

March 30, 1937.

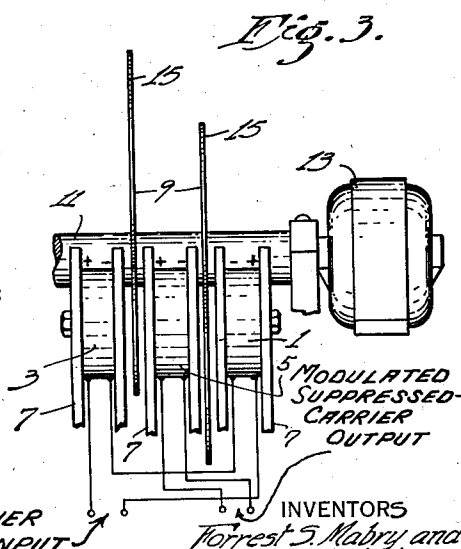
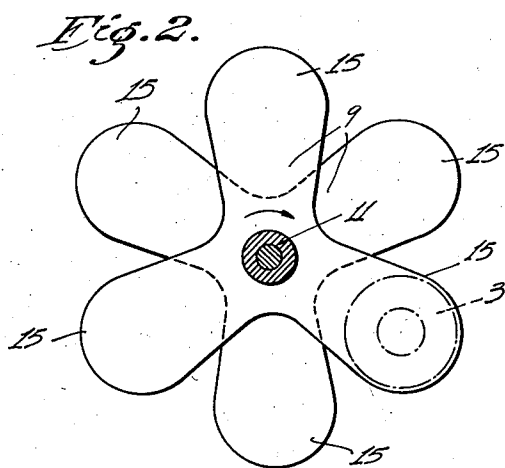
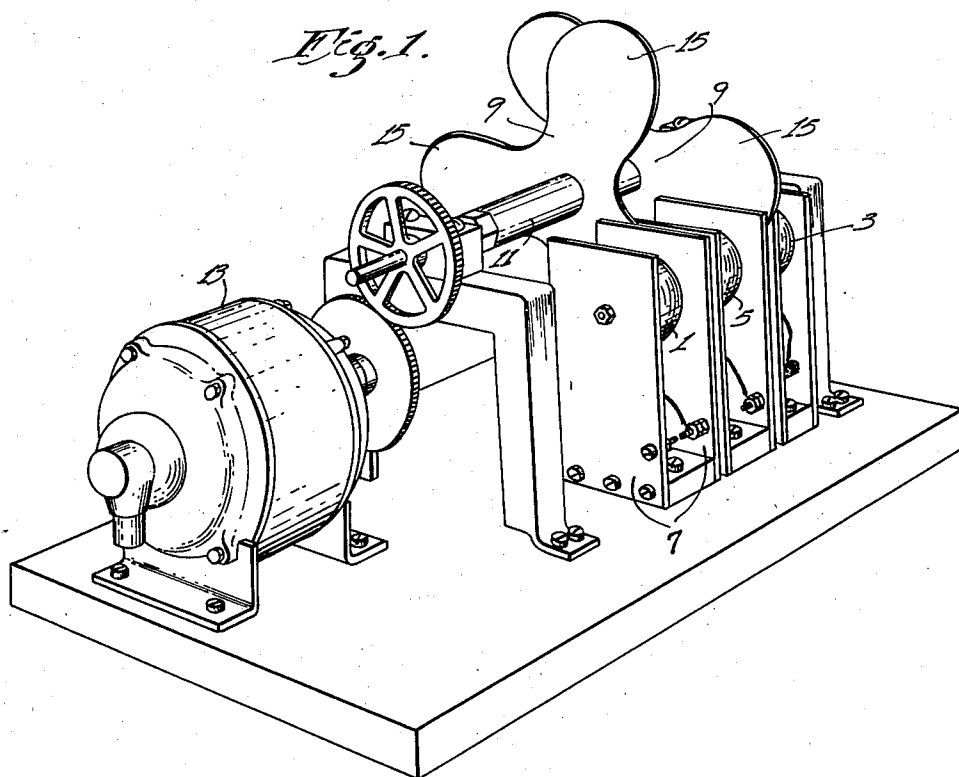
F. S. MABRY ET AL

2,075,125

BEACON SYSTEM

Filed June 9, 1934

2 Sheets-Sheet 1



WITNESSES:

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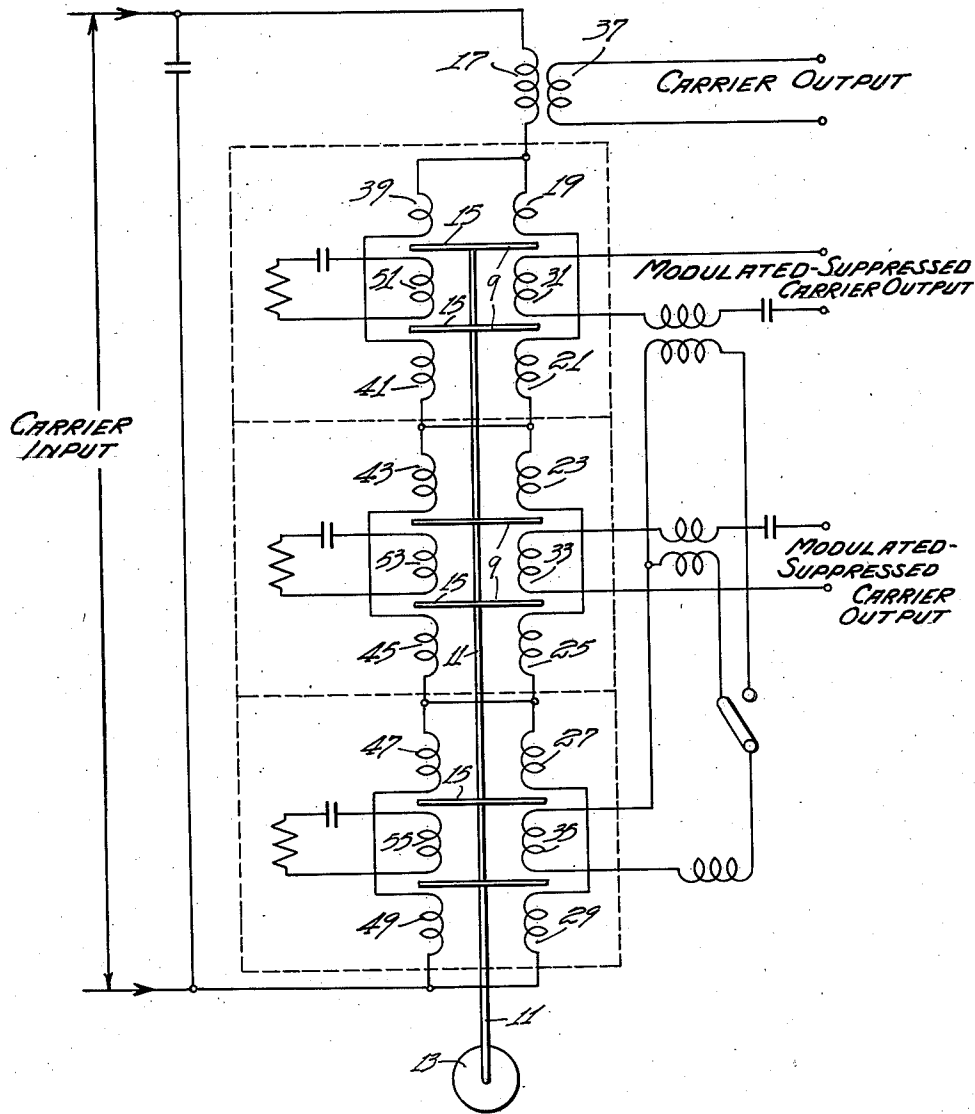
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2 Sheets-Sheet 2

Fig. 4.



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2,075,125

BEACON SYSTEM

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Application June 9, 1934, Serial No. 729,818

8 Claims. (Cl. 179-171)

Our invention relates to systems involving modulation and/or carrier suppression and more particularly to a means and method whereby such modulation and/or carrier suppression may be obtained.

It is an object of our invention to provide means for obtaining mechanical modulation and carrier suppression of a carrier.

It is a further object of our invention to obtain such results by means of a very simple mechanical device.

It is a further object of our invention to provide means for mechanically modulating a high frequency carrier wave with any desired wave shape.

It is a still further object of our invention to provide means whereby any desired modulating wave form may be obtained.

It is a still further object of our invention to provide simple apparatus of a mechanical type for modulating a carrier wave with a desired wave form and simultaneously therewith producing a suppression of the carrier.

An additional object of our invention is embodied in a method for obtaining modulation and carrier suppression.

Further objects of our invention will be pointed out in the following description of the same, taken in connection with the accompanying drawings, wherein

Figure 1 illustrates in perspective apparatus embodying the principles of our invention.

Figs. 2 and 3 are schematic diagrams illustrating the general principle of operation involved in the apparatus of Fig. 1, and

Fig. 4 illustrates one application of the invention to a radio beacon system employing a modulated suppressed carrier output.

Broadly speaking, our invention embodies the application of a plurality of rotating metallic shields of predetermined shape and configuration, these shields being caused to so rotate between a plurality of radio frequency transformer coils whereby the inductive coupling between the coils is interrupted periodically in proper phase relationship and at a rate determined by the shape and speed of the rotating shields.

Expressed in the form of a method, our invention contemplates the production of a modulated suppressed carrier by subjecting a secondary winding to the inductive influence of a plurality of primary coils energized 180° out of phase with each other and alternately shielding the secondary winding from each of said primary coils.

Should a suppression of the carrier wave be

undesirable in any particular system, the invention permits of such adjustments whereby a modulated carrier will be obtained without suppression of the carrier.

Referring to Fig. 1, for a more detailed description, we have provided a plurality of radio frequency coils 1, 3 and 5, respectively, each supported by a frame 7 in inductive relationship to each other. The two outer coils 1 and 3 constitute primary windings, the intermediate coil 5 being the secondary winding. A slight spacing is provided between the coil frames to permit of the rotation of a pair of metallic shields 9 which are mounted upon a shaft 11 geared to a driving motor 13, the gear ratio being such as to give the desired speed of rotation to the shields. Each of the shields is so shaped as to be provided with a number of blades 15 and are so positioned on the shaft as to be "out of phase with each other". In other words, a blade of one shield appears between the blades of another shield when viewed along the shaft on which they are mounted. The shields are so spaced on the shaft that each one is adapted to rotate between a pair of coils.

The theory underlying the operation of the apparatus of Fig. 1 may be understood by reference to Figs. 2 and 3. In Fig. 2 is shown the relative position of the rotating shields at the instant that the blade of one of the shields is passing between two of the coils. Radio frequency energy is fed to the two outer coils 1 and 3 in such a direction that the current through one of the coils will be 180° out of phase with the current in the other coil. Under these conditions, potentials of opposite polarity would be simultaneously induced in the center coil 5 were the rotating shields not present. However, with the shields mounted in position for rotation and at the instant that they occupy the position indicated in Fig. 2, the center coil will be shielded from one of the end coils and a potential will be induced in the center coil only from the coil which is not shielded. Due to the rotation of the shields, the coil which was previously shielded will be unshielded and the other coil which had just previously been unshielded will become shielded and a potential will be induced in the middle coil 180° out of phase from the potential which had previously been induced therein. The result will be, that in the center coil, there will be produced a suppressed carrier wave, modulated at a frequency proportional to the rotational speed of the rotating shields. The number of blades on each shield is a factor entering into the determination of the frequency of modulation but once

this number is fixed, then the modulating frequency will depend only upon the speed of rotation.

By shaping the blades on these rotating shields in any desired manner, the shape of the modulating wave can be made to satisfy any form desired. A pure sine wave may thus be obtained by shaping the blades to produce this wave form, and once the blades are suitably shaped, one will be assured of obtaining a pure sine wave output. If a more complicated wave form is desired, it may be obtained by utilizing shields of a different configuration.

To avoid any reactionary effects upon the input circuit, due to the varying load upon the same, it is possible to make the load constant by providing another set of coils corresponding to the coils 1, 3 and 5 and so position the same with respect to the rotating shields that when a coil of one set is shielded, the corresponding coil of the other set will be unshielded. The center coil of the compensating group should be provided with a load in the form of a resistor or other impedance, the value of which need not be critical, the only requirement to be fulfilled being that the sum of the currents induced in both center coils should be substantially constant for different positions of the rotating shields.

With the coils connected up in the manner specified, whereby the potentials induced in the center coil will be 180° out of phase, a suppressed carrier current modulated at a frequency proportional to the rate of rotation and the number of blades will be obtained in the output circuit. Should the end coils 1 and 3, however, be connected so that the potentials induced in the center coil will be in phase, and if the rotating shields are disposed in "in-phase relation" then a straight modulated carrier wave will be obtained, which will be 100% modulated providing that the shielding effect of the rotating shields will be 100% when the blades of the shields appear between the coils.

In the circuit of Fig. 4, we have shown one application of our invention, namely as it may be embodied in one type of radio beacon system. In this particular system, it is desired to provide voice modulation on a standard carrier, two suppressed carriers each modulated at a different audio tone frequency and, in addition, means for keying either of these tone modulated suppressed carriers. The carrier frequency supply is obtained from some source of high frequency such as an oscillation generator, not shown, and applied to the radio frequency coils 17, 19, 21, 23, 25, 27 and 29 connected in series all these coils except the first one 17 being disposed in pairs and constituting primary windings of radio frequency transformers. Output coils 31, 33, 35 are inductively coupled to and disposed between the coils of each pair of coils in this series connection. The rotating shields 9 are positioned to intercept the coupling between these output coils and the coils to which they are inductively coupled, when the blades of these shields pass between the coils in question. The first coil 17 is free of any such interference and is inductively coupled to an output coil 37 which will provide a non-suppressed carrier wave at all times, this carrier to be employed for voice modulation.

By reason of the presence of the rotating shields the energy in the output coils 31, 33 and 35 will be in the form of a suppressed carrier modulated at a frequency proportional to the number of blades on the rotating shields and the

speed of rotation thereof. To distinguish between the output of coil 31 and coil 33, one set of shields, associated with one of these output coils, is provided with more blades than the corresponding shields associated with the other output coil, whereby two different tone modulations will be produced.

In the output coil associated with the third pair of shields, there will also be induced a modulating frequency. This modulating frequency may be impressed inductively upon either of the outgoing circuits associated with the output coils 31 and 33 and may be keyed in any desired manner for aural reception.

To balance the load on the source of carrier frequency there is provided a set of series connected compensating coils 39 through 49 corresponding to the primary coils 19 through 29 and connected in parallel thereto. These compensating coils are inductively coupled to secondary windings 51, 53 and 55 which correspond to the secondary windings 31, 33 and 35 and are each shunted by a resistor and capacitor in series to provide a load on the compensating side of the circuit. The compensating windings including their secondary windings are so positioned with respect to the rotating shields that at the moment one of the windings is shielded from its associated secondary winding its corresponding primary winding is in inductive relationship to its associated secondary winding. Thus for example when coil 19 is shielded from its secondary 31, the coil 39 is inductively coupled to the winding 51.

It is conceivable that many other uses may be made of the mechanical modulator and carrier suppressor apparatus disclosed by us and various modifications of an obvious nature may occur to those skilled in the art. Our invention is not limited for example to any specific number of coils or shields and these may vary in size and shape to obtain desired conditions. We, accordingly, do not desire to be limited in our protection to the specific details disclosed by us except as may be necessitated by the prior art and the appended claims.

We claim as our invention:

1. Transmitting apparatus comprising a local generator of high frequency, a pair of coils, means for connecting said local generator to said coils for feeding high frequency energy thereto, another coil disposed in inductive relationship to said pair of coils, said pair of coils being so wound as to induce into said other coil potentials which are 180° out of phase with each other, means for alternately shielding said other coil from each coil of said pair of coils, and means for transmitting energy to a remote point in accordance with the energy changes taking place in said other coil.

2. Transmitting apparatus comprising a local generator of high frequency energy, a pair of coils, means for connecting said local generator to said coils for feeding high frequency energy thereto, another coil disposed in inductive relationship to said pair of coils, said pair of coils being so wound as to induce into said other coil potentials which are 180° out of phase with each other, means for alternately shielding said other coil from each coil of said pair of coils, said means comprising a pair of metallic shields of predetermined configuration, mounted for rotation between said coils, and means for transmitting energy to a remote point in accordance with the energy induced in said other winding.

3. Transmitting apparatus comprising a local

generator of high frequency energy, a pair of coils, means for connecting said local generator to said coils for feeding high frequency energy thereto, another coil disposed in inductive relationship to said pair of coils, said pair of coils being so wound as to induce into said other coil potentials which are 180° out of phase with each other, and means for alternately shielding said other coil from each coil of said pair of coils, said means comprising a pair of metallic shields each provided with a plurality of blades and mounted on a common shaft for rotational movement between said coils, said shields being disposed on said shaft in out-of-phase position with each other, and means for transmitting energy to a distant point in accordance with the energy induced in said other winding.

4. Transmitting apparatus comprising a local generator of high frequency energy, a pair of coils, means for connecting said local generator to said coils for feeding high frequency energy thereto, another coil disposed in inductive relationship to said pair of coils, said pair of coils being so wound as to induce into said other coil potentials which are 180° out of phase with each other, means for alternately shielding said other coil from at least one coil of said pair of coils, and means for transmitting to a remote point, a wave in accordance with the energy changes occurring in said inductively coupled coil.

5. Transmitting apparatus comprising a local generator of high frequency energy, a pair of coils, means for coupling said local generator to said coils for feeding high frequency energy thereto, another coil disposed in inductive relationship to said pair of coils, said pair of coils being so wound as to induce into said other coil potentials which are 180° out of phase with each other, means for periodically varying the ratio between the coefficient of mutual inductance between the last-mentioned coil and one coil of said pair and the coefficient of mutual inductance

between said last-mentioned coil and the other coil of said pair, and means for impressing upon a transmitting circuit for transmission to a remote point, a wave in accordance with the energy changes occurring in said inductively coupled coil.

6. Transmitting apparatus comprising a plurality of coils so positioned relative to each other as to be inductively coupled, a metallic shield capable of periodic interposition in a path through the line of coupling, a locally generated source of energy connected to feed energy to one of said coils, and means for maintaining a constant load on said source during said periodic movement of said shield.

7. Transmitting apparatus comprising a plurality of coils inductively coupled, a shielding member, means for periodically interposing said shielding member between said coils, a locally generated source of energy connected to one of said coils, and means for maintaining a substantially constant load on said source in spite of the variable load induced in said coupled coil.

8. Transmitting apparatus comprising a circuit including a winding, another circuit including a pair of windings so disposed relative to said first winding as to provide two paths of mutual induction between said first winding and said pair of windings which respectively induce two potentials 180° out of phase with each other, means for periodically varying the ratio of the coefficient of mutual inductance of one of said paths relative to the coefficient of mutual inductance of the other of said paths, a local generator of high frequency energy connected in one of said circuits and means for impressing upon a transmitting circuit for transmission to a remote point, a wave in accordance with the energy changes occurring in said other circuit.

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