July 16, 1929. H. P. DONLE 1,720,824

RADIODETECTOR

Filed May 5, 1922 2 Sheets-Sheet 1

Fig. 1.

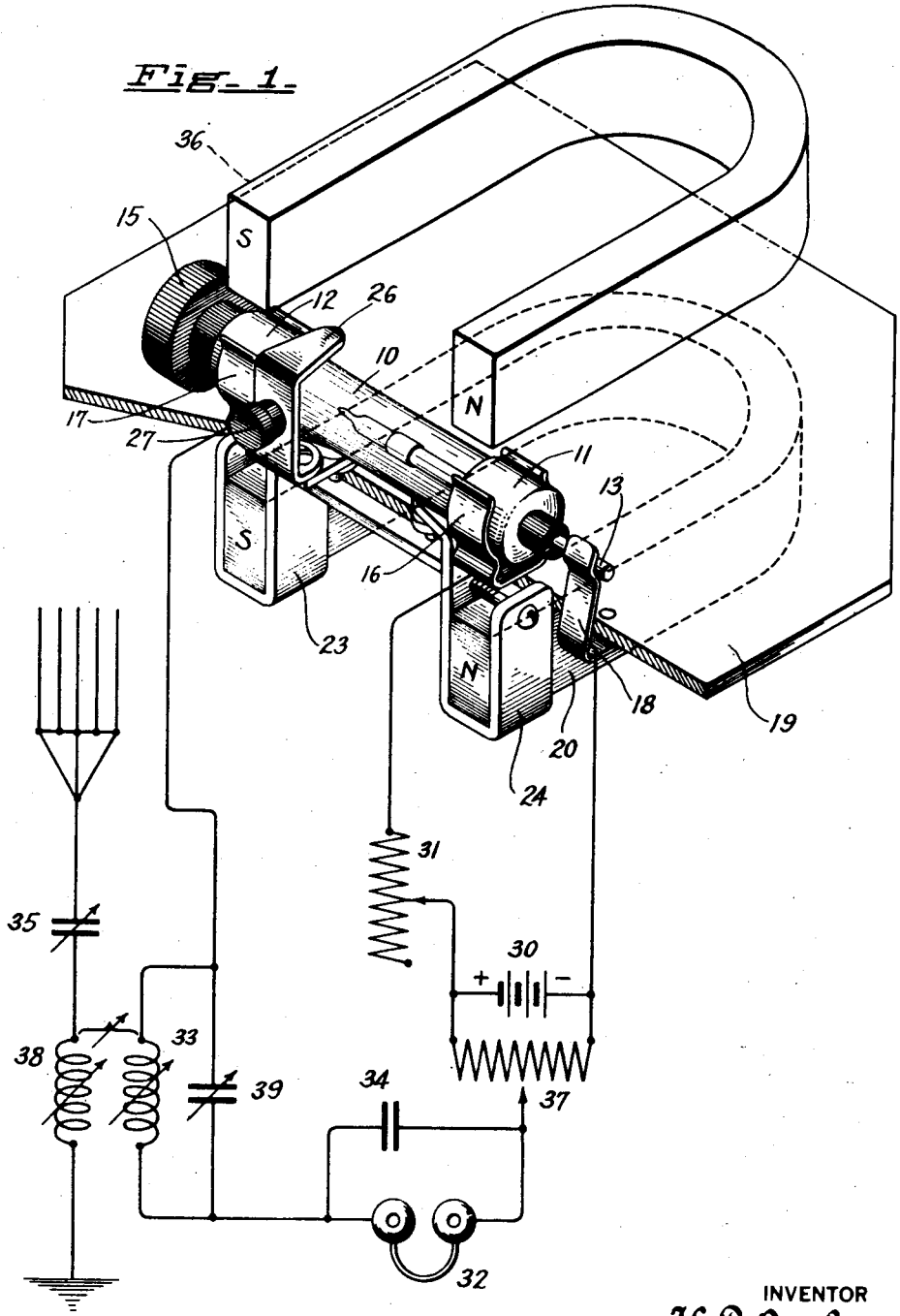

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Fig. 2.

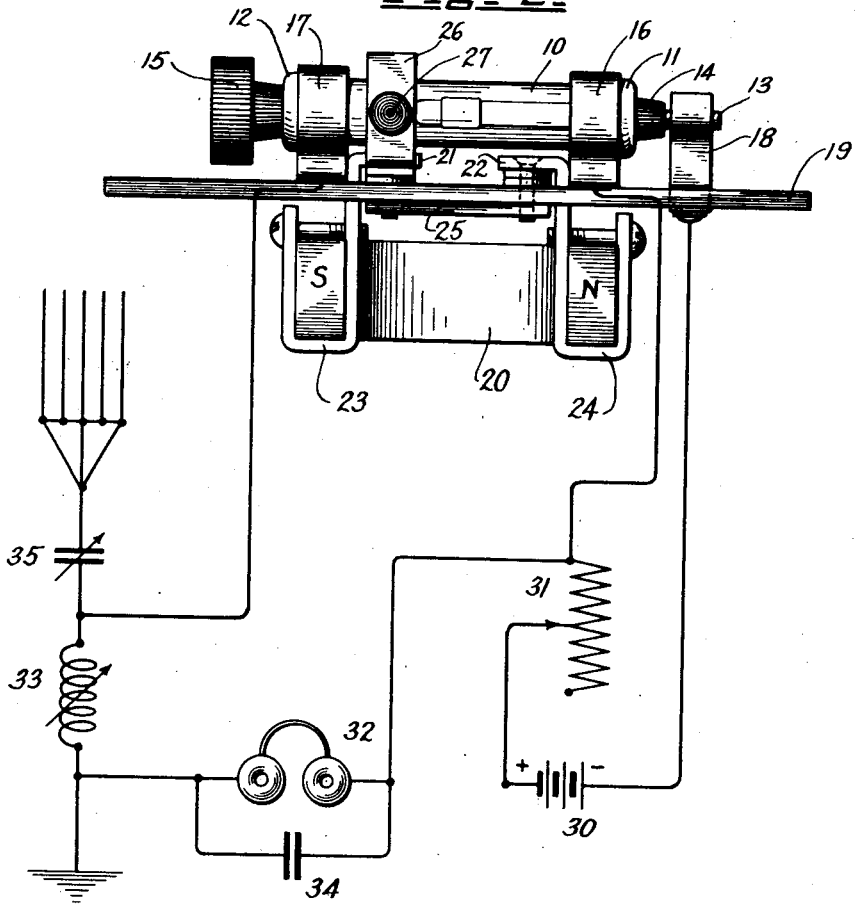


Fig. 3.

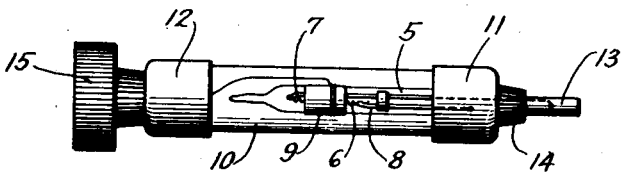
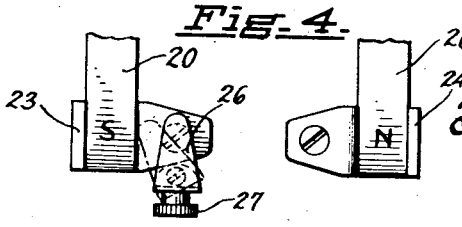


Fig. 4.



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UNITED STATES PATENT OFFICE.

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RADIODETECTOR.

Application filed May 5, 1922. Serial No. 558,706.

The primary object of my invention is to provide a highly efficient and sensitive, yet dependable and inexpensive, detector for the high frequency electric currents set up in the aerial and associated circuits of radio receiving stations. The structure described herein is simple in manufacture and assembly, and contains no costly parts. The preferred type of mounting, as well as the means for adjusting the magnetic field, permits easy control of the detector's sensitiveness. The small heating filament practical in my device requires less battery current than is common in vacuum tube detectors and gives economy in operation. The novel disposition of the magnetic field results in a relatively great sensitiveness and consequently permits the reception of faint radio signals from far distant points.

A still further object is to permit, by virtue of the large sensitiveness, the reception of signals from distant points without resorting to the complication of amplifying devices or regenerative circuits.

Another object is to provide receiving apparatus in which the expendable or replaceable parts are small and relatively inexpensive.

In the preferred form of the apparatus, I employ a vacuum tube device having an internal cathode and an external anode. I mount this tube within a magnetic field which is preferably produced by a permanent magnet having a movable pole piece for varying the field. In order to stabilize the action of the tube, and for convenience in handling, I prefer to mount the tube in a holder which in turn is adapted to be supported in spring clips such as are commonly employed for cartridge type fuses.

Figure 1 is a perspective view of the novel elements of a detector embodying the improvements of my invention and showing it in a receiving circuit.

Fig. 2 is an edge view of such a detector with a simplified circuit.

Fig. 3 is a side view of one of the tubes in its holder.

Fig. 4 is a plan view showing the pole pieces.

The tube 5 may be of any suitable material such as glass, commonly employed in making vacuum tubes. The filament 6 extends longitudinally of the tube and is supported by members 7 and 8, which may be secured in one end of the tube. The anode 9 is secured on the outside of the tube 5 surrounding the hottest part of the filament 6.

The vacuum tube is preferably mounted within a transparent glass cylinder 10, which has end members or caps 11 and 12. The ends of the filament are electrically connected through their supports to the cap 11 and the central pin 13, which extends through the insulating bushing 14. The anode 9 is electrically connected to the other cap 12. The holder may be provided with a knob or handle 15 for convenience in handling and adjustment.

This particular form of tube is especially adapted for mounting in spring clips such as 16 and 17. I also preferably provide a spring contact 18, the clips and contact being conveniently mounted upon an insulating panel or support 19.

The magnetic field is preferably formed by a permanent magnet 20 whose pole pieces 21 and 22 are arranged adjacent one side of the tube. For convenience in construction these pole pieces are parts of yokes 23 and 24, which are connected to the ends of the magnet 20 and extend through the panel 19. The non-magnetic piece 25 may serve to connect the pole pieces 21 and 22 and clamp them to the panel 19 in fixed relation. To one of the pole pieces is pivoted an extension 26 which extends part way around one end of the holder 10. For convenience in operating, this extension may be provided with a handle 27.

It will be seen that the field of the magnet extends between the pole pieces 21 and 22 at one side of the tube with a lateral deflection to the extension 26, which extends partially around one end of the holder beyond the tube. The tube and holder are rotatable in the clips 16 and 17, and also capable of longitudinal adjustment to bring the filament and anode into the most effective part of the field. In addition to these two adjustments, the extension piece 26 is adjustable to vary the shape of the magnetic field itself and thus alter the sensitiveness or other characteristics of the tube.

In the circuit arrangement of Fig. 2, the filament is lighted by the current from the battery 30, the intensity of which may be varied by the rheostat 31. From the positive side of the filament 6 a connection extends through the telephone receiver 32 and the tuning coil 33 to the anode clip 17, thus pro-

viding a circuit between the anode and cathode for the passage of telephone currents. The telephone 32 may be shunted by a condenser 34 to by-pass radio frequency potentials generated across the tuning coil 33, so that these potentials may be applied directly to the electrodes of the vacuum tube detector.

The usual antenna-ground circuit including the variable tuning condenser 35 and the tuning coil 33 is shown and serves the purpose of intercepting the radio waves which it is desired to receive.

For some purposes it is desirable to add to the system of Fig. 2 a second permanent magnet 36 as illustrated in Fig. 1. Such second magnet I find is preferably disposed immediately above the tube and its holder, and arranged so that its polarity corresponds with that of the main magnet 20.

In Fig. 1 I have shown a more completely adjustable detector circuit. As before, the filament is lighted from a battery 30, the amount of current flowing to the filament being controlled by the rheostat 31. Instead of connecting the telephone directly to the positive terminal of the filament, I provide a potentiometer 37, to the moving contact of which a telephone 32 is attached. As before the telephone circuit is completed through a tuning coil 33, but in Fig. 1, this coil forms the secondary of an oscillation transformer having a primary 38 in the antenna-ground circuit. The secondary may be shunted by a variable condenser 39 for tuning in the usual way. The telephone itself is shown shunted by a by-pass condenser 34. The primary coil 38 has in its circuit the tuning condenser 35.

In the operation of my device, radio frequency potentials produced in the coil 33 by the received waves are impressed upon the anode and cathode of the vacuum tube detector and result in pulsating electric currents which pass through the telephone 32 to produce audible indications. I find that when the vacuum tube is properly located with respect to the magnetic field, the receiver is exceedingly delicate and gives strong signal responses either to wireless telegraph or radio telephone waves.

Although I have shown the invention as utilizing the field of a permanent horseshoe magnet, I wish it understood that I do not intend that the claims shall be limited to this particular construction except as the claims may be specifically limited thereto, since I have found that advantageous results may be obtained in other ways under certain circumstances, as for instance by an electro-magnet, the field of which can itself be varied.

The tube itself will be seen to be very simple in construction and therefore inexpensive. It has but two elements, one of which is outside of the evacuated space. Such tubes have been found to be particularly stable and durable, and because of the fact that they contain nothing but the filament and its supports, have been found easy to evacuate and to maintain under a condition of high vacuum. The absence of complicated internal electrodes makes the construction of these tubes entirely comparable to the building of miniature incandescent lamps, and brings the cost of construction down to a comparatively low figure. Nevertheless, by reason of the combination of the external anode tube with the magnetic field which I have here shown, I am able to secure novel and striking increases of detector sensitiveness which are not obtainable by use of an internal anode detector tube with magnetic field or an external anode detector tube without magnetic field.

It should be understood that the type of receiver is immaterial to my invention and that I may utilize a relay or other responding instrument in place of the telephone shown. The type of aerial or antennæ and circuits may also be varied widely within the scope of my invention.

I claim:

1. In a receiving apparatus, a magnet, supporting yokes therefor having pole pieces, an extension pivoted to one pole piece and means for supporting a detector tube having a linear filament adjacent said pole pieces and said extension whereby the flux field from said magnet is distorted and caused to produce an increased response from said detector tube.

2. A detector comprising an evacuated tube having a filament and an external anode and a holder comprising a cylindrical shield having end caps, one of which is connected to the filament and the other to the anode, and a central conducting pin at one end connected to said filament.

3. A detector comprising an evacuated tube having a filament and an external anode and a holder comprising a cylindrical shield having end caps, one of which is connected to the filament and the other to the anode, an insulating knob at one end, and a central conducting pin at one end connected to said filament.

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