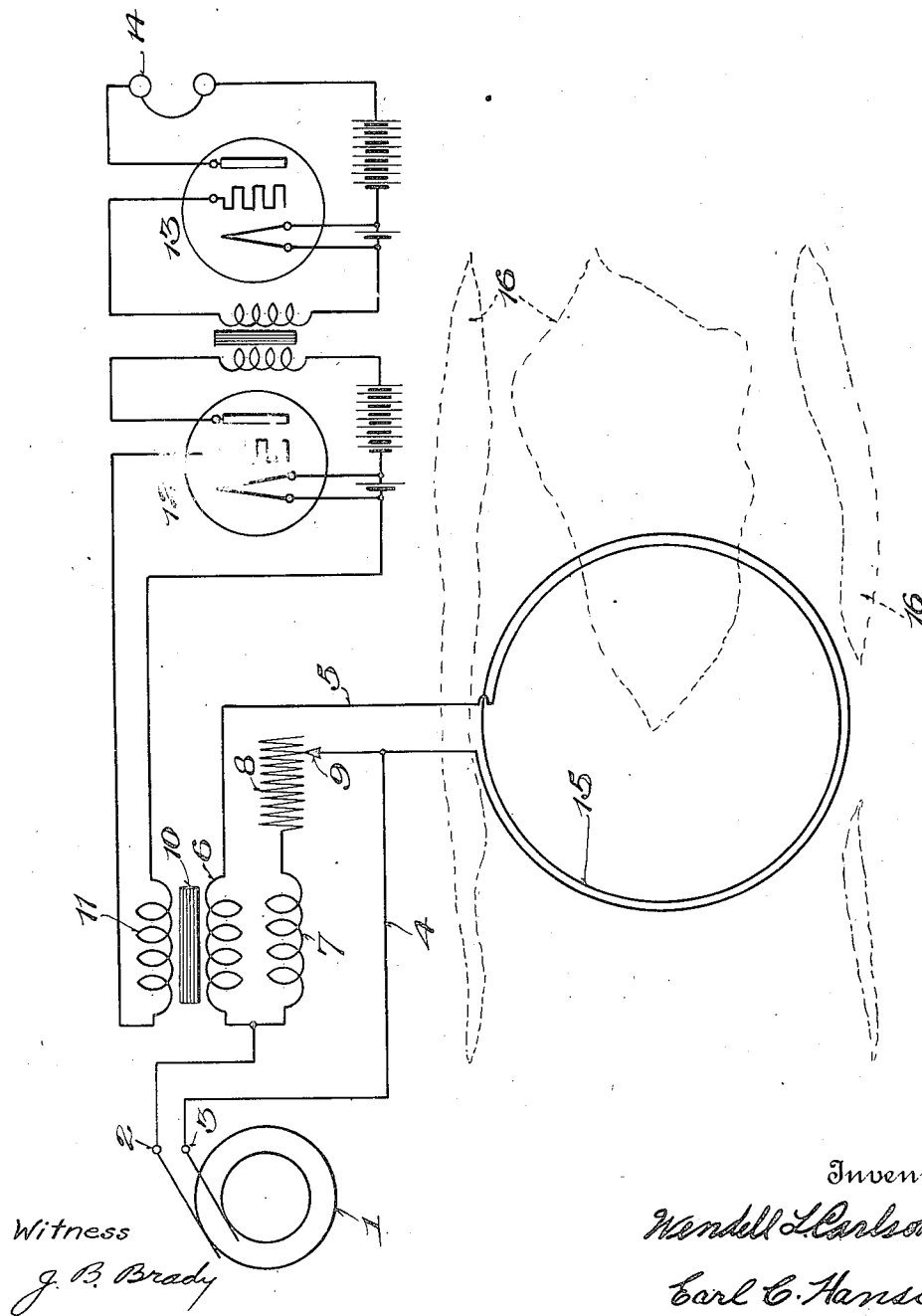


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 MEANS FOR LOCATING ORE BODIES BY AUDIO FREQUENCY CURRENTS.
 APPLICATION FILED MAY 7, 1919.

1,325,554.

Patented Dec. 23, 1919.



UNITED STATES PATENT OFFICE.

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MEANS FOR LOCATING ORE BODIES BY AUDIO-FREQUENCY CURRENTS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, WENDELL L. CARLSON and EARL C. HANSON, citizens of the United States, residing at Washington, District of Columbia, have invented new and useful Improvements in Means for Locating Ore Bodies by Audio-Frequency Currents, of which the following is a specification.

10 Our invention relates to a means for determining the location and approximate magnitude of bodies of ore buried in the earth.

15 The object of this invention is to provide simple and reliable electrical means for accurately spotting metallic ore deposits and indicating directly the extent of the ore bodies.

20 Another object of this invention is to provide a portable apparatus which can be transported without difficulty in the mining districts and used to explore promising ore regions to determine the position and magnitude of the metallic deposits.

25 A further object of this invention is to establish in an apparatus of this character an exploring coil connected in a balanced electrical circuit energized by a source of audio frequency current which circuit will
30 be immediately thrown out of balance when the exploring coil is brought into the vicinity of ore bodies and thus manifest the presence of the ore by actuating a suitable responsive device.

35 This invention is diagrammatically illustrated in the accompanying drawing which forms a part of the following specification.

Referring particularly to the drawing which has been selected to clearly set forth
40 the principle advanced in the present means for locating ore bodies, reference character 1 designates an audio frequency generator, for example a 1000 cycle machine, having terminals 2 and 3. The portable exploring
45 coil 15 is connected to the audio frequency generator on one side by conductor 4 and on the other side through conductor 5 and a primary winding 6 of a differential transformer.

50 A second primary winding 7 of the same differential transformer is connected in a circuit from terminal 2 of the audio frequency alternator through variable calibrated resistance 8 equipped with adjustable
55 contact 9, returning to the terminal 3 of the alternator through conductor 4. The differ-

ential transformer has a laminated iron core 10 and secondary winding 11 which comprises the input circuit of the audio frequency thermionic amplifiers 12 and 13. Although only two stages of amplification are shown it is obvious that additional stages might be employed. Responsive device 14 is connected in the output circuit of the final amplifier. This device is here shown as telephone receivers but it is apparent that any
60 electromagnetically controlled device might be employed.

Coil 15 is adapted to be moved over the area which it is desired to explore to locate
70 hidden ore deposits represented by dotted lines 16 as beneath the surface of the earth.

The variable resistance 8 is calibrated in terms of ore density. This is accomplished by noting the relative energy absorbed by
75 ore bodies due to the eddy currents induced therein by the magnetic field emanating from the exploring coil. A variation in energy absorbed by the ore body is accomplished by a like variation of current
80 intensity in the exploring circuit. The differential transformer is balanced for each setting by varying the resistance 8 until the currents in windings 6 and 7 are equal. Hence the variable amount of resistance 8
85 required to balance the differential circuits for various energy absorptions is a direct calibration of ore density.

In the practical operation of this system for locating bodies of ore the exploring coil
90 15 is placed horizontally in relation to the earth. The variable contact 9 is adjusted until the resistance 8 just allows sufficient current to flow through the differential winding 7 so as to balance the magnetic field
95 produced by a flow of current through the differential winding 6. With the apparatus so balanced no tone will be produced in the telephone receivers 14, due to the fact that the potential induced in the secondary winding 11 is zero. On moving the exploring
100 coil 15 over the earth's surface any change in energy absorbed due to the presence of ore causes a variation in current in the exploring coil 15, which in turn unbalances
105 the differential windings 6 and 7 due to the unequal flow of current therein. Any minute change thus produced induces a voltage in the secondary winding 11 which will be greatly amplified by the thermionic amplifiers 12 and 13 producing a clear audible
110 tone in the telephone receivers 14. The mass

of ore will be determined with close approximation by noting the relative amount of the calibrated resistance 8 required in the circuit to balance out the magnetic field produced in the secondary winding 11.

While the diagram discloses the fundamental circuit employed in this improved method for locating ore bodies, in practice the complete balance of the circuit is obtained by not only balancing the currents but also keeping their phase relations constant. This can be accomplished by balancing the reactances as well as the resistances of the differential circuit.

Having thus described our invention and illustrated its use, what we claim as new and desire to secure by Letters Patent is the following:

1. The combination in a means for locating ore bodies of an audio frequency generator, an exploring coil connected in a bal-

anced circuit therewith, and means comprising an audio frequency amplifier for indicating any disturbance in the balance of said circuit.

2. In a means for locating bodies of ore and determining the magnitude thereof, said means comprising a vacuum tube amplifier, an exploring coil excited by an audio frequency generator connected in a normally balanced circuit therewith, and an adjustable means in said circuit for maintaining the balance thereof.

3. The method of locating ore bodies which consists in subjecting the ore bodies to an audio frequency alternating current magnetic field and measuring the absorption of energy by the eddy currents induced in said ore bodies.

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