

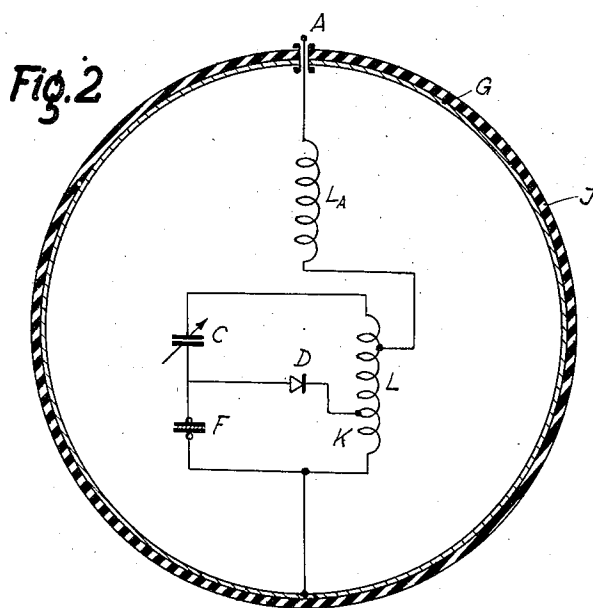
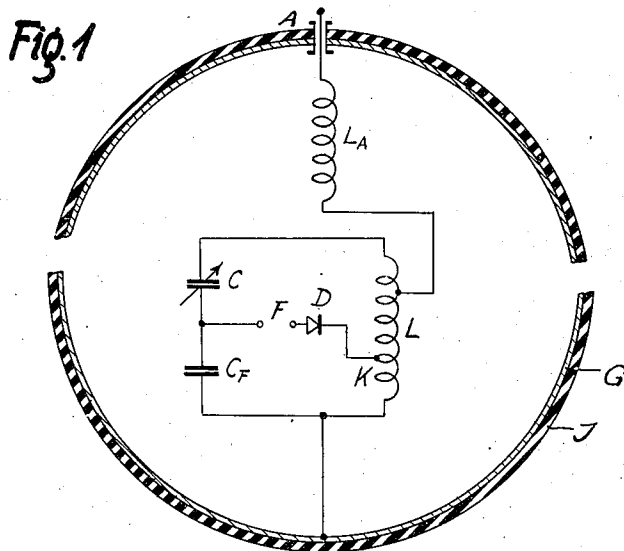
Sept. 16, 1941.

F. MORAWETZ

2,256,323

PORTABLE DETECTING DEVICE FOR ULTRASHORT WAVES

Filed Nov. 4, 1938



F. Morawetz
Inventor

By: Glascock Downing & Seebold
Attys.

UNITED STATES PATENT OFFICE

2,256,323

PORTABLE DETECTING DEVICE FOR ULTRA-SHORT WAVES

Friedrich Morawetz, Vienna, Germany, assignor
to Radio Watch Company, a corporation of
Delaware

Application November 4, 1938, Serial No. 238,919
In Austria December 14, 1937

5 Claims. (Cl. 250—20)

This application relates to radio receivers and more particularly to pocket size, ultra short wave receivers having high sensitivity.

For various purposes, for instance in the police service or for military purposes or for receiving time signals or the like a detecting apparatus capable of detecting ultra short waves and of such a small weight and of such compactness that it may be carried along permanently without inconvenience to the person who carries it, is of the greatest advantage. Such an apparatus must also be permanently ready for reception without adjustment or other manipulation. This is particularly necessary where, to obtain the greatest possible field intensities at a given place, directed ultra short waves (such as waves of less than 20 meters) are employed. With directed short waves, not only the tuning in but also the picking up of the waves presents special difficulty, and the requirement that the detecting apparatus should be carried along in a state of complete or almost complete readiness for operation, involves the addition of a suitable antenna to the detecting apparatus.

Detectors of this kind must moreover be highly sensitive, as the electrical energy that can be picked up is only very small. As a consequence of the difference in the general properties of the ultra-short waves, when compared with the usual waves (above 200 meters) used for broadcasting purposes it is necessary to use exclusively parts of the highest quality with the lowest possible high frequency losses; and it is moreover necessary to use a large oscillation circuit impedance which is only possible with a structure comparatively free of capacity and of wave damping effects.

Experiments have shown that the best antenna arrangement for this purpose is that in which the highest possible voltage is to be impressed on the oscillation circuit. This is in contradistinction to the usual arrangement, in which the antenna arrangement is so chosen, that the highest current intensity is obtained in the detector. The highest possible voltage can however not be obtained in portable receivers of this kind by making the natural wave length of the antenna equal to that of the wave to be received. Especially if the longer waves of the ultra short wave band are used, the length of the antenna in such a case would be by far too large for manipulation and for permanent readiness of the receiver; even antennae of $\frac{1}{4}$ to $\frac{1}{2}$ of the wave length are unpracticable, the former

as it is necessary with them to use an electric counterpoise, the latter because a dipole of $\frac{1}{2}$ wave length composed of two antennae of $\frac{1}{4}$ wave length is not suitable for this purpose on account of its length and on account of the necessity for making connections thereto at two points.

According to this invention an antenna for ultra short waves is used, which consists only of a short wire or rod or a short chain (watch chain), while the natural wave length of this linear antenna is artificially increased by means of a loading coil of exactly defined dimensions so as to be equal to half of the wave length of the oscillations to be received. At the ends of the antenna arrangement voltage maxima will occur. That end of the antenna which is provided with the loading coil is connected with a point of the oscillation circuit which energizes the detector in what may be called one-point-feeding. Said circuit itself is energized by voltage feeding; a loose effective coupling being preferably used between the antenna circuit and the oscillation circuit. The point of connection of the antenna with the coil or other member of the oscillation circuit, which is to be as free from losses as possible, is so chosen that the oscillation current resistance (impedance) of the antenna with respect to the impedance of the oscillation circuit is not only sufficient to be in accord with theoretical requirements, but is over compensated. That is, the antenna impedance is made higher than that of the oscillating circuit, and this decreases the damping of the oscillation circuit due to energy extracted by the antenna circuit and thereby increases the average energy in the oscillation circuit. This selection of the point of feeding at an intermediate point on the oscillation circuit coil causes the coil to operate as an autotransformer and thereby increases the voltage available for the oscillation circuit. This permits a reduction of the effective coupling between the antenna and oscillation circuits which adds in a high measure to increase the sensitivity. With transportable devices it is best to find out the most favorable point of connection by actual test.

This voltage-feeding (one point feeding) allows one to dispense with an electric counterpoise in spite of an antenna which is very short. It is best in this case to employ a screening device for the whole reception arrangement including the telephone receiver and to enclose the screening device itself within an insulating casing.

The invention is illustrated diagrammatically

in the accompanying drawing which shows in Fig. 1 the diagram of one embodiment of a portable detector receiver for ultra short waves. Fig. 2 shows another embodiment in which piezo-electric telephone receivers are used, the capacities of which are used as coupling capacity.

In the drawing L and C designate the oscillation circuit tuned to the received wave, and D is a detector of an almost capacity free design. F designates a telephone receiver, A a wire or rod forming the antenna, L_A an artificial inductance in the antenna, G a metallic screening and J an insulating coating or casing. The screening is preferably obtained by means of a metallic lining or deposit on the inner wall of the casing of insulating material, for instance by means of metal foil that has been pressed into the casing or that has been produced by spraying a metal layer upon it.

The antenna A is so constructed that when in use it will protrude from the casing and it may therefore be easily brought into the most suitable position for reception, when the apparatus is held to the ear of the person carrying the same. When not in use, for instance when the apparatus is in the pocket of the carrying person, the antenna A may be withdrawn by any suitable means into the casing. The antenna may be made in any desired suitable form, such as for example, a rod, a chain (like a watch chain) or a metal band like the well-known steel measuring tape.

The antenna A is connected through the loading coil L_A with an intermediate point of the coil L of the oscillation circuit feeding the detector (so called one-point-feeding). The coil L accordingly acts as an autotransformer to step up the voltage transferred from the antenna circuit to the oscillation circuit.

It will be noted that the detector D is connected from a point between the condensers C and C_F to a point K on the coil L and thereby forms the central leg of a bridge circuit, the balance of which is determined by the relationship between the condensers C and C_F and the inductance of the coil L above and below the point K. A detector, being a power operated device, requires for maximum sensitivity that maximum power be supplied thereto. In order to supply maximum power, however, it is necessary to connect the detector in such a way that the resistance thereof does not interfere with the flow of current in the oscillation circuit and thereby decrease the power available for operating the detector. In the embodiment shown the detector is not connected in the oscillation circuit proper, but is so connected that it is operated in accordance with the unbalance between the two portions of the oscillation circuit which constitute the bridge arms. The amount of energy transferred to the detector, that is, the effective coupling between the circuits, is therefore determined by the adjustment of the relative values of the capacities C and C_F and the position of the point K in the coil L.

An extremely loose effective coupling of the antenna circuit with the oscillation circuit is thus obtained and this feature is fundamental as regards obtaining of a very low damping during the whole energy transmission. The selection of the feeding point K at the coil L in conjunction with the working impedance of the oscillation circuit will determine the sensitivity of the apparatus; this adjustment is therefore very critical, but is made only once.

Adjustment of the effective coupling, that is, of the energy transferred to the detector may be obtained, to facilitate construction, by varying the relationship between the condenser C_F and the condenser C.

According to the invention piezoelectric telephone receivers may be used in the portable reception apparatus as they not only permit reduction in the weight and of the dimensions of the apparatus but, on account of their small metal mass, greatly reduce the damping influences. Damping is practically unavoidable when magnetic telephone receivers are used, as these of necessity would have to be placed in the vicinity of ultra short wave coils. With piezoelectric receivers this source of difficulties may be eliminated. A special advantage is derived where such piezo-electric telephone receivers are used by utilising the capacity of said receivers as a coupling capacity F (Fig. 2) as above explained.

It will be noted that the various features of the above described circuit contribute to obtaining maximum sensitivity. By tuning the antenna A to exactly one-half of the length of the received wave by means of the loading coil L_A , a maximum voltage is obtained at the point of connection between the coil L_A and the oscillation coil L. The damping in the oscillation circuit, including the coil L and the condensers C and C_F , is reduced to a minimum by eliminating the resistance of the detector D from the oscillation circuit proper, and by causing the impedance of the antenna circuit to be greater than that of the oscillation circuit so as to prevent extraction of energy therefrom. The adjustment of the relative capacities of the condensers C and C_F and the adjustment of the point K on the coil L may be so effected as to obtain maximum energy flow through the detector D. This transfer of energy to the detector, or the effective coupling of the detector circuit, may be controlled as desired from a substantially zero transfer, that is, an extremely loose coupling, to a maximum transfer, or close coupling, by varying the relative capacities and the point K on the coil L as above mentioned. The system is accordingly well adapted for use as a watch case receiver which can be conveniently carried by the person and may be used for receiving signals of the type specified. It is to be understood, however, that the system is capable of other uses and that the invention is only to be restricted in accordance with the following claims.

What I claim is:

1. A radio receiver adapted for receiving and detecting short waves, comprising an antenna having an effective length less than one-half of the length of the wave to be received, a loading coil connected to said antenna and having an inductance suited to increase the effective length of said antenna to about one-half of the length of the wave to be received, an oscillatory circuit tuned to the wave to be received comprising an inductance coil and a pair of condensers all connected in a series loop, means connecting said loading coil to a point on said inductance coil selected to obtain a step-up in voltage transferred to said oscillatory circuit, a detector connected from a point between said condensers to a point on said inductance coil to form a bridge circuit the sensitivity of which is determined by the balance between said condensers and the point of connection of said detector to said last coil, and a sound propagating device connected

to be actuated by the oscillatory current as demodulated by said detector.

2. A radio receiver adapted for receiving and detecting short waves, comprising an antenna having an effective length less than one-half of the length of the wave to be received, a loading coil connected to said antenna and having an inductance suited to increase the effective length of said antenna to about one-half of the length of the wave to be received, an oscillatory circuit tuned to the wave to be received comprising an inductance coil and a pair of condensers all connected in a series loop, means connecting said loading coil to a point on said inductance coil selected to obtain a step-up in voltage transferred to said oscillatory circuit, a detector connected from a point between said condensers to a point on said inductance coil to form a bridge circuit the sensitivity of which is determined by the balance between said condensers and the point of connection of said detector to said last coil, and a sound propagating device connected in series with said detector in said bridge circuit to be actuated by the current therein as demodulated by said detector.

3. A radio receiver adapted for receiving and detecting short waves, comprising an antenna having an effective length less than one-half of the length of the wave to be received, a loading coil connected to said antenna and having an inductance suited to increase the effective length of said antenna to about one-half of the length of the wave to be received, an oscillatory circuit tuned to the wave to be received comprising an inductance coil and a pair of condensers all connected in a series loop, means connecting said loading coil to a point on said inductance coil selected to obtain a step-up in voltage transferred to said oscillatory circuit, a detector connected from a point between said condensers to a point on said inductance coil to form a bridge circuit the sensitivity of which is determined by the balance between said condensers and the point of connection of said detector to said last coil, one of said condensers constituting a sound propagating device of the piezo-electric type, which is actuated by the current in the bridge circuit as demodulated by said detector.

4. A radio receiver adapted for receiving and

detecting short waves, comprising an antenna having an effective length less than one-half of the length of the wave to be received, a loading coil connected to said antenna and having an inductance suited to increase the effective length of said antenna to about one-half of the length of the wave to be received, an oscillatory circuit tuned to the wave to be received comprising an inductance coil and a pair of condensers all connected in a series loop, means connecting said loading coil to a point on said inductance coil selected to obtain a step-up in voltage transferred to said oscillatory circuit, a crystal detector connected from a point between said condensers to a point on said inductance coil to form a bridge circuit the sensitivity of which is determined by the balance between said condensers and the point of connection of said detector to said last coil, and a sound propagating device connected to be actuated by the oscillatory current as demodulated by said detector.

5. A radio receiver adapted for receiving and detecting short waves, comprising an antenna having an effective length less than one-half of the length of the wave to be received, a loading coil connected to said antenna and having an inductance suited to increase the effective length of said antenna to about one-half of the length of the wave to be received, an oscillatory circuit tuned to the wave to be received comprising an inductance coil and a pair of condensers all connected in a series loop, means connecting said loading coil to a point on said inductance coil selected to obtain a step-up in voltage transferred to said oscillatory circuit, a detector connected from a point between said condensers to a point on said inductance coil to form a bridge circuit the sensitivity of which is determined by the balance between said condensers and the point of connection of said detector to said last coil, a sound propagating device connected to be actuated by the oscillatory current as demodulated by said detector, an insulating housing containing said coil, condensers, detector and sound propagating device, said housing having an internal metallic shielding, and means grounding said shielding to said oscillatory circuit.

FRIEDRICH MORAWETZ.