

L. M. CLEMENT.
 DEVICE FOR VARYING ELECTRICAL COUPLING.
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1,353,145.

Patented Sept. 21, 1920.

Fig. 1.

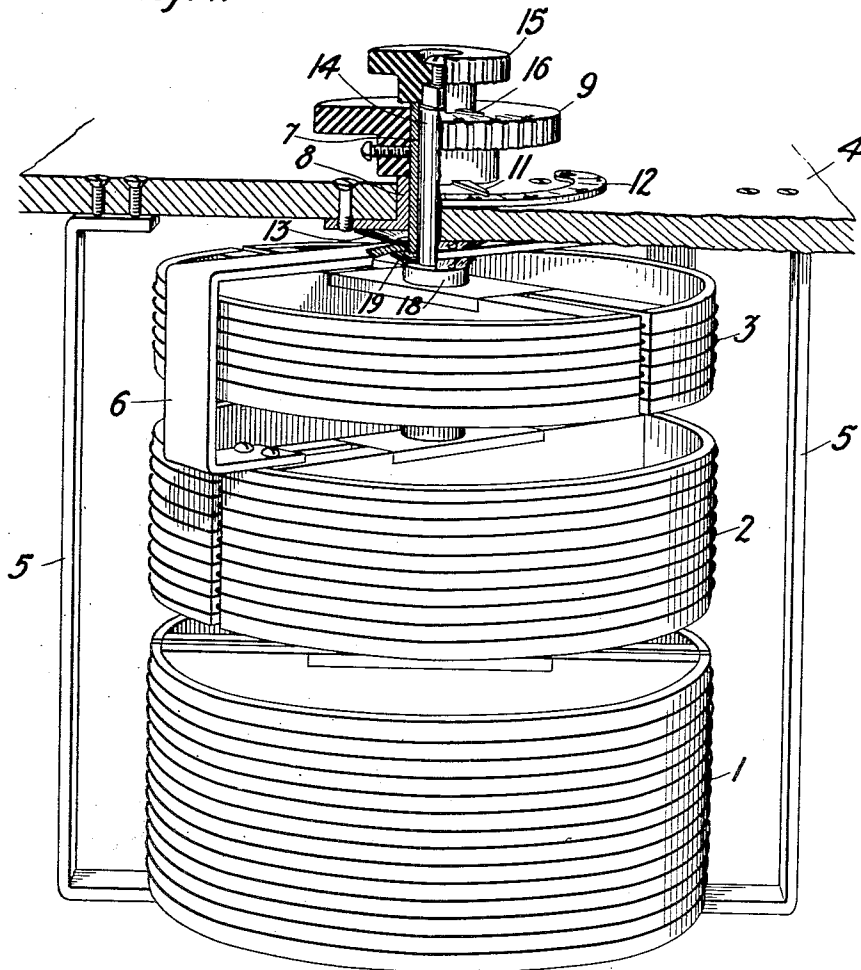


Fig. 2.

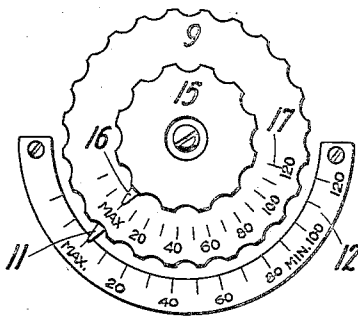
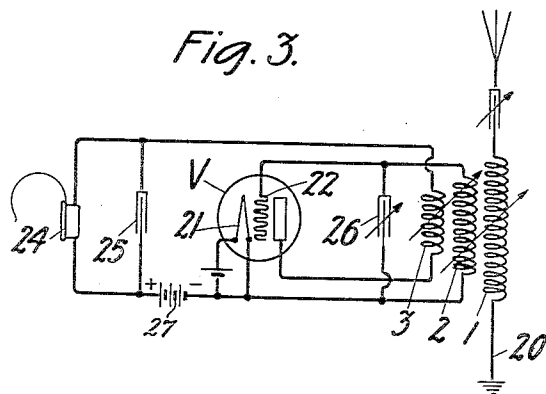


Fig. 3.



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UNITED STATES PATENT OFFICE.

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DEVICE FOR VARYING ELECTRICAL COUPLING.

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To all whom it may concern:

Be it known that I, LEWIS M. CLEMENT, a citizen of the United States, residing at Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Devices for Varying Electrical Coupling, of which the following is a full, clear, concise, and exact description.

10 This invention relates to means for coupling electrical circuits and impedance devices.

An object of the invention is to provide a means and method for varying the coupling between selected pairs of a plurality of coupled electrical circuits or impedances without thereby affecting the coupling between other pairs thereof.

A further object is to provide variable inductive coupling means suitable for use in signaling stations where it is of importance that variations of coupling be accomplished rapidly and precisely.

A more particular object is to provide a mounting for related primary, secondary and tertiary coils whereby the coupling between the primary and secondary can be conveniently varied without varying the coupling between the secondary and tertiary, and the coupling between the secondary and tertiary can be varied without varying the coupling between the primary and secondary.

In the particular embodiment herein described, the use of the invention is exemplified in connection with a station for receiving electromagnetic waves and is illustrated in the accompanying drawings, wherein Figure 1 is a perspective view with some parts in section of primary, secondary and feed-back coils with the coils represented as standing upright; Fig. 2 is a view of the operating handles and indicating scales which are connected with the coils; and Fig. 3 is a circuit diagram of a receiving circuit of a type wherein this invention may be conveniently applied.

Primary coil 1, secondary 2 and feed-back coil 3 are mounted in a suitable cabinet or other container 4. The primary coil 1 is supported by the bracket 5. Each of the coils has its winding in two semi-cylindrical parts and so wound that it has a negligible external field and, therefore, does not affect any surrounding electrical apparatus which may be affected by stray fields. The mag-

netic field of each coil will pass through one of the semi-cylindrical portions in a longitudinal direction and return through the other semi-cylindrical portion. The descriptive term "astatic" has been applied to such coils, which, when placed in end to end relation, as illustrated, will have maximum coupling when the transverse parts of the windings of the respective coils are in one relation, and will have minimum coupling when the transverse parts are in another relation. Other coils or apparatus may be placed so as to be adjacent to or surround coils of this type without being affected thereby. The coil 2 is rigidly attached by the bracket 6 to the spindle 7 which has attached thereto an operating handle 9 and is mounted in the bearing 8. A pointer 11 indicates upon a scale 12 the relative position of the coil 2 with respect to the coil 1 and hence the relative amounts of coupling or mutual inductance between the two coils. A spring 13, mounted between the bracket 6 and bearing 8, serves to frictionally hold the coil 2 in position after it has been properly placed. The coil 3 is mounted upon a spindle 14, which turns within the spindle 7 and has attached thereto an operating handle 15. By means of the handle 15, the coupling between the coils 2 and 3 can be varied from a maximum to a minimum as indicated by a pointer 16 upon a scale 17. An abutment 18 is provided upon the spindle 14 and a spring 19 is mounted between the abutment 18 and the bracket 6 to hold the coil 3 in position with respect to the coil 2 unless it is forcibly turned by operating handle 15. The spring 13 is designed to produce considerably greater friction than the spring 19 so that when the handle 15 is moved to rotate the coil 3, the coil 2 will continue to remain stationary on account of its frictional engagement with the bearing 8. However, when the coil 2 is rotated by the handle 9 the coil 3 will be carried with it. The mutual inductance between coils 1 and 3 will at all times be negligible. The leads to the coil windings will be flexible or of any other suitable nature to allow sufficient rotation of the coils. While described in connection with a special type of coil the invention may obviously be applied not only to other types of inductance coils but also to other electrical devices.

In Fig. 3 the coils 1, 2 and 3 are diagrammatically illustrated, coil 1 being located serially in a receiving conductor 20 and coil 2 being located in a circuit between the cathode 21 and grid 22 of a vacuum tube V. The coil 3 is connected in any suitable manner for feeding back energy from the output circuit 23 to the coil 2 for causing signals to be efficiently received in the receiver or other suitable indicating device 24 as is well known in the art. A condenser 25, variable condenser 26 and plate battery 27 are well known elements of such receiving circuits and hence need no further mention.

The term "electrically" coupled as used herein is intended to define any coupling of two electrical elements whereby the electrical condition of one is influenced by the presence of the other. The term inductive coupling is herein used to signify electrostatic coupling, *e. g.* that between condenser plates, as well as electromagnetic coupling.

The novel features of the invention, one form of which has been described above in detail, are set forth both broadly and specifically in the appended claims.

What is claimed is:

1. In combination, three electrical impedances, the first impedance being electrically coupled with the second and the second being electrically coupled with the third, means for changing the coupling between the first and second and simultaneously keeping the coupling between the second and third substantially constant, and means for changing the coupling between the second and third and simultaneously keeping the coupling between the first and second substantially constant, one of said means including devices for simultaneously acting upon two of said impedances.

2. In combination, three inductive elements, the first having a mutual inductance with the second and the second having a mutual inductance with the third, means for changing the mutual inductance between the first and second and simultaneously keeping the mutual inductance between the second and third substantially constant, and means for changing the mutual inductance between the second and third and simultaneously keeping the mutual inductance between the first and second substantially constant, one of said means including devices for simultaneously acting upon two of said elements.

3. In combination, three electrical elements so mounted that the first has an inductive effect upon the second and the second has an inductive effect upon the third, means for changing the inductive relationship between the first and second and simultaneously keeping the relationship of the second and third constant, and means

for changing the inductive relationship between the second and third and simultaneously keeping the relationship between the first and second constant, one of said means including devices for simultaneously acting upon two of said elements.

4. In combination, a mounting, three electrical elements mounted thereon on one side thereof, the first and second of said elements being coupled, the second and third thereof also being coupled, means for varying the coupling between the first and second, and means for varying the coupling between the second and third, both of said means being located on the side of said mounting remote from said elements.

5. In combination, three cylindrical induction elements permanently coaxially mounted, the first having a mutual inductance with the second and the second a mutual inductance with the third, means for changing the mutual inductance between the first and second while keeping the mutual inductance between the second and third substantially constant, and means for changing the mutual inductance between the second and third while keeping the mutual inductance between the first and second substantially constant.

6. In combination, three substantially cylindrical inductive elements permanently coaxially mounted, means for rotating the second relatively to the first while keeping the third in fixed relative relation to the second, and means for rotating the third relatively to the second while keeping the second fixed relatively to the first.

7. In combination, a series of impedance elements, each of said series being coupled to one or more other members of the series, and means for changing the coupling between any two coupled members while keeping the coupling between the other members of the series including one of said two members constant, said means including a common means for moving two of said elements simultaneously.

8. In combination, a series of inductances, each of said series having a mutual inductance between itself and such members of the series as are adjacent thereto, and means for changing the mutual inductance between any two adjacent members while keeping the mutual inductance between one of said two members and another member of the series constant, said means including operating means for acting upon at least two of said inductances simultaneously.

9. In combination, a fixed coil and two movable coils, each of said movable coils being mounted upon a spindle, said spindles being so related as to have coincident axes, means for turning each of said spindles, means for causing the first of said spindles to turn when the means for turning the sec-

ond spindle is operated, and means for causing the second of said spindles to remain fixed when the means for operating the first spindle is operated.

5 10. In combination, three movable inductive elements, means for changing the spacial relationship between the first and second, frictional means for simultaneously causing the spacial relationship of the second and third to remain constant, means for
10 varying the spacial relationship between the third and the second, and means for simultaneously causing the spacial relationship between the second and first to remain constant.
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11. In a signaling system, a fixed coil and two movable coils, means for moving the first of said movable coils with respect to said fixed coil, frictional means for causing
20 the second of said movable coils to simultaneously move with said first coil, other means for moving said second coil, and frictional means for preventing said first coil from moving when said second coil is being
25 moved by said other means.

12. In combination, in a signaling system, an astatic primary coil, an astatic secondary coil and an astatic feed-back coil, means for varying the mutual inductance between said
30 primary and secondary coils without affecting the mutual inductance between said secondary and feed-back coil, and means for varying the mutual inductance between said secondary and feed-back coils without varying the mutual inductance between said primary and secondary coils.
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13. Means for use in a signaling system including, in combination, a rigidly supported coil, a first rotary coil and a second
40 rotary coil, a spindle for rotating both of said rotary coils with respect to said fixed coil and indicating means for indicating the relative position of said first rotary coil with respect to said fixed coil, a second spindle concentric with said first mentioned spindle for rotating said second rotary coil with respect to said first rotary coil, and a second
45 indicating means for indicating the position of said second rotary coil with respect to said first rotary coil.
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14. The method of adjusting the coupling of three electrical devices which comprises adjusting the second relatively to the third and simultaneously and automatically caus-

ing the first and second to maintain a constant relation, then adjusting the first relatively to the second and simultaneously and automatically causing the second and third to maintain a constant relation. 55

15. In combination, a primary, a secondary and a tertiary coil, the first and second of said coils having a mutual inductance, and the second and third said coils having a mutual inductance, circuits individual to said coils, and means for changing
60 the value of each mutual inductance without varying the other. 65

16. A thermionic repeater having a plate circuit and a grid circuit, a coil individual to each of said circuits, a signaling circuit, a coil individual to said signaling circuit, said grid and plate circuit coils being coupled, said signaling circuit and grid circuit coils being coupled, and means for varying the coupling between each of said
70 pairs of coils while automatically maintaining the coupling between the other pair constant. 75

17. A thermionic repeater having a plate circuit and a grid circuit, a signaling circuit associated therewith, a coil individual to each of said circuits, two of said coils having a substantial maximum mutual inductance, one of said two coils and the third coil having a substantial maximum mutual inductance, and means for varying the mutual inductance between each of said pairs of coils while automatically maintaining the mutual inductance between the other pair constant. 80
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18. Means for use in radio systems comprising two electromagnetically related astatic coils, a third astatic coil electromagnetically related to one of said coils, and means to change the relation of either of said coils to its related coil without affecting the relation of the related coil to the third coil. 90
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19. A high frequency transformer comprising a rotatably mounted coil, a spindle for rotating said coil, a second rotatably mounted coil and a spindle for rotating said coil, said spindles being concentrically mounted. 100

In witness whereof, I hereunto subscribe my name this 14th day of June, A. D. 1918. 105

LEWIS M. CLEMENT.