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RADIO SIGNALING APPARATUS

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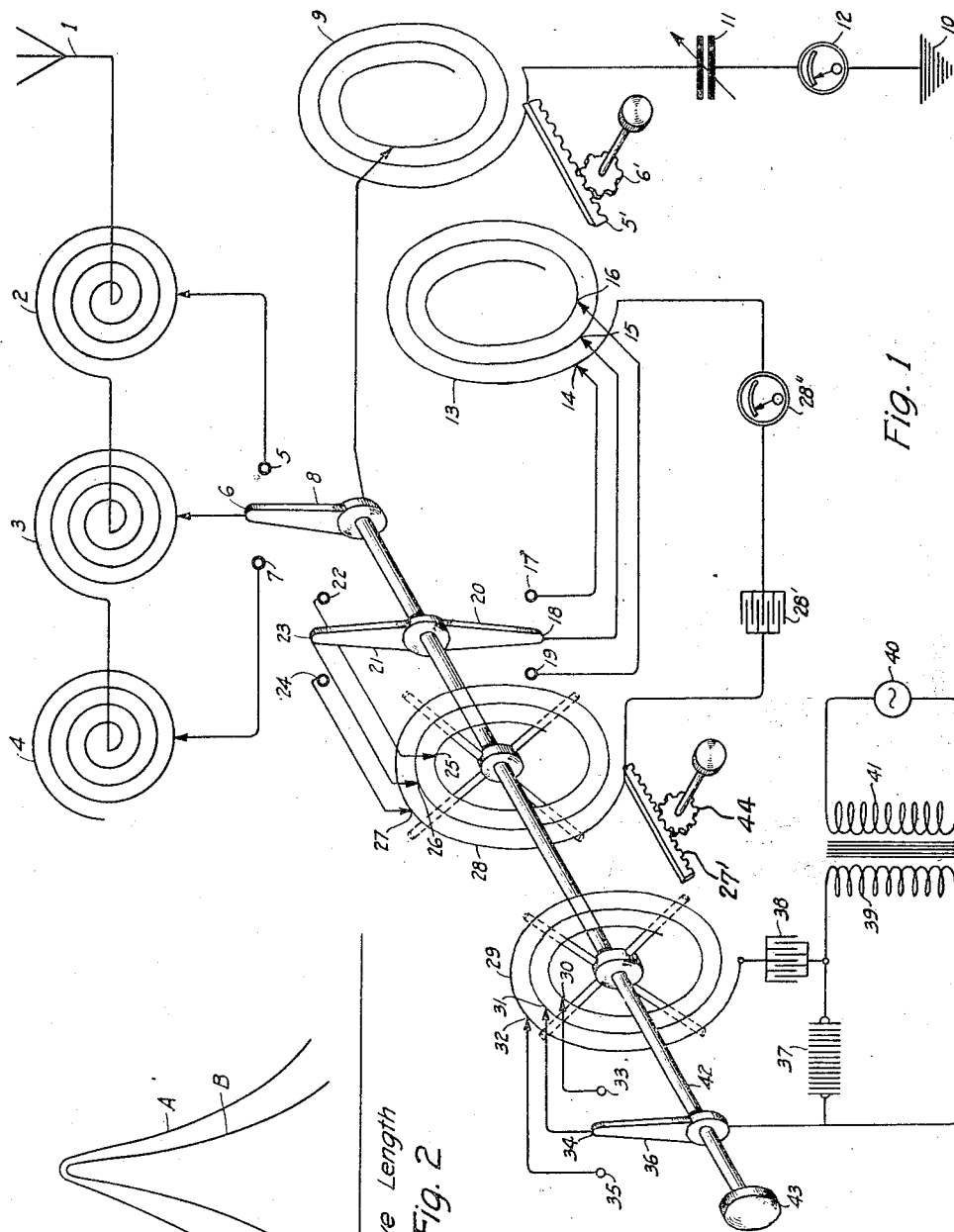


Fig. 1

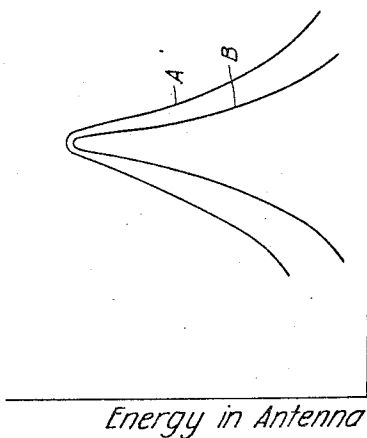


Fig. 2

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RADIO SIGNALING APPARATUS.

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To all whom it may concern:

Be it known that I, GEORGE H. CLARK, a citizen of the United States, and a resident of Brooklyn, New York, have invented certain new and useful Improvements in Radio Signaling Apparatus, of which the following is a specification accompanied by drawings:

This invention relates to improvements in signaling with the spark gap method and more particularly to improvements in systems using a quenched spark gap.

Quenched spark gaps or similar arrangements in which the energy is supplied to the radiating system as lumped energy and the gap or similar device is "quenched" to prevent interaction between the primary and radiating circuit have recently been widely used because they can be used with closer coupling and hence secure more powerful radiation than with ordinary spark gaps.

In using an unquenched spark gap it is well known that waves are radiated over a considerable range of wave lengths and particularly at the coupling wave lengths which are above and below the wave length corresponding to the natural period of the radiating circuit. The same is true to a much lesser degree of quenched gap systems as the antenna oscillates at its own period and damping after the primary is quenched. However, the initial impulses given to the antenna by supplying the energy in a lump produces a shock effect which causes the antenna to produce radiation and interference of considerable strength over a range considerably above and below the prescribed limits within which the system is supposed to operate. In other words, I find that although a low decrement of the antenna current is secured by means of the quenched gap arrangement, a high increment exists which gives interference by shock excitation. With a 100 k. w. set the antenna may be radiating equal to a 5 k. w. set on many wave lengths and the resultant interference with receiving stations from high powered spark sets in the vicinity may be so great that commercial operation is impossible on wave lengths for removed from that of the spark set.

Interference can be eliminated to a considerable extent by very loose coupling, but this greatly decreased the radiation, and furthermore the coupling between the an-

tenna and the primary cannot be changed efficiently as there is an optimum coupling required by quenching. Other methods of changing the increment or decrement, such as changing the number of gaps or the antenna constants, I have also found to be undesirable.

From the foregoing it will be seen that the principal object of my invention is to decrease the radiation of interfering wave lengths with quenched spark gap sets, or their equivalent, without proportionally decreasing the radiation on the desired wave length.

Another important object of my invention is to provide an arrangement for quickly adjusting a spark set for transmitting on any desired wave length without radiation of serious interference and without interfering with the quenching.

A further object of my invention is to provide an arrangement for conveniently changing the energy radiated by the antenna with a quenched gap set.

The novel features which I believe to be characteristic of my invention are pointed out with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood by reference to the following description taken in connection with the accompanying drawing in which:—

Fig. 1 is a diagrammatic view of an embodiment of the invention.

Fig. 2 is a curve showing the energy transmitted on the various wave lengths with an arrangement in accordance with the invention in comparison with an ordinary quenched gap set.

As previously set forth, I have found that in order to decrease interference with spark sets it is desirable to deliver the energy to the antenna with a low increment as well as a low decrement. I have further found that an economical and convenient way of doing this is to use an intermediate tuned circuit. This is preferably operated in conjunction with a wave changer to simultaneously vary the constants of the circuits to secure the proper resonant conditions and the correct amount of coupling between the circuits for proper quenching on any selected wave length.

Referring to the drawing, 1 represents the antenna and 2, 3, 4 are loading coils connected to contacts 5, 6 and 7 respectively which co-operate with the rotating contact arm 8 to connect one or more of the loading coils in the antenna. The contact arm is connected to antenna coupling coil 9 which is connected to ground at 10 through a condenser 11 and an ammeter 12. The intermediate or cushion circuit comprises a coil 13 in inductive relation to coil 9 and is provided with taps 14, 15, 16 connected respectively to contacts 17, 18, 19 which cooperate with the rotating contact arm 20 as it is moved into various positions to place different values of inductance in the circuit. The strength of the radiation is controlled by varying the coupling between coils 9 and 13 by means of a rack 5' and gear 6', preferably independently of any wave length adjustment. Contact arm 20 preferably is integral with a contact arm 21 which cooperates in various positions with contacts 22, 23, 24 connected to taps 25, 26, 27 respectively of coil 28. The intermediate circuit is completed by connecting the ends of coils 28 and 13 through a condenser 28' and an ammeter 28'.

The coil 28 is located in inductive relation to a primary coupling coil 29 having three taps 30, 31, 32 connected to contacts 33, 34, 35 which cooperate with rotating contact arm 36.

The inductance of coils 28 and 29 and the inductance between the different leads of these coils is so chosen that the coupling between cooperating portions of these coils is the optimum value for quenching on each wave length, and no special adjustment of the coupling between the primary and the intermediate circuit is required. However, a rack 27' and gear 44 may be provided for adjusting the coupling to take care of changes which may occur in the condition of the spark gap due to the effects of wear. It will be understood that no adjustment of the coupling by means of the rack and gear is required for changing wave-length, power, or even when the number of gaps in the quenched gap is changed over a considerable range.

A quenched spark gap 37 and condenser 38 are connected to arm 36 and the end coil 29. I have not definitely determined the most desirable relations of the inductance and capacity of the intermediate circuit, but have found that it is convenient and satisfactory to have the condensers 28' and 38 of approximately equal capacity, as with this condition the coils 28 and 29 may be of dimensions and inductance of somewhat the same order of magnitude and all of the necessary inductance of the intermediate circuit can be included in coils 13 and 28, so that no additional loading coils are required.

The secondary 39 of a step-up transformer will be connected across the condenser 38 and supplied with charging current from a source of alternating current 40, connected to the primary 41 in a well known manner.

As shown in the drawing, contact arms 8, 20, 21 and 36 will all preferably be mounted on shaft 42 so that the tuning of all the circuits will be changed simultaneously to accord with the optimum conditions of the circuits for resonance and quenching of the spark gap. Adjustment of the coupling between coils 9 and 13 does not appear to affect the quenching of the spark gap. I have only described and illustrated in the drawings an arrangement for varying the inductances and couplings as usually it is sufficient to alter these values without varying the capacities, but obviously both the capacity and inductance or the capacity only may be changed to secure resonant conditions.

The coils 2, 3, 4, 9, 13, 28 and 29 are conveniently in the form of flat inductance coils although other forms may be used. It is also convenient to mount the coils 28 and 29 on the shaft 42 as shown and also to arrange all of the rotatable arms on the same shaft, although obviously several shafts geared together could be used to secure simultaneous adjustments.

When the adjusting knob 43 is turned into the position corresponding to the desired wave length, such as that shown in the drawing, all the constants of the circuits are adjusted simultaneously for efficient operation at the desired wave length. The energy supplied to the primary circuit through the transformer and spark gap is transferred to the intermediate circuit and from the intermediate circuit to the antenna by reason of the coupling between the circuits previously described. No adjustment of the distance between the coils 28 and 29 is required in changing wave length as the coupling and the reaction between the circuits is initially chosen for proper quenching by including the correct values of inductance between cooperating taps of the coils. In this manner a constant reaction is secured between the primary and secondary circuit under all conditions. I find that by inserting the intermediate circuit and by selecting its constants and coupling with the antenna and primary with relation to the wave-length, the shock effect is greatly decreased.

Although the intermediate circuit is shocked by the primary circuit the oscillations set up therein are of the frequency to which the circuit is tuned by reason of the fact that it contains only lumped inductance and capacity. A radiating circuit comprising largely distributed inductance and capacity will oscillate over a wide range of

frequencies on either side of the wave length to which it is tuned. This difference in the characteristics of the intermediate circuit as compared with the characteristics of the radiating circuit which is usually coupled directly to the primary is probably the reason that the action is different when the intermediate circuit is interposed. It is believed that the oscillations are built up in the intermediate circuit with a high decrement by the shock effect of the primary although it is immaterial whether this is a correct explanation. The energy in the oscillating intermediate system, however, is supplied to the radiating system at a low decrement so that it does not shock the antenna into radiating strongly on wave lengths widely different from the main wave length. The interaction of the intermediate circuit on the radiating circuit does not appear to appreciably change the low decrement at which the latter oscillates after the primary circuit is opened by quenching the gap. In Fig. 2 curve A shows the energy in the antenna for various wave lengths for a spark set without a cushion or intermediate circuit and curve B shows the result for the same set when the invention is utilized. It will be noted that in curve A the slope is steep on both sides of the peak which represents the transmitting wave length and the energy transmitted on wave lengths considerably greater or less than the desired wave length is relatively high and sufficient to produce strong interference with neighboring stations receiving on wave lengths far from that on which the signal is being sent. This is due to the shock effect which results from the sudden supply of large amounts of energy which causes the antenna to oscillate on a wide range of wave lengths with considerable amplitude. With the cushion or intermediate circuit the lower ends of the curve B corresponding to interfering wave lengths oscillate with low energy and rise to a more abrupt peak, thus giving less interference. This is presumably due to the fact that the energy supplied in a lump to the primary circuit when transferred to the antenna through the intermediate circuit, is cushioned thereby so that the oscillations do not build up in the antenna solely by shock effects, but by supplying the energy in increments to build up the maximum effect without expending any large amount of the transferred energy for production of oscillations of such widely different frequency as will cause interference.

An important feature of my invention is that the power or strength of radiation may be adjusted on any operating wave length to the desired value by simply adjusting the coupling between the coils 9 and 13 without effecting the operation of the set as to

optimum quenching or adjusting the constants of any of the circuits. All adjustments of the latter are made by the wave changer and are substantially unaffected by the coupling of coils 9 and 13. With an ordinary quenched gap set, the coupling between the primary and radiating circuit cannot be changed to any considerable extent without harmfully affecting the quenching of the gap, changing the number of gaps or making some other adjustments between the constants of the primary and secondary.

Having described my invention, what I claim is:

1. In apparatus for transmitting signals, the combination of an antenna circuit, a primary circuit containing a quenched spark gap, a source of power for supplying energy to the spark gap, means for transferring said energy from the primary to the antenna in increments whereby the effect of shock excitation is eliminated, each of said circuits and said last mentioned means having means for adjusting for different wave lengths and means for operating said last mentioned means in unison.

2. In apparatus for transmitting signals, the combination of an antenna circuit, a primary circuit containing a quenched spark gap, a source of power for supplying energy to the spark gap, an intermediate circuit coupled to the antenna and primary circuits, each of said circuits having means for tuning to different wave lengths and means for establishing contact with points on each of said tuning means corresponding to the same wave length in unison.

3. In apparatus for transmitting signals, the combination of an antenna circuit, a primary circuit containing a quenched spark gap, a source of power for supplying energy to the spark gap, an intermediate circuit containing inductance and capacity of the optimum value for quenching of the spark gap, tuning elements in each of said circuits and means for establishing contact in unison with points of each of said tuning means corresponding to the same wave lengths.

4. In apparatus for transmitting signals, the combination of an antenna circuit, a primary circuit containing a quenched spark gap, a source of power for supplying energy to the spark gap, an intermediate circuit containing lumped inductance and capacity, said intermediate circuit being coupled to and containing values of inductance and capacity for optimum quenching of the spark gap, tuning means in each of said circuits, said tuning means having connections corresponding to different wave lengths, means for establishing contact in unison with connections corresponding to the same wave length and means for varying the coupling between said intermediate circuit and antenna circuit for changing the

power impressed on the antenna whereby the strength of radiation may be altered without varying the optimum relations existing between the primary and intermediate circuits.

5 5. In apparatus for transmitting signals, the combination of an antenna circuit, a primary circuit containing a quenched spark gap, an intermediate circuit, a pair of coupling coils in the primary and intermediate
10 circuits, having taps for simultaneously varying the coupling and tuning for different wave lengths.

6. In apparatus for transmitting signals,

the combination of an antenna circuit, a
15 primary circuit containing a quenched spark gap and an inductance coil, an intermediate circuit coupled to the antenna and primary circuits, inductance coils for coupling said
20 intermediate circuit to the primary circuit and means for simultaneously varying the tuning of all of said circuits and the coupling between the primary and intermediate
25 circuits comprising a shaft adapted to simultaneously vary each of said inductances.

In testimony whereof I have hereunto affixed my signature.

GEORGE H. CLARK.