

No. 647,007.

Patented Apr. 10, 1900.

G. MARCONI.

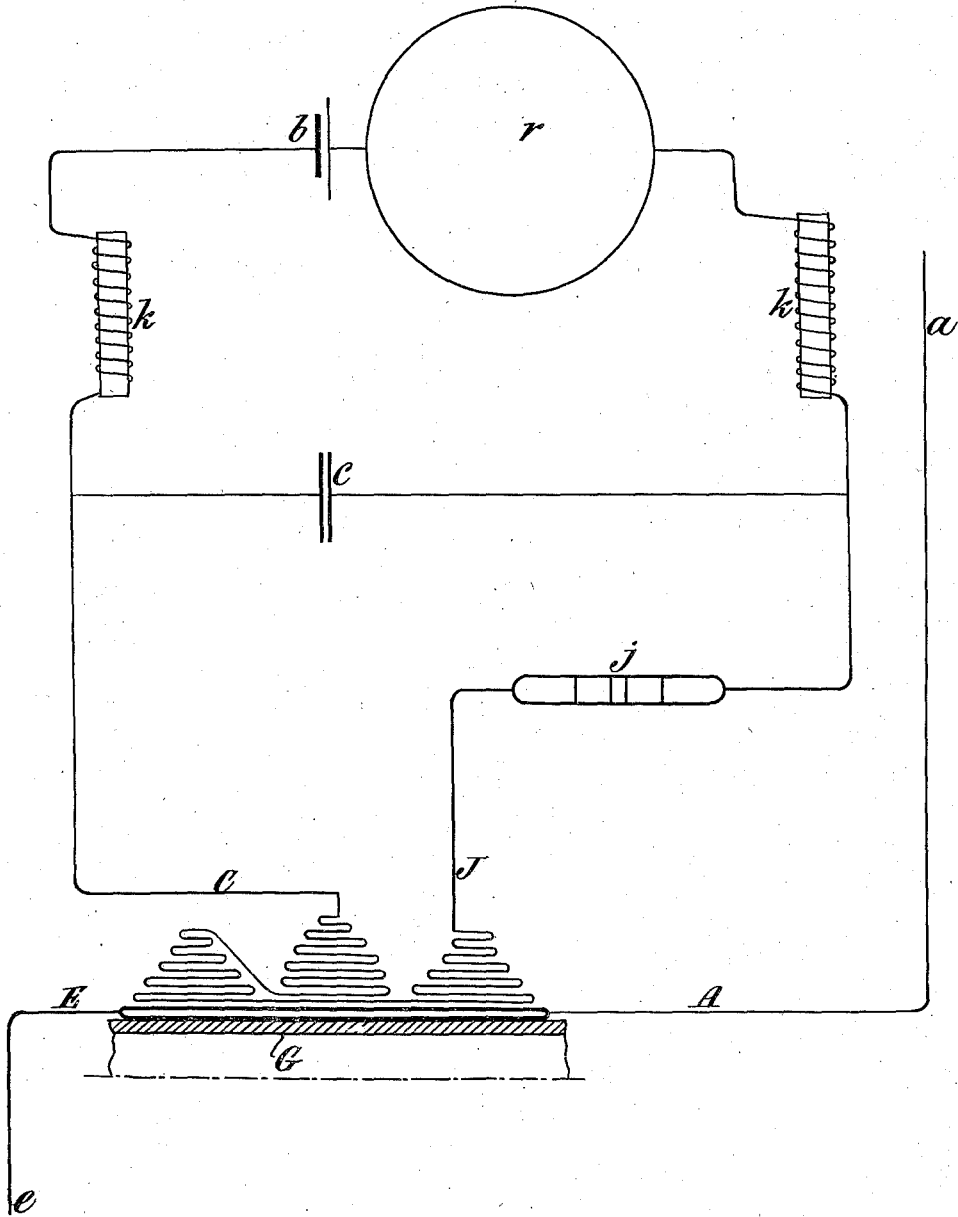
APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY.

(Application filed June 13, 1899.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.



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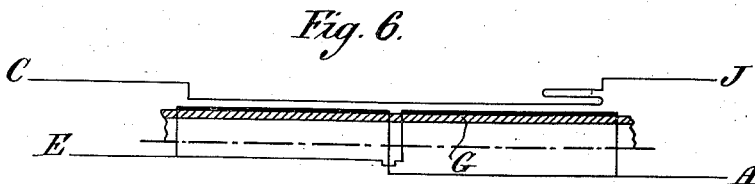
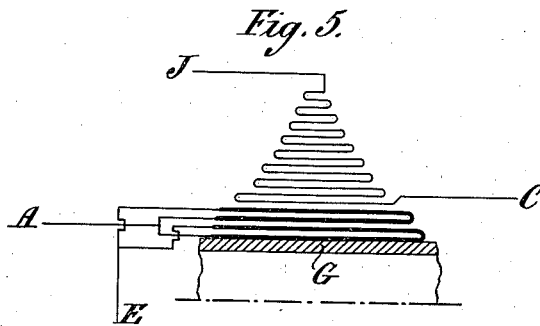
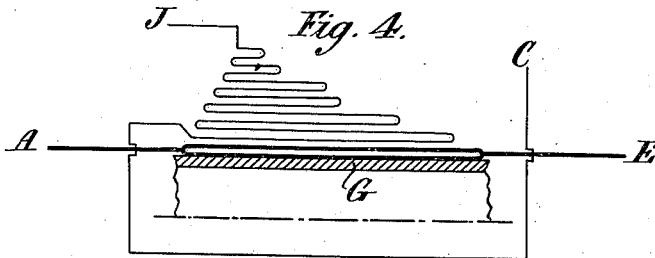
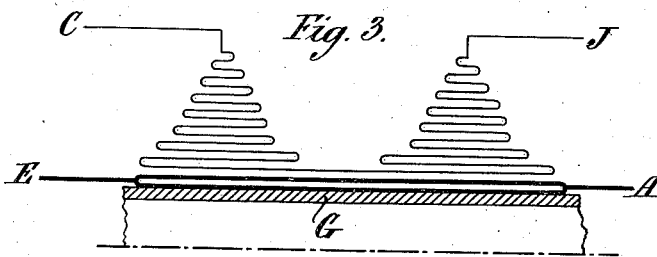
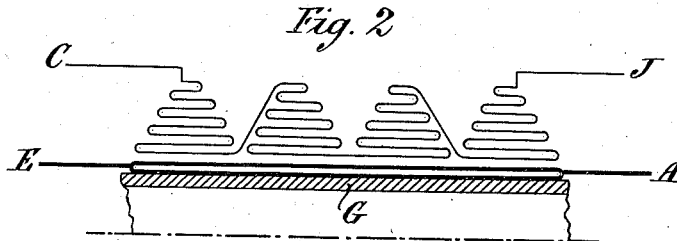
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APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY.

(Application filed June 13, 1899.)

(No Model.)

2 Sheets—Sheet 2.



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# UNITED STATES PATENT OFFICE.

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## APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 647,007, dated April 10, 1900.

Application filed June 13, 1899. Serial No. 720,355. (No model.)

*To all whom it may concern:*

Be it known that I, GUGLIELMO MARCONI, electrician, a subject of the King of Italy, residing at 23 Mark Lane, in the city of London, England, have invented certain new and useful Apparatus Employed in Wireless Telegraphy, of which the following is a specification.

This invention relates to improvements in the apparatus described in the specification of Patent No. 627,650, granted to me June 27, 1899. In that specification I described connecting the aerial conductor to a capacity which may be the earth through the primary of an induction-coil, the ends of the imperfect contact or sensitive tube being connected to the ends of the secondary. In place of winding both the primary and secondary in single layers, as claimed in that specification, the coils are now either made very short (not much exceeding two centimeters in length) or else are wound in sections. The number of turns in the successive layers of the secondary (and sometimes of the primary also) should diminish as the distance from the center increases; but this, although preferable, is not essential. It is also found desirable to connect direct to the sensitive tube or imperfect contact (not through the condenser) the end of the secondary which is farthest away from the nucleus or axial line of the coil.

Figure 1 is a diagram of the arrangement described in the former specification modified in accordance with the present invention, and Figs. 2 to 6 show modified forms of the induction-coil.

In Fig. 1, *a* is the aerial conductor; *b*, a local battery; *c*, a condenser; *e*, a connection to earth or other suitable capacity; *j*, a sensitive tube or imperfect contact. *k* are choking-coils, and *r* a relay working a signaling or other instrument. The diagrams of the coils are greatly-enlarged half-longitudinal sections, but are not strictly to scale. In place also of showing the section of each coil or layer of wire as a longitudinal row of dots or small circles, as it would actually appear, it is for simplicity shown as a single continuous longitudinal straight line. *A* is the end of the primary, which is connected to the aerial conductor *a*, and *E* is the end connected to earth or a capacity. *J* is the end of the secondary, which is directly connected to the sensitive tube or imperfect contact *j*, and *C* is the end which is connected to it through the condenser. *G* is a glass tube on which the coils are wound. The wires are preferably insulated by a single covering of silk.

The following table gives particulars of coils which have been successfully used:

Figure in drawings.	Diameter of tube G, in centimeters.	Diameter of wires, in centimeters.		Resistance, in ohms.		Number of turns in windings.		Length, in centimeters.
		Primary.	Secondary.	Primary.	Secondary.	Primary.	Secondary.	
Fig. 1	.083	.01	.01	.....	.....	2 layers of 100 turns each, in parallel.	3 sections of 10, 12, 10 layers, with 150 45 40 45 40 39 40 35 37 35 30 35 30 25 33 25 20 22 20 15 23 15 12 21 17 5 15 14 10 5 turns.	2.5
Fig. 2	.937	.012	.012	.....	.....	do .....	4 sections of 0 layers each, with 40 40 40 35 35 35 30 30 30 27 27 27 23 23 23 20 20 20 15 15 15 10 10 10 5 5 5 turns.	4.0

Figure in drawings.	Diameter of tube G, in centimeters.	Diameter of wires, in centimeters.		Resistance, in ohms.		Number of turns in windings.		Length, in centimeters.
		Pri- mary.	Sec- ond- ary.	Pri- mary.	Sec- ond- ary.	Primary.	Secondary.	
Fig. 3	.937	.011	.011	4.8	0.1	do	2 sections of 15 layers each, with 159 60 63 50 50 40 40 35 35 33 33 30 30 27 27 24 24 23 22 17 18 15 15 10 10 6 6 2 2 turns.	2.5
Fig. 4	.975	.012	.012	-----	-----	2 layers of 110 each, in parallel	12 layers of 100 80 75 60 50 45 40 28 20 15 10 5 turns.	1.8
Fig. 5	.975	.012	.012	-----	-----	4 layers, 80 turns, } in series. 78 turns, } 76 turns, } in series. 72 turns, }	10 layers of 60 54 46 42 40 36 32 29 26 23 20 18 14 12 9 7 turns.	1.5
Fig. 6	.975	.012	.012	5.75	28.5	1 layer of 2 wires in parallel, with 100 turns each, wound tandem.	3 layers of 310, 45, 45 turns	5.8

The coils are wound in the following man-  
ner: In Fig. 1, G is a glass tube, and on it is  
wound the primary in two layers, there being  
one hundred and sixty turns in each layer.  
5 The ends of these two coils or layers are con-  
nected in parallel one to the aerial conduc-  
tor and the other to earth. On the outer coil  
of the primary is wound the first or inner coil  
of the secondary, which is continuous and  
10 has one hundred and fifty turns. The left-  
hand end of the wire forming this layer is  
then wound or coiled upon it to form the  
second layer of the left-hand section of the  
secondary, forty-five turns being given. On  
15 this comes the third layer with forty turns,  
and the other layers with thirty-five, thirty,  
twenty-five, twenty, fifteen, twelve, and five  
turns, respectively, follow. After winding  
the outer layer (that with five turns) of the left-  
20 hand section of the secondary the wire is led  
down and coiled on the middle of the first or  
inner layer of the secondary, so as to form the  
middle section of the secondary, forty turns  
being given, and then follow layers with  
25 thirty-nine, thirty-seven, thirty-five, thirty-  
three, twenty-nine, twenty-five, twenty-one,

fifteen, ten, and five turns, respectively, the  
wire from the outer layer (that with five  
turns) being connected to the left-hand side  
of the condenser *c* and the left-hand choking  
coil *k*. The right-hand end of the wire form-  
ing the inner layer of the secondary is wound  
on the right-hand end of that layer, forty-five  
turns being given, and then follow layers  
with forty, thirty-five, thirty, twenty-five,  
35 twenty, fifteen, seventeen, and fourteen turns,  
respectively, so forming the right-hand sec-  
tion of the secondary, the wire from the outer  
layer (that with fourteen turns) being con-  
nected directly to the left-hand end of the  
40 sensitive tube *j*.

In Fig. 2, G is a glass tube, and on it is  
wound the primary in two layers, there being  
one hundred and sixty turns in each layer.  
The ends of these two coils or layers are con-  
45 nected in parallel one to the aerial conduc-  
tor and the other to earth. On the outer coil  
of the primary is wound the first or inner coil  
of the secondary, which is in three sections,  
the middle one having eighty turns. The  
50 other layers of the secondary are in four sec-  
tions, the two middle ones being formed by

winding the two ends of the wire forming the middle of the inner layer upon that layer, thirty-five turns being given in each case, and upon the second layers so formed follow 5 layers with thirty, twenty-seven, twenty-three, twenty, fifteen, ten, and five turns, respectively. After winding the outer layers of the two middle sections (those with five turns) the ends of the wire are led down and 10 coiled on the ends of the primary forming the inner layers of the two outer sections of the secondary, forty turns being taken in each case. On each of these inner layers follow in each case layers of thirty-five, thirty, 15 twenty-seven, twenty-three, twenty, fifteen, ten, and five turns, respectively, the wire from the outer layer (that with five turns) of the left-hand section being connected to the left-hand side of the condenser *c*, and the left-hand choking-coil *k* and the wire from the 20 outer layer (that with five turns) of the right-hand section being connected directly to the left-hand end of the sensitive tube *j*.

In Fig. 3, *G* is a glass tube, and on it is 25 wound the primary in two layers, there being one hundred and sixty turns in each layer. The ends of these two coils or layers are connected in parallel one to the aerial conductor and the other to earth. On the outer coil of 30 the primary is wound the first or inner coil of the secondary, which is continuous and has one hundred and fifty-three turns. The other layers of the secondary are in two sections, the second layers being formed by 35 winding the ends of the wire forming the inner layer upon that layer, sixty turns being given in the left-hand section and sixty-three in the right-hand section. These layers are followed by layers of fifty, forty, thirty-five, 40 thirty-three, thirty, twenty-seven, twenty-four, twenty-three, seventeen, fifteen, ten, six, and two turns each in the case of the left-hand section and by layers of fifty, forty, thirty-five, thirty-three, thirty, twenty-seven, 45 twenty-four, twenty-two, eighteen, fifteen, ten, six, and two turns each in the case of the right-hand section, the wire from the outer layer (that with two turns) of the left-hand section being connected to the left-hand 50 side of the condenser *c* and the left-hand choking-coil *k* and the wire from the outer layer (that with two turns) of the right-hand section being connected directly to the left-hand end of the sensitive tube *j*.

In Fig. 4, *G* is a glass tube, and on it is 55 wound the primary in two layers, there being one hundred and ten turns in each layer. The ends of these two coils or layers are connected in parallel one to the aerial conductor and the other to earth. On the outer coil of 60 the primary is wound the first or inner coil of the secondary, which is continuous and has one hundred turns. In this case the secondary is in a single section, and the second and succeeding layers have eighty, seventy-five, sixty, fifty, forty-five, forty, twenty-eight, twenty, fifteen, ten, and five turns, re-

spectively, the wire from the inner layer (that with one hundred turns) being connected 70 to the left-hand side of the condenser *c* and the left-hand choking-coil *k* and the wire from the outer layer (that with five turns) being connected directly to the left-hand end of the sensitive tube *j*. In this case the slope at the left-hand side of the coil is made steeper 75 than on the right-hand side.

In Fig. 5 the primary is wound on the glass tube *G* in four layers, the inner layer having eighty turns. The right hand end of the wire forming the inner layer is wound on that 80 layer, forming the second layer, which has seventy-eight turns. The left-hand end of the wire forming the inner layer is wound on the second layer, forming the third layer, which has seventy-six turns. The right-hand 85 end of the wire forming the third layer is wound on that layer, forming the fourth layer, which has seventy-two turns. The left-hand ends of the wires forming the inner and third layers are connected to the aerial conductor, 90 and the left-hand ends of the wires forming the second and fourth layers are connected to earth. The secondary is wound on the outer or fourth layer of the primary and consists of sixteen layers having sixty, fifty-four, 95 forty-six, forty-two, forty, thirty-six, thirty-two, twenty-nine, twenty-six, twenty-three, twenty, eighteen, fourteen, twelve, nine, and seven turns, respectively, the end of the wire from the inner layer (that with sixty 100 turns) being connected to the left-hand side of the condenser *c* and the left-hand choking-coil *k* and the end of the wire from the outer layer (that with seven turns) being connected directly to the left-hand end of the sensitive 105 tube *j*.

In Fig. 6 the primary consists of a single layer formed of two wires, each having one hundred and sixty turns around the tube *G*, their right-hand ends being connected to the 110 aerial conductor and their left-hand ends to earth. The secondary has three layers, the inner one having three hundred and ten turns and the second and third forty-five turns each, these being wound on the right- 115 hand end of the inner layer. The left-hand end of the inner layer is connected to the left-hand side of the condenser *c* and the left-hand choking-coil *k*, the end of the outer layer being connected directly to the left- 120 hand end of the sensitive tube *j*.

The method in which the sections of the coil are connected is found to be important.

Subject-matter herein disclosed, but not specifically herein claimed, is included in 125 divisional applications filed by me December 26, 1899, and respectively serially numbered 741,613 and 741,614.

I claim—

1. In a receiver for electrical oscillations, 130 the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the secondary of which consists of several layers, the number of turns in the



ends of the imperfect contact and the ends of the secondary, and a condenser in one of the latter connections.

13. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of two wires connected in parallel wound in four layers the first and second layers being formed of one wire and the third and fourth of the other, the secondary of which consists of several layers, the number of turns in the outer layers being less than in those next the primary, a capacity connected to one end of the primary, a conductor connected to the other end, and connections between the ends of the imperfect contact and the ends of the secondary.

14. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of two wires connected in parallel wound in four layers the first and second layers being formed of one wire and the third and fourth of the other, the secondary of which consists of several layers, the number of turns in the outer layers being less than in those next the primary, a capacity connected to one end of the primary, a conductor connected to the other end, connections between the ends of the imperfect contact and the ends of the secondary, and a condenser in one of the latter connections.

15. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of two wires connected in parallel wound in four layers the first and second layers being formed of one wire and the third and fourth of the other, the secondary of which consists of several layers, the number of turns in the outer layers being less than in those next the primary and wound unsymmetrically with a lump at one end, a capacity connected to one end of the primary, a conductor connected to the other end, and connections between the ends of the imperfect contact and the ends of the secondary.

16. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induc-

tion-coil, the primary of which consists of two wires connected in parallel wound in four layers the first and second layers being formed of one wire and the third and fourth of the other, the secondary of which consists of several layers, the number of turns in the outer layers being less than in those next the primary and wound unsymmetrically with a lump at one end, a capacity connected to one end of the primary, a conductor connected to the other end, connections between the ends of the imperfect contact and the ends of the secondary, and a condenser in one of the latter connections.

17. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of wires connected in parallel and wound in layers, the number of turns in the outer layers being less than in the inner layers, a capacity connected to one end of the primary, a conductor connected to the other end, and connections between the ends of the imperfect contact and the ends of the secondary.

18. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of wires connected in parallel, a capacity connected to one end of the primary, a conductor connected to the other end, and the secondary of which consists of several layers, the number of turns in the outer layers being less than in those next the primary, and connections which connect in circuit the imperfect contact and the secondary.

19. In a receiver for electrical oscillations, the combination of an imperfect electrical contact, a local circuit through it, an induction-coil, the primary of which consists of wires connected in parallel, a capacity connected to one end of the primary, a conductor connected to the other end, the secondary of which induction-coil is wound in sections, each consisting of several layers, and circuit connections connecting in circuit the imperfect contact and the secondary.

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