PUBLISHED
MAY 18, 1943.
BY A. P. C.

W. DÄLLENBACH

RESONANCE DEVICE FOR ULTRA-SHORT WAVES

Filed March 18, 1941

Serial No.
384,019

2 Sheets-Sheet 1

Fig. 1.

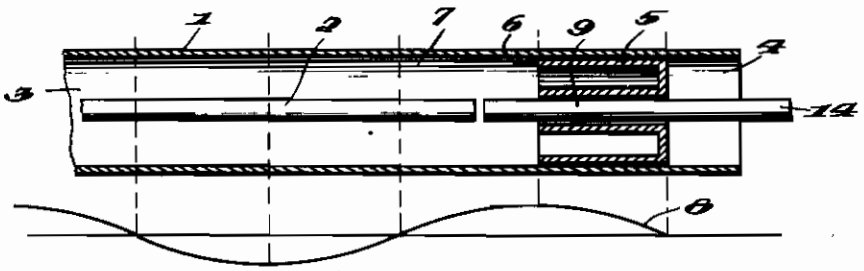


Fig. 2.

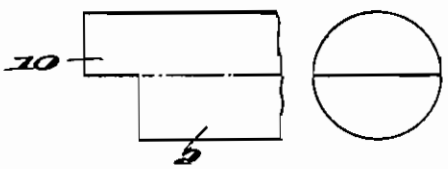


Fig. 3.

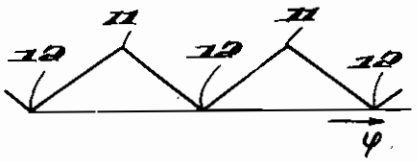


Fig. 4.

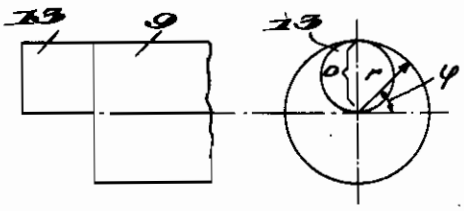
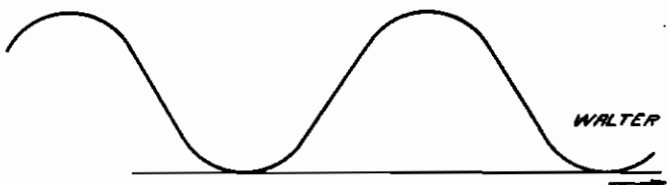


Fig. 5.



Inventor
WALTER DALLENBACH,

By Bailey & Pearson
Attorneys

PUBLISHED
MAY 18, 1943.
BY A. P. C.

W. DÄLLENBACH

RESONANCE DEVICE FOR ULTRA-SHORT WAVES

Filed March 18, 1941

Serial No.
384,019

2 Sheets-Sheet 2

Fig. 6.

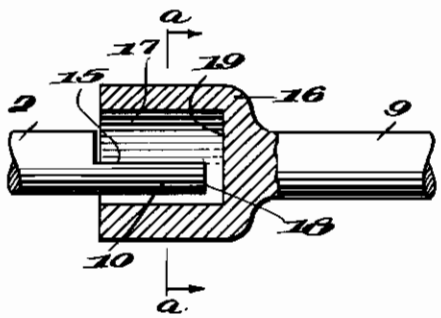


Fig. 6(a-a)

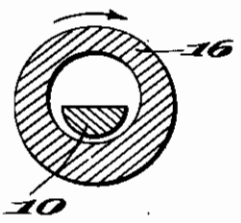
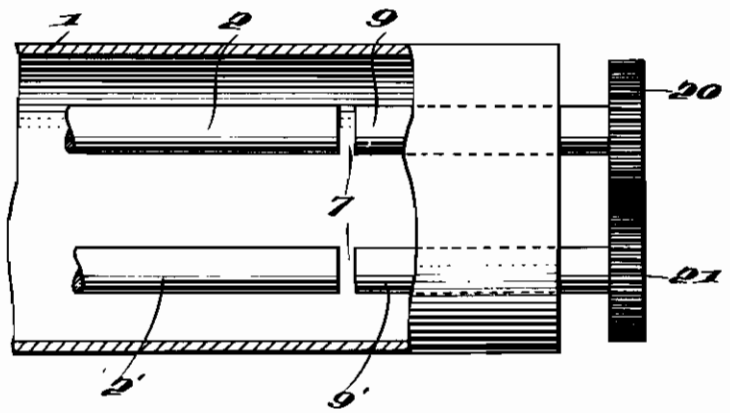


Fig. 7.



Inventor
WALTER DÄLLENBACH,

By Bailey & Parson
Attorneys

Published May 18, 1943

Serial No. 384,019

ALIEN PROPERTY CUSTODIAN

RESONANCE DEVICE FOR ULTRA-SHORT WAVES

Walter Dällenbach, Berlin W. 35, Germany; vested in the Alien Property Custodian

Application filed March 18, 1941

In regard to a resonance system for ultra short waves it often is necessary to vary the frequency of the oscillation same being produced in the resonance system. Furthermore it is often necessary to change the frequency periodically. These arrangement specially are useful for devices for measuring distances, working according to the method of frequency wabbling. This method can act f. i. as follows: the directly received wave and the reflected wave superpose each other and the seize of the beat frequency allows to measure the distance of the reflection point. The resonance system can be a single tuned straight lined conductor or more such conductors f. i. in form of a Lecher-system. The conductors can be shielded or not. Preferably concentric Lecher-systems are used as resonance devices and especially hollow space oscillating circuits with inner conductor are used.

According to the invention the resonance devices are constructed in sueh manner that one or all conductors and in case of a concentric Leeher-system the inner conductor are provided with a gap. Near the gap parts of the conduetor as well as parts of the inner conductor respectively are formed or profiled in such manner that in rotating same round their longitudinal axes a (periodical) variation of the capacity being formed by the gap takes place. This is happening without any longitudinal shifting.

For a fuller deseription of the invention reference is made to the accompanying drawings.

Figure 1 shows a concentric Leeher-system the inner conductor of whieh possesses a disconneetion point (gap). By shifting a short circuiting device f. i. a piston the disconnection point can be shifted from the position of a potential node to a potential loop and vice versa. In Figures 2 and 4 cross sectional views of inner conductors are shown which in turning effect a periodical variation of the capaeity. These variations being dependent of the angle of torsion are shown in the diagrams in Fig. 3 and 5. Figure 3 corresponds to the embodiment of the invention according to Fig. 2 whilst Fig. 5 corresponds to Fig. 4. The Figures 6 and 6a are showing embodiment with which a firmer coupling between the two parts of the eonductor is reached. Fig. 7 shows a two-wire line being arranged in a metallic casing.

Referring to Fig. 1 a concentric Lecher-system with the outer conductor 1 and the inner conductor 2 is connected at 3 to a generator especially for ultra high frequency. At the end 4 the Lecher-system is closed by a piston 5 which has a length of $\lambda/4$ (λ=wave length) for receiving small contact resistance. (Such devices have been already explicitely described in the specifications of the Patent Application ——— Serial Number 186,454). The inner conductor of this energy line possesses a disconnection point 7. This gap forms a series capacity of definite value. The wave length of the oscillations produced by the generator eventually can be varied by shifting the piston 5. The energy line as shown in Fig. 1 can be used for a steady variation of the wave length f. i. with an additional hollow space as it has been already explicitely described in the former Patent 2,163,589 and Patent Application ——— Serial Number 264,246. Firstly the case is considered the capacity 7 having an infinite value. Furthermore the distribution of the voltage being as shown by the curve 8. The eapacity 7 being at a point of a potential loop it has no influence to the potential distribution nor to the wave length, also if the capacity is becoming a limited value. If in contrary the capacity 7 is shifted away from a potential loop to a current loop when of course the potential reaches a minimum f. i. in the position as shown in Figure 1, a variation of the potential- and current-distributions along the energy line takes place by changing the capacity 7. Variations of capacity 7 are of bigger effect the nearer capacity 7 is provided to a current loop.

For using the device as per this invention of measuring distances it is advantageous to vary the wave lengths periodically and for this purpose to cause a variation of capacity 7 with a frequency of 10 to 100, f. i. 50 periods per one second without using bigger forces in the device or transmitting disturbing vibrations on same. This task ean be solved by making turn part 9 of the inner conductor like a shaft by a coupled motor, f. i. about 3000 times per minute. Shaft 9 turning round, a periodical alteration of capacity 7 takes place as soon as the ends of parts 9, 2 of the inner conductor are formed not like a plane perpendicular to the longitudinal axis but possess some form fit for its purpose.

Figure 2 shows such device of a free end of conductor 2 or 9 at the gap 7 in enlarged scale, i. e. showing the sectional elevation as well as the side elevation. In this embodiment conductor 2 over a half circle of its cross section is longer that is this forms a continuation 10 in respect to

the other half of conductor 2. Conductor 9 is formed in the same manner as before and the continuation 10 of conductors 9 and 2 are opposed each other in a tight slit, forming the field space of capacity. Turning conductor 9 and conductor 2 being unmovable, capacity 7 will be dependent of the angle of torsion φ as shown by the curve in Figure 3. At 11, there the capacity being a maximum, the two continuations 10 are placed opposite each other accurately. On the other hand at 12 the two continuations 10 of the conductors 2 and 9 are displaced opposite each other at 180° and the capacity 7 goes back to zero respectively some small value.

Wanting f. i. a sinus-shaped variation of capacity 7 the one conductor, f. i. conductor 2 can be constructed as per fig. 2 whilst the end at 7 of conductor 9 can be constructed as per fig. 4. A sinus-shaped variation can be reached in using a continuation 13 on conduetor 9 forming a flat circle cross section as per fig. 4 instead of continuation 10 forming a half-circle cross-section as per fig. 2. As per theoretical calculations and considerations the limiting curve of continuation 13 must satisfy the following equation:

$$r=D\sqrt{\sin\varphi}$$

Capacity 7 varies itself dependent of the angle of torsion of shaft 9 as per fig. 5 being the analogon to fig. 3.

Constructing the variable capacity 7 in such manner as per figures 2 and 4 showing it in two different embodiments their possible maximum value is limited by the measurements of the cross sections of the conductor respectively of the cross sections of the profiled continuations 10 and 13. Thus also the degree of coupling of both parts of the conductors 2 and 9 is limited. For reaching a firmer coupling as it is necessary especially for a periodical variation of frequency both the ends of the conductors being adjacent same can be advantageously constructed as per figures 6 and 6*a*. Conductor 2 f. i. is being constructed as per fig. 2 and is being provided with a continuation 10 of half-circle-like cross-section. The adjacent part 16 of the other conductor is thicker than shaft 9 and possesses an eccentric boring 17 in which the continuation 10 of conductor 2 projects. One or both of the parts of the conductors 2 and 9 rotating round their longitudinal axis a periodical variation of capacity 7 takes place as a follow of the periodical variation of the distance of the outer surfaces of the continuation 13 from the inner surfaces of the eccentric boring. Capacity 7 is at minimum value if the plane surface 15 of continuation 10 is directed downwards. In the contrary the capacity between the front surfaces 19 and 19 will not vary and are forming a constant additional capacity.

By correct measuring of boring 17 and continuation 10 projecting into same capacity 7 can reach any wanted value. The boring 17 and the continuation 10 can obtain any other fitting form thus varying the series capacity according to a function of convenient kind, f. i. linearily or sinusshaped as per fig. 3 and 5.

Figure 7 shows a further embodiment of the scope of the invention. Instead of a concentric energy line a Lecher-system constructed by the parts 2, 9 resp. 2', 9' serves as resonance device and is shielded by a metallic casing 1. The parts of the conductors are disconnected at 7 and forming series capacity receiving any convenient value by proper profiling the ends of the conductors being adjacently arrangcd. The variation of the series capacities can be obtained by rotating f. i. the parts of the conductors 9 and 9' round their longitudinal axis. This rotation can take place separately or commonly by coupling both the conductors 9 and 9' over gear whcels 20 and 21 as per fig. 7. Corresponding to the choice of the gear wheels a sympathic or unsympathic variation of the series capacity takes place.

Of course such arrangements can be varied in manifold ways. The metallic casing 1 can be left off or can be substitutcd by another shielding f. i. by a combination of half conductors. Furthermore the Lecher-system can be tuned by a bridge member of a length of $\lambda/4$(λ=wave length), in the direction of the longitudinal axis being shiftable along the Lecher-system as is shown in fig. 1 for the case of a concentric Lecher-system. Especially by the bridge a shifting of the capacity 7 in respcct to the current loops and current nodes along the Lecher-system can be obtained.

Instead of coupling the resonance device to a generator cxciting oscillations the resonance dcvice can be coupled to an energy line the tuning of which can be varied by it in a periodical way. In this manner instead of a direct frequency tuning an indirect tuning of the generator exciting the oscillations will take place. The coupling can be made in any wellknown manner it can f. i. be galvanic, inductive, capacitive or by radiator coupling. If the resonance device is shaped like a concentric pipe line as described in this specification the coupling can take place with a like energy line over a properly measured variable or unvariable slitlike opening.

If the resonance system according to fig. 1 is coupled at 3 loosely to a generator, one receive by periodical variations of capacity 7 instead of a periodical variation of wave lengths a periodical variation of the amplitude of the oscillations up to which the periodical varied and tuned rcsonance system is swinging. With an arrangement according to fig. 1 one can receive not only periodical variations of the wave lengths of an ultra short wave generator but also periodical variation of a coupling by firm wave length. In this manner one can f. i. produce periodical variations i. e. modulations of the energy radiated by an aerial system.

The arrangement according to the invention is effecting the periodical tuning resp. coupling of the resonance system by rotating means. By avoiding any longitudinal shifting parts of the apparatus the disturbing vibrations are completely suppressed.

Instead of periodical variations of the series capacity same can advantageously be used for changing spontaneously the frequency tuning resp. the dcgree of coupling from a distinct value to another distinct value. In this case the rotatable part of the conductors will not permanently rotate but being turned round a definite angle in dependance of any regulation value by hand or automatically. This rotations can be produced f. i. by a magnetical system. There a periodical variation of the series capacity will not take place but only a single or repeated alteration of its value. This alteration can be used in the same manner as the periodical variation f. i. for the frequency changing of the generator or for the alteration of tuning of one or more energy lines as well as for the changing of the degree of coupling of a generator and an energy line or the

coupling of one of themselves and a radiator or the coupling of several energy lines.

By tuning the rotating conductor part about 180° a preferable possibility of using this device is given in so far as the series capacity and thus the coupling degree are brought from their minimum value to their maximum value or vice versa. With such an arrangement a comfortable and correct morsing of aerial-systems (primary and secondary radiator) can be reached. This method has an essential advantage for ultra short waves in respect to mechanical morsing in so far as variable transition resistances at the gap and energy alterations necessarily caused hereby, can be avoided.

The use of the resonance device as per invention for varying the frequency tuning respectively the coupling degree naturally is not limited to the use in combination with generators producing ultra high frequency oscillations but can as well be used in reeeivers for the same purposes.

In using f. i. on part of the generator as well as on part of the receiver resonance devices of the same kind which cause a periodical variation taking place synchronically an undisturbed transmission of news can take place between two stations. Synchronising of the periodical variations of frequency is started advantageously by the generator f. i. by giving an impulse.

The influence of the variable capacity 7 to the tuning resp. coupling of the resonance system is by using this capacity in a potential loop of the most minimum value, by providing it in a current loop of the most maximum value.

By shifting their positions any intermediate values of the impression can be obtained.

WALTER DÄLLENBACH.