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TRANSMITTER POWER CONTROL

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Fig. 2

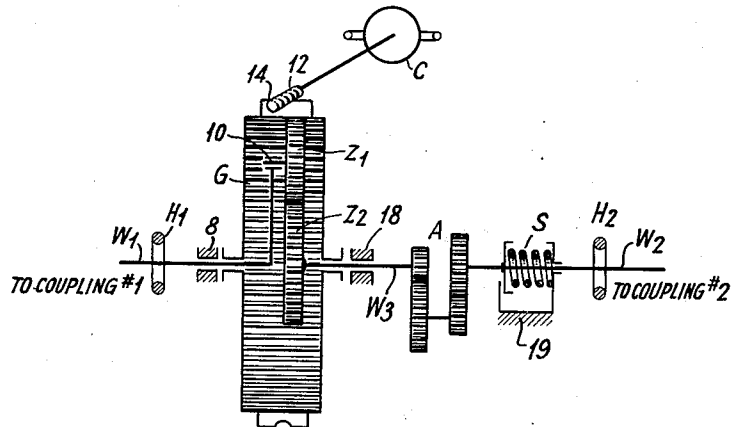
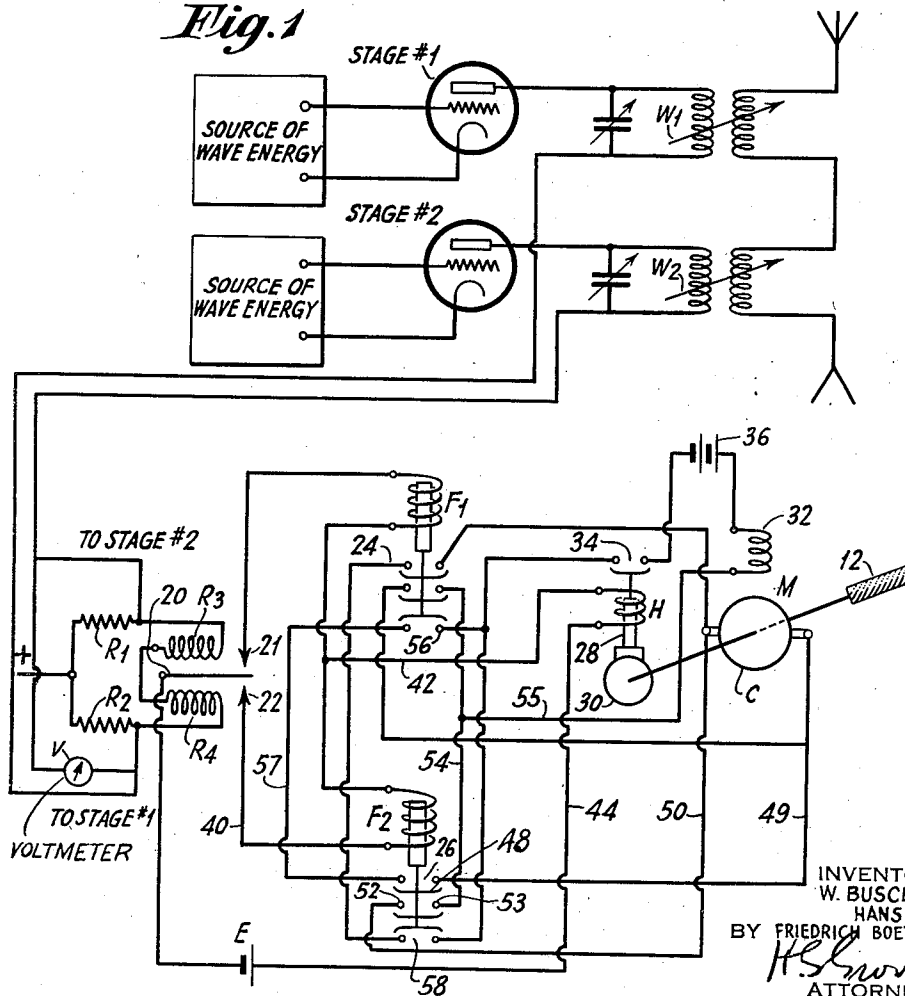


Fig. 1



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TRANSMITTER POWER CONTROL

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9 Claims. (Cl. 250—17)

In order to raise the power of transmitters, it is customary to run several transmitter tubes in parallel. However, the method of paralleling tubes has only a limited application because of incidentally arising difficulties such as total capacity and impedance etc. This holds good particularly for short-wave transmitters. One feature particularly disadvantageous and troublesome is the self-capacitance of the paralleled tubes which renders the production of short waves extremely difficult. Another disadvantage is that, if a relatively great number of tubes are operated in parallel relation, exact symmetry in electrical respect is not possible because this requires that the length of the leads be as short as possible and they cannot be kept short where numerous tubes are put in parallel.

For this reason, particularly where short waves are dealt with, it has become more general practice to arrange transmitters of large power so that two or more distinct transmitter stages are connected in parallel. These parallel stages are either directly, and this is the preferable plan, or else by way of input stages are excited from a joint master oscillator or amplifier tube or amplifier modulator tube. In order to insure a satisfactory efficiency, and in order that the utilization of the power of the tubes may be made as high as feasible, it is necessary that the paralleled transmitter tubes carry exactly equal loads. A measure of the loads of the several stages is in this case, the value of the plate direct current drawn thereby.

Now, according to this invention, for checking up on the load distribution of the various transmitters, we measure the difference in current intake of the several parallel stages.

We also use the difference in power or current drawn by the transmitters to produce indications of the difference and to actuate means for re-adjusting the parallel stages so that they draw equal amounts of power.

In describing our invention reference will be made to the drawing wherein Figure 1 shows a circuit means for producing indications of the difference in power drawn by different circuits which may supply parallel transmitters and for producing energy characteristic of said difference and using the same to re-adjust said transmitters, while

Figure 2 shows details of one means for adjusting the amount of power drawn by said transmitters by adjusting the load on said transmitters.

Figure 1 shows an exemplified embodiment of the idea applied to the potential supply circuit of two transmitters. The scheme is here predicated upon a comparison of the falls of potential across equal resistances R_1 and R_2 inserted in the leads to the parallel transmitters

shown schematically as including stages #1 and #2 coupling a source of wave energy to a radiating system. The voltmeter V is preferably of the type with right hand and left hand deflection readings, and it may be calibrated to read directly in terms of amperes of the differential current flowing in R_1 and R_2 . Under normal operating conditions, when both transmitters have the same current intake, the said instrument V will register no deflection and its pointer will take up a mean zero position. But if, for any reason at all, there arises a dissymmetry in the load flowing in R_1 and R_2 which manifests itself in a deflection and reading of the instrument V , it will be necessary to change the adjustment of one or of both transmitters in such a way that both draw the same amount of current and the dissymmetry disappears. The transmitters may be regulated as to any of their operating characteristics. In a preferred modification we adjust the coupling between the antenna and the output circuit of one or both of the transmitters. This coupling may be of any type such as, for example, adjustable inductive couplings as illustrated between the transmitter stage outputs and the aerial. For this purpose, the drive mechanisms of the antenna couplings of both transmitters, which normally insure simplification of operation and manipulation are fixedly connected with each other, must include disengaging means in order that the several couplings may be set independently of each other to put equal loads on the several stages.

A further development, and a further object of the invention is that the relative adjustment of the drives of both antenna couplings is made automatic in action, and this is accomplished, for instance, by a circuit including the circuit arrangement shown in Figure 1 cooperating with a control circuit and a novel drive mechanism. An exemplified embodiment of the coupling controlling mechanism and controlling circuit is illustrated in Figure 1, while one embodiment of the drive mechanism for the adjusting means has been shown in detail in Figure 2.

Referring to Figure 2, two driving shafts W_1 and W_2 for the antenna coupling means of any type are inter-coupled by an equalizing gear system which in this instance, consists of a planetary gear system. The shafts W_1 and W_2 correspond to controls W_1 and W_2 of Figure 1. Shaft W_1 supported at 8, in turn, supports in an arm 10, the bearing for the tooth-wheel Z_1 which meshes with the second tooth-wheel Z_2 and the internal teeth of the casing G . The casing G which may be driven by motor C acting on gear elements 12 and 14 on the outer

periphery of G is supported by shaft W₁. Z₂ is supported by shaft W₃. Shaft W₃ is supported at 18. Shaft W₃ is connected through reduction gearing A to a shaft W₂ connected to the coupling means between a second transmitter and the antenna. As long as G is locked, rotation of W₁ in a positive manner results in rotation of shaft W₂ in the same sense or direction. The gearing A insures that the same speed is established between W₁ and W₂. At the same time, A may be used for a transient disengagement between W₁ and W₂ in order that both shafts and couplings may be moved separately from each other, say, by the agency of hand wheel H₁ and H₂. The gears in A are normally kept in mesh by action of spring S and support 19. Pressure on H₂ in a direction to the right will disengage gears A. Rotation of the drives for shafts W₁ and W₂ relative to each other to regulating the load distribution over both transmitters is effected by turning the casing G. In the exemplified embodiment shown in Figure 2, a self-locking worm gear 12 and 14 is provided for the movement of G. The worm 12 is driven by a motor armature C capable of rotation in either direction under the control of the differential current when the stages operate at different loads.

Figure 1 also illustrates the wiring circuit for the driving motor C connected with the gear case G, the motor being in this instance of the series-wound type and being connected with a gear 12 as shown in Figures 1 and 2 which meshes with gear 14 as shown in Figure 2. The relay is fundamentally actuated in the same manner as the volt-meter V of Figure 1.

The voltmeter of Figure 1 is supplemented by a contact closing device comprising reactors R₃ and R₄ connected with the supply leads to transmitter stages numbers 1 and 2 and with the resistors R₁ and R₂ in series with said leads. Differential currents in these resistors act on the reactors R₃ and R₄ to control the position of the armature 20 so that in the presence of unequal loads in the parallel transmitters either contact 21 or 22 is closed. Contacts 21 and 22 are connected through the windings of solenoids F₁, F₂, the armatures of which are connected to multiple switches 24 and 26. Contacts 21 and 22 are also in circuit with a solenoid H, the armature 28 of which is connected to a wheel 30 connected with the armature C of a series wound motor M for driving the casing G by way of worm drive 12. The breaking mechanism 28, 30 is normally engaged to hold the armature C from rotation and thereby fix the position of the casing G. The solenoid winding H and one of the windings F₁, F₂ are energized by the closing of contacts 21 and 22. The energizing circuit includes a source E. The field winding 32 of motor M is in a circuit which, when completed by one of the switches 24 or 26 and the switch 34 controlled by H, includes a source of energizing potential 36. When a differential current flows in R₁ and R₂ one of the switches 21 and 22 is closed. If 22 is closed the solenoid winding F₂ and the solenoid winding H are placed in series with the source E by circuit 22, 40, F₂, 42, H, 44, E, and 22. The solenoid winding H disengages the breaking mechanism 28, 30 and the solenoid winding F₂ closes the contacts of switch 23. This completes a circuit through the armature C and field winding 32 as follows: Contact 43, lead 49, armature C, lead 50, contact 52, contact 53, leads 54 and 55, field winding 32,

source 36, contact 34 which is now closed, contact 56 normally closed when F₁ is de-energized, and lead 57, back to contact 48. This energizes the motor M to rotate the gear 12 in one direction to thereby drive casing G and produce relative rotation between the shafts W₂ and W₁. This, in turn, adjusts the couplings between the antenna and the parallel transmitter stages in a sense to insure that the several stages draw equal currents or use equal power. When the adjustment has been made the currents in R₁ and R₂ are equal. The windings R₃ and R₄ are energized equally and the armature 20 returns to zero position at which F₂ is de-energized, switch 26 is open and the breaking mechanism 28 and 30 is permitted by H to become engaged to hold the casing G stationary.

Circuits through the windings F₁ and F_H are in a like manner completed to rotate the motor M in the opposite direction when the contact 21 is closed. It is thought unnecessary to trace these circuits and describe this operation since the circuits and operation will be apparent from the detailed description of the circuits completed and the operation of the system when the circuits are completed by the closing of 22.

Thus, the current flow in R₃ or R₄ closes control 21 and energizes F₁ or else contact 22 and energizes F₂ to complete the circuit of the auxiliary source E which energizes the brake lift magnet H. Contactors or relays F₁ and F₂ each have working contacts described above and rest contacts 56 and 58. The circuit arrangement and wiring as here shown results for both contactors in opposite directions of rotation and prevents short-circuiting of the armature C, with simultaneous lift of both contactors F₁ and F₂. In order to reduce the coasting period of motor M prior to stop, the motor is fitted with the brake 28 and 30. Disengaging of this brake also completes the motor circuit through 36 so that the motor can start immediately. By the aid of this scheme, conditions in actual operation are made so that the motor will be fed with current only when the brake is disengaged. If desired, two single-action relays may be used in lieu of the double-action relay D.

Where more than two parallel-connected stages are dealt with, a load distribution device is preferably disposed between each pair of transmitter stages. And in order that simultaneous adjustment of all stages may be made feasible, all of the stages could be made dependent upon one and the master stage which is uninfluenced by the sense of balancing in that between each regulated stage and the master stage a distinct load distributor device is connected.

We claim:

1. In a transmitting system comprising a load circuit and a plurality of transmitter stages adjustably coupled thereto, means for producing currents characteristic of the difference between the currents supplied by said stages to said load circuit and means connected with said last named means for automatically adjusting said couplings so that said transmitter stages each supply substantially equal currents to said load circuit.

2. In a transmitting system comprising a load circuit and a plurality of transmitter stages adjustably coupled thereto, means for producing direct currents characteristic of the difference between the energies supplied by said stages to said load circuit and automatic means connected with said last named means and with said couplings for automatically adjusting said couplings

so that said transmitter stages each supply substantially equal energies to said load circuit.

3. In a transmission regulating system a load circuit, a plurality of sources of alternating current variably coupled to said load circuit, controlling means connected with said variable coupling means for controlling the amount of coupling to thereby control the amount of alternating current supplied by each source to said load circuit, circuit means coupled with said sources for producing direct currents characteristic of the difference in amounts of alternating currents supplied by each source to said load circuit and relay means coupling said circuit means to said controlling means for adjusting said couplings so that said sources supply substantially equal alternating currents to said load circuit.

4. In a transmission regulating system a load circuit, a plurality of sources of alternating current each variably coupled to said load circuit, common control means connected with each of said coupling means for controlling the amount of coupling to thereby control the amount of alternating current supplied by each source to said load circuit, circuit means coupled with said sources for producing direct currents of a polarity characteristic of the difference in amounts of currents supplied by each source to said load circuit and energizing circuits and relay means therein connected with said circuit means, and to said control means for adjusting said couplings in accordance with said direct current polarity so that said sources supply equal currents to said load circuit.

5. In a transmission regulation system, a load circuit, a plurality of sources of alternating current, variable coupling means between each of said sources and said load circuit, individual driving means for each of said variable coupling means, a motor, a gearing system coupling all of said driving means together adapted to be driven by said motor, a circuit connected with all of said sources, means in said circuit for producing a differential direct current when said sources supply different amounts of currents to said load circuit, a contact closing device connected with said last named means, a normally de-energized solenoid winding controlling a braking means for said motor, a plurality of normally open switching relays, energizing circuits including the contacts associated with said contact closing device for said winding and switching relays said contact closing device being adapted to close certain of said energizing circuits when energized by differential direct current to thereby energize said braking relay and complete circuits through said motor and drive said motor to adjust said coupling so that each source supplies equal alternating current to said load circuit.

6. In a transmission regulation system, a load circuit, a plurality of sources of alternating current, variable coupling means between each of said sources of said load circuit, individual driving means for said variable coupling means, a motor, a gearing system coupling all of said driving means together and connected to said motor, a circuit connected with all of said sources, means in said circuit for producing a differential current when said sources supply different amounts of currents to said load circuit, a contact closing device connected with said last named means, a normally de-energized relay comprising a solenoid controlling a braking means for said motor,

a plurality of normally open switching relays, circuits including contacts associated with said contact closing device and energizing sources for said solenoid and switching relays, one or more of said circuits being closed by said contact closing device when different amounts of currents are supplied to said load circuit to thereby energize said braking relay, and energizing circuits including the switches of said switching relays to rotate said motor in a direction determined by the polarity of said differential current.

7. In a transmission regulation system, a load circuit, a plurality of sources of alternating current, variable coupling means between each of said sources of alternating current and said load circuit, driving means for said variable coupling means, a motor, normally open energization circuits therefor, a gearing system coupling all of said driving means together and to said motor, means connected with all of said sources for producing a differential direct current when said sources supply different amounts of alternating current to said load circuit, and circuit closing means interposed between said last named means and said normally open motor energization circuits and energized by said differential direct current for closing one of said normally open motor energization circuits when said sources supply different amounts of alternating current to said loads to operate said motor to adjust said coupling so that each source supplies substantially equal alternating current to said load circuit.

8. In a transmission regulating system a load circuit, a plurality of sources of current variably coupled to said load circuit, gearing means connected with said coupling means for controlling the amount of coupling to thereby control the amount of current supplied by each source to said load circuit, normally inoperative driving means connected with said gearing means, circuit means coupled with said sources for producing currents of an intensity characteristic of the difference in amounts of currents supplied by each source to said load circuit and means coupling said circuit to said driving means to control the operativeness thereof for adjusting said couplings so that said sources supply equal currents to said load circuit.

9. In a transmission regulating system a load circuit, a plurality of sources of alternating current each variably coupled to said load circuit, controlling means connected with each of said coupling means for controlling the amount of coupling to thereby control the amount of alternating current supplied by each source to said load circuit, means for normally holding said controlling means relatively fixed, circuit means coupled with said sources for producing direct currents of a polarity characteristic of the difference in amounts of currents supplied by each source to said load circuit and energizing circuits and relay means therein connected with said circuit means and said holding and controlling means and responsive to a different current for releasing said means for normally holding said controlling means relatively fixed and for adjusting said couplings in accordance with said direct current polarity so that said sources supply equal currents to said load circuit.

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