Nov. 19, 1935. F. W. KOLKMANN 2,021,877

VACUUM TUBE TESTER

Filed Dec. 16, 1932 2 Sheets-Sheet 1

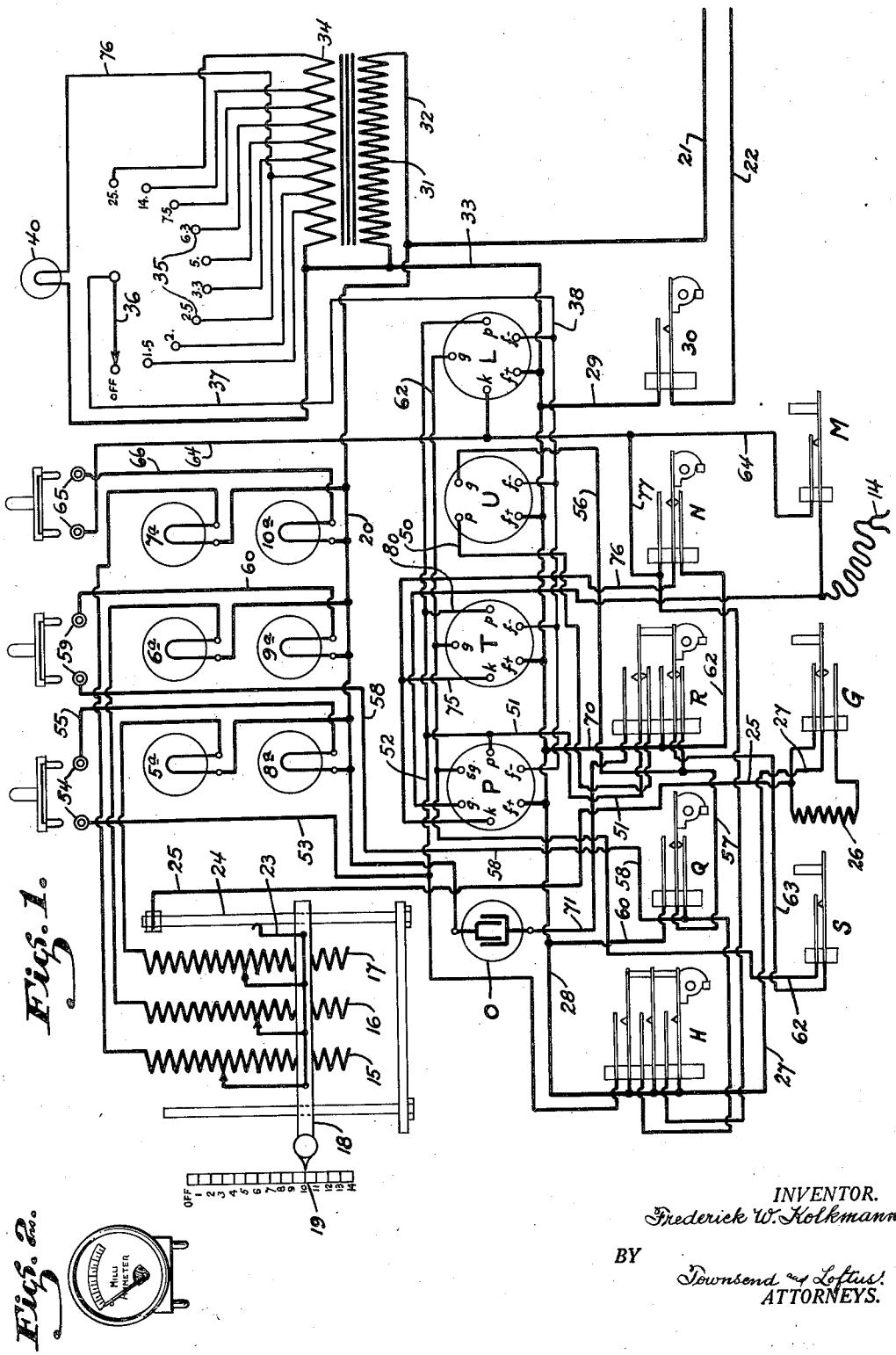

Fig. 1.

Fig. 2.

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Fig. 3.

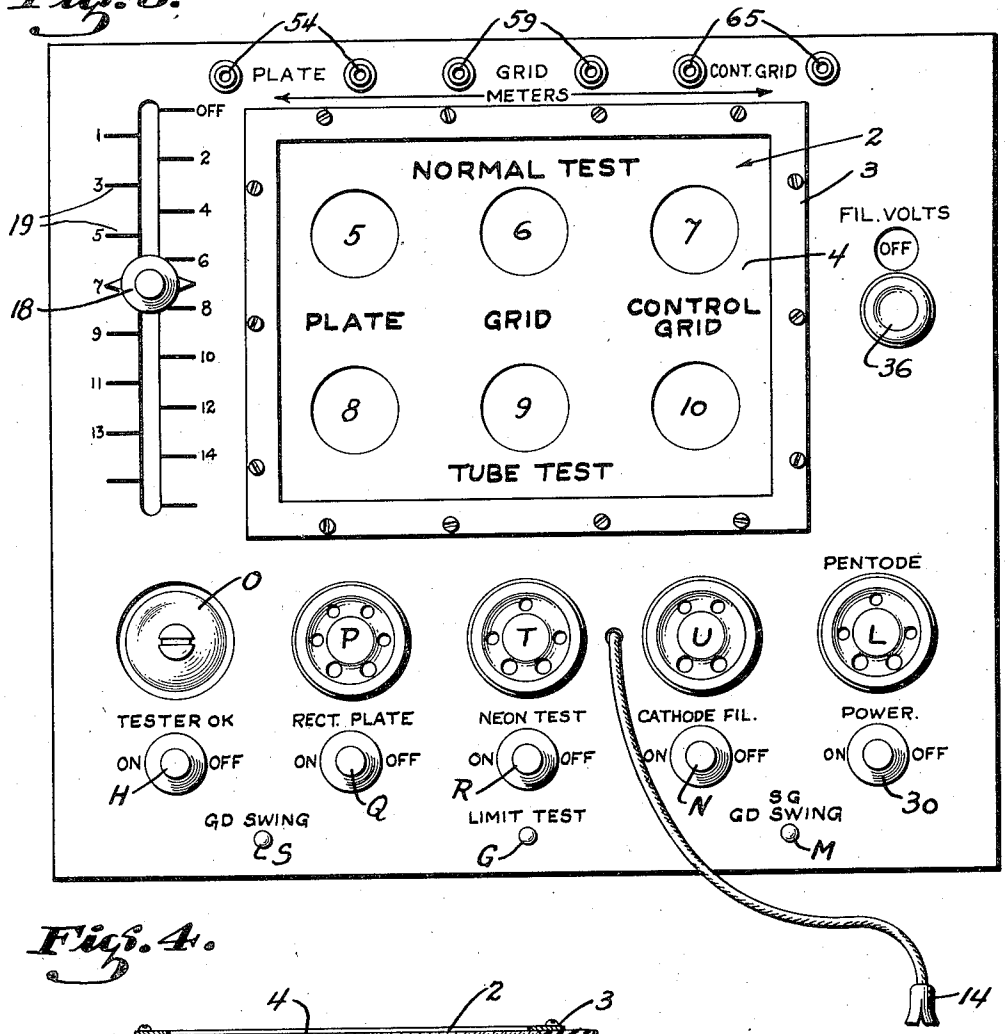
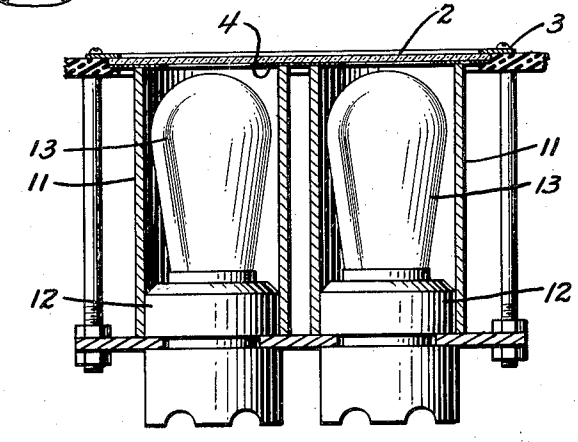


Fig. 4.



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Patented Nov. 19, 1935 2,021,877

UNITED STATES PATENT OFFICE

2,021,877

VACUUM TUBE TESTER

Frederick W. Kolkmann, San Francisco, Calif.

Application December 16, 1932, Serial No. 647,498

7 Claims. (Cl. 250—27)

This invention relates to a tube tester and particularly to a tester whereby vacuum tubes, such as rectifying tubes, radio tubes, and the like, may be tested to determine the condition of the same.

The object of the present invention is to generally improve and simplify the construction and operation of vacuum tube testers; to provide a tester in which the general condition of the tube or the condition of the individual elements in the tube may be determined; to provide a tester in which alternating current is employed; to provide a tester in which the current flowing through the tube being tested or through any element thereof is passed through the filament of an indicating lamp to produce light emission in the same and in which the condition of the tube being tested or any element thereof is determined by comparing the light intensity of the indicating lamp with that of the light intensity of a standard lamp; and further, to provide a tester in which current flow through the standard lamp or lamps may be varied so as to vary the light emission to conform to different types of tubes to be tested.

The invention is shown by way of illustration in the accompanying drawings, in which—

Fig. 1 is a wiring diagram of the tube tester.

Fig. 2 is a front view of a milliammeter.

Fig. 3 is a plan view of the testing instrument.

Fig. 4 is an enlarged vertical section taken on line IV—IV of Fig. 3.

Referring to the drawings in detail, and particularly Figs. 1 and 3, A indicates a panel in which is formed a window opening 2, said opening being covered by glass and the glass being secured by a frame 3. Disposed below the glass is a masking plate 4 and formed therein are six openings, such as indicated at 5, 6, 7, 8, 9 and 10. Disposed below each opening is a lamp housing 11 at the lower end of which is supported a socket 12 and carried by each socket and disposed within the lamp housing is a lamp or bulb 13, there being one bulb for each opening formed in the mask 4. The bulbs contained in, or aligning with, the openings 5, 6 and 7 in the mask will hereinafter be referred to as standard lights or lamps, and the bulbs contained in, or aligning with, the openings 8, 9 and 10 will hereinafter be referred to as indicating lights or lamps. The standard lamps are shown in the wiring diagram and are indicated by the numerals 5*a*, 6*a* and 7*a*. The indicating lamps are also shown in the wiring diagram and are indicated by the numerals 8*a*, 9*a* and 10*a*.

Each indicating lamp is provided with a filament as shown in the wiring diagram and current flow through the filaments is controlled by the vacuum tube being tested. There are numerous types of vacuum tubes, for instance, there are different types of rectifying tubes, such as half wave or full wave rectifying tubes, and there are different types of radio tubes, such as triode tubes, tetrode tubes, pentode tubes, and so on. Some of the tubes are provided with four prongs, others with five and six prongs, and so on, and it is accordingly necessary to provide a series of sockets for the reception of different types of tubes to be tested. The sockets employed are indicated at P, T, U and L, and a separate connection, such as indicated at 14, is provided for attachment to tubes which have a control grid terminal at the upper end thereof.

Before describing the different circuits, it might be well to state that one of the main features of the present invention is that of visibly indicating the general condition of the tube to be tested, and also the condition of the individual elements therein. This is accomplished by first placing the tube to be tested in the socket provided for its reception; secondly, passing a current through the tube. This current, after passage through the tube, is passed through one or more of the filaments in the indicating lamps, hence the current flow through the tube being tested is transformed into light, the light being emitted by the indicating lamps, and this light is in turn compared with the light emitted by the standard light or lamps, indicated at 5*a*, 6*a* and 7*a*. For instance, if a tube being tested is perfect the current flow through the elements of the tube will be equivalent to ten candle power and as this current passes through one or more of the filaments of the indicating lamps 8*a*, 9*a* and 10*a*, the light emission of said lamps will be equivalent to ten candle power. The light intensity of a particular tube, which is in perfect condition, is accordingly known and the light intensity of the standard lamps will previously have been set to that particular candle power, hence if the indicating tubes show a light intensity of ten candle power they will register the same light intensity as the standard lamps. On the other hand, if the electron emission of the filament in the tube being tested is poor, the current flow through the tube being tested and the filament of the indicating lamp connected therewith will be less and the light emission of the indicating lamp or lamps may in that case be only five candle power, hence the light intensity of the indicating lamp or lamps will be

less than that of the standard lamps and a visible indication will be thus given that the condition of the tube being tested is not what it should be. Again, if the tube being tested is soft, or in other words contains too much gas, the current flow through the tube being tested and the filament of the indicating lamp connected therewith will be greater and the light emission or intensity of the indicating lamp may in that case be five candle power more than that of the standard lamp, hence a visible indication is again given showing that the condition of the tube being tested is not what it should be.

Plainly speaking, one of the important features of the present invention is that of transforming the current flow through a tube being tested into light at a point on the testing panel where the light produced may be compared with a standard light.

Before proceeding further with the description of the invention a detailed description will be submitted describing some of the parts of the instrument. The sockets in which the lamps are tested have already been described and so have the indicating lamps coperating therewith, and the standard lamps with which they are compared. In view of the fact that numerous types of tubes will be tested, it is obvious that a standard light or lamp of constant light intensity cannot be employed as the current flow through different types of tubes when undergoing a test, even though they are perfect, will vary, hence it is essential that means be provided for varying the light intensity of the standard lamps prior to the testing of a given tube so that direct comparison may be made. For this purpose a plurality of variable resistances are provided such as indicated at 15, 16 and 17. The resistance 15 is connected with a filament of the standard lamp 7*a*, the resistance 16 is connected with a filament of the standard lamp 6*a*, and the resistance 17 with a filament of the standard lamp 5*a*. A contactor bar 18 is provided and this carries a series of contactors or brushes, such as shown in the wiring diagram. Hence, by moving the contactor bar in one direction or another, the current flow through the filament of the lamps 5*a*, 6*a* and 7*a* may be varied and as a consequence the light intensity of the same. A scale, such as shown at 19, is disposed at one side of the contactor and this is numbered from one to fourteen. This scale is employed by the operator using the instrument and he may refer to a table, for instance, if a certain type of heater tube is to be tested, the operator will merely refer to his table and he will find that the setting for that particular tube is number 10. He will, accordingly, slide the contactor bar 18 until it registers with the numeral 10. In this position the proper resistance is introduced in the circuit of the standard lamps and they will burn and emit the proper light intensity for that particular type or size of tube. Hence, means are provided for varying the current flow through the standard tubes so that the light intensity may be varied to suit the different types and sizes of tubes to be tested.

The other side of the filaments shown in the standard lamps 5*a*, 6*a* and 7*a* are connected to a main feed wire 20, and this is in turn connected to an alternating current source of supply through a feed wire 21, the other side of the source of current supply being connected through a wire 22. One hundred and ten volt alternating current supply may, for instance, be employed, and the circuit may be traced as follows: It passes through wires 21 and 20, then through the filaments of the tubes 5*a*, 6*a* and 7*a*, then out through the opposite sides of the filaments and the wires which are connected with the variable resistances 15, 16 and 17. The current then passes out through the contactors carried by the bar 18 and through a contactor 23. This engages contactor bar 24, and this is connected through a wire 25 with the other side of the circuit, or in other words, the wire 22. The wire 25 before reaching the wire 22 will, under certain conditions, be passed through a fixed resistance 26 through means of a switch generally indicated at G, but under normal conditions this switch is closed and the current from wire 25 is accordingly passed through the switch and passes out through wire 27. This connects with a wire 28 and the wire 28, in turn, connects with a wire 29 in which is interposed a power switch 30, the other side of the switch being connected with the wire 22.

Alternating current is employed throughout in making tests of different character. It is employed for heating the filaments in the indicating lamps and in the standard lamps, and it is also employed for heating the filaments in the tubes to be tested and for other purposes hereinafter to be described. The voltage required in the filaments of different types of tubes varies considerable, in fact, it may vary between one and one-half to twenty-five volts. A transformer is accordingly provided and the primary of the transformer is indicated at 31. One side of the transformer is connected to the feed wire 21 through wire 32 and the other side of the transformer is connected through wire 33 with wire 29, the power switch 30 and the other side of the line or the wire 22. The circuit through the primary of the transformer is normally open but whenever the power switch 30 is closed the circuit through the primary will be established. The secondary winding of the transformer is indicated at 34. This is provided with a series of taps, as shown at 35, and a contact switch arm 36, hence current of any voltage desired may be obtained. One side of the secondary transformer is connected through wire 33 with wire 28, while the current from the other side of the secondary is removed through one or another of the taps 35 through switch arm 36, this being in turn connected through wire 37 and a feed wire 38. The wires 28 and 38 are in turn connected with the two filament prongs of each of the tube sockets, indicated at P, T, U and L, hence if a tube to be tested is inserted in any socket the circuit through the filament prongs will be closed and the filament of the tube will be supplied with the proper voltage as the switch arm 36 will be moved to the tap which will supply the proper voltage.

In view of the foregoing it will be noted that a transformer is provided for supplying the filament current of the tubes to be tested and that the transformer is provided with taps so that a current of proper voltage may be supplied. The transformer is employed for no other purpose except that of operating a pilot light, such as indicated at 40, this pilot being merely provided for the purpose of indicating whether the circuit through the transformer has been closed or not, or in other words, shows whether the power switch has been closed or not.

There are many conditions in a vacuum tube which may render the same more or less inef-

ficient. Among them may be mentioned the following:

(1) Emission of the filament may be poor;

(2) A tube being tested may be soft, or in other words, contain too much gas;

(3) A high resistance or loose connection may be found in the tube;

(4) The plate capacity of a tube may be low;

(5) The grid capacity may be low; and

(6) A short may be formed between one or more of the elements, and so on.

Defects of this character do not only decrease the efficiency of the tube but also affect the radio receiving set in which it is used. For instance, certain defects may lower the selectivity of the receiving set, which may cause poor tone quality, and may cause noises similar to static noises, and so on. Hence, it is essential that if the tube has any defects, the defects should be located so that it may be determined whether it is essential to replace the tube.

In addition to the parts already described the panel carries a series of switches, indicated at H, Q, R, N, M and S, the switches 30 and G having already been referred to. The panel also carries a neon lamp O and in order that the circuits through the several switches, the sockets, and the indicating lamps may be readily traced, it might be stated that the filament prongs are indicated by the reference letters *f—f*, the plate prongs by the letters *p*, the cathode by the letters *k*, the grid by the letters *g*, and the screen grid by the letters *sg*. The several switches just referred to are employed for the purpose of opening or closing circuits through different elements in the tubes being tested, so that if there is any defect in the tube the defect may be positively located.

Switch 30, previously referred to, is known as the power switch as it is interposed in the supply feed wire 22, and as such makes or breaks the feed circuit to the instrument as a whole. When this switch is closed the transformer will be in operation and will supply current to the filaments of the tube or tubes to be tested and it will also supply current to the standard lamps 5*a*, 6*a* and 7*a*, and will furthermore supply current to test the different elements of the tube when the several switches referred to are operated. Switch H is employed for one purpose only, to-wit, that of determining whether the indicating lamps 8*a*, 9*a* and 10*a* are up to standard and are properly functioning, hence when the current is turned on by closing the power switch 30, switch H should first be closed and, when it is closed, a circuit is closed through the indicating lamps 8*a*, 9*a* and 10*a*, and if they show full brilliancy and equal brilliancy the operator will know that they are functioning properly. Switch H may then be opened and may not be used again for several days, as it is only necessary to test the indicating tubes once in awhile.

The switches Q, R and N will normally assume the position shown in the wiring diagram and when a tube to be tested is inserted in any socket an indication of the condition of the tube will be shown by the lamps 8*a*, 9*a* and 10*a*. The tube being tested may to all appearances be perfect but this is not necessarily so. For instance, there may be a loose connection in the lamp, and this would not show up. Again, the filament emission might be poor but it is off-set due to the fact that the tube contains a certain amount of gas, hence a tube should not be passed as perfect until the different elements have been tested. Switches Q, R and N in the normal or off position merely determine filament emission of the tube being tested. Switch Q has two contacts, the lower contact tests the tube for filament emission, while engagement of the switch with the upper contact places the plate and grid in series to determine if there is a short between them. If there is no short, indicating lamps 8*a* and 9*a* will show the same light indication as the standard lamps above the same. On the other hand, if there is a short, the lamps 8*a* will burn brighter and thus indicate that there is a short between the plate and the grid. Switch R has four contacts. The lower contacts are employed for testing filament emission. In the upper position of the switch, if there is a short between the grid and plate, it will be indicated in the indicating lamp 8*a* as this will burn brighter and it will also be indicated in the neon lamp. If there is a loose connection it will be indicated in the neon lamp only, loose connections being determined by striking the tube being tested by a rubber mallet, or the like. Switch N has two contacts. In the normal position it tests a tube for filament emission, and in the up position it disconnects the filament from the cathode to determine if there is a short between the filament and cathode, and if there is a short, it will be shown in the indicating lamp 10*a*, as this will burn brighter than the standard lamp 7*a* disposed above the same. Switches M and S are employed for the purpose of determining if the tube being tested is soft, or in other words, contains too much gas. By depressing either of these switches, the circuit through the control grid is broken, which is the same as changing the bias of the tube, and if there is any gas in the tube the indicating lamps 9*a* and 8*a* will continue to glow for a short time. On the other hand, if no gas is present these indicating lamps will be immediately extinguished.

The testing of different types of tubes and the circuits employed will now be described. The first tube to be tested will be a full wave rectifying tube and, as this tube has four prongs, it will be inserted in the socket indicated at U. After the tube has been inserted, the power switch 30 is closed so as to turn on the current. With the current turned on the transformer will be energized and the filaments in the standard lights 5*a*, 6*a* and 7*a* will be lighted. The contactor bar 18 is then moved to the proper setting with relation to the scale 19 so that the standard lights will burn with the proper intensity. Switch H may next be closed to determine if the indicating lamps are functioning properly, and if they are, this switch is again opened and the tube is ready for testing. The circuit through the filament of the tube being tested can be traced as follows: The current passes from one of the taps 35 on the secondary of the transformer through the switch arm 36, then through wire 37, which connects with the wire 38, the current then flows through the filament prongs of the socket and through the filament of the tube being tested, and the current then returns through wires 28 and 23 to the other side of the secondary 34 of the transformer. The first thing determined with the switches set as shown in the wiring diagram will be filament emission and that will be indicated in the indicating lamps 8*a* and 9*a*. The circuit through the filaments of these lamps will be as follows: Current entering on the supply wire 22 passes through switch 30 and wire 29 and as this connects with one side of the filament supply, to-wit, the wire 23, current will flow

through the heated filament of the tube being tested across to the plate prong, then passes through wire **50**, which is connected with one terminal of switch R, and as this terminal is closed, the current will pass out through the other terminal and wire **51**. This connects with wire **52**. It then passes through wire **53**, jack **54**, and wire **55**, which is connected with one side of the filament in the indicating lamp **8***a*. Current then passes out through the other terminal of the filament, which is connected with the feed wire **20**, and as this is connected with the return side of the supply circuit **21** the circuit is completed through one plate.

The circuit through the other plate will be as follows: Commencing with the feed wire **22**, the current passes through a switch **30** and wire **29**, which is connected with the wire **28**. Current again passes through the heated filament of the tube being tested and flows by electronic action to the grid connection of the socket, then passes through wires **56** and **57**. This is connected with one terminal of switch Q and as this switch is closed the current will pass out through the other terminal and through wire **58**. This is connected with a jack **59**, then passes through the jack and wire **60** and as this is connected with one terminal of the filament mounted in the indicating lamp **9***a*, the current will pass through this filament and out through the other terminal and as this is connected with the feed wire **20** the circuit will be completed to the other plate through the supply wire **21**. With the circuit through the two plates completed the emission of the filament in the tube will be indicated. If the emission is efficient, the indicating lamps **8***a* and **9***a* will burn with the same intensity as the standard lamps **5***a* and **6***a*. On the other hand, if the emission is poor the indicating lamps will burn with less intensity and if the light appears to be one-half or less than that of the standard lamps the rectifying tube should be thrown away, as it will be less than fifty percent efficient. However, if it appears to be less than fifty percent efficient this can be determined by throwing in the fixed resistance **26**, that is, this resistance is added to the resistances **16** and **17** and it is accomplished by depressing the switch G. When this switch is depressed the fixed resistance **26** is thrown in series with the resistances **16** and **17** and the current flow through the standard lamps **5***a* and **6***a* is reduced by fifty percent. If the light intensity of the indicating lamps is greater than that of the standard lamps the operator will know that the rectifying tube is a little better than fifty percent efficient. If it is the same, the operator will know that it is fifty percent efficient, and if it is less, the operator will know that it is less than fifty percent efficient, and in that case the rectifying tube should be discarded and replaced by a new tube. If during the filament emission test the indicating lamps **8***a* and **9***a* show up brighter than the standard lamps, this indicates that the rectifying tube being tested is gassed, and if the brightness is too intense it might be advisable to discard the tube. When the emission of the tube has been tested, it is desirable to test it for loose connections and this is accomplished by merely tapping the tube with a rubber mallet or the like. If there are any loose connections the indicating lamps will flicker.

The manner in which the tube is tested for filament emission and for loose connections has been described. It is also necessary to test the tube for shorts between the plates and this is accomplished as follows: Switch Q is turned to its opposite position where it engages the upper contact, and when this contact is closed, the circuit to determine shorts between the plates can be traced as follows: Current is supplied by feed wire **22**, passes through switch **30**, wire **29**, and wire **28**, and then passes through wire **60** and through the upper contact of switch Q, then passes out through the other side of the switch through wire **57** and wire **56**, which is connected with the grid terminal of the socket U. If there is a short between the plates, current will flow across the shorted plate from the grid prong to the plate prong, then through wire **50**, which is connected with switch R. It passes through the contacts of this switch and wire **51**, which connects with wire **52**, then passes through wire **53**, jack **54**, and wire **55** which is connected with the filament of the indicating tube **8***a*. It passes through this filament and through wire **20** which is connected with the other side of the line or wire **21**. Hence, if there is a short between the plates, the indicating lamp **8***a* will light up fully, thus indicating a short. On the other hand, if no short exists, a normal light will appear in the indicating lamp **8***a* and it is then known that the tube is perfect and it may be removed.

The testing of a heater type of tube will next be described. This tube has five elements, to-wit, a filament, a cathode, a plate, a control grid, and a screen grid. This type of tube has a terminal at its upper end with which the control grid is connected and when a test is being made a circuit is formed by attaching the flexible connector through clip **14**. The tube is inserted in the socket indicated at T. With the switches in normal position, the first test will be that of filament emission to the plate and this circuit can be traced as follows: The flow of current from the secondary of the transformer to the filament of the tube has already been described, as the filament current supply is the same for all tubes to be tested, the only difference being that the voltage supplied may be changed by swinging the switch arm **36** from one tap to another so as to provide the proper voltage for the particular tube to be tested. The flow of current through the filament when emission is being tested will be as follows: Current supplied by the feed wire **22** passes through the switch **30** and wire **29**, and it is delivered by wire **28** to the heated filament of the tube being tested. It then flows by electronic action from the filament to the plate and the prong with which it is connected. This prong is connected with wire **52**, by wire **80**, it next passes through wire **53**, jack **54**, and wire **55**, with which it is connected with the filament of indicating lamp **8***a*, then passes through the filament and as this is connected with the feed wire **20** the circuit is completed, as wire **20** is connected with the other side of the line or wire **21**. If the filament emission is proper the light intensity of the indicating lamp **8***a* will be the same as the light intensity of the standard lamp **5***a*. If the light intensity of the indicating lamp **8***a* is greater than that of the standard lamp further tests will be made as this may be due to an excess of gas in the tube. On the other hand, if the light in the indicating lamp **8***a* is less than that of the standard lamp it shows that filament emission is below standard, and just how much below standard it is, may be determined by throwing the fixed resistance **26** into the standard lamp circuit, as previously described. While the filament emission test is being made, light will

also appear in the indicating lamps 9a and 10a, this being due to electronic current flow from the filaments to the control grid and the screen grid.

Emission between filament and screen grid may be traced as follows: Current flowing by electronic action from the filament to the screen grid terminal g, passes through wire 62, which is connected with one terminal of the switch S, it then flows through the contact to the other side of the switch, and wire 63, which in turn connects with the one terminal of the switch R, it then flows through the closed contact to the opposite side of the switch, and through wire 57 which is connected with the switch Q, then through the contacts of this switch to the opposite side and through wire 58, to the jack terminals 59, then through wire 60 to the filament of the indicating lamp 9a, through the filament to the opposite side of the line by wires 20 and 21. If the emission through the filament of the tube to the screen grid is of poor efficiency, it will be indicated in the indicating lamp 9a in a manner similar to that described for the filament emission test to the plate.

Emission between filament and the control grid of the tube will be traced as follows: From one side of the supply line the current flows through wire 22, and switch 30, and wires 29 and 28, then through the filament, thence by electronic flow to the control grid. The control grid connection for this particular type of tube is mounted on top of the tube, as previously stated, and as clip 14 is attached thereto the current will flow through the control grid to the clip 14, then through switch M and wire 64 to jack terminal 65, thence through wire 66 to one side of the indicating lamp 10a, then through the filament to the other side of the line by wires 20 and 21. The switches in this position test the tube for electronic flow from the filament to the different elements.

The efficiency of the filament emission to the plate and to both grids has been described and the test may indicate a good tube but there may be other faults, such as loose connections and shorts between the elements, and this will be indicated as follows.

To determine if there are loose connections or a short between the plate and the screen grid, the switch R will be turned to its upper position and the circuit thus established can be traced as follows: Commencing with wire 22, current flows through switch 30 and wire 29, which is connected with wire 28, it then passes through wire 70 and switch R, then through wire 63, and through switch S, then through wire 62 to the grid terminal of the socket. If there is a short between the screen grid and the plate the current will pass from the terminal g to the terminal p of the socket, then out through wire 80 and wire 52, then through wire 51 and switch R, then through wire 71 and through the neon tube and as this is connected with the return side of the circuit through wires 20 and 21, the circuit through the neon lamp is completed and the neon lamp will glow and show that there is a short. It, however, happens that a circuit will also be closed through the indicating lamp 8a. This circuit is a parallel circuit to the neon circuit and the only portion that need be traced is as follows: Commencing with the plate terminal p, the current passes through the wire 80, wires 52 and 53, then through the jack 54 and wire 55, which connects with the indicating lamp 8a, it then passes through the filament of the lamp and through wires 20 and 21 which completes the circuit. Hence, if there is a short between the screen grid and the plate both the neon lamp and the indicating lamp will glow and indicate that there is a short. If no short exists neither light will show. While making this test it is also desirable to know if either of the elements, that, is the screen grid or plate have loose connections. This is accomplished by merely tapping the tube being tested with a rubber mallet. If any loose connections are present it will be indicated by a flicker in the neon tube, hence means are provided for testing a short between the grid and the plate and also for testing loose connections, and it is also possible in this test to determine if the spacing between the screen grid and the plate is proper. If either element should be displaced so as to make the spacing too close there would be an electronic flow between the two and the neon light and the indicating lamp would again glow.

The next test is to find out if there is a short between the filament and the cathode. Switch N in its normal position connects the cathode and one f terminal of the tube with one side of the line and should there be a short between the filament and the cathode it will be determined by turning the switch N to its upper position and to place the cathode and filament in series with each other. The circuit for a short between the filament and cathode will be traced as follows: Current supplied by wire 22 flows through switch 30, and wires 29 and 28 to the f terminal of the socket T, thence across the shorted filament and cathode connections to the wire 75. This wire connects with wire 76 and contactor arm of switch N, which has been turned to its upper position, making contact with the upper contact. The current then flows through wires 77 and 64 to the jack terminal 65 and by wire 66 to one side of the indicating lamp 10a, and through the filament to the other side of the supply line by wires 20 and 21. Therefore, if there is a short, the lamp 10a will be lit to its full brilliancy and if no short the indicating lamp will not show.

Should the tube appear to be in good order by the test so far indicated, a further test will be made which will be termed the grid swing or bias test which is an indication of the activity of the tube, or the amount of gas that exists in the tube. In making this test the circuit of the control grid will be broken as this is the equivalent of changing the bias of the tube and this is accomplished by depression of the switches M or S with all other switches in normal position as shown on the diagram. If the tube has a small amount of gas in it the amount will be determined by the length of time it takes for the indicating lamps 9a or 10a to become extinguished, depending upon which switch has been depressed. If there is no gas in the tube and it has the desired vacuum the indicating lamps will substantially go out or at least only show a dull glow, this depending upon the type of tube being tested.

It was previously stated that several sockets, such as shown at P, T, U and L, are provided so as to take care of practically all different types of tubes. The test of a full wave rectifying tube and a heater type of tube has been described and, as other types of tubes are tested in a substantially similar manner, detail description thereof is thought unnecessary. It might be further stated that meter readings when making tests are unnecessary, but meter readings may be made, if desired, by merely removing one or another of the jacks, indicated at 54, 59 and 65, and inserting a milliammeter, such as shown in Fig. 2.

Where the milliammeter is inserted, the flow of current can be measured and the light intensity will be shown in the corresponding indicating lamp at the same time.

From the foregoing, it will be noted that a new method of testing thermionic or vacuum tubes has been devised. This method has numerous advantages: First, any defect in a tube being tested is detected by the light emitted by one or more of the indicating lamps, indicated at 8*a*, 9*a* and 10*a*, and the extent of the defect, for instance, poor filament emission, a short circuit, etc., is indicated by the intensity of light emitted by the indicating lamp or lamps; second, the condition of the several elements in a tube being tested may be simultaneously indicated as there are several indicating lamps; third, all tests performed on a particular tube are completed in one socket, this being an advantage as it does away with the necessity of moving the tube from one socket to another when making tests; fourth, meter readings are not necessary but may be made, if desired; fifth, shorted tubes will not damage the testing instrument in any way; sixth, alternating current is employed throughout when making tests. The use of alternating current is an advantage when compared with direct current because of the fact that a direct current has a tendency to weld high resistance connections and sometimes loose connections within a tube, hence showing a good test and when the tube is put back into use the loose connection again shows up the moment it is subjected to vibration. Alternating current, due to its pulsating character, has a tendency to break down any weak parts in a tube and thus show up certain defects that are not indicated where a direct current is employed. Alternating current is furthermore available in practically all city and country districts and the testing instrument can thus be taken into the customer's home and set up for testing purposes, as practically every home is supplied with alternating current. If direct current was required, batteries, a generator, or some equivalent device would have to be employed and would thus destroy the portability of a testing device of this character, as it would render it too heavy to be carried about.

While certain features of the present invention are more or less specifically described, I wish it understood that various changes may be resorted to within the scope of the appended claims. Similarly, that the materials and finish of the several parts employed may be such as the manufacturer may decide, or varying conditions or uses may demand.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. A thermionic tube tester comprising a standard lamp and an adjacent indicating lamp both of said lamps being continuously variable in light intensity from zero to maximum luminosity, means for lighting said standard lamp to a predetermined brilliancy, means for connecting the elements of a tube to be tested to said indicating lamp, and means for energizing said tube whereby the brilliancy of said indicating lamp may be compared with that of said standard lamp.

2. A thermionic tube tester comprising a standard light source, means for lighting said source at a predetermined brilliancy, an indicating light source positioned adjacent said standard source both of said light sources being continuously variable in light intensity from zero to maximum luminosity, and means for passing a current through said indicating source and said tube whereby the brilliancy of said indicating light source may be compared with the brilliancy of said standard source.

3. Means for testing thermionic tubes having a cathode and a plurality of cooperating electrodes, comprising a plurality of standard light sources corresponding to the number of cooperating electrodes in said tube, means for lighting each of said sources to a predetermined brilliancy, an indicating light source connected to each of said cooperating electrodes and adapted to respond in brilliancy in proportion to the space current between said cathode and the electrode to which it is connected, both of said light sources being continuously variable in light intensity from zero to maximum luminosity and means for energizing said cathode and said electrodes to cause space current to flow, all of said lamps being adjacent so that the brilliancy of said indicating lamps may be compared with the brilliancy of said standard lamps.

4. Means for testing thermionic tubes having a cathode and a plurality of cooperating electrodes comprising a series of adjacent standard light sources, means for regulating each of said sources to a brilliancy corresponding to a predetermined standard as related to one of said cooperating electrodes, a series of indicating light sources positioned adjacent said standard series, each of said sources being separately connected to a cooperating electrode and adapted to respond in degree of brilliancy to the current between the cathode and said cooperating electrode with which it is connected, both of said light sources being continuously variable in light intensity from zero to maximum luminosity the indicating sources for each cooperating electrode being positioned in the series opposite the standard source related thereto, and means for energizing said cathode and at least one of said cooperating electrodes to illuminate the related indicating source for comparison with said standard source.

5. Means for testing thermionic tubes having a cathode and a plurality of cooperating electrodes comprising a series of adjacent standard light sources, means for regulating each of said sources to a brilliancy corresponding to a predetermined standard as related to one of said cooperating electrodes, a series of indicating light sources positioned adjacent said standard series, each of said sources being separately connected to a cooperating electrode and adapted to respond in degree of brilliancy to the current between the cathode and said cooperating electrode with which it is connected, both of said light sources being continuously variable in light intensity from zero to maximum luminosity the indicating sources for each cooperating electrode being positioned in the series opposite the standard source related thereto, and means for simultaneously illuminating said standard sources and energizing said cathode and said cooperating electrodes so that said sources may be simultaneously and contemporaneously compared.

6. Means for testing thermionic tubes having a cathode and cooperating electrodes, comprising a plurality of visual indicators each adapted to be pre-set to indicate a predetermined value related to said cooperating electrode, a plurality of current-operated indicators, the response of which varies proportionally with the current passed therethrough throughout an intensity range varying from zero to maximum luminosity, each of said sources being connected

to one of said cooperating electrodes to respond to the current received thereby, and means for energizing said cathode and current-operated indicators to give simultaneous indication for comparison with said pre-set indicators, all of said indicators being positioned adjacent each other for simultaneous viewing.

7. A thermionic tube tester comprising a standard light source, an indicating light source positioned adjacent said standard source, both of said sources being continuously variable in light intensity from zero to maximum luminosity, means for passing a current through said indicating source and said tube to produce a brilliancy less than maximum, means for lighting said standard source at a predetermined brilliancy less than maximum and corresponding to an intensity which would be produced by said indicating source by current passing through a good tube whereby the brilliancy of said indicating light source may be compared with the brilliancy of said standard source to determine the condition of a tube to be tested and whereby shorts in said tube to be tested can be determined by extreme brilliancy of said indicating light.

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