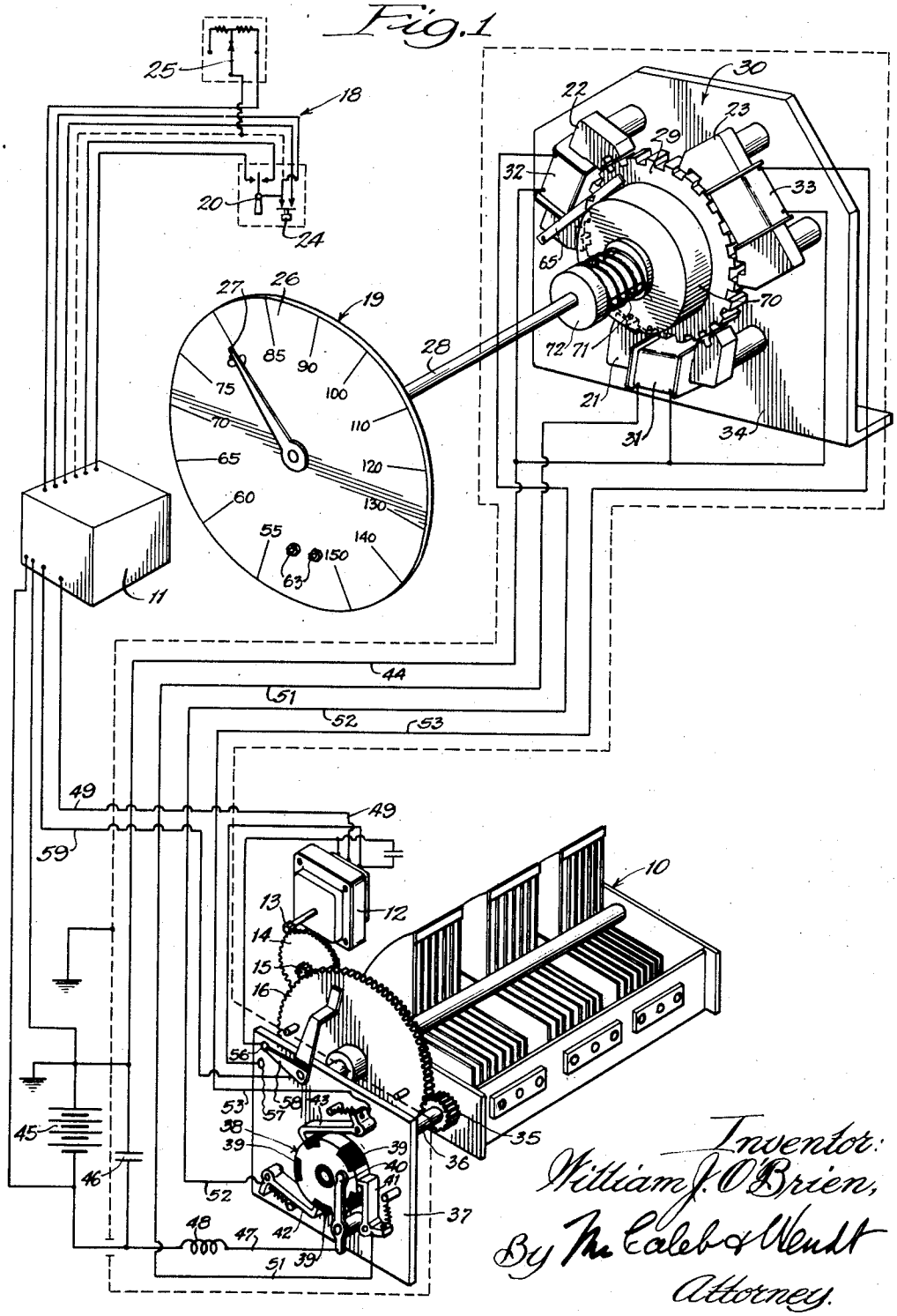
June 15, 1943. W. J. O'BRIEN 2,321,699

REMOTE INDICATOR AND CONTROL DEVICE

Filed Oct. 1, 1940 2 Sheets-Sheet 1

Fig. 1



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REMOTE INDICATOR AND CONTROL DEVICE

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Fig. 2

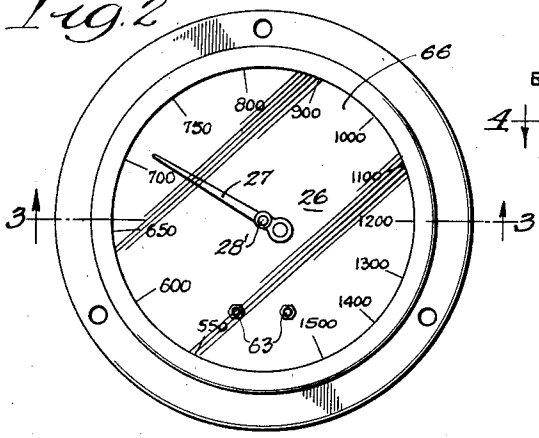


Fig. 3

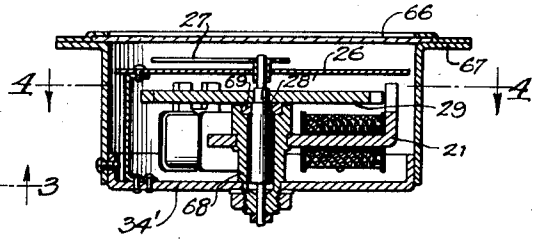


Fig. 4

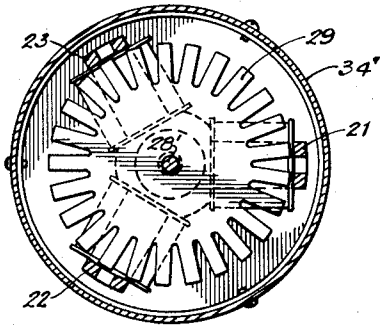


Fig. 5

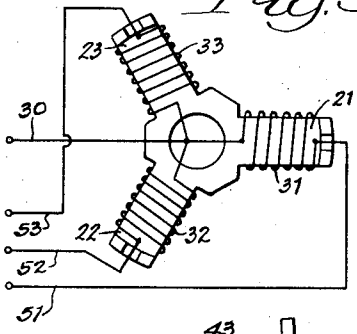


Fig. 1A

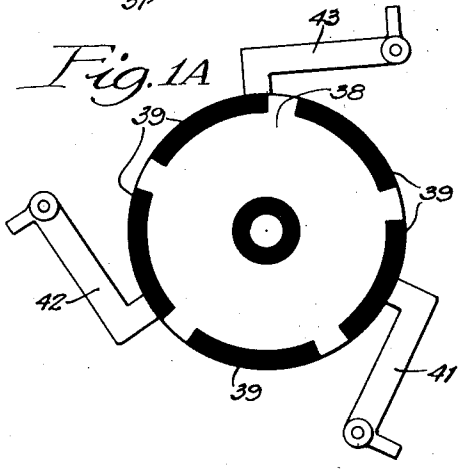
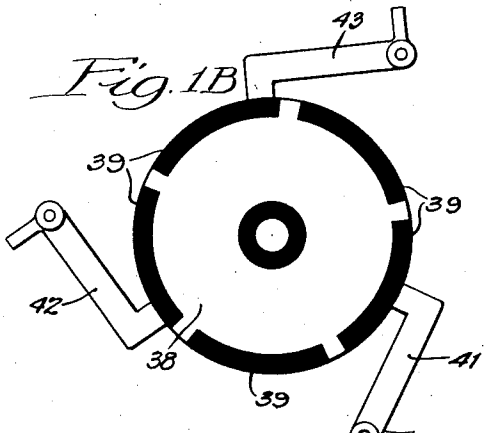


Fig. 1B



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UNITED STATES PATENT OFFICE

2,321,699

REMOTE INDICATOR AND CONTROL DEVICE

William J. O'Brien, Chicago, Ill., assignor to Edward F. Andrews, Chicago, Ill.

Application October 1, 1940, Serial No. 359,270

6 Claims. (Cl. 250—40)

This invention relates to remote indicating and control devices and particularly to indicators for such devices.

One of the objects of the invention is to provide an improved indicator for a remote control unit comprising means for initiating a change of condition of a mechanism at remote position, and an indicator controlled by said last mechanism for indicating at the remote control position response to said change of said mechanism.

A further object of the invention is to provide an improved remote control for remotely controlling devices through electrical connections.

A further object is to provide a remote indicator to indicate the frequency to which the set is tuned at a remote point by means of a stepping motor, the radio set being remotely controlled from a position adjacent the indicator by means of a mechanism other than a stepping motor, which is adapted to tune the set exactly to the frequency of stations received.

A further object is to provide an improved indicator motor.

A further object is to provide a stator element of such a motor upon which the coils can be wound cheaply and easily, resulting in an economical and advantageous motor.

Other objects, advantages, and capabilities of the invention will appear from the following description of preferred embodiments thereof, taken in conjunction with the accompanying drawings, in which

Fig. 1 is a diagrammatic view of a remote control unit applied to the condenser of a radio set and an indicator located remotely with respect to said set for indicating the tuning condition of the condenser;

Fig. 1*a* is a diagrammatic view of a modified form of commutator;

Fig. 1*b* is a diagrammatic view of a still further form of commutator;

Fig. 2 is a front view of an indicator unit embodying my invention;

Fig. 3 is a transverse sectional view taken therethrough, taken on the line 3—3 of Fig. 2;

Fig. 4 is a transverse section therethrough, taken on the line 4—4 of Fig. 3; and

Fig. 5 is a diagrammatic view illustrating the position of the coils and the wiring of the indicating unit shown in Figs. 2, 3, and 4.

Referring to the drawings, the reference numeral 10 designates the condenser of a radio set, the remainder of the set being indicated diagrammatically by the container 11. This particular radio set may correspond closely to the set described and claimed in the co-pending application of Edward F. Andrews, Serial No. 275,437, filed May 24, 1939.

The condenser 10 is adapted to be actuated in one direction or in the opposite direction by means of a reversible motor 12, which is connected to the condenser 10 through gears 13, 14, 15, and 16, the gear 16 being mounted on the shaft of the gang of condensers. The operation of the motor 12 is started at the remote control unit, which is designated generally by the reference numeral 18. Associated with this unit and preferably in close propinquity thereto is an indicator generally indicated by the reference numeral 19. As will readily be understood from the aforesaid application, the remote control unit 18 comprises a switch 20, whereby the volume of the set may be controlled, a switch 24 for initiating the drive of the motor 12, and an adjustable arm 25 for controlling the sensitivity of the automatic means for stopping the condenser 10 when a carrier of sufficient strength is received.

The indicator 19 comprises a dial 26 provided with suitable indicia and a pointer 27. The pointer 27 is mounted on the shaft 28, which carries the rotor 29 of a motor, designated generally by the reference numeral 30.

The rotor 29 is provided with a series of teeth equally spaced around its periphery. The rotor 29 is of a magnetic metal and is preferably constituted of laminations.

The shaft 28 is rotatably mounted on suitable members carried by a frame member 34. The frame member 34 carries at suitable positions around the rotor 29 three pole pieces 21, 22, and 23. Each pole piece is provided with a plurality of teeth directed towards and closely adjacent the teeth of the rotor 29. The teeth of each pole piece preferably correspond in size and spacing to the teeth of the rotor 29, the arrangement being such that all the teeth of each pole piece are adapted to register with corresponding teeth of the rotor 29. The teeth of the pole pieces are preferably displaced in different relation to the teeth of the rotor 29. Thus, the teeth of the pole piece 21, as shown in Fig. 1, are in alignment with the adjacent teeth of the rotor 29, while the teeth of the pole pieces 22 and 23 are out of alignment with the adjacent teeth of the rotor 29.

It is preferred that the teeth of the pole pieces 22 and 23 should overlap one-third of the adjacent teeth of the rotor 29 when the teeth of the pole piece 21 are in alignment with the adjacent teeth of the rotor 29. This overlap should occur on the sides of the teeth of the pole pieces

22 and 23 which are nearest to the pole piece 21. That is, the left hand one-third of the teeth of the pole piece 22 should overlap the adjacent teeth of the rotor 29 when the teeth of the pole piece 21 are in alignment with the adjacent teeth of the rotor 29. The pole pieces 21, 22, and 23 may suitably be of laminations of magnetic material. Each of the pole pieces 21, 22, and 23 is provided with a winding 31, 32, and 33 respectively. It will thus be seen that when the winding 32 is energized, the rotor 29 will move one step in the clockwise direction, as viewed in Fig. 1, whereas if the winding 33 is energized, the rotor 29 will move one step in the counterclockwise direction.

The gear 16 meshes with a pinion 35 carried by a shaft 36 which is rotatably mounted in a frame member 37. The shaft 36 has mounted thereon, with the aid of insulation, a commutator 38 which may suitably be a disc of metal provided with a peripheral series of insulating insets 39. An insulated brush 40 bears against the commutator disc at all times. Three brushes 41, 42, and 43 bear against the periphery of the commutator, these brushes being arranged to engage the commutator in different phase relation. The brushes are biased towards the commutator by means of suitable springs. The brushes 41, 42, and 43, respectively, are connected by conductors 51, 52, and 53, respectively, to the windings 31, 32, and 33, respectively. The other sides of these windings are connected to a common conductor 44, which is grounded at the set and is connected to one side of a battery 45 and to a condenser 46. The other side of the battery and the other side of the condenser are connected by a conductor 47 to the brush 40. This conductor 47 may include a choke coil 48 for a purpose hereinafter to be described. The reversible motor is provided with a common conductor 49 and two conductors 50 and 54 which are connected together through a condenser 55. The conductor 50 is connected to a contact 56, while the conductor 54 is connected to a contact 57. Each of the contacts 56 and 57 is adapted to be engaged alternately by the contact arm 58, which is connected to a conductor 59. An arm 60, rigidly connected to the switch arm 58, is adapted to be engaged by one or other of a pair of pins 61 or 62. These pins may suitably be mounted on the gear 16 so as to move the arm 58 from one to the other of the contacts 56 and 57 when the condenser attains its extreme position. Consequently, motor current supplied from the set 11 passes through conductor 49 and either of conductors 50 or 54 back to conductor 59 to drive the motor in one direction or the other, depending upon the position of the arm 58.

For the purpose of preventing interference with the receiving set, caused by the commutator, the commutator, the motor 30, and the cable, which includes the conductors 44, 51, 52, and 53, are surrounded by a grounded shield 64. The choke coil 48 and condenser 46 prevent any high frequency disturbance from passing out of the shielded system to the battery 45, or to any unshielded conductors from which it might be transferred to the receiving set. It will be understood that the control elements designated generally by the reference numeral 18 and the indicator 19 and motor 30 may be located in remote relation to the receiving set 11, the condenser 10, and the commutator 38. Thus, for example, the receiving set, including the condenser and associated element, may be located at the rear end of an automobile, the control element 18 may be located on the steering column, convenient to the hand of the driver, and the control 25 and the indicator 19 and motor 30 may be located on the dashboard. Also, the controls 20, 24, and 25, together with the dial 19 and motor 30, may be mounted in a single compact container and connected to the radio set and condenser 10 by means of a single cable containing all the necessary conductors.

The general control of the condenser 10 will be fully understood from the disclosure of the aforesaid application and need not be described here in detail. It suffices to say that when the switch 24 is closed momentarily, current is supplied through the circuit including conductors 49 and 59, and the motor is operated in one direction or the other until a station having sufficient carrier strength is received by the set 11. When that occurs, the motor 12 and condenser 10 are automatically arrested to tune in the station providing that carrier. When the switch 24 is closed again, the condenser 10 is driven in the same direction until another carrier is received and another station tuned in. This continues until the condenser reaches the end of its travel, whereupon the switch arm 58 is moved from one to the other of the contacts 56 and 57, and thereafter the condenser is moved from station to station in the opposite direction, tuning in the stations as before.

Assuming that the condensers are turning in the clockwise direction, as viewed in Fig. 1, the commutator 38 rotates in the opposite direction and the brushes 41, 42, and 43 are successively connected to the battery 45 in that order. Consequently, the poles 21, 22, and 23 are energized successively in that order and the rotor 29 is rotated in the clockwise direction in step with the movement of the condensers. When the condensers are driven in the counterclockwise direction, the brushes are connected to the battery in the order 41, 43, and 42, and the pole pieces are energized in the order 21, 23, 22, so that the rotor 29 is rotated step by step in a counterclockwise direction in synchronism with the movement of the condensers. The position of the condensers at any time is indicated by the position of the pointer 27 on the dial 26. It is to be noted that the indicator is self-synchronizing. Thus, assuming that the pointer 27 is out of synchronism with the condensers, being in advance of the condensers when moving in one direction, then before the condenser reaches its extreme position, the pointer 27 reaches its extreme position in that direction and engages the adjacent pin or stop 63. When the condensers reach their final position, the device is synchronized. Thus, all that is necessary to synchronize the indicator with the condensers is to drive the motor 12 to bring the condensers into one extreme position and then into the other extreme position.

In the embodiment of the invention shown in Fig. 1, the insulating insets 39 are of such length that at least one brush is always in engagement with the conductive disc 38, and that for part of the time, another brush may be in engagement with the conductive disc 38. Thus, as shown in Fig. 1, only the brush 41 is in engagement with the disc 38. Assuming the condensers to be rotated in the clockwise direction, the brush 42 engages the conductive surface of the disc 38 so that both brushes 41 and 42 are connected to the battery 45. Continued rotation of the condensers moves an insulating segment into engagement

with brush 41, leaving brush 42 alone connected to the battery. The brush 43, which has been in engagement with an insulating segment, now engages the conductive disc 38. Consequently, the pole piece 21 is energized, holding the adjacent teeth of the rotor 29 in alignment with its teeth. Thereafter, both pole pieces 21 and 22 become energized and the rotor makes a half step in the clockwise direction. Thereafter the pole piece 21 becomes de-energized so that the teeth of the rotor move a half-step into alignment with the teeth of the pole piece 22. Thereafter the pole piece 23 becomes energized and the teeth make a further half-step in the clockwise direction. Then the pole piece 22 is de-energized and the rotor 29 makes a further half-step to bring its teeth into alignment with the teeth of the pole piece 23, and so on, the rotor 29 rotating in the clockwise direction by half-steps.

In the embodiment shown in Fig. 1A, the insulating insets 39 are of sufficient length so that only one of the brushes 41, 42, and 43 is in engagement with the disc 38 at a time. Consequently, the pole pieces 21, 22, and 23 are energized individually in that order or in the opposite order so that the rotor 29 moves one step on each energization of one of the poles. In the embodiment shown in Fig. 1B, the segments 39 are still longer, so that in the intermediate positions of the commutator 39, no brush is in engagement with the metallic surface of the disc 38. In this embodiment of the invention, the poles 21, 22, and 23 are energized successively with intervals between successive energizations in which no pole is energized. In this embodiment of the invention, it is preferred to employ friction means to prevent movement of the rotor 29 and associated elements when no pole is energized. This friction means may suitably comprise a leaf spring 65 which bears lightly against the rotor 29.

For high speed operation, it is preferred to reduce the mass of the rotor as far as possible without too great an increase in its reluctance and to utilize the friction applied by the spring 65 to damp the rotor. For still higher speed operation, it is preferred to provide the rotor system with a frictionally mounted inertia member. This inertia member may suitably consist of a flywheel 70 loosely mounted on the shaft 28. The flywheel is in frictional contact with the rotor 29, being biased thereagainst by a coil spring 71 which abuts against a collar 72 mounted on the shaft 28. The flywheel 70 aids in preventing overstepping of the rotor, dissipating excess energy when the rotor is arrested. One or the other of these expedients may be employed to stabilize the motor when operated from an alternating current source instead of from the battery 45.

In Figs. 2, 3, 4, and 5 I show a modified form of indicator in which similar parts are designated by the same reference numerals. This indicator is mounted within a housing 34' provided with a window 66 for observation of the pointer 27 and dial 26. The housing also carries a flange 67 whereby it may be mounted on an instrument board or in other suitable locations.

In this modification, the spindle 28', preferably of magnetic material, is rotatably mounted in a hub member 68 which is rigidly mounted on the axis of the housing 34'. Thus a reduced end of the spindle 28' may project through a corresponding opening in the hub member 68. A bronze bushing 69 provides a bearing at the outer end of the hub member 68. The rotor 29 is rigidly mounted on the spindle 28' adjacent the bushing 51.

The hub member 68 is fixed to the pole system, the poles 21, 22 and 23 projecting radially outward from this hub member, their outer ends being turned upwardly into the plane of the rotor 29. These upturned ends are provided with teeth, two teeth in the embodiment shown, which are arranged to cooperate with the teeth of the rotor 29 in exactly the same way as in the previously described embodiment.

The windings 31, 32 and 33 are wound around the radial portions of the poles 21, 22 and 23, respectively, as diagrammatically shown in Fig. 5. These windings may therefore be built with great facility since the three radial arm structure provides easy access for the winding of the coil on each individual arm.

This embodiment of the invention differs from that shown in Fig. 1 in relation to the magnetic circuit. Thus, in the previously described embodiment, the magnetic circuit extended through the teeth from the pole piece on one side of each coil to the pole piece on the other side of that coil. In this embodiment of the invention the magnetic circuit extends through each radial pole member, radially through the rotor 29, and back through the spindle 28' and hub member 68 back to the radial pole member.

The windings 31, 32 and 33 are connected to conductors 51, 52 and 53 and to a common conductor 30. The shield may be employed as the common conductor.

The operation of the indicator shown in Figs. 2 to 5 is precisely similar to that of the indicator previously described. It will be understood that the spring 65 and/or the frictional inertia flywheel 70 may be applied to these embodiments, if desired.

It will be understood that the rotor 29 is preferably provided with a large number of teeth to insure an accurate indication. The effective number of teeth on the rotor, that is, the teeth which register with any tooth of a pole piece, should be equal to the number of conductive portions of the commutator engaged by any brush during the travel of the device whose condition is being indicated from one of its extreme positions to the other. The commutator may be provided with any number of conductive portions, depending upon the manner in which it is connected to the device whose position is to be indicated. This connection may be direct or through gearing, as shown in Fig. 1. It is also preferable, for reasons of economy and accuracy, that the number of teeth on the rotor should be very large relative to the three poles employed on the stator. Thus, in Fig. 1, I have shown the rotor provided with twenty-eight teeth. It will of course be understood that if more accurate indication is desired, the number of teeth may be very greatly increased. In this event, it will of course be understood that the commutator 38 is correspondingly changed to provide the increased number of impulses, from one end of the range of travel to the other, necessary to operate the indicator to its full extent.

Although the invention has been described in connection with specific details of preferred embodiments thereof, it must be understood that such details are not intended to be limitative of the invention except insofar as stated in the appended claims.

Having thus described my invention, what I

claim and desire to secure by Letters Patent of the United States is:

1. In combination, a radio device having tuning means adapted to tune desired stations to resonance and operable in opposite directions between predetermined limits, a reversible motor for driving said tuning means in opposite directions, means including a motor controlling reversing switch operated in response to the position of said tuning means for reversing the direction of movement of said tuning means at its limits of movement, a remote manual control for starting said motor, means operable in response to received signals for automatically arresting said motor when said tuning means is positioned to tune in a station, a tuning indicator located adjacent said remote control, a motor driving said tuning indicator, means operable in response to the movement of said tuning means for driving said last-mentioned motor in opposite directions in synchronism with said tuning means, and means including means limiting movement of said indicator at limits corresponding to limits of movement of the tuning means for automatically positionally synchronizing said indicator with said tuning means, in case it should be out of synchronism, upon movement of said tuning means to both its limits, whereby automatic synchronization of said indicator is insured when said tuning means is operated by its driving motor during the tuning in of stations.

2. A stepping motor for synchronous operation comprising a field frame having three radial arms, the outer end of each arm being bent through substantially a right angle to form a pole piece, a winding on each arm, a magnetic rotor mounted in the center of said field frame, said rotor having a series of peripheral teeth in close proximity to said pole pieces, said teeth being out of phase relative to said pole pieces by progressive increments in both directions, and complementary bearing means on said frame and rotor providing a narrow air gap for the passage of magnetic flux induced by said windings between the center of the field frame and the rotor.

3. A stepping motor for synchronous operation comprising a field frame having three radial arms, the outer end of each arm being bent through substantially a right angle to form a pole piece, a winding on each arm, a magnetic rotor mounted in the center of said field frame, said rotor having a series of peripheral teeth in close proximity to said pole pieces, said teeth being out of phase relative to said pole pieces by progressive increments in both directions, complementary bearing means on said frame and rotor providing a narrow air gap for the passage of magnetic flux induced by said windings between the center of the field frame and the rotor, and means for limiting the movement of said rotor.

4. A stepping motor comprising a field frame having at least three radial arms, the outer end of each arm extending at substantially a right angle relative to the radial portion to form a pole piece, a winding on each arm, a magnetic rotor mounted in the center of said field frame, said rotor having a series of peripheral teeth in close proximity to said pole pieces, said teeth being out of phase relative to said pole pieces by progressive increments in both directions, and complementary bearing means on said frame and rotor providing a narrow air gap for the passage of magnetic flux induced by said windings between the center of the field frame and the rotor.

5. A stepping motor comprising a field frame having at least three radial arms, the outer end of each arm extending at an angle relative to the radial portion to form a pole piece, a winding on each arm, a magnetic rotor mounted in the center of said field frame, said rotor having a series of peripheral teeth in close proximity to said pole pieces, said teeth being out of phase relative to said pole pieces by progressive increments in both directions, and complementary bearing means on said frame and rotor providing a narrow air gap for the passage of magnetic flux induced by said windings between the center of the field frame and the rotor.

6. A stepping motor comprising a field frame having at least three radial arms, the outer ends of which form pole pieces, a winding on each arm, a magnetic rotor having a series of peripheral teeth, the rotor teeth and the outer ends of the radial arms being angularly disposed in enveloping relation to each other and in close proximity to each other and the rotor teeth being out of phase relative to said pole pieces by progressive increments in both directions, and complementary bearing means on said frame and rotor providing a narrow air gap for the passage of magnetic flux induced by said windings between the center of the field frame and the rotor.

WILLIAM J. O'BRIEN.