

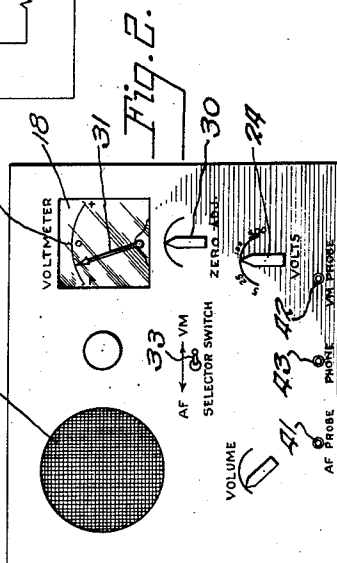
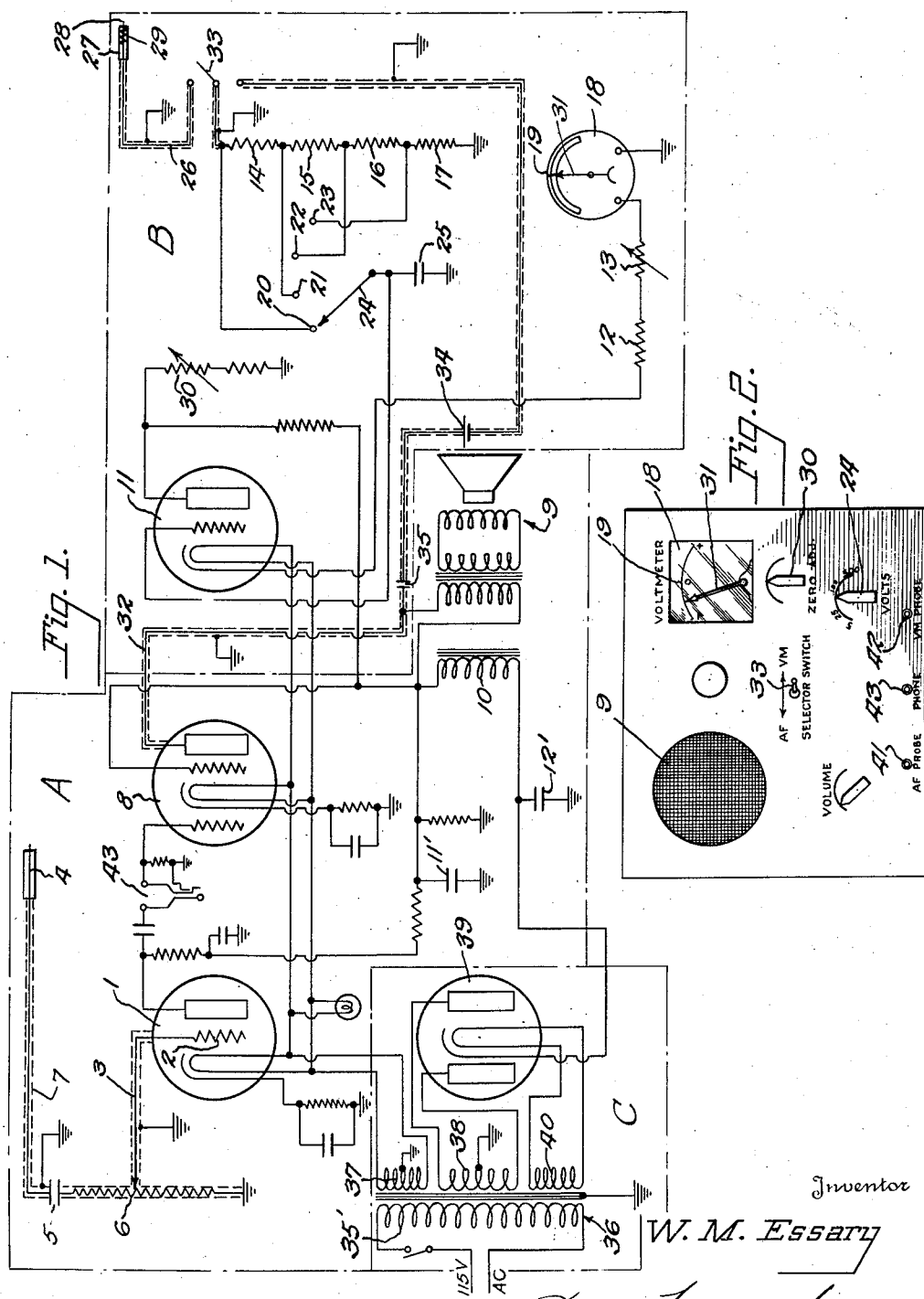
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W. M. ESSARY

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AUDIO AMPLIFIER ANALYZER

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Inventor

W. M. Essary

334 *Mason Fenwick & Lawrence*
Attorneys

Attorneys

UNITED STATES PATENT OFFICE

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AUDIO AMPLIFIER ANALYZER

William M. Essary, Corinth, Miss., assignor to
W. L. McPeters, Corinth, Miss., as trustee

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This invention relates to a testing instrument designed especially for audio amplifier analyzing, and while it will in the following pages be specifically described in relation to the testing of theater sound equipment, it is not confined to such use alone but will accurately and instantly locate any defective part or inoperative circuit in many other devices producing audio sound or amplifying audio sound, such as intercommunication systems, microphones, electric phonograph pick-ups, electric audio amplifiers, audio amplifiers used in recording and reproducing records, audio amplifiers used in transcription and reproduction, audio amplifiers used in public address systems, audio amplifiers employed in broadcasting stations, audio amplifiers used in telephone circuits, audio amplifiers employed in recording sound on film and reproducing same, and many other uses.

One of the objects of the invention is to provide a testing instrument so simple and fool-proof and yet so accurate and effective as to enable the average projectionist in a motion picture theatre, for example, to apply the instrument to any point in the sound amplification system and pick up the sound at said point and listen to it for defects, such as distortions, etc. Furthermore, that at any time the sound ceases to function in the sound equipment, the projection operator or sound engineer can instantly begin at the photo cells of a machine, pick up the sound and listen to it, and if the sound is present at this point he can then proceed to the in-input of the first audio amplifying tube, and if the sound is present at this point he can then proceed to the next tube, and so on throughout the entire audio amplifying system. At any point where the sound should be present and is not, the projectionist or sound engineer will instantly know that he has his trouble located and that the circuits leading to the stage in the amplifying equipment where no sound is present, is the point where some part is defective. With a sensitive voltmeter we can quickly determine the defective part and replace it, enabling the sound equipment to return to proper operation without serious loss of time.

Another object of the invention is to provide in a testing device of the character described, an audio amplifying unit of the resistance-coupled type having a test probe for tapping the sound system at any desired point, and including translating means such as phones or a dynamic speaker, so that the sound at the tested point may be directly listened to, said amplifying unit being characterized by the presence of means

for reducing the in-input capacity of the amplifying unit so that its application to the circuit under test will not affect the operation of said circuit.

A further object of the invention is to provide, in a testing instrument as described, the combination with the audio amplifying unit and a common power supply unit, of a vacuum tube voltmeter with associated test probe, capable of being selectively employed to test the direct current voltage at any point in any instrumentality or circuit of the sound amplification system, or as an out-put meter to test the audio voltage gains to be made from one audio stage to another, without affecting the amplifier being tested.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawing which accompanies and forms a part of the following specification, and in which the same characters of reference have been employed in the several figures to designate identical parts:

Figure 1 is a diagrammatic layout of the electrical system embodying the principles of the subject invention; and

Figure 2 is a front elevation of the panel board of the testing instrument.

Referring now in detail to the drawing, and particularly the diagrammatic showing in Figure 1, the invention can possibly be best apprehended by considering the diagram as showing three basic cooperative units, these having been indicated in broken line enclosures, A being the audio amplifier, including the loud speaker; B being the voltmeter; and C the common power supply unit.

The audio amplifier, as shown, is of the high gain two stage audio type with a frequency range of from 30 to 11,000 cycles, practically flat. It consists of a type 6F5 tube 1, which is used as the sound input tube and has its grid 2 in series connection with the flexible cable 3 terminating in the audio test probe 4, said probe having a metallic point which readily penetrates the insulation covering of a conductor to make contact with the metallic core. A condenser 5 of very small capacity, for example, of the order of .02 mmf. is intercalated in the in-input circuit anterior to the grid 2, for the purpose of making the capacity of the test probe and in-put cable too small to affect the operation of the circuit to which the testing instrument may be applied. This condenser is preferably of 1000 volt test, so that it is possible to pick up audio sound direct from a

plate circuit of 1000 volts or less, without damage to the testing instrument. This allows any audio signal that is present in any circuit to be quickly observed by the ear with this device, although the circuit may be carrying as much as 1000 volts, either A. C. or D. C. The condenser 5 also prohibits any D. C. voltage from any circuit under test to reach the in-put circuit of the amplifying tube 1 in the test instrument, which would render the instrument inoperative.

Inasmuch as there are certain points in an audio amplifying system where the audio signal is very great, if the audio test probe of the subject invention were applied to one of these points without some means of regulating the volume of the audio signal in-put to the test instrument, the audio amplifying unit would become overloaded, resulting in a distorted signal from the loud speaker. In view of this, a variable resistor 6 has been provided in the audio in-put circuit anterior to the grid of the tube 1, as a means for controlling the volume of the in-put signal so that one is enabled to pick up an audio signal with the audio test probe from any point in any audio amplifying system regardless of the strength of the audio signal and observe by ear the presence, absence and character of the signal, undistorted.

It will be observed that the in-put circuit conductor from the test probe to the grid is shielded, the shield being indicated at 7.

The out-put or plate circuit of the tube 1 is resistance capacity coupled to a type 6F6 output tube 8, and the plate out-put circuit of this tube is transformer coupled to an electro dynamic loud speaker 9. The field coil 10 of the dynamic loud speaker is used as a filter choke coil in combination with two 8 mfd. 450 volt test electrolytic condensers 11' and 12'. With this type of filter system no alternating current hum is heard in the loud speaker of the test instrument, thereby eliminating the use of a separate filter choke.

By the use of the dynamic loud speaker incorporated in the system as described, one is permitted to hear an exact reproduction of the audio signal that is present in any circuit under test. To be able to actually listen to the signal present in the equipment under test not only allows the characteristics of that signal to be observed by ear but speeds up the process of locating the defective circuit or part. This is brought about due to the fact that the service engineer can keep his eye on the points where the tests are being made, and not have to watch indicating devices on the testing instrument. The service engineer is furthermore enabled to quickly locate the exact point in any audio amplifying equipment where distortion, hum or noise is present. This distortion, etc., becomes audible in the loud speaker of this device, just as it is in the equipment under test, and the test probe, being applied to the circuit or part where the distortion, etc. is present, enables the exact point of its origination to be instantly located.

Referring to the voltmeter unit B, one of the purposes of this is to enable the service engineer to perform secondary tests on the sound amplifying system being tested, in order to locate the exact defective part causing the circuits of the equipment to become inoperative, it being assumed that the defective section has been localized through the audio indications of the loud speaker. The type of voltmeter used is of the vacuum tube type, and it will be observed from

Figure 1 that I have preferably employed a number 76 super-triode amplifier detector tube 11. I employ this type of tube because of its high resistance in-put which permits voltage measurements to be made without affecting the circuit under test. The in-put resistance of this type of voltmeter is preferably 10 megohms or greater. The high resistance of this voltmeter is accomplished by the use of a serial network of resistances 12, 13, 14, 15, 16 and 17, and the properties of which are characteristic of the vacuum tube.

The meter 18 is preferably of the direct reading type calibrated from a zero position 19 at the middle of the dial in both plus and minus directions in four scale readings, 5V, 25V, 100V, 500V. The voltmeter circuit includes a plurality of taps 20, 21, 22 and 23 taken from the serial resistances 14 to 17, inclusive, at points representing 5 volts, 25 volts, 100 volts and 500 volts and terminate in contacts of a selector switch 24 which makes it possible to select the proper range of the voltmeter desired. The condenser 25 in the selector switch circuit is used to bypass any audio frequency that might be present in the circuit under test, permitting only the D. C. voltage to be measured in said circuit. The voltmeter in-put circuit includes a flexible cable 26 terminating in a probe 27 having a pointed end 28 for penetrating the insulation on a conductor. The cable 26 and the probe 27 are similar to the cable 3 and probe 4 of the audio amplifier in-put circuit, excepting that the probe 27 of the voltmeter circuit is provided with a serial resistance 29 which limits the amount of current that can reach the voltmeter, so that the voltmeter will not be damaged, regardless of the setting of the selector switch.

Certain refinements are present in the voltmeter unit B, such as the calibration adjustment comprising the variable resistance 13 which permits the voltmeter to be properly calibrated, and when once adjusted it need not be readjusted unless the tube 11 be replaced. There is also a zero adjusting control consisting of a variable resistance 30 in the plate circuit of the tube 11 which permits the needle 31 of the meter dial to be adjusted to zero with reference to the scale of the meter when the instrument is first turned on, and before making voltage measurements.

The voltmeter unit, as described, has an alternative use as a sensitive out-put meter. With this end in view, the plate circuit 32 of the second amplifying tube 8 is brought into juxtaposition to the test probe cable 26 and the voltage selector circuit and a single pole double throw switch 33 is provided which is capable of cutting out the probe cable 26 and connecting the voltage selector circuit to the plate circuit 32. When the switch is thrown to make this latter connection it permits the out-put audio scale of amplifier unit A to be applied to the in-put of the vacuum tube voltmeter, employing, of course, the test probe 4. As the audio signal is of the alternating type voltage, and the vacuum tube voltmeter only measures direct current voltage, a copper oxide disk rectifier 34 or its equivalent is incorporated in the in-put circuit 32 to rectify the audio signal, permitting signal voltages to be measured by the vacuum type voltmeter. A blocking condenser 35 is also interposed in the circuit 32 which is similar in its capacity and voltage test characteristic to the condenser 5, and employed for a similar purpose. This permits audio voltage gains from one audio stage

to another in any audio amplifier to be measured without affecting the operation of the amplifier under test.

The power supply unit C is of the conventional type and includes a power transformer 36, the primary 35' of which is adapted to be plugged into an alternating current 110-115 volt power line. The transformer 36, as shown, has three step-up secondaries, 37, which feeds the heaters of the vacuum tubes in the audio amplifying unit and in the voltmeter, 38, which supplies high voltage to the plates in the rectifier tube 39 which, as shown, is of the 5W4 type, and 40, which feeds the heater of the rectifier tube 39. The purpose of the rectifying tube 39 is to rectify the A. C. voltage providing direct current to be supplied to the various elements of the types 6F5, 6F6, and 76 vacuum tubes employed in this test instrument.

Inasmuch as the instrumentalities constituting the testing instrument of the subject invention will be largely enclosed in a case or cabinet, it is preferred to have the probe cables 3 and 26 detachable, and making jack connections with the in-put circuits of which they are a part through the apertures 41 and 42, shown in Figure 2.

A phone jack 43 is inserted in the plate circuit of the first amplifier tube 1, making possible the use of head-phones or oscillograph in connection with this testing instrument. The use of the phone jack is extremely valuable where this instrument is used in motion picture booths where noisy projectors are running and the service engineer is running a test for distortion, or noise in amplifying sound equipment, and in enabling noise to be excluded from the ear by use of the headphones.

The audio sound amplifier, as above described and constituting the subject invention will accurately and instantly locate any defective part or inoperative circuit which is common in all audio equipment employing vacuum tubes, by simply applying one of the test probes to the equipment under test and with the ear observing the sound that is present and that which should be present. By this simple method any ordinary layman can effectively and quickly locate any type of trouble; where it originates, and where it ends. The audio sound analyzer will test every circuit in any audio system carrying sound from the circuit where the sound is fed into the system to the place where it ends. This is done without loading the circuit under test. This audio sound analyzer will instantly locate a hum, distortion, loose connections, broken microphone cables or any noisy in-put circuit and defective amplifying tube; also, defective phonograph electric pick-ups, defective rectifier tubes, defective microphones, noisy circuits and the point of the origination, defective filter condensers, defective by-pass condensers, defective coupling condensers, noisy audio transformers, A. C. hum in power supplies, A. C. hum in amplifier circuits, defective resistors, defective voice coils in loud speakers, defective volume controls in audio circuits, defective line coupling audio transformers. It will also accurately measure all D. C. voltage from .2 volt to 500 volts either minus or plus voltage with an in-put resistance to voltmeter of over ten megohms on all scales permitting voltage measures to be made without loading the circuit under test, and will

measure audio voltage gains in any of the several stages of any audio amplifier.

It is to be understood by those skilled in the art that the specific circuits or arrangement of the various instrumentalities in the circuits and the selection of instrumentalities having specific characteristics are by way of example and not to be construed as limiting the scope of the invention which is defined in the appended claims.

What I claim as my invention is:

1. Testing instrument for testing the audio signal in any radio amplifying system comprising a high gain plural stage audio amplifier including an in-put tube and an out-put tube, a testing probe connected to the grid of the in-put tube and a dynamic loud speaker connected to the plate of the out-put tube, and a condenser interpositioned in the in-put circuit between the probe and grid of the in-put tube, said condenser being of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably effect said circuit.

2. Testing instrument as claimed in claim 1, said condenser being of such high voltage test as to ensure against damage of the testing unit by voltage in the circuit under test.

3. Testing instrument for testing the audio signal in any audio amplifying system comprising a high gain plural stage audio amplifier including an input tube and an out-put tube, a testing probe connected to the grid of the in-put tube and a dynamic loud speaker connected to the plate of the out-put tube, a fixed condenser interposed in the in-put circuit of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit, and a variable resistor in series in the in-put circuit, constituting a volume control selector.

4. Testing instrument for testing the audio signal in any audio amplifying system, comprising a high gain plural stage audio amplifier including an in-put tube and an out-put tube resistance-coupled, a testing probe connected to the grid of the in-put tube and a dynamic loud speaker connected to the plate of the out-put tube, and a condenser interposed in the in-put circuit of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit.

5. Testing instrument for testing the audio signal of any audio amplifying system, comprising a high gain two stage audio amplifier including in-put and out-put tubes resistance-coupled, a testing probe connected to the grid of the in-put tube, a dynamic loud speaker connected to the plate of the out-put tube, a power supply unit for alternating current including a tube rectifier, for supplying direct current to the loud speaker and the heaters of the tubes, a fixed condenser in the in-put circuit of the in-put tube of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit, and of sufficiently large voltage test to ensure against damage to the testing instrument by voltage in the circuit under test, and a pair of condensers in a direct current circuit of said power supply unit on opposite sides of the field

coil of the loud speaker, whereby the latter functions as a choke filter eliminating alternating current hum from the loud speaker.

6. Testing instrument as claimed in claim 5, including a variable resistor in the in-put circuit functioning as a volume control selector.

7. Testing instrument for testing the audio signal in any audio amplifying system comprising a high gain two stage amplifier including in-put and out-put tube resistance-coupled, a testing probe connected to the grid of the in-put tube and a dynamic loud speaker connected to the plate of the out-put tube, and a condenser interpositioned in the in-put circuit, of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit, in combination with a vacuum tube type voltmeter, a voltage range selector circuit, a voltage indicator in said circuit, a voltage testing probe at the in-put end of said circuit, a circuit connection with the plate circuit of said out-put tube, a blocking condenser of small capacity in said circuit connection, a rectifier in said circuit connection, and a switch for alternatively connecting said voltage testing probe with said voltage range selector circuit or said voltage range selector circuit with said out-put tube plate circuit connection.

8. Testing instrument as claimed in claim 7, said voltage range selector circuit including a resistance in the testing probe limb thereof, with taps taken at intervals serially from said resistance, and a switch element in the indicator limb of said circuit engageable selectively with the terminals of said taps.

9. Testing instrument for testing the audio signal of any audio amplifying system, comprising a high gain two stage audio amplifier in-

cluding in-put and out-put tubes, a testing probe connected to the grid of the in-put tube, a dynamic loud speaker connected to the plate of the out-put tube, a power supply unit for alternating current including a tube rectifier, for supplying direct current to the loud speaker and the heaters of the tubes, a condenser in the in-put circuit of the in-put tube of such capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit, and a pair of condensers in a direct current circuit of said power supply unit on opposite sides of the field coil of the loud speaker, whereby the latter functions as a choke filter eliminating alternating current hum from the loud speaker.

10. Testing instrument for testing the audio signal in any audio amplifying system comprising a high gain two stage amplifier including in-put and out-put tube resistance-coupled, a testing probe connected to the grid of the in-put tube and a dynamic loud speaker connected to the plate of the out-put circuit, of such small capacity as to reduce the in-put capacity of said amplifier to a point at which the interposition of said instrument in the circuit being tested will not appreciably affect said circuit, in combination with a vacuum tube type voltmeter, a voltage range selector circuit, a voltage indicator in said circuit, a voltage testing probe at the in-put end of said circuit, a circuit connection with the plate circuit of said out-put tube, a rectifier in said circuit connection, and a switch for alternatively connecting said voltage testing probe with said voltage range selector circuit or said voltage range selector circuit with said out-put tube plate circuit connection.

WILLIAM M. ESSARY.