

RADIO'S LIVEST MAGAZINE



July
25 Cents

Radio-Craft

FOR THE
SERVICE MAN - DEALER - RADIOTRICIAN

HUGO GERNSBACK, Editor

The Radio
Robot

See page 24



What Radio Manufacturers Are Showing - The New Pentode Receivers - Home Recording
Latest Data for Service Men - Improving Short-Wave Reception - Rules for Coil Winding

IN radio, as in almost every other field, productive originality is amply rewarded in dollars and cents. A clever New York radio engineer, Mr. Paul Von Kunitz, has created "Mr. Radio Robot," a remarkable device which is attracting unusual attention and proving a source of profit to its originator.

The idea is passed along in this article, with complete details, to other radio men, as "Mr. Radio Robot" can undoubtedly be used to advantage in many towns and cities throughout the country.

The cover illustration gives an excellent idea of the appearance of the "Iron Man." From a theatrical costumer was procured the coat of mail used to represent a medieval armored knight. Such ensembles are fairly common, since they are extensively used for masquerades, and they can be rented or purchased at a reasonable price.

Before giving details as to the construction and actual mechanism of the robot, some of the startling things he can do may be mentioned. In response to a pre-determined series of whistled notes, or the whistling of a given tune, "Mr. Radio Robot" will stand up, sit down, move his left arm or his right arm, turn his head, fire a gun, start to talk, etc.

He will also go through a definite series of operations, which may be worked out in advance. For example, in response to a command in a certain tone, the "Iron Man" will stand up, move his head, make a speech, lift either arm to emphasize certain points, bow at the end of the speech, and then sit down. While he is talking, his eyes and teeth will be illuminated with a light of fluctuating brilliancy.

Furthermore, this robot will answer questions intelligently, and can be used to make

Introducing Our

*The mechanical and electrical
the "Iron Man" which is such
public, and is making big*

By H. G.

announcements and to entertain with the latest song or other musical selections. If desired, "Mr. Radio Robot" can be made to go through the various mechanical motions by means of switches or push-buttons located at a distance; or manual and audible control may be depressed with and he may be actuated through the mere interruption of an invisible ultra-violet beam. Thus an arrangement is possible, whereby he will fire a gun, or stand up, or start to talk—if someone walks past him.

In the cover illustration, the robot is shown answering questions put to it. There is a reproducer concealed in its chest; and a microphone (within it) at a distance of about five feet from the ground and therefore on a level with the mouths of people asking the questions. The operator and the portable amplifier may be located at any convenient point, no matter how far from the robot. It will be noted (Fig. A) that the operator uses a headset and that he talks into a microphone. Its adjustments are made on the small control box in front of the amplifier.

A portable power amplifier is used for this portion of the set-up. The two micro-

phones, the loud speaker and the headset are connected as shown in Fig. 1. Complete portable amplifiers are available for this type of work; one of the most suitable ones being the new Electrad Loftin-White Portable Amplifier.

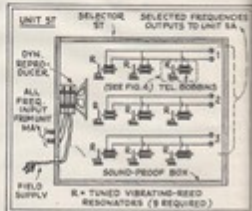


Fig. 3

Current generated in the bobbin of this frequency-selector when the headset reed vibrates with the loud-speaker signals, is later amplified.

Giving Commands by Sound

Fig. 2 is a pictorial layout of the signal-selector system, whereby a pre-determined series of notes of different pitches and timbres are used to actuate the mechanical man. Examining the layout from left to right, it will be noted that the microphone M1 (the one concealed within the robot) is connected to a microphone control box (G) in Fig. A.) This connects to the input of a high-quality amplifier, such as an Electrad direct-coupled Type A-245 unit, Fig. 4A. The output of this microphone amplifier, connects to a three-section selective tuning device ST, which is the portion of the apparatus that picks out or responds to the particular actuating notes or tones.

The output of the "mike" amplifier (M.A., Fig. 2) is connected directly to the voice coil of a small dynamic reproducer, mounted within a sound-proof wooden box (ST) containing nine differently tuned vibrator reeds. There are nine electromagnets, one in front of each vibrator reed; three of them being connected in parallel on each of the three electrical circuits, as shown in Fig. 3.

When a note of the required tone and pitch is sounded or whistled before the microphone M2, the microphone amplifier M.A. magnifies the impulse sufficiently to actuate the speaker. The amplified sound coming out of the speaker causes the reed which is tuned to correspond to this one note to vibrate; this, in turn induces a feeble current within the electromagnet placed before it.

By varying the position of the magnet, with relation to the vibrating reed, it is



Fig. A

This invariable, armored figure stolidly moves his head, his arms, and correctly answers questions put to him—a completely human Iron Man. (Mr. Clois, wearing headphones, is at the controls.) The reference letters indicate: A, pulleys and reproducer; B, microphone M1; C, sensor tube which lights the eyes; D, head and arm motors; E, selector, relay, and amplifier; G, microphone control box; H, additional amplifiers; I, microphone M2.

Mr. Radio Robot

details of the construction of an object of interest to the money for his constructor.

CISIN, M.E.

possible to pick off either the fundamental, the second harmonic, or the third harmonic, as clearly illustrated in Fig. 4. Incidentally, the reed will respond also to notes either one or two octaves higher than the fundamentals.

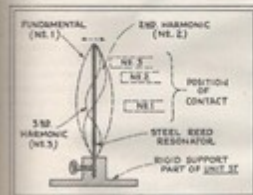


Fig. 4

A "curved steel" may be used in making this portion of the reed relay. Slowing the bobbin may raise the pick (positions 2, 3).

The feeble induced current flows into the corresponding selector-signal amplifier SA. There are three of these amplifiers, one for each of the three circuits. (Electrad Loftin-White A-245 amplifiers may be used for this purpose; the circuit connections are shown in Fig. 4A.) The main function of these amplifiers is to give voltage amplification and hence a "space-charge" amplifier having a screen-grid tube and a '2A tube would serve the purpose. (See Fig. 4B).

The output of each amplifier goes to a separate rectifier R. Details of the rectifier circuit, which is very simple, are shown in Fig. 5. Rectification is accomplished by means of a '2A tube. The rectified current then goes to the "time-delay relay" TDR. The plate voltage required on the '2A tube will depend upon the type and characteristics of the time-delay relay.

If it were possible to obtain a comparatively pure note at the microphone (for instance, by the use of a flute), the time-delay relay would not be necessary. In the case of a whistled note, however, strong harmonics and overtones are present, which cause the reed to "chatter." The time-delay relay overcomes this trouble, preventing continued vibrations.

Controlling the Relays

The output of each time-delay relay (TDR, Fig. 5A) goes to a corresponding heavy-duty circuit-breaking relay RC. A common 6-volt battery actuates three heavy-duty relays. (See Fig. 6.)

Each current impulse through a heavy-duty relay HDR attracts a pivoted armature. As the armature is drawn towards the magnet, it operates a ratchet through

a lever system; causing a heavy notched brass wheel W (Nos. 1, 2, or 3) to turn one notch. A spring pulls the armature back until a second impulse again causes the brass wheel to be turned another notch. If the correct number of whistled signals are given, it will turn until the copper strips A, B and C make contact with the brass studs fastened on its side. Before it is possible to actuate the heavy-duty master relay HDMR all three wheels must be turned the right number of notches (since the three circuits are in series).

The action is analogous to that of a Yale lock, or to the opening of a safe. Unless the correct, pre-determined notes are sounded, and unless the correct number of notes are sounded, "Mr. Radio Robot" will fall to respond. Since three distinct fundamentals are available on each of the three circuits (not to mention the second and

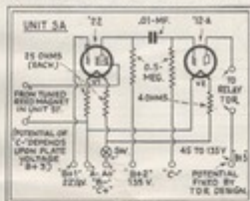


Fig. 4B

The selector amplifier, a "space-charge" circuit is shown. The output operates a time delay relay, Fig. 5A.

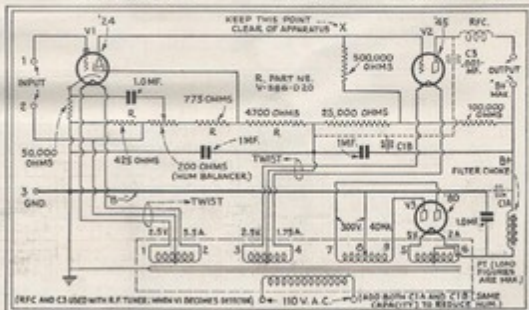


Fig. 4A

Schematic circuit of the direct-coupled amp, recommended by the author for use as a selector amplifier. The number of amplifiers used is determined by the desired number of actions, those being described by the author and illustrated in Fig. 2.

third harmonics available by changing the placement of the electromagnets, as shown in Fig. 4), it is apparent that the "Iron Man" may be arranged to respond to a certain melody, or to a song containing the correct sequence of pre-determined notes.

Once the circuits "A," "B," and "C" shown in Fig. 6, have been closed, the heavy-duty master relay is actuated. This is operated by the 6-volt battery, shown for the sake of clarity as a separate unit; in actual practice, the battery used for the time-delay relay may also be used for the heavy-duty master relay and for various other relays requiring six volts, as shown in Fig. 1.

The heavy-duty master relay is used to close any desired specific circuit; such as the one causing "Mr. Radio Robot" to ring, or to fire a gun, or to make a speech, etc. Details of the mechanical-motion circuits are shown in Fig. 7. The robot is equipped with two Ford fractional-horsepower starting motors, and with a number of Knapp toy motors ("series" motors are used in order to supply the necessarily high starting torque). The Ford starting motors are used to make the robot stand up and to fire the gun; while the toy motors perform the lighter tasks of moving the head and arm. Three wires are necessary in the circuits from the motors, in order to reverse their direction when required. Merely changing the polarity will not reverse the direction of these motors, and it is therefore necessary to reverse the current direction in the armature, without changing that in the motor field.

The Robot's Stunts

A mechanical stop prevents the motor from turning too far. For example, in order to make the "Iron Man" stand up, the motor can turn over only a certain amount; reversing the motor causes him to sit down. This motor (along with most of the relays) is mounted in the platform below the robot. In turning, the motor pulls two cords, which pass over pulleys in the knees, and which are fastened within the figure at the rear waist line. Tension on the cords promptly brings the "Iron Man" to his feet. Similarly ingenious arrangements

of cords, pulleys and levers produce the various other mechanical motions.

The most mystifying effects are produced through the use of a light-sensitive cell; this is mounted in an unobtrusive position, with a light-source constantly directed upon it, except when the light is obstructed by someone passing in front of "Mr. Radio Robot." (It is possible even to use an ultra-violet ray, which is invisible and hence still more dramatic.) As long as light falls on the cell, no appreciable current flows but, as soon as the light-source is obstructed, there is a sudden increase in current, sufficient to actuate the relay. Of course, it may also be connected in such a way that the reverse action will take place. That is to say, the relay may be actuated by an increase of light instead of a decrease—for example, by permitting the light source to strike the cell only when it is desired to operate the relay.

Business Possibilities of the Robot

The commercial possibilities of "Mr. Radio Robot" are tremendous. He may be rented to stores which are carrying on special sales and advertising campaigns; or he may be used at entertainments, fairs, bazaars

point, were amplified and reproduced through the speaker within the robot. At stated intervals, the "Iron Man" answered questions; and, between times, the latest song hits were reproduced by means of the electric phonograph. Although the original contract was for only one week, the robot was so successful in stimulating business, that he was held over for three entire weeks.

Since the idea was first conceived, "Mr.

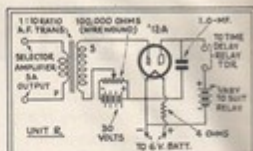


Fig. 5

One of the units rectifying the output of a selector unit (Fig. 3).

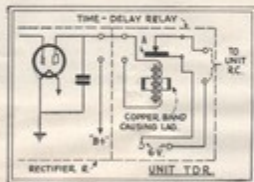


Fig. 5A

This relay gives a delay of about a minute; its winding is connected in series with the plate circuit of a rectifier (Fig. 3).

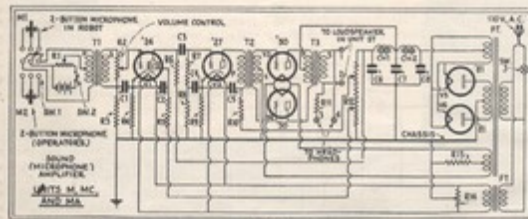


Fig. 1

The first section of the apparatus; care must be used in placing M_3 , to avoid heating, since there is a reproducer in the figure. The operating potentials demand high-voltage filter condensers. R_{11} may be variable, to adjust the sound level in the headphones.

said for a great variety of purposes. In New York, the "Iron Man" was recently loaned to a large furniture store on East 57th Street. The portable amplifier was set up at the rear of the store; and announcements, made from the microphone at that

Radio Robot" has been in continuous use, and now has more advance engagements than a popular vaudeville star!

The entire device needs practically no servicing, once it is set up, and consumes very little current while in operation. It

can be operated by a store manager or sales person and does not require a skilled attendant. Those who contemplate the construction of a robot can make the device comparatively simple at first, and afterwards make it more intricate from time to time. For instance, it may be desirable to start out with the portable-amplifier outfit for answering questions, making announcements and playing records. Later on, the relays and mechanical action may be added.

This flexibility is a great advantage and is a point which should not be overlooked by the radio man who may be deterred from starting the construction of a robot, because of imagined complexities.

LIST OF PARTS

(Units M, MC and MA, Fig. 1)

- One three-pole, double-throw switch, Sw1;
- One single-pole, single-throw switch, (Sw2, operated by R1);
- One single-pole, single-throw snap switch, Sw3;
- Three dry cells (1.5 volts);
- One Ferranti "Type AF3M" microphone transformer, T1;
- One Ferranti "Type AF9C" push-pull input transformer, T2;
- One Ferranti "Type OP1C" (for direct coupling to 8000-ohm line speaker) or "OP25C" (for dynamic speaker) push-pull output transformer, T3;
- One Electrad 200-ohm potentiometer (and switch Sw2), R1;
- One Electrad 95-ohm "Royalty" potentiometer, R2;
- Two Durban 50,000-ohm (1-watt) "metal-line" resistors, R3, R4;
- Two Electrad 2,000-ohm "flexible" grid resistors, R4, R9;

(Continued on page 46)

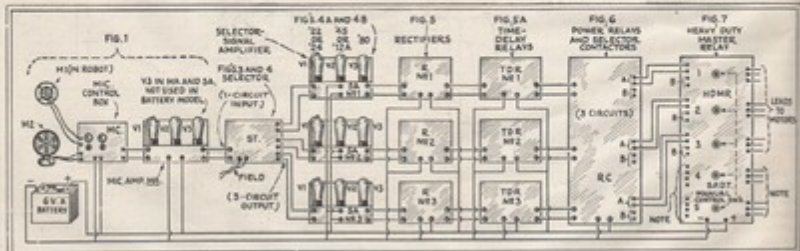


Fig. 2

A layout of the units shown in detail in the detail sketches, as noted at the top. Most of these units (except those of No. 3) may be concealed in the base beneath the robot. The binding posts 4 and 5 in the unit of Fig. 7 (at the right of this diagram) are for additional controls and motors.

SKINDERVIKEN Construction of the Radio Robot

(Continued from page 26)



The Most Sensitive Microphone Button

(ACTUAL SIZE NOT BIGGER THAN A QUARTER)

You can easily make a highly sensitive detector by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you can have with such an instrument.

You can install an outfit in your home and hear the conversation taking place all over the house. Full directions for connecting up the button for use as a detector are given in our 12-page booklet.

These wonderful little SKINDERVIKEN microphone buttons may be used for hundreds of uses, such as:

RADIO AMPLIFIER PHONOGRAPH AMPLIFIER
 DETECTORPHONE TELEPHONE AMPLIFIER
 STENOGRAPHER LOUS SPEAKER AMPLIFIER
 MICROPHONE CRYSTAL SET AMPLIFIER
 HOME RECORDING OUTFIT, ETC.

95c EACH Two for **\$1.75**
12-PAGE INSTRUCTION BOOKLET
 containing suggestions and diagrams for installation and use, furnished with each set.

EVERY AMATEUR SHOULD HAVE TWO OR THREE OF THESE AMPLIFIERS IN HIS LABORATORY

WE PAY 50c IN CASH for every new one developed for this unit and accepted and published by us.

SEND NO MONEY

When the postman delivers your order you pay him for whatever you have ordered, plus a few cents postage.

(Canada and Foreign: cash with orders)

ORDER FORM
 PRESS BUILD, INC. RC-231
 12 Murray St., New York, N. Y.
 Please mail me an order at any of the following items at 1 item indicated.
 Skinderviken Transmitter Unit at 50c. for 1; \$1.75 for 2; \$2.50 for 3; \$2.20 for 4.
 When delivered I will pay the postman the cost of the items specified and postage.

Name
 Address
 City State

PATENTS Write for Free Guide Book "HOW TO OBTAIN A PATENT" and Record of Use of your invention for our Free Opinion whether it comes within Patent Office Rules. RADIO and ELECTRICAL. Grant a Specialty. Patent, Electrical Service. PAYMENT OF FEES IN INSTALLMENTS.
 VICTOR J. EVANS & CO., 923 - 9th, Washington, D. C.

SOMETHING DIFFERENT
Mystery Cigar Lighter
Make Big Money
 Showing this Scientific Marvel in Men. New Principle of Ignition. What Modern Science Has Done. No Wind or Friction. All Guaranteed. Sample with Sales Plan, Free. Sample Cigar. Order on "Cheerless" Form, \$1.00. Agent. Write for Prospectus.
 NEW METHOD MFG. CO.
 Desk 37, New Method Bldg., Stratford, Pa.

Two Darban 10,000-ohm "metallized" resistors, R5, R10;
 Two Darban 1-meg. (1-watt) "metallized" resistors, R6, R7;
 One Electrad 10,000-ohm Type B-100 resistor, R11;
 One Electrad 21,000-ohm "Type 250" voltage divider, R12;
 One Electrad 150-ohm "Type B 1.5" wire-wound "Truvalt" resistor, R13;
 One Electrad 50-ohm "Type V" resistor, R14;
 Four Polymet 1-mf. "Type A" by-pass condensers, C1, C2, C4, C5;
 One Polymet .01-mf. mica-dielectric fixed condenser, C3;
 Two Polymet 4-mf. "Type C" filter condensers, C6, C7;
 One Polymet 2-mf. "Type C" filter condenser, C8;
 Two UY sockets, for V1, V2;
 Four UX sockets, for V3, V4, V5, V6;
 One Arcturus "Type 124" screen-grid tube, V1;
 One Arcturus "Type 121" tube, V2;
 Two Arcturus "Type 150" power tubes, V3, V4;
 Two Arcturus "Type 181" half-wave rectifiers, V5, V6;

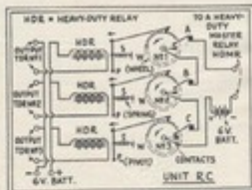


Fig. 6

When the three toothed wheels have been pulled around, then only does the relay operate.

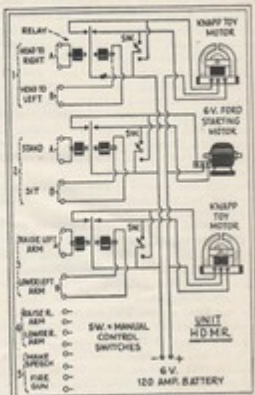


Fig. 7

Three channels turn the head one way, raise the left arm, or the whole figure. These move reverse the directions of motion.

Two American 80 ky. "Type 854" filter chokes, Ch1, Ch2;

One Arcturus "Type PF-250A" power transformer, PT1;

One Arcturus "Type H-6648" power transformer, PT2;

Two Universal two-button microphones, M1, M2;

Four binding posts, 1, 2, 3, 4;

One control-grid clip for V1;

One aluminum chassis (size optional).

(In August RADIO-CRAFT, Mr. Cirlin will explain light-ray and photograph record control of the robot, with other details of operation.)

Choosing Replacement Resistors

(Continued from page 17)

If we reduce this to plain figures, for the case given above, we shall find that at a screen-grid voltage of 90 and a normal effective impedance load of 100,000 ohms, the gain is equal to

$$\frac{400 \times 100,000}{100,000 + 100,000} = 80$$

whereas, when the screen-grid voltage is reduced to 50, the gain is only

$$\frac{800 \times 100,000}{1,200,000 + 100,000} = 61.6$$

The above shows how seriously the gain per stage (i.e., sensitivity) has been affected through the use of a poor quality resistor.

Many kinds of trouble may appear when cheap replacement resistors are used, but, regardless of the exact way in which the trouble manifests itself, it is sure to constitute a direct reflection on the ability and skill of the Service Man.

When a radio set has just been repaired,

the owner cannot be blamed for losing confidence, if it promptly develops new troubles or stops working altogether. The natural inference is that the Service Man did not understand his work, or that he performed an inferior repair job. It goes without saying that no radio man wants to risk the loss of his good reputation in this or any other such way.

The Service Man, however, invariably has many other things to worry about, besides rigging up meters to test every resistor that he uses. How, then, can he be reasonably certain that he is using the specified values?

The answer to this important question should serve as a guide to every reputable radio Service Man. All uncertainty can be eliminated by the use of standard, advertised and guaranteed resistors. Even if such resistors cost a little more at first, they are cheaper in the long run; since they give perfect performance and thus establish customer confidence and build up a lasting business for the Service Man.

the new '41—the rectifier is the standard '90. The front view of the chassis shows prominently the "angular-vision" ribbon scale described in the previous issue of this magazine; and which, with its vernier driving knob, makes tuning equally convenient from a seated or a standing position.

Noticeable in the construction of this chassis is the attention which has been paid to increasing its accessibility for the Service Man. The three knobs may be pulled off in an instant, as they are held in place only by spring pressure; two holding screws are removed, and the "antenna" and "ground" leads are disconnected from the push-type binding posts. The assembly may then be pulled from its cabinet.

To replace tubes, the one-piece aluminum shield which fits over the top of the three screen-grid types ('35 and '24) may be taken off easily; it is held, under spring tension, only by two thumb screws.

Volume control is obtained (see the



Fig. C

The "Sensitor" also uses the "39" chassis

schematic diagram, Fig. 1) with the potentiometer R1 which, by its position in two circuits, serves the double function of varying the cathode bias on both variable-tune tubes, and reducing the antenna's signal input to the first of them (V1).

The field coil of the dynamic reproducer, in the "B—" lead of the filter unit, in conjunction with the two high-capacity electrolytic condensers C4 and C5, serves to smooth the plate current adequately; the necessarily low control-grid bias for the output pentode V4 is obtained by tapping the voltage divider R2-R3 which shunts the field coil.

The R. F. transformers employ a late design, developed by the Hazeltine Laboratories, to equalize sensitivity throughout the tuning range; correct tone is maintained in the audio amplifier with resistance-capacity coupling between the screen-grid detector V3 and the output '41 tube V4, by using correct bypass capacities. The plate of V4 is bypassed to the cathode of V3 by an .0015-mf. condenser; and the primary of the output transformer is shunted by .01-mf. Other constants may be determined from Fig. 1.

The Radio Robot

How the "Iron Man" is caused to go through his routine under phonograph control; or by light signals.

By H. G. CISIN, M.E.

OPERATION of the radio robot, described in the preceding issue of RADIO-CRAFT, may also be directed by the use of a phonograph; which converts the figure into an automaton, going through a previously-rehearsed act, and relieves the operator from the task of giving each signal.

Fig. 8 shows the arrangement which enables the robot to deliver a speech, originating either from a phonograph record or from the operator, via the microphone. When using an electric phonograph, this is attached to the input of a good audio amplifier (such as the Electrad Type C-290 direct-coupled unit.) Where the microphone is used, a microphone amplifier MA, also is necessary, as indicated. The output of the direct-coupled amplifier is connected to the loud speaker, located in the chest of the robot. The neon lamp N, for lighting up the teeth and eyes, is also connected to the output of the amplifier.

The method used, to cause "Mr. Radio Robot" to go through an entire series of pre-determined acts, is illustrated in Fig. 5. For example, suppose it is desired to have him stand up, make a speech, lift his right arm at a certain point in the speech, fire a gun at another point, and then sit down when the speech has been completed.

This calls for five selective tuning cir-

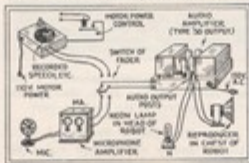


Fig. 8 (above)

Either a microphone message from the mouth of the operator, as explained in Part 1, or a record picked up from a phonograph disc may be used to control Mr. Radio Robot. The record enables a long act to be rehearsed, while it may be cut into at any moment.

Fig. 8 (right)

The Electrad portable amplifier, which may be used with either microphone or record, lends itself well to the operation of a robot. Observe the plug used to connect the reproducer when the unit is ported.

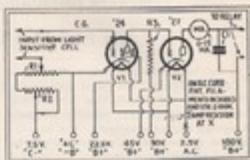


Fig. 10

To convey a signal to the robot by light (or darkness) this amplifier is used.

cuits, actuated by five tuned vibrator reeds. The actuating tones are received from a phonograph record. Discs are available (used for testing frequency-response of loud speakers) which contain "pure" notes of many different frequencies.

The electromagnet pick-up is connected to the input of an Electrad Type A-945, or equivalent amplifier, and the output to a small dynamic speaker within a wooden box containing the selective tuning circuits. The details of these circuits are similar to those shown in Fig. 3, except that only one tuned vibrator reed is used for each circuit. The reeds are arranged to respond to the notes on the phonograph record, in the desired sequence. Thus the reed controlling circuit No. 1 is actuated by the first note. The weak signal generated is amplified by amplifier No. 1; passing to rectifier No. 1, through the time-delay relay (used as explained above to prevent chattering of the reed), which in turn actuates the No. 1 power relay. This is connected to the STAND terminals shown at the left of Fig. 7.

In like manner, the record note operates after a desired interval of time, to actuate (Continued on page 103)



The Radio Robot

(Continued from page 77)

power relay No. 2. This is connected to throw the switch turning on the electric phonograph system outlined in Fig. 8. The other circuits are controlled in exactly the same way. By increasing the number of selective tuning circuits, it is possible to increase the number and variety of acts of the "Iron Man." If several acts are to be performed simultaneously, the master relay may be arranged to close a circuit actuating a number of "final" relays connected in series; that is to say, the relay causing him to stand up, the one turning on phono motor, etc., may be connected in series.

During the sequence of operations directed by the phonograph record (Fig. 9), it is possible to interrupt at any time and to produce any desired changes. If it is desired to make the robot move his head, arms, etc., at any particular point (not previously pre-determined by the note on the record), this can be done readily by merely throwing the proper "manual control switch." A single-pole double-throw switch permits the head to be turned to the right or to the left (depending on which way

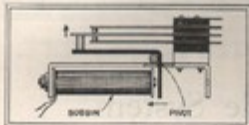


Fig. 11

Switched relay, which act as S.P.D.T. switches, are suitable for the robot; the bottom may be removed, if necessary, to give a correct valve for the circuit.

the switch is thrown). The recorded speech may also be interrupted, and any other speech substituted, by switching off the phonograph and switching in the microphone (See Fig. 8). The operator then talks into the microphone, substituting his own speech for that of the phonograph record.

Control by Light Signals

The "static amplifier" which was used in connection with the light-sensitive cell, is shown in Fig. 10; this used a 74-type tube V1, and a 27 output tube, V2; the latter connected to a relay. (Although the plate impedance of V2 is about 9000 ohms, good results may be obtained by using a relay of considerably lower impedance.) A common type of relay, used on telephone switchboards, and available in various resistances and contact combinations, is illustrated in Fig. 11.

If the robot is to be used out of doors in the daytime, the exciting beam may be furnished by the sunlight; when the day is bright, it is necessary to use a red or blue color filter, or a semi-transparent reduction mesh. On a cloudy day, the light from the south is employed.

When the demonstration is given indoors, or outdoors at night, a light beam from a small electric bulb is required.

In any case, a reflecting mirror is needed. It is desirable to make this portable, so



\$5 Postpaid

The Best \$5.00 Investment You Ever Made

This Is Why

Endorsed by New York and Philadelphia Radio Service Managers' Associations.

Approved by leading radio manufacturers.

974 pages of accurate, authentic service information. 1800 diagrams.

Schematic wiring diagrams—chain diagrams—electric values—socket locations—color coding of connecting wires and resistance—continuity of tests in sealed cans—loud speaker data—specialization of commercial receivers.

Complete, practical trouble-shooting methods used by set manufacturers.

A detailed account of principles and application of set analyzers.

Service data covers commercial broadcast receivers, short-wave receivers, power amplifiers, eliminators and power packs, oscillators, magnet sets and Console receivers.

FREE question and answer service.

Supplementary Monthly Data (96 pages minimum), keeps basic manual always up-to-date. Simple, quick index.

Satisfaction guaranteed or money refunded.

974 Pages of RADIO SERVICE INFORMATION

For the Service Man Who Must KEEP UP With Radio Progress to Make His Business MORE PROFITABLE

JOHN F. RIDER'S classic—a whole service library in one least volume, with FREE QUESTION and ANSWER SERVICE—and SUPPLEMENTARY MONTHLY INFORMATION that keeps you up-to-date for a moderate fee.

Radio service is the sale of knowledge and time. This book increases your knowledge and saves your time. With it, your patronage grows—your profits pile up.

Use Your Head

Don't be fooled by offers of "complete" service manuals. No manual can be complete in an industry that is constantly progressing, unless it keeps up with that progress.

The 1931 TROUBLE-SHOOTER'S MANUAL is the basic unit of a perpetual service library. It is the only manual of its size and scope—and with its supplementary feature of 88 pages of NEW Radio and 16 pages of Electric Refrigeration, Home Traction and Public Address Systems. Data each month, it keeps you FULLY INFORMED at all times—next month, next year, the next ten years—about all you must know in order to run your business successfully.

The 1931 TROUBLE-SHOOTER'S MANUAL is fully guaranteed. You are the judge of its value. If you don't think it is all we have represented—if you feel that you can afford to be without it—send it back and get your money. No quibbling.

Supplementary MONTHLY INFORMATION

Not less than 96 pages of NEW information mailed to subscribers each month—to KEEP them up-to-date. This thorough service costs for one year, only \$2.25 per month in installments. Only 99¢ a year, cash in advance.

RADIO TREATISE CO., Inc.

1440 BROADWAY,
New York, N. Y.

MAIL YOUR ORDER TODAY!
Radio Treatise Co., Inc. 1440 Broadway, New York, N. Y.
Send me for my monthly service information—TROUBLE-SHOOTER'S MANUAL—FREE QUESTION AND ANSWER SERVICE—\$2.25 per month in installments—99¢ a year, cash in advance.
Name _____
Address _____
City _____

Sell Aluminum Progressed Blank Records for Instantaneous Home Recording. Double Speed.



Give Volume Brilliance Durability

List Prices
6 inch \$0.20
8 inch 0.75
10 inch 1.00

Also Microphones—Double and Single Bottom, Transducers, Monitors, Cables, Plugs, etc. New 22-Page Catalog just out.

UNIVERSAL MICROPHONE CO., Ltd.
Englewood Dept. B.C. California

Makes Your Radio BEHAVE!

For Every Set

AMPERITE corrects line voltage variations, included in 5 minutes. No chain change. Write Dept. RC-8, giving make and model number of your set.

AMPERITE
Self-Adjusting
LINE VOLTAGE CONTROL

...set testing
reduced to
Simplicity
with the New
Readrite
analyzers

ACHIEVEMENT in perfecting and simplifying testing equipment for servicemen, dealers and experimenters is still of prime importance—and for the past twenty-seven years Readrite engineers have periodically placed on the market testing equipment of advanced design. Ideal testing equipment today is industry-recognized and for rapid adjustments, expert servicing and testing, Readrite products are increasingly being demanded. Investigate the advantages of using Readrite equipment—the products that have been sold for over a quarter of a century.



Model 700

THE MODEL 700 Meter is equipped with a practical selector switch for checking all parts of the tube circuits by connecting to the set sockets. Selection for testing voltages of plate, grid, cathode and screen-grid, also measuring resistance of transformers, chokes, etc. Capacity and resistance charts are furnished showing the use of instruments for testing condensers, also measuring resistances up to 200,000 ohms. The right scale readings of the meters may be used separately with jack terminals provided. The scale readings are 0-50, 100-500 D. C. volts, 0-15, 100-700 A. C. volts and 0-20-100 milliamperes. Both A. C. and D. C. filament voltages are accurately measured on one meter.

This model is housed in a strong case with leatherette covering, it is attractive and compact, as well as complete. Cover is removable. D. 325 every need for the expert serviceman or the beginner for radio set analyzing. Size 19 1/2 x 7 1/2 x 8 inches. No. 700 - List Price \$23.00

MODEL 600

contains exactly the same testing equipment as No. 700 but the carrying case is more compact and is provided with a lock. Same in providing for carrying tubes, tools and supplies. The test equipment and panel is in a removable tray in the top of the case. The tray may be used separately as a complete test panel for shop purposes. Size 14 1/2 x 7 x 7 1/2 inches. No. 600 - List Price \$30.00

Send for Catalog "R"—an Order Your Meter NOW!

If not at your jobbers order direct. Discount to dealers and service men.

READRITE METER WORKS

17 College Ave. Bluffton, Ohio
Manufacturers of Accurate Testing Instruments Since 1904

that no undue trouble will be experienced in moving the device from one place to another. For this reason, the reflecting mirror and the exciting-lamp assembly should be mounted on a surveyor's tripod, or similar arrangement. A screen or sheet steel, with a very dull black finish, is used as a screen; so that no light other than that from the mirror may be projected upon the photoelectric cell. A ring sight and a sighting hole through the screen assist in lining up the assembly.

The values for Fig. 10 are as follows: R1, 0-10,000 ohms; R2, 1,000 ohms; R3, 10,000 ohms, 1-watt; C1, 1 mf.

The milliammeter MA, shown in the plate circuit of the output amplifier tube, is essen-

tial for intelligent operation of the amplifier. The potentiometer R1 provides a suitable means of regulating the plate current; since the circuit is operated intermittently, the plate voltage should be adjusted to give the amplifier tube a plate current greatly in excess of its continuous rating. This permits the use of a relay of much lower impedance and, hence, higher current requirement, than would be possible if the plate impedance of the 27 tube had to be matched.

The relay, actuated by the photo-cell, was then used to operate the relays which produce mechanical motion, which turned on the electric phonograph or produced any of the other actions described above.

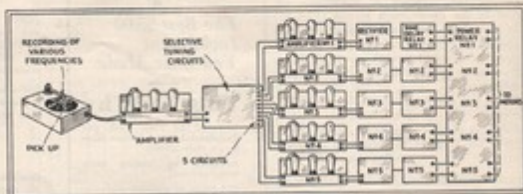


Fig. 9

A complex control method utilizing numerous recorded control-frequencies which are push-button selected. The general application is illustrated in Fig. 2, in the preceding issue.

The Stenode System

(Continued from page 94)

divided complex wave—and all will bring us finally to the same point.

However, when a carrier, or continuous radio-frequency wave, is modulated by audio frequencies of varying pitches, timbres and intensities, the effect we call "sidebands" is created; if this carrier, so modulated, is received by a properly-tuned circuit connected to a faithful amplifier and reproducer system (including of course a detector) the modulations are reproduced in their original form—the carrier wave being cancelled out. Furthermore, with a system of this kind, the result of tuning which is "too sharp" is to suppress the higher tones in the output; this fact was early discovered in the effort to obtain selectivity through cascaded H. F. amplifiers.

As a practical compromise, it has been assumed that audio tones above 5,000 cycles may be dispersed with in radio reproduction; that sparing the carrier-wave frequencies of broadcast stations ten kilocycles (10,000 cycles) apart will then prevent their interference; but that the number of broadcast stations is thereby naturally limited and, to increase their number, the quality of broadcasting must needs be reduced.

So, to make full use of the ten-kc. broadcast channels, for musical transmission, it was necessary that receivers should be correspondingly designed. We therefore find in modern receivers the "fast-tap" band-pass filter; designed to permit practically equal amplification of all the sidebands, and proper reproduction of the higher audio frequencies.

It therefore seemed like flying in the face, not merely of tradition, but of the laws of nature, when Dr. Robinson proposed his Stenode and proposed to receive the program of a broadcast station, with all the high tones of articulated speech and overtones of its musical instruments, yet without the aid of its sidebands. The public, and even the radio experts, had been so long told that they must choose between sensitivity and selectivity, and that they must give up one, so long as they demanded the other, that the proposition seemed incredible.

Restoring the Quality

Yet the fundamental principle is a simple one; that, even though the sidebands are cut off, by a circuit tuned far more sharply



Fig. 3

The principle (though not the actual curve) of the Stenode's compressor is shown here. It brings up to proper volume the high notes suppressed in the crystal circuit.