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SELECTIVE TRANSMITTING, RECEIVING, AND OSCILLATOR CIRCUIT

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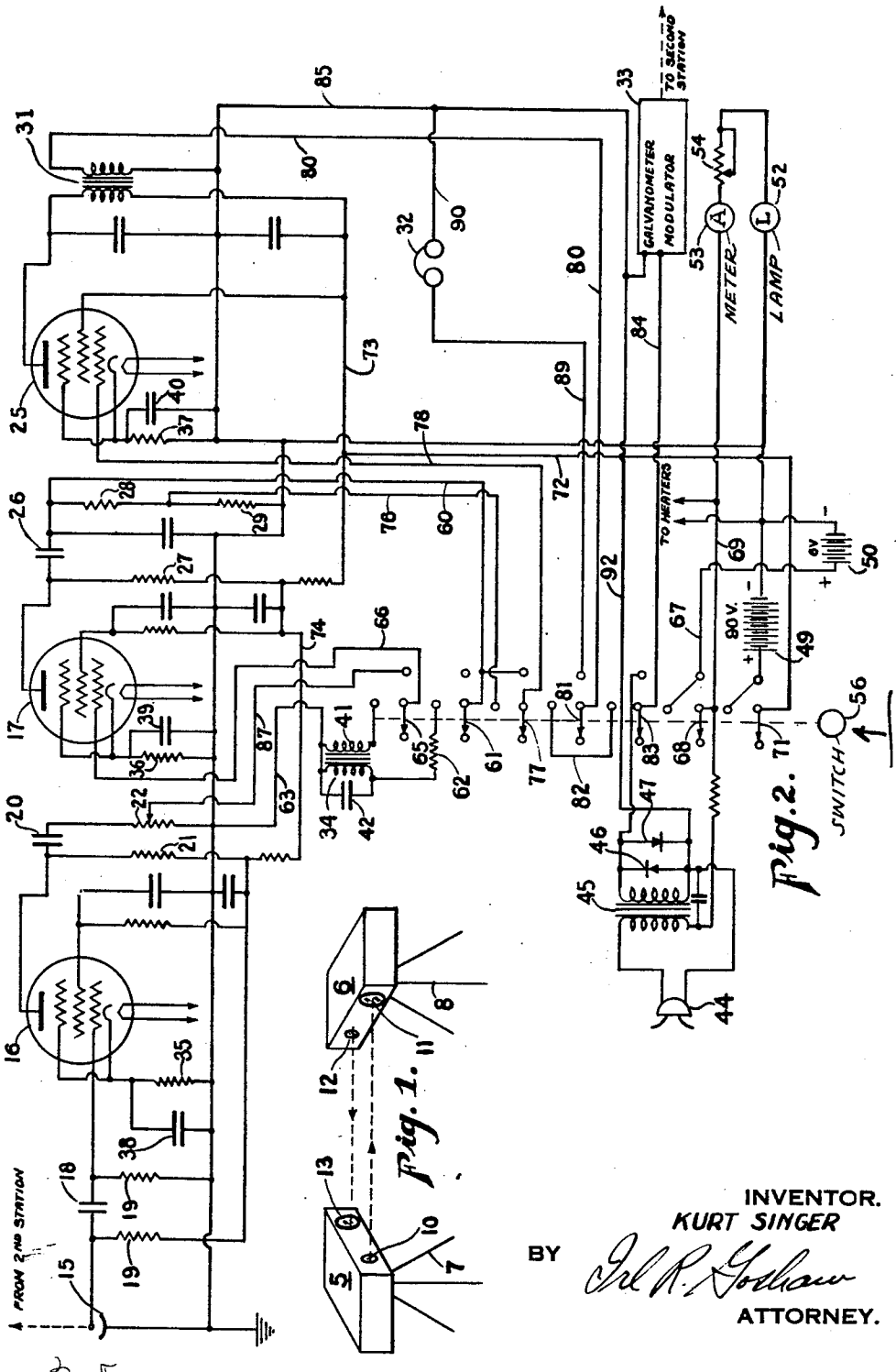


Fig. 2.

Fig. 1.

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As shown system off.
2nd position, Tube 17 osc, 31 connects to Modulator
3rd position Tubes 16, 17, 25, 3 stage Receiver Amplifier.

EXAMINER

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SELECTIVE TRANSMITTING, RECEIVING, AND OSCILLATOR CIRCUIT

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9 Claims. (Cl. 250—7)

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This invention relates to communication systems and particularly to a transmitting, receiving, and testing circuit for a light beam transmission unit.

The art of transmitting signals by modulated light in the visible spectrum is well-known, the present invention being directed to an improved circuit for a light beam transmitting and receiving unit. The unit utilizes the well-known photoelectric cell as the detector of the light being transmitted from a distant station, a three-stage amplifier which utilizes a single tube type in all stages, a light source of constant intensity, a galvanometer for modulating the light being transmitted, a microphone for translating sound waves into electrical currents for impression on the galvanometer, and head phones for translating the output of the amplifier into sound waves. The primary feature of the invention is the ability to transform one of the stages of the amplifier into an oscillator for the purpose of generating a tone of substantially 1000 cycles for activating the galvanometer modulator for the purpose of testing and aligning the stations. The translation of the amplifier circuit between the receiving condition and the test and aligning condition is made by a switching operation and can readily be accomplished so that the test may be run at any time during operation as well as prior to operation.

The transmitting circuit employs a current limiter in the form of a double acting rectifier unit for the protection of the sensitive galvanometer. To provide maximum sensitivity and modulation, a pair of light grids are employed, one being used as an imaging grid ahead of the modulator, and the other as a projection grid after the modulator. In this manner, movements of the galvanometer mirror will produce maximum modulation of the light beam.

The principal object of the invention, therefore, is to facilitate the reception and transmission of intelligence by means of light beams.

Another object of the invention is to provide an improved receiving amplifier for signals transmitted by light beams.

A further object of the invention is to provide an improved amplifier and test circuit for a unit of a two-way light beam transmission system.

A further object of the invention is to provide a combination transmitting, receiving, and test circuit for a unit of a two-way light beam transmission system.

A still further object of the invention is to provide an improved circuit for transforming an

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amplifier circuit into an oscillator test circuit for a light beam transmission system.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawings forming a part hereof in which:

Fig. 1 is a diagrammatic view of two units of a light beam transmission system embodying the invention, and

Fig. 2 is a schematic drawing of the circuit of one of the units embodying the invention.

Referring now to Fig. 1, two identical units 5 and 6 are shown mounted on tripods 7 and 8, respectively, for two-way communication. A transmitting lens 10 of unit 5 is shown projecting a light beam to a receiving lens 11 of unit 6, while a transmitting lens 12 of unit 6 is shown transmitting light to a receiving lens 13 of unit 5. In this manner, two-way communication may be accomplished, the details of the respective units being disclosed and claimed in copending application, Ser. No. 554,246, filed September 15, 1944.

The circuit of each of the units 5 and 6 is shown in Fig. 2. Light from an associated station is received on a photoelectric cell 15, which is coupled to the input of a vacuum tube 16 over condenser 18 and resistors 19. The output of vacuum tube 16 is coupled to the input of a second vacuum tube 17 by a condenser-resistance network including a condenser 20, a fixed resistor 21, and a potentiometer resistor 22. The output of the second stage 17 is coupled to the third and last stage 25 over a condenser-resistance network composed of a condenser 26 and fixed resistors 27, 28, and 29. The output of the tube 25 is coupled over an output transformer 31 to either a pair of head phones 32 or a galvanometer unit 33 as will be described hereinafter.

The usual grid biasing resistors 35, 36, and 37 are provided for the respective tubes together with respective bypass condensers 38, 39, and 40. Each of the tubes 16, 17, and 25 are of the same type, preferably RCA type 6G6G. A feedback transformer comprising a primary 34 and a secondary 41 is provided for insertion between the output circuit of tube 17 and the input circuit thereof, the primary 34 being shunted by a tuning condenser 42.

A transmitting microphone 44 is shown coupled over a transformer 45 to the galvanometer modulator 33, a protective current limiting circuit

being provided across the secondary of transformer 45 in the form of a pair of copper oxide rectifiers 46 and 47. The energy source for the anodes of the tubes 16, 17, and 25 is shown at 49, while a filament energy supply is shown at 50. Connected across the six-volt filament supply 50 is a lamp 52 for providing the transmitting light beam, the light circuit including an ammeter 53, and a rheostat 54. The usual protective and voltage dividing resistors are shown in the circuit and used in the normal manner.

Shown by a broken line with a hand knob 56 is a rotary gang switch mechanism which has three positions. The position shown in the drawing with the swingers to the left is the "off" position which de-energizes the entire system. The vertical position of the swingers energizes the circuit, converts the second amplifier tube 17 to an oscillator, and connects the output of the last stage 25 to the galvanometer modulator 33. The third or right-hand position of the rotary switch converts the circuit to a three stage amplifier, connects the head phones 32 to the output of the last stage 35 and connects the galvanometer modulator 33 to the microphone 44.

These connections may be traced as follows. With the switch 56 adjusted so that the swingers are in a vertical position, the output circuit of tube 17 may be traced from the anode of the tube over condenser 26, conductor 60, swinger 61, resistor 62, primary winding 34, and condenser 42 in parallel, conductor 63, and resistor 36 back to the cathode of tube 17. The input circuit of tube 17 includes the secondary 41 of the feedback transformer, the input circuit being from the cathode of tube 17, conductor 63, secondary winding 41, swinger 65, and conductor 66 to the grid of tube 17. Heating current is supplied to the heaters of the tubes from the positive terminal of the source 50 over conductor 67, swinger 68, conductor 69, and through the heater elements back to the negative terminal of the source 50. Plate potential from the source 49 is supplied over swinger 71, conductor 72, and conductor 73, to the anode of tube 25 and over conductor 74 to the anodes of tubes 16 and 17. The output of tube 17 is coupled to the tube 25 over a circuit including the anode of tube 17, condenser 26, resistor 28, conductor 76, swinger 77, and conductor 78 to the grid of tube 25. Normally, the coupling circuit between tubes 17 and 25 is over conductor 60, swinger 77, and conductor 78, when the swinger 77 is in its righthand position. However, to provide a reduced voltage on the tube 25 when the tube 17 acts as an oscillator, the output of the tube 17 is picked off between resistors 28 and 29, which forms a voltage divider.

Another circuit made when the rotary switch 56 has its swingers in a vertical position is the connection of the secondary of the output transformer 31 over conductor 80, swinger 81, conductor 82, swinger 83, and conductor 84, to the galvanometer 33, the return circuit from the galvanometer being over conductor 85. These circuit connections permit current oscillations to be generated by the tube 17 at a frequency of substantially 1000 cycles determined by the capacitance of condenser 42 and the inductance of primary 34. The generated oscillations are impressed on the galvanometer modulator 33 which correspondingly modulate the light being projected toward the second station for the purpose of permitting the second station to line up its receiving optical unit with the projecting unit and to adjust the receiving amplifier to the proper gain by adjustment of potentiometer 22.

After these adjustments have been made, the switch 56 may be rotated to its third position which will place the swingers to the right. This position of the swingers disconnects the feedback transformer 34—41 and connects the output of the tube 16 to the tube 17 over a circuit from the anode of tube 16, condenser 20, potentiometer 22, conductor 87, swinger 65, and conductor 66 to the control grid of tube 17. As mentioned above, the output of tube 17 is now connected to the input of tube 25 over conductor 60 instead of conductor 76, thus impressing the full output voltage from tube 17 on the input of tube 25. Simultaneously, the output circuit of tube 25 through transformer 31 is transferred from the galvanometer 33 to head phones 32 over conductor 80, swinger 81, conductor 89, phones 32, conductor 90, and conductor 85. The energizing circuits are connected over the paths traced above, but from the right-hand contacts of swingers 68 and 71 which are strapped to their respective upper contacts.

The circuit is now conditioned for reception and transmission inasmuch as the microphone 44 is connected over swinger 83 and conductor 84 to the galvanometer 33, the return circuit being directly over conductor 92. The limiting circuit 46—47 is adjusted so that it becomes active at 5 db. below 100 percent amplitude of the galvanometer modulator 33. If, at any time during operation, it is desired to test or check on the alignment of the stations, it is only necessary to throw the switch 56 so that each swinger is in its vertical positinon.

It will be noted that in two-way communication, if both amplifiers are operating in the oscillator position, neither station is capable of receiving the other, consequently before aligning the stations, an agreement should be established between operators as to which of the two stations will send the 1000 cycles and which will receive. It has been found preferable that one station send the 1000 cycles tone for some predetermined time to permit the other station to line up for optimum reception. After this predetermined time, the procedure is reversed in order to permit the other station to adjust for optimum reception from the second station.

By reference to the above-identified copending application, the details of the positioning of the respective optical elements of the system with respect to the detecting photoelectric cell, the light source, and the galvanometer modulator, are described in detail together with a telescopic aligning sight. It has been found in practice that the above circuit is particularly suitable for a combination light beam receiving and transmitting system to permit the amplifier to be transformed into an oscillator for testing and aligning the respective signaling stations.

I claim as my invention:

1. In combination, a plural stage vacuum tube amplifier, a modulator, means for generating electrical currents for amplification by said amplifier and impression on said modulator, a second means for generating electrical currents for actuating said modulator, a tuned circuit, and means for switching said tuned circuit between the input and output of one of said amplifier stages to produce said first mentioned generating means and simultaneously disconnecting said second generating means from said modulator and connecting said amplifier to said modulator.

2. A light beam detecting and modulating circuit comprising a plural stage amplifier, a light-to-electrical-current translator, the output of said translator being connected to the input of said amplifier, at tuned circuit, a sound reproducer, a light beam modulator, and switching means, one position of said switching means connecting said reproducer to the output of said amplifier and a second position of said switching means disconnecting said reproducer from said amplifier and connecting said modulator thereto, and simultaneously disconnecting said translator and connecting said tuned circuit between the output and input of one of said stages to form a feedback circuit to generate electrical oscillations at the frequency of said tuned circuit.

3. A circuit in accordance with claim 2 in which an amplifier stage is intermediate said oscillator stage and said modulator.

4. A circuit for amplifying detected light modulations and for modulating a light beam in accordance with sound waves comprising a light detector, an amplifier for amplifying the output of said detector, a sound reproducer for reproducing the output of said amplifier, a light beam modulator, means for generating currents corresponding to sound waves for impression on said modulator, and switching means, one position of said switching means connecting said light detector to the input of said amplifier, said reproducer to the output of said amplifier, and said generating means to said modulator, a second position of said switching means disconnecting said light detector and said reproducer from said amplifier, disconnecting said generating means from said modulator and connecting said modulator to said amplifier.

5. A circuit in accordance with claim 4 in which said switching means in said second position interconnects the output and input circuits of said amplifier for generating current oscillations of a predetermined frequency.

6. A combination amplifier-oscillator circuit comprising a plural stage amplifier, means for varying the coupling between said stages, a tuned feedback circuit, a sound reproducer, a light beam modulator, and means for connecting and disconnecting said sound reproducer to and from said amplifier, said means also connecting and disconnecting said modulator to and from said amplifier simultaneously with the connection and disconnection of said tuned feedback circuit between the input and output of one of said stages, said means varying the coupling between said stages.

7. A circuit in accordance with claim 6 in which a microphone is provided, said connecting means connecting said microphone to said modulator simultaneously with the connection of said reproducer to said amplifier.

8. A light beam detecting, transmitting, and testing circuit comprising a plural stage amplifier, a sound reproducer for reproducing received transmitted signals from a distant station, a light beam modulator for transmitting signals to said distant station, said plural sage amplifier amplifying said received signals, and means for transforming one stage of said amplifier into a current oscillator of substantially constant frequency and impressing said current on said modulator for transmission to a distant station.

9. A circuit in accordance with claim 8 in which a microphone and current limiting unit are provided, said microphone being connected to said modulator through said unit.

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