

March 6, 1934.

L. A. GEBHARD ET AL
COUPLING CONDENSER SYSTEM

1,950,237

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2 Sheets-Sheet 1

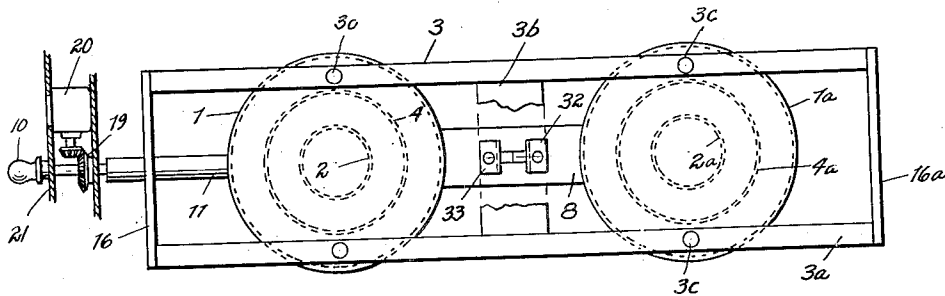


Fig. 2

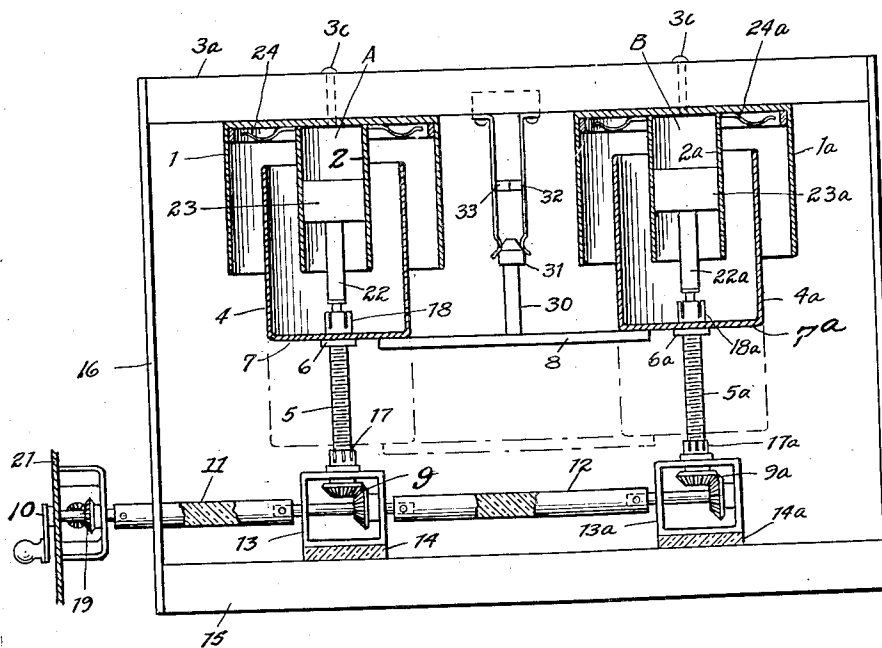


Fig. 1

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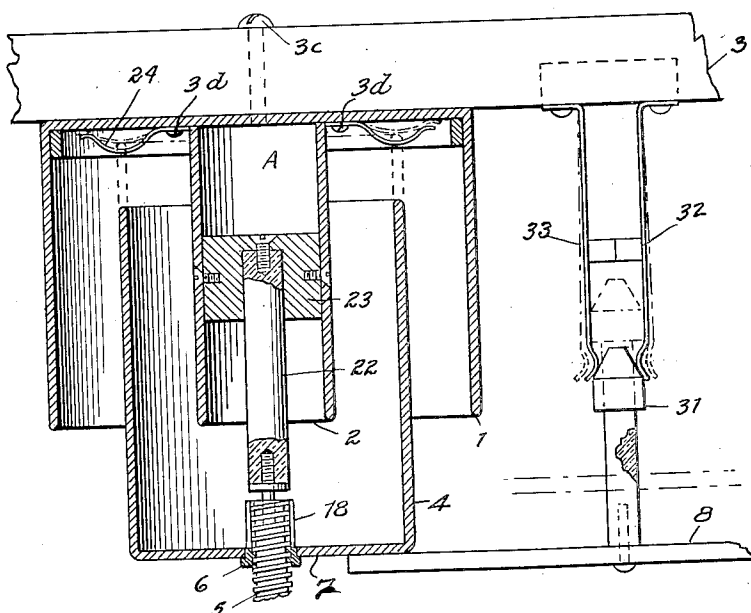


Fig. 3

Fig. 4

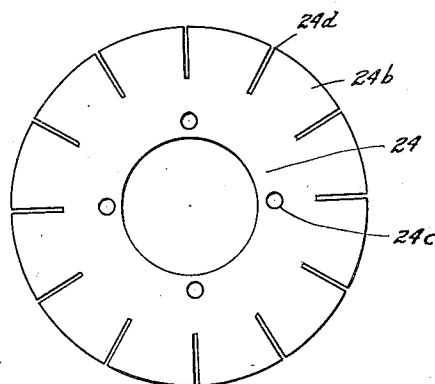
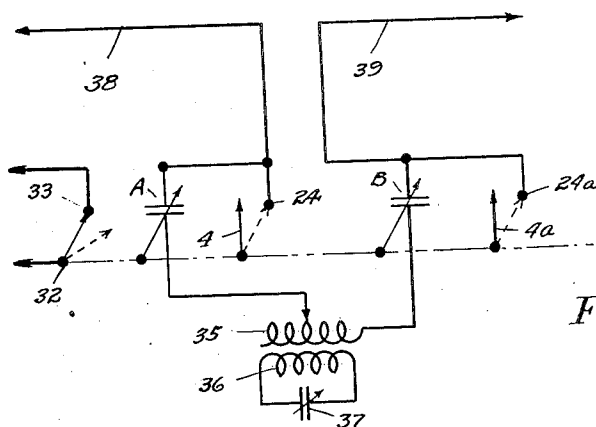


Fig. 5

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COUPLING CONDENSER SYSTEM

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6 Claims. (Cl. 175—41.5)

Our invention relates to electrical adjustable condensers employed in signaling systems.

An object of our invention is to provide a condenser system adapted to control the type and degree of coupling between two circuits.

Another object of our invention is to provide an adjustable coupling condenser system whereby high frequency electrical energy may be selectively associated with an antenna by either voltage or current transfer of energy.

Still another object of our invention is to provide a coupling condenser system wherein two or more circuits may be coupled selectively by voltage or current transfer of energy whereby such selection is accomplished by a single control.

A further object of our invention is to provide a condenser suitable to be employed in circuits where the flexibility of such circuits for certain operations requires the capacity of such condenser to be of relatively small value.

A still further object of our invention is to provide certain structural features of an adjustable condenser whereby the normal insulation between the plates is relatively high and whereby a certain predetermined adjustment of said condenser effects a relatively low resistance between such normally insulated plates.

A better understanding of our invention can be had from the description following and from the accompanying drawings, wherein:

Figure 1 is a side view in section of the condenser of our invention; Fig. 2 shows a top plan view; Fig. 3 shows a part section of one unit employed in the condenser of our invention; Fig. 4 shows a part of the condenser system of our invention in greater detail; and Fig. 5 is a schematic circuit diagram showing the operation of the coupling condenser system of our invention.

In high frequency transmitters designed to be operated over a relatively wide band of frequencies, it is necessary that the antenna and the coupling to the antenna be proper to admit efficient operation on all of the frequencies employed. It has been the practice heretofore in the art to employ loading inductances or capacities in the antenna to obtain the desired operational characteristics for frequencies other than the fundamental frequency characteristics of the antenna. Antenna systems may be of very simple design such as a single vertical wire or of the "doublet" type where the antenna proper is divided and the energy transferred to the individual sections.

In the latter type of antenna, two lead in conductors are employed which conductors are associated with the source of high frequency energy such as the output circuit of the transmitter either conductively, inductively, or capacitively. It is known that by employing inductance coils or condensers in series with the antenna, the frequency characteristics of the antenna circuit are changed. This applies not only to an antenna circuit but to other circuits as well. By inserting inductance, the antenna circuit may be caused to have a much lower frequency than the frequency of the antenna alone. By inserting a condenser in series with the antenna, the antenna circuit may be caused to have much higher frequency characteristics than the frequency characteristics of the antenna alone. When the antenna is operated at the fundamental frequency of the circuit, the reactance is zero, the resistance is a minimum and the current a maximum. It is therefore desirable to provide an antenna and coupling circuit adapted to be controlled in accordance with the frequency to be transmitted. The coupling condenser system of our invention provides the desired flexibility of control whereby efficient operation is possible over a wide band of frequencies. While the adjustable condenser of our invention is especially adapted to antenna circuits, nevertheless other applications of the condenser may be employed to advantage.

Fig. 1 of the accompanying drawings shows a side elevation of the coupling condenser system of our invention. The stationary plates of the condenser comprises cylinders 1, 1a, 2 and 2a. The movable or adjustable plates comprise cylinders 4 and 4a. Two individual condenser units designated as "A" and "B", are electrically insulated from each other and both supported on insulating bars 3 and 3a. Cylinder 4 is movable axially by threaded rod 5, engaging with threaded bushing 6 provided in cylinder head 7. Cylinder 4a is likewise movable axially by threaded rod 5a engaging with threaded bushing 6a provided in cylinder head 7a. Cylinders 4 and 4a are mechanically connected by insulating member 8. Threaded rods 5 and 5a are mechanically connected at their lower ends by bevel gears 9 and 9a, respectively, to insulating shaft 12. The ends of threaded rods 5 and 5a and gears 9 and 9a rotate in bearing boxes 13 and 13a, respectively. Shafts 12 and 11 are connected mechanically but insulated electrically. Bearing boxes or frames 13 and 13a are mounted on insulating parts 14 and 14a. Insulating members 14 and 14a are in turn mounted on frame member 15. Frame

member 15 extends between front and rear panels 16 and 16a, the latter attached also to insulating frame member 3. Electrical connection is established with movable plate 7 by brushes at 17 and 18 bearing against rod 5. Likewise electrical connection is established with movable plate 7a by brushes 17a and 18a bearing against rod 5a. Rods 5 and 5a and cylinder plate members 7, 7a, 1, 1a, 2, 2a are of suitable metallic material having a relatively low electrical resistance. Crank 10 extends through panel 21 and is engaged with insulating shaft 11. Bevel gears 19 are carried by the connecting member between crank 10 and shaft 11.

Parts 23 and 23a are carried by members 22 and 22a, respectively, which latter are carried by threaded rods 5 and 5a, respectively, serving as bearings therefor. Members 22 and 22a are lengths of insulating material. In the bottom of cylinders 1 and 1a are provided annular shaped metallic brushes 24 and 24a positioned in such a manner as to engage with the upper edges of cylinders 4 and 4a respectively when the cylinders are adjusted to the position of maximum capacity. Brushes 24 and 24a serve as electrical contacts establishing a low resistance connection between plates 1, 4 and 1a, 4a, respectively. An insulating arm 30 is carried by member 8, the former having an enlargement as shown at 31. Contact members 32 and 33 are attached to insulating member 3b in such a manner as to be in line with the movement of arm 30. Contact members 32 and 33 are adapted to engage with the enlarged portion 31 of rod 30 whereby an external electrical circuit is controlled in accordance with the condenser adjustments. This external electrical circuit may include a warning signal or other indicating device or may be associated with the transmitter control circuits whereby the transmitter is caused to be inoperative when a certain adjustment of capacity is effected and the resistance is caused to be of a low order and whereby the transmitter is again energized after the low resistance circuit of the condenser is established.

Fig. 2 of the accompanying drawings shows a top plan view of the coupling condenser system of our invention. Corresponding reference characters are employed in all the drawings. Fig. 2 shows counter mechanism 20 associated with bevel gears 19. Counter mechanism 20 is visible through panel 21, the turns indicated corresponding to the relative capacity adjustment of the condenser. This provides an improved method for indicating and determining adjustments of capacity. The numbers indicated may be recorded and the setting necessary to produce a certain capacity adjustment may be reproduced by again setting the adjusting mechanism to the correct number.

Fig. 3 shows a part section of the condenser in detail corresponding to unit A or B of Fig. 1. Cylindrical plates 1, 2 and 4 may be of any suitable metal such as aluminum, brass or the like. The closed end of cylinder 4 is provided with a nut or threaded bushing 6 of metal with which the threaded portion of shaft 5 engages. Brushes 18 are of suitable metallic material having low electrical resistance. Brushes 18 bear against shaft 5 and establish an electrical connection of low resistance between cylinder 4 and shaft 5. Insulating member 22 is of sufficient length to keep the effective capacity of the parts small. Brushes 24 are shown mounted in a recess in the closed end of cylinder 1 in such a manner as to

be in contact with the open edge of cylinder 4 when the normal position for approximately maximum capacity adjustment is obtained.

Brushes 24 are shown in greater detail in Fig. 4 of the accompanying drawings. The brush in its entirety comprises an annular shaped member of suitable metal such as spring brass, phosphor-bronze or any other metal or alloy. The annular shaped member is provided with radially cut slots 24d dividing the member into a plurality of sectors 24b. Holes 24c are provided by means of which member 24 may be secured to the closed end of the stationary cylinder by machine screws 37 shown in the foregoing figures. Member 24 may however be permanently attached to the cylinder by soldering, brazing or welding. Since it may be desirable to replace member 24 or adjust the resilient properties thereof it is advisable to attach the same by means of screws. As shown particularly in Fig. 3, brushes 24 are so constructed and mounted that they present to the ends of the movable cylindrical plates a curvilinear surface of large radius of curvature, so that at high voltages discharges from points and edges are avoided.

Fig. 5 is a schematic circuit diagram representing the coupling condenser system of our invention and certain operational features thereof. The two condenser units are designated as units A and B; brush contact members 24 and 24a and arms 4 and 4a representing the electrical contacting means which are engaged when the adjustments are those of normally maximum capacity. A circuit comprising inductance 36 and capacity 37 represents the source of high frequency energy or radio transmitter.

Inductance 35 is inductively related to inductance 36 whereby the energy from circuit 36—37 is transferred to antenna system 38—39. The antenna circuit includes branches 38 and 39 and the lead wires therefrom, units A and B and inductance 35. Under normal operations with the adjustment shown, assuming the frequency from source 36—37 to be twice the fundamental frequency of the antenna circuit, the furthestmost ends of antennas 38 and 39 would be of maximum potential and minimum current. It is also true that should the frequency of the energy from source 36—37 change, a change in the energy distribution along antenna 38—39 would result. To maintain the proper distribution it is therefore necessary to change the frequency characteristics of the antenna circuit. This change is accomplished by changing the value of capacity of condenser units A and B. The coupling condenser system is normally employed with a doublet antenna connected to a transmission line. The antenna system is so adjusted that the period of oscillation corresponds to some multiple of quarter wave length operation at a certain frequency. Let us say that the point corresponds to three quarters wave length which in this case would require a large current at the transmitter end of the transmission line. This would require a type of coupling containing inductance without series capacity and in this case the condensers would be short-circuited. As the frequency adjustment of the transmitter is increased, the physical dimensions of the antenna system remaining the same, a point would be reached where the current required at the end of the transmission line would be small but the voltage would be large. To obtain proper coupling the condensers must now be inserted in the circuit and therefore affording control of the coupling. Should the

frequency adjustment of the transmitter be further increased, the coupling system functions through successive periods of current and voltage feed as each harmonic of the antenna system is passed and the condensers are connected out of and into the circuit. In this manner, a large range of frequencies may be employed using only a given antenna system.

The minimum frequency adjustment of the transmitter is obtained by providing a low-resistance short circuit across units A and B. This is obtained by means of switches 4—24 and 4a—24a, respectively. This short circuiting is actually accomplished by adjusting the movable plates to approximately the normal positions of maximum capacity. Contacts 24 and 24a represent the annular shaped metallic members attached to the closed ends of cylinders 1 and 1a respectively and shown in detail in the foregoing figures. By adjusting the condenser to approximately the position of maximum capacity the capacitive reactance is made very small and normal distribution of energy in the antenna circuit is made possible. Due to the fact that for certain frequencies with a given antenna it is necessary to employ voltage feed and for certain other frequencies it is necessary to employ current feed, it is obvious that the coupling condenser of our invention provides a coupling system of sufficient flexibility to meet the requirements. The change in frequency characteristics of the transmitter necessitates a change in the coupling whether current feed or voltage feed, to maintain the proper distribution of energy in the antenna circuit and thereby radiate the greatest amount of energy. When voltage feed is used the coupling to antenna 38—39 is by means of the capacity provided by condenser units A and B. When the frequency of the generated energy from source 36—37 is changed the capacity of units A and B must be changed accordingly.

Auxiliary contact members 32—33 may be actuated by the adjustment of the movable plates and these contact members connected with the control circuit of source 36—37 or any suitable indicating circuit. Fig. 5 shows an arrangement whereby the transmitter is deenergized shortly before the circuits between 4—24 and 4a—24a are completed, as shown by the full line positions of the switches, the contacts 32—33 being connected to deenergize the control circuit of source 36—37. As shown by the dotted lines, further adjustment establishes circuits between 4 and 24 and between 4a and 24a, and simultaneously members 32—33 are actuated thereby starting the transmitter. Contact members 32—33 may be adjustably mounted whereby the source may be deenergized just prior to the voltage breakdown between members 4, 4a and 24, 24a.

Referring to the foregoing figures it is obvious that many modifications are possible. When certain types of antenna systems are employed either unit A or B may alone be employed. Spring contact members 24 and 24a shown in Fig. 4 may be designs differing from that shown. The radial slots provided in the annular ring permit flexing of the spring whereby the same establishes a low resistance contact with the movable cylindrical plate engaging therewith. Units A and B may be adjusted simultaneously with adjustments in the frequency characteristics of the source of high frequency energy by providing mechanical means interconnecting the units A

and B with the frequency adjusting means of the transmitter proper.

By employing the arrangement for obtaining the low resistance path in accordance with the condenser system of our invention, many advantages are obtained. Should an external switch member be provided, actuated by the movement of the adjustable plate members, considerable loss of efficiency would result in that connecting wires would be necessary. To avoid the necessity of employing connecting wires between the condenser plates and the switching mechanism, it would be necessary to attach the switching members directly to the plates. Referring to Fig. 3 of the accompanying drawings, it is obvious that annular shaped contact member 24 may be of the proper dimensions and attached to the closed end 7 of cylinder 4 in such a manner as to contact with the open end of cylinder 2 when normal adjustments of maximum capacity are effected. In either case, member 24 is mounted inside one of the cylinders where it would be least affected by climatic conditions and where it will not introduce any sharp corners for potential concentration. An obstruction of metal may be mounted on cylinder 4 in such a manner as to contact with the open edge of cylinder 1. This would result in voltage concentration at the switching members which is to be avoided in high frequency signaling systems.

We realize that many modifications of our invention are possible without departing from the spirit of our invention and it is to be understood that the embodiments of our invention are not to be restricted by the foregoing specification or by the accompanying drawings but only by the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a condenser structure, a frame having upper and lower portions, stationary inner and outer cylindrical condenser plates connected with the upper portion of said frame, said plates being disposed concentric to each other and closed at their upper ends and open at their lower ends, an annular brush between the upper ends of said plates having resilient radially extending bowed arms, a movable cylindrical plate closed at its lower end and extending upwardly between the stationary plates concentric thereto, and means to shift the movable plate vertically into and out of position for its upper edge to contact with the resilient arms of said brush.

2. In a condenser structure, a frame having upper and lower portions, stationary inner and outer cylindrical condenser plates connected with the upper portion of said frame, said plates being disposed concentric to each other and closed at their upper ends and open at their lower ends, an annular brush between the upper ends of said plates having resilient downwardly bowed arms, a movable cylindrical plate extending between the stationary plates concentric thereto and having a head closing its lower end, a block secured in the inner stationary plate, a stem of insulating material extending downwardly from said block, an internally threaded sleeve extending through the head of the movable plate centrally thereof, a threaded shaft extending vertically in said frame and engaged through said sleeve with its upper end swiveled to the lower end of said stem, and means carried by the lower portion of the frame to rotatably mount the lower end of the threaded shaft and impart rotary motion to the shaft to shift the sleeve and stationary plate verti-

cally and move the upper edge of the plate into and out of position to contact with the arms of said brush.

3. In a condenser structure, a frame, stationary inner and outer cylindrical condenser plates mounted vertically in said frame concentric to each other and closed at their upper ends, an annular brush between said plates having downwardly bowed arms, a cylindrical movable plate extending vertically between the inner and outer plates concentric thereto and having a head closing its lower end, an internally threaded sleeve extending through the center of said head, a mounting secured in said inner plate and having a depending centrally located stem of insulating material, a mounting in the lower portion of said frame, a threaded shaft engaged through said sleeve with its upper end swiveled to said stem and its lower end rotatably connected with said mounting, and a drive shaft rotatably mounted in said mounting and geared to said threaded shaft to impart rotary motion to the threaded shaft for shifting the movable plate vertically towards and away from said brush.

4. In a condenser structure, a frame, condenser units in said frame each having a set of concentric cylindrical stationary plates mounted in the upper portion of the frame and a cylindrical movable plate extending between its stationary plates concentric thereto, brushes between the stationary plates engageable by the movable plates, a bar of insulating material connecting the movable plates of said units, an arm rising from said bar between the units, contacts carried by said frame between said units, said contacts being normally in engagement with each other and being separated by said arm prior to engagement of the movable plates with the brushes when the movable plates are moved upwardly, and means in said frame for simultaneously shifting the movable plates vertically.

5. In a condenser structure, a frame, condenser

units in said frame each having a set of concentric cylindrical stationary plates mounted in the upper portion of the frame and a cylindrical movable plate extending between its stationary plates concentric thereto, brushes between the stationary plates engageable by the movable plates, a bar of insulation connecting the movable plates of said units, contacts mounted in the upper portion of said frame between said units and normally in engagement with each other, an arm rising from said bar to engage between and separate said contacts prior to engagement of the movable plates with said brushes when the movable plates are shifted upwardly, an internally threaded sleeve mounted centrally of each movable plate, a stem of insulating material mounted centrally of each set of stationary plates, threaded shafts engaged through said sleeves and having their upper ends swiveled to the lower ends of said stems, mounting members disposed in the lower portion of said frame, and rotatably supporting the lower ends of the threaded shafts, and a drive shaft having insulated sections rotatably supported by said mounting members and geared to the threaded shafts whereby the threaded shafts may be simultaneously rotated and the movable plates of said units simultaneously shifted vertically towards and away from said brushes.

6. In a condenser structure, a frame, condenser units in said frame spaced transversely from each other and each having a stationary section and a movable section, a cross bar extending between said units and connected to the movable sections thereof, a switch between said units having contacts yieldably engaging each other, a plunger extending from said bar, and means to simultaneously advance the movable sections towards the stationary sections and bring the plunger into position to engage the contacts and separate the same for opening the switch.

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