R. H. MARRIOTT.

ELECTRICAL TUNING DEVICE.

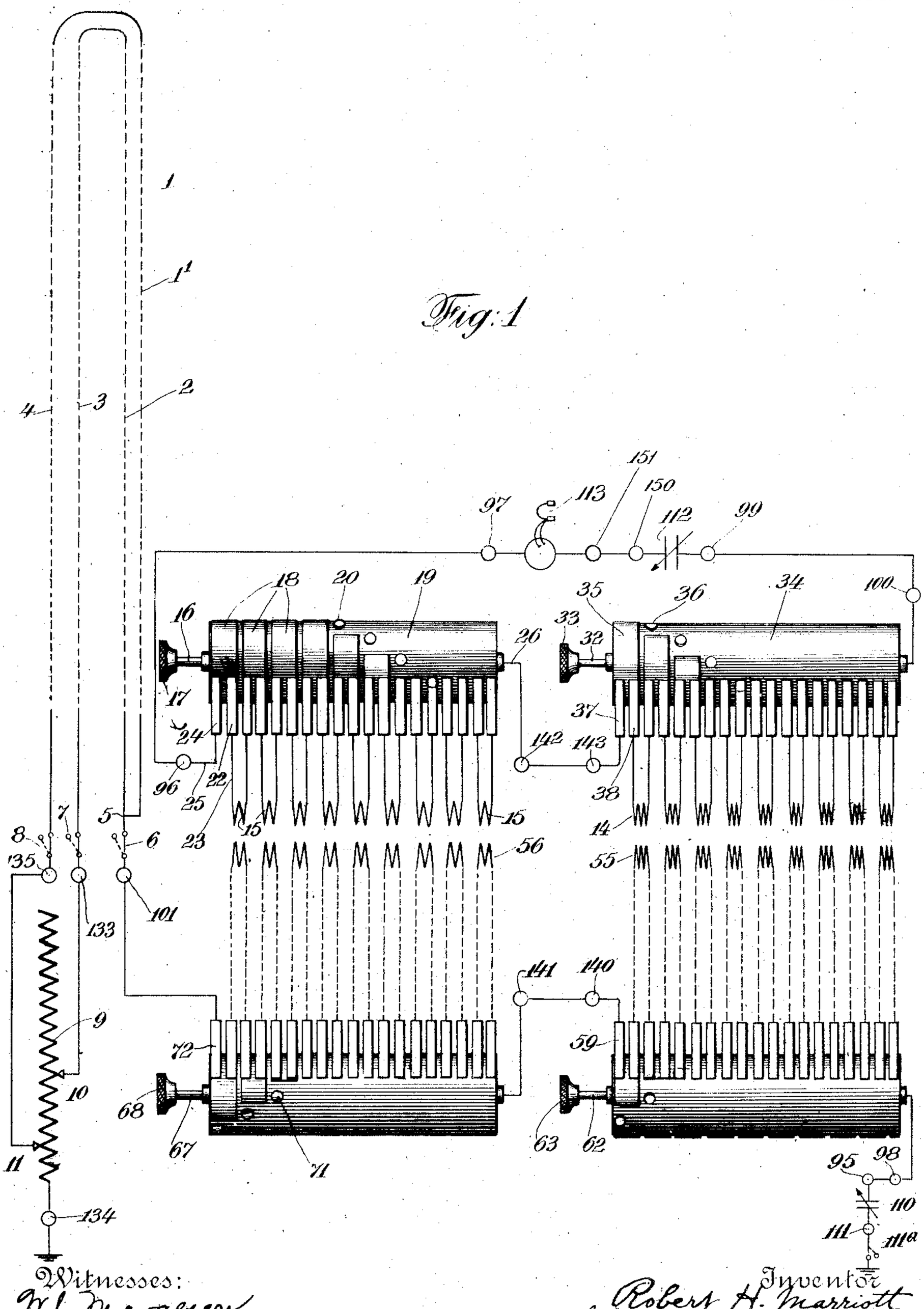
APPLICATION FILED NOV. 13, 1908

978,604.

Patented Dec. 13, 1910.

8 SHEETS—SHEET 1.

Fig: 1



Witnesses:

W. L. Margeson

Sarah Flock.

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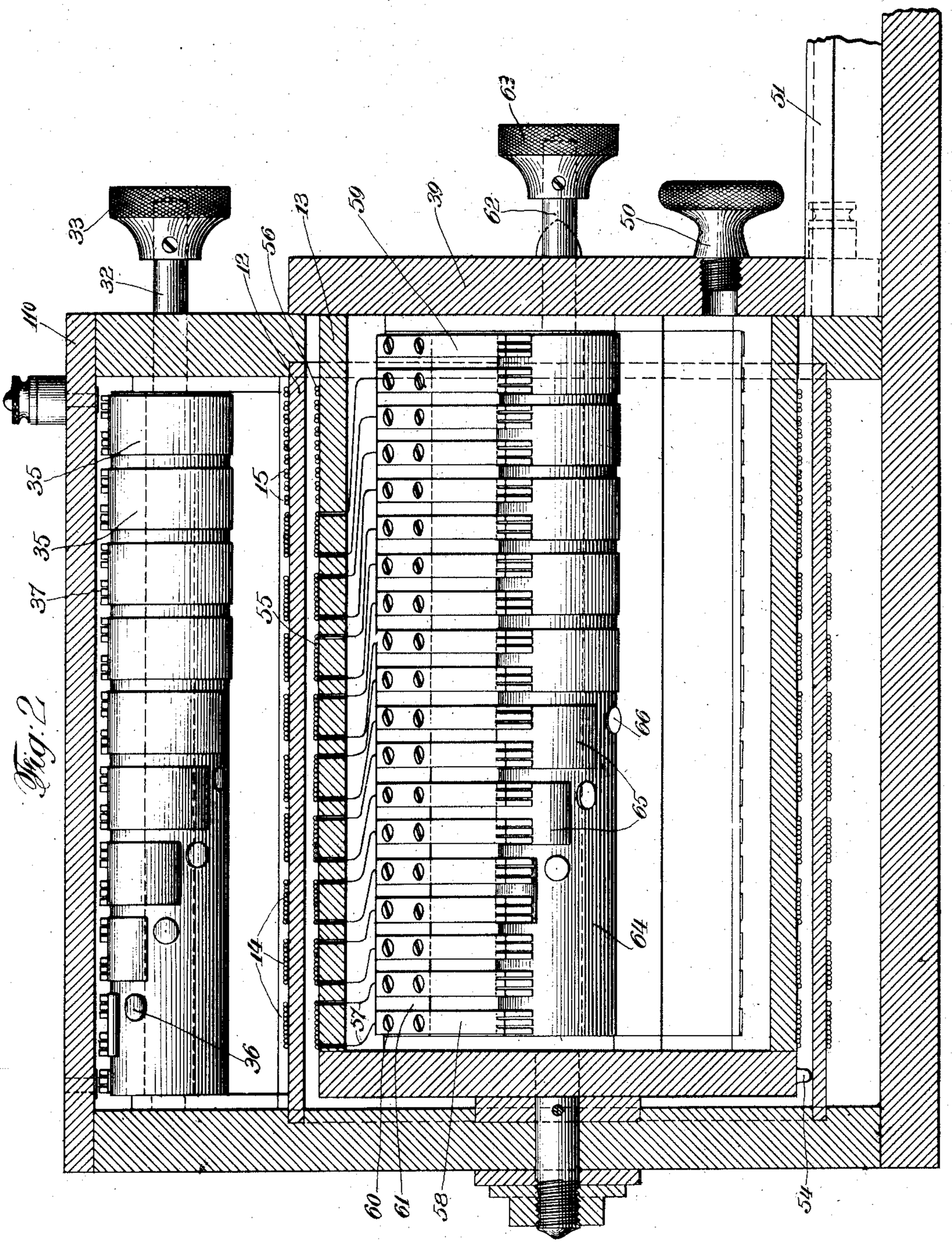

Fig. 2

Witnesses.
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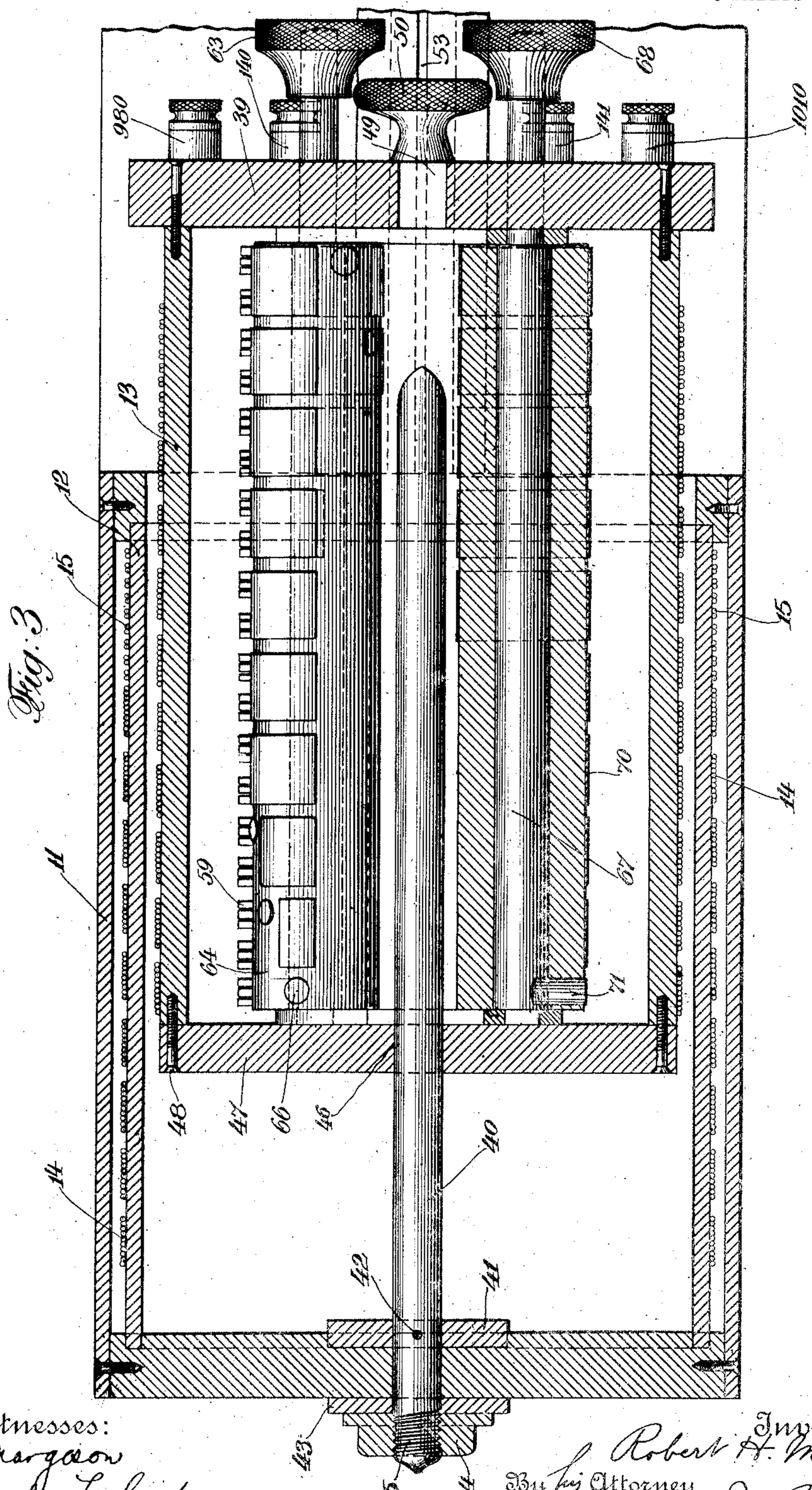

Fig. 3.

Witnesses:
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8 SHEETS—SHEET 4.

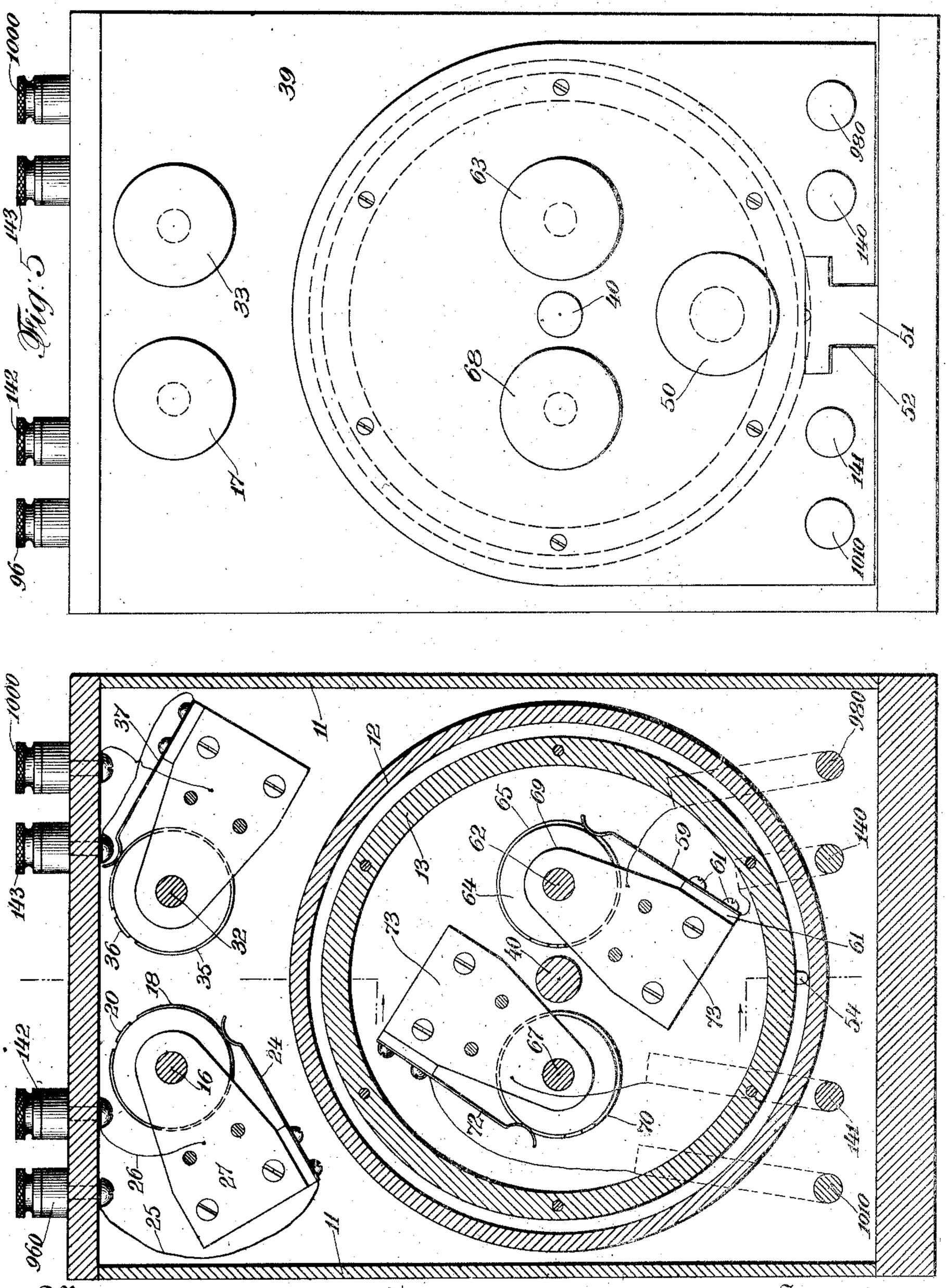

Fig. 5

Fig. 4

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8 SHEETS—SHEET 5.

Fig: 7

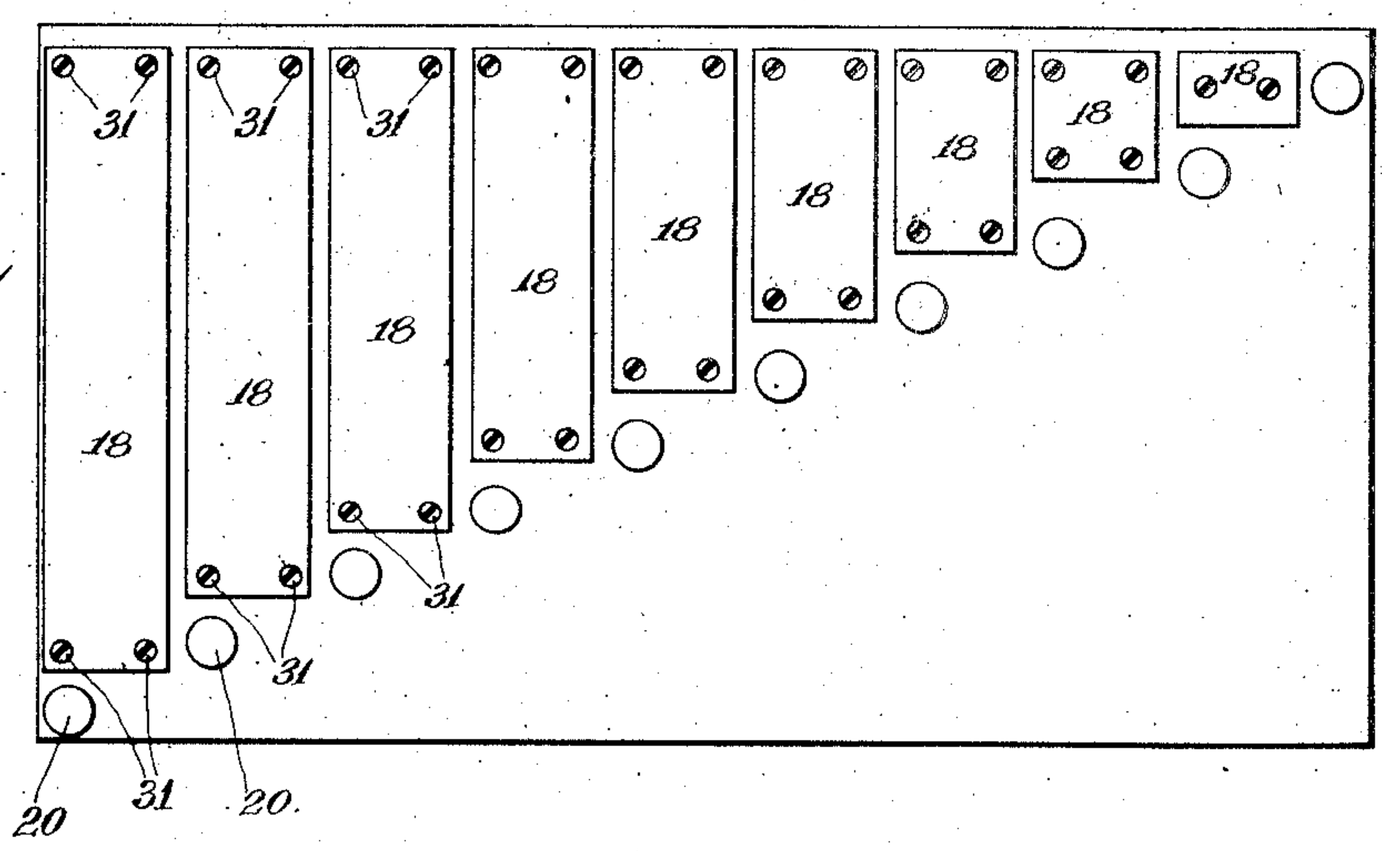


Fig: 6

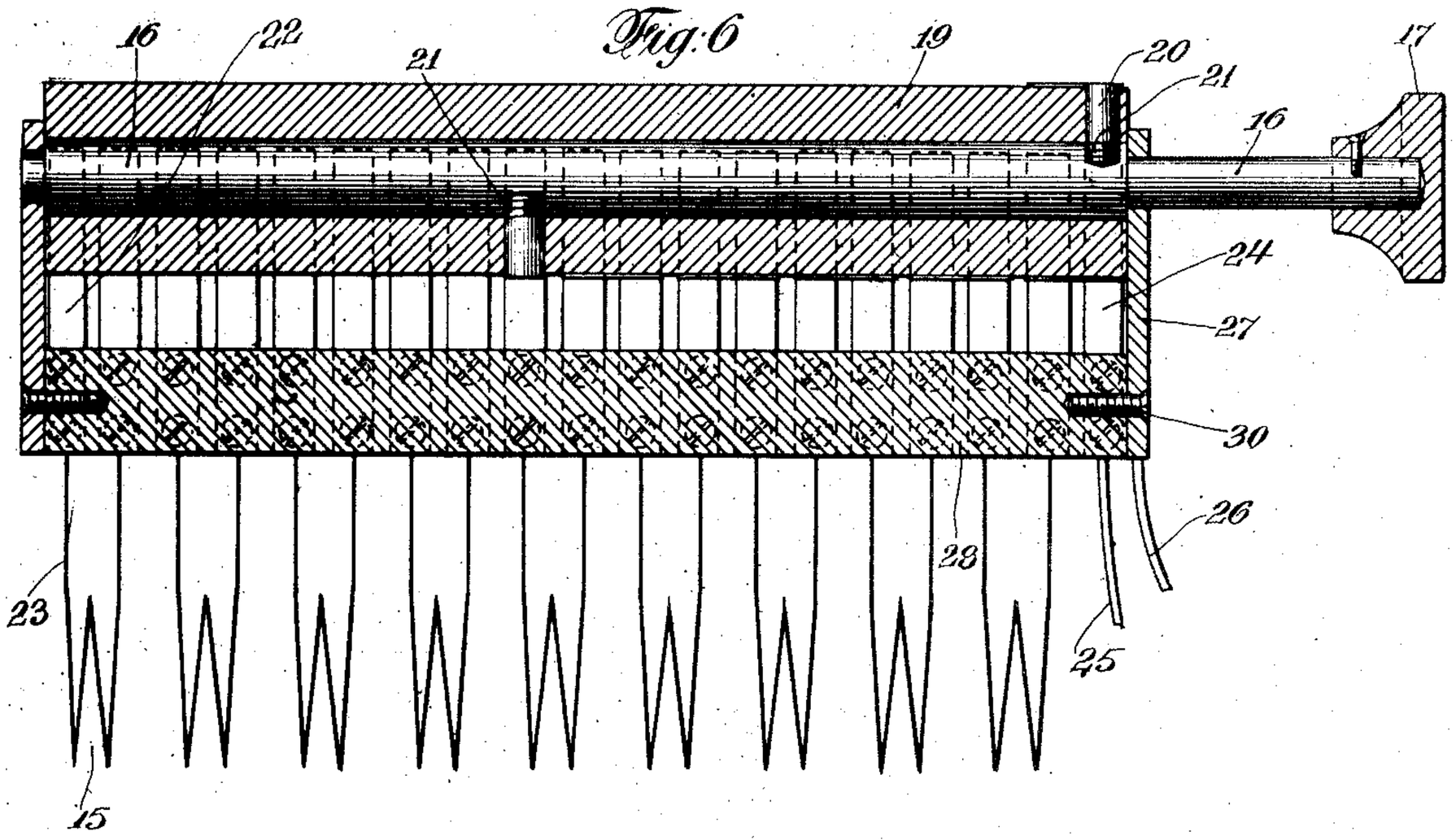
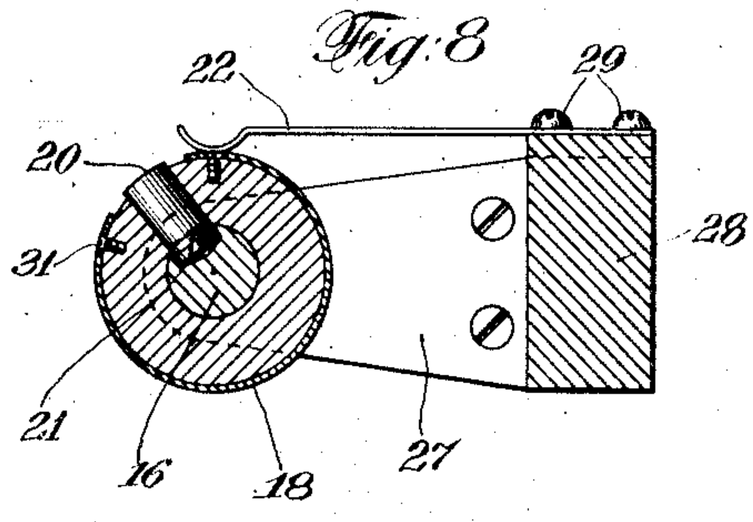


Fig: 8



Witnesses:
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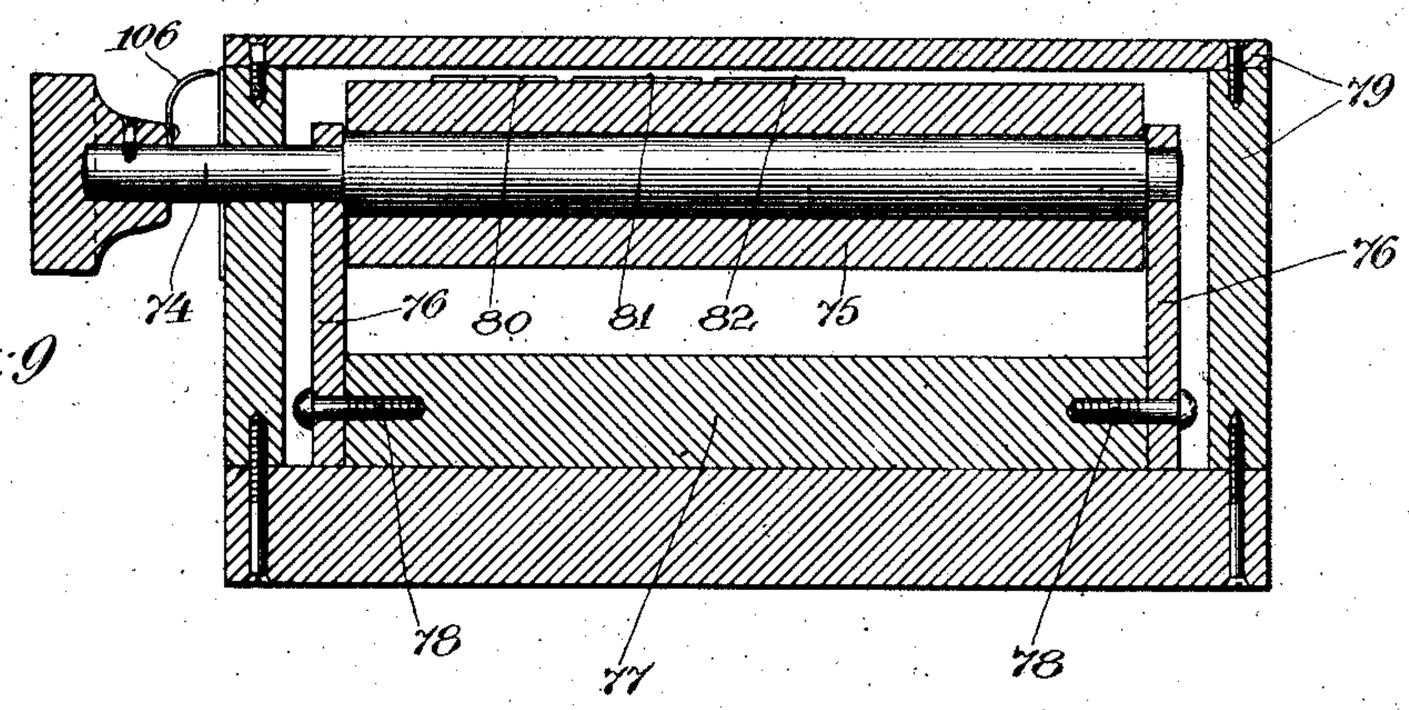

Fig: 9

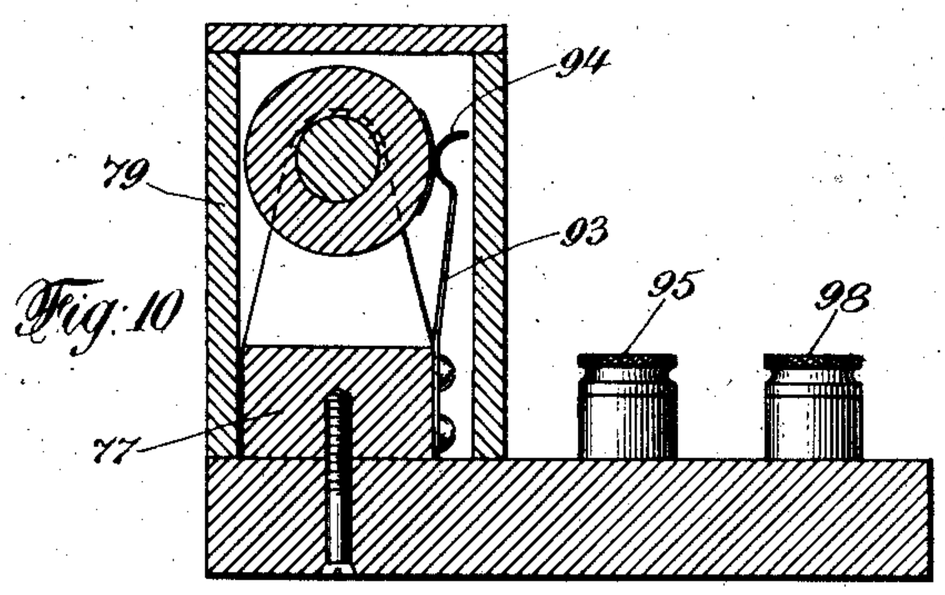

Fig: 10

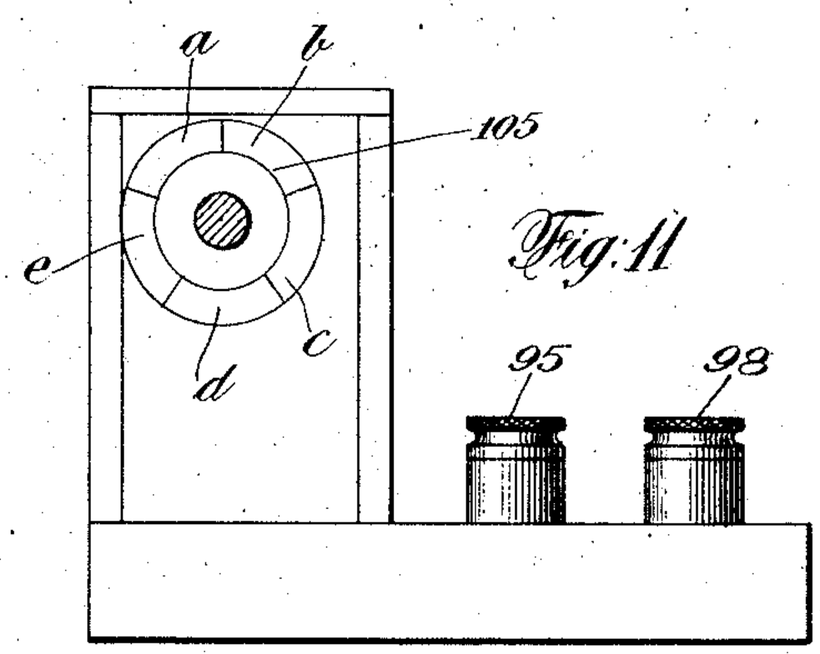

Fig: 11

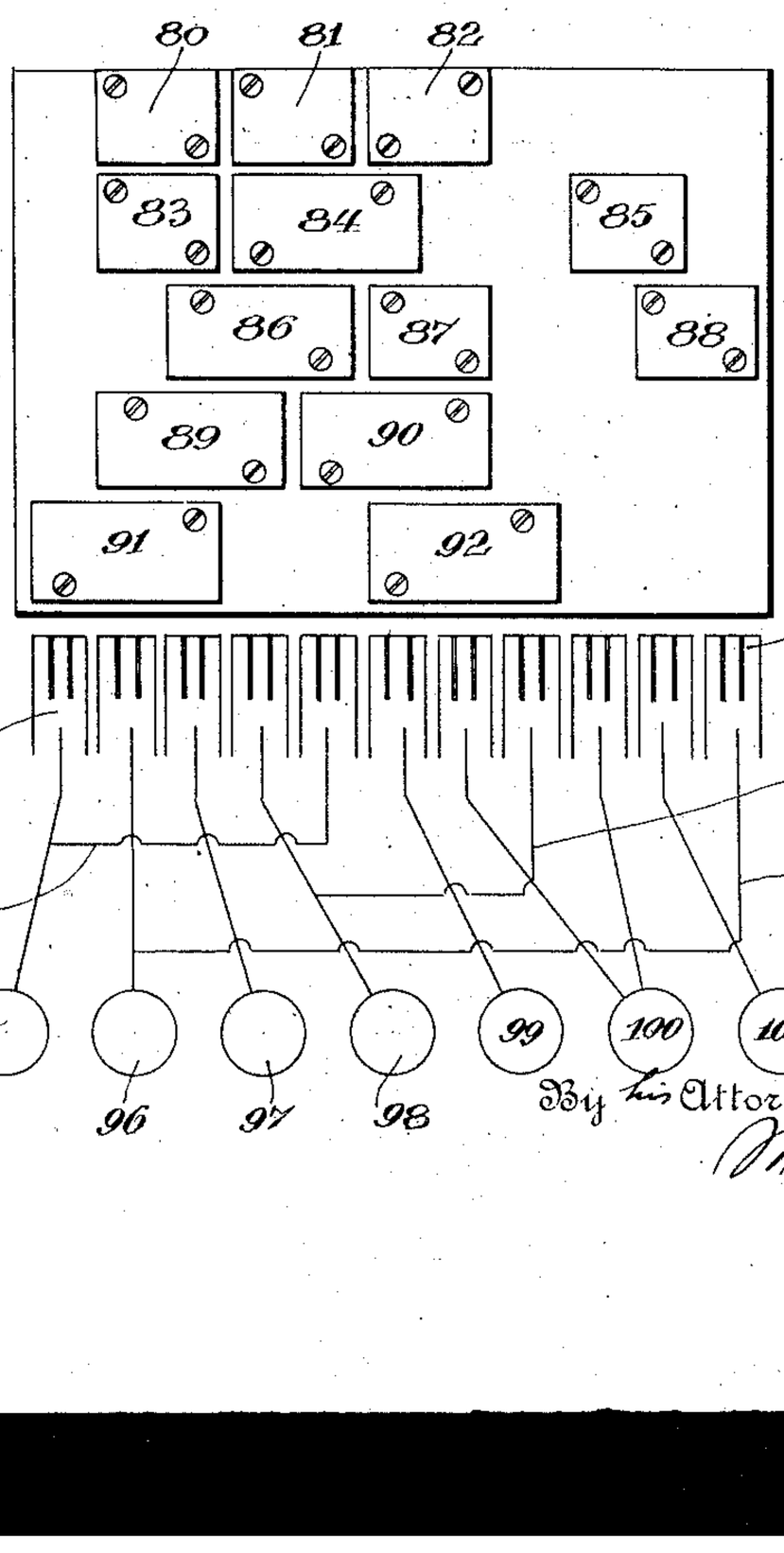

Fig: 12

Witnesses:
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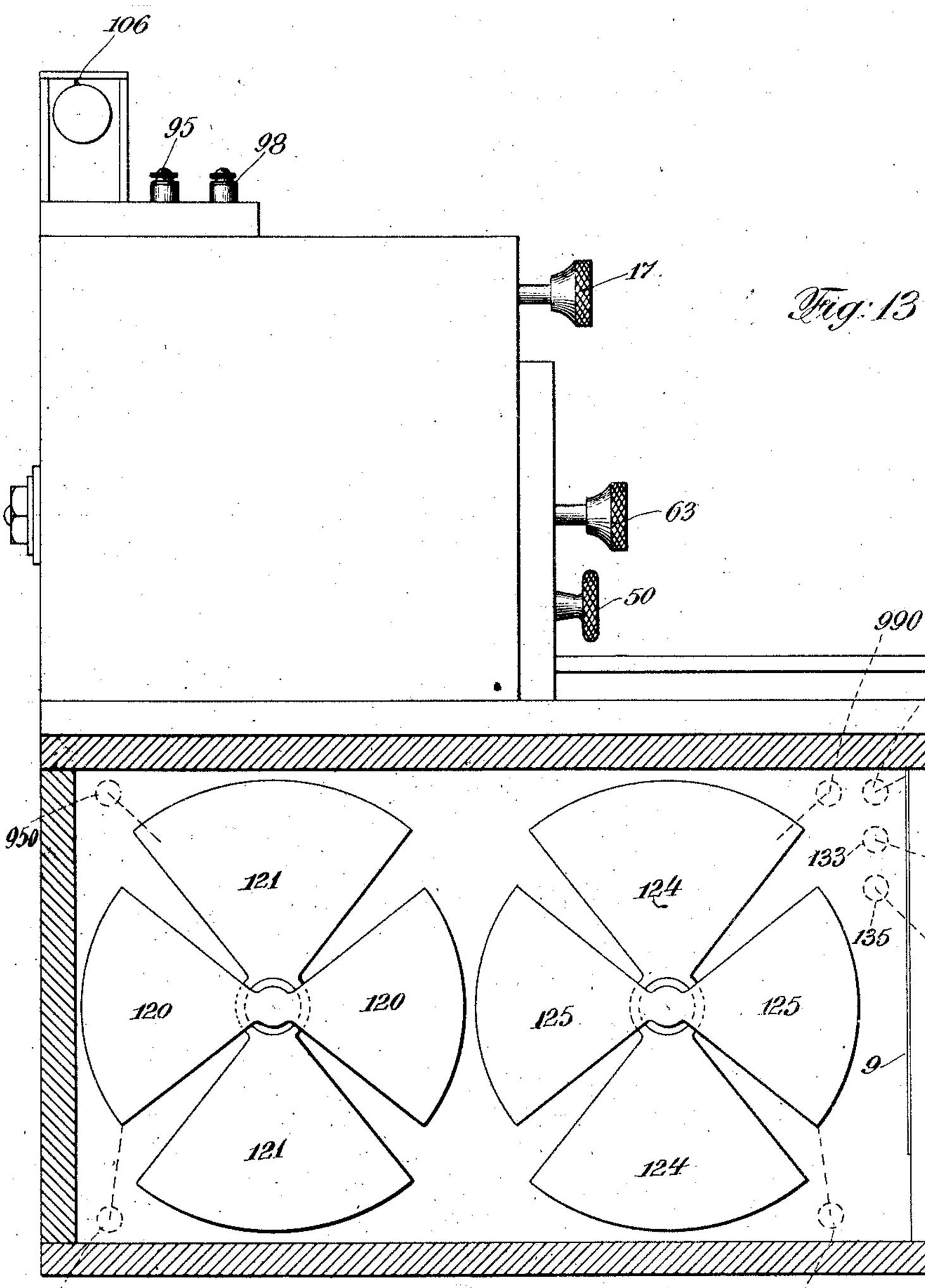

Fig: 13

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8 SHEETS—SHEET 8.

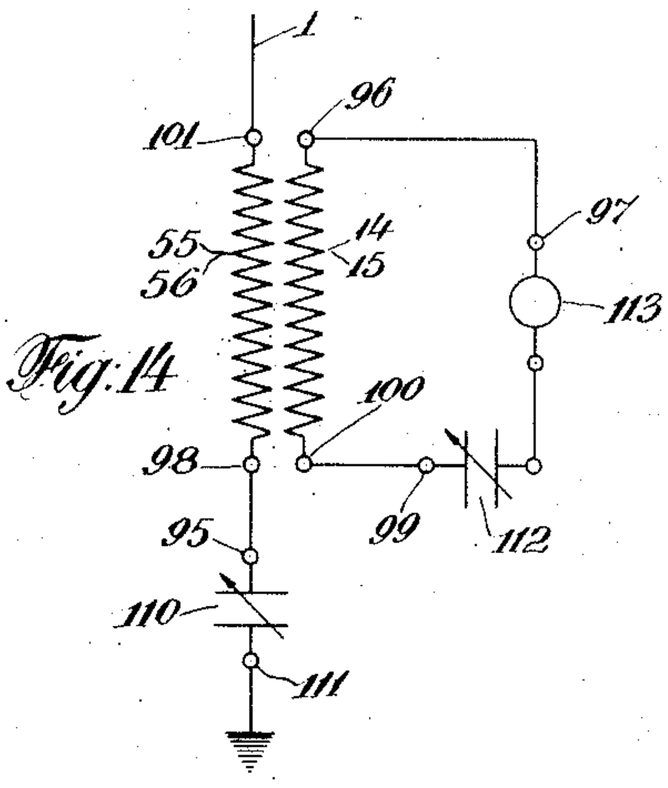

Fig: 14

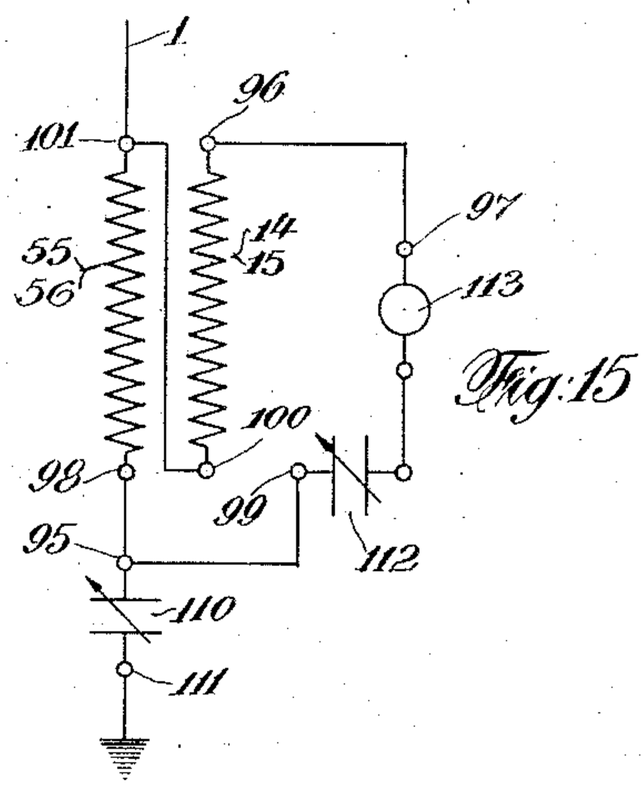

Fig: 15

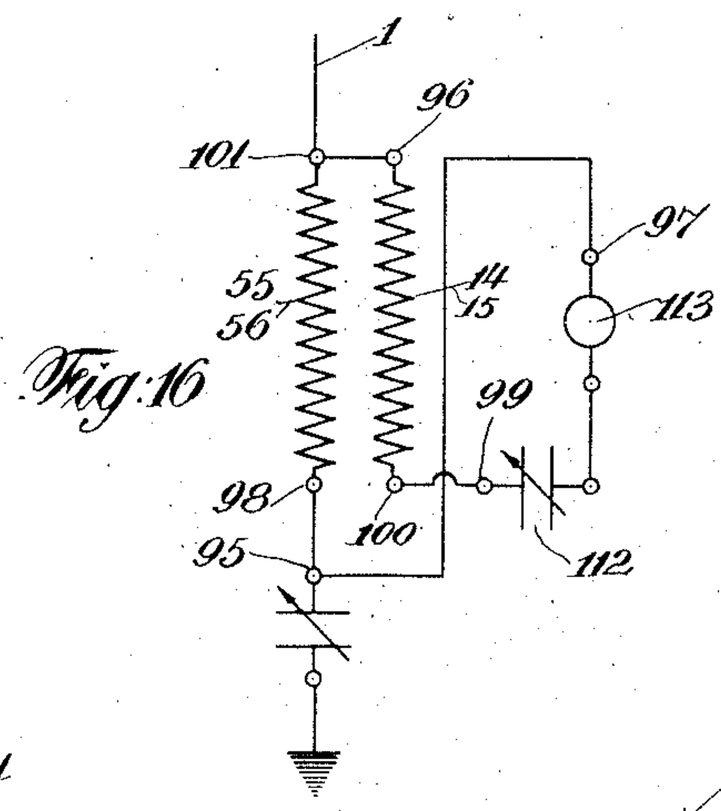

Fig: 16

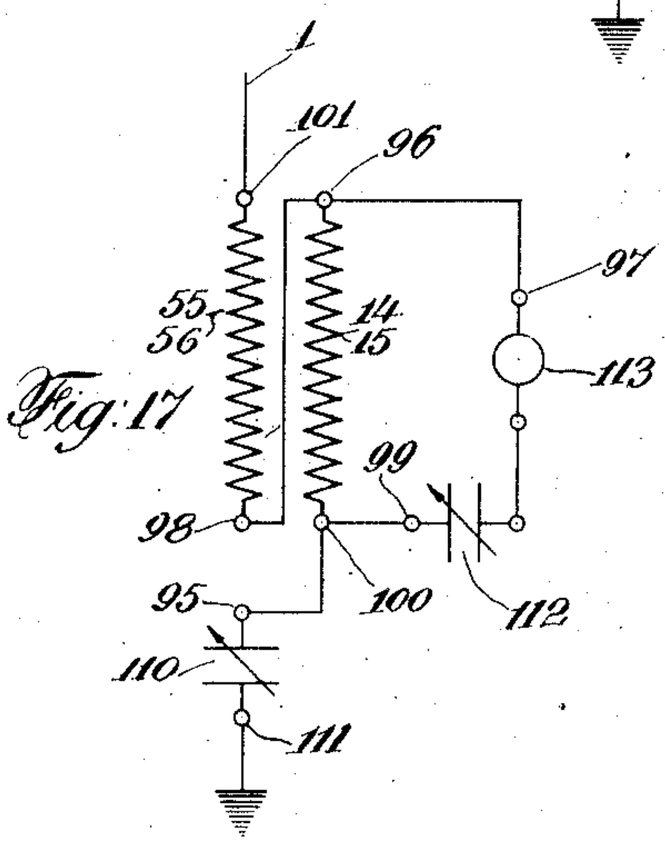

Fig: 17

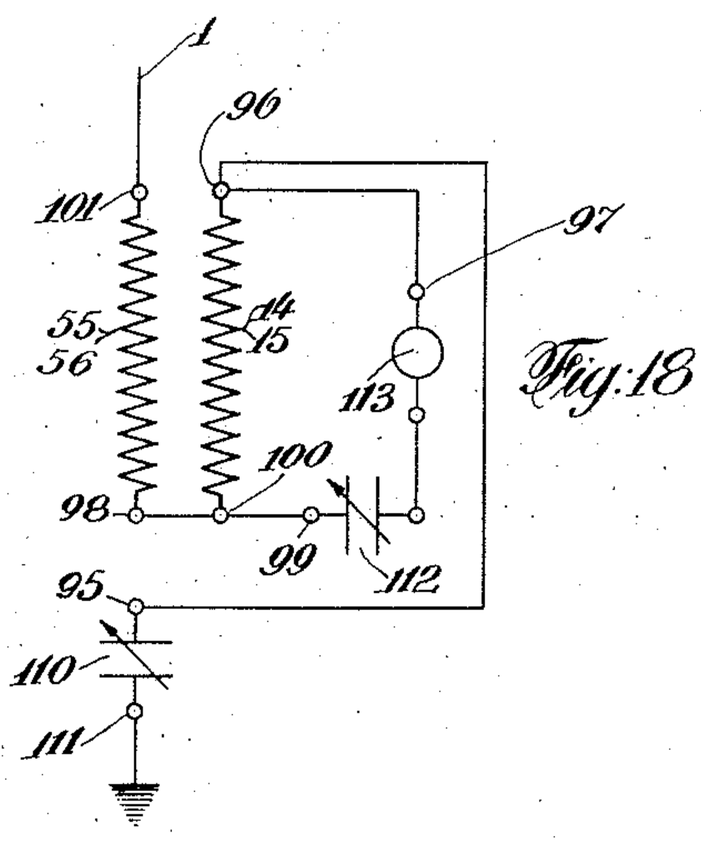

Fig: 18

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UNITED STATES PATENT OFFICE.

ROBERT H. MARRIOTT, OF BROOKLYN, NEW YORK, ASSIGNOR TO UNITED WIRELESS TELEGRAPH COMPANY, A CORPORATION OF MAINE.

ELECTRICAL TUNING DEVICE.

978,604. Specification of Letters Patent. **Patented Dec. 13, 1910.**

Application filed November 13, 1908. Serial No. 462,496.

To all whom it may concern:

Be it known that I, ROBERT H. MARRIOTT, a citizen of the United States, and a resident of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Electrical Tuning Devices, of which the following is a specification.

My invention relates to a high frequency system of transmission of energy, and particularly to a tuning device for a wireless telegraph or telephone, sending or receiving system.

One of the objects of my invention is to provide one or more variable inductances, each of which is adapted to be connected in its respective aerial or local circuit, and which inductances are also adapted to be inductively or conductively connected with relation to each other, together with switching means for changing from the inductive to the conductive connection at will.

Another object of my invention is to connect an aerial and local inductance in their respective circuits, and to provide switching means for varying the kind of conductive connection between the aerial and local inductance at will.

A more particular object of my invention is to provide means so that said aerial inductance may be thrown in series with said local inductance, both inductances being included in one local circuit, with the coils of the two inductances connected so that the self-induction of the coils is greater than that of either coil acting alone or with the coils so connected that the self-induction of the coils is less than that of either coil.

Another object of my invention is to provide means whereby the aerial inductance may be thrown in series with the local circuit and said aerial, with the coils of the aerial and local inductance in agreement or opposition.

Another object of my invention is to provide a variable inductance for a high frequency transmission of electrical energy comprising a plurality of coils with means for including one or more of said coils in a circuit and disconnecting the remaining coils from said circuit so as to avoid connecting the dead ends of the coils with the circuit.

With the above and other objects in view, my invention consists in the parts, improvements and combinations more fully set forth hereinafter.

Turning now to the drawings which are attached to the specification and form a part thereof, Figure 1 is a diagrammatic view of the entire system. Fig. 2 is a vertical section illustrating one form of the variable inductance used in the tuning apparatus. Fig. 3 is a horizontal section of the variable inductance, with the sliding frame partly pulled out. Fig. 4 is a transverse vertical section of the apparatus shown in Fig. 2. Fig. 5 is a front view of the variable inductance illustrated in Fig. 2. Fig. 6 is a section through one of the regulating switches illustrating the connection of the induction coils with the conductors controlled by the switch. Fig. 7 is a developed view of the surface of the regulating switch shown in Fig. 6. Fig. 8 is a sectional detail through the regulating switch shown in Fig. 6. Fig. 9 is a longitudinal sectional detail of the switch for throwing the inductances in various relations with each other. Fig. 10 is a transverse sectional detail of the switch illustrated in Fig. 9. Fig. 11 is an end view of the switch shown in Fig. 9. Fig. 12 is a diagrammatic view illustrating the arrangement of switch contacts of the switch shown in Fig. 8. Fig. 13 is a vertical section of the complete tuning apparatus. Figs. 14, 15, 16, 17 and 18 are diagrammatic views illustrating some of the various connections that may be made by means of the invention.

In the particular embodiment of the invention illustrated upon the drawings, the high frequency system of transmission of energy includes an aerial 1, which is preferably in the form of a loop. The loop comprises antennæ wires 1, 2, 3, 4, which wires are connected together at 5 so as to be connectible by means of the switch 6 to the tuning circuit. The other end of the loop may be connected through switches 7, 8 with a variable inductance 9. Two switches 10 and 11 which will be more fully described below are preferably used to cut in the two branches of the loop. The tuning apparatus of my invention includes a variable inductance and a variable capacity. The form of the variable inductance may be widely varied. In the particular embodiment of the invention illustrated upon the drawings,

it comprises a casing 110, which contains a fixed frame 12 and a sliding frame 13 arranged within the fixed frame so as to slide into and out of it. The fixed frame carries a plurality of inductance coils 14, 15, each electrically disconnected from the others. The coils are preferably divided into sets. As illustrated two sets of coils are carried by the fixed frame one set 15 consisting of two turns of wire each, and the other 14 of ten turns. These illustrations are diagrammatic, it being understood that the coils are so wound that the inductance of each of the coils of one set is substantially a multiple of the inductance of each of the coils of the other set. This permits a variation of the inductance in small and uniform amounts.

A plurality of regulating switches is provided, one for each set of coils in order to connect one or more of the coils in circuit. The form of the switches may be widely varied. As illustrated, they comprise a carrier which may take the form of a shaft 16. The shaft is provided with a finger wheel 17. A plurality of sets of conductors 18, each insulated from the other by an insulator 19 is carried by said shaft. These conductors preferably form conducting segments which extend part way around the insulating material, each segment lying in its appropriate zone or strip. The heads of the conductors 18 are preferably staggered with relation to each other. As illustrated, they lie on a helical curve about the shaft 16, which is clearly shown in Figs. 1 and 7. The feet of the conductors are preferably arranged in a row which extends parallel with the shaft 16. It will be observed that the conductors differ in length from each other by substantially equal amounts. A plurality of conducting pins 20 is likewise carried by the carrier. These pins project through the insulating covering 19. They are electrically connected together, preferably by screwing one end of each pin into the metallic conducting shaft 16, as illustrated at 21. Each pin is preferably within the zone or strip which contains the conductor 18, and is arranged opposite the head of the conductor. Each pin is also arranged alongside of the head of the conductor adjacent to the zone or strip containing the pin. The described arrangement of conductors and pins forms a simple, effective and compact switch.

Means are provided whereby one terminal of each coil 15 may be connected to a respective pin and the other terminal of the coil to its respective segmental conductor. To accomplish this result, a plurality of metallic brushes 22 are arranged in pairs and each brush connected with the respective terminal 23 of the coil 15. An end brush 24 is connectible to one part of the circuit, and the shaft 16 through bracket 27 and wire 26 to the other side of the circuit. The brushes, pins and conducting segments are so arranged that as the regulating switch is turned by the finger wheel 17 one or more of the coils 15 is connected in circuit, the remaining coils of the set being disconnected from the circuit. The circuit wires 25, 26 lead to the end brush 24 and bracket 27 respectively, the bracket being electrically connected with the shaft 16. As shown in Fig. 1, the circuit is completed through end brush 24 conducting segment 18, brush 22, coil 15 to the adjacent segment 18 which in turn electrically connects the coil with a brush leading to the next coil and so on until a conducting pin is reached. By means of the pin the circuit is completed through the shaft 16 and wire 26. The coils at the far side of the pin, *i. e.* beyond the point where the circuit is completed are disconnected from the circuit and consequently do not add perjudicial inductance or capacity thereto. The brushes 22 are carried by an insulating strip 28 to which they are secured by screws 29. The bracket 27 is likewise secured to the strip 28 by screws 30. The conducting segments 18 are secured to the insulator 19 by screws 31 or other suitable means.

I preferably employ a plurality of regulating switches for throwing the inductance coils into circuit—one for each set of coils. The unit coils 15 are thrown in by one regulating switch and the multiple coils 14 by another. As shown in Fig. 1, the regulating switch for the coils 14 is provided with a shaft 32 and finger wheel 33, insulating material 34, conducting segments 35, pins 36, terminal brush 37, and brushes 38 for the ends of the coils 14. The various parts are connected and arranged as heretofore described in connection with the unit coil regulator.

The movable frame 13 which is arranged within the fixed frame and slides in and out thereof is provided with a cover 39 so as to effectively close and protect the coils and regulating switches from dust and damp. A guide rod is used to guide the sliding frame. The rod is preferably removably secured at one end to the casing. A washer 41 pinned to the rod 40 by a pin 42 and a nut 44 screwed on the end 45 of the rod, which presses against a washer 43, removably secure the rod in place. The other end of the rod is unsupported and free. The sliding frame is guided in its movements by the rod which passes through a hole 46 in the plate 47 secured to a part of the frame by screws 48. A hole 49 in the cover 39 centers the frame when it is in its innermost position. A handle 50 enables the operator to slide the frame. The cover 39 is also guided by suitable means, such as a tongue 51 and groove connection 52. A pin 54 which when

the sliding frame is pulled all the way out fits in the groove 53 supports the end of the sliding frame when the plate 47 leaves the free end of the rod 40.

A plurality of inductance coils 55 and 56 is carried by the sliding frame. These coils are arranged in sets, two sets being shown, and their inductances differ in value, the inductance of each of the coils of one set being a multiple of that of the other set. The coils are preferably wound around the outside the sliding frame, which as well as the fixed frame, is preferably cylindrical in form and circular in cross section. Electrical connections 57 pass from the ends of the inductance coils through the sliding frame to be connected at the inside thereof to suitable brushes 58. These brushes are arranged in pairs, one pair for each coil. An end brush 59 is connected in circuit as indicated in Fig. 1. The brushes are insulated from each other and attached by means of screws 60 to an insulator 61. One or more regulating switches, one for each set of coils are arranged within the sliding frame and carried thereby. As illustrated the switch for the multiple set of inductances includes a shaft 62 provided with a finger wheel 63. The shaft is covered with insulating material 64 and carries conducting segments 65 and pins 66 with which the brushes 58 are adapted to contact. The parts are arranged to throw in successive coils and keep the remaining coils disconnected from the circuit in the same manner as heretofore described in connection with the switch for the coils 15. Another switch is provided for the unit coils 55 carried by the sliding frame. It is provided with a shaft 67, finger wheel 68, insulator 69, conducting segments 70 and pins 71. In each switch the conducting segments are insulated from each other and the pins are electrically connected, preferably to the shaft. A terminal brush 72 connects the inductance to the circuit at one point, the other connection being made through the shaft and bracket 73.

Suitable means are provided for connecting the variable inductances either inductively or conductively with respect to each other, and means are also provided to connect the windings of the inductances in opposition or in agreement, that is to say in unison. Some of the ways in which, in accordance with the invention, the windings are adapted to be connected are illustrated in the diagrams Figs. 14–18. I provide a simple form of switching means to effect these connections. In the embodiment of the invention illustrated, a switch is used having a shaft 74 with insulating material 75 carried by arms 76 secured to a base 77 by screws 78. The switch is contained in a box 79. The insulating material of the switch carries a series of conducting plates 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92. These plates are arranged in accordance with the invention to connect the inductance coils in the ways necessary for practical working.

A plurality of brushes 93, whose ends 94 are adapted to contact with the plates 80—92 are respectively connected to binding posts 95, 96, 97, 98, 99, 100, 101. Branch wires 102, 103, 104 are used so as to connect each of the binding posts 95, 96, 98 with two brushes. A scale 105 and pointer 106 indicate each of the five positions at which the switch is placed, lettered *a*, *b*, *c*, *d*, *e*, which correspond to five of the connections made by the operator. In order that the switching means may connect the tuning inductances, the local and aerial condensers, the aerial and the receiver in the various ways indicated in Figs. 14 to 18, the binding posts 95, 96, 97, 98, 99, 100, 101 of the switch are electrically connected by connecting wires to various parts of the apparatus. These connections are made manually when the apparatus is set up. By then turning the shaft 74 of the switch, the various combinations required are effected. The wired connections will first be described and then the operation of the switch.

Binding post 95 is connected by a wire with binding post 950 (Fig. 13) at one side of the aerial condenser. The other side of the condenser connects to ground via terminal 111. Binding post 96 is connected by a wire with binding post 960 (Fig. 4) which connects the brush 24 at one end of the regulating switch that includes shaft 16. Binding post 97 is connected by a wire with one side of the telephone receiver. Binding post 98 is connected by a wire with binding post 980 (Fig. 4) at one end of the regulating switch that includes shaft 62. Binding post 99 is connected by a wire with post 990 (Fig. 13) at one side of the local condenser circuit. Binding post 100 is connected by a wire with post 1000 (Fig. 4) which leads to the shaft 32 and binding post 101 is connected by a suitable wire to post 1010 which connects with brush 72 (Fig. 4). The terminal 150 of the local condenser circuit and the remaining terminal 151 of the receiver circuit are connected together by a wire. Connectors 140, 141 connect the unit inductances of the aerial circuit with the multiple inductances of the aerial circuit and connectors 142, 143 are used to make the same connection for the local inductances.

Fig. 14 illustrates diagrammatically the inductive connection between the coils which connection is more fully illustrated in Fig. 1. The aerial wire 1 is connected at 101 with the inductances 55, 56 and then by connections 98, 95 to a condenser of variable capacity 110, (the variability of the capacity of the condenser being indicated by the ar-

row) and then to ground through the connection 111 and switch 111ª. The local circuit which contains the condenser 112 and telephone receiver 113 also contains the variable tuning inductance 14, 15. The two sets of inductances are in series in the local circuit. This system of connection corresponds to position *a* of switch 74 with blocks, 80, 81, 82 in contact with their respective brushes.

The diagram of Fig. 15 shows the inductances arranged in conductive relation with their coils in agreement or unison that is so that the inductive effects of the separate coils assist each other, thereby increasing the self induction of the circuit. The two sets of inductances are in series in the local circuit. This corresponds to position *b* of the switch 74 with blocks 83, 84, 85 in contact with the brushes.

Fig. 16 illustrates the inductances in conductive relation with their coils in opposition, thus more or less diminishing the joint self inductance of the coils. This corresponds to position *c* of the switch with blocks 86, 87, 88 in contact with their respective brushes.

Fig. 17 illustrates the inductances so arranged that one is contained in the local circuit and the other is in series with the aerial and the local circuit. The coils of the respective inductances are arranged in agreement or unison so as to add their self induction. This corresponds to position *d* of the switch with blocks 89 and 90 in contact with their respective brushes.

Fig. 18 illustrates the inductances so arranged that one is in the local circuit and the other is in series with the aerial and the local circuit. The coils of the respective inductances are arranged to oppose each other, so that the total self induction is more or less diminished. This corresponds to position *e* of the switch 74 with the blocks 91 and 92 in contact with their respective brushes.

By the above described circuit connections and by sliding the sliding frame carrying one set of inductance coils in and out, the self induction of the circuit may be greatly varied so as to tune the apparatus for many different wave lengths and to distinguish between signals varying in intensity although produced by waves of the same wave length.

The variable condenser 112 of the local circuit preferably contains balanced plates 124, 125 and the variable condenser 110 for the aerial circuit preferably contains balanced plates 120, 121. By balancing the plates of the condenser, that is by having them on opposite sides of the supporting shafts, there is no tendency of the plates to shift their position owing to their inertia as might happen if unbalanced condensers were used as on shipboard if the ship rolls. The local variable condenser 112 may be connected in circuit in any desired manner, for example in shunt or in series with the telephone receiver and the variable condenser in the aerial circuit may be connected at any desired point in that circuit. The inductance 9 for the aerial loop is preferably divided so that a part of the inductance is placed in each branch of the loop. I employ two switches 10 and 11 to secure this result. The inductance 9 is wound around the drum 160 and the switches 10 and 11 slide lengthwise of the drum. These switches are constructed as follows: A slide 130, which slides in a suitable groove is cut away so as to receive the finger. A metallic brush 131 with head 132 is carried by the slide, the head contacting with the bare wire 9 of the inductance. One end of the inductance is grounded at 134. The brush 131 is connected in circuit through the connector 133 and the switch 10 is connected in circuit through the connector 135. These switches afford a means for varying the inductance in each branch of the loop.

Having thus described one embodiment of the invention, it will be obvious that many changes may be made in its form without departing from the principle thereof.

What I claim and desire to obtain by Letters Patent, is the following:

1. In a high frequency system of transmission of energy, the combination of a receiving circuit, a variable inductance arranged in said circuit, a local circuit, a variable inductance in said local circuit, all of the inductance in the receiving circuit being adapted to be connected either inductively or conductively with relation to the inductance in the local circuit and switching means for changing from the inductive to the conductive connection at will.

2. In a high frequency system of transmission of energy, an aerial, a variable inductance in circuit with said aerial, a local circuit including a variable inductance, said inductances being adapted to be connected either inductively or conductively with respect to each other, means for grounding said aerial circuit and switching means for changing from the inductive to the conductive connection at will.

3. In a high frequency system of transmission of energy, an aerial, a variable inductance in circuit with said aerial, a local circuit including a variable inductance, a receiver in said local circuit, said inductances being adapted to be connected either inductively or conductively with respect to each other, means for grounding said aerial circuit and switching means for changing from the inductive to the conductive connection at will.

4. In a high frequency system of trans-

mission, the combination of a grounded aerial, a variable aerial inductance in circuit with said aerial, a local circuit including a receiver, a local variable inductance and switching means whereby said aerial inductance and local inductance may be thrown in series with each other in said local circuit, and whereby also said aerial inductance is adapted to be thrown in series with said aerial and said local circuit.

5. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a frame carrying a plurality of self-induction coils, each insulated from the other and each disconnectible from the other, another frame carrying a plurality of inductance coils, each insulated from the other and each disconnectible from the other, a regulating switch for connecting one or more of said first named coils in circuit, a regulating switch for connecting one or more of said latter coils in circuit and means for moving one of said frames with respect to the other so as to vary the inductive relation between said coils.

6. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, each insulated from the other, the coils being electrically disconnectible from the circuit, and a regulating switch for including in circuit one or more of said coils at will.

7. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a regulating switch, means for connecting in circuit one or more inductance coils at will; a second plurality of inductance coils adapted to be inductively connected with the first set of inductance coils and a regulating switch for conductively connecting the second set of inductance coils in circuit in series with said first named set.

8. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a regulating switch adapted to connect one or more of said coils in series in a circuit, a second plurality of inductance coils, a regulating switch adapted to connect said second plurality of coils in a circuit, frames for carrying the two pluralities of coils adapted to bring them into inductive relation with each other, and a switch adapted to connect the two pluralities of coils in circuit with their windings in unison or in opposition.

9. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils electrically disconnected from the circuit, each coil having an inductance equal to or a multiple of a common unit, and regulating means for including one or more of said coils in a circuit, and disconnecting the remaining coils from said circuit.

10. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a regulating switch carrying a plurality of sets of conductors, the conductors of one set being insulated from each other and the conductors of another set being conductively connected, means for connecting one terminal of each coil to the respective conductor of the connected set and means for connecting the other terminal of each coil to its respective insulated conductor.

11. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a rotatable regulating switch, a conducting shaft on which said switch is mounted, a plurality of conducting segments carried by said shaft and insulated therefrom, a plurality of conductors insulated from said segments, but electrically connected with said shaft, a plurality of brushes arranged to contact respectively with said segments and said conductors and means for electrically connecting the ends of the respective inductance coils with corresponding brushes.

12. A high frequency receiving system comprising an aerial, a plurality of inductance coils, a regulating switch carrying a plurality of sets of conductors, the conductors of one set being insulated from each other and the conductors of another set being conductively connected, means for connecting one terminal of each coil to the respective conductor of the connected set, means for connecting the other terminal of each coil to its respective insulated conductor and means for connecting one of said insulated conductors to the aerial and one of said connected conductors to ground.

13. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a frame carrying a plurality of inductance coils, each electrically disconnected from the other, a second frame carrying a plurality of inductance coils, each electrically disconnected from the other, the frames being arranged to telescope one within the other, electrical

connectors carried by each of said frames for respectively connecting said inductance coils in circuit, and one or more regulating switches for connecting one or more of said inductance coils with said connectors.

14. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, an outer fixed frame on which said coils are mounted, an inner sliding frame carrying a plurality of inductance coils and a regulating switch carried by said sliding frame for connecting one or more of the coils on the sliding frame in circuit.

15. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including an outer frame carrying a plurality of inductance coils, an inner frame carrying a plurality of inductance coils arranged in sets, the inductance of each of the coils of one set being substantially a multiple of the inductance of one of the coils of another set and a regulating switch carried by said inner frame for connecting one or more of the coils of each set of coils carried by the inner frame in circuit.

16. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including an outer frame carrying a plurality of inductance coils, an inner frame carrying a plurality of inductance coils arranged in sets, the inductance of each of the coils of one set being substantially a multiple of the inductance of one of the coils of the other set, and a plurality of regulating switches, one for each set of coils for connecting one or more of the coils of the set in circuit.

17. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including an outer frame carrying a plurality of inductance coils, an inner frame carrying a plurality of inductance coils arranged in sets, the inductance of one of the coils of one set being substantially a multiple of the inductance of one of the coils of the other set, and a plurality of rotary regulating switches, one for each set of coils for connecting one or more of the coils of each set in circuit.

18. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including an outer cylindrical fixed frame, a plurality of sets of inductance coils wound around the outside of said frame, the inductance of each coil of one set being substantially a multiple of the inductance of a coil of the other set, a plurality of brushes with which the ends of said coils are respectively connected, a plurality of regulating switches for said coils, said regulating switches including a shaft, a plurality of conductors adapted to contact with said brushes, said conductors being arranged with their leading ends in a spiral curve about said shaft, a plurality of conducting pins insulated from said conductors, each pin arranged in advance of a corresponding conductor, means for electrically connecting said pins and means for connecting said pins in circuit.

19. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a casing, a fixed frame within the casing, a plurality of inductance coils wound around said frame, a sliding frame arranged to slide into and out of said casing, a plurality of inductance coils carried by said sliding frame and a cover attached to said sliding frame and adapted to close said casing when said sliding frame is within said casing.

20. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a casing, a fixed frame, a plurality of inductance coils carried by said fixed frame, a guide rod, a sliding frame, a plurality of inductance coils carried by said sliding frame, said sliding frame being guided in its movements by said rod, a cover attached to said sliding frame and guiding means for said cover.

21. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a casing, a fixed frame, a sliding frame, a plurality of sets of inductance coils wound around said sliding frame, a guide rod rigidly secured at one end to said fixed frame, the other end of the guide rod being unsupported and means for guiding said sliding frame on said guide rod.

22. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a casing, a fixed frame, a plurality of inductance coils wound around said frame, a guide rod, means for removably securing one end of said guide rod to the frame of the apparatus, the other end of the guide rod being unsupported, a sliding frame, a plurality of inductance coils wound around said sliding frame, said latter frame being adapted to be guided on said guide rod, a cover secured to said sliding frame, a plurality of regulating switches carried by said sliding frame, said regulating switches being adapted to include one or more of said inductance coils in circuit.

23. In a high frequency system of trans-

mission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a frame, a plurality of inductance coils wound around the outside of said frame, one or more regulating switches arranged within said frame and carried thereby, a plurality of brushes arranged within said frame, and adapted to coöperate with said regulating switches and electrical connections between the ends of the inductance coils and the respective brushes, said connections passing through said frame.

24. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a fixed frame, a plurality of inductance coils wound around said frame, a sliding frame arranged to slide within said fixed frame, a plurality of inductance coils wound around the outside of said sliding frame, one or more shafts extending longitudinally of said sliding frame, a plurality of conductors carried by said shafts, said conductors being insulated from each other and from said shafts, the heads of said conductors being arranged spirally around their respective shafts, a plurality of conducting pins each arranged opposite the head of one of the conductors, means for electrically connecting said pins, a plurality of brushes adapted to contact with said conductors and said pins and electrical connecting means connecting the ends of the respective coils to respective brushes.

25. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils normally disconnected from each other, a plurality of brushes including an end brush, the ends of the coils being connected to respective brushes, a carrier, a plurality of conductors carried by said carrier, each insulated from the other, the heads of the conductors being staggered with relation to each other, a plurality of conducting pins, each pin arranged within the zone of the corresponding conductor in front of said conductor and alongside of the head of the adjacent conductor, means for electrically connecting said pins, means for connecting the circuit to one of said pins and means for connecting another portion of the circuit to the end brush.

26. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a plurality of pairs of brushes, a plurality of inductance coils, each coil having its ends connected respectively to the brushes of a pair, means for insulating each pair of brushes from the adjacent pair, a plurality of conductors each insulated from the other and mounted upon a common carrier and adapted to successively connect adjacent brushes, a plurality of conducting pins insulated from each other and mounted upon said carrier, each of said pins being adapted to successively contact with the terminal brush of a coil, when the other brush attached to said coil is electrically connected through one of said conductors with the adjacent coil, means for electrically connecting said pins and means for connecting said pins in circuit.

27. In a high frequency system of transmission of energy, the combination of a receiving circuit, a variable inductance arranged in said circuit, a local circuit, a variable inductance in said local circuit, said inductances being adapted to be connected either inductively or conductively with relation to each other, switching means for changing from the inductive to the conductive connection at will and means for moving one of said inductances with relation to the other so as to vary the inductive relation between them.

28. In a high frequency system of transmission of energy, the combination of a circuit to be tuned and a tuning apparatus therefor, the latter including a plurality of inductance coils, a regulating switch, means for connecting in circuit one or more inductance coils at will, a second plurality of inductance coils adapted to be inductively connected with the first set of inductance coils, a regulating switch for conductively connecting the second set of inductance coils in circuit in series with said first named set and means for moving one of said inductances with relation to the other so as to vary the inductive relation between them.

29. A tuning apparatus for high frequency system of transmission of energy comprising a casing containing a balanced local and aerial condenser of variable capacity, an inductance, a pair of sliding switches adapted to connect one or more turns of said inductance in the branches of an aerial loop, a local inductance, an aerial inductance, a plurality of regulating switches for connecting said local and aerial inductance respectively in circuit.

30. A tuning apparatus for high frequency system of transmission of energy comprising a casing containing a balanced local and aerial condenser of variable capacity, an inductance, a pair of sliding switches adapted to connect one or more turns of said inductance in the branches of an aerial loop, a local inductance comprising a plurality of coils electrically disconnected, an aerial inductance comprising a plurality of coils electrically disconnected, a plurality of regulating switches for connecting one or more of said local and aerial inductances in circuit

without connecting the remaining coils in circuit.

31. A tuning apparatus for a high frequency system of transmission of energy including the combination of a plurality of inductance coils electrically disconnectible from each other, and switching means for connecting one or more of said coils to the circuit to be tuned without connecting the remaining coils to the circuit, thereby avoiding the connection of dead ends to the circuit.

32. A tuning apparatus for a high frequency system of transmission of energy comprising the combination of a plurality of inductance coils, one of which may be electrically disconnected from the remaining coils and switching means for connecting said coil to the circuit and disconnecting the remaining coils from said circuit, whereby the connection of the dead ends of the remaining coils with the circuit is avoided.

33. A tuning apparatus for a high frequency system of transmission of energy comprising the combination of one or more inductance coils adapted to be connected in series with each other and electrically disconnectible from a circuit and switching means for connecting one or more of said coils in series with each other and to said circuit and disconnecting the remaining coils from said circuit, thereby avoiding the connection of dead ends to the circuit.

34. A tuning apparatus for a high frequency system of transmission of energy comprising the combination of one or more inductance coils electrically disconnectible from a circuit and a movable switch for connecting one or more of said coils to said circuit and disconnecting the remaining coils from said circuit, thereby avoiding the connection of dead ends to the circuit.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

ROBERT H. MARRIOTT.

Witnesses:
W. C. MARGESON,
W. F. BISSING.