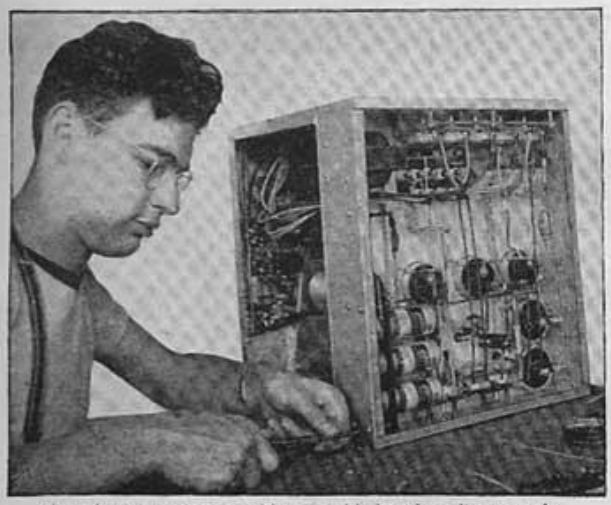


The television unit is readily assembled with ordinary tools.

10 by 8 Inch Television Images

BY THE TELEVISION CLUB OF BROOKLYN TECHNICAL HIGH SCHOOL

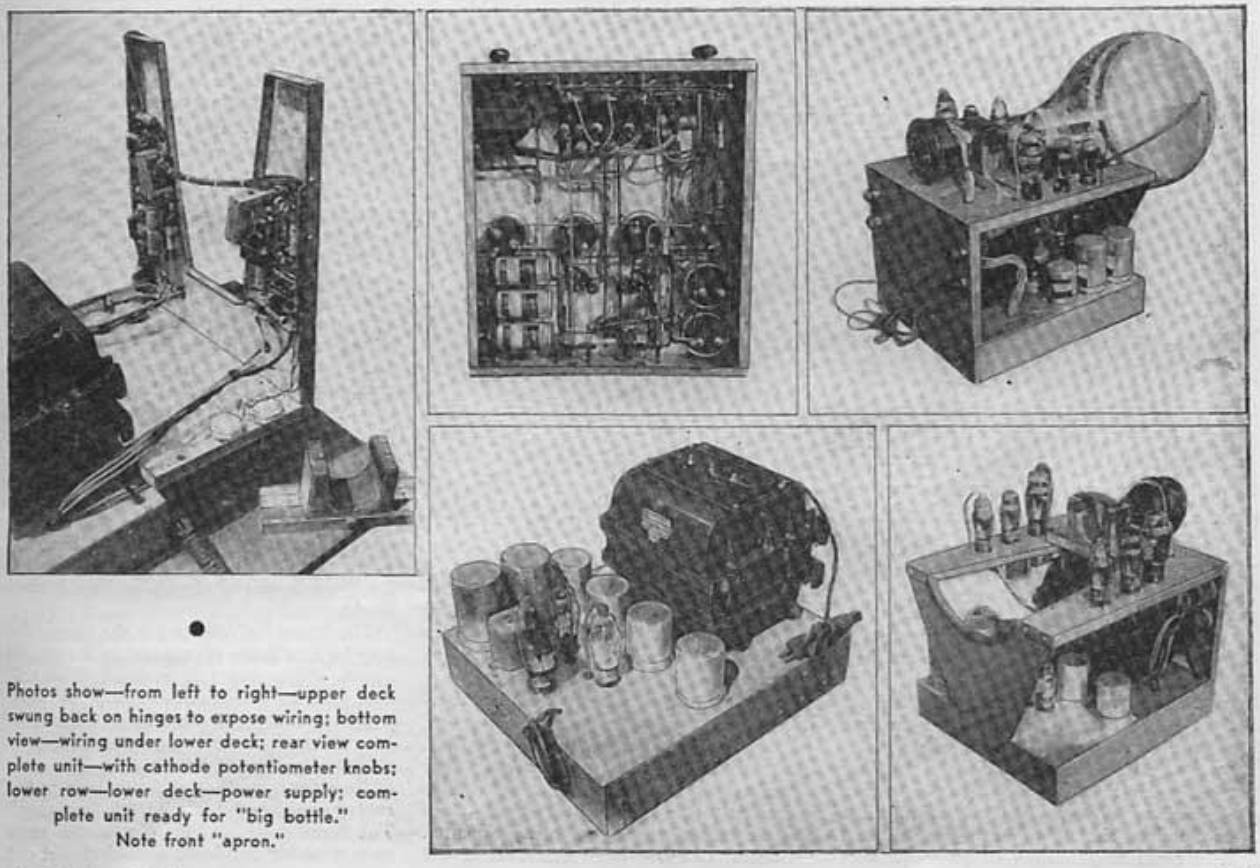
Faculty Adviser:—Ricardo Muñiz, E.E.
President:—Saul Morton Decker
Vice President:—Martin Rosenberg

Here is a picture reproducing unit which will operate from the video output of any television receiver. It will reproduce large images from small television receivers—also useful as a serviceman's universal test picture reproducer.

● **Large Pictures from Your Small Televisor:** This picture reproducing unit when used in conjunction with any of the Televisors described for home construction in RADIO & TELEVISION, or with any of the kits now on the market, will give the constructor **Ten Inch** by **Eight Inch** television pictures.

Serviceman's Universal Pix Reproducer: To the repairman or serviceman anticipating any quantity of *television* work, this unit offers all the advantages that a *Universal speaker* gives in radio servicing—plus some. Having this unit on the bench will make possible the application of *signal tracing* service methods. This unit will enable the worker to align and repair the *television receiver* portion of the Televisor with the assurance that his adjustments and tests will not be confused by troubles located in the synchronizing separator, clipper, D.C. restorer, deflection oscillator, high voltage power supply, or picture tube. He can *concentrate* on the *receiver* itself. This MUST be working before troubles can be easily diagnosed in the remaining portions of the Televisor. We consider a unit of this character a MUST for the busy "Television-Man".

Television Experimenter's Necessity: The



Photos show—from left to right—upper deck swung back on hinges to expose wiring; bottom view—wiring under lower deck; rear view complete unit—with cathode potentiometer knobs; lower row—lower deck—power supply; complete unit ready for "big bottle." Note front "apron."

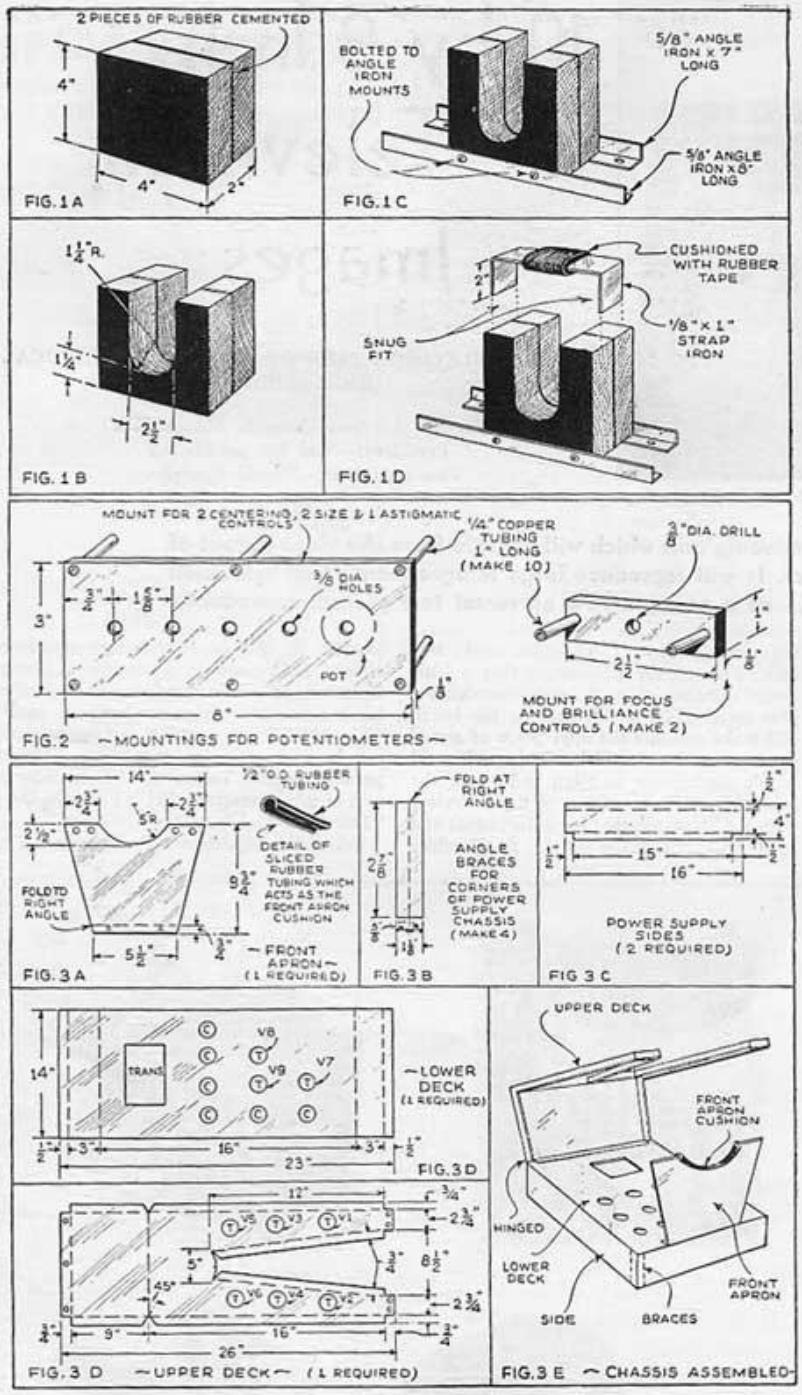


Fig. 1—Tube mounting.

Fig. 2—Mounting for potentiometers, chassis layout, etc.

television experimenter is most usually concerned with the more subtle and intriguing *receiver* portion of the television set. The high voltage power supply and deflection circuits are more or less routine. One of these units on the bench will leave him free to experiment with all the various types of receiver circuits, T.R.F., Super-Het, Filter type, and all the various Video amplifier circuits for producing correct amplification of the video signal, without phase shift and with equal amplification of all frequencies in the video range. He can connect the *picture reproducer* to any of his television receivers with a minimum of effort. He can compare, under controlled conditions, two designs of receiver. He can use this reproducer with his amateur television receiver. (A complete amateur television system will be described in this magazine by Mr. Muñiz in the very near future.) In short, it is as necessary to the television experimenter as a loud speaker is to the radio experimenter.

General Constructional Features: It will be noted upon viewing the photographs of the unit built by the Tech. Club that two chassis were used. The upper chassis provides mounting for the synchronizing pulse separator-clipper-amplifiers (6J7), the saw tooth deflection oscillators (6AC5G), and the deflection amplifiers (802) and their associated circuit parts.

The C-R *picture tube* is also mounted on this chassis by means of an ingenious arrangement which is here described. The lower chassis contains the power-supply and bleeders. Note that the heavy power transformer is braced in two places. Drawings of the necessary sheet metal work are provided herewith for the guidance of the constructor. Unless some facilities for sheet-metal work are available to you, it might pay to have the chassis bent by a sheet metal shop—it takes very little time. At Tech. the chassis was made in the school's sheet metal shop under the supervision of Mr. Hochberg of that department.

Details of Construction

1. **Upper Deck of Chassis:** In the drawing and photograph it will be noted that this deck has a large area cut out of its upper surface to accommodate the cathode-ray tube. This forms two "arms" of the chassis on either side of the bulb. One side is devoted to the "horizontal" circuits, the other to the "vertical." The "horizontal" includes the 6J7, 6AC5G and 802 tubes. These circuits produce the horizontal deflection or "line frequency." The "vertical" tube complement is the same, but these circuits produce the vertical deflection of the cathode-ray beam—that is the "frame frequency."

Thus six tube sockets are mounted on the upper deck besides the "moorings" of the big tube. On the under side of the deck are found the condensers, resistors and transformers which constitute this portion of the unit. These parts are grouped in the section of the circuit diagram enclosed in the single dotted line and labeled "upper deck."

It will be noted that the upper deck has a vertical portion in the rear which extends down to the lower deck. The Power Transformer, the main mountings of which are on the lower deck, is braced against this portion of the upper deck for additional support. Mounted upon this rear "apron" of the upper deck are four of the adjustment potentiometers. These are the four pots. found in the cathode circuits of the oscillator and amplifier tubes. Those in the oscillator tubes are the *frequency* controls, while those in the amplifier tube circuits are the *size* controls. More about their functions later. They are mounted directly on the chassis metal because only a small voltage difference to ground exists at this point of the circuit. **All other potentiometers are insulated from the chassis and from their knobs.**

The "mooring" device for the large tube may be seen in the photos and in the special sketch which shows it in detail. You will note that the Teletron tube socket is NOT anchored to the chassis. The socket has no provisions for mounting provided; *the socket is supported by the tube.* The neck of the tube is gently but firmly held in the rubber cushioned jaws of its "mooring." The flared portion of the big "bottle" rests upon a rubber cushioned semi-circle cut out

of the third piece of the chassis. The cushion is a piece of ½" O.D. rubber tubing. This third piece is designated "Front Apron" in the chassis drawings. The radius shown is correct to fit the big tube at the place which will rest there. No attempt is made to anchor the tube at this support.

All holes in the upper deck made for the passage of wire leads must be protected with rubber grommets. These grommets serve a dual purpose here. They re-enforce the insulation of the high voltage carrying leads at their most critical point, where they pass through the chassis, and they protect the lead mechanically against abrasion. It will be noted that the leads from the socket of the big tube are bunched into two groups. Each group is "laced-up" and passed through BOTH decks by means of large grommetted holes. This lacing does not detract from the performance and does improve neatness.

2. Lower Deck of Chassis: Mounted on the lower deck of the chassis are all parts within the single dotted line in the circuit diagram. These constitute the transformer, choke, condensers, tubes and bleeder of the power supplies. Also the potentiometers which are too "hot" to mount directly on chassis metal are mounted here on sub-panels. A detail of these sub-panels is shown in the drawings. The "pots." are supported some distance behind the back of the chassis with the exception of the brilliance and

Figs. 4, 5 and 6—Fig. 4: Diagram for complete upper deck. Fig. 5: Diagram for complete lower deck. Fig 6: a, b and c: Graphs showing push-pull deflection.

focus controls (which have to be re-set frequently) which are similarly mounted behind the front of the chassis. Insulated extension shafts (not shown) extend from the pots. out through the chassis onto knobs. Now is as good a time as any to WARN the constructor that the potentials used in this, and all other, electronic television circuits are LETHAL—that is to say THEY KILL! You don't get a second chance from the demon HIGH VOLTAGE. But with care and judgment, NO HAZARD WILL EXIST in using and operating this device. BUT when we say mount a potentiometer on an insulated sub-panel—we're not fooling!

Hinges are provided at the rear of the lower deck for mounting the rear apron of the upper deck in such a manner (see photo) that it can be swung back for servicing or experimental changes. (After unbolting transformer from it, etc.)

Explanation of Circuit: Let us start with the input to the 6J7G's. This input must be a video signal of *negative* polarity. The club obtained this from the plate of the first video amplifier in the school's Televisor. Naturally a blocking condenser was used in series with this lead to keep D.C. out of the grid circuits of the 6J7G's. These two tubes function as *synchronizing signal separators* and the outputs of their plates are applied to the synchronizing windings of the horizontal and vertical oscillation transformers. Thus the saw tooth deflection oscillators are "triggered" to keep in perfect step with the transmission. Of course the "synch" won't take control unless our

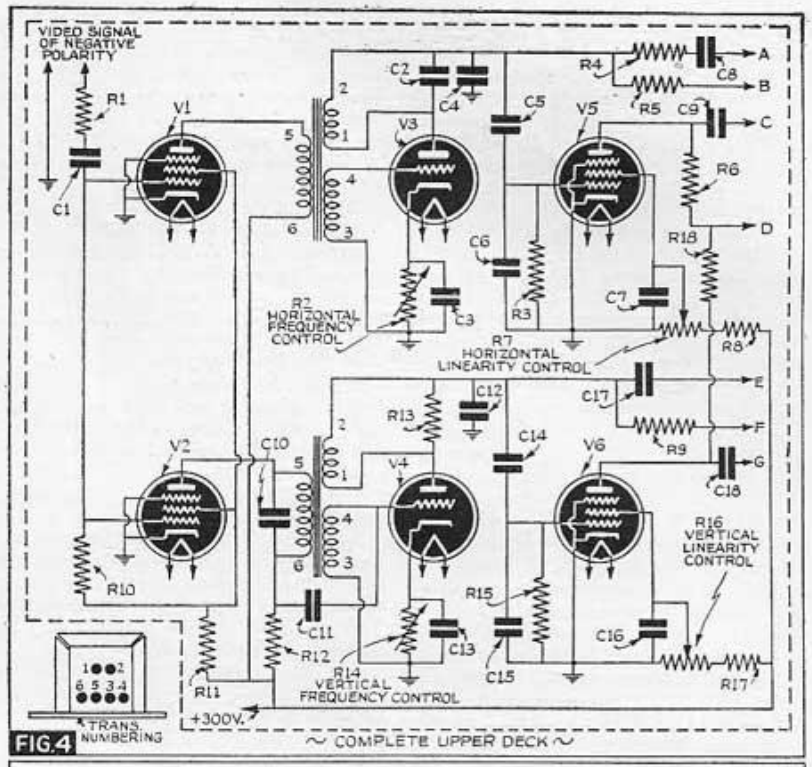


FIG.4

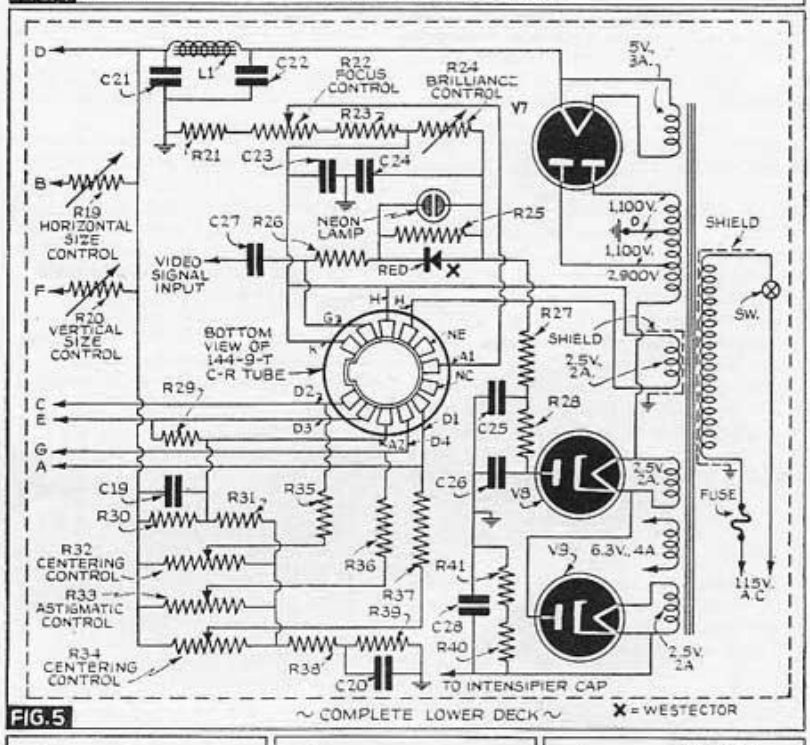
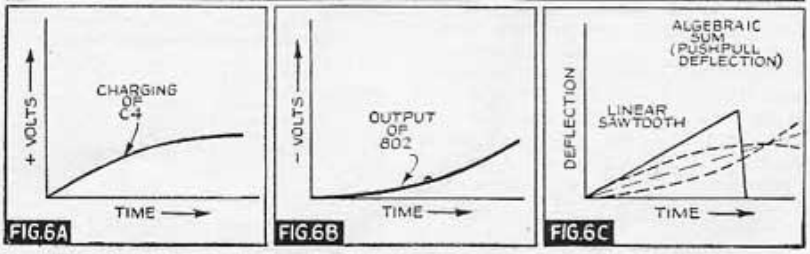


FIG.5



frequency of sweep is adjusted to very near the correct value with the frequency control "pot."

As an oscillator, or saw tooth generator, we use a 6AC5G. Hung on its plate circuit is condenser C_1 (considering the horizontal sweep circuit). Condenser C_1 is charged through resistor R_3 and potentiometer R_{19}. In this circuit the timing is such that C_1 reaches nearly the full 1,100 volts before it is discharged through the 6AC5G, which was held at cut-off by the charge existing on cathode condenser C_2 from a previous cycle of oscillation. This charge on C_2 is bled off by potentiometer R_2 to ground. When the charge on C_2 is low enough—the 6AC5G draws plate current. This plate current comes from the condenser C_1. Pot. R_2 acts as horizontal frequency control. Pot. R_{19} acts as size or amplitude control.

Actually the presence of the transformer acts to decrease return time, etc.—but a longer explanation is available in the Du Mont Teletron 144-9-T Bulletin, which you can get for the asking (from Du Mont) so we won't go into the elaborate details.

Fig. No. 6a shows the signal wave appearing at the output of this tube. You will note that it is not a perfect straight sided saw tooth. This wave is applied to one of the deflecting plates of the Teletron. The other plate receives its potential from the 802 tube. The 802 input comes from this same wave through a voltage divider. The 802 is operated with such a potential on its screen grid as to obtain action similar to that observed in a volume expander circuit encountered in audio practice. The result is a voltage wave output from the 802 as shown in Fig. No. 6b. This voltage wave is applied to the other of the pair of horizontal deflecting plates in the Teletron. Since the curvature of the output wave of the 802 is opposite in direction from that of the 6AC5G the resulting deflection of the cathode-ray beam in the horizontal, or line, direction is as shown in Fig. No. 6c. Thus we have *linear* deflection.

Had we generated a linear saw tooth in the usual manner we might have gotten about 11 volts of sweep from the saw tooth generator (instead of nearly 1,100). We would then have to amplify this saw tooth in a linear manner to obtain a 1,100 volt saw tooth. This would require a very large amplifier tube capable of withstanding high plate voltages and would have increased the cost of the unit very greatly.

The vertical sweep circuit is similar in every respect.

Power-Supply Circuit: Both halves of the A.C. cycle are rectified in the 2,900 volt power-supply section. We do not obtain a full wave output, however. With ground = 0 volts we take 2,900 volts D.C. positive from the 2Y2 marked Rec. No. 1 for the intensifier electrode which accelerates the cathode-ray beam AFTER it has been *deflected*, thus improving picture brilliance without decreasing deflection sensitivity of the "big bottle." The accelerating anode is operated near 1,000 volts positive potential. This electrode is marked A_2. The *modulating* electrode, that is the control grid, of the big bottle is held at 2,900 volts negative, or "below ground," by the output of the second 2Y2 marked Rec. No. 2. The control grid is marked G.

D.C. Restorer: The Westinghouse dry rectifier Westector acts to introduce the correct bias on the modulation electrode of the Teletron, to maintain the background level at the transmitted level. The neon lamp across it protects it against surges. The control pots. will be found to have the correct range. Their manipulation is self-explanatory once they are turned, so explanation is not called for.

While all the members of the Brooklyn Technical High School Television Club contributed their share of effort in the design and construction of the unit just described, the author and faculty advisor of the club wishes to especially commend the president, S. M. Decker, and the vice-president, M. Rosenberg, for their unstinting effort. Mr. Rosenberg did much of the preliminary planning and ordering of materials, as well as some of the construction. Decker brought the project to a conclusion at Monmouth Beach, N. J., completing the assembly and wiring, checking, testing and experimental work.

Additional Notes: The service man and the experimenter will find it more convenient to add a phase inverter and voltage divider for feeding the synch. separator. This will avoid having to break into the first video stage for a negative feed.

Another convenience for these two would be an extra small, low-voltage power-supply to avoid having to tap into the vision receiver for B+ for the 300 volt supply.

In the case of some few vision receivers it might be necessary to add more video amplification, in order to swing the grid of the "big bottle" enough to get good contrast. We at Tech. did not find it necessary, however.

These possible alterations are conventional and do not, I believe, require further treatment here. The author would be glad to provide data, however, to any constructor who became puzzled about these points or any others. Address him care of this publication and enclose a self-addressed and stamped envelope.

(The circuits used in this unit were adapted from those in the Bulletin of the Teletron 144-9-T made by Du Mont. Permission was obtained to make use of this data.)

Parts List

AEROVOX CORPORATION (Condensers)
Ordering Data
4—Type 3012 .25 mf. C-23, C-24, C-25, C-26
2—Type 2089 .05 mf. C-17, C-18
2—Type 1686 .01 mf. C-8, C-9
1—Type 1684 .04 mf. C-12
1—Type 1654 .001 mf. C-27
3—Type 1510 .5 mf. C-28 (three in series)
2—Type 1505 4. mf. C-21, C-22
1—Type 1467 .0025 mf. C-10
1—Type 1457 .0025 mf. C-14
1—Type 1457 .0002 mf. C-4
1—Type 1457 .00005 mf. C-5
2—Type 1455 .0003 mf. C-2, C-6
2—Type 684 .25 mf. C-15, C-19
1—Type 684 .005 mf. C-11
2—Type 484 .1 mf. C-1, C-20
1—Type 484 .05 mf. C-3
1—Type 484 .02 mf. C-7
2—Type PR 50 25. mf. C-13, C-16

Circuit Legend (repeats above)

C-1	.1 mf.	C-15	.25 mf.
C-2	.0003 mf.	C-16	25.0 mf.
C-3	.05 mf.	C-17	.05 mf.
C-4	.0002 mf.	C-18	.05 mf.
C-5	.00005 mf.	C-19	.25 mf.
C-6	.0003 mf.	C-20	.1 mf.
C-7	.02 mf.	C-21	4.0 mf.
C-8	.01 mf.	C-22	4.0 mf.
C-9	.01 mf.	C-23	.25 mf.
C-10	.0025 mf.	C-24	.25 mf.
C-11	.005 mf.	C-25	.25 mf.
C-12	.04 mf.	C-26	.25 mf.
C-13	25.0 mf.	C-27	.001 mf.
C-14	.0025 mf.	C-28	(3—5's in series)

INTERNATIONAL RESISTANCE CO. (Resistors)
Ordering Data
Type BT-½
2—10,000 ohm; R-1, R-26
2—15,000 ohm; R-12, R-39
1—40,000 ohm; R-4
1—50,000 ohm; R-13
2—300,000 ohm; R-30, R-31
2—1 meg.; R-3, R-25
4—5 meg.; R-29, R-35, R-36, R-37
1—10 meg.; R-10
Type DG
1—80,000 ohm; R-6
Type BT-1
3—100,000 ohm; R-5, R-27, R-28
1—40,000 ohm; R-8
2—200,000 ohm; R-11, R-17
1—5 meg.; Part of R-15
3—20 meg.; Part of R-15, R-40, R-41
Type BT-2
2—800,000 ohm; R-9 (two in parallel)
1—3 meg.; R-18
1—2 meg.; R-21
2—750,000 ohm; R-23, R-38

P. R. MALLORY & CO. INC. (Potentiometers)
2—5,000 ohm, E5MP, Potentiometer; R-2, R-14
1—50,000 ohm, K, Potentiometer; R-16
1—100,000 ohm, Y 100 MP, Potentiometer, R-24
1—250,000 ohm, UC 519, Potentiometer, R-7
1—500,000 ohm, UC 513, Potentiometer, R-19
2—1 meg., Y 1000 MP, Potentiometer, R-20, R-22
3—2 meg., P, Potentiometer; R-32, R-33, R-34

Circuit Legend for Resistors
(All values above are repeated here)

R-1	10,000 ohm	R-22	1 meg.
R-2	5,000 ohm	R-23	750,000 ohm
R-3	1 meg.	R-24	100,000 ohm
R-4	40,000 ohm	R-25	1 meg.
R-5	100,000 ohm	R-26	10,000 ohm
R-6	80,000 ohm	R-27	100,000 ohm
R-7	250,000 ohm	R-28	100,000 ohm
R-8	40,000 ohm	R-29	5 meg.
R-9	400,000 ohm	R-30	300,000 ohm
R-10	10 meg.	R-31	300,000 ohm
R-11	200,000 ohm	R-32	2 meg.
R-12	15,000 ohm	R-33	2 meg.
R-13	50,000 ohm	R-34	2 meg.
R-14	5,000 ohm	R-35	5 meg.
R-15	25 meg.	R-36	5 meg.
R-16	50,000 ohm	R-37	5 meg.
R-17	200,000 ohm	R-38	750,000 ohm
R-18	3 meg.	R-39	15,000 ohm
R-19	500,000 ohm	R-40	20 meg.
R-20	1 meg.	R-41	20 meg.
R-21	2 meg.		

AMERICAN PHENOLIC CORP. (Amphenol)
5—MIP8 sockets
2—MIP7L sockets
2—MIP4 sockets

NATIONAL UNION RADIO CORP.
2—6J7G Tubes V1, V2
2—6AC5G Tubes V3, V4
2—2Y2 Tubes V8, V9
1—5X4G Tubes V7

RCA MANUFACTURING CO., INC. (Tubes)
2—802 V5, V6

CORNISH WIRE COMPANY
1—Line Cord & Plug

INSULINE CORP. OF AMERICA (I.C.A.)
5—Cat. No. 2436 Terminal Strips
11—Cat. No. 2439 Terminal Strips
1—Cat. No. 1230 Switch

Other Parts Used in Construction
1—Power transformer made to following specification:
Primary:—110 volts 60 cycles; surrounded with electrostatic shield
Secondary:—1100—0—1100—2900 volts
the 1100 at 30 milliamperes
the 2900 at 2 milliamperes
two—2.5 volt filament at 2 amps each
one—2.5 volt Cathode Ray tube filament at 2 amps with electrostatic shield
one—5 volt filament at 3 amps
one—6.3 volt filament at 4 amps.
(This transformer was made up and delivered to Club for $12.50)
1—Filter choke; 15 henrys, 60 milliamperes, 5000 volt insulation.
1—Picture tube 144—9—T (Du Mont) & socket
1—Horizontal Oscillation Transformer & socket—Du Mont
1—Vertical Oscillation Transformer & socket—Du Mont
1—Copper Oxide High Voltage Rectifier (for D.C. restorer) 3,000 v. (Club used British-made Westinghouse unit sold by Du Mont)
1—3000 v. Neon Lamp
100 ft. Automobile lighting type cable for high voltage wiring.
Soft sheet rubber for tube mooring.