

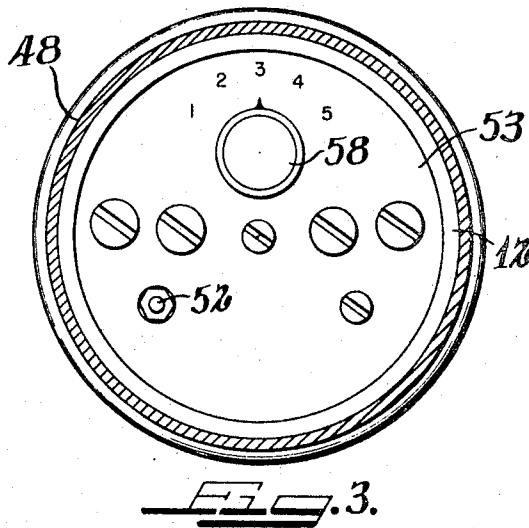
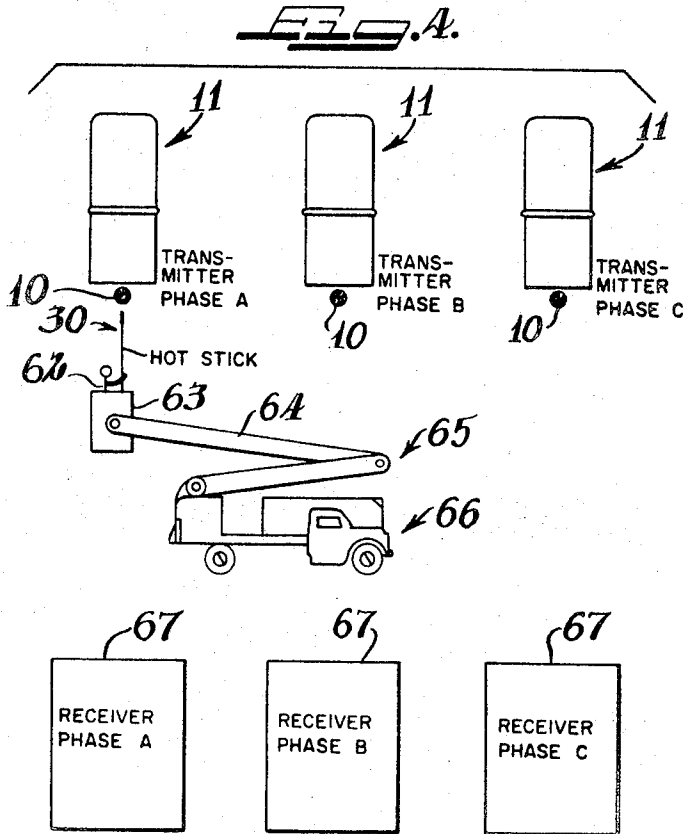
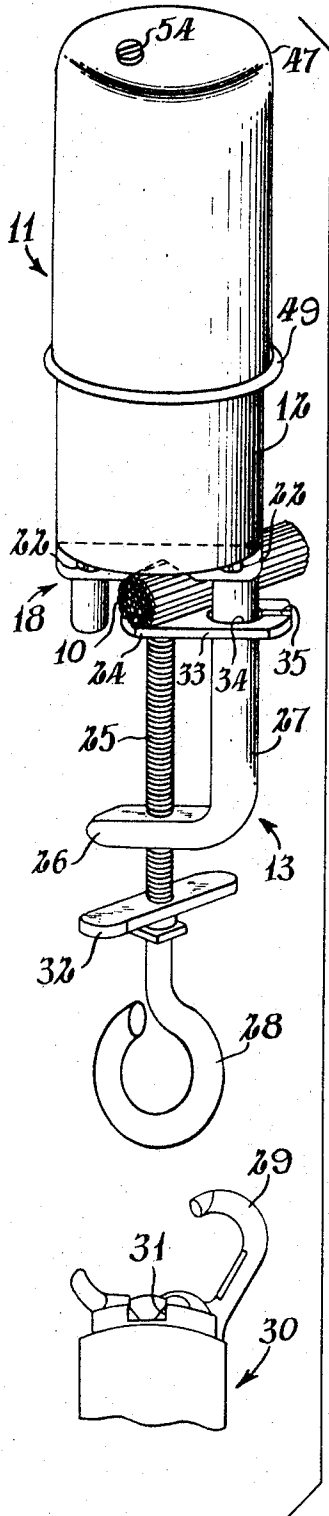
July 1, 1969

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WAVE TRANSMITTER HAVING A MAGNETIC CORE FOR DETACHABLY
CLAMPING TO A HIGH VOLTAGE CONDUCTOR

3,453,544

Filed Jan. 14, 1965

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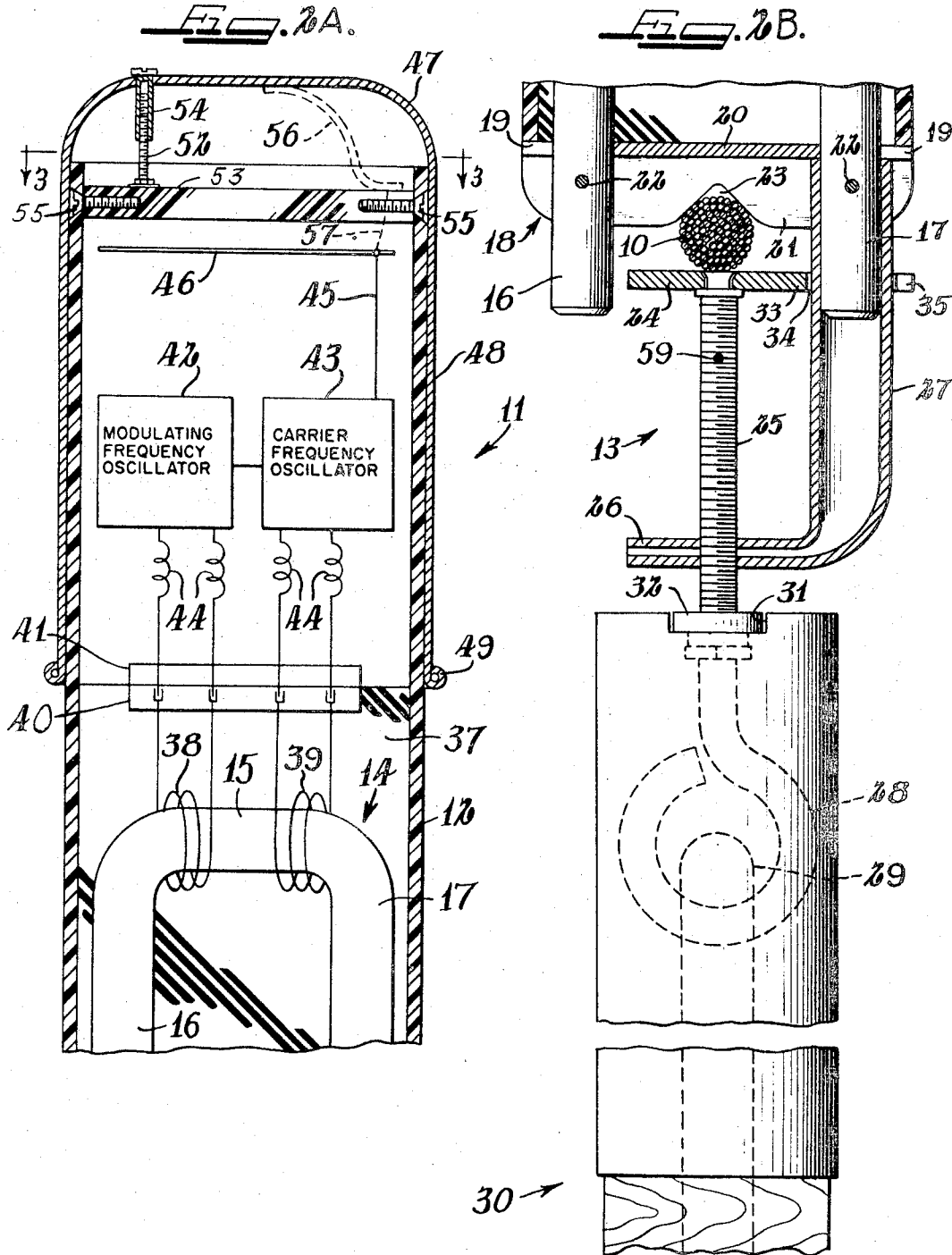
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3,453,544

WAVE TRANSMITTER HAVING A MAGNETIC CORE FOR DETACHABLY CLAMPING TO A HIGH VOLTAGE CONDUCTOR

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16 Claims

ABSTRACT OF THE DISCLOSURE

A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in the conductor is provided comprising a magnetic core for linking the conductor and for induction therein of alternating magnetic flux generated by the current flow, a clamp on the magnetic core for detachably clamping it to the conductor, live line tool attaching means on the clamp for detachable connection to the live line tool, a winding on the magnetic core into which alternating current is induced by the alternating magnetic flux and wave transmitting means modulated by the alternating current from the winding, the magnetic core, clamp and live line tool attaching means being positioned on the same side of the wave transmitting means.

This invention relates to and constitutes an improvement over the inventions disclosed in U.S. Patent No. 2,724,821, issued Nov. 22, 1955, and in applications having the following serial numbers and filing dates: 9,992, Feb. 19, 1960, Patent No. 3,197,702, issued July 27, 1965; 253,100, Jan. 22, 1963, Patent No. 3,223,889, issued Dec. 14, 1965; 282,450, May 22, 1963, Patent No. 3,340,472, issued Sept. 5, 1967; 286,345, June 7, 1963, Patent No. 3,275,892, issued Sept. 27, 1966; 302,197, Aug. 14, 1963; 330,339, Dec. 13, 1963, Patent No. 3,297,913, issued Jan. 10, 1967.

It has to do with radio and sound wave transmitters adapted to be detachably clamped to conductors of high voltage electric power transmission lines for energization from and modulation by current flow therein for transmitting to a remote point a signal corresponding to and providing indications of the current flow therein.

Application Ser. No. 282,450, filed May 22, 1963, discloses a radio transmitter employing the circuits of application Ser. No. 9,992, filed Feb. 19, 1960, and arranged to be detachably mounted on a conductor of a high voltage alternating electric current power transmission system. The circuits for the transmitter are mounted in a tubular insulating housing having a core of magnetic material projecting from the upper end for detachably linking a conductor and supporting the assembly thereon. Alternating magnetic flux generated by current flow in the conductor is induced in the core which carries windings into which alternating current is induced for energizing and modulating the transmitter.

If desired, the transmitter can be energized by a battery independently of the current flow in the conductor or the battery can be maintained in charged condition by such current flow. A sound wave transmitter can be employed instead of a radio wave transmitter as disclosed in application Ser. No. 253,100, filed Jan. 22, 1963.

At the lower end of the tubular housing a metallic bracket extends downwardly in the construction as disclosed in application Ser. No. 282,450, filed May 22, 1963. The metallic bracket not only functions as the antenna for the radio transmitter but also it provides a convenient

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means for receiving a hook of a live line stick. This permits a lineman to manipulate the transmitter and to move the core of magnetic material into engagement with the conductor for electrical and mechanical connection thereto and for it removing it therefrom without requiring that the conductor be opened. This can be accomplished while the conductor remains energized.

The construction above described has been satisfactory to electric power transmission systems operating at voltages ranging upwardly to 69 kv. when the usual safety precautions are taken by the lineman in manipulating the live line stick. When this construction is applied to a conductor of a system operating at a higher voltage, for example 138 kv., it has been found that the charging current due to the capacity effect to ground through the live line stick, lineman's body and his insulating support is sufficient to affect adversely certain of the components of the transmitter with the result that its operation is likely to be impaired. It is to overcome this difficulty that this invention is addressed.

Among the objects of this invention are: To provide for detachable connection of a live line stick to a portable radio or sound wave transmitter adapted to be detachably mounted on an energized high voltage electric power transmission line conductor in such manner that the charging current incident to such application or removal by a lineman does not traverse the circuit components of the transmitter; to provide the detachable connection for the live line stick on the magnetic circuit that detachably links the conductor; to provide for detachably clamping the magnetic circuit to the conductor by manipulation of the live line stick; to construct the transmitter with the magnetic circuit clamping means and live line tool attaching means on the same side of the circuit components of the transmitter thereby positioning the latter out of the path of flow of charging current from the energized high voltage conductor to the live line stick; to employ for the clamping means a clamp screw threaded through a portion of the magnetic circuit having at one end an eye for engagement with a hook of a live line stick and at the other end a conductor engaging member for bearing against one side of the conductor with a non-magnetic yoke stationarily mounted on the transmitter for bearing against the opposite side of the conductor; to mount winding means on the magnetic circuit for energizing and modulating the transmitter with alternating current corresponding to the alternating current in the conductor through high frequency impedance means so as to permit flow of such alternating current while preventing flow of high frequency current from the conductor to the transmitter; to embed the magnetic circuit in one end of an insulating housing that encloses the transmitting component with the clamp means and live line tool attaching means exteriorly of the housing in such relation that the center of gravity of the transmitter when clamped to the conductor is below the conductor, thereby facilitating mounting the transmitter with the housing extending upwardly from the conductor; to mount a corona shield on the end of the housing opposite the magnetic circuit; to employ the corona shield as a part of the antenna when the transmitter is a radio transmitter; and to detachably mount the corona shield on the housing and to provide electrical connection thereto.

In the drawings:

FIG. 1 is a perspective view of a current measuring device embodying the present invention and illustrating how it is mounted on a high voltage conductor and showing the relationship with a live line tool that can be employed for manipulating it.

FIGS. 2A and 2B, taken together with the former placed above the latter, show at an enlarged scale a vertical cross sectional view of the transmitter, certain

parts being shown diagrammatically and the upper end of the live line stick being shown in elevation.

FIG. 3 is a horizontal sectional view taken generally along the line 3—3 of FIG. 2A.

FIG. 4 shows the application of the present invention to a polyphase high voltage transmission system and illustrates how a lineman in an insulated bucket employs a live line stick to manipulate the transmitter for applying it to or removing it from a conductor.

In FIGS. 1, 2A and 2B a conductor 10 is indicated which may be one conductor of three conductors making up a three phase alternating current high voltage electric power transmission system. The phase to phase voltage may be of the order of 700 kv. or lesser voltage, this figure being mentioned for illustrative purposes only.

For measuring the flow of alternating current through the conductor 10 energized at high voltage there is provided a current measuring device, indicated generally at 11. It includes a cylindrical insulating housing 12 having at its lower end a magnetic core structure or magnetic circuit that is indicated, generally, at 13. The magnetic core structure 13 comprises an inverted U-shaped magnetic core 14 having a central section 15 and arms 16 and 17 depending therefrom. As shown in FIG. 2B a yoke 18 of non magnetic material, such as a channel formed of aluminum, is located at the lower end of the cylindrical insulating housing 12 and is provided with slots 19 at the ends of a central web 20 through which the arms 16 and 17 extend downwardly through suitable openings. Depending sides 21 of the yoke 18 are juxtaposed to opposite sides of the arms 16 and 17 and screws 22 extending therethrough secure the assembly together. Downwardly opening notches 23 are formed in the depending sides 21 for receiving the upper side of the conductor 10. In order to clamp the assembly securely to the conductor 10 there is provided a clamp plate 24 of magnetic material that is arranged to be moved by a clamp screw 25 that is also formed of magnetic material. The clamp screw 25 is threaded in an outstanding flat end 26 of a metallic sleeve 27 of magnetic material that is telescoped over the lower end of the arm 17 and secured thereto by the screw 22. At its lower end the clamp screw has an eye that is arranged to be engaged by a hook 29 of a live line tool or stick 30 of conventional construction. At its upper end the live line tool 30 has a transverse slot 31 for receiving a bar 32 at the lower end of the threaded portion of the clamp screw 25 when the hook 29 is withdrawn within the upper end of the live line tool 30 as shown in FIG. 2B. This arrangement serves to steady the current measuring device 11 at the distal end of the live line tool 30. An extension 33 from the clamp plate 24 is provided with a clearance opening 34 for guiding the clamp plate 24 in movements toward and away from the conductor 10. A slot 35 is provided in the outer end of the extension 33 in order to avoid the provision of a short circuited turn of conducting material around the metallic sleeve 27 and the arm 17. It is for this same reason that the slots 19 are provided in the ends of the web 20.

The magnetic core 14 is secured in the lower end of the insulating housing 12 by a potting compound 37. The potting compound 37 also embeds a modulating winding 38 and an energizing winding 39 that are located on the central section 15 of the magnetic core 14. The conductors from the windings 38 and 39 extend to a socket member 40 that is embedded in the potting compound 37 and is arranged to cooperate with a plug member 41 for energizing and controlling the operation of a modulating frequency oscillator 42 and a carrier frequency oscillator 43 arranged and constructed as described in application Ser. No. 9,992, filed Feb. 19, 1960.

In order to prevent the application of high frequency oscillations from the conductor 10 to the oscillators 42 and 43 while permitting the energization and modulation thereof by the 60 cycle frequency current from the conductor 10 high frequency impedance means in the form of choke coils 44 are provided between the plug member

41 and the oscillators 42 and 43. The impedance means in the form of choke coils 44 effectively prevents the application of high frequency oscillations to the oscillators 42 and 43 which high frequency oscillations are incident to the application of the current measuring device 11 to an energized conductor 10. Also such high frequency oscillations are incident to switching surges and lightning surges applied to the conductor 10 or in its vicinity.

The carrier frequency oscillator 43 is connected by a conductor 45 to a ring 46 of conducting material such as copper wire which provides a capacitive connection to a metallic cap 47 that is formed of good conducting material such as aluminum and acts not only as an antenna for the current measuring device 11 but also it acts as a corona shield to protect the oscillators 42 and 43 from the effects of high frequency oscillations and from the application thereto of high voltage from the conductor 10. It will be observed that the metallic cap 47 has depending sides 48 which extend downwardly over the outer surface of the insulating housing 12 substantially to the plug member 41. A rolled edge 49 is formed along the lower end of the metallic cap 47 in order to minimize the effects of corona discharge.

The metallic cap 47 is detachably held in position on the upper end of the housing 12 by a threaded stud 52 that extends upwardly from an end closure insulating plug 53. A sleeve nut 54 extends downwardly through a suitable opening in the metallic cap 47 for threaded engagement with the stud 52. Screws 55 extend through the walls of the housing 12 and into the end closure plug 53 for holding it in position.

If desired, the conductor 45 can be connected directly to the metallic cap 47. For this purpose, the ring 46 is omitted and the connection made through conductor 57, shown by broken lines, to a contact spring 56, also shown by broken lines. As a further alternate, the conductor 57 can be connected to the threaded stud 52 which, by the sleeve nut 54, is electrically connected to the metallic cap 47.

As shown in FIG. 3 a control knob 58 is carried by the end closure plug 53. The purpose of the control knob 58 is to shift the channel on which the carrier frequency oscillator 43 functions in order to provide for individually monitoring current flow in several adjacent conductors 10.

As shown in FIG. 2B, when the current measuring device 11 is clamped in position on a conductor 10, the distribution of weight is such that the center of gravity of the assembly is located as indicated at 59 below the conductor 10. This arrangement facilitates the application of the current measuring device 11 to the conductor 10 and also reduces the tendency for it to turn about the conductor 10 under the influence of gravity.

FIG. 4 shows the application of three current measuring devices 11 to three phase conductors 10 and indicated as phase A, phase B and phase C. In order to apply the current measuring devices 11 to the conductors 10, a lineman, indicated at 62, takes up his position in a basket 63 that is carried by the distal end of an insulated boom 64 that forms a part of a derrick, indicated generally at 65, which is arranged to be carried by a truck 66. It will be understood that the lineman 62 attaches the live line stick 30 to the eye 28 at the lower end of the clamp screw 25 and then operates the clamp mechanism of the live line stick to clamp the current measuring device 11 thereto as an endwise projection such as illustrated in FIG. 2B. This is accomplished with the clamp screw 25 withdrawn sufficiently far to permit the application of the magnetic core structure 13 to the conductor 10 with the insulating housing 12 extending upwardly from the conductor 10. Then the lineman rotates the live line stick 30 about its vertical axis with the conductor in place in the notches 23. The clamp plate 24 is moved upwardly to the clamping position as shown in FIGS. 1 and 2B. Thereafter, the lineman operates the live line stick 30 to disengage the hook 29 from the eye 28. This leaves the cur-

rent measuring device 11 securely clamped to and extending upwardly from the conductor 10. Then the truck 66 is moved to another position or the derrick 65 is swung to another position which permits these steps to be repeated for applying the other current measuring devices 11 to the other phase conductors 10.

When it is desired to monitor continuously the current flow in each of the conductors 10 simultaneously three receivers 67 are provided, one for each of the phases as indicated in FIG. 4. Each receiver 67 can be constructed as described in application Ser. No. 9,992, filed Feb. 19, 1960.

Instead of employing radio transmitters for the current measuring devices 11, sound wave transmitters can be employed as described in application Ser. No. 253,100, filed Jan. 22, 1963. Also, instead of employing the receivers 67 solely for current measuring purposes to indicate the magnitude of current flow, the arrangement may be such, as described in application Ser. No. 253,100, filed Jan. 22, 1963, for using the current indication for the control of circuit breakers. For this purpose, instead of employing the modulating frequency oscillator 42, as described in application Ser. No. 9,992, filed Feb. 19, 1960, any of the radio transmitting circuits shown in application Serial No. 253,100, filed Jan. 22, 1963, can be employed. Also, it will be understood that the other transmitting and receiving circuits described in certain of the other applications referred to herein can be employed.

While specific radio frequencies are referred to herein by way of reference to the copending applications above noted, it will be understood that other frequencies in the radio spectrum between 10 kc./s. and 3,000,000 mc./s. can be employed in practicing this invention.

What is claimed as new is:

1. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and wave transmitting means adapted to be modulated by said alternating current from said winding means, said magnetic core means, clamp means and live line tool attaching means being positioned on the same side of said wave transmitting means.

2. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and wave transmitting means adapted to be modulated by said alternating current from said winding means, said magnetic core means, clamp means and live line tool attaching means being positioned on the same side of said wave transmitting means, said magnetic core means comprising a U-shaped magnetic member; and said clamp means comprising a metallic sleeve having one end telescoped over one branch of said U-shaped magnetic member and the other end flattened and extending transversely of said one end and having a threaded opening therethrough, a screw in said threaded opening having said live line tool attaching means at one end and a con-

ductor engaging jaw at the other end, and a yoke for engaging said conductor on the side opposite said jaw.

3. The wave transmitter of claim 2 wherein said metallic sleeve, screw and jaw are formed of magnetic material and said yoke is formed of non-magnetic material.

4. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, wave transmitting means adapted to be modulated by said alternating current from said winding means, and housing means having a portion of said magnetic core means embedded therein and enclosing said wave transmitting means, said clamp means and live line tool attaching means being positioned exteriorly of said housing means.

5. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, wave transmitting means adapted to be modulated by said alternating current from said winding means, and housing means having a portion of said magnetic core means embedded therein and enclosing said wave transmitting means, said clamp means and live line tool attaching means being positioned exteriorly of said housing means, the center of gravity of said wave transmitter when clamped to said conductor being located below the center of said conductor whereby mounting of said wave transmitter with said housing extending upwardly from said conductor is facilitated.

6. In combination, a polyphase high voltage alternating current power transmission line comprising a plurality of conductors in insulated spaced relation, and a wave transmitter detachably clamped at its lower end to each conductor and extending upwardly therefrom for measuring current flow therein, each wave transmitter comprising: magnetic core means linking the respective conductor and having induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means detachably securing the same to said conductor, live line tool attaching means on said clamp means for detachable connection to a live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and wave transmitting means modulated by alternating current from said winding means.

7. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into

which alternating current is induced by said alternating magnetic flux, wave transmitting means adapted to be modulated by said alternating current from said winding means, elongated housing means having a portion of said magnetic core means embedded therein at one end and enclosing said wave transmitting means, another portion of said magnetic core means projecting from said one end of said housing means and having said clamp means and live line tool attaching means thereon, and a metallic corona shield overlying the other end of said housing means.

8. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and radio transmitting means adapted to be energized and modulated by said alternating current from said winding means, said magnetic core means, clamp means and live line tool attaching means being positioned on the same side of said radio transmitting means.

9. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and radio transmitting means including a carrier frequency generator adapted to be energized by said alternating current from said winding means, and modulating means adapted to be controlled by said alternating magnetic flux and connected to modulate said carrier frequency as a function of the magnitude of said alternating current, said magnetic core means, clamp means and live line tool attaching means being positioned on the same side of said radio transmitting means.

10. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and radio transmitting means adapted to be energized and modulated by said alternating current from said winding means, elongated insulating housing means having a portion of said magnetic core means embedded therein and enclosing said radio transmitting means, another portion of said magnetic core means projecting from said one end of said housing means and having said clamp means and live line tool attaching means thereon, and a metallic member at the other end of said housing means connected to said radio transmitting means to function as an antenna therefor.

11. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by

an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and radio transmitting means adapted to be energized and modulated by said alternating current from said winding means, elongated insulating housing means having a portion of said magnetic core means embedded therein and enclosing said radio transmitting means, another portion of said magnetic core means projecting from said one end of said housing means and having said clamp means and live line tool attaching means thereon, and a metallic cap at the other end of said housing means connected to said radio transmitting means to function as an antenna therefor and also acting as shield therefor against corona from said conductor and parts connected thereto.

12. The radio transmitter of claim 11 wherein said metallic cap is detachably mounted on said housing means and a contact spring provides the connection to said radio transmitting means.

13. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, live line tool attaching means on said clamp means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, radio transmitting means adapted to be energized and modulated by said alternating current from said winding means, elongated insulating housing means having a portion of said magnetic core means embedded therein and enclosing said radio transmitting means, another portion of said magnetic core means projecting from said one end of said housing means and having said clamp means and live line tool attaching means thereon, a metallic member positioned at the other end of said housing means and connected to said radio transmitting means, and a metallic cap at said other end of said housing means in insulated spaced relation to said metallic member to function therewith as the antenna for said radio transmitting means and also acting as a shield therefor against corona from said conductor and parts connected thereto.

14. A radio transmitter for detachable mounting on a high voltage alternating current power transmission conductor by a detachable live line tool manipulated by an operator for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, live line tool attaching means on said magnetic core means for detachable connection to said live line tool, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, and radio transmitting means adapted to be modulated by said alternating current from said winding means, said magnetic core means and live line tool attaching means being positioned on the same side of said radio transmitting means.

15. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, winding means on said magnetic core means

into which alternating current is induced by said alternating magnetic flux, and wave transmitting means adapted to be modulated by said alternating current from said winding means, said magnetic core and means and clamp means being positioned on the same side of said wave transmitting means.

16. A wave transmitter for detachable mounting on a high voltage alternating current power transmission conductor for measuring current flow in said conductor comprising: magnetic core means adapted to link said conductor and have induced therein alternating magnetic flux generated by said current flow, clamp means on said magnetic core means for detachably clamping the same to said conductor, winding means on said magnetic core means into which alternating current is induced by said alternating magnetic flux, wave transmitting means adapted to be modulated by said alternating current from said winding means, elongated housing means having a portion of said magnetic core means embedded therein at one end and enclosing said wave transmitting means, another portion of said magnetic core means projecting from said one end of said housing means and having said clamp means thereon, and a metallic corona shield overlying the other end of said housing means.

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