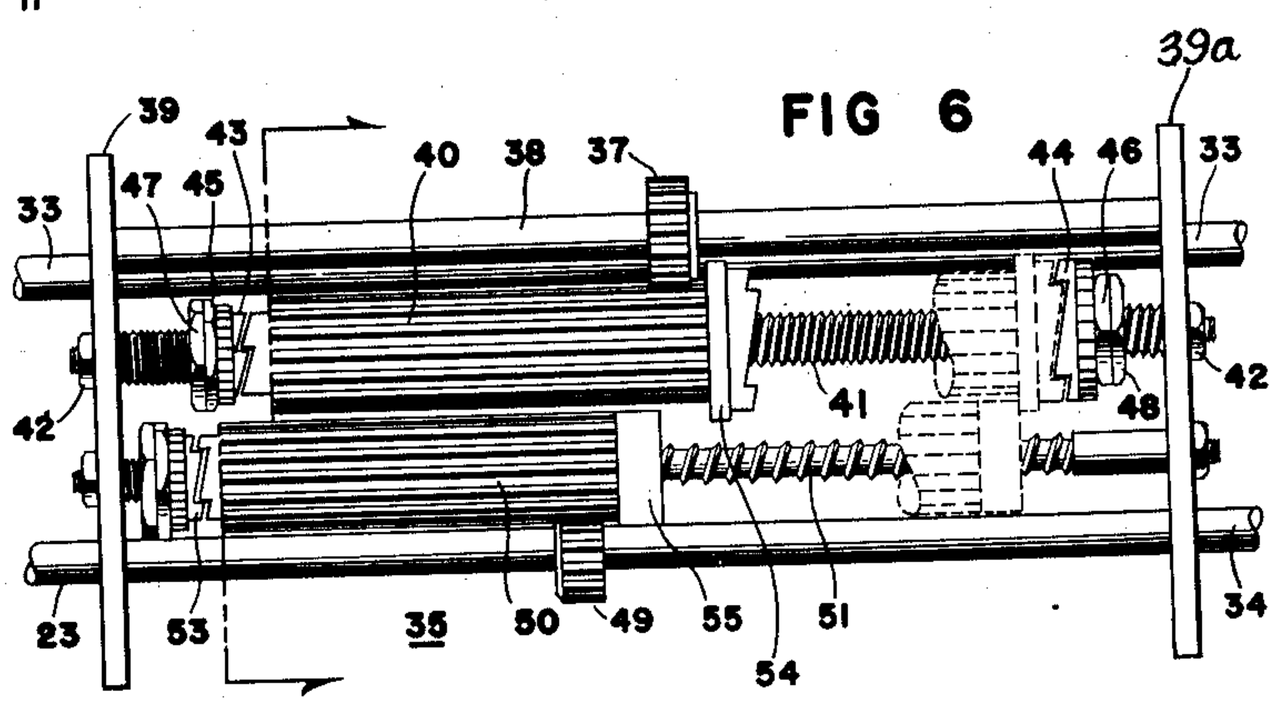

FIG 6

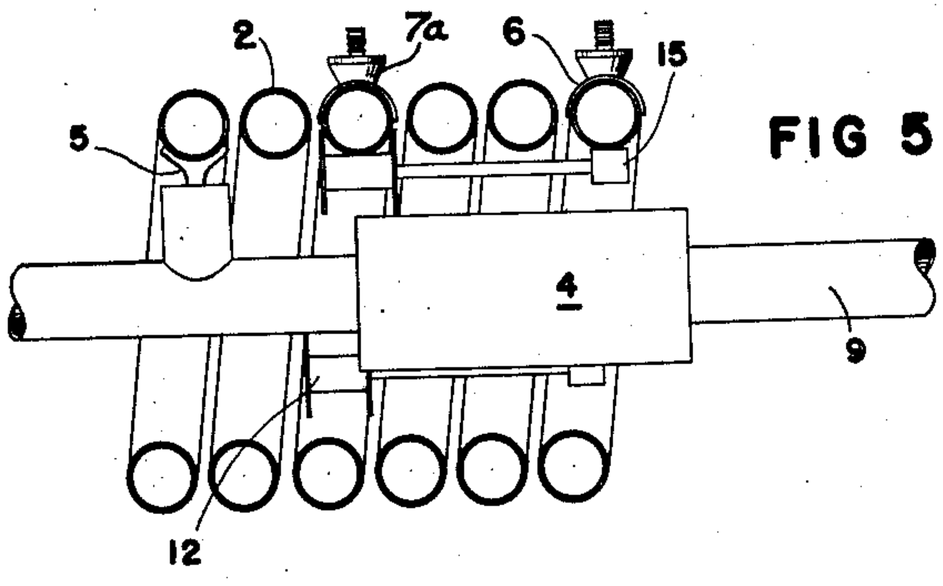

FIG 5

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TUNING MECHANISM

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7 Claims. (Cl. 171—242)

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This invention relates to variable tuning mechanisms and more particularly to stopping means for the prevention of over-travel of variable tuning mechanisms.

It is an object of my invention to provide new and improved means for stopping the rotation of the traveling member or members of a variable tuning mechanism at predetermined points. It is another object of my invention to provide new and improved means associated with the traveling contact member of a variable tuning device to enable the contact member to be stopped exactly in a predetermined desired position.

The present invention relates to tuning mechanisms of a type employing rigid helically-wound inductance coils and a traveling contact member, which may include rollers engaging the turns of the coil and which is movable longitudinally with respect to the coil in order to effect tuning. There is provided a simple and positive stop mechanism for halting the traveling member at a desired place on the coil. The stopping mechanism may be in the form of an adjustable nut or nuts for example.

In case two or more movable contact members are employed, interlocking controls are necessary in order to prevent conflict in the adjustment of the various contact members. Thus, according to one form of my invention, stopping mechanism is provided such that travel of one tuning device in one direction is limited before one end of the coil is reached and limited in the opposite direction before the device reaches the other contact member. The other contact member is limited in motion in the first mentioned direction to prevent engagement with the first tuning device and in the opposite direction before reaching the other end of the tuning coil.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is a perspective view of a tuning mechanism embodying the principles of my invention, Fig. 2 is an exploded view of certain parts of the tuning mechanism shown in Fig. 1 and illustrates the parts necessary to drive the various tuning or contact members, Fig. 3 is a perspective view of one of the contact members, Fig. 4 is an end view of the tuning member or device shown in Fig. 3, Fig. 5 is a simplified diagram illustrating the relationship between the two different types of contact members shown in Figs. 1 and 2, Fig. 6 is a plan view of the stopping mechanism shown in Fig. 1, and Fig. 7 depicts the gearing arrangement of the stopping mechanism.

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Referring to the drawings and particularly Fig. 1, there is shown a pair of variably tuned helically wound inductance coils 1 and 2, preferably tubular in cross section. Each coil is provided with a contact member carried by traveling tuning slugs 3 and 4 respectively arranged for longitudinal movement with respect to the coil with which it is associated as will be explained in detail hereinafter. There is also provided a second contact member or tuning element 5 in the nature of a probe, also arranged for longitudinal movement with respect to one of the coils, such as coil 2 for example.

In order to support the coils 1 and 2 and yet leave the space within the convolutions of the coil free to permit unobstructed movement of the tuning devices, there is provided supporting means external to the coils. In the illustrated form of my invention the supports comprise channel-shaped members or saddles 6 suitably carried by the member 7, for example, as by means of suitable fastening members 7*a*. The inside radius of the channel is substantially the same as the cross-sectional radius of the conductor used in winding the coils. The channel is formed to have the same pitch as the coils but the inside diameter is slightly smaller than the outside diameter of the coils so that the coil may be forced into the saddle or supporting member and securely held. The retaining effect is enhanced if the segment of the channel extends over a little more than 180° of arc. As shown in Fig. 1, I prefer to use two saddles or supports for each coil.

The tuning slugs 3 and 4 will next be described. Particular reference is made to Figs. 3 and 4. Each tuning slug comprises a generally cylindrical member 8 carried upon a shaft assembly indicated by the numeral 9 (see Figs. 1 and 2) which extends from front to back of the tuning mechanism. One end of the cylinder 8 has an inwardly directed flange 10 having a pair of diametrically-opposed radial slots 11. The tuning slug employs a plurality of rollers 12, in this case three rollers spaced approximately 120° apart, in order to support the tuning slug or device 3 within the coil and to enable its longitudinal movement therein. The rollers 12 engage the inside diameter of the inductor or coil, following the convolutions of the coil in such a way that they give

axial and rotary movement to the slug whenever rotational movement is applied as will be explained hereinafter. The shafts 13 on which the rollers are fitted are mounted on leaf springs 14 so that the rollers are always biased outwardly into engagement with the inside surface of the coil. This feature insures good mechanical contact by the rollers despite any small inaccuracies that may occur in the diameter of the coil. In order to balance the pressure on the leaf springs, there are provided rollers 15 on the opposite ends of the shafts 13 from the rollers 12. Rollers 15 also bear against the inside of the coil whenever the tuning slug or device is inserted sufficiently into the coil. The shafts and rollers are positioned axially to conform to the pitch of the coil.

In order to provide electrical contact there is provided the wiper type contact member 16 suitably carried by the tuning slug. For example, the contact member 16 may be secured to the wall of cylinder 8. In order to short circuit all convolutions of the inductor which are not active in the electrical circuit, there is provided a series of contact members 17 carried by the cylinder 8 and positioned to contact the respective turns of the coil. The contact portion 16 preferably is placed ahead of the most advanced of the rollers 12 so that contact may be made between the coil and the movable contact as close as possible to its terminal when tuned to the highest frequency.

In order to rotate the tuning slug to advance or retract the slug with respect to its associated coil, there is provided a system of shafts and gearing. Only so much of the gearing is shown as appears necessary to illustrate the operation of my tuning mechanism. In order to drive the tuning slugs 3, there is provided the tubular member 18 adapted to be inserted through the opening 19 in the end of the cylinder 8. The portion 18 is provided with splines 20 corresponding to the slots 11 in the cylinder 8. In order to impart rotation to the tubular member 18 and hence to the tuning slug 3, there is provided a gear 21 of suitable dimension and shape attached to the outer end of the tubular member 18 in any satisfactory manner. In order to drive the gear 21, there is provided a driving pinion 22 suitably attached to a shaft 23 which extends through the front end of the tuning unit and terminates in suitable operating mechanism which may include the crank 24. The shaft 23 is suitably supported as by means of supporting plates 25 and 26 located at opposite ends of the tuning unit. As will be understood from a study of Fig. 1, rotation of the crank 24 causes rotation of shaft 23 and gear 22 which will result in rotation of gear 21 and tubular member 18 and tuning slug 3.

Tuning slug or member 4, in this form of our invention, is simultaneously driven by suitable gearing at the other end of the unit.

In this embodiment of my invention, inductor or coil 2 is provided with a contact member, such as the coaxially arranged probe 5 carried by the shaft assembly 9. The details of the probe are not shown. In order to transmit rotary motion to the probe and longitudinal movement thereof in respect to the coil 2, the shaft member 9 is provided at one end thereof with a threaded portion 27 arranged to engage a suitably threaded tubular member 28 carried by the end plate 29 of the tuning unit. It will be seen from an inspection of Fig. 2 that rotation of shaft 9 causes the shaft to enter or be retracted from the tubular portion 28 according to the direction of rotation.

In order to impart rotary motion to shaft 9, the

threaded portion 27 is provided with an axial opening 30 of suitable shape and there is mounted on the back plate 29 a gear 31 having an axially extending shaft member 32 having the same cross-sectional shape as the opening 30 extending through the back plate 29 and tubular member 28 into opening 30. In order to drive gear 31 there is provided a suitable driving gear 32 suitably mounted on a shaft 33 extending to the front of the tuning unit and terminating in suitable operating mechanism which may include a crank 34.

From the foregoing, it is seen that the wiper contact or probe 5 travels laterally and together with or independently of tuning slugs 3 and 4 in the inductors or coils following the convolutions of the coils, i. e., following the same course or path of movement as one of the slugs. Referring to coil 2, it is seen that the wiper or probe 5 must be limited in its travel in one direction before reaching the left-hand end of the coil 2, as viewed in the drawing, and be limited in the other direction before reaching the tuning slug 4, regardless of the latter's position in the inductor or coil. Similarly the tuning slug 4 must be stopped before reaching the end of the coil 2 in the right-hand direction or interfering with the wiper 5 after travel in the left-hand direction. In order to accomplish these limitations, there is provided the stopping mechanism 35 best seen in Fig. 6. The stopping mechanism or unit 35 is linked to the tuning drive system through driving shafts 23 and 33. The shaft 33 is provided with a gear 36 which meshes with an idler gear 37 suitably mounted on shaft 38 which is journaled in any satisfactory manner between end plates 39 and 39*a* of the stop unit 35. The idler gear 37 meshes with a longitudinally extended pinion 40 which has a tapped axial opening having threaded engagement with a suitable longitudinally extending suitably threaded support member 41 which is fixed in position as by means of fastening means 42 between end plates 39 and 39*a*. The pinion 40 acts as a nut on the threaded member 41 so that any rotary movement of pinion 37 transmitted through shaft 33 and gear 36 is transposed into longitudinal movement of pinion 40. On the threaded member 41 there are positioned two stops 43 and 44 which may be nuts or which may have nuts 45 and 46, respectively, suitably secured thereto. The stops 43 and 44 may be suitably secured in position as by means of stop nuts 47 and 48, respectively. It will be seen that movement of pinion 40 to the left will be halted by engagement with the stop 43 and movement toward the right will be limited by stop 44. The opposed faces of the stops may be provided with sawtooth or other desired surfaces and the associated ends of pinion 40 may have corresponding surfaces if it is desired to provide a more positive stop mechanism and an arrangement which has a minimum tendency to jam. Shaft 23 is equipped with a driving gear 49 arranged for engagement with a longitudinally extended pinion 50 suitably mounted for axial movement along a threaded member 51. The member 51 is provided with a stop 53 at the left-hand end of the device as seen in Fig. 6. The right-hand end of pinion 40 is provided with an annular shoulder 54 which serves as a stop for the end portion 55 of the pinion 50.

It is seen from Fig. 6 that the contact mechanism associated with shaft 33 is limted in one direction by engagement with a first stop 44 and in the other direction by engagement with a second stop 43 or by engagement with a third stop comprising the end part 55 of pinion 50 depend-

ing upon the position of the contact device associated with shaft 23, whereas the second contact device associated with shaft 23 is limited in the one direction by the third stop comprising engagement with the shoulder 54 and in the other by the fourth stop 53.

When, by reason of the mechanical arrangement of parts, different gear ratios are effective with respect to the driving shafts, compensating means must be provided in the stop unit. This compensation may be achieved by using different numbers of threads, i. e., thread pitch, per unit of length on the shafts or members 41 and 51 as shown in order to eliminate extra gears or gears of proper ratios may be chosen. This principle is applicable to any problem where a stop or interference mechanism is needed on two shafts using different speeds.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention in its broader aspects. I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim is:

1. A variable tuning mechanism comprising a helical coil, first movable contact means, first and second stop means for limiting the movement of said first contact means at predetermined points in each direction, a second movable contact means, a third stop means carried by said first contact means to stop said second contact means in one direction of movement and a fourth stop means for limiting the movement of said second contact means in the other direction whereby the movement of said first contact means is limited in one direction by engagement with said first stop means and in the other direction by engagement with said second stop means or said third stop means depending upon the position of said second contact means and said second contact means being limited in said one direction by said third stop means and in said other direction by said fourth stop means.

2. A variable tuning mechanism comprising a helical coil, first movable contact means, first and second stop means for limiting the movement of said first contact means at predetermined points in each direction, a second movable contact means, a third stop means carried by said first contact means to stop said second contact means in one direction of movement and a fourth stop means for limiting the movement of said second contact means in the other direction whereby the movement of said first contact means is limited in one direction by engagement with said first stop means and in the other direction by engagement with said second stop means or said third stop means depending upon the position of said second contact means and said second contact means being limited in said one direction by said third stop means and in said other direction by said fourth stop means, said first, second, and fourth stop means being adjustable.

3. A variable tuning mechanism comprising a helical coil, first and second movable contact means arranged for engagement with said coil, means for moving each contact means with respect to said coil, stop means for limiting the movement of each contact means and for preventing interference between said contact means, said means comprising a pair of parallel shafts, a member carried by each of said shafts and arranged for movement therealong, means associated with each of said contact moving means for causing movement of the respective members, first and second stop means carried by one of said shafts for limiting movement of the associated member at predetermined positions in opposite directions, third stop means carried by the other of said shafts for limiting at a predetermined position the movement of the other of said members in one direction, said second member and one of said stops being arranged for engagement at a predetermined point when said second member moves in the other direction.

4. A variable tuning mechanism comprising a helical coil, first and second movable contact means arranged for engagement with said coil, means for moving each contact means with respect to said coil, stop means for limiting the movement of each contact means and for preventing interference between said contact means, said means comprising a pair of parallel threaded shafts, a member carried by each of said shafts and having threaded engagement therewith to permit movement therealong, means associated with each of said contact moving means for causing movement of the respective members, first and second stop means carried by one of said shafts for limiting movement of the associated member at predetermined positions in opposite directions and third stop means carried by the other of said shafts for limiting at a predetermined position the movement of the other of said members in one direction, said second member and one of said stops being arranged for engagement at a predetermined point when said second member moves in the other direction.

5. A tuning mechanism comprising a helically wound coil and having a tuning member slug arranged for longitudinal and rotary motion with respect to said coil, said member being provided with a plurality of rollers having engagement with the inner surfaces of the convolutions of said coil, said rollers being carried by longitudinally extending shafts mounted for rotation on said slug, means for biasing said rollers into said engagement, and means for balancing the effect of said biasing means comprising rollers carried by said shafts longitudinally spaced apart from the first mentioned rollers and engaging other turns of said coil.

6. In a tuning mechanism, a helical coil, a first contact bearing assembly including a first contact member arranged for longitudinal movement with respect to said coil whereby said first contact member engages said coil, a second contact bearing assembly including a second contact member arranged for longitudinal movement with respect to said coil whereby said second contact member engages said coil along a path of movement which may result in physical engagement between said contact members and electrical or mechanical interference therebetween, means for individually imparting movement to said assemblies in order to enable adjustment of said assemblies with respect to said coil, and means for preventing engagement between said assemblies including stop mechanism operatively associated with each of said imparting means and positioned in accordance with the positions of the corresponding imparting means, said stop members being arranged to engage at predetermined positions of said contact members as said assemblies are moved toward each other whereby

physical engagement between said assemblies or contact members is prevented.

7. In a tuning mechanism, a helical coil, a first contact bearing assembly including a first contact member arranged for longitudinal movement with respect to said coil whereby said first contact member engages said coil, a second contact bearing assembly including a second contact member arranged for longitudinal movement with respect to said coil whereby said second contact member engages said coil along a path of movement which may result in physical engagement between said contact members and electrical or mechanical interference therebetween, means for individually imparting movement to said assemblies in order to enable adjustment of said assemblies with respect to said coil, each of said imparting means including a traveling stop member arranged to move similarly to the imparting means with which it is associated, the positions of said stop members being determined by the relative positions of said assemblies, said stop

members being positioned relative to each other such that said stop members engage before physical engagement between said assemblies or said contact members as either or both of said imparting means are operated to cause movement of said assemblies toward each other.

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