

This may be your work bench: In foreground is the "Sparx" dynamic signal tracer, with probes in use on a radio chassis. Functions and circuits are analyzed: "improved" setup shown in Figure 1.



"SPARX" AT WORK

ONCE in a while a manufacturer will come up with a *natural* in test equipment, and as a result paves the way for smoother servicing. Examples of this are the vacuum tube voltmeter and the signal tracer. Instruments of this type in the serviceman's shop a few years ago were the exception rather than the rule; today the opposite is true.

Within the past few months an instrument called "Sparx" has been made available to radiomen which bids fair to fall in the category of *naturals* mentioned above. Manufactured by the McMurdo Silver Company, its versatility and dependability have already made it immensely popular with those whose first requisite of a piece of test equipment is its ability to speed up servicing.

FUNCTIONAL INSTRUMENT BREAKDOWN ANALYSIS

Actual operation uncovers the following range of utility of this instrument:

1. High input resistance vacuum

A versatile serviceman's operating tool, with improved circuit suggested by manufacturer (page 26) and instructions for changing earlier models.

by SAMUEL L. MARSHALL

tube voltmeter, D.C. and A.C., the latter with a frequency limit well above 100 megacycles.

2. Aural and visual, gain controlled, A.F. and R.F. signal tracer.

3. A.F. amplifier for measuring phono-pickup and speaker characteristics.

4. Test speaker.

5. Power supply source of high voltage (280 V.) rectified and filtered D.C.

CIRCUIT BREAKDOWN ANALYSIS

The circuit diagram is illustrated in Fig. 1. The instrument will be seen to contain the following circuit units:

1. Crystal probe. This consists of

the new 1N34 crystal diode rectifier. The mechanical construction of this probe is shown in Fig. 2.

2. Visual indicator. This is the 6E5 electron ray tube.

3. Linear gain control. Indicated in the diagram as P1, this control has a linear taper so that quantitative voltage measurements may be calculated from its corresponding dial readings.

4. Audio amplifier. With an audible frequency response extending to 20 cycles in the lower audio frequencies, this unit is particularly suitable for locating sources of hum in a receiver.

5. Loud Speaker. This speaker may be switched to panel jacks for use independently as a shop speaker, or used in conjunction with the aural signal

tracing units of the instrument.

6. *Indicator switch.* The purpose of the indicator switch, S1, is to enable the operator to:

- a) Apply the measured input to the 6E5 directly. (Indicator switch in INPUT position. See Fig. 3)
- b) Apply the measured input to the 6E5 through the linear gain control. (Indicator switch in OSCILLATOR position)
- c) Apply the measured input to the 6E5 through the gain-controlled amplifier. (Indicator switch in OUTPUT position.)

7. *Output switch.* The purpose of the output switch, S2, is to enable the operator to:

- a) Connect the speaker to the final tube of the amplifier for aural testing. (OUTPUT switch in INT. position)
- b) Connect the amplifier for use with an external speaker. (OUTPUT switch in AMP. position) Terminals P and B+ are used to connect up this external speaker.
- c) Make available the speaker itself as a test speaker through terminals P and B+. (OUTPUT switch in SPKR. position.) Line plug of instrument need not be inserted in power receptacle for this test position.
- d) Make available the rectified D.C. of the power supply



Figure 3. Front panel view, with operating indications. Referred to in text at left, beginning with paragraph 6.

through terminals GND. and B+. (Speaker position of OUTPUT switch)

8. *Input terminals* to amplifier through gain control.

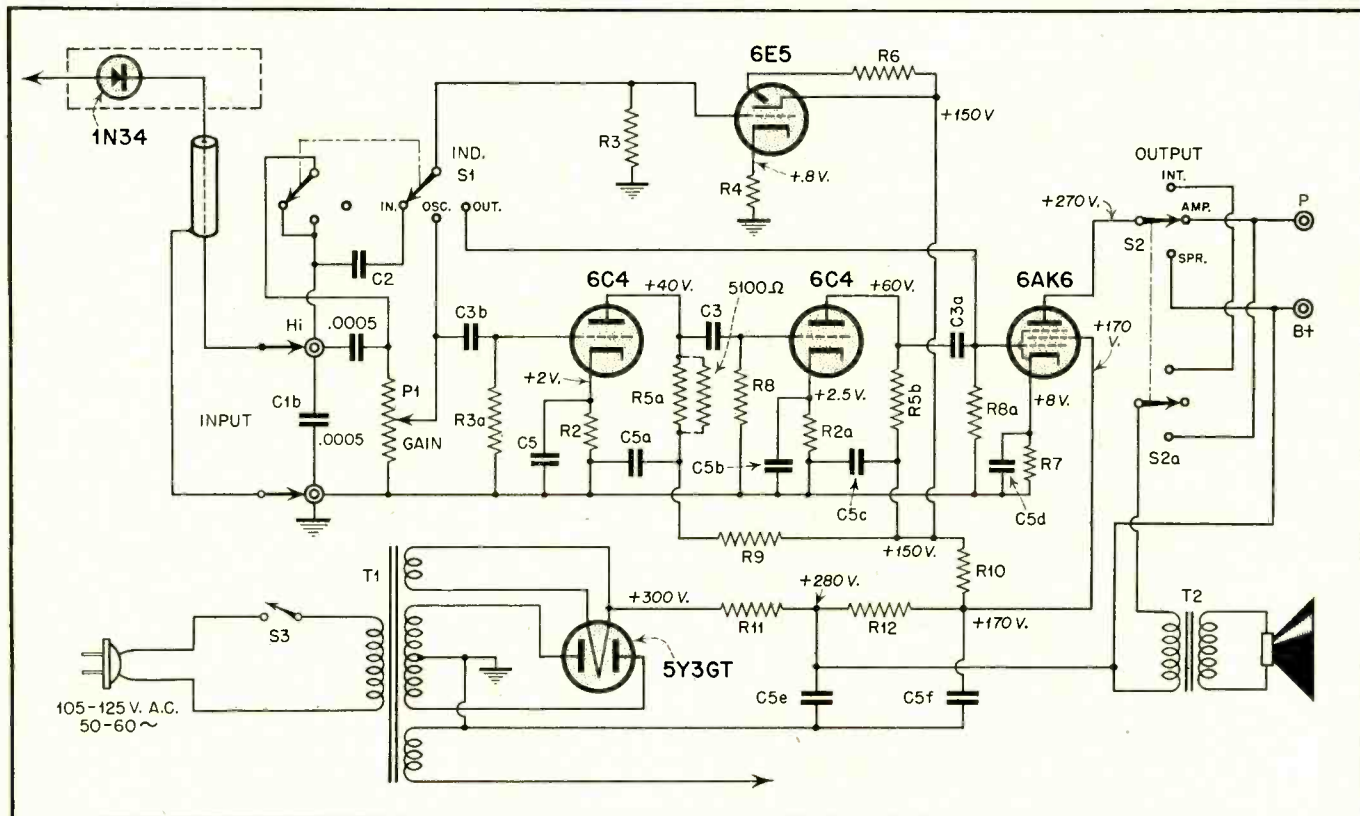
9. *Output terminals.* The circuit connections to the output terminals have been covered in the discussion on the Output switch.

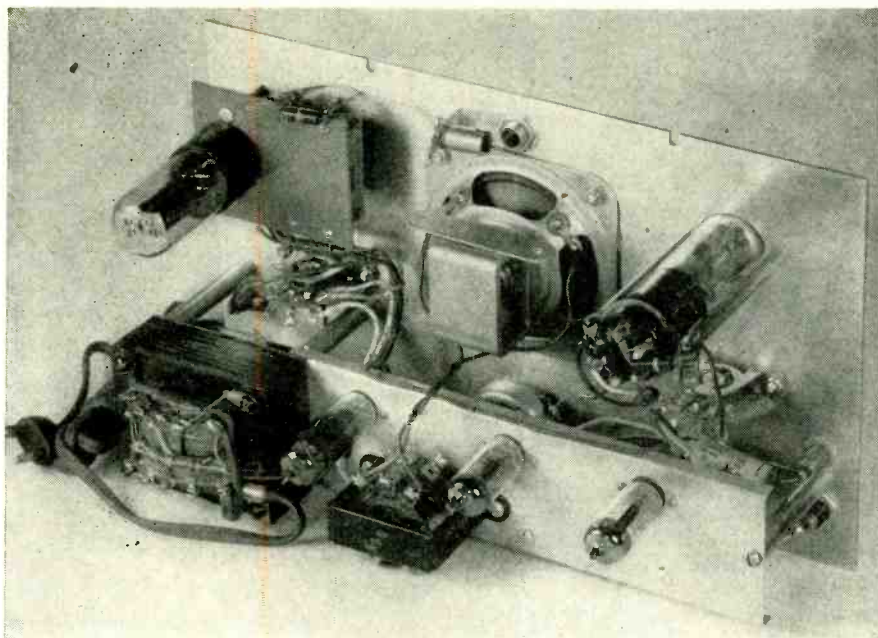
SERVICING APPLICATIONS

1. As a *vacuum tube voltmeter*

Sparx can be used to measure D.C. terminal voltages without affecting or disturbing the circuit constants in the circuit being measured. Since the shadow of the 6E5 tube is completely closed when the applied input voltage is about 5.5 volts, this value represents the minimum measurable voltage. Higher D.C. voltages can be measured by reducing the gain control until the shadow is just about ready to open again. The value of the measured

Figure 1. Circuit diagram of "Sparx". Note Crystal probe with new 1N34 crystal diode rectifier. Schematic is revised as described in section under "Special Note"



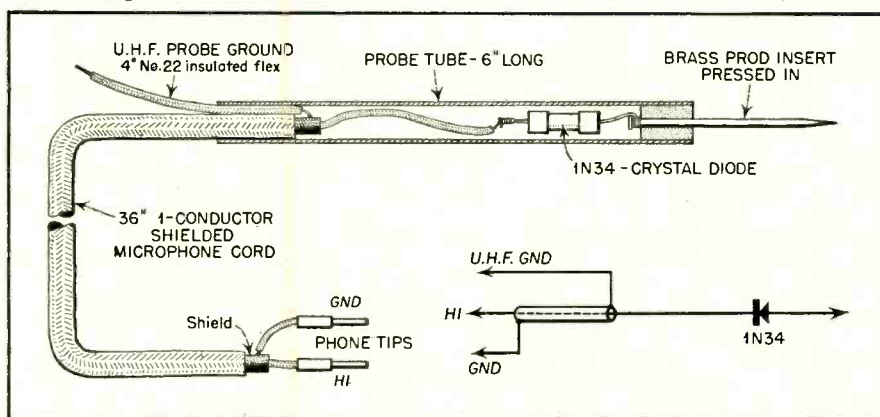


Rear panel view, showing compact arrangement of components, indicated in Figure 1.

voltage can then be calculated from the setting of the gain control. Thus, if the control setting reads 50, it stands to reason that the voltage measured is $100/50 \times 5.5 = 2 \times 5.5 = 11$ volts. If the gain control setting for another voltage reading is 20 the voltage measured is $100/20 \times 5.5 = 5 \times 5.5 = 27.5$ volts. A chart indicating the voltages measured for corresponding gain control readings can easily be drawn up by the operator. The calibration of this

the prod attached to the antenna terminal of the receiver it is possible to hear the signal in the loud speaker. Since the probe has little or negligible effect on the tuning of a circuit it is possible to trace this signal from the antenna to successive grids and plates of each stage of the receiver aurally. Actual quantitative signal gain measurements can be made by feeding the output of a signal generator into the antenna terminals of the receiver. With

Figure 2. Mechanical construction of probe, with revisions as explained in text at right.



chart, of course, is determined by the voltage required to close the shadow of the particular 6E5 tube in use.

Some of the more difficult voltage measurements, such as oscillator grid, A.V.C., and contact bias grid voltages can be determined by this section of the instrument. To repeat, those voltage values above 5.5 volts can be determined quantitatively, those less than 5.5 volts can only be roughly estimated.

2. As a signal tracer, the sensitivity of this instrument is such that with

the magic eye connected in the output circuit of the amplifier it doesn't take too much of a signal from the signal generator to close the shadow even when the probe is connected directly across the output of the signal generator.

To make measurements of audio or radio frequency gain between two points it is only necessary to place the probe at the first point and adjust the gain control until the shadow is just about ready to open. The gain control position being duly noted, the probe is

placed at the second point, and again the gain control is adjusted until the shadow is just about to open. The voltage gain of the stage is then equal to the first gain control reading divided by the second. For example, if with the probe placed successively at the grid and plate of a tube, the corresponding gain control readings are 90 and 3, the gain of the tube is $90/3 = 30$.

All the advantages of signal tracing are thus made available with this instrument. These include measurements of stage to stage gain, phase inversion, and inverse feedback. In addition, a resourceful serviceman should be able to develop many testing techniques in F.M. and television receiver measurements that are potentially possible with a Sparx.

3. Phono pickup and speaker characteristics may be obtained with the A.F. amplifier which is an integral part of the instrument. In addition, recording head characteristics may be determined in conjunction with a frequency test record.* Because of its excellent low frequency response the amplifier may also be used in tracing down the source of hum in a receiver. This applies to noise tracing as well.

4. A test speaker in a service shop is almost indispensable. The one in the Sparx is easily made available through the output terminals.

5. Examination of the circuit diagram will reveal that the power supply voltage is also made available through the output terminals. The need of this type of supply and its applications are so obvious that any discussion on this subject is superfluous.

SPECIAL NOTE TO USERS

It has been found that upon some A.C./D.C. receivers no audible signal will be heard when the prod is connected to the converter plate and the return is connected to the receiver chassis. Shifting the return connection to the "low" end of the first I.F. transformer primary (B+) will render the converter output (I.F. input) signal audible.

All instruments shipped from the factory after March 1, 1947 are known as the "Improved Model", being so identified by a stamp upon the rear of each instrument panel. The design modifications involved are so simple, however, that owners of earlier "Sparx" can easily and quickly change them into Improved Models at small cost in time and material — only two .0005 mfd. condensers and one 5100 [see page 40]

*See Shop Notes, March 1947, "Radio Service Dealer."

SILVER

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906

Thanks for your patience. Model 906 Signal Generator is now flowing to your favorite jobber. And what an instrument . . . 90 kc. through 170 mc. on fundamentals . . . 6 air-trimmed bands . . . variable % 400 ~ amplitude modulation . . . built-in variable electronic FM sweep . . . laboratory triple adjustable attenuator . . . metered microvolts . . . output 1/2 microvolt to over 1 volt . . . multiple shielded . . . strays lower than \$300.00 laboratory generators. Yet all this costs you only \$89.90 net. Better order your 906 now for demand far exceeds production capacity on this precision instrument for months to come.

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OVER 36 YEARS OF RADIO ENGINEERING ACHIEVEMENT

McMurdo Silver Co., Inc.

1249 MAIN ST., HARTFORD 3, CONNECTICUT

"SPARX" AT WORK

[from page 27]

ohm, 1/2 watt resistor (any resistor between 5000 and 5500 ohms is satisfactory) are needed.

To convert "Sparx" into Improved Model, proceed as follows:

1. Holding tip of r.f. probe between thick paper in jaws of bench vise, gently pull red sleeve off metal tip-insert. Remove R1 and C1a from circuit. Modify r.f. probe circuit so "-" lead of 1N34 crystal diode is soldered to metal insert, "+" lead of 1N34 to inner conductor of shielded cable, and short u.h.f. grounding wire is soldered to cable shield braid. Keep 1N34 leads short, with cable shield braid running up close to 1N34 so as to avoid hum due to hand capacity in handling r.f. probe. Reassemble probe by pressing red sleeve back over vise-held metal tip-insert plug.

2. Shunt R5a (1000,000 ohms) with a 5100 ohm, 1/2 watt resistor. (R5a is found beneath amplifier channel close to 6C4 first a.f. amplifier stage). Shown in Fig. 1.

3. Remove all connections to four lugs on top of INDICATOR switch. Connect left top lug (seen from rear) to bottom lug of GAIN control P1. Connect two top center lugs of INDICATOR switch to INPUT jack. Remove connection (or .02 mfd. capacitor) between bottom lug of P1 and INPUT jack. Connect .0005 mfd. condenser between bottom lug of P1 and INPUT jack. (See Fig. 1).

4. Make sure C1b (connected across INPUT and GND. jacks) is .0005 mfd. (See Fig. 1).

5. Recheck operations made as above for correctness. Note elimination of any hum which may have been present in original "SPARX" and greatly increased sensitivity in signal tracing when INDICATOR switch is set to OUTPUT position.

G-C Flock Finish Spray Kits

General Cement Mfg. Co. has recently placed on the market a new patented blower spray gun for flock. A professional job can be done without any experience; no special skill is required. This new method is applicable on phono turntables, cabinets, grilles, instrument cases, tool boxes, toys, ornaments, signs, and hobby uses. The kit contains: 1 blower gun; 1 can brown flock; 1 can ivory flock; 1 can thinner; 1 brush and instructions; 1 can brown undercoat. List price \$10.75.

For further information write to the company at 919 Taylor Avenue, Rockford, Illinois.