RADIO - TELEVISION

Practical • J. A. ROSENKRANZ, Pres. • Training

NATIONAL SCHOOLS

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Los Angeles, California

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FOUNDATIONAL TRAINING

The Basis of Your Success

At the outset of your training, you were told that National Training is thorough and complete and that you would receive practical instruction in every field or division of the Radio Industry. This institution is abiding by its word and offering you everything that it promised and even more.

You have now completed the first important part of our training program and which consisted of laying a solid foundation for all of your advanced work. This foundational training has offered you complete information regarding all of the important basic principles upon which the entire radio industry is dependent and you have been shown in detail how these principles are applied to receivers and associated equipment.

You are now prepared to commence your advanced studies dealing with transmitters, talking pictures, television etc. These, you must remember, are all highly specialized fields of the Radio Industry and before anyone can undertake an intelligent study of any one of these fields, he must first have the foundational training which you have ac-

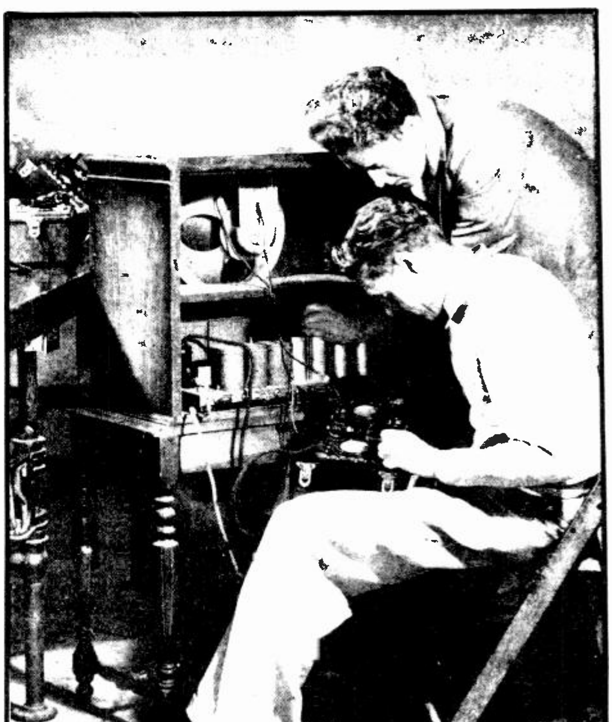


FIG. 1
Radio Service - A Profitable Profession.

QUIRED THROUGH YOUR STUDIES SO FAR.

PRACTICALLY WITHOUT EXCEPTION, YOU WILL FIND THAT EVERY SUCCESSFUL MAN WHO TODAY IS AN EXPERT IN ANY ONE OF THESE ADVANCED FIELDS WAS AT SOME TIME OR OTHER A RADIO SERVICEMAN OR ELSE ACTIVE IN AN ENGINEERING CAPACITY INVOLVING RADIO RECEIVERS. THESE MEN ALL NEEDED THEIR FOUNDATIONAL TRAINING AND SO DO YOU -- PAST EXPERIENCES HAVE CONCLUSIVELY PROVED THIS TO BE THE SHORTEST AND MOST CERTAIN ROUTE TO SUCCESS.

BEFORE EVER COMMENCING TO WRITE THIS COURSE, IT WAS FIRST SCIENTIFICALLY PLANNED.

NATIONAL'S INSTRUCTION PROGRESSES IN LOGICAL STEPS. YOU BUILD YOUR PRACTICAL KNOWLEDGE FIRST AND BUILD YOUR TECHNICAL KNOWLEDGE UPON IT. WITH THIS SYSTEMATIC METHOD OF TRAINING THE STUDENT CAN FULLY VISUALIZE HOW TO APPLY THEORETICAL AND TECHNICAL PRINCIPLES TO PRACTICAL PROBLEMS AND THIS IN THE FINAL ANALYSIS IS THE KEY-NOTE TO RADIO SUCCESS.

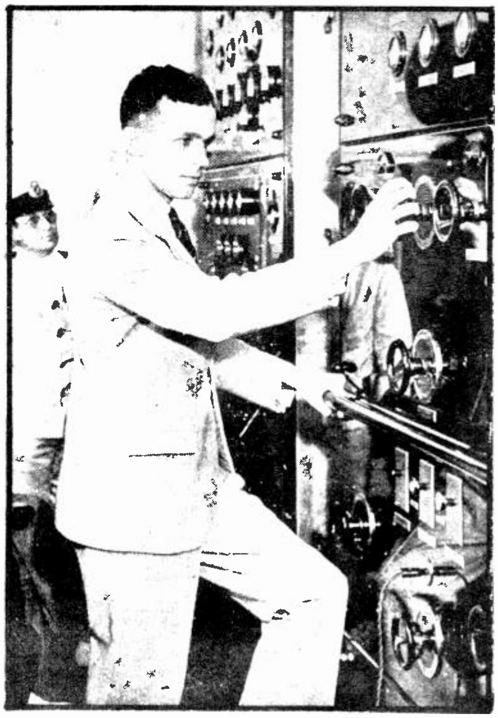


FIG. 2
Unlimited Opportunities in the Field of Transmission.

ALTHOUGH YOU HAVE SO FAR ONLY BEEN SHOWN HOW THE BASIC RADIO PRINCIPLES ARE APPLIED TO RECEIVERS, YET YOU MUST NOT OVERLOOK THE FACT THAT THESE SAME PRINCIPLES CAN ALSO BE APPLIED TO TRANSMITTERS, TO AMPLIFYING EQUIPMENT FOR PUBLIC ADDRESS INSTALLATIONS, TO TALKING PICTURES, TELEVISION ETC.

THIS MEANS THAT MANY OF THE IMPORTANT PRINCIPLES WHICH YOU HAVE ALREADY LEARNED, ARE GOING TO BE USED AGAIN IN YOUR COMING STUDY OF THE SPECIALIZED FIELDS OF RADIO. BY YOUR ALREADY KNOWING THEM, THERE WILL BE NO NEED TO EXPLAIN THEM AGAIN IN DETAIL WITH RESPECT TO THE EQUIPMENT TO BE DESCRIBED IN THE ADVANCED LESSONS. THIS IN TURN WILL CONSTITUTE A SAVING IN TIME AND WILL MAKE YOUR PROGRESS THROUGH THE ADVANCED SUBJECTS MORE RAPID, MORE INTERESTING AND FREE FROM UNNECESSARY REPETITION.

SINCE THIS FOUNDATIONAL TRAINING IS SO ESSENTIAL TOWARDS YOUR MASTERING THE ADVANCED WORK WHICH IS YET TO COME, WE MOST URGENTLY ADVISE YOU TO CONDUCT A SYSTEMATIC REVIEW OF ALL STUDY MATERIAL WHICH YOU NOW HAVE ON HAND. THIS GENERAL REVIEW SHOULD BE THOROUGH, FOR AFTER ALL IT ISN'T A QUESTION OF HOW MANY DIFFERENT RADIO SUBJECTS YOU READ ABOUT DURING THIS PERIOD OF YOUR TRAINING OR WHAT YOU SHOULD KNOW BUT WHAT YOU ACTUALLY REMEMBER ABOUT THEM NOW.

YOUR REVIEW

THE PLAN TO FOLLOW DURING THIS REVIEW IS TO START AT THE FIRST LESSON OF THE COURSE. READ THE TITLE OF THE LESSON AND THEN READ EACH OF THE SUB-TITLES OF THE LESSON CAREFULLY ONE AT A TIME AND AS YOU DO SO, PAUSE

FOR AN INSTANT AND ASK YOURSELF THIS QUESTION - "DO I REMEMBER THE IMPORTANT FACTS INCLUDED IN THIS SECTION OF THE LESSON?" -- IF YOU DO, FINE. THEN CONTINUE WITH THE NEXT SUB-TITLE IN THE SAME MANNER ETC. UNTIL YOU HAVE GLANCED THROUGH THE ENTIRE LESSON.

THE INSTANT YOU COME TO A SUB-TITLE FOR SOME SECTION OF A LESSON TREATING WITH A SUBJECT WHICH YOU CANNOT TRUTHFULLY ADMIT AS REMEMBERING, THEN READ THIS PART OF THE LESSON CAREFULLY UNTIL YOU ARE CERTAIN THAT YOU HAVE MASTERED IT. CONTINUE IN THIS MANNER THROUGH ONE LESSON AT A TIME. BY ALL MEANS, DON'T RUSH THROUGH THIS WORK -- YOU ARE THE ONE WHO IS GOING TO BENEFIT BY THIS GENERAL REVIEW, SO BE FAIR TO YOURSELF IN CONDUCTING THIS WORK CONSCIENTIOUSLY. EVEN IF IT TAKES YOU A WEEK OR TWO TO COMPLETE THIS REVIEW, THIS IS NO LOSS OF TIME -- ON THE CONTRARY, YOU ARE SIMPLY SPENDING A COMPARATIVELY LITTLE TIME NOW IN CHECKING UP ON YOUR KNOWLEDGE AND WHICH WILL WITHOUT A DOUBT SAVE YOU A GREAT DEAL OF TIME IN THE FUTURE IF YOU HAVE TO SUDDENLY LOOK UP SOMETHING WHICH YOU SHOULD HAVE REMEMBERED.

SO AS TO BE SURE THAT YOU ARE GETTING THE FULL VALUE FROM YOUR REVIEW, WE ARE REQUESTING YOU TO ANSWER COMPLETELY EACH OF THE QUESTIONS WHICH ARE INCLUDED IN THE SPECIAL EXAMINATION AT THE LATTER PART OF THIS MESSAGE. THIS EXAMINATION IS BASED UPON THE ENTIRE FOUNDATIONAL TRAINING AND IT IS IMPERATIVE THAT YOU RECEIVE A PASSING GRADE UPON IT BEFORE CONTINUING WITH YOUR ADVANCED WORK.

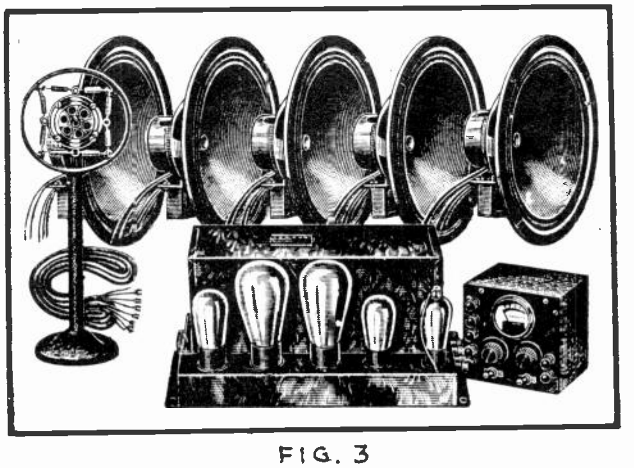


FIG. 3
Amplifying Systems -- A Most Fascinating Division of Radio.

YOUR ADVANCED TRAINING

YOUR ADVANCED TRAINING IS DIVIDED INTO FIVE GENERAL GROUPS OR DIVISIONS AND WHICH ARE CLASSIFIED AS "RADIO TRANSMISSION"; "PUBLIC ADDRESS SYSTEMS"; "TALKING PICTURES"; "TELEVISION" AND "PHOTO-ELECTRIC CELLS". AS YOU WILL IMMEDIATELY REALIZE, THESE ARE ALL INDIVIDUAL AND HIGHLY SPECIALIZED FIELDS OF THE RADIO INDUSTRY.

EACH OF THESE DIVISIONS ARE TREATED SEPARATELY AND IN THEIR PROPER ORDER. YOU DON'T STUDY ONE SUBJECT FOR A LITTLE WHILE AND THEN JUMP TO ANOTHER SPASMODICALLY BUT YOU START A SUBJECT AND FINISH IT AND THEN PROCEED WITH THE NEXT ETC. THERE IS ABSOLUTELY NO MIX-UP IN SUBJECT MATTER TO CAUSE CONFUSION ON YOUR PART.

YOU WILL FIND THESE DISTINCT DIVISIONS OF ADVANCED STUDY TO BE AN OUTSTANDING FEATURE OF NATIONAL TRAINING.

LET US NOW BRIEFLY CONSIDER WHAT YOU CAN HOPE TO ACCOMPLISH UPON COMPLETING YOUR FOLLOWING STUDIES PERTAINING TO THE ADVANCED SPECIALIZED FIELDS.

RADIO TRANSMISSION

WHEN YOU HAVE FINISHED YOUR STUDIES IN THIS DIVISION, YOU WILL HAVE

THE NECESSARY KNOWLEDGE TO ENABLE YOU TO BECOME A COMMERCIAL RADIO OPERATOR IN SHIP SERVICE, AERONAUTICAL SERVICE, POLICE SERVICE OR AS AN OPERATOR IN A BROADCASTING STATION. YOU WILL ALSO BE ABLE TO SERVICE ALL OF THIS EQUIPMENT AND LATER AS YOU ACQUIRE ADDITIONAL EXPERIENCE IN THIS PARTICULAR FIELD, YOU MAY QUALIFY AS AN ENGINEER AND DESIGNER.

BROADCASTING STATIONS, IN ADDITION TO REQUIRING THE SERVICES OF OPERATORS, ALSO NEED STUDIO TECHNICIANS, MONITORING MEN, AND AN ENGINEER IN CHARGE. ALL OF THESE MEN SHOULD HAVE THE TYPE OF TRAINING YOU ARE RECEIVING AND ALL OF THESE POSITIONS OFFER YOU UNLIMITED OPPORTUNITIES.

PUBLIC ADDRESS SYSTEMS

PUBLIC ADDRESS INSTALLATIONS ARE BECOMING INCREASINGLY POPULAR SO THAT THIS HAS BECOME A MOST PROFITABLE FIELD. YOUR STUDIES IN THIS DIVISION WILL FURNISH YOU WITH THE NECESSARY KNOWLEDGE TO CONSTRUCT, AND OPERATE EQUIPMENT OF THIS TYPE FOR PORTABLE USE, AS WELL AS TO MAKE PERMANENT INSTALLATIONS.

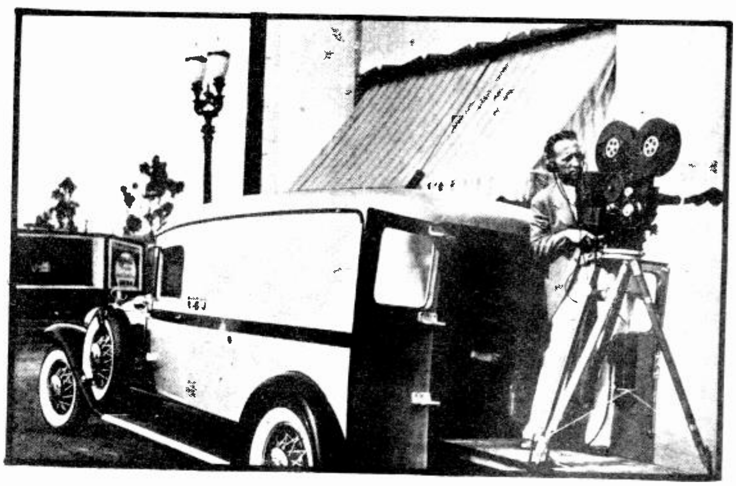


FIG. 4
Specialized Training Essential For Talking Picture Technicians.

MANY OF THE PUBLIC ADDRESS INSTALLATIONS PRESENT DIFFICULT PROBLEMS WHICH ONLY A MAN SPECIALLY TRAINED FOR THIS WORK CAN HANDLE SUCCESSFULLY. THESE PROBLEMS AND THE MOST EFFECTIVE MEANS OF SOLVING THEM WILL ALL BE BROUGHT TO YOUR ATTENTION.

ALL OF THE POPULAR AMPLIFYING CIRCUITS WILL BE FULLY EXPLAINED FROM A PRACTICAL AS WELL AS A TECHNICAL STANDPOINT.

TALKING PICTURES

THE TALKING PICTURE INDUSTRY ALONE REQUIRES THOUSANDS OF SKILLED TECHNICIANS TO CONSTRUCT, INSTALL, OPERATE AND SERVICE TALKING PICTURE EQUIPMENT FOR THEATERS, AS WELL AS TO CONSTRUCT, INSTALL, OPERATE AND SERVICE RECORDING EQUIPMENT IN THE STUDIOS. TALKING PICTURE EQUIPMENT IS RAPIDLY BEING ADAPTED BY SCHOOLS TO PROVIDE THEIR STUDENTS WITH INSTRUCTIVE PICTURES AND PORTABLE TALKING PICTURE EQUIPMENT IS NOW IN GREATER DEMAND THAN EVER BEFORE -- ALL OF THIS ACTIVITY MEANS MORE JOBS FOR THOSE MEN WHO ARE QUALIFIED TO HANDLE THEM.

THIS IS A LARGE AND MOST PROFITABLE FIELD FOR THE TRAINED MAN AND YOU WILL FIND YOUR INSTRUCTION UNDER THIS DIVISION TO ENABLE YOU TO TAKE ADVANTAGE OF ANY ONE OF THE GREAT MANY OPPORTUNITIES WHICH THIS GREAT FIELD OF RADIO HAS TO OFFER.

TELEVISION

YOUR TRAINING IN TELEVISION PREPARES YOU FOR THE FUTURE. ALTHOUGH

MANY TELEVISION STATIONS ARE ALREADY OPERATING ON REGULAR SCHEDULE AND BEING RECEIVED BY TELEVISION FANS, YET THIS BRANCH OF RADIO IS STILL IN ITS INFANCY AS COMPARED TO THE OTHER ALREADY HIGHLY DEVELOPED DIVISIONS.

TELEVISION IS THE THING FOR THE MAN WHO IS PLANNING AHEAD. THIS FIELD IS WAITING FOR NEW TALENT, CAPABLE OF ASSISTING IN THE DEVELOPMENT OF NEW EQUIPMENT, FOR THE EXPERIMENTER AND THE RESEARCH WORKER. TELEVISION IS BOUND TO BECOME A MOST POPULAR FORM OF ENTERTAINMENT IN THE NEAR FUTURE AND THE MEN WHO ARE GOING TO SHARE THE GREATEST PORTION OF THE PROFITS BROUGHT ABOUT BY THIS COMING INDUSTRY ARE THOSE WHO ARE PREPARING THEMSELVES NOW SO AS TO GET IN ON THE GROUND FLOOR.

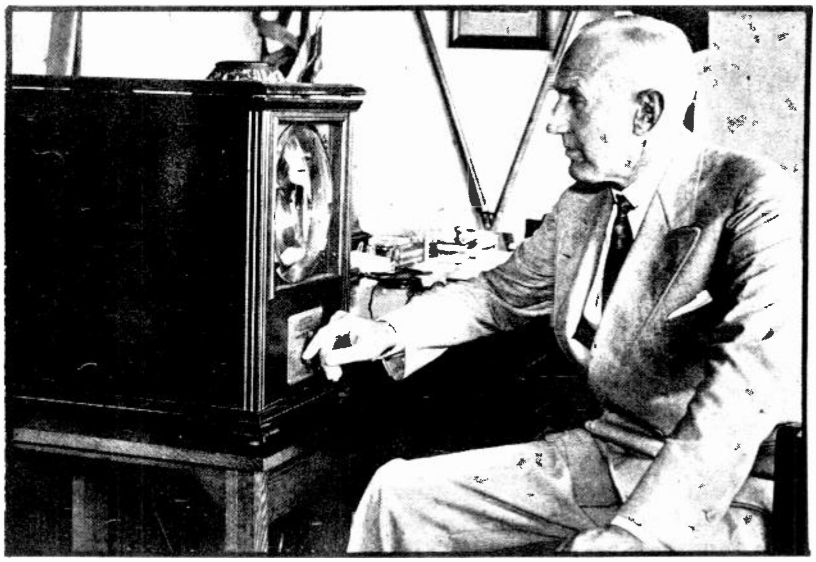


FIG. 5
Television - The Industry of Tomorrow.

YOU WILL FIND NATIONALS' INSTRUCTION IN TELEVISION TO PROVIDE YOU WITH A MOST THOROUGH KNOWLEDGE OF THIS SUBJECT SO THAT YOU WILL BECOME THOROUGHLY FAMILIAR WITH EVERY SUBJECT PERTAINING TO THIS FASCINATING BRANCH OF RADIO.

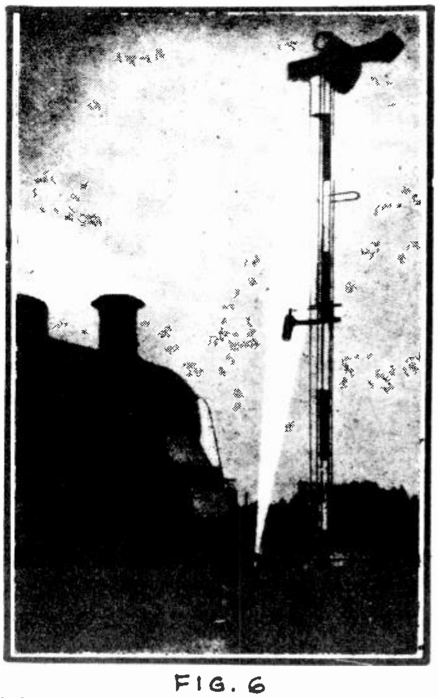


FIG. 6
Typical Application of the Photo Electric Cell.

PHOTO-ELECTRIC CELLS

CONTINUALLY, INDUSTRY IS FINDING NEW APPLICATIONS FOR THE PHOTO-ELECTRIC CELL OR "ELECTRIC-EYE" AS IT IS FREQUENTLY CALLED. THIS MARVELOUS DEVICE IS BEING USED IN A COUNTLESS NUMBER OF DIFFERENT WAYS FOR INDUSTRIAL PURPOSES, SUCH AS IN AUTOMATIC COUNTERS, ALARM SYSTEMS, SMOKE DETECTORS, COLOR ANALYZERS, PROTECTIVE DEVICES ETC.

EVERY ONE OF THESE MANY APPLICATIONS ARE BASED ENTIRELY UPON RADIO PRINCIPLES AND THE WORK ASSOCIATED WITH THIS EQUIPMENT IS CONFINED SOLELY TO THE RADIO MAN WITH SPECIALIZED TRAINING IN THIS FIELD SUCH AS YOU ARE RECEIVING.

WHEN YOU LOOK BACK AND CONSIDER WHAT YOU HAVE ALREADY LEARNED ABOUT RADIO THROUGH NATIONALS' SYSTEM OF TRAINING AND THEN LOOK AHEAD TO THE INSTRUCTION WHICH IS STILL IN STORE FOR YOU, YOU CANNOT HELP BUT REALIZE THE TREMENDOUS OPPORTUNITIES WHICH NATIONAL TRAIN ing is extending to you.

Upon completion of your training, you may select the branch of Radio in which you will specialize — Radio Service or Construction, Broadcasting or Commercial Transmission, Talking Pictures, Public Address Work, Television, Photo-Electric Cells or any other line of work associated with Radio.

Before you start this advanced work, we again caution you against rushing through your studies. From a financial standpoint, it is obvious that we would realize greater profits by forcing our students through this training program as quickly as possible but such a practice would be unfair to the student and is therefore not a policy of National.

This institution has offered residence training for over thirty years and not only have ambitious men come from all parts of the United States to take advantage of National's Time Tested Training but practically every country on the Globe has been represented in its Student Body. These many years of experience in vocational training have conclusively proved to us that our most successful graduates are those, who as students, progressed through their studies at a reasonable rate rather than centering their interest upon the rapidity with which they could complete the course.

Our Extension Training is by no means an ordinary correspondence course but is modeled after our Residence Curriculum where we have had the opportunity to personally supervise the instruction of every type of student. We are therefore offering you through the Extension Method the same high class form of instruction which you would receive as a student in our Residence Division and where every effort is made to offer the best type of instruction possible.

Although the lessons which are to come are of an advanced nature, yet we know that you are going to find them exceedingly interesting and to contain the type of information which will enable you to attain outstanding success in Radio or any of its branches.

Special Examination # 6

1. – Draw a circuit diagram of a six-tube T.R.F. receiver which is to be operated from an A.C. lighting supply. This receiver is to employ type -58 tubes in three R.F. stages, a -57 power detector, a 2A5 power amplifier and an -80 rectifier. This receiver is to be operated with a dynamic speaker whose 2500 ohm field coil is to be used as the only filter choke. This diagram is to be complete with power pack and the values of all resistors and condensers plainly marked.

2. – It is desired to wind the secondary winding of an R.F. transformer with #28 B&S enameled wire on a tubular-shaped cardboard form having a diameter of $1\frac{1}{2}$". This winding is to cover a frequency band of 540 to 1570 Kc. when tuned by a condenser having a rating of .00035 mfd. How many turns of wire should be used for this winding?

3. – Draw a circuit diagram of an A.C. operated superheterodyne receiver having the following features: One preselector R.F. stage using a type 58 tube; a first detector stage using a 58 tube; an oscillator using a 56 tube and two I.F. stages each employing type 58 tubes. The second detector is to be a 2A6 used simultaneously as a half-wave diode detector as an A.F. amplifier and to supply automatic volume control energy to the two I.F. stages, as well as to its own grid circuit. This second detector is to be followed by a push-pull power amplifier stage employing a pair of 2A5's. A dynamic speaker is to be used having a field coil of 2500 ohm resistance rating and which is to serve as the second filter choke of the power pack. The speaker field is to be preceded in the filter system by a choke of 30 henry rating.

   This diagram is to be complete and with the values of all resistors and condensers clearly marked.

4. – A certain milliammeter has an internal resistance of 27 ohms and a scale calibrated from 0 to 1 ma. It is desired to use this meter as a multi-range milliammeter and voltmeter having the following ranges: 0-1-10-100-200 milliamperes and 0-10-100-200-400 volts D.C. Supply complete constructional data for building a test unit which will meet the requirements called for.

5. – If an inductance of 250 microhenries is connected in series with a condenser of .0005 mfd., to what frequency will this combination resonate? What will be the corresponding wavelength?

6. – If a certain A.C. receiver is inoperative but all tube filaments light and the plates of the -80 tube take on a red color when the switch is turned on, what is the most likely cause for the trouble?

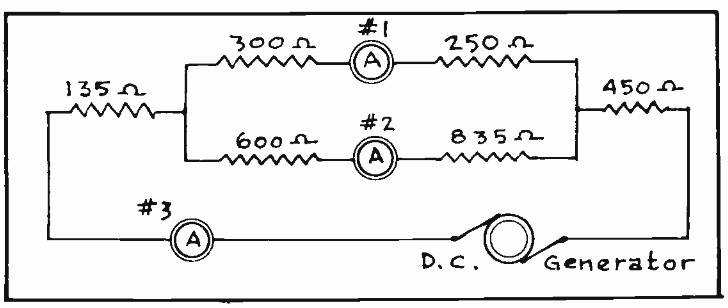
7. – If a certain superheterodyne radio-phonograph combination has the pick-up unit connected to the second detector tube through an impedance matching transformer and volume control, and phonograph reproduction is entirely satisfactory but radio reception is impossible, then where would you look to locate the trouble?

8. - A choke coil having an inductance value of 30 henries and a D.C. resistance of 100 ohms is connected in series with two condensers, each of which has a capacity rating of 4 mfd. What impedance will this arrangement offer to a 120 cycle current? What will be the power factor of this circuit?

9. - In order to deliver an output power of 3 watts, the recommended plate circuit load for the 2A5 tube is 7000 ohms. If two of these tubes are used in a push-pull power stage and are to be coupled to a dynamic speaker whose voice coil has an impedance rating of 8 ohms, then what turns ratio should be employed on the output or speaker coupling transformer?

10.- What rule can be applied in order to determine the capacitive rating of a condenser which is to be used for by-passing purposes around a resistor in an R.F. or A.F. circuit?

11.- What is the total or combined resistance of the circuit which is here illustrated? What value of current flow will the ammeter #1; #2 and #3 each indicate if the generator voltage is 650 volts? Show all calculations in your answers to this problem.



12.- Describe in detail how you would completely align a superheterodyne receiver which employs three I.F. transformers, a padded oscillator circuit, and a single tuned R.F. stage preceding the first detector tube (the tuning condenser is of the conventional three gang type).

13.- A certain superheterodyne receiver fails to reproduce any broadcast signals, and yet upon conducting an analyzer test at all tube sockets, the readings are found to be correct. Explain in detail how you can determine whether the trouble is located in the A.F. amplifier system, I.F. amplifier system, first detector stage, pre- selector stage or in the oscillator circuit.

14.- How can you determine the mutual inductance between two coils by measurement? Having determined this value, how can the coefficient of coupling be determined by calculation?

15.- The winding of a certain tuned circuit in an R.F. amplifier has an inductance of 280 microhenries and the D.C. resistance of the tuning circuit is 10 ohms. What will be the width of the resonance curve for this circuit at a point equivalent to .707 times the current at resonance, if the resonant frequency is 850 Kc.?

PRACTICAL RADIO JOB SHEET

NO. 1

SPECIALLY PREPARED FOR THE STUDENTS OF

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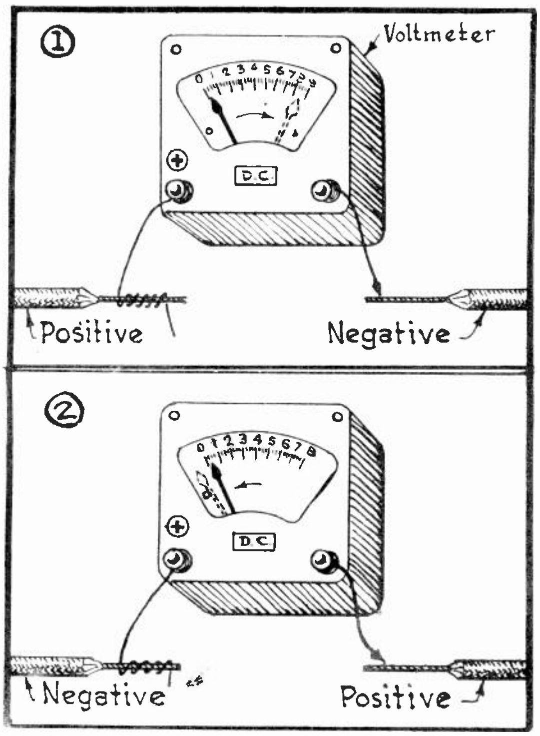
Los Angeles California

DETERMINING POLARITY OF D.C. CIRCUITS

WHEN ENGAGED IN RADIO WORK, THE OCCASSION FREQUENTLY ARISES WHERE IT BECOMES NECESSARY TO DETERMINE WHICH SIDE OF A D.C. (DIRECT CURRENT) CIRCUIT IS "POSITIVE" AND WHICH "NEGATIVE". THIS CAN BE DETERMINED THROUGH THE USE OF EITHER A D.C. VOLTMETER OR BY MEANS OF ELECTROLYSIS IN THE MANNER NOW TO BE EXPLAINED.

THE VOLTMETER METHOD

1. - USE A D.C. TYPE VOLTMETER WHOSE SCALE RANGE IS SUFFICIENTLY GREAT TO INDICATE THE VOLTAGE OF THE CIRCUIT UNDER TEST.



Voltmeter Method.

2. - CONNECT ONE TEST LEAD TO THE POSITIVE OR (+) TERMINAL OF THE VOLTMETER AND A SECOND TEST LEAD TO THE OTHER VOLTMETER TERMINAL AS SHOWN IN FIG. 1.

3. - TOUCH THE TWO TEST POINTS TO THE TWO SIDES OF THE CIRCUIT UNDER TEST AS ALSO SHOWN IN FIG. 1 AND NOTE THE MOVEMENT OF THE METER NEEDLE AS YOU DO SO. THIS CONNECTION SHOULD BE COMPLETED FOR ONLY AN INSTANT SO AS TO AVOID DAMAGING THE VOLTMETER IN CASE THAT THE NEEDLE SWINGS OFF ITS SCALE TOWARDS THE LEFT OF THE ZERO MARK.

4. - SHOULD THE VOLTMETER NEEDLE SWING OFF ITS SCALE TOWARDS THE LEFT OF ZERO AS IN FIG. 2, THEN THE TEST INDICATES THAT THE POSITIVE OR (+) TERMINAL OF THE VOLTMETER IS CONNECTED TO THE NEGATIVE SIDE OF THE CIRCUIT UNDER TEST. ON THE OTHER HAND, IF THE METER NEEDLE SWINGS ACROSS ITS SCALE TOWARDS THE RIGHT OR IN ITS NORMAL DIRECTION, AS IN FIG. 1, THEN THE TEST INDICATES THAT THE POSITIVE OR (+) TERMINAL OF THE VOLTMETER IS CONNECTED TO THE POSITIVE SIDE OF THE CIRCUIT UNDER TEST. THE OTHER SIDE OF THE CIRCUIT WILL THEN NATURALLY BE THE NEGATIVE SIDE.

THE ELECTROLYSIS METHOD

IF NO D.C. VOLTMETER IS AVAILABLE, THEN THE UNKNOWN LINE POLARITY CAN BE DETERMINED THROUGH THE PRINCIPLE OF ELECTROLYSIS AS ILLUSTRATED IN

(OVER)

FIG. 3. IN THIS CASE, PROCEED AS FOLLOWS:

1. – CONNECT A PAIR OF TEST LEADS ACROSS THE CIRCUIT UNDER TEST AND SUBMERGE THE FREE ENDS OF THE TEST LEADS IN A GLASS OF WATER TO WHICH A LITTLE TABLE SALT HAS BEEN ADDED. AN ALTERNATIVE IS TO SUBMERGE THE BARED COPPER ENDS OF THE CIRCUIT WIRES DIRECTLY INTO THE SALT WATER.

2. – USE CARE THAT THE TWO BARE ENDS OF THE WIRE OR TEST POINTS, WHICH ARE SUBMERGED IN THE SALT WATER, ARE NOT PLACED TOO CLOSE TOGETHER SO AS TO FORM A SHORT CIRCUIT AND WATCH FOR THE FORMATION OF BUBBLES. THE WIRE OR TEST LEAD, AROUND WHICH THE MOST BUBBLES ARE PRODUCED, CORRESPONDS TO THE NEGATIVE SIDE OF THE CIRCUIT.

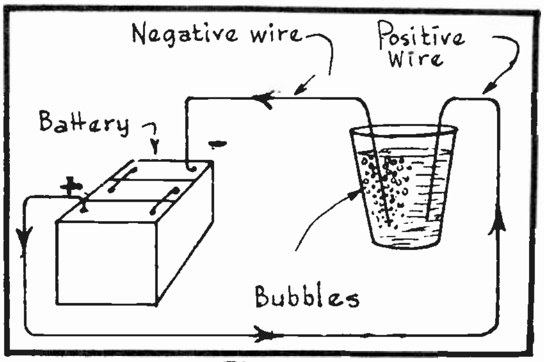


Fig. 3
Electrolysis Method.

3. – WHEN HANDLING WIRES ACROSS WHICH CONSIDERABLE VOLTAGE EXISTS, ALWAYS BE SURE NEVER TO GRASP THE BARE WIRES AT ANY TIME DURING ANY TEST WHILE THE CIRCUIT IS "ALIVE". ONLY GRASP THE INSULATIVE MATERIAL WHICH YOU ARE CERTAIN AS BEING ADEQUATE TO PREVENT YOUR RECEIVING AN ELECTRIC SHOCK.

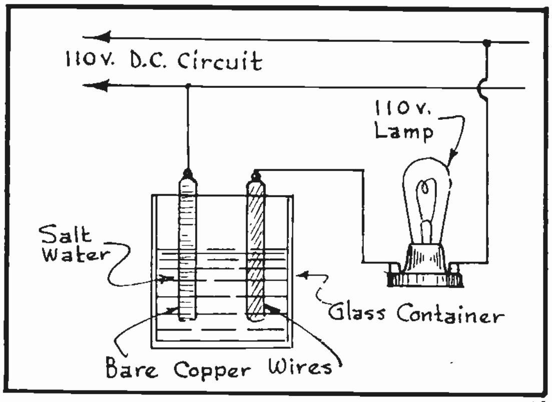


Fig. 4
Limiting The Current Flow.

4. – WHENEVER TESTING CIRCUITS, WHICH HANDLE VOLTAGE OF 110 VOLTS AND UP, A LAMP SHOULD BE CONNECTED IN SERIES WITH THE CIRCUIT BEING TESTED AND THE ELECTROLYTIC POLARITY INDICATOR AS SHOWN IN FIG.4. THE LAMP WILL THUS ACT AS A RESISTANCE AND THEREBY PREVENT SHORT CIRCUITS AND DISASTROUS ACCIDENTS. FOR A 110 VOLT CIRCUIT, A 110 VOLT LAMP SHOULD BE USED AND FOR A 220 VOLT CIRCUIT, A 220 VOLT LAMP. THE LAMP IN EITHER CASE MAY BE RATED AT ABOUT 40 WATTS.

5. – ALL PARTS OUTSIDE OF THE SALT WATER IN THE GLASS CONTAINER SHOULD BE MAINTAINED IN A PERFECTLY DRY CONDITION WHEN USING THIS TESTER, AS SHOULD ALSO THE HANDS OF THE OPERATOR SO AS TO REDUCE TO A MINIMUM THE POSSIBILITY OF RECEIVING AN ELECTRIC SHOCK.

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PRACTICAL RADIO JOB SHEET

NO. 2

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

HOW TO DETERMINE IF A GIVEN CIRCUIT IS OF A.C OR D.C. TYPE

PARTICULARLY WHEN A RECEIVER IS TO BE INSTALLED, THE QUESTION OFTEN ARISES AS TO WHETHER THE CIRCUIT FROM WHICH IT IS TO BE OPERATED IS OF THE A.C. OR D.C. TYPE. IT IS OF COURSE TRUE THAT THIS INFORMATION CAN BE OBTAINED FROM THE POWER COMPANY OR BY READING THE DATA SUPPLIED ON THE SPECIFICATION PLATE OF SOME OTHER ELECTRICAL APPARATUS SUCH AS A VACUUM CLEANER, WASHING MACHINE ETC. WHICH IS BEING OPERATED FROM THE SAME CIRCUIT, OR EVEN FROM THE COMPANY METER AT THE SERVICE ENTRANCE. IN THIS JOB SHEET, HOWEVER, A SIMPLE BUT PRACTICAL TEST IS DESCRIBED WHICH WILL DEFINITELY DEMONSTRATE WHETHER THE CIRCUIT IN QUESTION IS OF THE A.C. OR D.C. TYPE. THE TEST SHOULD BE CONDUCTED IN THE FOLLOWING ORDER:

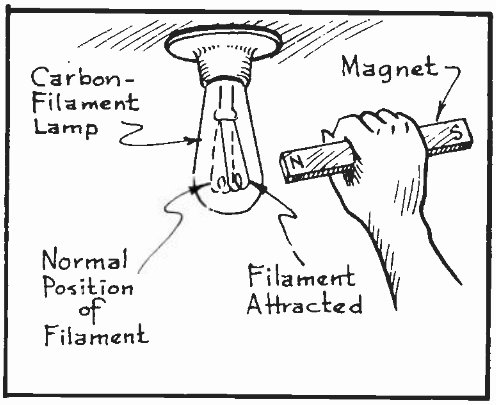

Fig. 1
The D.C. Indication.

1. – SCREW A CARBON-FILAMENT LAMP INTO A SOCKET WHICH IS CONNECTED ACROSS THE CIRCUIT TO BE TESTED. WHEN THE LAMP FILAMENT IS HEATED TO INCANDESCENCE, THE FILAMENT WILL BE NOTED TO REMAIN AT REST AT THE APPROXIMATE CENTER OF THE GLASS BULB.

2. – NOW SLOWLY MOVE A PERMANENT MAGNET (EITHER A BAR OR HORSESHOE TYPE) TOWARDS THE LAMP AS ILLUSTRATED IN FIG. 1 AND CAREFULLY NOTE THE REACTION UPON THE LAMP FILAMENT.

3. – IF THE MAGNET ATTRACTS THE LAMP FILAMENT AS SHOWN IN FIG. 1, THEN THE TEST DEMONSTRATES THAT THE CIRCUIT IN QUESTION IS OF THE D.C. TYPE.

4. – SHOULD THE LAMP FILAMENT UNDERGO A VIBRATIONAL MOVEMENT AS SHOWN IN FIG. 2 WHEN THE MAGNET IS SLOWLY BROUGHT TOWARDS IT, THEN THE TEST DEMONSTRATES THAT AN ALTERNATING CURRENT IS FLOWING THROUGH THE CIRCUIT.

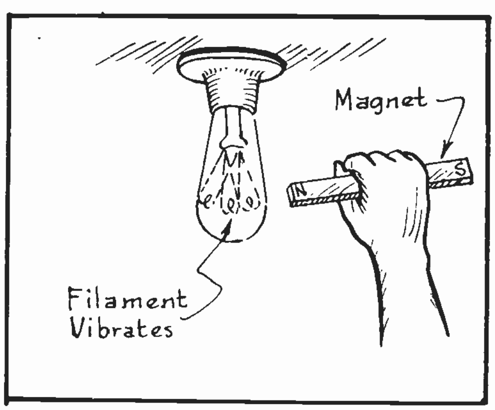

Fig. 2
The A.C. Indication.

5. – IT IS IMPORTANT TO NOTE THAT A CARBON-FILAMENT TYPE LAMP IS SPECIFIED FOR THIS TEST. THE REASON FOR THIS IS THAT THE FILAMENT IN THIS TYPE

(OVER)

OF LAMP IS NOT SO RIGIDLY SUPPORTED AS IN THE TUNGSTEN-FILAMENT LAMPS AND CAN THEREFORE RESPOND TO MOVEMENT MORE READILY WHEN ACTED UPON BY A MAGNETIC FIELD. ALSO BEAR IN MIND THAT WHEN THE TEST IS MADE ON AN A.C. CIRCUIT, THE MAGNET SHOULD NOT BE BROUGHT TOO NEAR THE LAMP AS EXCESSIVE VIBRATION OF THE FILAMENT WILL CAUSE IT TO BREAK AND THEREBY DESTROY THE LAMP.

VOLTMETER INDICATION

IF A DIRECT-CURRENT, PERMANENT MAGNET TYPE VOLTMETER IS AVAILABLE, IT WILL ALSO SERVE TO INDICATE WHETHER THE CIRCUIT IN QUESTION IS OF THE A.C. OR D.C. TYPE. IN THIS CASE, THE TEST SHOULD BE PERFORMED AS FOLLOWS:

1. FIRST MAKE SURE THAT THE RANGE OF THE VOLTMETER IS GREAT ENOUGH TO STAND THE VOLTAGE OF THE CIRCUIT ACROSS WHICH THE TEST IS TO BE MADE.

2. CONNECT THE VOLTMETER ACROSS THE CIRCUIT MOMENTARILY AS ILLUSTRATED IN FIG. 3. SHOULD THE NEEDLE TEND TO SWING OFF ITS SCALE TOWARDS THE LEFT OF THE ZERO MARK, THEN REVERSE THE CONNECTIONS.

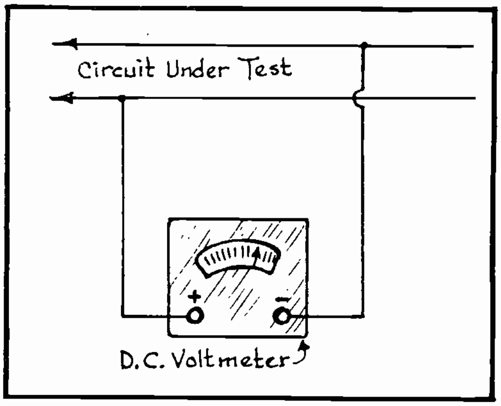

Fig. 3
The Voltmeter Test.

3. IF THE CIRCUIT IN QUESTION HAPPENS TO BE OF THE D.C. TYPE, THEN THE METER WILL OFFER A STEADY READING AND INDICATE THE VOLTAGE OF THE CIRCUIT IN THE NORMAL MANNER.

4. SHOULD THE CIRCUIT IN QUESTION BE OF THE A.C. TYPE, THEN THE VOLTMETER NEEDLE WILL VIBRATE SLIGHTLY.

5. WHEN CONDUCTING THIS TEST, IT IS NOT NECESSARY TO LEAVE THE VOLTMETER CONNECTED TO THE CIRCUIT FOR ANY APPRECIABLE LENGTH OF TIME. THE DESIRED INDICATION CAN BE OBTAINED AT A GLANCE.

PRACTICAL RADIO JOB SHEET

NO. 3

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

DIMENSION, WEIGHT & RESISTANCE OF BARE SOLID COPPER WIRE

(Brown & Sharpe Gauge)

B&S WIRE SIZE	DIAM. IN MILS. AT 20°C.	CROSS-SECTIONAL AREA		WEIGHT LBS. PER 1000 FT.	FEET PER LB.	RESISTANCE OHMS PER 1000 FEET		
		CIRCULAR MILS.	SQUARE INCHES			AT 20°C. 68°F.	AT 25°C. 77°F.	AT 75°C. 167°F.
0000	460.0	211,600.	0.1662	640.5	1.561	0.04901	0.04998	.05961
000	409.6	167,800.	0.1318	507.9	1.968	0.06180	0.06302	0.07516
00	364.8	133,100.	0.1045	402.8	2.482	0.07793	0.07947	0.09478
0	324.9	105,500.	0.08289	319.5	3.130	0.09827	0.10020	0.11950
1	289.3	83,640.	0.06573	253.3	3.947	0.12390	0.12640	0.15070
2	257.6	66,370.	0.05213	200.9	4.977	0.15630	0.15930	0.19000
3	229.4	52,640.	0.04134	159.3	6.276	0.19700	0.20090	0.23560
4	204.3	41,740.	0.03278	126.4	7.914	0.24850	0.25330	0.30220
5	181.9	33,100.	0.02600	100.2	9.980	0.31330	0.31950	0.38100
6	162.0	26,250.	0.02062	79.46	12.58	0.39510	0.40280	0.48050
7	144.3	20,820.	0.01635	63.02	15.87	0.49820	0.50800	0.60590
8	128.5	16,510.	0.01297	49.98	20.01	0.62820	0.64050	0.76400
9	114.4	13,090.	0.01028	39.63	25.23	0.79210	0.80770	0.96330
10	101.9	10,380.	0.00815	31.43	31.82	0.99890	1.018	1.2150
11	90.74	8,234.	0.00646	24.92	40.12	1.260	1.284	1.5320
12	80.81	6,530.	0.00512	19.77	50.59	1.588	1.619	1.9310
13	71.96	5,178.	0.00406	15.68	63.80	2.003	2.042	2.4360
14	64.08	4,107.	0.00322	12.43	80.44	2.525	2.575	3.0710
15	57.07	3,205.	0.00255	9.858	101.4	3.184	3.247	3.8730
16	50.82	2,583.	0.00202	7.818	127.9	4.016	4.094	4.8840
17	45.26	2,048.	0.00160	6.200	161.3	5.064	5.163	6.1580
18	40.30	1,624.	0.00127	4.917	203.4	6.385	6.510	7.7650
19	35.89	1,288	0.00101	3.899	256.5	8.051	8.210	9.7920
20	31.96	1,022.	0.00080	3.092	323.4	10.15	10.35	12.350
21	28.46	810.10	0.00063	2.452	407.8	12.80	13.05	15.570
22	25.35	642.40	0.00050	1.945	514.2	16.14	16.46	19.630
23	22.57	509.50	0.00040	1.542	648.4	20.34	20.76	24.760
24	20.10	404.00	0.00031	1.223	817.4	25.67	26.17	31.220
25	17.90	320.40	0.00025	0.9699	1031.0	32.37	33.00	39.360
26	15.94	254.10	0.00019	0.7692	1300.0	40.81	41.62	49.640
27	14.20	201.50	0.00015	0.6100	1639.0	51.47	52.48	62.590
28	12.64	159.80	0.00012	0.4837	2067.0	64.90	66.17	78.930
29	11.26	126.70	0.00009	0.3836	2607.0	81.83	83.44	99.520
30	10.03	100.50	0.00007	0.3042	3287.0	103.2	105.2	125.50
31	8.928	79.70	0.00006	0.2413	4145.0	130.1	132.7	158.20
32	7.950	63.21	0.00004	0.1913	5227.0	164.1	167.3	199.50
33	7.080	50.13	0.000039	0.1517	6591.0	206.9	211.0	251.60
34	6.305	39.75	0.000031	0.1203	8310.0	260.9	266.0	317.30
35	5.615	31.52	0.000024	0.0954	10480.	329.0	335.5	400.10
36	5.000	25.00	0.000019	0.0756	13210.	414.8	423.0	504.50
37	4.453	19.83	0.000015	0.0600	16660.	523.1	533.4	636.20
38	3.965	15.72	0.000012	0.0475	21010.	659.6	672.6	802.20
39	3.531	12.47	0.000009	0.0377	26500.	831.8	848.1	1012.0
40	3.145	9.88	0.000007	0.0299	33410.	1049	1069	1276.0

PRACTICAL RADIO JOB SHEET

NO. 4

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

ALLOWABLE CARRYING CAPACITIES OF COPPER WIRE AND CABLE

B&S SIZE	CIRCULAR MIL AREA	CURRENT CARRYING CAPACITY		
		RUBBER INSULATION	ENAMELED COTTON COVERED	OTHER INSULATION
18	1,624	3	5	5
16	2,583	6	10	10
14	4,107	15	18	20
12	6,530	20	25	25
10	10,380	25	30	30
8	16,510	35	40	50
6	26,250	50	60	70
5	33,100	55	65	80
4	41,740	70	85	90
3	52,630	80	95	100
2	66,370	90	110	125
1	83,690	100	120	150
0	105,500	125	150	200
00	133,100	150	180	225
000	167,800	175	210	275
	200,000	200	240	300
0000	211,600	225	270	325
	250,000	250	300	350
	300,000	275	330	400
	350,000	300	360	450
	400,000	325	390	500
	500,000	400	480	600
	600,000	450	540	680
	700,000	500	600	760
	800,000	550	660	840
	900,000	600	720	920
	1,000,000	650	780	1,000
	1,000,000	690	830	1,080
	1,200,000	730	880	1,150
	1,300,000	770	920	1,220
	1,400,000	810	970	1,290
	1,500,000	850	1,020	1,360
	1,600,000	890	1,070	1,430
	1,700,000	930	1,120	1,490
	1,800,000	970	1,160	1,550
	1,900,000	1,010	1,210	1,610
	2,000,000	1,050	1,260	1,670

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PRACTICAL RADIO JOB SHEET

NO. 5

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

ALIGNING THE TUNING CIRCUITS OF T.R.F. RECEIVERS – USING BROADCAST SIGNALS

By "aligning" a receiver is meant that the various sections of the gang tuning condenser are all adjusted so that they will tune together or be in synchronism throughout the entire tuning range. This particular Job Sheet offers instructions for doing this work on receivers of the straight "tuned radio-frequency" or T.R.F. type only. Later Job Sheets supply the information for doing this work on Superheterodynes.

Proper alignment will make possible a louder and clearer signal, better tone quality and greater freedom from inter-station interference.

1. – To align the receiver, first tune the set to resonance with the signal of some fairly distant station which is broadcasting at a medium frequency (around 1000 Kc) and set the volume control at the position offering medium signal intensity.

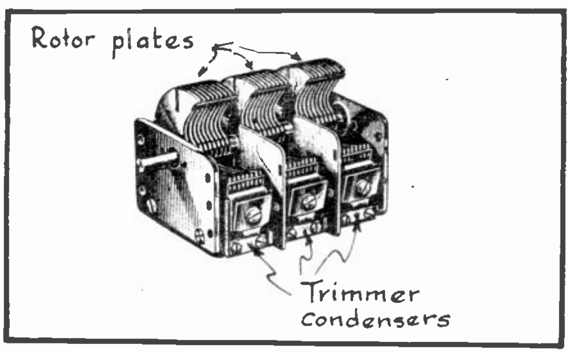

Fig. 1
Three-Gang Tuning Condenser.

2. – With the tuning dial set to the position offering sharpest tuning to this frequency, adjust the compensating or trimmer condenser of the detector stage until loudest signal volume is emitted by the speaker. These trimmers should be adjusted with either a bakelite screw-driver or bakelite wrench, whichever is suitable for the particular design. Do NOT alter the position of either the tuning or volume control while making the aligning adjustments.

3. – The trimmers of the following stages are then each adjusted in turn and set for the loudest speaker signal in the same manner as just described.

4. – After this average setting has been made for all sections of the tuning condenser, tune-in another signal at the high frequency end of the dial or at about the 1400 Kc. position. If slotted rotor plates are employed on the condenser, then bend the last segment of the trailing end of each condenser section slightly one way or the other until each section is adjusted for maximum volume.

This plate segment would correspond to segment #1 as pointed out in Fig.2 and which will be found on the outer rotor plates in each section of modern gang condensers.

(OVER)

5. - Tune in signals at 1100 - 850 - 700 - 600 and 550 Kc. each in turn and at each setting, bend for loudest signal the last slotted segment of each rotor plate group which came into mesh with the statorplates as the position of the rotor plates was changed.

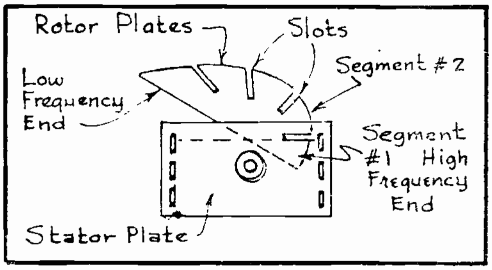

Fig. 2
Provisions For Bending Plates.

In other words, as the dial settings are gradually changed from the higher to the lower frequencies, rotor plate segments #2 as per Fig. 2 will be adjusted at each section as they follow segments #1 into mesh with the stator plate groups etc., until the final segments at the other extreme position have been adjusted for the lowest frequency settings.

6. - Upon completion of this job, the receiver will be properly aligned throughout its range of tuning and as a final check, stations at various frequencies can be tuned in and the performance of the receiver carefully noted. Any additional adjustment which may be found necessary can then be made.

ALIGNING RECEIVER WITH SERVICE OSCILLATOR

Instead of using a broadcast signal for aligning purposes, the use of a modulated R.F. service oscillator, or signal generator, offers a more accurate method for making the aligning adjustments. This is done in the following order:

1. Disconnect the antenna and ground wires from the receiver.

2. Connect the "antenna" terminal of the service osicllator to the antenna terminal of the receiver and the "ground" terminal of the service oscillator to the ground terminal of the receiver, as shown in Fig. 3.

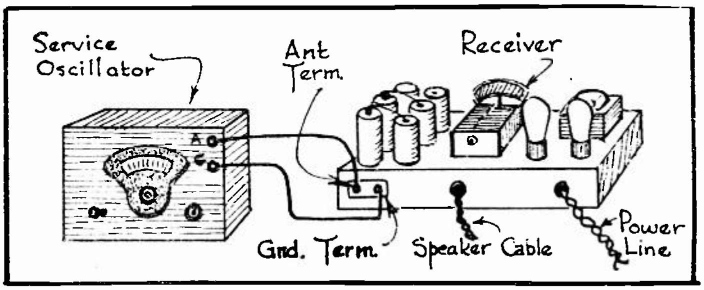

Fig. 3
Set-Up For Aligning Receiver With Service Oscillator.

3. Place the oscillator and receiver in operation, adjust the oscillator to produce a 1000 Kc. signal and tune in this signal on the receiver and adjust the volume control for medium oscillator signal through the loud speaker.

4. Adjust the receiver's tuned circuits for maximum signal in the same order as already described when using a broadcast signal for this purpose.

5. Tune the service oscillator and receiver in turn to 1400-1100-850 - 700 - 600 and 550 Kc. and adjust the tuned circuits for maximum signals in the same manner as already explained when using a broadcast signal for this purpose.

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PRACTICAL RADIO JOB SHEET

NO. 6

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

NEUTRALIZING THE R.F. STAGES OF RADIO RECEIVERS

By neutralization is meant the process of counteracting the regenerative feed back, which flows from the plate to grid circuits in R.F. stages, in which tubes of the non-screen grid type are used.

If an adjustment of this nature is necessary, it will make itself known by the fact that the receiver, when in operation, will oscillate and thereby cause squealing sounds to be emitted from the speaker.

1. - To make a neutralizing adjustment, you can either use the signal energy supplied by a broadcasting station or else the output of a modulated oscillator. The latter is preferable.

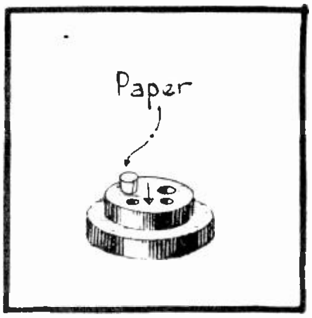

Fig. 1
Insulating The Filament Prong.

2. - Tune the receiver to a signal frequency of about 1400 Kc. and set the volume control at its loudest position.

3. - Remove the R.F. tube preceding the detector and insert a piece of paper into one of the filament holes of this tube's socket, as shown in Fig. 1, so that one filament prong of the tube will be insulated from the socket contact when the bulb is again inserted, thus preventing the filament from burning.

4. - Insert the tube in its socket, leaving the paper sleeve undisturbed and note that its filament doesn't burn. Be sure that you do not disturb the setting of neither the volume or tuning control during this work and only use the switch as a means of starting or stopping the receiver's operation, or else connect and disconnect the receiver from the line in order to start and stop it.

5. - With this "dead" tube inserted in its socket, no sound should come from the speaker. If a sound is heard, then adjust the neutralizing condenser for this stage by means of a bakelite screw driver. With a proper adjustment obtained, no signal should be heard at the speaker. Having neutralized this R.F. stage, open the switch, remove the tube and paper and re-insert the tube in its socket.

6. - Now perform the same adjusting process with the R.F. tube preceding the last R.F. tube, and gradually carry out this work until you have finally adjusted the first R.F. stage in like manner. Each R.F. stage is thus neutralized in consecutive order from the one preceding the detector towards the antenna.

7. - Remember, that the volume and tuning control settings should not under any conditions be disturbed from their original setting until

(OVER)

THE ENTIRE RECEIVER IS NEUTRALIZED.

8. – WHEN NEUTRALIZING THE R.F. STAGES OF A RECEIVER IN WHICH THE FILAMENTS OF THE VARIOUS R.F. TUBES ARE CONNECTED IN SERIES INSTEAD OF PARALLEL, THEN THE FILAMENT OF THE TUBE BEING NEUTRALIZED CAN BEPREVENTED FROM BURNING BY SHORTING ITS FILAMENT PRONGS CLOSE TO THE TUBE BASEBY MEANS OF A FAIRLY THIN PIECE OF WIRE AS SHOWN IN FIG.2. THIS WILL STILL PERMIT THE TUBE TO BE INSERTED INTO ITS SOCKET,AT THE SAME TIME PUTTING THE FILAMENT OUT OF COMMISSION.

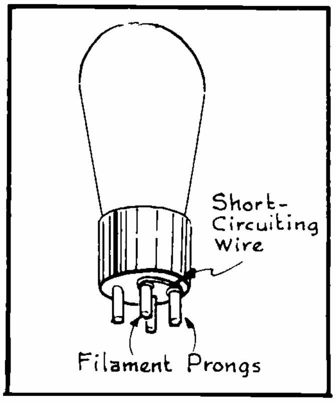

Fig. 2
Short Circuiting
The Filament Prongs.

THE OSCILLATOR METHOD

TO MAKE THESE NEUTRALIZING ADJUSTMENTS,IT IS ALSO POSSIBLE TO USE A MODULATED R.F.SERVICE OSCILLATOR AS THE SOURCE FOR THE SIGNAL AND THIS IS ACCOMPLISHED IN THE FOLLOWING MANNER:

1.– DISCONNECT THE ANTENNA AND GROUND WIRES FROM THE RECEIVER.

2.– CONNECT THE "ANTENNA"TERMINAL OF THE SERVICE OSCILLATOR TO THE ANTENNA TERMINAL OF THE RECEIVER AND THE "GROUND" TERMINAL OF THE SERVICE OSCILLATOR TO THE GROUND TERMINAL OF THE RECEIVER,AS SHOWN IN FIG.3.

3. PLACE THE OSCILLATOR AND RECEIVER IN OPERATION, ADJUST THE OSCILLATOR TO PRODUCE A 1400 KC. SIGNAL AND TUNE IN THIS SIGNAL WITH THE RECEIVER AT HIGH VOLUME.

4.–FROM THIS STEP ON, THE SAME PROCEDURE IS FOLLOWED AS OUTLINED IN PARAGRAPHS #3 TO #8 IN THIS SAME JOB SHEET,WHERE THE BROADCAST SIGNAL IS USED FOR THIS PURPOSE.

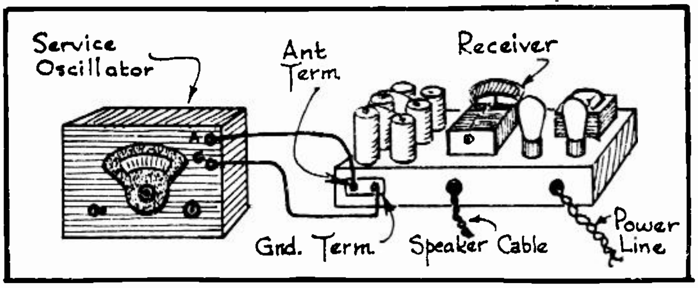

Fig. 3
Set–Up For Aligning Receiver With
Service Oscillator

5.–THE ADVANTAGE OF USING A MODULATED R.F. SERVICE OSCILLATOR FOR SUPPLYING THE SIGNAL FOR TESTING PURPOSES IN PREFERENCE TO BROADCAST SIGNALS IS THAT THE SIGNAL WHICH IS PRODUCED BY THE OSCILLATOR WILL BE STEADY AND OF UNVARYING INTENSITY AS IT IS REPRODUCED BY THE RECEIVER'S LOUD SPEAKER. THE BROADCAST SIGNALS WILL VARY ACCORDING TO THE LOUDNESS AND SOFTNESS OF THE SOUNDS WHICH ARE PICKED UP AT THE MICROPHONE AND THESE SOUND INTENSITIES WILL VARY CORRESPONDINGLY WHEN EMITTED FROM THE LOUDSPEAKER OF THE RECEIVER. THIS NATURAL VARIATION IN THE LOUDNESS OF SOUND MAKES IT SOMEWHAT MORE DIFFICULT TO ASCERTAIN WHETHER THE SOUND AT ANY INSTANT IS BEING AFFECTED BY THE RECEIVER ADJUSTMENT WHICH IS BEING MADE OR DUE TO THE PICK UP OF THE STUDIO MICROPHONE AT THE SAME INSTANT.

PRACTICAL RADIO JOB SHEET

NO. 7

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

COMMON TROUBLES IN BATTERY OPERATED RECEIVERS

TROUBLE	POSSIBLE CAUSE	TESTS
NO TUBES LIGHT.	1. "A" BATTERY RUN DOWN. 2. BAD CONNECTIONS OR OPEN "A" CIRCUIT.	1. TEST WITH VOLTMETER OR HYDROMETER. 2. INSPECT WIRING AND APPLY CONTINUITY TESTS.
ONE OR MORE TUBES (BUT NOT ALL) FAIL TO LIGHT.	1. DEFECTIVE TUBES. 2. OPEN OR SHORT IN FILAMENT CIRCUIT.	1. TRY OTHER TUBES. 2. APPLY CONTINUITY TESTS.
TUBES LIGHT BUT SIGNALS ARE NOT RECEIVED.	1. WRONG BATTERY CONNECTION. 2. "B" VOLTAGE LOW. 3. DEFECT IN ANTENNA OR GROUND CIRCUIT CONNECTIONS. 4. DEFECTIVE OR WORN OUT TUBE OR TUBES. 5. DEFECTIVE SPEAKER OR SPEAKER LEADS. 6. DEFECTIVE PLATE OR GRID CIRCUIT.	1. INSPECT. 2. TEST WITH VOLTMETER 3. INSPECT. 4. TRY OTHER TUBES. 5. TRY ANOTHER SPEAKER OR HEADPHONES. 6. TEST SOCKET VOLTAGES AND APPLY CONTINUITY TESTS.
LOW VOLUME.	1. RUN-DOWN BATTERY OR BATTERIES OR ELSE EXCESSIVE "C" VOLTAGE. 2. AERIAL SHORTER THAN RECOMMENDED; DEFECTS IN AERIAL OR GROUND SYSTEM; POOR LOCATION. 3. DEFECTIVE TUBE OR TUBES. 4. DEFECTIVE SPEAKER. 5. RECEIVER OUT OF ALIGNMENT. 6. DEFECTIVE AUDIO OR RADIO FREQUENCY TRANSFORMER. 7. DEFECTIVE CONNECTIONS, BAD SOLDERING ETC.	1. TEST BATTERY VOLTAGE WITH RECEIVER IN OPERATION. 2. INSPECT AERIAL AND GROUND SYSTEM FOR SHORTS, OPENS, BAD CONNECTIONS, DIRTY INSULATORS ETC. 3. TRY OTHER TUBES. 4. TRY ANOTHER SPEAKER. 5. CHECK ALIGNMENT. 6. APPLY CONTINUITY TESTS. 7. INSPECT
INTERMITTENT RECEPTION	1. LOOSE OR BROKEN CONNECTION IN AERIAL OR GROUND CIRCUIT. 2. LOOSE OR BROKEN CONNECTION IN RECEIVER.	1. EXAMINE FOR BREAKS AND POOR CONNECTIONS. 2. CHECK SOCKET VOLTAGES AND APPLY CONTINUITY TESTS, JARRING RECEIVER WHILE MAKING TESTS.

(OVER)

(CONTINUED)

INTERMITTENT RECEPTION	3. DEFECTIVE SPEAKER OR SPEAKER CONNECTIONS. 4. DEFECTIVE RESISTOR OR CONDENSER	3. TRY DIFFERENT SPEAKER. 4. CHECK RESISTORS AND CONDENSERS.
UNSATISFACTORY QUALITY.	1. RUN DOWN BATTERIES. 2. DEFECTIVE TUBE OR TUBES. 3. IMPROPER "C" BIAS 4. DEFECTIVE SPEAKER. 5. DEFECTS IN CIRCUIT, GRID LEAK ETC.	1. TEST ALL BATTERIES. 2. TRY OTHER TUBES. 3. TEST "C" BATTERY AND INSPECT CONNECTIONS. 4. TRY ANOTHER SPEAKER. 5. CHECK BY CONTINUITY TESTS, SOCKET VOLTAGES TESTS, AND INSPECTION OF WIRING.
OSCILLATIONS IN NEUTRODYNE RECEIVERS.	1. POOR R.F. TUBES. 2. AERIAL LENGTH DIFFERENT FROM THAT RECOMMENDED FOR RECEIVER OR ELSE A DEFECTIVE GROUND. 3. RECEIVER REQUIRES NEUTRALIZING ADJUSTMENT.	1. TRY CHANGING R.F. TUBES AROUND OR TRY DIFFERENT TUBES IN R.F. SOCKETS. 2. INSPECT 3. CHECK NEUTRALIZATION
OSCILLATIONS IN SCREEN GRID RECEIVERS.	1. AERIAL TOO SHORT OR ELSE AN OPEN IN AERIAL - GROUND CIRCUIT. 2. DEFECTIVE R.F. TUBES OR TUBES WITH TOO HIGH "MU". 3. HIGH RESISTANCE GROUNDS TO CHASSIS. 4. COUPLING BETWEEN SPEAKER LEADS AND ANTENNA OR GROUND WIRES. 5. OPEN OR DISCONNECTED SCREEN-GRID BYPASS CONDENSER.	1. INSPECT AND TRY RECEIVER ON A LONGER AERIAL. 2. TRY OTHER TUBES IN R.F. SOCKETS. 3. TIGHTEN UP ALL CONNECTIONS TO CHASSIS. EXAMINE VARIABLE CONDENSER ROTOR CONNECTION. 4. SEE THAT LEADS ARE AS FAR APART AS POSSIBLE. 5. INSPECT AND CHECK THESE CONDENSERS.
OTHER OSCILLATIONS, SQUEALS, A.C. HUM WITH ELIMINATOR-EQUIPPED RECEIVERS ETC.	1. RUN DOWN "C" BATTERY. 2. MICROPHONIC TUBE. 3. DEFECTIVE GROUND OR AERIAL SYSTEM. 4. DEFECTS IN CIRCUIT, ESPECIALLY IN A.F. TRANSFORMERS. 5. ELIMINATOR OR OTHER A.C. LEADS TOO CLOSE TO RECEIVER. 6. AERIAL TOO CLOSE TO POWER LINES	1. CHECK VOLTAGE WITH RECEIVER IN OPERATION. 2. PREVENT RECEIVER VIBRATIONS OR USE NEW TUBE. 3. INSPECT 4. INSPECT AND APPLY CONTINUITY TESTS. 5. INSPECT. 6. NOTE WHETHER OR NOT DISCONNECTING AERIAL STOPS A.C. HUM.

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NO. 8

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

COMMON TROUBLES IN A.C. RECEIVERS

TROUBLE	POSSIBLE CAUSE	TESTS
No TUBES LIGHT.	1. POWER OFF AT SOCKET 2. FUSE BLOWN 3. OPEN IN SUPPLY CORD OR PRIMARY CIRCUIT OF POWER TRANSFORMER.	1. PLUG IN LAMP AT SOCKET OR USE VOLTMETER ACROSS LINE. 2. TRY NEW FUSE, NOTING WHETHER OR NOT TUBES LIGHT. 3. TEST FOR CONTINUITY.
ONE OR MORE (BUT NOT ALL) FAIL TO LIGHT.	1. BURNED OUT TUBE OR TUBES. 2. OPEN IN POWER TRANSFORMER SECONDARY WHICH SUPPLIES FILAMENTS. 3. SHORT OR OPEN FILAMENT CIRCUIT	1. TRY OTHER TUBES 2. USE VOLTAGE TEST AT SOCKETS. 3. TEST FOR CONTINUITY.
TUBES LIGHT BUT SIGNALS ARE NOT RECEIVED.	1. ANTENNA, GROUND OR BOTH DISCONNECTED, OPEN OR SHORTED. 2. OUTPUT TO SPEAKER NOT CONNECTED OR OPEN IN OUTPUT - SPEAKER CIRCUIT. 3. DEFECT IN PLATE CIRCUIT OF OTHER TUBES, SUCH AS OPEN RESISTOR ETC. 4. DEFECTS, SUCH AS OPEN RESISTORS IN GRID CIRCUITS ETC. 5. DEFECTIVE SPEAKER.	1. INSPECT AERIAL AND GROUND SYSTEM. 2. INSPECT CONNECTIONS AND CHECK OUTPUT PLATE VOLTAGES. 3. CHECK SOCKET PLATE VOLTAGES. 4. CHECK VOLTAGES OF OPERATING GRIDS AND SCREEN GRIDS. 5. TRY A DIFFERENT SPEAKER.
UNSATISFACTORY VOLUME.	1. AERIAL TOO SHORT; DEFECTS IN AERIAL, GROUND OR BOTH; POOR LOCATION. 2. LOW LINE VOLTAGE. 3. DEFECTIVE TUBE OR TUBES. 4. IMPROPER SOCKET VOLTAGES DUE TO DEFECTIVE CIRCUITS SUCH AS DEFECTIVE RESISTANCES ETC. 5. DEFECTIVE SPEAKER. 6. TUNED CIRCUITS NOT ALIGNED. 7. DEFECTIVE AUDIO OR R.F. TRANSFORMER 8. DEFECTIVE CONNECTIONS, BAD SOLDERING ETC.	1. INSPECT AERIAL AND GROUND SYSTEMS FOR SIZE, SHORTS, POOR INSULATION, POOR CONNECTIONS ETC. IF NECESSARY, TEST SAME WITH ANOTHER RECEIVER. 2. CHECK LINE VOLTAGE WITH A.C. METER. 3. TRY NEW TUBES. 4. TEST TO SEE IF "VOLTAGE LIMITS" ARE COMPLIED WITH. 5. TRY A NEW ONE. 6. CHECK FOR ALIGNMENT. 7. INSPECT CONNECTIONS AND APPLY CONTINUITY TESTS. 8. INSPECT ALL CONNECTIONS AND SOLDERED JOINTS.

(OVER)

(CONTINUED)

INTERMITTENT RECEPTION.	1. LOOSE OR BROKEN CONNECTION IN AERIAL OR GROUND CIRCUIT. 2. LOOSE OR BROKEN CONNECTION IN RECEIVER. 3. DEFECTIVE SPEAKER OR SPEAKER CONNECTIONS. 4. DEFECTIVE TUBE 5. DEFECTIVE RESISTOR OR CONDENSER.	1. EXAMINE THROUGHOUT FOR BREAKS AND POOR CONNECTIONS. 2. CHECK SOCKET VOLTAGES AND APPLY CONTINUITY TESTS JARRING RECEIVER WHILE MAKING TESTS. 3. TRY A DIFFERENT SPEAKER. 4. CHECK TUBES. 5. CHECK SAME.
UNSATISFACTORY QUALITY.	1. DEFECTIVE OR WORN OUT TUBES. 2. WRONG SOCKET VOLTAGES(ESPECIALLY BIAS)DUE TO DEFECTS IN CIRCUIT,DEFECTIVE RESISTORS ETC. 3. DEFECTIVE SPEAKER. 4. TUNING CIRCUITS IMPROPERLY ALIGNED.	1. TRY OTHER TUBES. 2. TEST TO SEE THAT SOCKET VOLTAGES COMPLY WITH "VOLTAGE LIMITATIONS". 3. TRY ANOTHER SPEAKER. 4. CHECK ALIGNMENT.
A.C. HUM.	1. DEFECTIVE TUBE(ESPECIALLY RECTIFIER) OR DETECTOR. 2. POOR GROUND. 3. SHORTED FILTER CHOKE OR OPEN CONDENSER 4. INDUCTIVE PICK-UP OF AERIAL SYSTEM,GROUND WIRE,LEAD-IN ETC.FROM POWER LINE OR A.C. LEADS. 5. OTHER DEFECTS IN CIRCUIT.	1. TRY OTHER TUBES. 2. INSPECT. 3. CHECK SOCKET VOLTAGES AND APPLY CONTINUITY TESTS. 4. INSPECT.SEE IF DISCONNECTED AERIAL OR GROUND STOPS HUM. 5. CHECK SOCKET VOLTAGES AND APPLY CONTINUITY TESTS THROUGHOUT.
MICROPHONISM.	1. JARRING OR VIBRATION OF RECEIVER. 2. DEFECTIVE DETECTOR TUBE.	1. INSPECT FOR CAUSE OF VIBRATION (OFTEN DUE TO SPEAKER VIBRATIONS TRANSFERRED TO SET). 2. TRY ANOTHER DETECTOR TUBE.
OSCILLATION IN NEUTRODYNE RECEIVER.	1. R.F. TUBES 2. IMPROPER AERIAL LENGTH. 3. RECEIVER NOT PROPER NEUTRALIZED.	1. CHANGE TUBES AROUND OR TRY DIFFERENT TUBES IN R.F. SOCKETS. 2. INSPECT. 3. CHECK FOR NEUTRALIZATION.
OSCILLATIONS IN SCREEN-GRID RECEIVER.	1. AERIAL TOO SHORT,OR OPEN IN AERIAL - GROUND CIRCUIT. 2. DEFECTIVE R.F. TUBES OR TUBES WITH TOO HIGH "MU" 3. HIGH-RESISTANCE GROUNDS TO CHASSIS. 4. TOO HIGH LINE VOLTAGE. 5. OPEN OR DISCONNECTED SCREEN GRID BY-PASS CONDENSER.	1. INSPECT AERIAL AND GROUND SYSTEM THROUGHOUT.IF NECESSARY TEST RECEIVER ON LONGER AERIAL. 2. TRY OTHER TUBES IN R.F. SOCKETS. 3. TRY TIGHTENING UP ALL CONNECTIONS. 4. TEST LINE VOLTAGE WITH A.C. METER. 5. INSPECT AND CHECK.

NO. 9

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

COMMON POWER PACK TROUBLES

TROUBLE	POSSIBLE CAUSE	TESTS
No D.C. Voltage Available at output of Power Pack.	1. Defective Power transformer.	1. Check suspicious winding for voltage with volt meter and also for continuity.
	2. If tube filaments also fail to burn, look for defective primary winding in power transformer or defective A.C. input line.	2. Check for continuity.
	3. Rectifier tube burned out.	3. Inspect and insert new rectifier tube.
	4. Filter condenser broken down.	4. Rectifier tube's plates will become red hot. Check filter condenser for short.
	5. Open or grounded choke coil.	5. Test for continuity and ground.
Low D.C. Output Voltages.	1. Low A.C. line voltage.	1. Check line voltage with A.C. voltmeter.
	2. Excessive load on D.C. circuit.	2. Check current drain with milliammeter.
	3. Worn out rectifier tube.	3. Try a new rectifier tube.
	4. Excessive D.C. resistance in filter system.	4. Check connections and also measure volt drop across each filter choke.
	5. Shorted divider resistor.	5. Check divider resistors.
Lack of D.C. voltage across a portion of divider only.	1. Shorted by-pass condenser in voltage divider.	1. Test voltage divider by-pass condensers.
	2. An open voltage divider resistor.	2. Check divider resistors for continuity.
A.C. hum, for which power pack may be responsible.	1. Low line voltage.	1. Check voltage with A.C. voltmeter.
	2. Defective rectifier tube.	2. Replace with a new tube.
	3. Shorted filter choke.	3. Test choke for continuity and note meter reading.
	4. An open or poor filter condenser.	4. Check condenser and try a replacement
	5. Open in a voltage divider by-pass condenser or lack of such a condenser.	5. Inspect and check such condensers for continuity
	6. Loose transformer laminations.	6. Listen for rattle.

NO. 10

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

COMMON TROUBLES IN DIRECT CURRENT RECEIVERS
(110 or 220 Volts)

TROUBLE	POSSIBLE CAUSE	TESTS
No TUBES LIGHT.	1. ONE OR MORE TUBES "BURNED OUT."	1. IN SOME D.C. RECEIVERS, ALL OF THE TUBE FILAMENTS ARE CONNECTED IN SERIES AND IF ONE BURNS OUT, ALL WILL FAIL TO LIGHT. IN OTHER D.C. RECEIVERS, CERTAIN GROUPS OF TUBES ARE CONNECTED IN SERIES WHILE OTHERS ARE CONNECTED IN PARALLEL, SO THE EFFECT OF ONE OPEN FILAMENT WILL BE ACCORDINGLY.
	2. POWER OFF AT SOCKET.	2. PLUG IN LAMP AT SOCKET OR TEST WITH VOLTMETER ACROSS LINES.
	3. FUSE OR FUSES BLOWN.	3. TRY NEW FUSE OR FUSES (SOME D.C. RECEIVERS HAVE 2 FUSES, ONE ON CHASSIS AND ONE ON SUPPLY CORD).
	4. OPEN IN SUPPLY CORD OR FILAMENT CIRCUIT.	4. TEST FOR CONTINUITY.
ONE OR MORE TUBES (BUT NOT ALL) FAIL TO LIGHT.	1. BURNED OUT TUBE	1. POSSIBLE ONLY IN CASES WHERE FILAMENTS OF SOME TUBES ARE PARALLELED.
	2. DEFECT IN FILAMENT CIRCUIT.	2. NOTE (1) ABOVE ALSO APPLIES IN THIS CASE. APPLY CONTINUITY TESTS.
TUBES LIGHT BUT SIGNALS ARE NOT RECEIVED.	1. POLARITY MAY BE REVERSED. OTHER POSSIBLE CAUSES ARE THE SAME AS THOSE GIVEN RELATIVE TO A.C. RECEIVERS IN THE PRECEDING "JOB SHEET".	1. CHECK POLARITY OF LINE.
UNSATISFACTORY VOLUME.	1. WRONG LINE VOLTAGE. OTHER POSSIBLE CAUSES ARE THE SAME AS THOSE GIVEN RELATIVE TO A.C. RECEIVERS IN A PRECEDING "JOB SHEET".	1. TEST LINE VOLTAGE WITH A D.C. VOLTMETER.
1. INTERMITTENT RECEPTION. 2. UNSATISFACTORY QUALITY. 3. MICROPHONISM.	4. OSCILLATION IN NEUTRODYNE RECEIVERS. 5. OSCILLATION IN SCREEN GRID RECEIVERS.	THE POSSIBLE CAUSES FOR THESE TROUBLES ARE THE SAME AS THOSE OUTLINED WITH RESPECT TO THESE SAME TROUBLES FOR A.C. RECEIVERS IN A PRECEDING "JOB SHEET".

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PRACTICAL RADIO JOB SHEET

NO. 11

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

TROUBLES AND TESTING OF MAGNETIC SPEAKERS

DEFINITION:- SPEAKERS, WHOSE FIELD IS ESTABLISHED BY A PERMANENT MAGNET OR MAGNETS AND WHICH ARE NOT EQUIPPED WITH A MOVING COIL, ARE CLASSIFIED AS "MAGNETIC SPEAKERS." THE BALANCED ARMATURE TYPE SPEAKER, FOR EXAMPLE, WOULD BE INCLUDED IN THIS GROUP. THE TERM "HIGH IMPEDANCE" IS ALSO FREQUENTLY ASSOCIATED WITH THIS CLASS OF SPEAKERS.

CAUTION:- ALL FAULTS INDICATED BY AN IMPROPERLY OPERATING SPEAKER DO NOT INDICATE THAT THE SPEAKER ITSELF IS DEFECTIVE. THE FOLLOWING TABLE ASSUMES THE TROUBLE TO BE WITHIN THE MAGNETIC SPEAKER AND NOT IN THE RECEIVER.

TROUBLE	POSSIBLE CAUSE	TESTS
NO SOUNDS FROM SPEAKER.	1. DEFECTIVE SPEAKER. 2. DEFECTIVE RECEIVER. 3. OPEN OR SHORTED SPEAKER LEADS. 4. OPEN SPEAKER COIL. 5. DEFECTIVE SPEAKER COUPLING.	1&2. CHECK OUTPUT OF RECEIVER WITH A DIFFERENT SPEAKER OR HEADPHONES. 3. TEST LEADS FOR CONTINUITY. 4. TEST COIL FOR CONTINUITY. 5. INSPECT AND TEST COUPLING FOR CONTINUITY.
LACK OF VOLUME.	1. A WEAK SPEAKER MAGNET. 2. AN OPEN SPEAKER COIL. 3. A SHORTED SPEAKER COIL. 4. POOR INSULATION IN CONNECTING CORD.	1. TEST WITH A KNIFE BLADE FOR MAGNETIC ATTRACTION AT POLES. 2. TEST FOR CONTINUITY. 3. TEST FOR CONTINUITY. 4. INSPECT CORD.
WEAK, TINNY SOUNDS.	DAMAGED OR CRUSHED CONE PAPER (ESPECIALLY NEAR APEX).	INSPECT AND REPLACE PAPER CONE WITH A NEW ONE.
LOUD CHATTERING SOUNDS.	ARMATURE STRIKING POLE TIPS.,	INSPECT AND ADJUST BY CENTERING ARMATURE IN AIR GAP.
RASPY SOUNDS.	DIRT, IRON FILINGS, OR OTHER SMALL FOREIGN SUBSTANCE LODGED IN NARROW MAGNETIC GAPS.	INSPECT AND REMOVE DIRT BY FORCING A STIFF PIECE OF PAPER BETWEEN ARMATURE AND POLE TIPS.
RATTLING SOUNDS.	LOOSENESS IN SOME PART OF THE DRIVE SYSTEM; PROBABLY A LOOSE DRIVE PIN OR LOOSE CONE ATTACHMENT.	INSPECT

PRACTICAL RADIO JOB SHEET

NO. 12

SPECIALLY PREPARED FOR THE STUDENTS OF

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• TROUBLES & TESTING OF ELECTRODYNAMIC SPEAKERS •

TROUBLE	POSSIBLE CAUSE	TESTS
"DEAD" SPEAKER.	1. NO SIGNAL OUTPUT FROM RECEIVER. 2. LACK OF EXITING VOLTAGE FOR FIELD COIL. 3. OPEN FIELD COIL. 4. SHORTED FIELD COIL. 5. OPEN VOICE COIL. 6. DISCONNECTED VOICE COIL. 7. DEFECTIVE SPEAKER COUPLING.	1&2. CHECK OUTPUT WITH ANOTHER SPEAKER OR PHONES. 2. CHECK VOLTAGE ACROSS FIELD COIL WITH D.C. VOLTMETER. 3. TEST FIELD COIL FOR CONTINUITY. 4. CHECK WITH CONTINUITY TESTER. 5. TEST FOR CONTINUITY 6. INSPECT. 7. CHECK COUPLING.
WEAK, RASPY REPRODUCTION	WEAK MAGNETIZATION OF SPEAKER FIELD (PROBABLY DUE TO LOW EXITING VOLTAGE).	HOLD THE POINT OF A KNIFE BLADE AGAINST THE CENTRAL PORTION OF THE SPEAKER CORE PROJECTING IN APEX OF CONE AND TEST FOR MAGNETIC ATTRACTION WHILE SPEAKER IS IN OPERATION.
DISTORTED OUTPUT.	1. INCORRECTLY CENTERED VOICE COIL. 2. INCORRECT COUPLING UNIT SO THAT IMPEDANCES ARE NOT MATCHED. 3. IMPERFECTLY CENTERED CONE. 4. DAMAGED CONE. 5. EXCESSIVE HUM.	1. INSPECT. 2. CHECK AND TRY A DIFFERENT COUPLING 3. INSPECT. 4. INSPECT. 5. CHECK SPEAKER FOR HUM.
EXCESSIVE SPEAKER HUM.	1. WORN OUT RECTIFIER UNIT. IF SPEAKER IS OF THE A.C. TYPE. 2. POOR OPERATION OF "B" POWER PACK IF SPEAKER IS OF D.C. TYPE. 3. DEFECTIVE HUM BUCKING COIL. 4. SPEAKER LEADS INDUCTIVELY COUPLED TO A.C. LINES.	1. REPLACE RECTIFIER UNIT (SPEAKER CAN BE TESTED FOR HUM BY SHORTING THE PRIMARY TERMINALS OF THE COUPLING TRANSFORMER. ANY REMAINING HUM DOES NOT COME FROM RECEIVER BUT FROM SPEAKER CIRCUIT). 2. INSPECT. 3. INSPECT. 4. INSPECT.
SCRATCHING SOUNDS.	DIRT OR IRON FILINGS LODGED IN AIR GAP BETWEEN FIELD CORE AND APEX SLEEVE OF PAPER CONE.	INSPECT AND REMOVE FOREIGN PARTICLES.

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PRACTICAL RADIO JOB SHEET

NO. 13

SPECIALLY PREPARED FOR THE STUDENTS OF

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METER READINGS AND POSSIBLE RECEIVER TROUBLE

THE OUTLINE HERE GIVEN WILL OFFER YOU A NUMBER OF VALUABLE SUGGESTIONS REGARDING THE MOST COMMON RECEIVER TROUBLES WHICH CORRESPOND TO THE VARIOUS METER READINGS OBTAINED UPON TESTING THE CIRCUITS.

METER READINGS	POSSIBLE TROUBLES
VOLTMETER READS ZERO WHEN CONNECTED ACROSS THE FILAMENT TERMINALS OF THE TUBE SOCKET.	1. DISCHARGED "A" BATTERY IN BATTERY SETS. 2. AN OPEN OR ELSE COMPLETE SHORT IN THIS CIRCUIT. 3. DEFECTIVE TUBE SOCKET. 4. DEFECTIVE FILAMENT CIRCUIT SWITCH. 5. DEFECTIVE POWER TRANSFORMER. 6. PRIMARY CIRCUIT OF POWER TRANSFORMER INCOMPLETE.
FILAMENT OR HEATER VOLTAGE TOO HIGH.	1. HIGH LINE VOLTAGE, OR WRONG CONNECTION OF LINE VOLTAGE TAP. 2. HEATER OR FILAMENT BURNED OUT. 3. ONE OR MORE TUBES IN SAME CIRCUIT BURNED OUT, THEREBY DECREASING LOAD ON CIRCUIT. 4. TUBE OF WRONG TYPE FOR SOCKET. 5. PRIMARY WINDING OF POWER TRANSFORMER PARTIALLY SHORTED.
PLATE VOLTAGE LACKING AT ALL TUBES.	1. SHORTED FILTER CONDENSER. 2. OPEN FILTER CHOKE. 3. DEFECTIVE RECTIFIER TUBE. 4. DEFECTIVE POWER TRANSFORMER. 5. PLATE CIRCUIT OF POWER TUBE GROUNDED. 6. OPEN IN MAIN "B" CIRCUIT FEEDING ALL OTHER "B" CIRCUITS.
NO PLATE VOLTAGE ON ONE TUBE AND LOW PLATE VOLTAGE ON OTHER TUBES.	1. SHORTED BY-PASS OR COUPLING CONDENSER. 2. OPEN R.F. CHOKE. 3. DEFECTIVE TUBE. 4. GROUNDED PLATE CIRCUIT. 5. OPEN RESISTOR.
NO PLATE VOLTAGE ON POWER TUBES BUT PRESENT AT OTHER TUBES.	1. OPEN IN OUTPUT OR SPEAKER COUPLING UNIT. 2. OPEN IN POWER TUBE PLATE CIRCUIT.
LOW PLATE VOLTAGE ON ALL TUBES	1. DEFECTIVE RECTIFIER TUBE. 2. DEFECTIVE FILTER CONDENSER. 3. SHORTED BIAS RESISTOR BY-PASS CONDENSER. 4. SHORTED GRID BIAS RESISTOR. 5. DEFECTIVE BY-PASS CONDENSER. 6. LOW LINE VOLTAGE. 7. DEFECTIVE VOLTAGE DIVIDER. 8. DEFECTIVE FILTER CHOKE. 9. DEFECTIVE POWER TRANSFORMER.

(OVER)

(CONTINUED)

HIGH PLATE VOLTAGE.	1. HIGH LINE VOLTAGE. 2. SHORTED FILTER CHOKE. 3. SHORT CIRCUITED RESISTOR. 4. WORN OUT TUBES PLACING INSUFFICIENT "B" LOAD UPON POWER SUPPLY. (OPEN IN "B" CIRCUIT OF POWER STAGE WILL INCREASE THE "B" VOLTAGE AT TUBES IN THE OTHER STAGES). 5. EXCESSIVE GRID BIAS RESISTANCE IN POWER STAGE.
EXCESSIVE PLATE CURRENT.	1. EXCESSIVE PLATE VOLTAGE. 2. EXCESSIVE SCREEN GRID VOLTAGE. 3. OPEN GRID CIRCUIT. 4. NOT ENOUGH GRID BIAS. 5. GASEOUS TUBE.
LOW PLATE CURRENT WITH NORMAL PLATE VOLTAGE.	1. DEFECTIVE TUBE. 2. TOO MUCH BIAS RESISTANCE. 3. LOW FILAMENT VOLTAGE. 4. LOW SCREEN GRID VOLTAGE.
NO SCREEN GRID VOLTAGE.	1. SHORTED SCREEN-GRID BY-PASS CONDENSER. 2. DEFECTIVE TUBE. 3. DEFECTIVE RESISTOR. 4. OPEN SCREEN GRID CIRCUIT.
NO GRID BIAS.	1. OPEN GRID CIRCUIT. 2. GROUNDED CATHODE. 3. GROUNDED FILAMENT. 4. SHORTED GRID BY-PASS CONDENSER.
LOW GRID BIAS.	1. LOW PLATE CURRENT. 2. OLD TUBES. 3. DEFECTIVE BIAS RESISTANCE OR ONE OF INCORRECT VALUE. 4. DEFECTIVE BIAS RESISTOR BY-PASS CONDENSER.
HIGH GRID BIAS.	1. EXCESSIVE PLATE CURRENT. 2. BIAS RESISTOR OF TOO MUCH VALUE. 3. DEFECTIVE BIAS RESISTOR.

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PRACTICAL RADIO JOB SHEET NO. 14

SPECIALLY PREPARED FOR THE STUDENTS OF

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Los Angeles California

• RADIO TUBE CHART •

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	FILAMENT OR HEATER AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
1A6	PENTAGRID CONVERTER ¤	SMALL 6-PIN	FIG. 26	4 17/32" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.4	1.3	500000	Anode-Grid (#2) 135 max. volts, 2.3 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 300 micromhos.				1A6
1C6	PENTAGRID CONVERTER ¤	SMALL 6-PIN	FIG. 26	4 17/32" x 1 9/16"	D-C FILAMENT	2.0	0.12	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.0	1.5	750000	Anode Grid (#2) 135 max. volts, 3.3 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 325 micromhos.				1C6
2A3	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 3/8" x 2 1/16"	FILAMENT	2.5	2.5	250	—	CLASS A AMPLIFIER	250	−45	—	—	60.0	800	5250	4.2	2500	3.5	2A3
								300	—	PUSH-PULL AMPLIFIER	300 300	−62 −62	Self-bias Fixed-bias		40.0 40.0	Power Output is for 2 tubes at stated load, plate-to-plate			5000 3000	10.0 15.0	
2A5	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.0	2A5
2A6	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250✖	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			2A6
2A7	PENTAGRID CONVERTER ¤	SMALL 7-PIN	FIG. 20	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	100	CONVERTER	250	−3.0 min.	100	2.2	3.5	360000	Anode Grid (#2) 200 max. volts, 4.0 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 520 micromhos.				2A7
2B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	125	PENTODE UNIT AS R-F AMPLIFIER	100 250	−3.0 −3.0	100 125	1.7 2.3	5.8 9.0	300000 650000	950 1125	285 730	—	—	2B7
										PENTODE UNIT AS A-F AMPLIFIER	250✠	−4.5	50	—	0.65	—	—	—	—	—	
6A4 also LA	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	4 11/16" x 1 13/16"	FILAMENT	6.3	0.3	180	180	CLASS A AMPLIFIER	100 180	−6.5 −12.0	100 180	1.6 3.9	9.0 22.0	83250 45500	1200 2200	100 100	11000 8000	0.31 1.40	6A4 also LA
6A7	PENTAGRID CONVERTER ¤	SMALL 7-PIN	FIG. 20	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	100	CONVERTER	250	−3.0 min.	100	2.2	3.5	360000	Anode Grid (#2) 200 max. volts, 4.0 ma. Oscillator Grid (#1) Resistor, 50000 ohms. Conversion conductance, 520 micromhos.				6A7
6B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	125	PENTODE UNIT AS R-F AMPLIFIER	100 250	−3.0 −3.0	100 125	1.7 2.3	5.8 9.0	300000 650000	950 1125	285 730	—	—	6B7
										PENTODE UNIT AS A-F AMPLIFIER	250✠	−4.5	50	—	0.65	—	—	—	—	—	
6C6	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 15/16" x 1 9/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	6C6
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms.**				
6D6	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 15/16" x 1 9/16"	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0 min.	100	2.0	8.2	800000	1600	1280	—	—	6D6
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—		Oscillator peak volts = 7.0.				

¤ Grids #3 and #5 are screen. Grid #4 is signal-input control-grid.

✠ Applied through plate coupling resistor of 200000 ohms. **For grid of following tube.
✖ Applied through plate coupling resistor of 250000 ohms.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE ■	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
6F7	TRIODE-PENTODE	SMALL 7-PIN	FIG. 27	4 17/32" x 1 9/16"	HEATER	6.3	0.3	100	—	TRIODE UNIT AS AMPLIFIER	100	−3.0	—	—	3.5	17800	450	8	—	—	6F7
								250	100	PENTODE UNIT AS AMPLIFIER	250	−3.0 min.	100	1.5	6.5	850000	1100	900	—	—	
								250	100	PENTODE UNIT AS MIXER	250	−10.0	100	0.6	2.8	Oscillator peak volts = 7.0. Conversion conductance = 300 micromhos.					
'00-A	DETECTOR TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	45	—	GRID LEAK DETECTOR	45	Grid Return to (−) Filament			1.5	30000	666	20	—	—	'00-A
01-A	DETECTOR★ AMPLIFIER	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −9.0	—	—	2.5 3.0	11000 10000	725 800	8.0 8.0	—	—	01-A
10	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 5/8" x 2 3/16"	FILAMENT	7.5	1.25	425	—	CLASS A AMPLIFIER	350 425	−31.0 −39.0	—	—	16.0 18.0	5150 5000	1550 1600	8.0 8.0	11000 10200	0.9 1.6	10
11 12	DETECTOR★ AMPLIFIER TRIODE	WD 4-PIN MEDIUM 4-PIN	FIG. 12 FIG. 1	4 1/8" x 1 3/16" 4 11/16" x 1 7/16"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −10.5	—	—	2.5 3.0	15500 15000	425 440	6.6 6.6	—	—	11 12
19	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 25	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.26	135	—	CLASS B AMPLIFIER	135 135	0 −3.0	—	—	Power output value is for one tube at stated load, plate-to-plate.				10000 10000	2.1 1.9	19
'20	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.132	135	—	CLASS A AMPLIFIER	90 135	−16.5 −22.5	—	—	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	0.045 0.110	'20
22	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 1/32" x 1 13/16"	D-C FILAMENT	3.3	0.132	135	67.5	SCREEN GRID R-F AMPLIFIER	135 135	−1.5 −1.5	45 67.5	0.6* 1.3*	1.7 3.7	725000 325000	375 500	270 160	—	—	22
24-A	R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 1/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180 250	−3.0 −3.0	90 90	1.7* 1.7*	4.0 4.0	400000 600000	1000 1050	400 630	—	—	24-A
										BIAS DETECTOR	250●	−5.0 approx.	20 to 45	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
26	AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	1.5	1.05	180	—	CLASS A AMPLIFIER	90 180	−7.0 −14.5	—	—	2.9 6.2	8900 7300	935 1150	8.3 8.3	—	—	26
27	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	2.5	1.75	275	—	CLASS A AMPLIFIER	135 250	−9.0 −21.0	—	—	4.5 5.2	9000 9250	1000 975	9.0 9.0	—	—	27
										BIAS DETECTOR	250	−30.0 approx.	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
30	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	—	CLASS A AMPLIFIER	90 135 180	−4.5 −9.0 −13.5	—	—	2.5 3.0 3.1	11000 10300 10300	850 900 900	9.3 9.3 9.3	—	—	30

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.

● Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor. *Maximum.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE ■	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
31	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.13	180	—	CLASS A AMPLIFIER	135 180	−22.5 −30.0	—	—	8.0 12.3	4100 3600	925 1050	3.8 3.8	7000 5700	0.185 0.375	31
32	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 1/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135 180	−3.0 −3.0	67.5 67.5	0.4* 0.4*	1.7 1.7	950000 1200000	640 650	610 780	—	—	32
										BIAS DETECTOR	180♥	−6.0 approx.	67.5	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
33	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	4 11/16" x 1 13/16"	D-C FILAMENT	2.0	0.26	180	180	CLASS A AMPLIFIER	180	−18.0	180	5.0	22.0	55000	1700	90	6000	1.4	33
34	SUPER-CONTROL R-F AMPLIFIER PENTODE	MEDIUM 4-PIN	FIG. 4A	5 1/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135 180	−3.0 min.	67.5 67.5	1.0 1.0	2.8 2.8	600000 1000000	600 620	360 620	—	—	34
35	SUPER-CONTROL R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 1/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180 250	−3.0 min.	90 90	2.5* 2.5*	6.3 6.5	300000 400000	1020 1050	305 420	—	—	35
36	R-F AMPLIFIER TETRODE	SMALL 5-PIN	FIG. 9	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	100 180 250	−1.5 −3.0 −3.0	55 90 90	— — 1.7*	1.8 3.1 3.2	550000 500000 550000	850 1050 1080	470 525 595	—	—	36
										BIAS DETECTOR	100● 250●	−5.0 −8.0	55 90	—	Plate current to be adjusted to 0.1 milliampere with no signal.						
37	DETECTOR★ AMPLIFIER TRIODE	SMALL 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	90 180 250	−6.0 −13.5 −18.0	—	—	2.5 4.3 7.5	11500 10200 8400	800 900 1100	9.2 9.2 9.2	—	—	37
										BIAS DETECTOR	90 250	−10.0 −28.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
38	POWER AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	250	CLASS A AMPLIFIER	100 180 250	−9.0 −18.0 −25.0	100 180 250	1.2 2.4 3.8	7.0 14.0 22.0	140000 115000 100000	875 1050 1200	120 120 120	15000 11600 10000	0.27 1.00 2.50	38
39-44	SUPER-CONTROL R-F AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	90 180 250	−3.0 min.	90 90 90	1.6 1.4 1.4	5.6 5.8 5.8	375000 750000 1000000	960 1000 1050	360 750 1050	—	—	39-44

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
■Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.

● Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor.
♥Applied through plate coupling resistor of 100000 ohms.

*Maximum.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE ■	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
40	VOLTAGE AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	135✖ 180✖	−1.5 −3.0	—	—	0.2 0.2	150000 150000	200 200	30 30	—	—	40
41	POWER AMPLIFIER PENTODE	SMALL 6-PIN	FIG. 15A	4 1/4" x 1 9/16"	HEATER	6.3	0.4	250	250	CLASS A AMPLIFIER	100 180 250	−7.0 −13.5 −18.0	100 180 250	1.6 3.0 5.5	9.0 18.5 32.0	103500 81000 68000	1450 1850 2200	150 150 150	12000 9000 7600	0.33 1.50 3.40	41
42	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	6.3	0.7	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.00	42
43	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	25.0	0.3	135	135	CLASS A AMPLIFIER	95 135	−15.0 −20.0	95 135	4.0 7.0	20.0 34.0	45000 35000	2000 2300	90 80	4500 4000	0.90 2.00	43
45	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	2.5	1.5	275	—	CLASS A AMPLIFIER	180 250 275	−31.5 −50.0 −56.0	180 250 275	—	31.0 34.0 36.0	1650 1610 1700	2125 2175 2050	3.5 3.5 3.5	2700 3900 4600	0.82 1.60 2.00	45
46	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	5 5/8" x 2 3/16"	FILAMENT	2.5	1.75	250	—	CLASS A AMPLIFIER □	250	−33.0	—	—	22.0	2380	2350	5.6	6400	1.25	46
								400	—	CLASS B AMPLIFIER ✧	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				5200 5800	16.0 20.0	

CONTINUED ON OTHER SIDE

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH X DIAMETER	CATHODE TYPE ■	RATING — FILAMENT OR HEATER VOLTS	RATING — FILAMENT OR HEATER AMPERES	RATING — PLATE MAX. VOLTS	RATING — SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
47	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	5 3/8″ x 2 1/16″	FILAMENT	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.0	31.0	60000	2500	150	7000	2.7	47
48	POWER AMPLIFIER TETRODE	MEDIUM 6-PIN	FIG. 15	5 3/8″ x 2 1/16″	D-C HEATER	30.0	0.4	125	100	CLASS A AMPLIFIER	96 125	−19.0 −20.0	96 100	9.0 9.5	52.0 56.0	— —	3800 3900	— —	1500 1500	2.0 2.5	48
49	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	4 11/16″ x 1 13/16″	D-C FILAMENT	2.0	0.12	135	—	CLASS A AMPLIFIER □	135	−20.0	—	—	6.0	4175	1125	4.7	11000	0.17	49
								180	—	CLASS B AMPLIFIER ◆	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				12000	3.5	
50	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	6 1/4″ x 2 11/16″	FILAMENT	7.5	1.25	450	—	CLASS A AMPLIFIER	300 400 450	−54.0 −70.0 −84.0	—	—	35.0 55.0 55.0	2000 1800 1800	1900 2100 2100	3.8 3.8 3.8	4600 3670 4350	1.6 3.4 4.6	50
53	TWIN-TRIODE AMPLIFIER ✓	MEDIUM 7-PIN#	FIG. 24	4 11/16″ x 1 13/16″	HEATER	2.5	2.0	300	—	CLASS B AMPLIFIER	250 300	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				8000 10000	8.0 10.0	53
55	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 17/32″ x 1 9/16″	HEATER	2.5	1.0	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	55
56	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	4 1/4″ x 1 9/16″	HEATER	2.5	1.0	250	—	CLASS A AMPLIFIER	250	−13.5	—	—	5.0	9500	1450	13.8	—	—	56
										BIAS DETECTOR	250	−20.0 (approx.)	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
57	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 15/16″ x 1 9/16″	◆ HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	57
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**				
	★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode # Requires different socket from small 7-pin.										□Grid next to plate tied to plate. ◆Two grids tied together. **For grid of following tube. ✕ Applied through plate coupling resistor of 250000 ohms.										
58	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 15/16″ x 1 9/16″	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0 min.	100	2.0	8.2	800000	1600	1280	—	—	58
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—	Oscillator peak volts = 7.0.					
59	TRIPLE-GRID POWER AMPLIFIER	MEDIUM 7-PIN#	FIG. 18	5 3/8″ x 2 1/16″	HEATER	2.5	2.0	250	—	AS TRIODE ¶ CLASS A AMPLIFIER	250	−28.0	—	—	26.0	2300	2600	6.0	5000	1.25	59
								250	250	AS PENTODE ** CLASS A AMPLIFIER	250	−18.0	250	9.0	35.0	40000	2500	100	6000	3.00	
								400	—	AS TRIODE ⊛ CLASS B AMPLIFIER	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				4600 6000	15.0 20.0	
71-A	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16″ x 1 13/16″	FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−19.0 −43.0	—	—	10.0 20.0	2170 1750	1400 1700	3.0 3.0	3000 4800	0.125 0.790	71-A
75	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 17/32″ x 1 9/16″	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250 ✕	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			75
76	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	4 1/4″ x 1 9/16″	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER	250	−13.5	—	—	5.0	9500	1450	13.8	—	—	76
										BIAS DETECTOR	250	−20.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
77	TRIPLE-GRID DETECTOR AMPLIFIER	SMALL 6-PIN	FIG. 11	4 17/32″ x 1 9/16″	HEATER	6.3	0.3	250	100	SCREEN GRID R-F AMPLIFIER	100 250	−1.5 −3.0	60 100	0.4 0.5	1.7 2.3	650000 1500000	1100 1250	715 1500	—	—	77
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**				
78	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	4 17/32″ x 1 9/16″	HEATER	6.3	0.3	250	125	SCREEN GRID R-F AMPLIFIER	90 180 250 250	−3.0 min.	90 75 100 125	1.3 1.0 1.7 2.6	5.4 4.0 7.0 10.5	315000 1000000 800000 600000	1275 1100 1450 1650	400 1100 1160 990	—	—	78
79	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 19	4 17/32″ x 1 9/16″	HEATER	6.3	0.6	250	—	CLASS B AMPLIFIER	180 250	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				7000 14000	5.5 8.0	79
85	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	4 17/32″ x 1 9/16″	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	85
89	TRIPLE-GRID POWER AMPLIFIER	SMALL 6-PIN	FIG. 14	4 17/32″ x 1 9/16″	HEATER	6.3	0.4	250	250	AS TRIODE ¶ CLASS A AMPLIFIER	160 180 250	−20.0 −22.5 −31.0	—	—	17.0 20.0 32.0	3300 3000 2600	1425 1550 1800	4.7 4.7 4.7	7000 6500 5500	0.300 0.400 0.900	89
										AS PENTODE ** CLASS A AMPLIFIER	100 180 250	−10.0 −18.0 −25.0	100 180 250	1.6 3.0 5.5	9.5 20.0 32.0	104000 80000 70000	1200 1550 1800	125 125 125	10700 8000 6750	0.33 1.50 3.40	
										AS TRIODE ⊛ CLASS B AMPLIFIER	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				13600 9400	2.50 3.50	
V-'99 X-'99	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-NUB SMALL 4-PIN	FIG. 10 FIG. 1	3 1/2″ x 1 1/16″ 4 1/8″ x 1 3/16″	D-C FILAMENT	3.3	0.063	90	—	CLASS A AMPLIFIER	90	−4.5	—	—	2.5	15500	425	6.6	—	—	V-'99 X-'99
112-A	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16″ x 1 13/16″	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−4.5 −13.5	—	—	5.0 7.7	5400 4700	1575 1800	8.5 8.5	—	—	112-A

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
■ Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.
Requires different socket from small 7-pin.

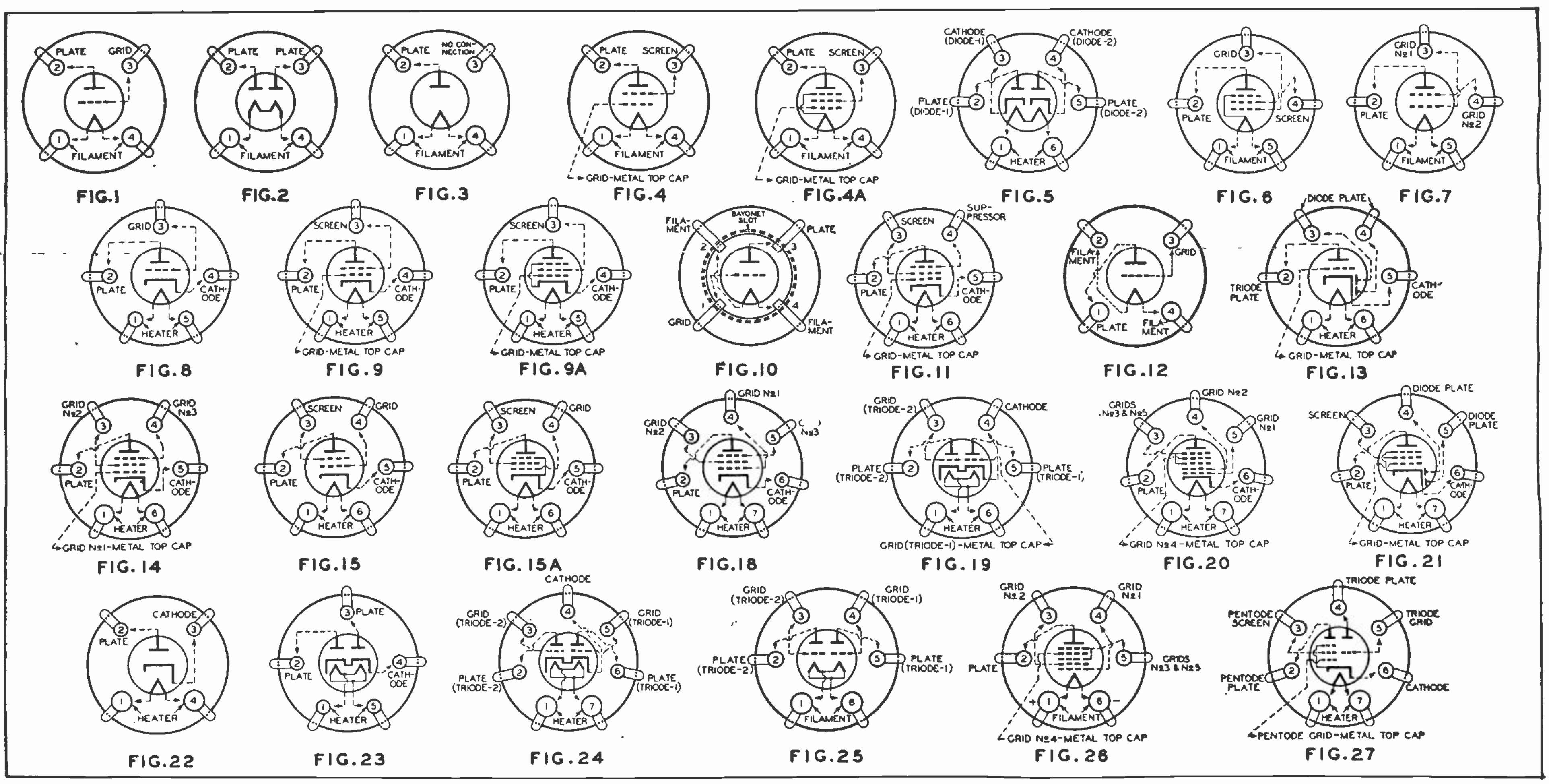
** Grid #1 is control grid. Grid #2 is screen. Grid #3 tied to cathode.
¶ Grid #1 is control grid. Grids #2 and #3 tied to plate. ✕ Applied through plate coupling resistor of 250000 ohms.
⊛ Grids #1 and #2 connected together. Grid #3 tied to plate. **For grid of following tube.

RECTIFIERS

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	VOLTS	AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	RATINGS	TYPE
5Z3	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	5 3/8″ x 2 1/16″	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate......500 Volts, RMS Maximum D-C Output Current......250 Milliamperes	5Z3
12Z3	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4″ x 1 9/16″	HEATER	12.6	0.3	—	—	Maximum A-C Plate Voltage......250 Volts, RMS Maximum D-C Output Current...... 60 Milliamperes	12Z3
25Z5	RECTIFIER-DOUBLER	SMALL 6-PIN	FIG. 5	4 1/4″ x 1 9/16″	HEATER	25.0	0.3	—	—	Maximum A-C Voltage per Plate......125 Volts, RMS Maximum D-C Output Current......100 Milliamperes	25Z5
1-v°	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	4 1/4″ x 1 9/16″	HEATER	6.3	0.3	—	—	Maximum A-C Plate Voltage......350 Volts, RMS Maximum D-C Output Current...... 50 Milliamperes	1-v°
80	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 11/16″ x 1 13/16″	FILAMENT	5.0	2.0	—	—	A-C Voltage per Plate (Volts RMS).. 350 400 550 D-C Output Current (Maximum MA.) 125 110 135 The 550 volt rating applies to filter circuits having an input choke of at least 20 henries.	80
'81	HALF-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 3	6 1/4″ x 2 7/16″	FILAMENT	7.5	1.25	—	—	Maximum A-C Plate Voltage......700 Volts, RMS Maximum D-C Output Current...... 85 Milliamperes	'81
82	FULL-WAVE ➤ RECTIFIER	MEDIUM 4-PIN	FIG. 2	4 11/16″ x 1 13/16″	FILAMENT	2.5	3.0	—	—	Maximum A-C Voltage per Plate......500 Volts, RMS Maximum D-C Output Current......125 Milliamperes Maximum Peak Inverse Voltage......1400 Volts Maximum Peak Plate Current...... 400 Milliamperes	82
83	FULL-WAVE ➤ RECTIFIER	MEDIUM 4-PIN	FIG. 2	5 3/8″ x 2 1/16″	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate......500 Volts, RMS Maximum D-C Output Current......250 Milliamperes Maximum Peak Inverse Voltage......1400 Volts Maximum Peak Plate Current...... 800 Milliamperes	83
84 also 6Z4	FULL-WAVE RECTIFIER	SMALL 5-PIN	FIG. 23	4 1/4″ x 1 9/16″	HEATER	6.3	0.5	—	—	Maximum A-C Voltage per Plate......350 Volts, RMS Maximum D-C Output Current...... 50 Milliamperes	84 also 6Z4

➤ Mercury Vapor Type. ° Interchangeable with Type 1.

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS



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PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

METAL TUBE CHARACTERISTICS

1. - THE TABLE BELOW CONTAINS THE OPERATING CHARACTERISTICS OF THE MORE POPULAR METAL TUBES, WHICH ARE EQUIPPED WITH THE "OCTAL" BASE (8 - PRONG BASE). IN THIS TABLE, THE LETTERS APPEARING TO THE RIGHT OF THE TUBE NUMBER IN THE TUBE TYPE COLUMN DO NOT APPEAR ON THE TUBE ITSELF AS A PART OF THE NUMBER BUT IN THIS PARTICULAR TABLE, THESE LETTERS INDICATE THE MANUFACTURER OF THE TUBE IN THE FOLLOWING MANNER:

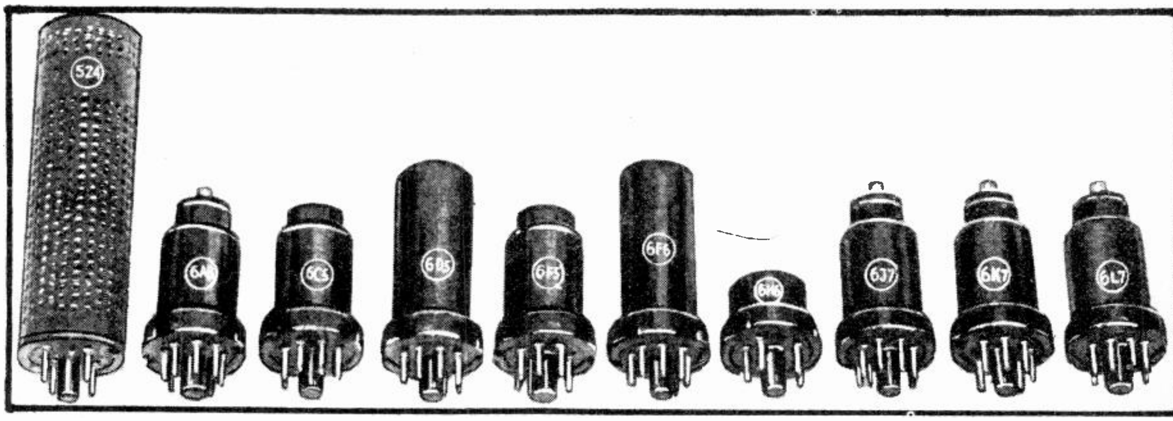

Fig. 1
A Group Of Popular Metal Tubes.

CHARACTERISTIC TABLE OF METAL TUBES.

TUBE TYPE	Fil. or Heater V.	Fil. or Heater A	Max. Pl. V.	Max. S.-G. V.	Grid V. Neg.	Pl. Ma.	Cath. Ma.	Plate Resis.	Mutual Cond.	Amp. Factor	Plate Load	Out-Put Watts	Equiv. Types	No. of Pins	Function
6A8 *RK*	6.3	0.3	250	100	3.0	4.0	14	300M	520				6A7	8	Pent. Converter
6A8 *A*	6.3	0.3	250	100	3.0	2.6	12.8						6A7	8	Pent. Converter
6A8 *TNS*	6.3	0.3	250	100	3.0	3.5		360M					6A7	7	Pent. Converter
6C5 *RATNKS*	6.3	0.3	250		8.0	8.0		10M	2,000	20			76	6	Triode Amply.
6D5 *RATNKS*	6.3	0.7	275		40	31		2,250	2,100	4.7	7,200	1.4	45	6	Triode Amp., Class A
6D5 *NKA*	6.3	0.7	300		50	23					-5,300	5.0	45	6	Triode Amp., Class AB
6F6 *RKS*	6.3	0.7	250	250	16.5	34		100M	2,300	200	7,000	3.0	42	7	Pentode Output, Class A
6F6 *TAN*	6.3	0.7	250	250	16.5	34	40.5	100M	2,200	220	7,000	3.0	42	7	Pentode Output, Class A
6F6 *KS*	6.3	0.7	250		20.0	31	31	2,600	2,700	7.0	4,000	.85	42	7	Triode Output, Class A
6F6 *K*	6.3	0.7	250	250	26.0	17	19.5				10,000	19.0	42	7	Pentode Output, Class AB
6F6 *K*	6.3	0.7	350		38.0	22.5					6,000	18.0	42	7	Triode Output, Class AB
6H6 *RATNKS*	6.3	0.3	100	Direct Current 2 Ma. (max.)									none	7	Duodiode Detector
6J7 *RTKANS*	6.3	0.3	250	100	3.0	2.0	2.5	1.5 meg. +	1,225	1,500 +			6C6	7	Pentode Det.-Amp.(Non-var. Mu.)
6K7 *RTANKS*	6.3	0.3	250	100	3.0	7.0	8.7	800M	1,450	1,160			6D6	7	Var. Mu. Amplifier
6L7 *RNKS*	6.3	0.3	250	150	6.0	3.5		2.0 meg. +	325				none	7	Pentagrid Mixer-Amplifier
6L7-G *A*	6.3	0.3	250	100	3.0	5.3		800M	1,100				none	7	Pentagrid Mixer-Amplifier
5Z4 *RKNTS*	5.0	2.0	400			125 Max							5Z3	5	Full-wave—H.-V. Amplifier
43-MG *T*	25.0	0.3	135	135	20	34	41	35,000	2,300	80	4,000	2.0	43	7	AC-DC Power Amp. Pentode
6F5 *NATKS*	6.3	0.3	250		2.0	0.9	0.9	66,000	1,500	100			none	5	High-Mu. Triode
25Z5-MG *T*	25.0	0.3	125	100									25Z5	7	Full-Wave Rectifier
50A2-MG *T*	50 V. total drop; 0.3-A.;												none	4	Ballast tube
50B2-MG *T*	50 V. total drop; 0.3-A.;												none	4	Ballast tube

(OVER)

R = RCA and Raytheon; K = Ken-Rad; A = Arcturus; T = Triad; N = National Union; S = Sylvania. These letters appearing after the tube types above mean that data was available from the makers on these particular types. Some manufacturers do not as yet make all the types at present available. Arcturus tube designations are all "terminated by "G", meaning glass-"metal"; the Triad termination is "MG", meaning metal-glass. Where manufacturers differ somewhat in their tube characteristics, the tube is listed twice, as is the case with the 6A8. The power tubes, 6D5 and 6F6 appear more than once because they are used under different operating conditions. The 6H6 is equivalent to the two diodes of a 75, while the 6F5 resembles the triode section of a 75. The Triad 50A2-MG and 50B2-MG are ballast tubes, both having a voltage drop of 50, the former for use with one Type No.40 pilot lamp and the latter for use with two. They are to be used in A.C.-D.C. sets, in place of the usual series resistors.

2. - The arrangement of the elements, together with the base connections for these metal tubes, are illustrated in Fig.2.

3. - The base connections for the remaining special tubes appearing in the table are illustrated in Fig.3. In both Figs. 2 and 3 base prong #1 is grounded in all cases-in this manner grounding the metal shell of the tube.

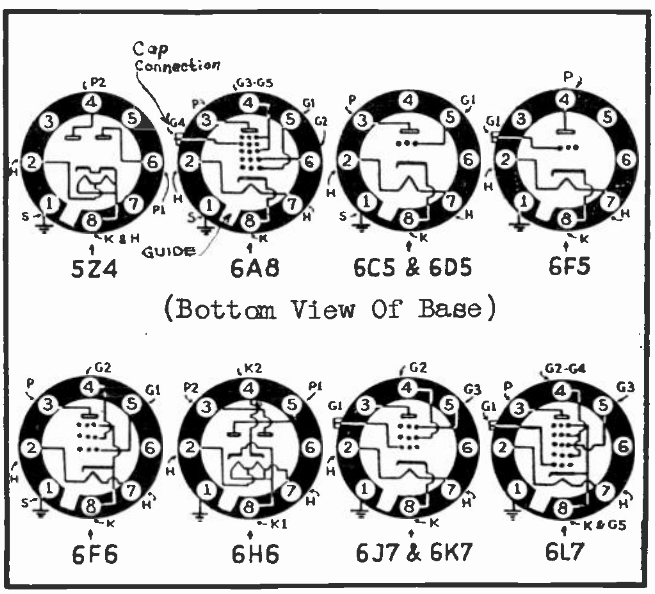

Fig. 2
Standard Metal Tube Bases

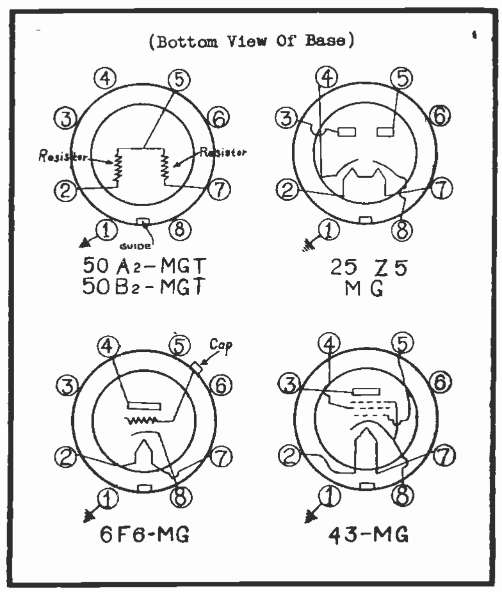

Fig. 3
Metal-Glass Octal-Base
Tube Connections

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NO. 15

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

CONTINUITY TESTS

THE PURPOSE OF THIS JOB SHEET IS TO DESCRIBE SIMPLE BUT ACCURATE METHODS FOR CHECKING THE CONTINUITY OF WINDINGS AND CIRCUITS, AS WELL AS THE METHOD OF TESTING RESISTORS AND CONDENSERS WITH THE AID OF THE MOST INEXPENSIVE EQUIPMENT. LATER JOB SHEETS DESCRIBE MORE ELABORATE TESTS OF THIS NATURE.

CHECKING A WINDING

1. — TO DETERMINE WHETHER OR NOT A WINDING SUCH AS USED IN AN A.F. TRANSFORMER, R.F. TRANSFORMER, CHOKE ETC. IS COMPLETE OR NOT PROCEED AS ILLUSTRATED IN FIG. 1, THAT IS, CONNECT A 4½ VOLT "C" BATTERY IN SERIES WITH A PAIR OF TEST LEADS AND A D.C. VOLTMETER HAVING A RANGE OF 0–10 VOLTS.

2. — TOUCH THE TWO TEST POINTS TO THE TWO TERMINALS ACROSS WHICH THE WINDING UNDER TEST IS CONNECTED. IF THE WINDING IN QUESTION IS OPEN CIRCUITED AS INDICATED IN FIG. 1, THEN THE VOLTMETER WILL OFFER A ZERO READING.

3. — SHOULD THE WINDING UNDER TEST BE INTACT OR COMPLETE, THEN THE VOLTMETER WILL OFFER A READING WHICH IS APPROXIMATELY EQUAL TO THE VOLTAGE OF THE BATTERY BEING USED. THE EXACT READING WILL DEPEND UPON THE RESISTANCE OF THE WINDING THROUGH WHICH THE TEST IS BEING MADE.

CHECKING A CONDENSER

1.— THE METHOD OF CHECKING A CONDENSER SO AS TO DETERMINE WHETHER IT IS SHORTED ("BURNED OUT") OR NOT IS ILLUSTRATED IN FIG. 2. HERE THE SAME TESTING EQUIPMENT IS EMPLOYED AS HAS ALREADY BEEN DESCRIBED RELATIVE TO FIG. 1.

2.— WHEN CONDUCTING THIS TEST, THE TEST POINTS ARE CONNECTED ACROSS THE CONDENSER TERMINALS

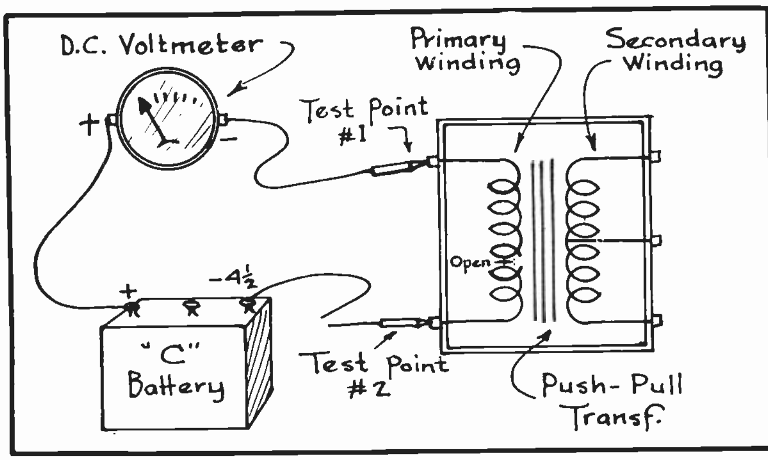

Fig.1
Checking A Transformer.

AND THE ACTION OF THE VOLTMETER CAREFULLY NOTED.

3. — IF THE VOLTMETER INDICATES THE VOLTAGE OF THE "C" BATTERY, THEN THE CONDENSER IN QUESTION IS SHORTED AND SHOULD BE REPLACED WITH A NEW ONE.

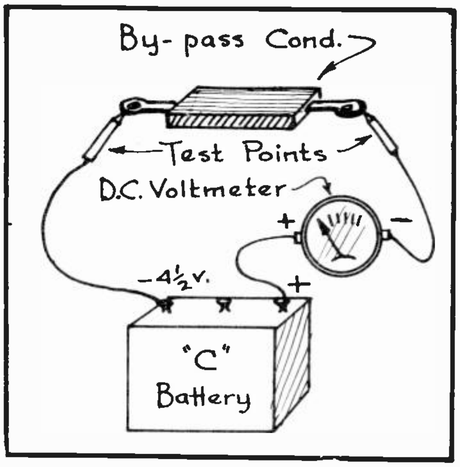

Fig. 2
Testing A Condenser.

4. — IF THE CONDENSER IS IN GOOD CONDITION THEN THE INSTANT THAT THE TEST POINTS ARE CONNECTED ACROSS THE CONDENSER TERMINALS, THE VOLTMETER NEEDLE WILL MOVE VERY SLIGHTLY TOWARDS THE RIGHT FROM THE ZERO MARK BUT ONLY FOR AN INSTANT. THE NEEDLE WILL THEN IMMEDIATELY DROP TO THE ZERO LINE OF THE VOLTMETER SCALE AND AT WHICH POSITION IT WILL REMAIN AS LONG AS THE TEST POINTS ARE HELD IN PLACE.

CHECKING RESISTORS

1. — RESISTORS WHOSE NORMAL RESISTANCE VALUE IS NOT TOO HIGH CAN BE CHECKED FOR CONTINUITY AS PER FIG. 3.

2. — IF THE RESISTOR IS OPEN CIRCUITED, THE VOLTMETER READING WILL BE ZERO. IF THE RESISTOR IS IN A GOOD CONDITION, A METER READING WILL BE OBTAINED — THE EXACT READING DEPENDING UPON THE RESISTANCE VALUE OF THE RESISTOR UNDER TEST.

3. — FOR RESISTORS OF HIGH OHMIC VALUE, THIS TEST ISN'T RELIABLE IN THAT THE RESISTANCE MAY NORMALLY BE SUFFICIENTLY GREAT SO THAT 4½ VOLTS IS NOT ABLE TO FORCE SUFFICIENT CURRENT THROUGH THE UNIT TO OFFER A LEGIBLE READING. AN OHMMETER RESISTOR CHECK IS MORE DESIRABLE AND IS FULLY EXPLAINED IN A LATER JOB SHEET.

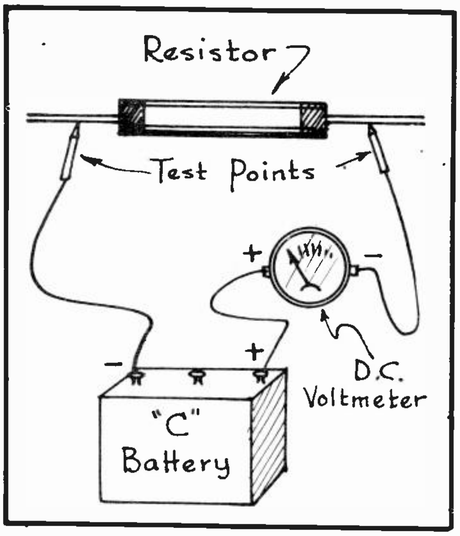

Fig. 3
Checking The Resistor.

NOTE: WHEN PERFORMING THE CONTINUITY TESTS AS DESCRIBED IN THIS JOB SHEET, IT IS ADVISABLE THAT THE UNIT WHICH IS BEING TESTED BE DISCONNECTED FROM THE RECEIVER CIRCUITS DURING THE TIME THAT THE TEST IS CONDUCTED. IN THIS WAY, YOU ARE CERTAIN THAT YOU ARE NOT TESTING THRU AN EXTERNAL CIRCUIT RATHER THAN THROUGH THE UNIT ITSELF.

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PRACTICAL RADIO JOB SHEET NO. 16

SPECIALLY PREPARED FOR THE STUDENTS OF

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THE RESISTOR COLOR CODE

IT IS NOT THE GENERAL PRACTICE AMONG THE MANUFACTURERS OF RESISTORS TO MARK THE OHMIC VALUE UPON THE UNIT. INSTEAD OF THIS, THE OUTER SURFACE OF THE RESISTOR UNIT IS PAINTED IN A COMBINATION OF COLORS AND BY PROPERLY INTERPRETING THIS COLOR-COMBINATION, ONE CAN READILY DETERMINE THE RESISTANCE VALUE OF THE UNIT.

1. – FIG. 1 SHOWS YOU THE CUSTOMARY MANNER IN WHICH FIXED RESISTORS ARE COLORED. AS YOU WILL OBSERVE, THE BODY OF THE RESISTOR IS PAINTED ONE COLOR, THE END OF THE RESISTOR ANOTHER COLOR AND A THIRD COLOR IS ADDED IN THE FORM OF A SPOT OR BAND AT THE CENTER OF THE BODY.

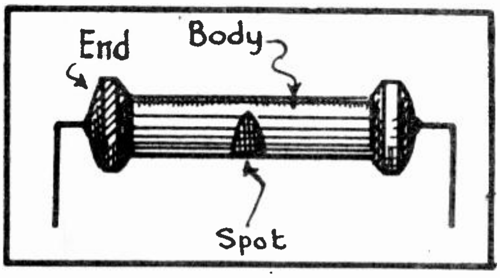

Fig. 1
A Color-Coded Resistor.

2. – THE BODY COLOR OF THE RESISTOR INDICATES THE FIRST SIGNIFICANT FIGURE, THE END COLOR DESIGNATES THE SECOND SIGNIFICANT FIGURE AND THE SPOT OR BAND COLOR DESIGNATES THE THIRD SIGNIFICANT FIGURE OF THE UNIT'S OHMIC VALUE.

3. – THE FOLLOWING TABLE EXPLAINS THE NUMERICAL VALUE FOR THE RESPECTIVE COLORS.

BODY COLOR		END COLOR		SPOT OR BAND COLOR	
BROWN	1	BLACK	0	BLACK	0
RED	2	BROWN	1	BROWN	0.
ORANGE	3	RED	2	RED	00.
YELLOW	4	ORANGE	3	ORANGE	000.
GREEN	5	YELLOW	4	YELLOW	0000.
BLUE	6	GREEN	5	GREEN	00000.
VIOLET	7	BLUE	6	BLUE	000000.
GRAY	8	VIOLET	7		
WHITE	9	GRAY	8		
BLACK	0	WHITE	9		

EXAMPLE: A FIXED RESISTOR HAS A RED BODY COLOR, A BLACK END COLOR AND A GREEN SPOT ON ITS BODY. WHAT IS THE RESISTANCE IN OHMS OF THIS UNIT?

ANSWER: BODY COLOR OF RED DESIGNATES A FIRST SIGNIFICANT FIGURE OF 2; END COLOR OF BLACK DESIGNATES A SECOND SIGNIFICANT FIGURE OF 0, BRINGING THE VALUE SO FAR TO 20; GREEN SPOT ON BODY DESIGNATES A THIRD SIGNIFICANT FIGURE OF 00000; THE RESISTANCE OF THIS PARTICULAR UNIT IS THEREFORE 2,000,000 OHMS OR 2 MEGOHMS.

NO. 17

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

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THE CONDENSER COLOR CODE

SOME MANUFACTURERS OF FIXED MICA CONDENSERS EMPLOY A COLOR CODE FOR DESIGNATING THE CAPACITIVE VALUE OF THEIR UNITS. IN SUCH CASES, THREE DOTS ARE PLACED ON THE TRADEMARK SIDE AND EACH OF A DIFFERENT COLOR AS ILLUSTRATED IN FIG. I.

I. – TO INTERPRET THE CODE, THE CONDENSER IS HELD IN THE POSITION SHOWN IN FIG. I AND THE DOTS ARE READ FROM THE LEFT TOWARDS THE RIGHT. THE FIRST DOT REPRESENTS THE FIRST FIGURE OF THE CONDENSER CAPACITY, THE SECOND DOT REPRESENTS THE SECOND FIGURE OF THE CONDENSER CAPACITY AND THE THIRD DOT REPRESENTS THE NUMBER OF ZEROS FOLLOWING THE FIRST TWO FIGURES.

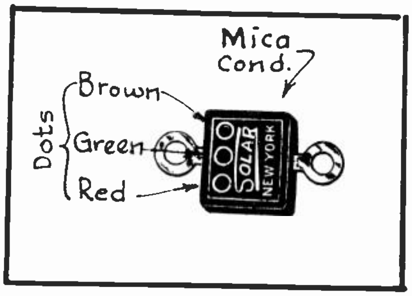

Fig. 1
Condenser Code Marks.

2. – THE COLOR CODE AS USED WITH THIS SYSTEM APPEARS IN THE TABLE OF FIG. 2 AND WHEN INTERPRETED, THE CONDENSER CAPACITY IS EXPRESSED IN MICRO-MICROFARADS.

3. – WITH REFERENCE TO BOTH FIGS. I AND 2 OF THIS JOB SHEET, THE CAPACITIVE VALUE OF THE CONDENSER SHOWN IN FIG. I WORKS OUT AS FOLLOWS: THE RED DOT INDICATES A CAPACITIVE VALUE WHOSE FIRST DIGIT IS 2; THE GREEN DOT INDICATES A SECOND DIGIT OF THIS VALUE AS BEING 5 AND THE BROWN DOT INDICATES THAT ONE ZERO FOLLOWS THE SECOND DIGIT. THUS THE CAPACITIVE VALUE OF THIS CONDENSER IS 250, MMFD. OR .00025 MFD.

BLACK	0	GREEN	5
BROWN	1	BLUE	6
RED	2	VIOLET	7
ORANGE	3	GRAY	8
YELLOW	4	WHITE	9

Fig. 2
Color Code Table.

4. – AS ANOTHER EXAMPLE LET US CONSIDER A CONDENSER ON WHICH APPEAR A GREEN DOT, A BLACK DOT, AND A BROWN DOT READING FROM LEFT TO RIGHT. IN THIS CASE, THE GREEN DOT INDICATES A FIRST DIGIT 5; THE BLACK DOT INDICATES A SECOND DIGIT OF 0; AND THE BROWN DOT INDICATES THAT ONE ZERO FOLLOWS THE SECOND DIGIT. THEREFORE, THE CAPACITIVE VALUE OF THE CONDENSER IN THIS CASE WILL BE 500 MMFD. OR .0005 MFD.

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NO. 18

PRACTICAL RADIO JOB SHEET

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IDENTIFYING POWER TRANSFORMER TERMINALS

As a general rule the terminals of power transformers are not marked by the manufacturer for identification purposes. In such cases, the method as described in this JobSheet can be employed so that one can ascertain definitely which of the transformer windings are connected to the various terminals.

1. – First connect a 110 volt–25 watt incandescent lamp in series with the 110 volt lighting circuit and a pair of test points as shown in the accompanying illustration. Naturally, if a 220 volt transformer is involved, a 220 volt lamp and circuit would be used.

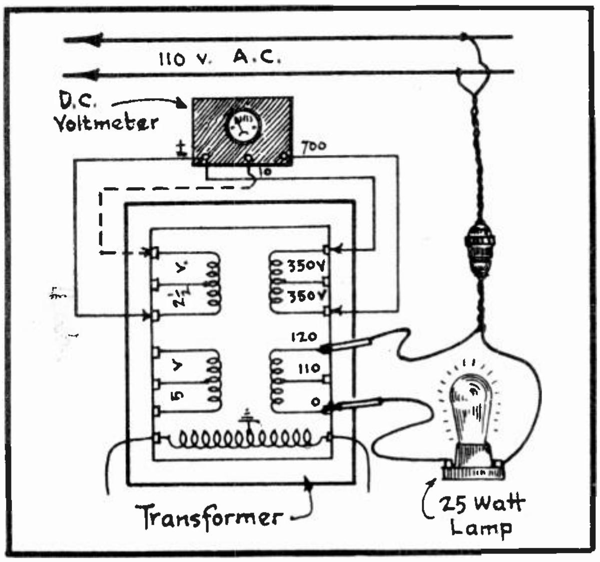

Fig. 1
Testing The Transformer.

2. – With the lamp circuit test points, test between the various terminals until you locate a pair which cause the lamp to burn very dim. These terminals have the primary winding connected to them.

3. – Connect the lamp circuit across these primary terminals and with an A.C. voltmeter of suitable range test between the remaining terminals until readings corresponding to the high voltage winding are obtained. For instance, if the high voltage winding is rated for 700 volts across its extremeties, then a voltmeter reading of this value will be obtained when connected across these two corresponding terminals. A reading of one-half this amount will be obtained between each end terminal of this winding and its center tap.

4. – Using the low range A.C. voltmeter scale, continue testing for the terminals of the low voltage windings, again remembering that between the center tap of any of these windings and either end terminal, the reading will be one-half that obtained across the two ends of the same winding. Also make it a practice to consider the transformer core as a terminal while testing.

5. – If the primary winding is designed for high and low line voltage, the lamp will burn dim when one test point is held in contact with one end of the primary and with the other test point in contact with either of the two remaining primary terminals.

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PRACTICAL RADIO JOB SHEET

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APPLICATION OF A LINE VOLTAGE REGULATOR

IN SOME LOCALITIES IN WHICH A.C. RECEIVERS ARE OPERATED, THE LINE VOLTAGE VARIES TO SUCH AN EXTENT THAT THE VOLTAGE AT TIMES BECOMES SUFFICIENTLY GREAT TO BURN OUT THE RECEIVER TUBES OR ELSE DAMAGE THE POWER PACK.

1. – TO REMEDY SUCH A CONDITION A LINE VOLTAGE REGULATOR CAN BE CONNECTED IN SERIES WITH THE A.C. LINE AND THE PRIMARY WINDING OF THE RECEIVER'S POWER TRANSFORMER AS SHOWN IN FIG. 1.

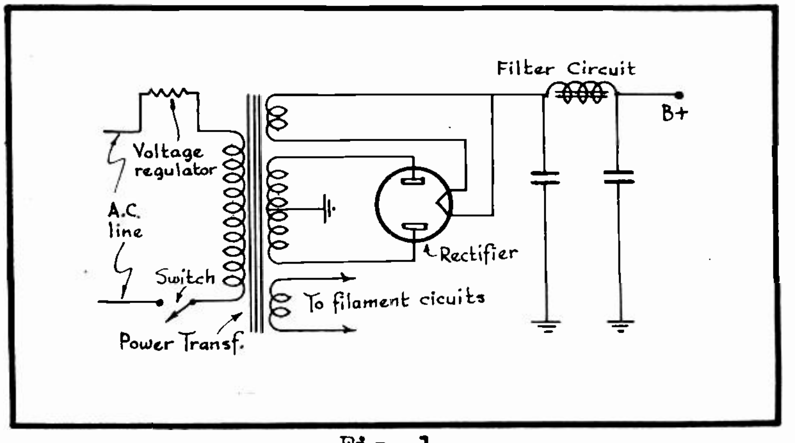

Fig. 1
Installation Of Voltage Regulator In Circuit.

2. – TWO POPULAR LINE VOLTAGE REGULATORS ARE SHOWN IN FIG. 2. THE ONE AT THE LEFT IS A "CLAROSTAT" AND CONSISTS OF A PERFORATED METAL CONTAINER IN WHICH A SPECIAL RESISTANCE ELEMENT IS CONTAINED. ITS DESIGN IS SUCH THAT IT CAN BE INSERTED INTO AN ORDINARY SCREW TYPE PLUG OR CONVENIENCE OUTLET OF THE LIGHTING CIRCUIT. THE PLUG WHICH IS ATTACHED TO THE RECEIVER'S POWER CORD IS THEN INSERTED IN THE TWO HOLES PROVIDED FOR THIS PURPOSE ON THE REGULATOR.

3. – THE TUBE TYPE REGULATOR ("AMPERITE") ALSO SHOWN IN FIG. 2 CAN BE MOUNTED AT ANY CONVENIENT POINT IN THE RECEIVER CABINET SO THAT THE UNIT WILL BE IN SERIES WITH THE A.C. LINE AND THE RECEIVER.

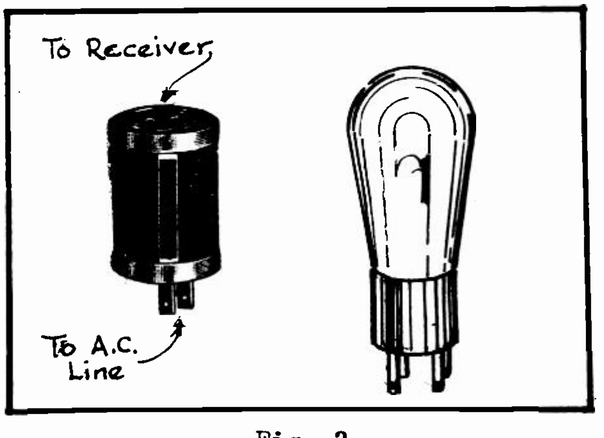

Fig. 2
Typical Voltage Regulators.

4. – FOR 110 VOLT RECEIVERS THESE REGULATORS WILL MAINTAIN THE RECEIVER VOLTAGE VERY NEARLY CONSTANT EVEN THOUGH THE LINE VOLTAGE MAY VARY BETWEEN 95 AND 140 VOLTS. WHEN ORDERING SUCH A REGULATOR FROM A DEALER, IT IS IMPORTANT TO SPECIFY THE VOLTAGE AND POWER CONSUMPTION RATING OF THE RECEIVER.

5. – WHEN PURCHASING A REGULATOR REPLACEMENT ALWAYS SPECIFY THE NAME AND MODEL OF RECEIVER.

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PRACTICAL RADIO JOB SHEET NO. 20
SPECIALLY PREPARED FOR THE STUDENTS OF
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COMMON TROUBLES IN BROADCAST SUPERHETERODYNE RECEIVERS

IN THIS JOBSHEET ONLY THE MORE COMMON TROUBLES PECULIAR TO SUPERHETERODYNES ARE CONSIDERED. GENERAL CIRCUIT TROUBLES SUCH AS DEFECTIVE TUBES, RESISTORS, CONDENSERS ETC. WHICH MAY OCCUR IN ANY RECEIVER REGARDLESS IF IT BE OF THE T.R.F. OR SUPERHETERODYNE TYPE ARE NOT TREATED HERE.

WEAK SIGNALS THROUGHOUT TUNING RANGE

1. – IMPROPER ADJUSTMENT OF I.F., OSCILLATOR, MIXER OR R.F. TRIMMERS OR A DEFECT IN ANYONE OF THESE UNITS.
2. – DEFECTIVE ANTENNA OR GROUND SYSTEM.
3. – DEFECTIVE R.F., MIXER, OSCILLATOR, OR I.F. TRANSFORMER.
4. – DEFECTIVE A.V.C. SYSTEM.
5. – POOR OSCILLATOR TUBE, OR CIRCUIT CONDITION IS SUCH THAT LOW OSCILLATOR OUTPUT IS FURNISHED.

WEAK SIGNALS OVER A PART OF TUNING RANGE

1. – IMPROPER ALIGNMENT OF R.F., MIXER, AND OSCILLATOR TRIMMERS OVER THAT PART OF THE BAND WHERE THE RECEIVER AFFORDS LOW OUTPUT
2. – POOR OSCILLATOR TUBE.
3 – DEFECTIVE COUPLING BETWEEN OSCILLATOR AND MIXER TUBES.
4. – WRONG VOLTAGE SUPPLIED TO OSCILLATOR.
5. – UNSATISFACTORY ANTENNA SYSTEM.

RECEIVER INOPERATIVE OVER A PORTION OF DIAL

1. – POOR OSCILLATOR TUBE.
2. – OSCILLATOR TUBE BEING OPERATED WITH WRONG VOLTAGES APPLIED TO IT.
3. – HIGH RESISTANCE IN TUNED CIRCUITS OF OSCILLATOR OR MIXER TUBE.

4. – R.F., MIXER, OR OSCILLATOR TRIMMERS NOT PROPERLY ADJUSTED.

5. – DEFECTIVE OSCILLATOR COIL.

6. – DEFECTIVE COUPLING BETWEEN OSCILLATOR AND MIXER.

7. – LEAK OR SHORT CIRCUIT BETWEEN TUNING CONDENSER PLATES AT CERTAIN POINTS OF THEIR TRAVEL.

DEAD RECEIVER

1. – DEFECTIVE OSCILLATOR TUBE.

2. – DEFECTIVE OSCILLATOR CIRCUIT OR COMPONENT THEREOF, SUCH AS THE COIL, CONDENSERS, ETC.

3. – DEFECTIVE A.V.C. SYSTEM.

4. – ALIGNMENT OF TUNING CIRCUITS COMPLETELY DISTURBED.

5. – DEFECT IN R.F. OR MIXER CIRCUIT (SAME AS COMMON TO T.R.F. RECEIVERS).

6. – DEFECT IN I.F. CHANNEL AS SHORTED TRIMMER CONDENSERS, OPEN OR SHORTED I.F. TRANSFORMER WINDINGS, ETC.

7. – DEFECT IN SECOND DETECTOR CIRCUIT OR A.F. CHANNEL.

8. – ANY OTHER DEFECT COMMON TO BOTH T.R.F. AND SUPERHETERODYNES SUCH AS DEFECTIVE POWER PACK, OPEN FEEDER CIRCUITS, GROUNDED CIRCUITS ETC.

HETERODYNE WHISTLE AS EACH STATION IS TUNED IN

1. – AN OSCILLATORY CONDITION IN THE R.F., I.F., OR MIXER TUBE CIRCUITS.

2. – INCORRECT LOCATION OF CONTROL GRID OR PLATE LEADS IN R.F., MIXER, OR I.F. CIRCUITS.

3. – OPEN BYPASS CONDENSERS IN A.V.C. VOLTAGE FEED CIRCUITS.

4. – SHORTED GRID FILTER RESISTORS IN R.F., MIXER, AND I.F. CIRCUITS.

5. – OPEN CONDENSERS IN R.F., MIXER, I.F., OR SECOND DETECTOR CIRCUITS.

6. – SHIELDS NOT PROPERLY GROUNDED.

WHISTLE OR GROWL BACKGROUND TO ALL STATIONS

1. – OSCILLATORY CONDITION IN I.F. OR A.F. AMPLIFIER.

2. — Improper operation of oscillator circuit.

3. — Excessive resistance in grid circuits.

4. — Imperfect bias resistors.

5. — Imperfect bypass condensers across bias and grid filter resistors.

WHISTLE WHEN TUNING IN CERTAIN STATIONS ONLY

1. — Insufficient selectivity in tuning circuits preceding the mixer tube.

2. — Improper alignment of I.F. tuning circuits.

3. — Trimmers of R.F., oscillator, and mixer circuits not properly adjusted for that particular section of the band.

4. — Excessive signal strength of interfering station preceding the mixer circuit.

5. — Undesired coupling between antenna or ground leads and second detector circuit.

6. — Poor shielding.

REPEAT POINTS (STATION RECEIVED AT MORE THAN ONE POINT ON DIAL)

1. — Oscillator trimmer adjustment not correct.

2. — R.F. tuning condenser trimmer adjustment not correct.

3. — Excessive pick-up from station.

4. — Mixer circuit trimmer not properly adjusted.

5. — Incorrect location of aerial leads.

6. — Imperfect shielding.

7. — Excessive control grid bias on R.F. and mixer tubes.

DISTORTION ALTHOUGH ALL CIRCUIT CONSTANTS ARE NORMAL

1. — R.F. mixer or oscillator circuits not properly aligned.

2. — I.F. trimmers out of alignment.

3. — Overloading of tubes.

4. — Excessive control grid bias when receiver is operated at low volume.

5. — IMPROPERLY DESIGNED OR OPERATING A.V.C. SYSTEM

6. — DEFECTIVE TUBE OR TUBES.

7. — DEFECTIVE TRANSFORMER IN R.F., MIXER, OR OSCILLATOR CIRCUIT.

8. — EXCESSIVELY SHARP TUNING.

9. — INSUFFICIENT STRENGTH OF HETERODYNING SIGNAL.

FREQUENT NEED FOR RETUNING

THIS CONDITION IS GENERALLY DUE TO OSCILLATOR FREQUENCY DRIFT AND WHICH MEANS THAT THE OSCILLATOR OUTPUT CHANGES AFTER THE RECEIVER HAS BEEN IN USE FOR A WHILE ALTHOUGH THE OPERATOR HAS MADE NO CHANGE IN THE SETTING OF THE TUNING DIAL. MOST PROBABLE CAUSES FOR THIS TROUBLE ARE:

1. — IMPERFECT MOUNTING OF TUNING CONDENSER OR SLIPPING TUNING CONDENSER DRIVE IN WHICH CASE TOO MUCH PLAY MAY CAUSE A SLIGHT SHIFT IN THE SETTING OF THE TUNING CONDENSER BECAUSE OF THE VIBRATIONS CREATED BY OPERATION OF THE SPEAKER IN THE SAME CABINET.

2. — IMPERFECT MOUNTING OF OSCILLATOR COILS OR IMPERFECT COUPLING BETWEEN OSCILLATOR AND MIXER CIRCUIT.

3. — FLUSTRATIONS IN THE APPLIED OPERATING VOLTAGE.

4. — IMPERFECT GROUND CONNECTION TO TUNING CONDENSER ROTOR OF THE OSCILLATOR.

5. — IF SHIELD IS USED ON OSCILLATOR COIL, IT MAY NOT BE GROUNDED PROPERLY.

6. — DEFECTIVE RESISTOR IN OSCILLATOR CIRCUIT, ESPECIALLY IN THE GRID CIRCUIT. ANY VARIATION IN RESISTANCE DURING THE COURSE OF OPERATION WILL PRODUCE A CHANGE IN THE FREQUENCY OUTPUT OF THE OSCILLATOR.

7. — DEFECTIVE (LEAKY) BYPASS CONDENSERS CONNECTED ACROSS THE VARIOUS RESISTORS WHICH ARE RELATED TO THE OSCILLATOR CIRCUIT.

INTERFERING SIGNAL APPEARS AFTER RECEIVER HAS BEEN IN OPERATION FOR SOME TIME AND DISAPPEARS IF SHUT OFF FOR AWHILE AND THEN AGAIN PLACED IN OPERATION.

SAME TROUBLES AS LISTED UNDER THE HEADING FREQUENT NEED FOR RETUNING.

PRACTICAL RADIO JOB SHEET NO. 21
SPECIALLY PREPARED FOR THE STUDENTS OF
NATIONAL SCHOOLS
Los Angeles California

OUTPUT METER CONNECTIONS

WHEN ALIGNING THE TUNED CIRCUITS OF RECEIVERS AS WELL AS WHEN CONDUCTING OTHER TESTS IN WHICH THE OUTPUT OF THE SET IS TO BE CHECKED, OUTPUT METERS ARE USED EXTENSIVELY. THE PURPOSE OF THIS JOBSHEET, THEREFORE, IS TO FAMILIARIZE YOU WITH THE PROPER METHODS OF CONNECTING THE OUTPUT METER TO RECEIVERS EMPLOYING VARIOUS TYPES OF OUTPUT CIRCUITS.

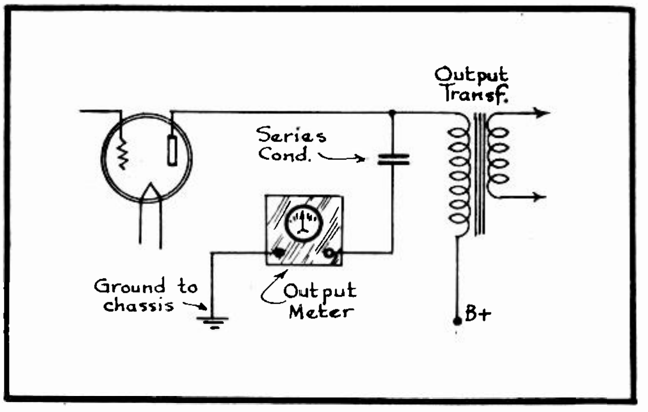

Fig.1
Meter Connection For Single Tube Output.

SINGLE TUBE OUTPUT

1. — IN FIG. I YOU ARE SHOWN THE PROPER METHOD OF CONNECTING THE OUTPUT METER TO A RECEIVER WHICH IS EQUIPPED WITH AN OUTPUT STAGE EMPLOYING A SINGLE POWER TUBE AND WHERE A DYNAMIC SPEAKER IS USED.

2. — THE OUTPUT METER IN THIS CASE IS CONNECTED BETWEEN THE PLATE TERMINAL OF THE POWER TUBE'S SOCKET AND THE CHASSIS. A CONDENSER HAVING A CAPACITY FROM .I MFD. TO 2 MFD. IS CONNECTED IN SERIES WITH THE OUTPUT METER IN ORDER TO PREVENT ANY DIRECT CURRENT FROM FLOWING THROUGH THE METER. IN THIS WAY ONLY THE ALTERNATING COMPONENT OF THE SIGNAL VOLTAGE IS PERMITTED TO ACT UPON THE METER. IN MOST COMMERCIAL OUTPUT METERS, THIS SERIES CONDENSER IS ALREADY INCLUDED IN THE UNIT.

3. — TO FASCILITATE THE METER CONNECTION TO THE PLATE CIRCUIT OF THE POWER TUBE, THE PLATE CIRCUIT CONNECTION CAN BE MADE AT THE PROPER TERMINAL OF THE RECEIVER'S OUTPUT TRANSFORMER WHEN CONVENIENT, OR ELSE THE POWER TUBE CAN BE REMOVED FROM ITS SOCKET, AN ADAPTER CLIP SLIPPED OVER ITS PLATE PRONG AND AFTER WHICH THE TUBE CAN BE RE-INSERTED IN ITS SOCKET.

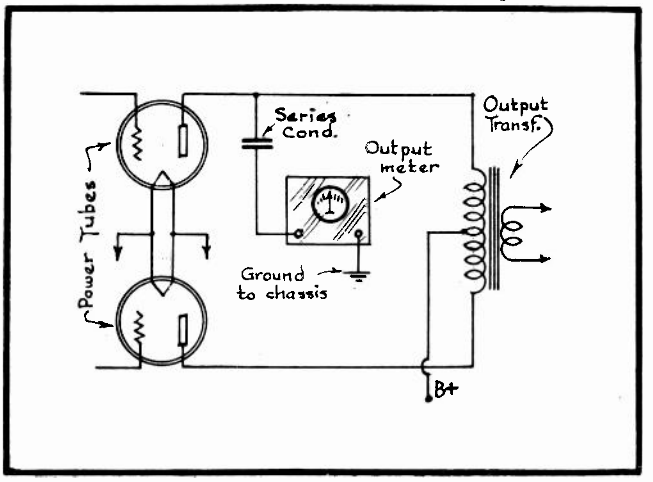

Fig. 2
Meter Connection For Push-Pull Output.

PUSH-PULL OUTPUT

1. — ON RECEIVERS WHICH EMPLOY A PUSH-PULL OUTPUT CIR-

CUIT, THE OUTPUT METER SHOULD BE CONNECTED BETWEEN THE CHASSIS AND THE PLATE TERMINAL OF EITHER ONE OF THE TWO POWER TUBES. IN THIS CASE ALSO, A CONDENSER SHOULD BE INSERTED IN SERIES WITH THE OUTPUT METER.

2. — ALTHOUGH IT IS POSSIBLE TO CONNECT THE OUTPUT METER DIRECTLY ACROSS THE PLATES OF THE TWO POWER TUBES THROUGH THE SERIES CONDENSER, YET THIS ARRANGEMENT WILL NOT PROVIDE METER DEFLECTIONS AS GREAT AS WILL THE CONNECTIONS ILLUSTRATED IN FIG. 2.

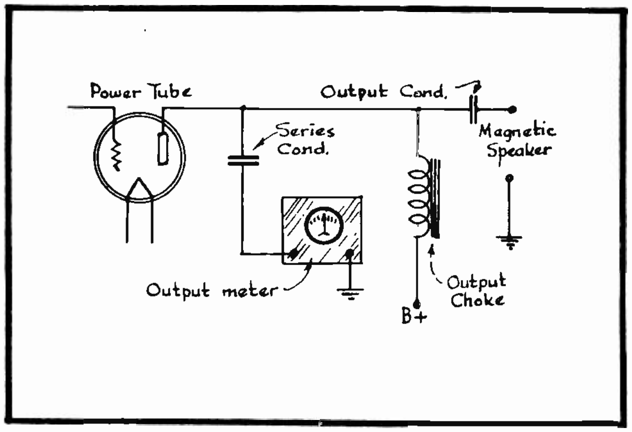

Fig. 3
Meter Connection When Using Magnetic Speaker.

OUTPUT FOR MAGNETIC SPEAKER

1. — IF A MAGNETIC SPEAKER IS BEING USED WITH A RECEIVER AND THE CIRCUIT ARRANGEMENT IS SUCH AS ILLUSTRATED IN FIG. 3, THEN THE OUTPUT METER CONNECTION AS ALSO SHOWN IN THIS SAME DIAGRAM CAN BE USED.

EMERGENCY REPAIR OF A.F. TRANSFORMER

IN RECEIVERS WHERE AN A.F. TRANSFORMER IS USED AS A MEANS OF COUPLING BETWEEN THE A.F. STAGES, AS ILLUSTRATED IN FIG. 4, ONE OF THE WINDINGS SOMETIMES BECOMES OPEN CIRCUITED AFTER THE UNIT HAS BEEN IN SERVICE. IN THE EVENT THAT A NEW TRANSFORMER CANNOT BE OBTAINED READILY, AN EMERGENCY REPAIR CAN BE MADE IN THE FOLLOWING MANNER:

1. — IF THE PRIMARY WINDING IS OPEN CIRCUITED, THEN CONNECT A 25,000 OHM RESISTOR ACROSS THE PRIMARY TERMINALS OF THE TRANSFORMER AND CONNECT A .05 MFD. CONDENSER BETWEEN THE PLATE (P) AND THE GRID (G) TERMINAL OF THE TRANSFORMER AS SHOWN IN THE UPPER ILLUSTRATION OF FIG. 4.

2. — SHOULD THE SECONDARY WINDING BE OPEN CIRCUITED, THEN CONNECT A 75,000 OHM RESISTOR ACROSS THE SECONDARY TERMINALS OF THE TRANSFORMER AND AN .05 MFD. CONDENSER BETWEEN THE PLATE AND GRID TERMINALS OF THE TRANSFORMER AS SHOWN IN THE LOWER ILLUSTRATION OF FIG. 4.

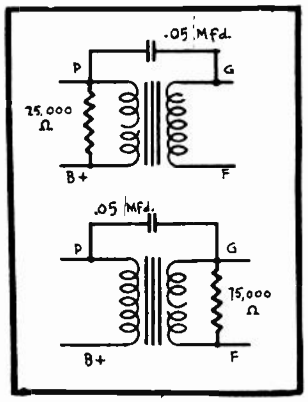

Fig. 4
The Connections.

3. — IF EITHER OF THESE TWO WINDINGS IS DEFECTIVE TO THE EXTENT OF BEING NOISY (CAUSING FRYING AND CRACKLING SOUNDS) THEN IT IS BEST TO DISCONNECT THAT WINDING FROM THE CIRCUIT ENTIRELY AND USE THE PROPER RESISTOR IN ITS PLACE.

NO. 22

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

NATIONAL SCHOOLS

Los Angeles California

TABLE OF INTERMEDIATE FREQUENCIES

MODEL	K.C.
AIR KING	
37-39-52-54	456
ALLIED	
Knight 118 AVC	175
" 6 tube	175
" 7 tube	175
" P	175
" P9541	175
" P9616	175
" E9830	177.5
" E9831	177.5
" 12 tubes	177.5
" P9660	177.5
" P9640	177.5
" P9505	456
" P9511	456
" P9515	456
" P9531	456
" P9591	456
" P9501	456
" P9571	456
" P9631	456
" P9610	465
ATWATER KENT	
137	125
91-91B-91C	262.5
81-155-246-266	262.5
555-636-756-756B	262.5
165Q-525Q	264
217-427-667-217D	264
427D-667D-275-387	264
4270-424-425-665	264
534	450
480-708-808-711	472.5
808A	472.5
93 Converter	1000
All Other Models	130
ALL AMERICAN MOHAWK CORP.	
See R. Wurlitzer	
ANSLEY RADIO CORP.	
All Models	175
AUDIOLA RADIO CO.	
1931 Super-Hets	175
5W-3374-3385	456
3387-33S10SW-3485LW	456
3386B-34C5AC-DC	456
3485AVC	456
All Others	177.5
BALKEIT RADIO CO.	
L7-L8-58-85-100	175
BELMONT RADIO CORP.	
81	105
625-650-660	175
670-750-1050	175
71C	175
775	370
525-530-540	456
550	456
BOSCH RADIO CO.	
See United American Bosch	
BROWNING DRAKE RADIO CORP.	
40-80	175
BRUNSWICK	
11-12-16	175
33AC-17-24-25	175
3NC8-5NC8	180
3NW8	180
BULOVA WATCH CO.	
All Models	175
CAPEHART CORP.	
All Models	180
CLARION RADIO	
See Transformer Corp. of America	
COLONIAL RADIO CORP.	
Laboratory Models 132 & 139	450
150	480
55	1000
All Others	175
COLUMBIA PHONOGRAPH CO., INC.	
All Models	175
CROSLEY RADIO CORP.	
120-121-122-123-124	175
124-1—125-126-126-1—127	175
127-1—128-131	175
148-154-155-156-159	456
163-166-167-169-172	456
173-173-5—174	456
All Others	181.5
DELCO APPLIANCE CORP.	
32 Volt DC Super 110 Volt AC Super	175
DELCO RADIO	
3026	175
De WALD	
AC746-7M - DAH-62	175
PLO	115
500A	130
58R-60-61-61R	455
55X 58EX-59-61-555	456
570-630	456
ECHOPHONE RADIO MFG. CO., LTD.	
62-72-92	115
All Others	175
ELEC. RESEARCH LAB., INC. Erla -- Sentinel	
1020A-1030A	115
513-570*	262
560-561-510-263	265
540-599-600-602	265
501-502-570*	465
622-623-634-635	465
5000-5010-6101-6102	465
6317-6321	465
All Others	175
ELEC. AUTO LITE	
062A-072A	262
EMERSON	
L-755 - 50-L	115
375-LW	125
35-30-250-300-B10	172.5
H5-77-667-678-965	172.5
J8-KS-CB-M-AC-7-B-AC-10	175
40-373-M-755-80M	175
350-LW - H5L - 30LW	132
250LW-321LW	132
AW55	445
26-30AW-33AW	456
250AW-321AW-350AW	456
39-59-71-770-8-755	456
S50	456
ERLA	
See Electrical Research Lab.	
EMPIRE ELEC. PRODUCTS	
74	462.5
All Others	175
FADA RADIO & ELEC. CORP.	
RX93-RX95-RX	125
RN106-RN107-RN108	470
RY-RS112	470
131-132RU-133-134-136	265
78-10-79-10-97-10-141NA	265
151-152NE	265
All Others	175
FEDERATED PURCHASER	
31-40	175
FORDSON	
F.U.-F.W.-F.P.32V-F.P.	456
FRANKLIN	
63L	130
100-102-200	175
94	450
53-54L	456
FREED TEL. & RADIO CORP.	
76	115
81DC-72-74-MB7-360	175
360X	175
58-70-72-74	177.5
A7-A9-358-365-365X	456
94-55-77	456
78	462.5
JESSE FRENCH	
Models - U-1 up	175
GALVIN MFG. CO.	
J-8-810	175
Dual 8 - Twin 8	262
44-55-66-77-77A	456
GENERAL ELECTRIC CO.	
K64-M65-M68	370
K80-K80X-K85	445
M41-K43-M49	480
All Others	175
GENERAL HOUSEHOLD UTILITIES	
700-701-801-901-902-1101	262
501-502-403	455
GENERAL MOTORS	
281	535
All Others	175
GRAYBAR ELEC.	
340	180
All Others	175
GREBE	
61R	456
All Others	175
GRIGSBY-GRUNOW CO.	
250A-250B	125
44-49-194-440-560	456
566-195-55-59-75	456
116-370-400	456
10	1000
All Others	175
GULBRANSEN CO.	
10-13-20-23-53	175
92-93-322-130-135	175
235-236-237-330-535	175
925-3225-3226	175
3025-8725	175
V622-Z621-352	262
362-06W-5521	262
3525-3622	262
HALSON	
All Models	456
HAMMARLUND MFG. CO.	
All Models	465
CHARLES HOODWIN CO.	
Models 11 tube rec.	485
All Others	175
H. H. HORN	
59-69-90-70-71-101B	175
102-101-310	175
24-36-58-156-158	456
HOWARD RADIO CO.	
EX	140
Q	170
Auto receivers	260
S-3	456
A & W Converter	680
All Others	175
INSULINE CORP.	
AC Super 7L.W.-AC Super 6L.W.	115
Super Conqueror Uni-nine	115
5 tube Unaradio-Elite-Classic	132
Super 7-AVC Super 6	175
INTERNATIONAL	
JS-KS-CS	175
Kaydette A-B-A8-9-10-CM	262.5
A7-BW-CD-D11-12-14	262.5
AW55	445
JACKSON BELL	
25-27-28-29-89	175
205	465
33	840
KELLER-FULLER MFG. CO., LTD.	
Radiette Models 70-80-90	175
120-505	175

MODEL	K.C.
COLIN B. KENNEDY CORP.	
Model 67 (Export)	110
" 52 (Export)	135
538W-548W	1000
54	1525
All Others	175
KOLSTER RADIO, INC.	
All Models	175
LANG RADIO CORP.	
All Models	175
C. R. LEUTZ, INC.	
C10	47
Special Short Wave Receiver	450
LINCOLN RADIO CORP.	
Deluxe SW-33	460
DC-SW10 - R9	460
LYRIC RADIO	
See R. Wurlitzer Co.	
MAJESTIC	
See Grigsby-Grunow	
MID-WEST	
Miraco Pentode 11 tube super.	175
RT9-G9-F9-H9-RT16	456
A16-B16-D16-F.R.16-RM14	456
MISSION BELL	
10A-11-19-19A-25A	252
14-40	456
MONTGOMERY WARD	
62-11-62-12-62-14-62-27	175
62-19-62-20-62-20X-62-25	175
1111-62-1611-811-62-1711	175
62-29-11-12-17-62-1-62-2	175
62-7-62-8-62-9-62-69	175
62-91-62-93-62-103-62-105	175
62-106-62-107-62-121-77	175
95-11-11X-811X-62-14X	175
62-19X-62-40-62-31-62-31X	175
62-54-62-54X-62-58X	175
62-52-62-64-62-64X	175
62-76-62-76X-62-74-62-74X	175
62-80-62-82-62-23-62-41	175
62-83-62-16-62-16X-62-18	175
62-13-62-15-11-12-17	175
22-1040	175
1238-1838-1838X-62-26	262
62-20X-62-46-62-46X-1358	262
1358X-1955-62-22-62-22X	262
62-30-62-30X-62-42-62-42X	262
62-48-62-48X-62-36	262
62-36X-62-34-62-34X-62-38	262
62-38X-62-44-62-44X-62-50	262
62-50X-62-68462-68X	262
62-21-13-15-16X-16	262
17-18-16X-62-1838	262
62-1955-62-40	262
Auto Radio-62-96-62-98	262
62-97-62-99-62-97X	262
62-99X-62-101-62-101X	262
62-104-87	262
62-70-62-70X-62-72	455
62-72X-62-81-62-81X	455
MOTOMETER GAUGE & EQUIP.	
10A	175
MOTOROLA AUTO RADIO	
See Galvin Mfg. Co.	
NATIONAL CO.	
A.C.S.	500
NORLETT SPARKS	
10A-30A	175
20A-20B	175
NORCO	
4 Super	250
PACKARD	
4-24-24C	235
4 tube Super 5	465
85 - 8 tube auto	470
PATTERSON RADIO CO.	
Straight Models	177.5
Amateur	457.5
70AW-107AW-207AW-210AW	262
80AW-84AW-508AW	262
104AW-510AW	262
PHILCO RADIO & TEL. CORP.	
7-8-12-15-17-37-48	175
51-51A-90-90A-111-111A-52	175
112-112A-116-116A-211-	175
211A-212-212A-Broadcast IF.	175
6-10-11-16-91-18-19-128	260
32-35-71-70-70A-270	260
270A-89-19-90-91A (with 2-47)	260
91-121-221-22L-23X 47DC	260
Broadcast I.F. 503	260
700-22-23-36-37-47DC Series	260
43-53-80	450
5-16-34-34A-38-38A	460
44-57-60-61-64-144	460
504-506-60	460
4-470-470A SW-1.R-490 SW-1.F.	1000
4 & 4C Series	3600

MODEL	K.C.
PILOT RADIO & TUBE CORP.	
8-81-10AC-11-28-39-41	115
1010	115
S148-S164-C162-C165	175
C153-C154-149	175
2-82-F14-18-20-D-3	456
81	482
4 tube D.C.	482.5
PLAZA MUSIC (HAMILTON LLOYD RADIOS)	
711 Super-6 tube LW-7 tube Super	175
5 tube Super	456
RADIO BAR	
505	175
508-526-21DB-510	262
RADIO CHASSIS	
L6D	115
L6W	125
Auto Set-A6D-LSA37	175
AC-36-QAC-36-LSA36	175
L5D	456
RCA-VICTOR CO., INC.	
R7LW	110
R51-62-64	180
121-122-221-Duo 320	370
Duo 321	370
140-141-141E-240-Duo 340	445
9 tube General Purpose-340-340E	445
301	460
SW Adapter	1000
SWAZ-RO-23 (SWIF)	1075
All Others	175
RADOLEK	
951	265
956-958	465
RADIOTROPE	
70R-71R-72R-73R	262
REMLER CO., LTD.	
Beat 115KC	115
10-15-3-17-19-15-21	180
10-3-21-3	250
21-4-26-30-40-11-12-13	450
REPUBLIC INDUSTRIES	
SL6	115
SL5D-SL6D	175
Sky Hawk Patrician-S.K.RC5-RC6	175
SCOTT LABS., INC.	
All Wave Super	470
SEARS ROEBUCK	
1320-1322-1324-1390-1400	175
1402-1404-1406-1430	175
1462-1480-1482-1484	175
1580-1582-1584-1570	175
1572-1574-1590-1592	175
1630-1640-1700	175
1705	175
1708-1709-1710-1711	175
7090-1712-1713-1714	175
1715-1720-1725-7065	175
1721-1722-1732-1726X	175
1730-1750	175
1704-7070-7071-7072-7073	480
7074-1706-1707-1711A	480
7090A-1760-7075-7076	480
7077-7078-7091-7092	480
7093-7094	480
1600	1000
SENTINEL RADIO	
See Elec. Research Lab.	
SILVER-MARSHALL, INC.	
36A-Bearcat Midget-714	175
716-683-724-726-728	175
773-A-B-C-D-E-G-J-R	175
4801-4802-41-724B-726SW	175
782-1040-F	175
727-729SW-Z10-Q-QD-R-RT-V-X-Y	465
Z DEluxe Z13	472.5
738	1000
SIMPLEX RADIO CO.	
B-K-J-L-N-P-Q	175
P-AC-P-32V-W	456
V-T	465
SONORA	
70-71-72-73-84-85-86-87	262
SPARKS-WITHINGTON CO.	
10-12-14-15-16-16AW-18-25-26.	172.5
26AW-27-27A-30-33-34-36	172.5
45-56-72-74-78-28-30A-35	172.5
61-62-71-71P-81-82-333	454
STEINITE	
All Models	175
STEWART-WARNER	
102A-B & E-R102-A-B & E	177.5
R104A-B & E Broadcast I.F.	177.5
1090-91-92-93-94-95-96-97-98-1099	177.5
R106-R110-R117-R119-R120	177.5
R111-R115-R112-R116	456
105 (SWIF)	1525
STROMBERG-CARLSON	
33	260
All Others 175 KC	175

MODEL	K.C.
SUPERTONE PRODUCTS	
Superba	465
L. TATRO PRODUCTS	
L-74-N74-AK54-AM54-094	175
084-P54	177.5
TRANSFORMER CORP. OF AMERICA	
125 (Export Model	100
80-81-90-90A-91-84-85-94-25-94	175
100-120-139-160-25-160-220-260	175
280-300-320-340-420	175
422-423-425-440-480	465
240	490
200	600-1000-1500
TRAVELOR RADIO & TEL. CO.	
S-8 - S-9 - S-10	175
UNITED AIR CLEANER	
All Models	175
UNITED AMERICAN BOSCH	
10-20J-20K-20L-31-32-36-37	175
40-41-92-100 Auto-108-150	175
160-236-237-242-243-250-251	175
312-313-226-313	175
140A-305A-360-500-502	456
305-405-805-117-127-500	456
260-261	517.5
325-20-22-36-40-91	125
100-150-224	125
UNITED MOTORS SERVICE	
2035-4036-4037 & BOP receivers	262
4048	455
U.S. RADIO & TELEVISION	
7-8-10-10C-9-19-12-120	262
69-99-1006-1007-3070-9A-9B	262
12B-19B-120B	262
5A-7D-24-25-3040-3056-25A	455
VICTOR RADIO	
See RCA Victor	
WARE MFG. CO.	
All Models	175
WELLS GARDNER, INC.	
00A-02A-06A-07A-022	175
073-092-40-40A-50	175
92-93-502-572	175
05A-05AA-05BA-06W-072	262
052-062-5B-V6Z2-V6Z1	262
6V	262.5
7D	456
WESTINGHOUSE	
Flat top in some cases	175
WEXTARK RADIO, INC.	
Knight 7 & 9 tube	175
WHOLESALE RADIO	
10-20-L1-80M-80MA	175
L-20 - Auto Radio	262
WILCOX-GAY	
3PA 6-66	115
2S5-2T5-2VA7-3D5	175
3R6-3J5-3K5-37566	175
3T665	175
WONDER BAR RADIO CORP.	
All Models	175
RUDOLPH WURLITZER CO.	
LW5	125
SA-133-SA120-SA99-SA5-SA6	175
B6-SA130-SA110-SA111-SA91	175
SA91A-S50-863-SA65-B80	175
S7-B6-S8-S10-DC65-880	175
SA130-460	175
C4-M4-P5-SU5-A60-U500	456
U50-840	456
SW8-LU5-450	456
SW8-A60-SW80-SW88	485
U50-U58	485
ZENITH RADIO CORP.	
91-92-AH-CH-RH-BH-LH-WH	175
MH-103-210-220-230-240-245	175
Broadcast I.F. 410-411-420-430	175
440-500-501-503-514-515	175
600-604-606-610-616-618-715	175
755-756-474-730-735-740	175
770-760-765-767-475-775	175
760-476-476A-770B-775B	175
215-216-217-221-225-241	175
244-263-271-412-414-441	175
442-443-470-502-516-520	175
521-530-531-532-602-603	175
605-607-608-611-612-614-615	175
617-619-620-621-622-623	175
210-5 - 211-5 - 270-5 - 510-5	125
462-650HD-651HE-660TD	252.5
661TE	252.5
701	456
460-705-706-707-711-617	485
712-750-2056-2056-1	485
518 - 550	485
250-251-252-260-261	485
272-472-473	175 & 1000
CANADIAN RECEIVERS	
Brunswick of Canada	175
Canadian Marconi Co.	175
Canadian Westinghouse Co., Ltd...Models 89, 90, 99, 99A, 110, 120	171
Columaires 8, 10 and Models 101, 801, 802	178
DeForest Crosley	175
Grimes Radio Corp.	175
C. B. Kennedy of Canada, Ltd.	175
Mohawk Radio Ltd.	175
Northern Elec. Co., Ltd.	175
Rogers Majestic Co., Ltd.	175

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NO. 23

PRACTICAL RADIO JOB SHEET

SPECIALLY PREPARED FOR THE STUDENTS OF

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ALIGNING PEAKED I.F. AMPLIFIERS

ALL SUPERHETERODYNE RECEIVERS WHICH DO NOT EMPLOY A SPECIALLY DESIGNED FLAT-TOP OR BAND-PASS I.F. AMPLIFIER USE WHAT IS KNOWN AS A "PEAKED I.F. AMPLIFIER". THE PROCEDURE FOR ALIGNING A PEAKED I.F. AMPLIFIER IS AS FOLLOWS:

1. - FIRST ASCERTAIN THE EXACT INTERMEDIATE FREQUENCY FOR WHICH THE I.F. AMPLIFIER IN QUESTION IS DESIGNED. THIS CAN BE DETERMINED FROM FACTORY SPECIFICATIONS, BY REFERRING TO JOB SHEET #22, OR ELSE BY MEANS OF TESTS WHICH ARE DESCRIBED IN FOLLOWING JOBSHEETS.

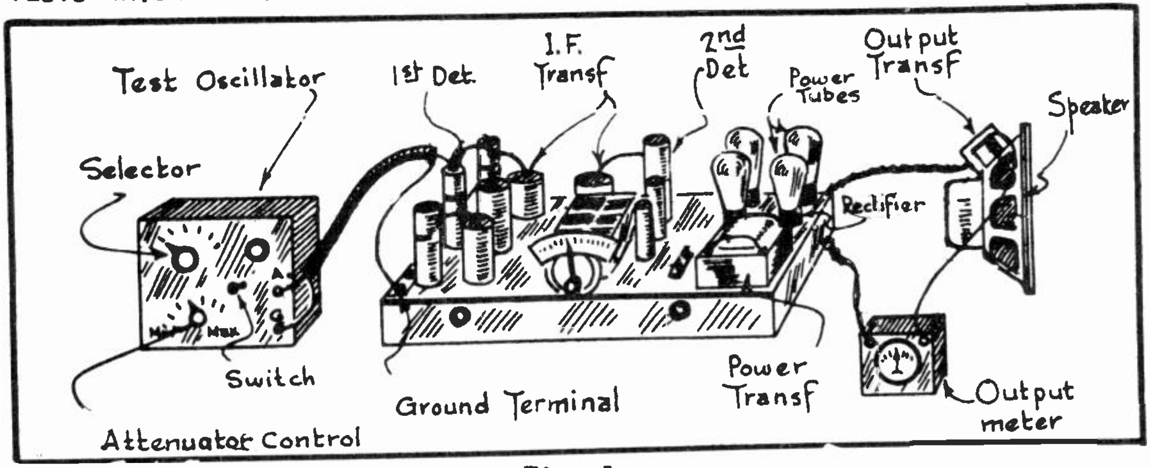

Fig. 1
Set-Up For Aligning The I.F. Stages.

2. - DISCONNECT THE ANTENNA LEAD-IN FROM THE RECEIVER BUT LEAVE THE GROUND WIRE IN PLACE.

3. - CONNECT THE INNER WIRE OF THE TEST OSCILLATOR'S SHIELDED OUTPUT CABLE TO THE CONTROL GRID OF THE FIRST DETECTOR OR MIXER TUBE AS SHOWN IN FIG. 1 AND CONNECT THE OUTER SHIELD OF THIS WIRE TO THE RECEIVER'S GROUND TERMINAL. PERMIT THE CONTROL GRID CONNECTION OF THE MIXER TUBE TO REMAIN IN POSITION AND ALSO PERMIT THE SHIELD OF THIS TUBE TO REMAIN IN PLACE.

4. - CONNECT THE OUTPUT METER TO THE RECEIVER CIRCUIT IN THE PROPER MANNER AND WITH THE TEST OSCILLATOR'S ATTENUATION CONTROL SET AT THE MINIMUM POSITION, ADJUST THE TEST OSCILLATOR FOR THE CORRECT I. F. FREQUENCY OF THE PARTICULAR RECEIVER IN QUESTION.

5. - TEMPORARILY SHORT CIRCUIT THE RECEIVER'S OSCILLATOR TUNING CONDENSER SO AS TO PREVENT ITS OPERATION DURING THE ALIGNING PROCESS. TURN ON BOTH THE RECEIVER AND THE TEST OSCILLATOR, TURN THE RECEIVER'S VOLUME CONTROL TO THE "FULL ON" POSITION AND CAREFULLY ADJUST THE ATT-

ENUATION CONTROL OF THE TEST OSCILLATOR UNTIL THE OUTPUT METER READS ABOUT ONE-HALF FULL SCALE DEFLECTION. BE SURE THAT THE OUTPUT SIGNAL OF THE TEST OSCILLATOR IS BEING MODULATED IN THE EVENT THAT A SWITCH FOR EITHER A MODULATED OR UNMODULATED SIGNAL IS FURNISHED ON IT.

6. - COMMENCING WITH THE TUNING CONDENSER OF THE SECONDARY WINDING CORRESPONDING TO THE I.F. TRANSFORMER PRECEDING THE SECOND DETECTOR, ADJUST THIS CONDENSER CAREFULLY WITH A SPECIAL INSULATED ALIGNING TOOL UNTIL THE GREATEST READING IS INDICATED ON THE OUTPUT METER. IF THE INDICATOR EXCEEDS A HALF-SCALE READING DURING THE PROCESS OF ADJUSTMENT, THEN READJUST THE ATTENUATION CONTROL OF THE TEST OSCILLATOR SO THAT THE OUTPUT METER RETURNS TO A HALF-SCALE READING.

7. - CONTINUE BY NEXT ADJUSTING THE PRIMARY TUNING CONDENSER OF THE SAME I.F. TRANSFORMER FOR MAXIMUM READING OF THE OUTPUT METER. WITH THIS ADJUSTMENT MADE, RE-CHECK THE SECONDARY TUNING CONDENSER ADJUSTMENT BECAUSE IT IS FREQUENTLY AFFECTED BY ANY CHANGE MADE IN THE TUNING OF THE PRIMARY CIRCUIT. ALSO RE-CHECK THE PRIMARY CIRCUIT TUNING AFTER MAKING ANY CHANGE IN THE SECONDARY TUNING CIRCUIT.

8. - REPEAT THE SAME PROCEDURE AS JUST EXPLAINED FOR EACH OF THE REMAINING I.F. TRANSFORMERS, GRADUALLY WORKING TOWARDS THE MIXER TUBE. IN ALL CASES, ALWAYS TUNE THE SECONDARY CIRCUIT BEFORE THE PRIMARY CIRCUIT AND THEN RE-CHECK BOTH CIRCUITS.

HOW TO OPERATE A 110 VOLT A.C. RECEIVER FROM A 220 VOLT CIRCUIT

OCCASIONALLY, THE RADIO TECHNICIAN IS CONFRONTED WITH THE PROBLEM WHERE A RECEIVER WHICH IS DESIGNED TO OPERATE FROM A 110 VOLT A.C. LINE IS EXPECTED TO BE OPERATED FROM A 220 VOLT A.C. LINE.

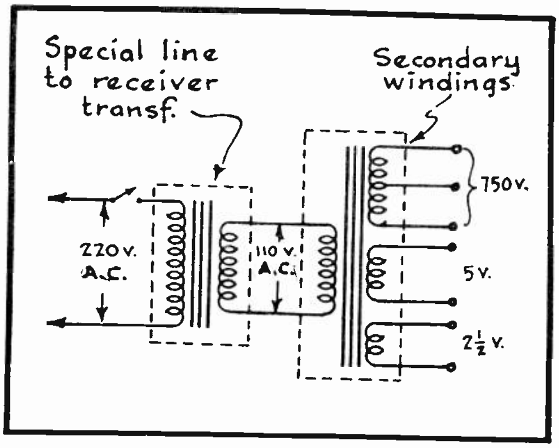

Fig. 2
Transformer Connections.

1. - ONE METHOD OF SOLVING THIS PROBLEM IS TO REMOVE THE POWER TRANSFORMER AND IN ITS PLACE MOUNT ANOTHER TRANSFORMER WHOSE PRIMARY WINDING IS DESIGNED FOR 220 VOLTS AND WHICH IS CAPABLE OF FURNISHING THE SAME SECONDARY VOLTAGES AND CURRENTS AS THE ORIGINIAL TRANSFORMER.

2. - ANOTHER SOLUTION IS TO LEAVE THE ORIGINAL POWER TRANSFORMER IN THE RECEIVER AND TO CONNECT A SPECIAL LINE TRANSFORMER BETWEEN THE A.C. LINE AND THE PRIMARY WINDING OF THE RECEIVER TRANSFORMER AS SHOWN IN FIG. 2. THE PRIMARY WINDING OF THIS SPECIAL TRANSFORMER IS DESIGNED FOR 220 VOLTS AND ITS SECONDARY FOR 110 VOLTS. THE WATT-RATING OF THIS SPECIAL TRANSFORMER MUST CORRESPOND WITH THAT OF THE RECEIVER.

PRACTICAL RADIO JOB SHEET

NO. 24

SPECIALLY PREPARED FOR THE STUDENTS OF

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ALIGNING BAND-PASS I.F AMPLIFIERS

IN SUPERHETERODYNE RECEIVERS OF THE HIGH-FIDELITY TYPE THE I.F. TRANSFORMERS ARE SO DESIGNED AND ADJUSTED THAT THEY ARE RATHER BROAD TUNING SO AS TO AVOID SUPPRESSION OF THE SIDE BANDS AND THEREBY MAKE A BETTER TONE QUALITY POSSIBLE. THESE "FLAT-TOP" TRANSFORMERS HAVE THEIR WINDINGS MORE CLOSELY COUPLED THAN DO THE SHARP TUNING I.F. TRANSFORMERS AND ARE GENERALLY ADJUSTED TO PASS A BAND OF FREQUENCIES FROM 5 TO 7.5 KC. EACH SIDE OF THE MAIN INTERMEDIATE FREQUENCY.

TO ALIGN I.F. AMPLIFIERS OF THIS TYPE PROCEED IN THE FOLLOWING MANNER:

1. - FIRST DETERMINE FROM FACTORY SPECIFICATIONS THE MAIN INTERMEDIATE FREQUENCY BEING USED AND THE FREQUENCY RANGE OVER WHICH THE RESPONSE CURVE IS TO BE "FLAT-TOPPED". EXAMPLE: A CERTAIN RECEIVER REQUIRES THAT ITS MAIN INTERMEDIATE FREQUENCY BE 175 KC. AND THAT ITS RESPONSE CURVE BE FLAT-TOPPED FROM 170 KC. TO 180KC. THIS I.F. AMPLIFIER WOULD BE ALIGNED AS FOLLOWS:

2. - CONNECT A TEST OSCILLATOR AND OUTPUT METER TO THE RECEIVER IN THE SAME MANNER AS EXPLAINED IN JOBSHEET #23. ADJUST THE TEST OSCILLATOR FOR THE UPPER FLAT-TOP FREQUENCY LIMIT OF 180 KC. AND ADJUST FOR HIGHEST OUTPUT THE SECONDARY CIRCUIT OF THE I.F. TRANSFORMER WORKING IN TO THE SECOND DETECTOR. THEN ADJUST THE TEST OSCILLATOR FOR THE LOWER FLAT-TOP FREQUENCY LIMIT, OR 170 KC. IN THIS PARTICULAR CASE, AND ADJUST THE PRIMARY CIRCUIT OF THIS SAME I.F. TRANSFORMER FOR MAXIMUM OUTPUT AT THIS FREQUENCY.

3. - THE SAME PROCEDURE IS CARRIED OUT AT EACH I.F. TRANSFORMER, GRADUALLY WORKING TOWARDS THE MIXER TUBE AND EACH ADJUSTMENT SHOULD BE RE-CHECKED AT LEAST THREE TIMES SO AS TO INSURE AN ACCURATE SETTING.

4. - AS A FINAL CHECK ROTATE THE DIAL OF THE TEST OSCILLATOR THRU THE FLAT-TOP FREQUENCY RANGE CALLED FOR. THE OUTPUT METER READING SHOULD VARY ONLY SLIGHTLY AND THE CHANGE IN READING SHOULD BE THE SAME ON EITHER SIDE OF THE MAIN INTERMEDIATE FREQUENCY.

5. - ANOTHER METHOD WHICH IS SOMETIMES USED IS TO FIRST ADJUST BOTH THE SECONDARY AND PRIMARY OF EACH I.F. TRANSFORMER TO THE MAIN INTERMEDIATE FREQUENCY AND THEN SLIGHTLY DETUNE ONE OF THE WINDINGS ABOVE AND THE OTHER BELOW UNTIL ONLY A SLIGHT VARIATION IN THE OUTPUT METER READING IS OBTAINED UPON ROTATING THE DIAL OF THE TEST OSCILLATOR THRU THE FLAT-TOP FREQUENCY RANGE WHICH IS DESIRED.

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DETERMINING AN UNKNOWN INTERMEDIATE FREQUENCY

IN THE EVENT THAT THE CORRECT I.F. FOR A PARTICULAR RECEIVER IS NOT KNOWN AND CANNOT BE OBTAINED BY REFERRING TO ANY SPECIFICATION CHARTS, THEN IT CAN BE DETERMINED IN THE FOLLOWING MANNER:

1. – CONNECT A TEST OSCILLATOR AND OUTPUT METER TO THE RECEIVER IN QUESTION IN EXACTLY THE SAME MANNER AS WHEN ALIGNING THE I.F. AMPLIFIER.

2. – SLOWLY TUNE THE TEST OSCILLATOR FROM ITS LOWER I.F. FREQUENCY LIMIT TOWARDS ITS HIGHER I.F. FREQUENCY LIMIT AND NOTE AT WHICH OF ITS SETTINGS THAT THE OSCILLATOR FREQUENCY IS AMPLIFIED BY THE RECEIVER. ALSO NOTE THE EXTENT TO WHICH THE NEEDLE OF THE OUTPUT METER DEFLECTS.

3. – WE SHALL ASSUME THAT A SIGNAL IS OBTAINED AT THE 87.5 KC AND THE 175 KC. SETTING OF THE TEST OSCILLATOR AND THAT IN ADDITION THE SIGNAL STRENGTH AVAILABLE AT THE RECEIVER OUTPUT IS GREATER WHEN THE TEST OSCILLATOR IS ADJUSTED FOR 175 KC.

4. – UNDER THE CONDITIONS DESCRIBED, IT IS CLEAR THAT WHEN THE TEST OSCILLATOR WAS TUNED TO A FUNDAMENTAL OF 87.5 KC., THE RECEIVER AMPLIFIED ITS SECOND HARMONIC OR 175 KC. FURTHERMORE, THE FACT THAT THE SIGNAL STRENGTH AT THE RECEIVER OUTPUT WAS GREATEST WITH THE OSCILLATOR ADJUSTED FOR 175 KC., THAT THIS SAME VALUE IS AN EXACT HARMONIC OF THE 87.5 KC. SIGNAL AND THAT A FREQUENCY OF 175 KC. IS A STANDARD INTERMEDIATE FREQUENCY FOR SUPERHETERODYNE RECEIVERS, PERMITS US TO COME TO THE CONCLUSION THAT THE PROPER INTERMEDIATE FREQUENCY FOR THIS PARTICULAR RECEIVER IS 175 KC.

5. – SOMETIMES, YOU MAY FIND THAT SIGNALS APPEAR WHEN THE TEST OSCILLATOR IS ADJUSTED TO SOME ODD VALUE. THIS IS QUITE NATURAL SINCE THE FUNDAMENTAL WHICH HAS A HARMONIC EQUAL TO THE I.F. PEAK MAY BE AN ODD FREQUENCY. FOR EXAMPLE, IF THE I.F. AMPLIFIER OF A RECEIVER IS 252.5 KC., THEN A SIGNAL WILL APPEAR WHEN THE TEST OSCILLATOR IS TUNED TO THIS FREQUENCY AND ALSO WHEN IT IS TUNED TO 126.25 KC. LIKEWISE, IF THE I.F. AMPLIFIER IS PEAKED AT 460 KC., SIGNALS MAY APPEAR WITH THE TEST OSCILLATOR TUNED TO 460 KC., 230 KC., 153.3 KC. AND AT 115 KC.

6. – WHEN CONDUCTING TESTS OF THIS NATURE GREAT CARE MUST BE EXERCISED AND HASTY CONCLUSIONS SHOULD BE AVOIDED BECAUSE THE APPEARANCE OF HARMONICS CAN READILY CAUSE CONFUSIONS WHICH LEAD TO ERRORS.

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ALIGNING THE OSCILLATOR AND - R.F. SECTION OF SUPERHETERODYNES

NO ATTEMPT SHOULD BE MADE TO MAKE ANY ADJUSTMENT ON THE ALIGNMENT OF THE OSCILLATOR, FIRST DETECTOR OR PRE-SELECTOR STAGE OF A SUPERHETERODYNE RECEIVER UNTIL IT HAS FIRST BEEN DEFINITELY ASCERTAINED THAT THE I.F. STAGES ARE ALL PROPERLY ALIGNED.

ALIGNING THE OSCILLATOR

WITH THE RECEIVER IN AN OPERATING CONDITION, THE PROCEDURE FOR ALIGNING THE OSCILLATOR CIRCUIT IS AS FOLLOWS:

1. - FIRST CONNECT THE SERVICE OSCILLATOR AND OUTPUT METER TO THE RECEIVER AS ILLUSTRATED IN FIG. 1.

2. - THE ADJUSTMENTS FOR THE OSCILLATOR TUNING CIRCUIT IN THE CONVENTIONAL TYPE OF SUPERHETERODYNE RECEIVER ARE POINTED OUT TO YOU IN FIG. 2.

3. - COMMENCE ALIGNING THE RECEIVER'S OSCILLATOR CIRCUIT BY FIRST ADJUSTING THE HIGH FREQUENCY TRIMMER. TO DO THIS, SET THE FREQUENCY SELECTOR OF THE SERVICE OSCILLATOR SO THAT THIS APPARATUS WILL PRODUCE A 1400 KC. SIGNAL FREQUENCY, SET THE VOLUME CONTROL OF THE RECEIVER TO ITS MAXIMUM POSITION AND ITS TUNING DIAL TO THE 1400 KC. POSITION.

4. - TURN "ON" THE SWITCH OF BOTH THE RECEIVER AND THE SERVICE OSCILLATOR AND ADJUST THE ATTENUATOR OF THE SERVICE OSCILLATOR UNTIL A

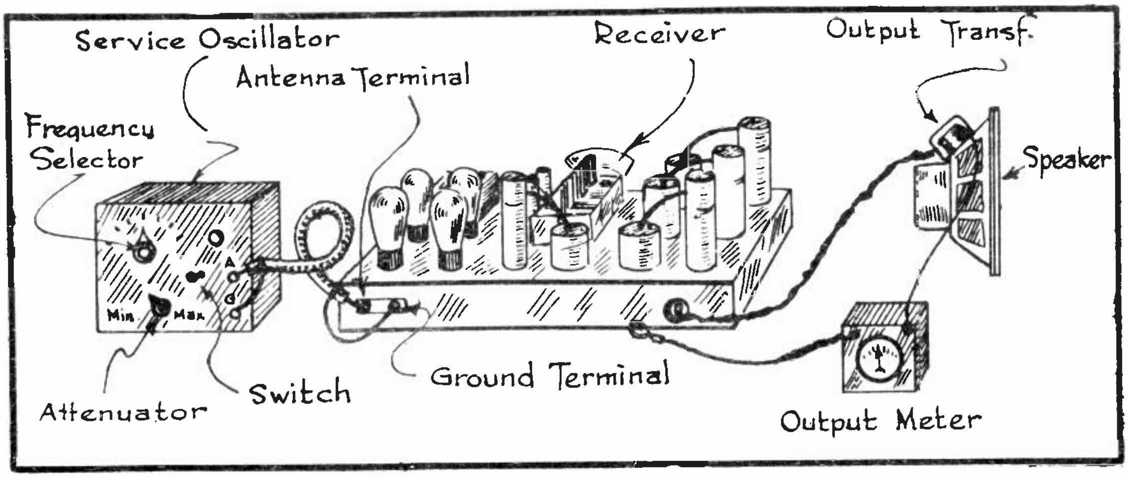

FIG. 1
SET-UP FOR ALIGNING RECEIVER'S OSCILLATOR AND R.F. CIRCUITS.

ONE-HALF SCALE READING IS OBTAINED ON THE OUTPUT METER. IF THE RECEIVER IS BADLY OUT OF ADJUSTMENT, THEN THIS METER READING MAY BE DIFFICULT TO OBTAIN BUT IF SUCH BE THE CASE, THE SIGNAL AS COMING FROM THE SPEAKER CAN BE USED AS A TEMPORARY GUIDE.

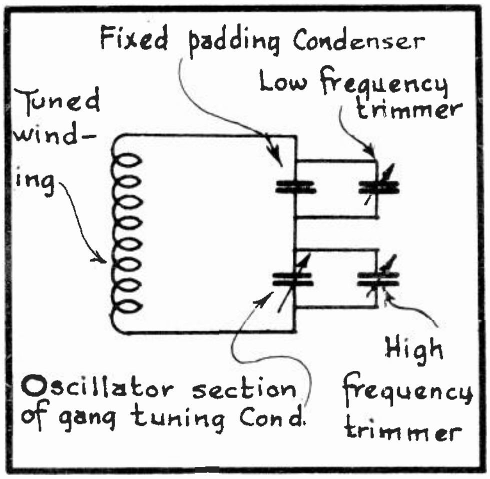

FIG. 2
OSCILLATOR ADJUSTMENTS.

5. - ADJUST THE HIGH FREQUENCY TRIMMER CONDENSER OF THE RECEIVER'S OSCILLATOR CIRCUIT CAREFULLY FOR MAXIMUM READING ON THE OUTPUT METER OR FOR MAXIMUM SIGNAL VOLUME IN THE SPEAKER. AFTER MAKING THIS ADJUSTMENT, TURN THE TUNING DIAL OF THE RECEIVER SLIGHTLY BOTH WAYS FROM ITS 1400 KC. SETTING AND NOTE WHETHER OR NOT ANY INCREASE IN THE METER READING OR SOUND VOLUME IS OBTAINED. IF SO, THEN THE R.F. AND FIRST DETECTOR TRIMMER CONDENSERS MUST BE ADJUSTED AS WILL BE DESCRIBED SHORTLY.

6. - THE NEXT STEP IS TO ADJUST THE RECEIVER OSCILLATOR AT THE LOW FREQUENCY END OF THE DIAL. TO DO THIS, LEAVE THE SERVICE OSCILLATOR AND OUTPUT METER CONNECTIONS JUST AS THEY ARE BUT SET THE FREQUENCY SELECTOR OF THE SERVICE OSCILLATOR TO THE 700 KC. POSITION AND ALSO SET THE TUNING DIAL OF THE RECEIVER TO THE 700 KC. POSITION. NOW ADJUST THE "LOW FREQUENCY TRIMMER" FOR MAXIMUM READING ON THE OUTPUT METER OR MAXIMUM SIGNAL STRENGTH IN THE SPEAKER. IT IS ADVISABLE TO AGAIN RECHECK THE HIGH FREQUENCY ADJUSTMENT IN CASE THAT IT HAS BECOME AFFECTED BY THE LOW FREQUENCY ADJUSTMENT AND TO MAKE ANY FINAL CORRECTION AS FOUND NECESSARY.

ALIGNING THE R.F. STAGES

7. - TO ALIGN THE R.F. AND FIRST DETECTOR STAGES, LEAVE THE SERVICE OSCILLATOR AND OUTPUT METER CONNECTIONS AS THEY ARE AND ALSO LEAVE THE ANTENNA LEAD-IN WIRE CONNECTED TO THE RECEIVER. SET THE FREQUENCY SELECTOR OF THE SERVICE OSCILLATOR TO THE 1400 KC. POSITION AND ALSO SET THE TUNING DIAL OF THE RECEIVER TO THE 1400 KC. POSITION. THEN ADJUST THE TRIMMER OR COMPENSATOR CONDENSERS OF THE R.F. AND FIRST DETECTOR SECTIONS OF THE GANG TUNING CONDENSER SO AS TO OBTAIN THE MAXIMUM READING ON THE OUTPUT METER.

8. - AFTER THE ENTIRE SET HAS ONCE BEEN ALIGNED IN THIS MANNER, IT IS ADVISABLE TO RECHECK THE OSCILLATOR, FIRST DETECTOR, AND R.F. ADJUSTMENTS OF THE RECEIVER OVER THE ENTIRE TUNING RANGE.. IF ANY FURHTER ADJUSTEMNTS ARE REQUIRED IN THE MEDIUM FREQUENCY RANGE, THEY CAN BE MADE BY BENDING THE SLOTTED ROTOR PLATES OF THE TUNING CONDENSER.

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ALIGNING RECEIVERS USING A. V. C.

THE OPERATION OF AUTOMATIC VOLUME CONTROL SYSTEMS IS SUCH THAT THE RECEIVER OUTPUT IS KEPT PRACTICALLY CONSTANT WITH CHANGES IN THE INPUT SIGNAL INTENSITY DUE EITHER TO SIGNAL STRENGTH OR SENSITIVITY OF THE CIRCUIT. THIS BEING TRUE, WIDE CHANGES IN THE ALIGNMENT OF THE RECEIVER WILL IN SOME INSTANCES NOT PRODUCE ANY NOTICEABLE CHANGES IN THE INDICATION OF THE OUTPUT METER. FOR THESE REASONS, SPECIAL PRECAUTIONS MUST BE EXERCISED WHEN ALIGNING SUPERHETERODYNES WHICH ARE EQUIPPED WITH AN AUTOMATIC VOLUME CONTROL SYSTEM. THE METHODS USED IN SUCH CASES MAY BE ANY ONE OF THE FOLLOWING:

1. - USE A VERY WEAK SIGNAL FROM THE TEST OSCILLATOR SO THAT THE A.V.C. ACTION DOES NOT OCCUR. THIS APPLIES PARTICULARLY WHEN DELAYED A.V.C. IS USED.

2. - IF A SEPARATE A.V.C. TUBE IS EMPLOYED IN THE CIRCUIT, THEN OPEN THE LEAD WHICH DELIVERS THE SIGNAL TO THE CONTROL GRID OF THE A.V.C. TUBE. THIS LEAD SHOULD REMAIN OPEN DURING ALL ALIGNING PROCEDURES.

3. - IN SYSTEMS WHERE A SINGLE TUBE FUNCTIONS AS AN A.V.C. TUBE AS WELL AS A SECOND DETECTOR (ALSO AS AN A.F. AMPLIFIER IN SOME INSTANCES), DISCONNECT THE LEAD WHICH PICKS OFF THE A.V.C. VOLTAGE FROM THE A.V.C. CIRCUIT AND DELIVERS IT TO THOSE TUBES OF THE CIRCUIT WHICH ARE CONTROLLED BY A.V.C. ACTION.

4. - IN SOME RECEIVERS OF THE TYPE MENTIONED IN NOTE #3, THE RECEIVER WILL NOT OPERATE PROPERLY DUE TO LACK OF SUFFICIENT BIAS VOLTAGE FOR SOME OF THE R.F. TUBES. IF THIS IS TRUE, THE NORMAL BIAS CAN BE FURNISHED BY CONNECTING THE END TERMINALS OF A 100,000 OHM POTENTIOMETER ACROSS THE TERMINALS OF A 45 VOLT B BATTERY. CONNECT THE POSITIVE B BATTERY TERMINAL TO THE RECEIVER CHASSIS, OPEN THE SAME RECEIVER LEAD AS DESCRIBED IN NOTE #3 AND TO THE ARM TERMINAL OF THE POTENTIOMETER CONNECT THAT PART OF THE LEAD WHICH GOES TO THE GRID CIRCUITS OF THE CONTROLLED TUBES. ADJUST THIS POTENTIOMETER FOR NORMAL BIAS VOLTAGE AND PROCEED WITH THE ALIGNING WORK.

5. - ANY ONE OF THESE METHODS WILL MAKE THE A.V.C. SYSTEM INOPERATIVE SO THAT ACCURATE OUTPUT METER INDICATIONS MAY BE OBTAINED DURING THE PROCESS OF ALIGNING THE RECEIVER.

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TESTING ELECTROLYTIC CONDENSERS

1. - WHEN IN DOUBT AS TO THE CONDITION OF AN ELECTROLYTIC CONDENSER, THIS TYPE OF CONDENSER CAN BE TESTED BY MEANS OF THE CIRCUIT SHOWN IN FIG. 1.

2. - A COMPLETELY SHORTED OR OPEN CONDENSER CAN OF COURSE BE DETERMINED VERY QUICKLY, SIMPLY BY MAKING A CONVENTIONAL CONTINUITY TEST THROUGH THE CONDENSER BUT THIS CRUDE METHOD DOES NOT TELL ONE HOW GOOD AN ELECTROLYTIC CONDENSER IS.

3. - NOTICE IN FIG. 1 THAT A D.C. VOLTAGE OF ABOUT 400 VOLTS SHOULD BE AVAILABLE AND THIS CAN BE IN THE FORM OF SERIES CONNECTED "B" BATTERIES OR ANY FILTERED "B" POWER SUPPLY. THE POSITIVE END OF THE BATTERY MUST BE CONNECTED TO THE POSITIVE SIDE OF THE CONDENSER. THE 2000 OHM RESISTOR IS USED SOLELY AS A PRECAUTIONARY MEASURE IN ORDER TO PROTECT THE METER IN CASE THE CONDENSER SHOULD BECOME SHORT CIRCUITED.

4. - IF THE CONDENSER HAS BEEN OUT OF USE FOR SOME TIME, IT IS ADVISABLE TO FIRST CONNECT THE BATTERY ACROSS IT WHILE THE METER IS DISCONNECTED FROM THE CIRCUIT. THE CONDENSER SHOULD BE CHARGED IN THIS MANNER FOR AT LEAST 5 MINUTES, SO THAT A GOOD DIELECTRIC WILL BUILD UP.

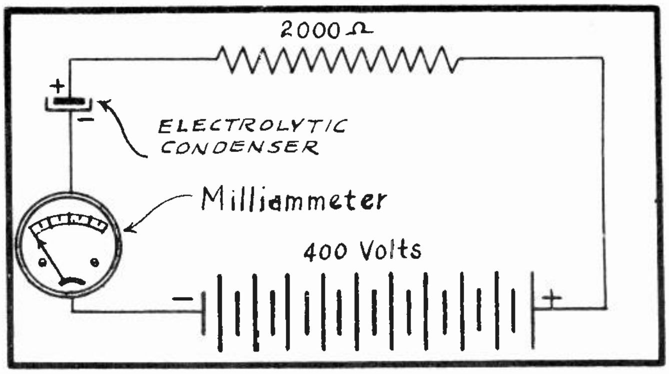

FIG. 1
SET-UP FOR TEST.

5. - WITH THE CIRCUIT CONNECTED AS SHOWN IN FIG. 1, THE MILLIAMMETER SHOULD REGISTER A LEAKAGE CURRENT OF FROM 0.05 TO 0.5 MILLIAMPERE PER MICROFARAD. THAT IS, IF AN 8 MFD. CONDENSER IS BEING TESTED IN THIS MANNER AND THE LEAKAGE CURRENT IS FOUND TO BE ANYWHERES BETWEEN .4 AND 4 MILLIAMPERES, THEN THE CONDENSER CAN BE CONSIDERED AS BEING IN A GOOD CONDITION.

6. - THE LEAKAGE CURRENT GENERALLY DECREASES TO ITS MINIMUM VALUE AFTER THE CONDENSER HAS BEEN WORKING FOR A CONSIDERABLE TIME.

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AUTOMATIC VOLUME CONTROL TROUBLES

WEAK RECEPTION

1. - POOR A.V.C. TUBE -- IT MAY BE GASSY OR SUPPLY TOO HIGH AN EMISSION. CHECK FOR THIS CONDITION BY TUNING IN A WEAK STATION AND THEN WITHDRAW A.V.C. TUBE FROM ITS SOCKET. IF THE VOLUME INCREASES CONSIDERABLY, REPLACE THIS TUBE WITH A NEW ONE. QUITE OFTEN, SEVERAL TUBES OF THE SAME TYPE MUST BE TRIED UNTIL SATISFACTORY OPERATION IS OBTAINED.

2. - IF A.V.C. TUBE IS O.K., CHECK GRID VOLTAGE AND PLATE CURRENT OF A.V.C. TUBE. IF GRID VOLTAGE IS TOO LOW, THIS TUBE WILL PASS PLATE CURRENT WHEN NO SIGNAL VOLTAGES ARE APPLIED TO ITS GRID AND THUS DELIVER AN EXCESSIVE BIAS VOLTAGE TO THE CONTROLLED TUBES, THEREBY REDUCING THE VOLUME.

3. - CHECK BIAS VOLTAGE OF CONTROLLED TUBES WHEN TUNED TO A STATION. IF THIS VOLTAGE IS EXCESSIVE, SUSPECT A LEAKY BY-PASS CONDENSER BETWEEN GROUND AND THE A.V.C. LEADS TO THE GRID CIRCUITS OF THE CONTROLLED TUBES.

NO RECEPTION

1. - CHECK GRID BIAS OF CONTROLLED TUBES. IF THIS IS EXCESSIVE, THERE IS A POSSIBILITY OF A LACK OF BIAS VOLTAGE AT THE A.V.C. TUBE DUE TO AN OPEN RESISTOR IN THE GRIDCIRCUIT OR LEAKY BY-PASS CONDENSERS.

2. - DEFECTIVE A.V.C. TUBE.

3. - OPEN CIRCUITED A.V.C. COUPLING CONDENSER.

INTERMITTENT A.V.C. ACTION

1. - IF RECEPTION IS NORMAL FOR A MINUTE OR TWO AFTER FIRST TURNING ON RECEIVER AND THE VOLUME THEN GRADUALLY DECREASES UNTIL EVEN POWERFUL STATIONS ARE RECEIVED WEAKLY, THEN THE GRID BY-PASS CONDENSERS OF THE A.V.C. SYSTEM SHOULD BE CHECKED FOR LEAKAGE.

2. - IF RECEPTION HAS BEEN NORMAL FOR AN HOUR OR TWO AND THEN GRADUALLY FADES, LEAKY A.V.C. GRID BY-PASS CONDENSERS SHOULD BE SUSPECTED.

ABRUPT A.V.C. ACTION

IF STATIONS ARE TUNED IN WITH A SUDDEN "PLOPPING" SENSATION SO AS TO MAKE IT DIFFICULT TO TUNE THE RECEIVER TO A POINT OF RESONANCE, THEN THIS MAY BE DUE TO ANY ONE OF THE FOLLOWING CONDITIONS: (A) EXCESSIVE HEATER VOLTAGE FOR THE A.V.C. TUBE; (B) PLATE RESISTOR OF TOO HIGH VALUE USED IN A.V.C. CIRCUIT.

DISTORTION

DISTORTION CAUSED BY OVERLOADING OF R.F. OR I.F. STAGES, POOR A.V.C. CONTROL, OSCILLATION, AND MOTOR-BOATING MAY BE CAUSED BY A LEAKY OR SHORT CIRCUITED BY-PASS CONDENSER IN THE GRID-RETURN CIRCUITS OF THE R.F. AND I.F. STAGES TO WHICH THE A.V.C. ACTION IS APPLIED. FADING, WEAK, UNSTABLE, AND INTERMITTENT OPERATION MAY RESULT FROM THIS SAME CONDITION.

NO CONTROL OF VOLUME

IN SOME RECEIVERS EMPLOYING A.V.C. THE VOLUME IS NOT AFFECTED WHEN OPERATING THE VOLUME CONTROL. THIS IS ONLY THE CASE IF THE VOLUME CONTROL IS LOCATED IN SOME PART OF THE A.V.C. CIRCUIT AND NOT IN THE AUDIO PORTION OF THE RECEIVER. THIS CONDITION MAY BE DUE TO ANY ONE OF THE FOLLOWING REASONS:

1. - WEAK A.V.C. TUBE

2. - LEAKY BY-PASS CONDENSERS IN THE CONTROL GRID RETURN CIRCUITS OF A.V.C. CONTROLLED TUBES.

TIME LAG

MOST A.V.C. SYSTEMS ARE DESIGNED FOR OPERATION WITH A "TIME LAG". IN THIS WAY THE A.V.C. ACTION IS PREVENTED FROM BEING ABRUPT IN ACTION AND THUS ELIMINATES EXCESSIVE NOISE BETWEEN STATIONS WHEN OPERATING THE DIAL AT A REASONABLE SPEED. IF THE TIME LAG IS EXCESSIVE, SO AS TO MAKE IT DIFFICULT TO TUNE STATIONS TO THE POINT OF RESONANCE, THEN IT CAN BE REDUCED BY LOWERING THE VALUE OF THE BY-PASS CONDENSERS OR ISOLATING RESISTORS IN THE A.V.C. SYSTEMS.

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SERVICING SILENT TUNING SYSTEM

IN FIGS. 1 AND 2 ARE SHOWN TWO TYPICAL CIRCUITS WHICH INCLUDE THE FEATURES OF BOTH THE DUPLEX DIODE TYPE TUBE AND NOISE SUPPRESSION. BY USING THESE AS EXAMPLES, THE FOLLOWING TROUBLE ANALYSIS CAN BE MADE.

INTER-STATION NOISE

IN A SYSTEM OF THE TYPE ILLUSTRATED IN FIG. 1, THIS CONDITION MAY BE DUE TO ANY ONE OF THE FOLLOWING CAUSES:

1. - ARM OF POTENTIOMETER R_2 SHORTED TO CHASSIS.

2. - OPEN SCREEN GRID RESISTOR IN SILENCING TUBE CIRCUIT.

3. - DEFECTIVE SILENCING TUBE.

IN THE CASE OF THE CIRCUIT APPEARING IN FIG. 2 THIS CONDITION MAY BE DUE TO:

1. - SHORTED OR LEAKY 0.1 MFD. CONDENSER BY-PASSING THE CATHODE OF V_3.

2. - LEAKAGE BETWEEN CATHODE AND HEATER OF V_3. THIS SAME CONDITION WILL CAUSE A HUM WHEN THE RECEIVER IS TUNED TO RESONANCE AND NO A.V.C. ACTION WILL OCCUR.

DISTORTION

IN THE ARRANGEMENT ILLUSTRATED IN FIG. 1, DISTORTED OR A CHOKED-REPRODUCTION MAY BE DUE TO:

1. - FAULTY ADJUSTMENT OF

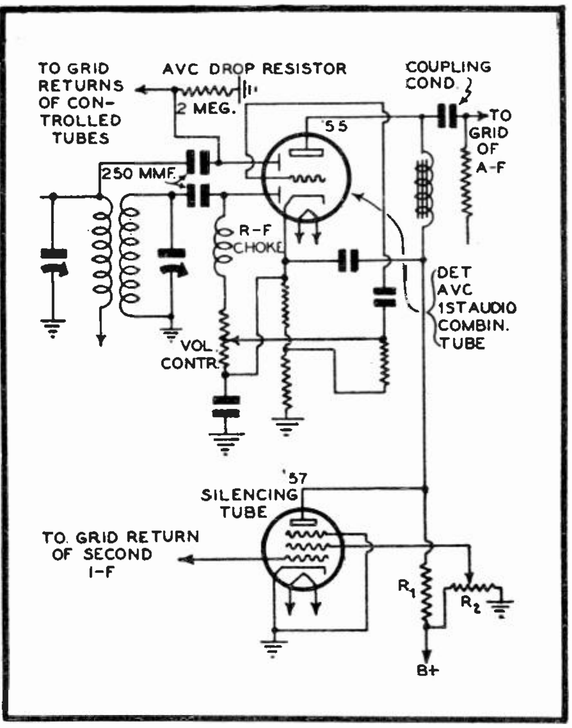

FIG. 1
A.V.C. WITH NOISE SUPPRESSION.

R_2 OR WRONG RESISTANCE VALUE AT THIS POINT.

2. - GROUNDED SILENCING TUBE CONTROL-GRID LEAD.

3. - LEAKY BY-PASS CONDENSER IN THE A.V.C. CIRCUIT TO WHICH THE CONTROL GRID LEAD IS CONNECTED.

HEADPHONE CONNECTIONS

QUITE OFTEN, IT IS DESIRABLE TO CONNECT A SET OF HEADPHONES TO A MODERN RECEIVER WHICH IS BEING USED IN CONJUNCTION WITH A LOUD SPEAKER. THIS CAN BE DONE IN THE FOLLOWING MANNER:

1. - THE CIRCUIT AT "A" OF FIG. 3 ILLUSTRATES HOW THE HEADPHONE CONNECTION IS MADE ON A RECEIVER EMPLOYING A POWER STAGE WITH A SINGLE TUBE. THE 10,000 OHM POTENTIOMETER SERVES AS A VOLUME CONTROL FOR THE HEADPHONES. A "PLUG-JACK OFFERS A CONVENIENT METHOD BY MEANS OF WHICH THE HEADPHONES CAN BE CONNECTED TO THE CIRCUIT WHENEVER DESIRED.

2. - "B" OF FIG. 3 ILLUSTRATES HOW TO MAKE THE HEADPHONE CONNECTIONS IN A PUSH-PULL POWER STAGE.

3. - THE SWITCH IN THE SPEAKER CIRCUIT CAN EITHER BE USED OR NOT, DEPENDING UPON THE REQUIREMENTS OF THE PARTICULAR INSTALLATION. THE SWITCH IN THE HEADPHONE CIRCUITS AFFORDS A MEANS OF DISCONNECTING THE SHUNTING EFFECT OF THE HEADPHONE CIRCUIT WHEN NOT EMPLOYING HEADPHONE RECEPTION.

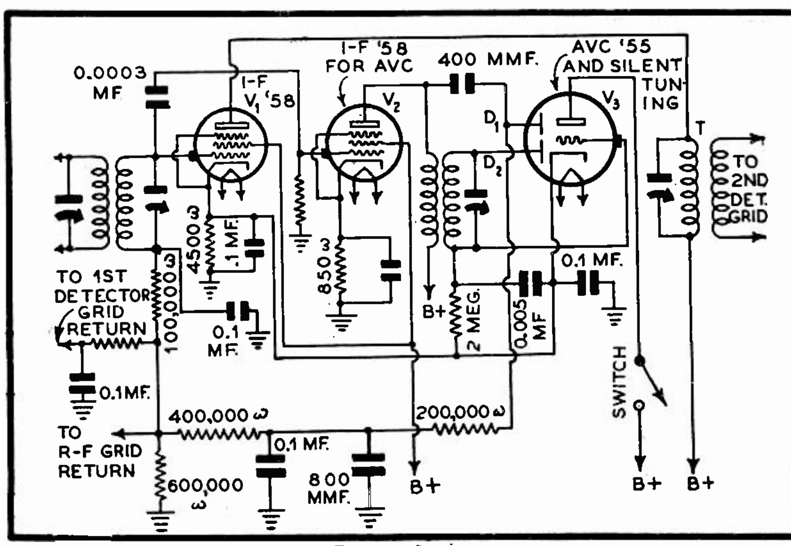

FIG. 2
COMBINATION A.V.C. AND SILENCING TUBE.

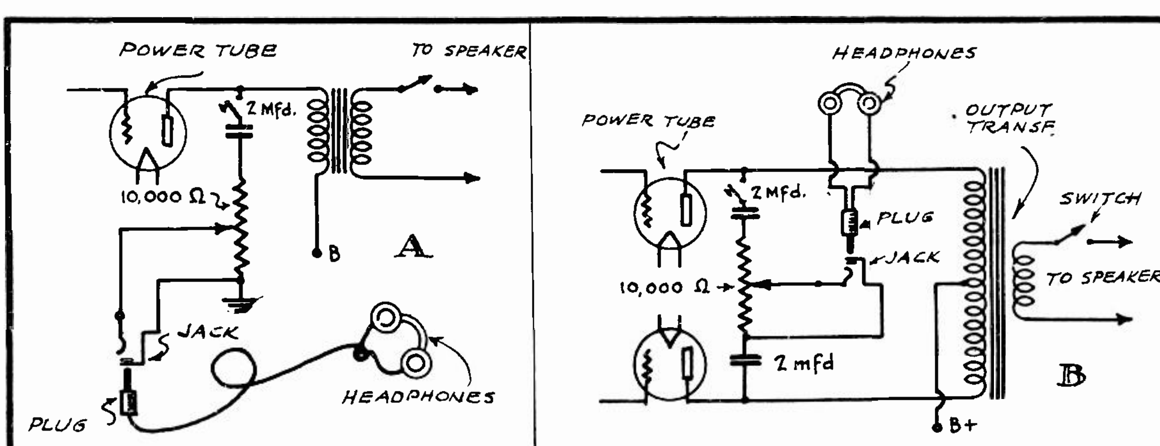

FIG. 3
HEADPHONE CONNECTIONS.

NATIONAL RADIO AND ELECTRICAL SCHOOL
LOS ANGELES, CALIF.

EDUCATIONAL DEPT.

SPECIAL EXAMINATION #1

Answered February 24 1940

DEAR STUDENT:

ALTHOUGH YOU HAVE BEEN ENROLLED IN MY COURSE OF TRAINING FOR ONLY A SHORT TIME AND ARE JUST BEGINNING TO GET A GOOD START, YET I AM CERTAIN YOU WILL ADMIT THAT YOU HAVE ALREADY LEARNED CONSIDERABLE ABOUT RADIO.

Grade 100

AS I TOLD YOU BEFORE IN ONE OF MY EARLY MESSAGES—IN ORDER TO SUCCEED IN THE RADIO PROFESSION, IT IS NECESSARY THAT YOU REMEMBER THE IMPORTANT FACTS WHICH ARE PRESENTED.

SOME EXCEPTIONALLY IMPORTANT RADIO PRINCIPLES HAVE BEEN BROUGHT TO YOU ATTENTION IN YOUR FIRST TEN LESSON ASSIGNMENTS AND SO THAT I MAY HAVE A MEANS OF CHECKING UP ON YOU AND SEEING HOW WELL YOU REMEMBER THEM, I AM ASKING YOU TO ANSWER IN FULL ALL OF THE QUESTIONS WHICH ARE INCLUDED IN THIS SPECIAL EXAMINATION.

ALL OF THESE QUESTIONS ARE BASED UPON THE FIRST TEN LESSONS, SO REVIEW THESE LESSONS, IF NECESSARY, AND ANSWER ALL OF THE QUESTIONS TO THE BEST OF YOUR ABILITY. NUMBER ALL OF YOUR ANSWERS SO THAT THEY WILL CORRESPOND WITH THE QUESTION NUMBER. WRITE PLAINLY OR USE TYPEWRITER AND THINK OUT ALL OF YOUR ANSWERS CAREFULLY SO AS TO AVOID ANY UNNECESSARY ERRORS BECAUSE THE WORK YOU DO ON THESE SPECIAL EXAMINATIONS IN A GREAT MEASURE AFFECTS YOUR FINAL GRADE.

I AM LOOKING FORWARD TO A FINE SET OF ANSWERS FROM YOU, SO PLEASE MAIL THEM TO ME AS SOON AS YOU CAN.

SINCERELY YOURS,

J.A. Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS

1. — DESCRIBE IN DETAIL THE OPERATING PRINCIPLES OF THE MICROPHONE.

2. — HOW MAY SOUND WAVES BE PRODUCED?

3. — WHAT DO WE MEAN BY THE TERM "ELECTROMOTIVE FORCE"?

4. — IF TWO COPPER WIRES, ONE HAVING A GREATER DIAMETER THAN THE OTHER, ARE BOTH CONNECTED ACROSS THE SAME SOURCE OF VOLTAGE, THEN WHICH OF THESE TWO WIRES WILL PASS THE MOST CURRENT?

5. — WHAT PARTS CONSTITUTE THE CONVENTIONAL TYPE OF TUNING CIRCUIT IN A RADIO RECEIVER?

6. — WHAT IS A RHEOSTAT?

(OVER)

7. - What is the difference between a damped and continuous type radio wave?

8. - If a condenser is connected in a circuit through which an alternating current is flowing, will the condenser pass more or less current if the frequency of the alternating current is increased?

9. - If four resistances, having the respective values of 10 ohms, 6 ohms, 4 ohms and 3 ohms are all connected in parallel across a voltage source offering an electromotive force of 100 volts, then how much current will flow thru each resistor? What will be the total current flowing through the entire circuit?

10.- If two coils are each wound on a tubular-shaped form having a diameter of 1" and one of these coils consists of 10 turns of wire while the other consists of 30 turns of wire, then which of the two coils will have the greater inductance?

11.- Describe the operating principles of a grid condenser and leak type detector.

correspond.

12.- If the filaments of two tubes drawing 1 ampere each are connected in parallel and together connected across a 2 volt "A" supply, then what will be the total filament current which is drawn by this combination of tubes?

co respond

13.- If you should have a magnet, whose polarity is not marked, how can you identify its north and south poles with the aid of a magnetic compass?

14.- What is the chief advantage obtained from resistance-capacity inter-stage coupling in an A.F. amplifier?

15.- What is the diameter of a #26 B&S copper wire?

16.- A resistance of 10 ohms, 5 ohms, 30 ohms and 50 ohms are all connected in series and an electromotive force of 200 volts is applied across the extremities of the entire group. How much current will flow through the circuit? What will be the voltage drop across each resistor?

17.- Describe exactly what occurs in each circuit of a crystal receiver during the reception of a broadcast program.

18.- If the voltage supplied by a source of E.M.F. is greater than can be tolerated by a certain appliance what means may be employed to reduce this voltage the proper amount?

19.- Draw a circuit diagram of a one-tube receiver employing regeneration.

20.- Draw a circuit diagram of a transformer-coupled A.F. amplifier.

NATIONAL SCHOOLS
LOS ANGELES, CALIF.

RADIO DIVISION

SPECIAL EXAMINATION #2

Answered May 27, 1940

DEAR STUDENT:

HAVING COMPLETED TWENTY LESSONS OF YOUR COURSE, IT IS AGAIN TIME FOR US TO FIND OUT HOW MUCH KNOWLEDGE YOU HAVE ACQUIRED SINCE ANSWERING YOUR FIRST SPECIAL EXAMINATION. FROM THE GRADE YOU RECEIVED IN THAT EXAMINATION, WE KNOW THAT YOU HAVE MASTERED THE FIRST TEN LESSONS. THE QUESTIONS IN THIS SECOND SPECIAL EXAMINATION ARE BASED UPON LESSONS #11 TO 20, INCLUSIVE. I AM SURE THAT YOU REALIZE THE IMPORTANCE OF THIS EXAMINATION AND THAT YOU WILL GIVE IT CAREFUL CONSIDERATION TO OBTAIN THE BEST POSSIBLE GRADE.

YOU ARE NO DOUBT PLEASED BECAUSE YOU ARE IN THE HEART OF YOUR RADIO SERVICE STUDY AT SUCH AN EARLY STAGE OF YOUR TRAINING. BY IMMEDIATELY APPLYING THIS INFORMATION TO PRACTICAL USE, MANY STUDENTS HAVE BEEN ABLE TO EARN CONSIDERABLE MONEY IN SPARE TIME WORK DURING THE ENTIRE LATER PERIOD OF THEIR STUDIES.

REMEMBER THAT IT PAYS TO REVIEW YOUR LESSONS FROM TIME TO TIME, TO FIX THE IMPORTANT POINTS IN YOUR MIND. ALSO BEAR IT IN MIND THAT TO OBTAIN THE GREATEST POSSIBLE BENEFIT FROM YOUR LESSONS REQUIRES EARNEST STUDY; JUST READING THE LESSON ONCE OR TWICE IS NOT SUFFICIENT.

WE WILL BE ESPECIALLY INTERESTED IN YOUR ANSWERS TO THE SECOND SPECIAL EXAMINATION AND HOPE THAT YOU WILL GIVE THIS IMPORTANT MATTER YOUR IMMEDIATE ATTENTION.

SINCERELY YOURS,

J. A. Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS

1. - WHAT IS MEANT BY RADIO FREQUENCY AMPLIFICATION?

2. - DESCRIBE THE CONSTRUCTIONAL FEATURES OF A TYPICAL MODERN R.F. TRANSFORMER.

3. - SUPPOSE THAT YOU DESIRE TO WIND A SECONDARY WINDING OR TUNING COIL OF AN R.F. TRANSFORMER FOR BROADCAST RECEPTION ON A PIECE OF BAKELITE TUBING HAVING A DIAMETER OF 1", AND THAT THE TUNING CONDENSER TO BE USED WITH THIS COIL HAS A RATED CAPACITY OF .00035 MFD. WHAT SIZE AND TYPE OF WIRE, AND HOW MANY TURNS, WOULD YOU USE IN THIS COIL?

4. - DESCRIBE HOW NEUTRALIZING PRINCIPLES MAY BE EMPLOYED TO PREVENT OSCILLATION IN AN R.F. AMPLIFIER IN WHICH TRIODES ARE USED.

5. - BY MEANS OF A DIAGRAM, SHOW THE NUMBER AND ARRANGEMENT OF DRY CELLS YOU WOULD USE TO OBTAIN A VOLTAGE OF 4 1/2 VOLTS AND SUPPLY A CURRENT DEMAND OF 1/2 AMPERE.

6.- HOW WOULD YOU TEST A #6 DRY CELL TO DETERMINE IF IT IS SERVICEABLE?

7. - WHAT MINIMUM VOLTAGE WOULD YOU ALLOW A NOMINAL 45-VOLT "B" BATTERY BEFORE CONSIDERING ITS REPLACEMENT?

8. - DESCRIBE THE CONSTRUCTION OF A LEAD-ACID TYPE STORAGE CELL.

9. - IF A LEAD-ACID TYPE STORAGE CELL IS FULLY CHARGED, WHAT SHOULD BE ITS SPECIFIC GRAVITY?

10.- WHAT SPECIFIC GRAVITY READING INDICATES A LEAD-ACID STORAGE CELL AS BEING FULLY DISCHARGED?

11.- WHAT IS THE NORMAL VOLTAGE DEVELOPED ACROSS A FULLY-CHARGED LEAD-ACID STORAGE CELL?

12.- DESCRIBE THE CONSTRUCTIONAL FEATURES OF AN ELECTROLYTIC TYPE OF TRICKLE CHARGER.

13.- DRAW A CIRCUIT DIAGRAM OF A TRICKLE CHARGER IN WHICH A COPPER-OXIDE RECTIFIER IS USED.

14.- DRAW A CIRCUIT DIAGRAM OF A "B" ELIMINATOR IN WHICH A RAYTHEON GASEOUS RECTIFYING TUBE IS USED.

15.- DESCRIBE THE CONSTRUCTION AND OPERATION OF AN ELECTROMAGNETIC TYPE OF DYNAMIC SPEAKER.

16. - DESCRIBE THE CONSTRUCTION OF THE TYPE OF SCREEN-GRID TUBE USED IN BATTERY-OPERATED RECEIVERS.

17.- WHY IS SHIELDING USED IN MODERN RECEIVERS?

18.- WHAT ARE THE OPERATING CHARACTERISTICS OF THE TYPE 2A5 POWER TUBE?

19.- WHAT ARE THE OPERATING CHARACTERISTICS OF THE TYPE -58 TUBE?

20.- HOW IS THE GRID BIAS VOLTAGE GENERALLY OBTAINED IN A.C. RECEIVERS?

21.- DRAW A CIRCUIT DIAGRAM SHOWING HOW TWO TYPE 2A5 TUBES MAY BE CONNECTED IN A PUSH-PULL POWER STAGE.

22.- DRAW A CIRCUIT DIAGRAM SHOWING HOW THE FIELD COIL OF A DYNAMIC SPEAKER MAY BE USED AS A FILTER CHOKE IN THE POWER SUPPLY OF AN A.C. RECEIVER.

23.- DESCRIBE THE OPERATING PRINCIPLES OF A STANDARD TYPE SUPERHETERODYNE RECEIVER.

24.- WHAT IMPORTANT FACTS WOULD YOU TAKE INTO CONSIDERATION WHEN DESIGNING AN ANTENNA INSTALLATION?

25.- NAME THE MOST IMPORTANT ITEMS WHICH SHOULD BE INCLUDED IN THE RADIO MAN'S SERVICE EQUIPMENT.

NATIONAL SCHOOLS

RADIO DIVISION

4000 South Figueroa St. , Los Angeles, California

Special Examination #3

answered Oct 13/40

Dear Student:

Upon completing your 27th Lesson, you have passed another important stage of your training. By checking back over the last nine lessons which you studied, you will find that you have learned considerable about receiver troubles, radio interference, automobile receivers, midget receivers, and portable receivers, as well having received many suggestions regarding the construction of receivers in general. This, you will no doubt agree, is a great deal of information to have acquired in only nine lessons and MIGHTY IMPORTANT information too.

I want you to realize that I am deeply interested in how well you remember the many things which your lessons have made known to you and it is for this reason that I am asking you to answer the questions of this special examination.

Each of the questions to follow is based upon Lessons #19 to 27 inclusive and so it would be advisable that you review these lessons carefully before attempting to answer the questions.

I also wish to take this opportunity of congratulating you for the fine way in which you have applied yourself to your studies so far and I am confident that you will continue to do your utmost in maintaining a high standard in the work which is yet to come.

Sincerely yours,

[signature]

President

EXAMINATION QUESTIONS

10/13/40

1. – If in a battery operated receiver, the filament wires to one of the tubes become short circuited, how will this affect the receiver and the "A" battery?

2. – Explain how you can determine if a winding of a transformer is open circuited or not.

3. – What symptoms would cause you to suspect a filter condenser in the power pack of an A.C. receiver being short circuited?

4. – What are some of the possible causes for weak signal reproduction?

(over)

5. — If you were called upon to diagnose the cause for the failure of an A.C. receiver to operate, how would you proceed to determine the trouble?

6. — Explain a quick and simple test which will enable you to determine which stage of a tuned R.F. receiver is preventing the set from operating?

7. — What are the most probable causes for poor tone quality?

8. — What are the most common causes for excessive hum in A.C. receivers?

9. — What are some of the most common causes for scratching and crackling noises in a receiver?

10.— If plate voltage is lacking at all of the R.F. tube sockets in a receiver but is present at the other tube sockets, where would you look for the trouble?

11.— Explain how you would determine if an interference noise originates within the receiver or not.

12.— How would you go about the task of locating an external source of interference?

13.— If an electric motor is known to produce an interfering noise, how could you correct the condition?

14.— Describe an interference rejecting antenna system.

15.— Describe a suitable antenna system for an automobile receiver installation.

16.— Explain what provisions should be made in the electrical system of an automobile to prevent the receiver from picking up excessive interference noise.

17.— Draw a circuit diagram of a vibrator type Automotive "B" eliminator using a vacuum tube rectifier.

18.— Explain the operating principle of the "B" eliminator which you have drawn as your answer for question #17 of this examination.

19.— Describe one common method of supplying the bias voltage for a filament type power tube in a midget A.C. receiver, illustrating your description by means of a simple diagram.

20.— What are the most important points which you would take into consideration upon comtemplating the construction of a portable receiver?

21.— Describe the constructional features of a typical loop antenna.

22. — What important facts would you take into consideration upon contemplating an antenna installation?

NATIONAL SCHOOLS
RADIO DIVISION
4000 South Figueroa St. Los Angeles, California

Special Examination # 4

DEAR STUDENT:

YOU ARE PROGRESSING SPLENDIDLY WITH YOUR STUDIES AND IT IS INDEED MOST PLEASING TO ME TO SEE YOU TAKE SUCH A COMPLETE INTEREST IN YOUR WORK. FROM NOW ON, YOUR STUDIES ARE GOING TO BECOME MORE TECHNICAL AND IT MAY REQUIRE A LITTLE HARDER STUDY FOR YOU TO MASTER THEM. HOWEVER, YOU MUST BEAR IN MIND THAT THIS ADVANCED TYPE OF STUDY IS MOST NECESSARY IN ORDER THAT YOU MAY PREPARE YOURSELF FOR THE BETTER JOBS WHICH THE RADIO INDUSTRY HAS TO OFFER YOU.

IT IS NOW TIME FOR ANOTHER SPECIAL EXAMINATION. THIS PARTICULAR EXAMINATION IS BASED SOLELY UPON LESSONS #28 TO #36 INCLUSIVE AND SO BEFORE COMMENCING TO ANSWER THE FOLLOWING GROUP OF QUESTIONS, I SUGGEST THAT YOU FIRST REVIEW THESE LAST NINE LESSONS CAREFULLY, SO THAT YOU WILL BE SURE TO HAVE A PERFECT UNDERSTANDING OF EVERYTHING WHICH HAS BEEN EXPLAINED IN THEM.

I AM CERTAIN THAT YOU WILL FIND THIS EXAMINATION TO BE INTERESTING, AS WELL AS INSTRUCTIVE AND THAT YOU WILL DO YOUR BEST TO RECEIVE A SPLENDID GRADE UPON IT.

SINCERELY YOURS,

J. A. Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS

1. – DRAW A DIAGRAM OF A TYPICAL AUTOMATIC VOLUME CONTROL CIRCUIT, USING A SEPARATE A.V.C. TUBE AND EXPLAIN HOW IT OPERATES.

2. – WHY IS IT THAT RECEIVERS EMPLOYING AN AUTOMATIC VOLUME CONTROL SYSTEM HAVE A TENDENCY TO AMPLIFY BACK GROUND NOISE CONSIDERABLY WHEN TUNED TO SOME POINT BETWEEN STATIONS?

3. – DRAW A CIRCUIT DIAGRAM OF AN AUTOMATIC NOISE SUPPRESSION CIRCUIT, SHOWING HOW IT IS USED IN CONJUNCTION WITH AN AUTOMATIC VOLUME CONTROL SYSTEM OF A RECEIVER.

4. – EXPLAIN THE OPERATION OF THE CIRCUIT WHICH YOU HAVE DRAWN IN ANSWER TO QUESTION #3.

(OVER)

5. – ILLUSTRATE BY MEANS OF A DIAGRAM HOW A TYPE 2A6 TUBE CAN BE USED IN A SUPERHETERODYNE RECEIVER SO AS TO FUNCTION SIMULTANEOUSLY AS A SECOND DETECTOR, A.F. AMPLIFIER AND AN A.V.C. TUBE.

6. – WHEN USING A DUPLEX–DIODE TRIODE TUBE SO THAT IT WILL FUNCTION AS A HALF–WAVE DETECTOR, HOW WILL THE AMOUNT OF ITS RECTIFIED SIGNAL VOLTAGE COMPARE WITH THAT OBTAINED WHEN THIS SAME TUBE IS USED IN A FULL–WAVE DETECTOR ARRANGEMENT?

7. – EXPLAIN THE MECHANISM AND OPERATION OF THE SHADOW–TUNING INSTRUMENT.

8. – SHOW BY MEANS OF A DIAGRAM HOW IN A SERIES STORAGE BATTERY CHARGING CIRCUIT THE RATE OF CHARGE THROUGH ONE OF THE BATTERIES CAN BE REDUCED WITHOUT REDUCING THE RATE OF CHARGE THROUGH THE OTHER BATTERIES OF THE CIRCUIT.

9. – DRAW A CIRCUIT DIAGRAM SHOWING HOW A PHONOGRAPH PICK–UP UNIT CAN BE CONNECTED TO THE GRID CIRCUIT OF A RECEIVER'S DETECTOR STAGE.

10.– DRAW A CIRCUIT DIAGRAM SHOWING HOW A PHONOGRAPH PICK–UP UNIT CAN BE CONNECTED TO THE SECOND DETECTOR OF A SUPHETERODYNE RECEIVER IN WHICH A TYPE 2A6 TUBE IS EMPLOYED.

11.– DRAW A CIRCUIT DIAGRAM WHICH ILLUSTRATES A TONE–CONTROL CIRCUIT.

12.– WHAT IS AN IMPORTANT ADVANTAGE OF CONTROLLING REGENERATION IN SHORT WAVE RECEIVERS THROUGH VARIATION OF THE DETECTOR TUBE'S SCREEN–GRID POSITIVE POTENTIAL.

13.– EXPLAIN HOW YOU WOULD TEST A LEAD–ACID STORAGE BATTERY BY MEANS OF THE CADIMUM TEST.

14.– HOW DOES THE EDISON STORAGE CELL DIFFER FROM THE LEAD–ACID TYPE STORAGE CELL?

15.– EXPLAIN THE "SKIP–DISTANCE" PHENOMENA AS EXPERIENCED WITH SHORT–WAVE RECEPTION.

16.– DESCRIBE BRIEFLY HOW A RECEIVER DESIGNED FOR 110 VOLT D.C. OPERATION DIFFERS FROM A RECEIVER DESIGNED FOR 110 VOLT A.C. OPERATION.

17.– HOW DOES A 110 VOLT A.C. RECEIVER DIFFER FROM A 220 VOLT A.C. RECEIVER?

18.– DESCRIBE BRIEFLY ANY ONE UNIVERSAL RECEIVER CIRCUIT.

19.– DESCRIBE THE 25Z5 TUBE AND EXPLAIN HOW IT MAY BE USED.

20.– WHAT ARE SOME OF THE MORE IMPORTANT POINTS WHICH SHOULD BE CONSIDERED AT THE TIME THE CONSTRUCTION OF ANY RECEIVER IS CONTEMPLATED?

NATIONAL SCHOOLS

RADIO DIVISION

4000 South Figueroa St. · Los Angeles, California

Special Examination #5

DEAR STUDENT:

DURING THE PAST NINE LESSONS, YOU HAVE LEARNED MANY NEW THINGS OF A TECHNICAL NATURE WHICH ARE GOING TO PROVE THEMSELVES OF GREAT VALUE TO YOU LATER ON. THE PRINCIPLES AND FORMULAS GIVEN YOU IN THE LESSONS FROM #37 TO 45 FORM THE BASIS OF RADIO DESIGN WORK IN GENERAL.

IT IS KNOWLEDGE OF THE TYPE WHICH YOU ARE NOW ACQUIRING THAT WILL PERMIT YOU TO RISE ABOVE THE RANKS OF THE AVERAGE TECHNICIAN. FURTHERMORE, THIS IS THE TYPE OF TRAINING WHICH ENABLES YOU TO DERIVE REAL DIVIDENDS FROM THE INVESTMENT YOU MADE AT THE TIME YOU ENROLLED.

BEAR IN MIND THAT THIS EXAMINATION IS BASED ON LESSONS #37 TO 45, SO BE SURE TO REVIEW THESE LESSONS CAREFULLY FIRST BEFORE ATTEMPTING TO ANSWER THE FOLLOWING QUESTIONS.

SINCERELY YOURS,

PRESIDENT

EXAMINATION QUESTIONS

1. — HOW DOES THE IMPEDANCE OF A SERIES RESONANT TUNING CIRCUIT COMPARE WITH THAT OF A PARALLEL RESONANT CIRCUIT AT THE RESONANT FREQUENCY?

2. — WHAT IS MEANT BY THE TERM POWER FACTOR?

3. — IF A CONDENSER OF .00025 MFD. CAPACITY IS CONNECTED IN SERIES WITH A COIL HAVING AN INDUCTANCE VALUE OF 4 MICROHENRIES, AT WHAT WAVELENGTH WILL THIS TUNED CIRCUIT RESONATE?

4. — IF A CONDENSER OF 140 MMFD. CAPACITY IS CONNECTED IN SERIES WITH A COIL HAVING AN INDUCTANCE VALUE OF 4 MICROHENRIES, AT WHAT WAVELENGTH WILL THIS TUNED CIRCUIT RESONATE?

5. — HOW MANY TURNS TO THE INCH CAN A #30 B&S ENAMELLED COPPER WIRE BE WOUND IF NO SPACING IS ALLOWED BETWEEN ADJACENT TURNS?

6. — TO WHAT FREQUENCY DOES AN "LC" FACTOR OF 0.1013 CORRESPOND?

(OVER)

7. — If it is desired to wind a coil on a 1" diameter tubular form with a #30 B&S enamelled wire and so that it will tune over a frequency band of 550 to 1500 Kc. when used in conjunction with a .00035 mfd. tuning condenser, then how many turns of this wire should be used if no spacing is allowed between turns?

8. — An unknown resistance is being measured on a Wheatstone Bridge and a 10 ohm resistor is used as a standard. With the "bridge" in a state of balance, the distances "S" and "T" are found to be 20 cm. and 80 cm. respectively. What is the value of the unknown resistance?

9. — What is the advantage of using a band-pass or band-selector circuit in the R.F. amplifier of a receiver?

10.— Draw a circuit diagram showing how a fixed condenser may be used as the means of coupling in a band-pass circuit.

11.— In order to have a ganged tuning condenser tune the oscillator, as well as the pre-selector and first detector stages in a superheterodyne receiver employing a padding system in the oscillator's tuned circuit, what relation may exist between the inductance rating of the oscillator's tuned winding and the other tuned windings and between the size of padding condenser and the ratings of the ganged condenser sections so as to obtain proper tracking?

12.— If the peak voltage in a certain A.C. circuit is 450 volts, what will be the effective voltage of this circuit?

13.— If four resistors having respective values of 10; 20; 5 and 4 ohms are all connected in parallel, what will be their combined resistance?

14.— If the voltage of an A.C. circuit as measured with a voltmeter is found to be 130 volts, then what peak voltage will be present in this same circuit?

15.— What inductive reactance will an 85 millihenry R.F. choke offer towards a 600 Kc. current?

16.— What capacitive reactance will a .00035 mfd. condenser offer towards an oscillating current having a frequency of 850 Kc.?

17.— A circuit consisting of a 100 millihenry choke, a .005 mfd. condenser and 15 ohms of D.C. resistance are all connected in series. If the ends of this combination are connected across a source of 2 volts signal voltage and of 600 Kc. frequency, then how much current will flow through the circuit?

18.— What is the phase relation between the voltage and current in a pure inductive A.C. circuit?

19.— If three condensers having respective capacitive values of .00025 mfd., .0005 mfd. and .00075 mfd. are all connected in series, what will be their combined capacity?

NATIONAL SCHOOLS

LOS ANGELES CALIFORNIA

ESTABLISHED 1905 J. A. ROSENKRANZ, *President*

RADIO DIVISION

SPECIAL EXAMINATION NO. 7

Dear Student:

You have just completed an intensive study treating with A-F amplifying systems and mathematics. This knowledge is going to be of tremendous help to you in constructing sound amplifying equipment, broadcast transmitters, talking picture equipment, television equipment, etc.

I advise you most urgently to review this series of lessons on amplifiers so that there will be no doubt in your mind concerning any of the subjects discussed therein. This is important because in the studies that follow you will have need for this information -- also, the explanations as given in succeeding lessons assume that you remember these facts.

I am delighted in seeing you make such splendid progress in your studies, and am anxiously looking forward to the time when you will take your place in the industry as a thoroughly qualified technician.

Sincerely yours,

J. A. Rosenkranz,
President

EXAMINATION QUESTIONS

1. - Draw a circuit diagram of an A-F amplifier employing a 57 tube in the input stage, a 56 tube in the intermediate stage and two 2A5's in a push-pull power stage. Show how you would connect a double-button carbon microphone to this amplifier and how you would connect four speakers to the output of the amplifier. Each of the speakers used is to be of the A-C type and having a voice coil impedance of 8-ohms. This diagram is to be complete, with the values of all parts designated.

2. - Four dynamic speakers, having voice coil impedances of 9-ohms each and individual input transformers, are to be connected to a 200-ohm transmission line. Show by means of a diagram how you would make the connections, indicating the impedance values of the various parts involved.

3. - Explain in detail how you would proceed to determine the acoustic conditions of a room, preparatory to installing amplifying equipment.

4. - Draw a diagram of a pre-amplifier circuit, showing how a condenser microphone is connected to it and how you would couple this amplifier to the input of a main amplifier through a 500-ohm transmission line. This diagram is to be complete, with all necessary parts values specified.

(OVER)

5. - DESCRIBE THE PRINCIPLES INVOLVED IN DESIGNING A DIRECT-COUPLED A-F AMPLIFIER, AND ILLUSTRATE YOUR EXPLANATION WITH A SUITABLE DRAWING.

6. - MAKE A DIAGRAM SHOWING HOW A TYPE 53 TUBE MAY BE USED AS A PHASE-INVERTER, DRIVING A PAIR OF RESISTANCE COUPLED PUSH-PULL 56 TUBES AND WHICH IN TURN DRIVE A PAIR OF RESISTANCE COUPLED PUSH-PULL 2B6 TUBES.

7. - REDUCE THE FOLLOWING FRACTION TO ITS LOWEST TERMS:

$$\frac{(X+Y)\,(X-Y)^2}{X(X-Y)^2}$$

8. - REDUCE THE FOLLOWING TO EQUIVALENT FRACTIONS HAVING A LOWEST COMMON DENOMINATOR:

(A) $\frac{A}{X - A}$ (B) $\frac{X}{X - A}$ (C) $\frac{A^2}{X^2 - A^2}$

9. - SOLVE FOR X IN THE FOLLOWING EQUATION: $2X-(5X+5) = 7$.

10.- DIVIDE $4x^4y^6+8x^7y^3 - 12x^6y^4$ BY $2x^2y^2$

11.- SOLVE FOR "X" IN THE FOLLOWING EQUATION: $X^2 - 16 = 48$

12.- DIVIDE $\frac{3X+Y}{9}$ BY $\frac{4X}{3}$

13.- SOLVE THE FOLLOWING PROBLEM BY USING LOGARITHMS, SHOWING ALL YOUR WORK:

$$\frac{110 \times 3.1 \times 0.650}{33 \times 0.7854 \times 1.7}$$

14.- AN AMPLIFIER HAS AN EMF OF ONE VOLT APPLIED ACROSS ITS INPUT RESISTANCE OF 20,000-OHMS. AN EMF OF 18 VOLTS APPEARS ACROSS ITS OUTPUT RESISTANCE OF 5000-OHMS. WHAT IS THE POWER-GAIN IN DB AND WHAT IS THE VOLTAGE GAIN IN DB OF THIS AMPLIFIER? WOULD IT BE WORTH WHILE TO INCREASE THE AMPLIFICATION SO THAT 30 VOLTS APPEARED ACROSS THE OUTPUT?

15.- A CERTAIN AMPLIFIER IS KNOWN TO OFFER A GAIN OF 80 DB, AND AT WHICH TIME A SIGNAL VOLTAGE OF 35 VOLTS IS AVAILABLE AT ITS OUTPUT. ASSUMING THE INPUT AND OUTPUT IMPEDANCES TO BE EQUAL, WHAT IS THE SIGNAL-VOLTAGE INPUT TO THE AMPLIFIER AT THIS TIME?

16.- DRAW A DIAGRAM SHOWING HOW THREE MICROPHONES CAN BE MADE TO OPERATE INTO A MIXER CIRCUIT WHICH IN TURN FEEDS INTO THE INPUT OF AN AMPLIFIER. T-PAD VOLUME CONTROLS ARE TO BE USED IN THIS SYSTEM.

17.- IT IS DESIRED TO DESIGN AN H-PAD FOR A 500-OHM TRANSMISSION LINE WHICH IS BEING USED TO CONNECT TWO AMPLIFIERS TOGETHER. THIS PAD IS EXPECTED TO FURNISH AN ATTENUATION OF 8 DB. WORK OUT THE DESIGN FOR THIS PAD AND MAKE A DRAWING OF THE SYSTEM, DESIGNATING THE ELECTRICAL VALUES FOR ALL RESISTOR VALUES USED IN THE PAD, AS WELL AS THE SOURCE AND LOAD IMPEDANCES.

18.- DESIGN A DB VOLUME CONTROL TO MEET THE FOLLOWING SPECIFICATIONS: THIS CONTROL IS TO BE USED AS THE GRID LEAK RESISTOR FOR AN AMPLIFIER TUBE AND THE ASSUMED GRID LEAK RESISTOR VALUE IS TO BE 250,000 OHMS. THE TOTAL ATTENUATION IS TO BE 30 DB. THERE ARE TO BE TEN STEPS OF ATTENUATION, 3 DB PER STEP, IN ADDITION TO THE "FULL-ON" AND "OFF" POSITIONS.

NATIONAL SCHOOLS

RADIO DIVISION

4000 South Figueroa St. • Los Angeles, California

Answered March 12, 1940
Grade 98

SPECIAL JOB SHEET EXAMINATION #1

DEAR STUDENT:

YOU HAVE BY THIS TIME STUDIED THE FIRST TEN JOB SHEETS AND BEFORE CONTINUING WITH THOSE WHICH ARE TO FOLLOW, IT IS ADVISABLE THAT WE TAKE THE TIME NOW TO ASSURE OURSELVES THAT YOU ARE LEARNING FROM THEM ALL THAT YOU SHOULD.

IT IS OF COURSE TRUE THAT THIS FIRST GROUP OF TEN JOB SHEETS ARE OF A RATHER ELEMENTARY NATURE BUT NEVERTHELESS THEY CONTAIN MANY IMPORTANT FACTS WHICH YOU CANNOT AFFORD TO PASS BY UNNOTICED. AS YOU PROGRESS, YOU WILL FIND YOUR JOB SHEETS TO TREAT WITH THE MORE COMPLEX SUBJECTS AND TO BECOME INCREASINGLY INTERESTING.

BEFORE COMMENCING TO ANSWER THE QUESTIONS WHICH FOLLOW, PLEASE NUMBER YOUR EXAMINATION PAPER AS JS-1 FOR IDENTIFICATION PURPOSES.

SINCERELY YOURS,

J. A. Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS
(JS-1)

1. – EXPLAIN IN DETAIL HOW YOU WOULD ALIGN THE TUNING CIRCUITS OF A T.R.F. RECEIVER WITH THE AID OF A SERVICE OSCILLATOR.

2. – DESCRIBE TWO METHODS WHEREBY YOU CAN DETERMINE WHICH SIDE OF A D.C. CIRCUIT IS POSITIVE AND WHICH NEGATIVE.

3. – A CERTAIN HOME WHICH YOU ARE CALLED UPON TO VISIT IS WIRED FOR ELECTRIC LIGHTING AND YOU ARE EXPECTED TO DETERMINE WHETHER THIS PARTICULAR INSTALLATION IS OF THE A.C. OR D.C. TYPE AND ALSO THE VOLTAGE OF SAME. HOW WOULD YOU PROCEED TO DETERMINE THESE FACTS?

4. – WHAT IS THE DIAMETER OF A #10 B&S COPPER WIRE EXPRESSED IN MILS AND WHAT IS THE RESISTANCE PER THOUSAND FEET OF THIS WIRE?

5. – YOU ARE CALLED UPON TO SERVICE AN OLD T.R.F. RECEIVER WHICH EMPLOYS TRIODES IN AN R.F. AMPLIFIER OF NEUTRODYNE DESIGN. THE SELECTIVITY OF THIS RECEIVER IS FOUND TO BE SATISFACTORY BUT THE SET HAS A TENDENCY TO SQUEAL OR WHISTLE ESPECIALLY WHEN TUNED TO THE HIGHER FREQUENCIES. WHAT IS WRONG WITH THIS RECEIVER AND HOW WOULD YOU PROCEED TO CORRECT THE CONDITION?

(OVER)

6. — How much current can be passed safely through a #12 B&S rubber covered wire?

7. — Upon being called upon to service a battery operated receiver, you find that the tubes light but no signals are received. What is the probable cause of the trouble and how would you remedy it?

8. — Upon testing an A.C. receiver, it is found that no "B" voltages are available from the power pack and the plates of the rectifier tube become red hot. What is the most probable cause for this trouble and how would you remedy it?

9. — A certain receiver has a tendency to emit a howling sound when certain strong notes are reproduced by the speaker and also if the chassis is jarred. What is the most probable cause for this trouble and how would you remedy it?

10.— What may be the trouble in a 110 or 220 volt D.C. receiver in which none of the tube filaments light?

11.— How would you proceed to align the tuning circuits of a T.R.F. receiver in the event that no service oscillator is available?

12.— What are some of the most common causes for excessive hum in an A.C. receiver and how would you reduce it in each case?

13.— What are some of the most common causes for low volume in A.C. receivers?

14.— If the line plug of a D.C. receiver should be reversed in the receptacle of the D.C. lighting circuit, how would this affect the performance of the receiver?

15.— What are some of the most common causes of intermittent reception?

16.— If voltage is lacking across only a portion of a power pack voltage divider system, what is the most probable cause of trouble? How would you correct the condition?

17.— What are some of the most common causes for low volume in battery operated receivers?

18.— What are some of the most common causes for poor tone quality in receivers, assuming that the quality was satisfactory originally?

19.— A certain receiver which uses screen-grid tubes in the R.F. stages has a tendency to oscillate, that is, produce squealing sounds. What are some of the most probable causes for this trouble and how would you correct it?

20.— What precautions should be exercised when measuring line voltage or when making a line polarity test?

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NATIONAL SCHOOLS
FIGUEROA AND SANTA BARBARA STS.
LOS ANGELES, CALIF.

RADIO DIVISION

EDUCATIONAL DEPT.

Answered May 8 9, 40

SPECIAL JOB SHEET EXAMINATION #2

DEAR STUDENT:

SINCE ANSWERING YOUR LAST JOB SHEET EXAMINATION YOU HAVE RECEIVED AN ADDITIONAL GROUP OF JOBSHEETS AND WHICH YOU HAVE NO DOUBT FOUND TO BE OF GREAT VALUE.

THESE JOBSHEETS ARE A SPECIAL FEATURE OF NATIONAL TRAINING AND OFFER YOU IN A CONDENSED FORM AND FOR EASY REFERENCE ALL OF THE MORE IMPORTANT SERVICE JOBS PERTAINING TO RADIO. IT IS THEREFORE ESSENTIAL THAT YOU STUDY THESE JOBSHEETS WITH THE SAME ATTENTION AS YOU WOULD DEVOTE TO YOUR REGULAR LESSONS.

AS YOU RECEIVE ADDITIONAL JOB SHEETS, YOU WILL FIND THEM TO CONTAIN DETAILED INFORMATION TREATING WITH THE ALIGNING OF SUPERHETERODYNE RECEIVERS AND ALL-WAVE RECEIVERS, SPECIAL ALIGNING PROCEDURES WHEN AUTOMATIC VOLUME CONTROL SYSTEMS ARE USED, COMMON TROUBLES IN AUTOMATIC VOLUME CONTROL SYSTEMS AND THEIR CORRECTION, SPEAKER REPAIRS, PHONOGRAPH PICK-UP TROUBLES AND REPAIRS, SPECIAL CONDENSER AND RESISTOR TESTS ETC. BY ADDING ALL THIS INFORMATION TO THAT CONTAINED IN THE MANY REGULAR LESSONS, YOU WILL HAVE A MOST COMPLETE REFERENCE LIBRARY.

THIS PARTICULAR EXAMINATION IS BASED ON JOBSHEETS #11 TO 20 INCLUSIVE AND IT IS THEREFORE ADVISABLE THAT YOU STUDY THIS GROUP OF JOBSHEETS WITH SPECIAL CARE SO THAT YOU CAN ANSWER THE GREATER PORTION OF THE FOLLOWING QUESTIONS WITHOUT REFERRING BACK TO THE JOBSHEETS THEMSELVES.

AGAIN LET ME SUGGEST THAT BEFORE COMMENCING TO ANSWER THE QUESTIONS WHICH FOLLOW, TO PLEASE NUMBER YOUR EXAMINATION PAPER AS JS-2 FOR IDENTIFICATION PURPOSES.

SINCERELY YOURS,

J. A. Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS
(JS-2)

1. – IN A CERTAIN RECEIVER USING A MAGNETIC SPEAKER NO SOUNDS ARE EMITTED BY THE SPEAKER AND YET UPON CONNECTING A PAIR OF HEADPHONES TO THE OUTPUT, SIGNALS ARE HEARD SATISFACTORILY. WHAT ARE THE MOST PROBABLE CAUSES FOR THIS TROUBLE? (BE SPECIFIC IN YOUR ANSWER).

2. – WHAT ARE SOME OF THE MORE COMMON CAUSES FOR A "DEAD" DYNAMIC SPEAKER?

3. – EXPLAIN IN DETAIL AND ILLUSTRATE BY MEANS OF A DIAGRAM HOW YOU WOULD TEST A TRANSFORMER WINDING FOR CONTINUITY.

4. – FOR WHAT PURPOSE IS A TYPE 6C6 TUBE SUITABLE? DRAW THE SYMBOL AND SOCKET CONNECTIONS FOR THIS TUBE AND SPECIFY ITS OPERATING CHARACTERISTICS.

(OVER)

5. – FOR WHAT PURPOSE IS A 5Z3 TUBE SUITABLE? DRAW ITS SYMBOL AND SOCKET CONNECTIONS AND SPECIFY ITS OPERATING CHARACTERISTICS.

6. – IF IN AN A.C. RECEIVER, PLATE AND SCREEN VOLTAGE IS AVAILABLE AT A CERTAIN R.F. TUBE BUT NO GRID BIAS VOLTAGE READING IS OBTAINED, WHAT IS THE MOST LIKELY CAUSE OF TROUBLE?

7. – IN A CERTAIN RECEIVER PLATE VOLTAGE IS AVAILABLE IN THE DETECTOR AND A.F. STAGES BUT NOT IN ANY OF THE R.F. STAGES. WHAT ARE THE MOST LIKELY TROUBLES?

8. – EXPLAIN IN DETAIL AND ILLUSTRATE BY MEANS OF A DIAGRAM HOW YOU WOULD DETERMINE WHETHER OR NOT A BY-PASS CONDENSER IN A CERTAIN RECEIVER CIRCUIT IS SHORT CIRCUITED.

9. – A CERTAIN MICA CONDENSER IS COLOR CODED WITH DOTS OF THE FOLLOWING COLORS — BROWN, BLACK, AND BROWN AND WHICH ARE ARRANGED IN THE SAME ORDER AS HERE GIVEN. WHAT IS THE CAPACITIVE VALUE OF THIS CONDENSER?

10.– A CERTAIN COLOR CODED RESISTOR HAS AN ORANGE BODY COLOR, A YELLOW END COLOR, AND A RED SPOT. WHAT IS THE RESISTANCE VALUE OF THIS UNIT?

11.– WHAT ARE THE ADVANTAGES TO BE ACQUIRED BY THE USE OF A VOLTAGE REGULATER IN A RECEIVER? HOW SHOULD SUCH A UNIT BE INSTALLED AND WHAT PRECAUTIONS SHOULD BE TAKEN IN SELECTING A VOLTAGE REGULATOR OF CORRECT RATING FOR A GIVEN RECEIVER?

12.– EXPLAIN IN DETAIL HOW YOU WOULD PROCEED TO IDENTIFY THE VARIOUS TERMINALS OF A POWER TRANSFORMER IN THE EVENT THAT THESE ARE NOT MARKED BY THE MANUFACTURER.

13.– IN A CERTAIN SUPERHETERODYNE RECEIVER A WHISTLING SOUND IS HEARD AS EACH STATION IS TUNED IN. WHAT ARE THE MOST LIKELY CAUSES FOR THIS TROUBLE?

14.– AFTER TUNING IN A LOCAL STATION ON A CERTAIN SUPERHETERODYNE IT IS FOUND THAT AFTER LISTENING TO THE PROGRAM FOR AWHILE THE STATION'S SIGNAL GRADUALLY BECOMES WEAKER AND FINALLY DISAPPEARS ALTOGETHER. HOWEVER, BY SIMPLY RESETTING THE TUNING CONTROL KNOB AGAIN, THE SAME SIGNAL WILL ONCE MORE COME THROUGH CLEAR. WHAT ARE THE MOST LIKELY CAUSES FOR THIS TROUBLE.

15.– IF A SUPERHETERODYNE RECEIVER TUNES SATISFACTORILY OVER ONE SECTION OF THE DIAL BUT NOT OVER THE REMAINING SECTION OF THE DIAL, WHAT ARE THE MOST PROBABLE CAUSES FOR THIS TROUBLE?

16.– WHAT ARE SOME OF THE MORE PROBABLE CAUSES FOR DISTORTION IN A SUPERHETERODYNE RECEIVER EVEN THOUGH ALL TUBE VOLTAGES AND GENERAL CIRCUIT CONSTANTS ARE CORRECT?

17.– WHAT ARE SOME OF THE MORE PROBABLE CAUSES FOR A SUPERHETERODYNE RECEIVER BEING DEAD?(NOT CONSIDERING GENERAL CIRCUIT TROUBLES AS POWER PACK BREAKDOWNS ETC. WHICH MAY OCCUR IN ANY TYPE OF RECEIVER)

NATIONAL SCHOOLS

RADIO DIVISION

4000 South Figueroa St. Los Angeles, California

SPECIAL JOB SHEET EXAMINATION #3

Dear Student:

I am confident that you realize the full value of the JobSheets and that you are studying them diligently. The various jobs and tests as described by them are representative of the types of problems which will confront you in the industry and it is therefore necessary that you familiarize yourself thoroughly with the correct manner of handling them.

The questions appearing in this examination are based on JobSheets #21 to #30 inclusive, so be sure to review this series well before attempting to answer these questions. Also please number your examination papers for this set of questions as JS-3.

Sincerely yours,

answered Nov 6, '40

[signature]

President

EXAMINATION QUESTIONS
(JS-3)

1. - Explain in detail how you would proceed to determine the intermediate frequency of a superheterodyne receiver in the event that this information is not known nor available in specification form.

2. - Explain and illustrate with a diagram how you would connect an output meter to the push-pull power stage of a receiver.

3. - Explain in detail how you would proceed to align a band-pass type I.F. amplifier used in a superheterodyne receiver.

4. - How would you proceed to align a peaked I.F. amplifier?

5. - If you were called upon to operate a 110 volt A.C. receiver from a 220 volt A.C. circuit, how would you accomplish this?

6. - What special steps must be taken in order to align the tuning circuits of a superheterodyne receiver equipped with A.V.C.?

7. - How would you proceed to adapt a set of headphones to a receiver which is already equipped with a speaker?

(OVER)

8. - What are some of the most probable causes for intermittent action of a receiver's A.V.C. system?

9. - What are some of the most probable causes for inter-station noise if the receiver is equipped with a silent tuning system?

10.- Explain in detail how an electrolytic condenser should be tested.

11.- How would you proceed to align the oscillator of a superheterodyne receiver?

12.- Explain how you would align the R.F. section of a superheterodyne.

13.- How can the time-lag of a superheterodyne's A.V.C. action be regulated?

14.- Describe a simple emergency repair of an A.F. transformer.

15.- What are some of the most probable causes for weak reception when the receiver is equipped with an A.V.C. system?

16.- (a) What is a flat-top I.F. transformer?
(b) What special precautions must be exercised in tuning such transformers?

17.- Make a diagram and explain in detail how an output meter may be connected to a receiver's power stage in which a single tube is employed.

18.- What are some of the most probable causes of abrupt A.V.C. action?

19.- Why is it advisable to connect a resistance in series with the test circuit when testing electrolytic condensers?

20.- What are the most probable causes for no control of volume in receivers employing an A.V.C. system?

RADIO - TELEVISION

Practical • J. A. ROSENKRANZ, Pres. • Training

NATIONAL SCHOOLS

Established 1905

Los Angeles, California

RADIO EXPERIMENTS

LESSON NO. 1

In addition to having a good technical understanding of Radio, it is also of vital importance that you learn how to apply this knowledge to practical use. So that you may attain both of these qualifications, we are including a complete assortment of experimental equipment as a regular part of your training.

The experiments, which you are going to perform, will enable you to prove for yourself many of the important principles which were presented to you in your regular lessons. With each experimental outfit, you will receive a complete set of instructions regarding their use so that you may be assured of deriving the greatest benefit from this part of your work.

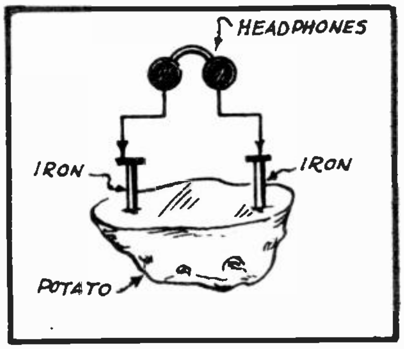

Fig. 1
Very Low Voltage.

Naturally, your first experiments are going to be of a very elementary nature, dealing mostly with fundamental electrical principles. However, as you progress and receive additional equipment, you will construct many different types of receiver circuits, perform service adjustments and cope with any number of good practical trouble shooting jobs. In all this work, you will be closely guided by carefully prepared instructions.

EXPERIMENT #1: — THE PRODUCTION OF AN E.M.F. BY CHEMICAL MEANS

Our first experiment is going to be a very simple one, however, it is going to illustrate how an E.M.F. may be produced by chemical action.

The first step will be to obtain a fairly good sized piece of a fresh raw potato and to insert two iron nails into it as illustrated in Fig. 1. This done, clamp your headphones over your ears and then touch one of the phone tips to one nail and the second phone tip to the other nail as also pointed out in Fig. 1. Listen carefully for a "click" in the headphones as you establish this contact.

Having completed this test, continue by removing both of the nails and insert two pieces of clean bare copper wire in their place and establish contact to the copper wires with the headphone tips. Listen carefully for a click in your headphones as you make and break contact with your headphone tips.

From these two simple tests, you will find that no perceptible click will be experienced in the headphones when establishing contact with either the two nails or the two pieces of copper wire, thus showing that no appreciable voltage exists with which to force an electric current through the headphone windings so as to actuate their diaphragms.

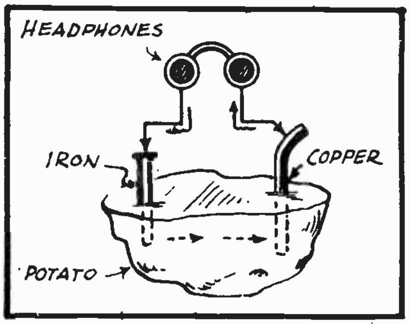

Fig. 2
Appreciable Voltage.

Now insert one nail and one piece of copper wire into the potato and again establish contact with the headphone tips as illustrated in Fig. 2. This time, you will hear a pronounced click in the phones each time that the circuit is completed and the test thus shows you that a definite voltage now exists which is capable of forcing a current through the headphone windings so as to actuate the diaphragms.

What we really have here is a simple form of primary cell, where the acids contained in the potato serve as the electrolyte and the two pieces of metal which are inserted into the potato act as electrodes.

When using two dissimilar metals for electrodes, such as iron and copper in our last test, the acids of the potato or electrolyte attack the iron more than they do the copper, thereby resulting in a potential difference across the two electrodes. In other words, a voltage is thus established and it is capable of causing an electric current to flow thru a completed circuit. The headphones in this case serve to complete this circuit and the magnetic reaction caused by this current flow is such as to act upon the diaphragm of the headphones as already explained in your regular lessons.

If two like metals are used as the electrodes, the chemical reaction occuring at each of them is the same and consequently no potential difference is established across them.

It is possible to use several combinations of dissimilar metals as electrodes and when immersed in various types of electrolytes, they will produce various voltage values.

For instance, zinc and carbon when immersed in an electrolyte consisting chiefly of ammonium cloride and zinc chloride will produce an E.M.F. or 1.5 volt; copper and zinc in an electrolyte consisting of zinc

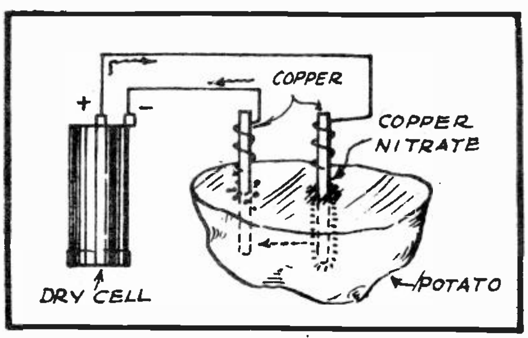

Fig. 3
Charging The Cell.

SULPHATE AND COPPER SULPHATE WILL PRODUCE I VOLT ETC.

EXPERIMENT #2: – A SIMPLE SECONDARY CELL

NOW LET US TEST THE THOERY OF THE SECONDARY CELL OR STORAGE CELL BY MEANS OF A SIMPLE EXPERIMENT. WE SHALL BEGIN BY AGAIN INSERTING TWO PIECES OF BARE COPPER WIRE INTO THE RAW POTATO BUT THIS TIME, BE SURE THAT THE TWO WIRES ARE QUITE CLOSE TO EACHOTHER BUT NOT TOUCHING.

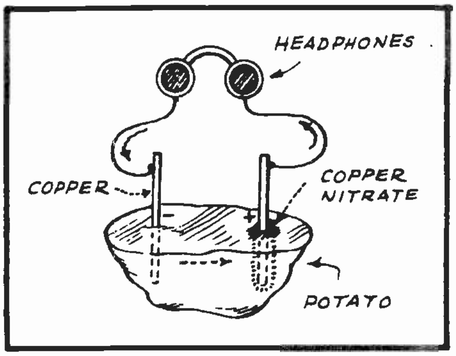

Fig. 4
Discharging The Cell.

NOW MAKE A PRELIMINARY TEST BY CONNECTING YOUR HEADPHONES ACROSS THE TWO COPPER WIRES. YOU WILL HEAR NO CLICK BECAUSE NO APPRECIABLE VOLTAGE EXISTS AT THIS TIME, AS YOU ALREADY LEARNED.

THE NEXT STEP WILL BE TO CONNECT A DRY CELL ACROSS THE TWO COPPER ELECTRODES AS SHOWN IN FIG. 3. THE DRY CELL WILL DISCHARGE THROUGH THE POTATO AS SHOWN IN FIG. 3. BECAUSE THE MOISTURE AND ACID WITHIN THE POTATO ACTS AS A CONDUCTOR.

AFTER A LITTLE TIME HAS ELAPSED, YOU WILL OBSERVE THE FORMATION OF A GREEN COLORED MATERIAL AROUND THE COPPER ELECTRODE WHICH IS CONNECTED TO THE POSITIVE TERMINAL OF THE DRY CELL, WHILE SMALL GASEOUS BUBBLES RESEMBLING FOAM WILL ACCUMULATE AROUND THE ELECTRODE WHICH IS CONNECTED TO THE NEGATIVE TERMINAL OF THE CELL. THESE OBSERVATIONS CLEARLY DEMONSTRATE THAT A CHEMICAL ACTION IS NOW TAKING PLACE.

WHAT ACTUALLY HAPPENS DURING THIS TIME IS THAT THE FLOW OF CURRENT THROUGH THE SYSTEM CAUSES A CHEMICAL ACTION OF SUCH A NATURE THAT ONE OF THE COPPER ELECTRODES COMBINES WITH THE ELECTROLYTE TO FORM COPPER NITRATE OR THE GREENISH LOOKING SUBSTANCE; WHILE HYDROGEN, WHICH IS EXTRACTED FROM THE WATER CONTAINED IN THE POTATO IS LIBERATED IN THE FORM OF BUBBLES AT THE OTHER ELECTRODE.

IN OTHER WORDS, ELECTRICAL ENERGY IS NOW BEING CONVERTED INTO CHEMICAL ENERGY AND THE ORIGINAL CHEMICAL CONDITIONS ARE BEING ALTERED.

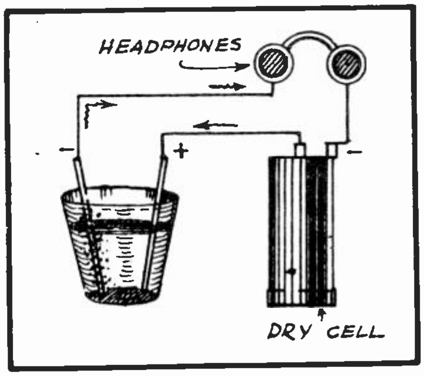

Fig. 5
The Water Rheostat.

NOW BY DISCONNECTING THE DRY CELL, WE HAVE LEFT A CHARGED SECONDARY CELL AT THE POTATO. THAT IS, THE CHARGING CURRENT AS FURNISHED BY THE DRY CELL HAS CHANGED THE CHEMICAL CONDITION OF OUR HOME-CONSTRUCTED CELL TO SUCH AN EXTENT THAT THE ACTIVE ELEMENT AT ONE OF THE ELECTRODES WILL BE PURE COPPER WHILE THE ACTIVE ELEMENT AT THE OTHER ELECTRODE HAS BECOME COPPER NITRATE.

TO PROVE THAT THE CELL HAS ACTUALLY BECOME CHARGED DURING THIS PROGRESS, IT IS ONLY NECESSARY TO AGAIN CONNECT THE HEADPHONES ACROSS THE TWO COPPER WIRES AS SHOWN IN FIG. 4. THIS TIME, A VERY PRONOUNCED CLICK WILL BE

EXPERIENCED IN THE HEADPHONES AS THE CELL DISCHARGES THROUGH THE HEADPHONE WINDINGS IN THE DIRECTION DESIGNATED IN FIG.4.

THUS WE HAVE SEEN THAT AN INITIAL FLOW OF CURRENT IS CAPABLE OF CHARGING THE CELL BY CONVERTING ELECTRICAL ENERGY TO CHEMICAL ENERGY AND THAT IN TURN, THE CELL WAS CAPABLE OF CONVERTING CHEMICAL ENERGY TO ELECTRICAL ENERGY, THEREBY FULFILLING THE REQUIREMENTS OF A SECONDARY CELL.

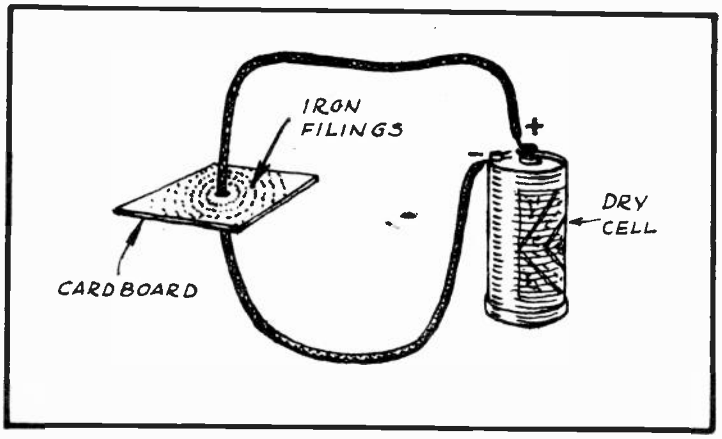

Fig. 6
Lines Of Force Encircle The Conductor.

NATURALLY, THIS WAS ACCOMPLISHED IN ONLY A SMALL WAY IN THIS SIMPLE EXPERIMENT BUT THESE SAME PRINCIPLES ARE EMPLOYED MORE PRACTICALLY IN THE POPULAR LEAD-ACID TYPE STORAGE BATTERY, WHERE THE POSITIVE PLATES ARE IN THE FORM OF LEAD PEROXIDE, THE NEGATIVE PLATES BEING SPONGY LEAD AND A DILUTE SULPHURIC ACID SOLUTION SERVING AS THE ELECTROLYTE.

EXPERIMENT #3: - DETERMINING D.C. POLARITY

THE HUMBLE POTATO ALSO OFFERS A MEANS WHEREBY ONE CAN DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE AND THIS CAN BE ACCOMPLISHED IN THE FOLLOWING MANNER: INSERT TWO PIECES OF BARE COPPER WIRE INTO THE POTATO AND CONNECT THE SOURCE OF VOLTAGE ACROSS THEM THE SAME MANNER AS WAS ALREADY SHOWN YOU IN FIG. 3 OF THIS LESSON.

THE GREEN COPPER NITRATE WILL THEN FORM AROUND THE COPPER ELECTRODE WHICH IS CONNECTED TO THE POSITIVE TERMINAL OF THE VOLTAGE SOURCE AND IN THIS WAY INDICATES THE POLARITY.

EXPERIMENT #4: - THE WATER RHEOSTAT

FILL A GLASS CONTAINER ABOUT 3/4 FULL WITH ORDINARY WATER AND ADD A LITTLE TABLE SALT TO IT. NOW IMMERSE TWO BARE PIECES OF COPPER WIRE IN THE SALT WATER SO THAT THEY WILL SERVE AS ELECTRODES.

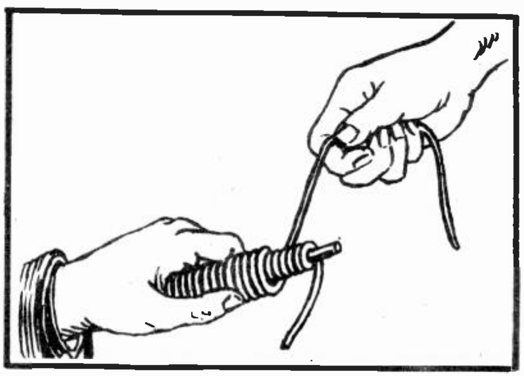

Fig. 7
The Electromagnet.

CONNECT A DRY CELL WITH THE HEADPHONES IN SERIES ACROSS THE ELECTRODES AS IN FIG.5. VARY THE DISTANCE BETWEEN THE ELECTRODES AND MAKE AND BREAK THE THE HEADPHONE CIRCUIT. AS YOU DO SO YOU WILL FIND THAT THE CLICK IN THE PHONES WILL INCREASE AS THE DISTANCE BETWEEN THE ELECTRODES IS DECREASED, THUS SHOWING THAT THE CURRENT FLOW THROUGH THE HEADPHONES INCREASES AS THE ELECTRODES

ARE BROUGHT CLOSER TOGETHER. IN OTHER WORDS, THE POSITION OF THE ELECTRODES WILL CONTROL THE RESISTANCE OF THE CIRCUIT AND THE ARRANGEMENT THEREFORE SERVES AS AN EFFECTIVE RHEOSTAT. WE CALL SUCH A DEVISE A "WATER RHEOSTAT."

REPEAT THE ABOVE EXPERIMENTS BY INCREASING THE SALT CONTENT OF THE SOLUTION. YOU WILL FIND THAT AS THE AMOUNT OF SALT IS INCREASED FOR A GIVEN QUANTITY OF WATER, THE BETTER WILL BE THE ELECTRICAL CONDUCTING QUALITIES OF THE SOLUTION.

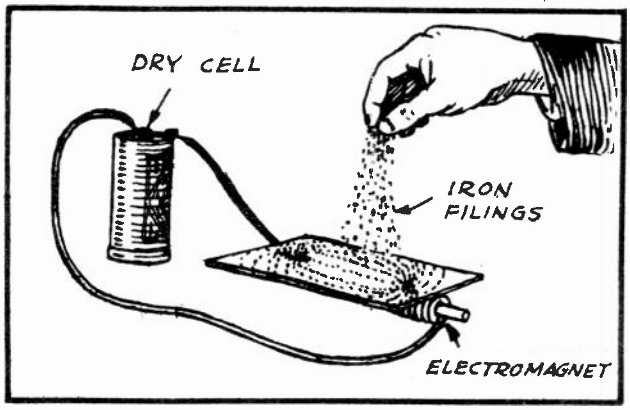

Fig. 8
Demonstration Of The Magnetic Field.

BY MEANS OF THIS SAME "SET UP", IT IS ALSO POSSIBLE FOR YOU TO DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE DUE TO THE FACT THAT BUBBLES WILL COLLECT AROUND THE ELECTRODE WHICH IS CONNECTED TO THE NEGATIVE POLE OF THE VOLTAGE SOURCE. THESE BUBBLES ARE DUE TO THE DECOMPOSITION OF THE WATER BROUGHT ABOUT BY THE ELECTRICAL CURRENT WHICH IS FLOWING THROUGH IT.

EXPERIMENT #5: - MAGNETIC FIELD SURROUNDING A CONDUCTOR

TAKE A PIECE OF LIGHT CARDBOARD AND PASS A LENGTH OF WIRE THROUGH ITS CENTER, CONNECTING THE ENDS OF THIS WIRE ACROSS THE TERMINALS OF A DRY CELL AS SHOWN IN FIG.6.

SPRINKLE SOME IRON FILINGS UPON THE SURFACE OF THE CARDBOARD AND TAP THE CARDBOARD LIGHTLY WITH YOUR FINGERS. YOU WILL FIND THE IRON FILINGS TO ARRANGE THEMSELVES INTO A DEFINITE PATTERN ENCIRCLING THE CONDUCTOR, THEREBY ACTUALLY SHOWING YOU HOW THE LINES OF FORCE SURROUND A CONDUCTOR THROUGH WHICH AN ELECTRICAL CURRENT IS FLOWING.

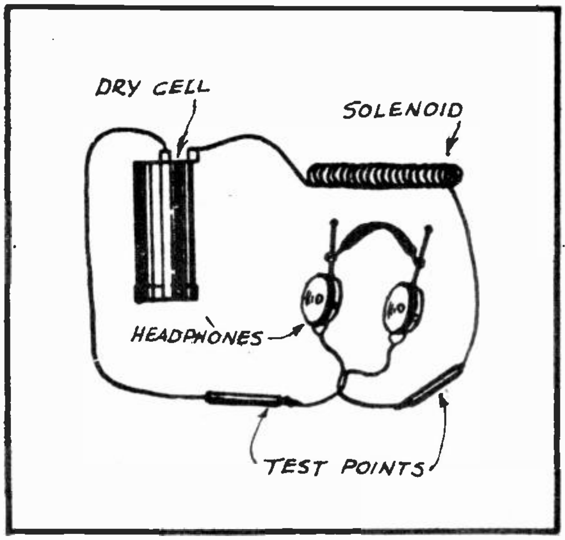

Fig. 9
A Continuity Test With Headphones.

(YOU CAN OBTAIN THE NECESSARY IRON FILINGS FOR THIS EXPERIMENT BY SIMPLY FILING A LARGE NAIL AND GATHERING TOGETHER THE FILINGS WHICH WILL THUS BE PRODUCED).

EXPERIMENT #6: - THE ELECTROMAGNET

WRAP A LAYER OF HEAVY PAPER AROUND A LARGE NAIL AND THEN WIND SEVERAL LAYERS OF INSULATED WIRE OVER THE PAPER AND ACROSS THE GREATER PORTION OF THE NAIL'S LENGTH AS ILLUSTRATED IN FIG.7. CONNECT THE FINISHED WINDING ACROSS A DRY CELL AND TEST THE MAGNETIC PROPERTIES OF THIS ELECTROMAGNET BY OBSERVING ITS ATTRACTION UPON SMALL PIECES OF IRON, NAILS, TACKS ETC. ALSO NOTICE HOW THE POWER OF ATTRACTION IS LOST THE

INSTANT THAT THE ELECTRICAL CIRCUIT IS INTERRUPTED.

NOW PLACE A PIECE OF LIGHT CARDBOARD OVER THE ELECTROMAGNET AS ILLUSTRATED IN FIG.8 AND SPRINKLE IRON FILINGS OVER ITS SURFACE. BY TAPPING THE CARDBOARD LIGHTLY, THE IRON FILINGS WILL ARRANGE THEMSELVES INTO A PATTERN SIMILAR TO THAT SHOWN IN FIG.8, IN THIS MANNER DEMONSTRATING THE PATHS ALONG WHICH THE LINES OF FORCE SURROUNDING THE ELECTROMAGNET EXERT THEMSELVES.

CAREFULLY, REMOVE THE IRON CORE WITHOUT DESTROYING THE WINDING. YOU WILL NOW HAVE A "SOLENOID" AND BY PERFORMING ALL OF THE PRECEDING ELECTROMAGNET EXPERIMENTS WITH THIS SOLENOID YOU WILL NOTICE THAT ITS MAGNETIC POWER HAS DECREASED CONSIDERABLY WITH THE REMOVAL OF THE IRON CORE.

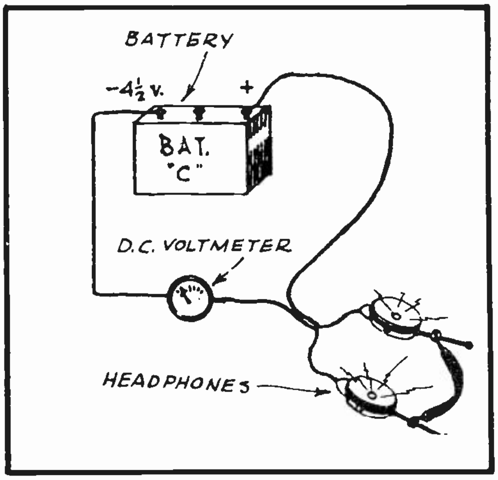

Fig. 10
A Voltmeter Continuity Test.

EXPERIMENT #7: - TESTING CIRCUIT CONTINUITY WITH HEADPHONES

YOUR HEADPHONES ALSO OFFER YOU A MEANS WHEREBY YOU CAN TEST THE CONTINUITY OF A CIRCUIT OR ANY PART THEREOF. THAT IS, YOU CAN DETERMINE WHETHER THE CIRCUIT IS COMPLETE OR NOT.

TO DO THIS, CONNECT THE HEADPHONES IN SERIES WITH A CELL OR BATTERY. THEN TOUCH THE ENDS OF THIS TEST CIRCUIT ACROSS THE UNIT OR CIRCUIT TO BE TESTED. FOR INSTANCE, IN FIG.9 THE SOLENOID WINDING IS BEING TESTED FOR CONTINUITY.

IF THE WINDING OF THE SOLENOID IS COMPLETE THEN A CLICK WILL BE HEARD IN THE PHONES UPON TOUCHING THE TEST POINTS TO THE CIRCUIT UNDER TEST. HOWEVER, IF THE WINDING OF THE SOLENOID SHOULD BE BROKEN OR OPEN CIRCUITED, THEN NO CLICK WILL BE EXPERIENCED DURING THIS TEST.

PRACTICALLY ANY PIECE OF ELECTRICAL EQUIPMENT CAN BE TESTED FOR CONTINUITY IN THIS WAY, PROVIDED THAT ITS NORMAL RESISTANCE IS NOT EXCESSIVE SO THAT THE CELL OR BATTERY COULD NOT POSSIBLY FORCE SUFFICIENT CURRENT THROUGH THE SYSTEM TO ACTUATE THE HEADPHONE DIAPHRAGMS EVEN THOUGH THE CIRCUIT OR COMPONENT BEING TESTED WERE FREE FROM DEFECTS.

EXPERIMENT #8: - A VOLTMETER TYPE CONTINUITY TESTER

A VERY EFFECTIVE VISUAL TYPE OF CONTINUITY TESTER CAN BE MADE BY CONNECTING A BATTERY IN SERIES WITH A D.C. TYPE VOLTMETER HAVING A RELATIVELY LOW VOLTAGE SCALE. THE BATTERY MAY CONSIST OF ABOUT TWO OR THREE SERIES CONNECTED DRY CELLS, OR ELSE A $4\frac{1}{2}$ VOLT RADIO "C" BATTERY CAN BE USED SATISFACTORILY.

WHENEVER, THE FREE ENDS OF THIS TEST CIRCUIT ARE TOUCHED TOGETHER, THE VOLTMETER WILL INDICATE THE FULL VOLTAGE OF THE BATTERY BUT WHEN THESE SAME ENDS ARE HELD APART OR SEPARATED, THE VOLTMETER WILL OFFER A ZERO READING.

FIG. 10 SHOWS YOU HOW THE WINDINGS OF A PAIR OF HEADPHONES MAY BE TESTED FOR CONTINUITY. NOTICE HOW THE TEST POINTS OF THE TESTING CIRCUIT ARE CONNECTED TO THE TIPS OF THE HEADPHONES. IF THE WINDINGS ARE IN GOOD CONDITION, THE METER WILL INDICATE VERY NEARLY THE VOLTAGE OF THE BATTERY BEING USED, WHEREAS A ZERO READING WOULD INDICATE THE HEADPHONE WINDINGS AS BEING OPEN CIRCUITED.

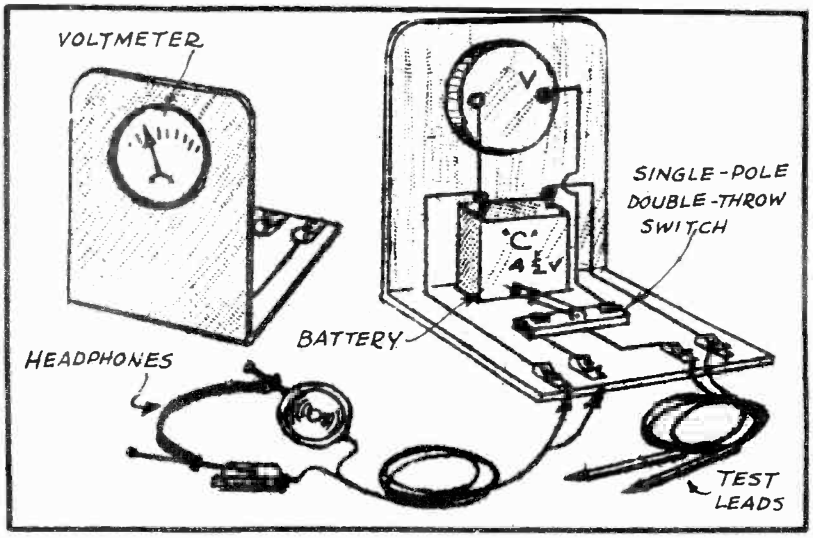

Fig. 11
The Continuity Tester.

THIS SAME TEST CAN BE APPLIED TO VARIOUS TYPES OF ELECTRICAL EQUIPMENT, RESPONDING IN THE SAME MANNER AS JUST DESCRIBED. HOWEVER, WHEN TESTING WITH THIS APPARATUS THRU CIRCUITS HAVING CONSIDERABLE RESISTANCE, THE METER READING WILL VARY WITH THE AMOUNT OF RESISTANCE THROUGH WHICH THE TEST IS BEING MADE. IN OTHER WORDS, THE GREATER THE RESISTANCE OF THE CIRCUIT, THE LOWER WILL BE THE METER READING. THIS FACT MUST BE TAKEN INTO CONSIDERATION WHEN MAKING A TEST OF THIS KIND. YOU WILL HAVE AMPLE OPPORTUNITY OF BECOMING FAMILIAR WITH THIS TEST AS YOU APPLY IT TO THE VARIOUS RECEIVER CIRCUITS AND PARTS WHILE EXPERIMENTING WITH THE EQUIPMENT WHICH IS GOING TO BE SENT YOU IN THE FUTURE.

THE VOLTMETER ALSO OFFERS YOU A MEANS FOR DETERMINING THE POLARITY OF A D.C. VOLTAGE SOURCE, PROVIDED THAT THE VOLTAGE DOES NOT EXCEED THE MAXIMUM VOLTAGE VALUE FOR WHICH THE PARTICULAR INSTRUMENT IS CALIBRATED. IN THIS CASE, IT IS ONLY NECESSARY TO CONNECT THE VOLTMETER ACROSS THE TERMINALS OF THE VOLTAGE SOURCE BEING TESTED. THEN IF THE METER NEEDLE SWINGS ACROSS ITS SCALE IN THE PROPER DIRECTION, THAT SIDE OF THE CIRCUIT WHICH IS CONNECTED TO THE (+) METER TERMINAL WILL BE THE POSITIVE SIDE OF THE CIRCUIT.

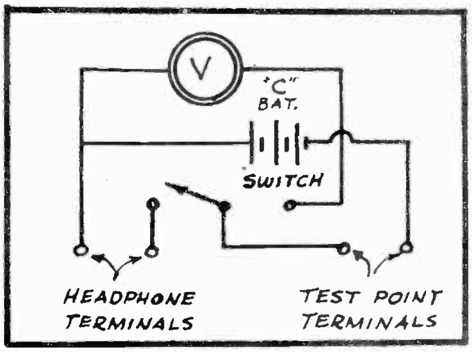

Fig. 12
Circuit Of The Tester

SHOULD THE METER NEEDLE TEND TO MOVE ACROSS ITS SCALE IN THE WRONG DIRECTION WHEN MAKING THIS TEST, THEN THE METER CONNECTIONS WILL HAVE TO BE REVERSED. THE SAME RULE CONCERNING POLARITY, WHICH WAS JUST GIVEN YOU, CAN THEN BE APPLIED.

CONSTRUCTION OF A CONTINUITY TESTER

SHOULD YOU WISH TO CONSTRUCT A COMPACT CONTINUITY TESTER WHICH WILL BE QUITE HANDY IN YOUR WORK FROM NOW ON, YOU CAN USE THE HEADPHONES, VOLTMETER AND "C" BATTERY

WHICH YOU NOW HAVE ON HAND AND BUILD A UNIT SOMEWHAT AS THAT ILLUSTRATED IN FIG.11.

THE VOLTMETER CAN BE MOUNTED FLUSH WITH THE PANEL BY CUTTING A HOLE IN THE PANEL EQUAL TO THE DIAMETER OF THE VOLTMETER BODY. THE MOUNTING RING SHOULD THEN BE REMOVED FROM THE VOLTMETER AND THE METER INSERTED IN ITS MOUNTING HOLE WITH ITS FACE TOWARD THE FRONT. THE MOUNTING RING CAN THEN BE REPLACED FROM THE BACK OF THE METER AND LOCKED IN POSITION SO AS TO HOLD THE METER FIRMLY IN PLACE.

ANOTHER SMALLER HOLE SHOULD BE DRILLED IN THE PANEL BELOW THE VOLTMETER TO ACCOMMODATE THE SWITCH. THE "C" BATTERY CAN BE HELD IN PLACE WITH A METAL STRAP AND A PAIR OF WOOD-SCREWS. THE CIRCUIT DIAGRAM FOR THIS CONTINUITY TESTER IS SHOWN IN FIG.12 SO THAT YOU MAY BECOME MORE FAMILIAR WITH IT.

WHEN THE DOUBLE-THROW SWITCH IS CLOSED TO POSITION "V", THE VOLTMETER WILL OFFER A READING WHENEVER THE TEST POINTS ARE TOUCHED TOGETHER, WHEREAS CLOSING THIS SWITCH TO POSITION "H" WILL CAUSE A CLICK TO BE HEARD IN THE HEADPHONES WHENEVER THE TEST POINTS ARE TOUCHED TOGETHER. IN THIS MANNER, EITHER OF THESE TWO TESTING METHODS CAN BE EMPLOYED SIMPLY BY CLOSING THE SWITCH IN THE PROPER DIRECTION.

THIS SAME TESTER CAN ALSO BE HOUSED IN A BOX IF SO DESIRED AND MORE ELABORATE TERMINALS MOUNTED ON ITS FRONT PANEL FOR THE HEADPHONE AND TEST POINT CONNECTIONS. THIS IS A MATTER OF PERSONAL CHOICE. YOU ARE NOT REQUIRED TO BUILD THIS TESTER IN THAT NOT ALL OF THE NECESSARY PARTS ARE INCLUDED IN YOUR EXPERIMENTAL EQUIPMENT. HOWEVER, IF YOU SHOULD WISH TO DO SO, YOU WILL NO DOUBT FIND THESE SUGGESTIONS HELPFUL.

Answ May 28/40

Examination Questions

EXPERIMENT LESSON NO. 1

1. – WHY IS THAT AN E.M.F. IS PRODUCED WHEN ONE IRON AND ONE COPPER ELECTRODE ARE STUCK INTO THE POTATO BUT NOT WHEN TWO COPPER OR TWO IRON ELECTRODES ARE USED TOGETHER. (AS ILLUSTRATED BY EXPERIMENT #1)
2. – WHAT OCCURS IN YOUR EXPERIMENT #2 WHICH ENABLES AN E.M.F. TO BE PRODUCED EVEN THOUGH TWO COPPER ELECTRODES ARE USED?
3. – DESCRIBE ONE SIMPLE METHOD WHEREBY YOU CAN DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE WITHOUT THE USE OF A METER.
4. – DESCRIBE YOUR OBSERVATIONS WHILE CONDUCTING EXPERIMENT #4.
5. – HOW WERE YOU ABLE TO DEMONSTRATE THE FACT THAT LINES OF FORCE SURROUND A CONDUCTOR THROUGH WHICH AN ELECTRIC CURRENT IS FLOWING?
6. – DURING YOUR EXPERIMENTS WITH THE ELECTROMAGNET, HOW DID THE PRESENCE OF AN IRON CORE AFFECT THE MAGNETIC STRENGTH AS COMPARED TO THE PERFORMANCE OF THE UNIT WHEN NO IRON CORE WAS USED?
7. – DESCRIBE HOW YOU CAN USE A SET OF HEADPHONES IN ORDER TO TEST THE CONTINUITY OF A CIRCUIT.
8. – DESCRIBE HOW YOU CAN TEST A CIRCUIT FOR CONTINUITY WITH A D.C. VOLTMETER HAVING A LOW VOLTAGE RANGE.
9. – DESCRIBE AND ILLUSTRATE BY MEANS OF A DIAGRAM A SIMPLE CONTINUITY TESTER.
10. – HOW DOES THE NUMBER OF TURNS USED ON THE WINDING OF AN ELECTROMAGNET AFFECT ITS MAGNETIC STRENGTH?

RADIO - TELEVISION

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NATIONAL SCHOOLS

Established 1905

Los Angeles, California

RADIO EXPERIMENTS

LESSON NO. 1

In addition to having a good technical understanding of Radio, it is also of vital importance that you learn how to apply this knowledge to practical use. So that you may attain both of these qualifications, we are including a complete assortment of experimental equipment as a regular part of your training.

The experiments, which you are going to perform, will enable you to prove for yourself many of the important principles which were presented to you in your regular lessons. With each experimental outfit, you will receive a complete set of instructions regarding their use so that you may be assured of deriving the greatest benefit from this part of your work.

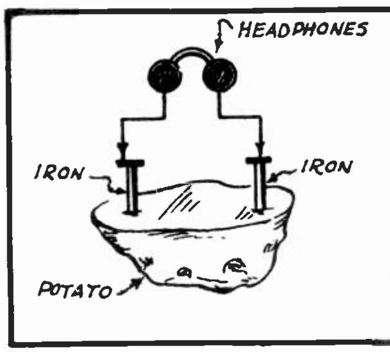

Fig. 1
Very Low Voltage.

Naturally, your first experiments are going to be of a very elementary nature, dealing mostly with fundamental electrical principles. However, as you progress and receive additional equipment, you will construct many different types of receiver circuits, perform service adjustments and cope with any number of good practical trouble shooting jobs. In all this work, you will be closely guided by carefully prepared instructions.

EXPERIMENT #1: - THE PRODUCTION OF AN E.M.F. BY CHEMICAL MEANS

Our first experiment is going to be a very simple one, however, it is going to illustrate how an E.M.F. may be produced by chemical action.

The first step will be to obtain a fairly good sized piece of a fresh raw potato and to insert two iron nails into it as illustrated in Fig. 1. This done, clamp your headphones over your ears and then touch one of the phone tips to one nail and the second phone tip to the other nail as also pointed out in Fig. 1. Listen carefully for a "click" in the headphones as you establish this contact.

HAVING COMPLETED THIS TEST, CONTINUE BY REMOVING BOTH OF THE NAILS AND INSERT TWO PIECES OF CLEAN BARE COPPER WIRE IN THEIR PLACE AND ESTABLISH CONTACT TO THE COPPER WIRES WITH THE HEADPHONE TIPS. LISTEN CAREFULLY FOR A CLICK IN YOUR HEADPHONES AS YOU MAKE AND BREAK CONTACT WITH YOUR HEADPHONE TIPS.

FROM THESE TWO SIMPLE TESTS, YOU WILL FIND THAT NO PERCEPTIBLE CLICK WILL BE EXPERIENCED IN THE HEADPHONES WHEN ESTABLISHING CONTACT WITH EITHER THE TWO NAILS OR THE TWO PIECES OF COPPER WIRE, THUS SHOWING THAT NO APPRECIABLE VOLTAGE EXISTS WITH WHICH TO FORCE AN ELECTRIC CURRENT THROUGH THE HEADPHONE WINDINGS SO AS TO ACTUATE THEIR DIAPHRAGMS.

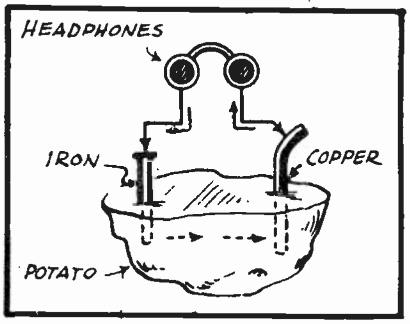

Fig. 2
Appreciable Voltage.

NOW INSERT ONE NAIL AND ONE PIECE OF COPPER WIRE INTO THE POTATO AND AGAIN ESTABLISH CONTACT WITH THE HEADPHONE TIPS AS ILLUSTRATED IN FIG.2. THIS TIME, YOU WILL HEAR A PRONOUNCED CLICK IN THE PHONES EACH TIME THAT THE CIRCUIT IS COMPLETED AND THE TEST THUS SHOWS YOU THAT A DEFINITE VOLTAGE NOW EXISTS WHICH IS CAPABLE OF FORCING A CURRENT THROUGH THE HEADPHONE WINDINGS SO AS TO ACTUATE THE DIAPHRAGMS.

WHAT WE REALLY HAVE HERE IS A SIMPLE FORM OF PRIMARY CELL, WHERE THE ACIDS CONTAINED IN THE POTATO SERVE AS THE ELECTROLYTE AND THE TWO PIECES OF METAL WHICH ARE INSERTED INTO THE POTATO ACT AS ELECTRODES.

WHEN USING TWO DISSIMILAR METALS FOR ELECTRODES, SUCH AS IRON AND COPPER IN OUR LAST TEST, THE ACIDS OF THE POTATO OR ELECTROLYTE ATTACK THE IRON MORE THAN THEY DO THE COPPER, THEREBY RESULTING IN A POTENTIAL DIFFERENCE ACROSS THE TWO ELECTRODES. IN OTHER WORDS, A VOLTAGE IS THUS ESTABLISHED AND IT IS CAPABLE OF CAUSING AN ELECTRIC CURRENT TO FLOW THRU A COMPLETED CIRCUIT. THE HEADPHONES IN THIS CASE SERVE TO COMPLETE THIS CIRCUIT AND THE MAGNETIC REACTION CAUSED BY THIS CURRENT FLOW IS SUCH AS TO ACT UPON THE DIAPHRAGM OF THE HEADPHONES AS ALREADY EXPLAINED IN YOUR REGULAR LESSONS.

IF TWO LIKE METALS ARE USED AS THE ELECTRODES, THE CHEMICAL REACTION OCCURING AT EACH OF THEM IS THE SAME AND CONSEQUENTLY NO POTENTIAL DIFFERENCE IS ESTABLISHED ACROSS THEM.

IT IS POSSIBLE TO USE SEVERAL COMBINATIONS OF DISSIMILAR METALS AS ELECTRODES AND WHEN IMMERSED IN VARIOUS TYPES OF ELECTROLYTES, THEY WILL PRODUCE VARIOUS VOLTAGE VALUES.

FOR INSTANCE, ZINC AND CARBON WHEN IMMERSED IN AN ELECTROLYTE CONSISTING CHIEFLY OF AMMONIUM CLORIDE AND ZINC CHLORIDE WILL PRODUCE AN E.M.F. OR 1.5 VOLT; COPPER AND ZINC IN AN ELECTROLYTE CONSISTING OF ZINC

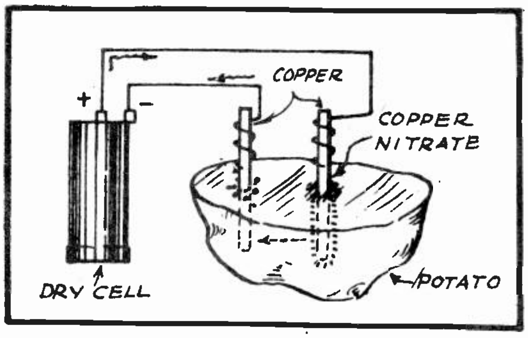

Fig. 3
Charging The Cell.

SULPHATE AND COPPER SULPHATE WILL PRODUCE I VOLT ETC.

EXPERIMENT #2: – A SIMPLE SECONDARY CELL

NOW LET US TEST THE THOERY OF THE SECONDARY CELL OR STORAGE CELL BY MEANS OF A SIMPLE EXPERIMENT. WE SHALL BEGIN BY AGAIN INSERTING TWO PIECES OF BARE COPPER WIRE INTO THE RAW POTATO BUT THIS TIME, BE SURE THAT THE TWO WIRES ARE QUITE CLOSE TO EACHOTHER BUT NOT TOUCHING.

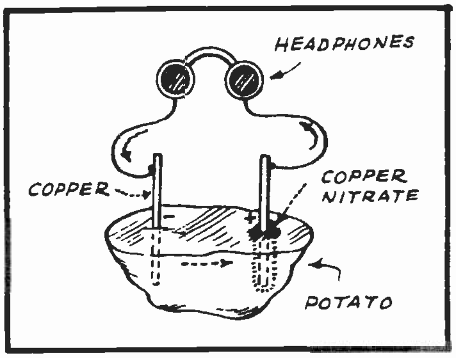

Fig. 4
Discharging The Cell.

NOW MAKE A PRELIMINARY TEST BY CONNECTING YOUR HEADPHONES ACROSS THE TWO COPPER WIRES. YOU WILL HEAR NO CLICK BECAUSE NO APPRECIABLE VOLTAGE EXISTS AT THIS TIME, AS YOU ALREADY LEARNED.

THE NEXT STEP WILL BE TO CONNECT A DRY CELL ACROSS THE TWO COPPER ELECTRODES AS SHOWN IN FIG. 3. THE DRY CELL WILL DISCHARGE THROUGH THE POTATO AS SHOWN IN FIG. 3. BECAUSE THE MOISTURE AND ACID WITHIN THE POTATO ACTS AS A CONDUCTOR.

AFTER A LITTLE TIME HAS ELAPSED, YOU WILL OBSERVE THE FORMATION OF A GREEN COLORED MATERIAL AROUND THE COPPER ELECTRODE WHICH IS CONNECTED TO THE POSITIVE TERMINAL OF THE DRY CELL, WHILE SMALL GASEOUS BUBBLES RESEMBLING FOAM WILL ACCUMULATE AROUND THE ELECTRODE WHICH IS CONNECTED TO THE NEGATIVE TERMINAL OF THE CELL. THESE OBSERVATIONS CLEARLY DEMONSTRATE THAT A CHEMICAL ACTION IS NOW TAKING PLACE.

WHAT ACTUALLY HAPPENS DURING THIS TIME IS THAT THE FLOW OF CURRENT THROUGH THE SYSTEM CAUSES A CHEMICAL ACTION OF SUCH A NATURE THAT ONE OF THE COPPER ELECTRODES COMBINES WITH THE ELECTROLYTE TO FORM COPPER NITRATE OR THE GREENISH LOOKING SUBSTANCE; WHILE HYDROGEN, WHICH IS EXTRACTED FROM THE WATER CONTAINED IN THE POTATO IS LIBERATED IN THE FORM OF BUBBLES AT THE OTHER ELECTRODE.

IN OTHER WORDS, ELECTRICAL ENERGY IS NOW BEING CONVERTED INTO CHEMICAL ENERGY AND THE ORIGINAL CHEMICAL CONDITIONS ARE BEING ALTERED.

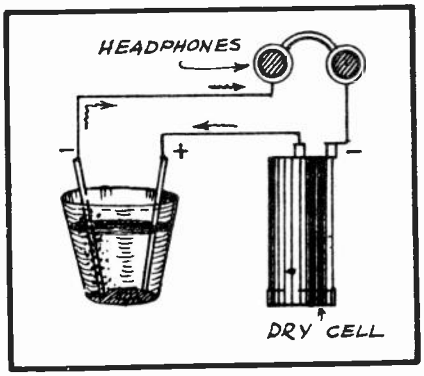

Fig. 5
The Water Rheostat.

NOW BY DISCONNECTING THE DRY CELL, WE HAVE LEFT A CHARGED SECONDARY CELL AT THE POTATO. THAT IS, THE CHARGING CURRENT AS FURNISHED BY THE DRY CELL HAS CHANGED THE CHEMICAL CONDITION OF OUR HOME-CONSTRUCTED CELL TO SUCH AN EXTENT THAT THE ACTIVE ELEMENT AT ONE OF THE ELECTRODES WILL BE PURE COPPER WHILE THE ACTIVE ELEMENT AT THE OTHER ELECTRODE HAS BECOME COPPER NITRATE.

TO PROVE THAT THE CELL HAS ACTUALLY BECOME CHARGED DURING THIS PROGRESS, IT IS ONLY NECESSARY TO AGAIN CONNECT THE HEADPHONES ACROSS THE TWO COPPER WIRES AS SHOWN IN FIG. 4. THIS TIME, A VERY PRONOUNCED CLICK WILL BE

EXPERIENCED IN THE HEADPHONES AS THE CELL DISCHARGES THROUGH THE HEADPHONE WINDINGS IN THE DIRECTION DESIGNATED IN FIG.4.

THUS WE HAVE SEEN THAT AN INITIAL FLOW OF CURRENT IS CAPABLE OF CHARGING THE CELL BY CONVERTING ELECTRICAL ENERGY TO CHEMICAL ENERGY AND THAT IN TURN, THE CELL WAS CAPABLE OF CONVERTING CHEMICAL ENERGY TO ELECTRICAL ENERGY, THEREBY FULFILLING THE REQUIREMENTS OF A SECONDARY CELL.

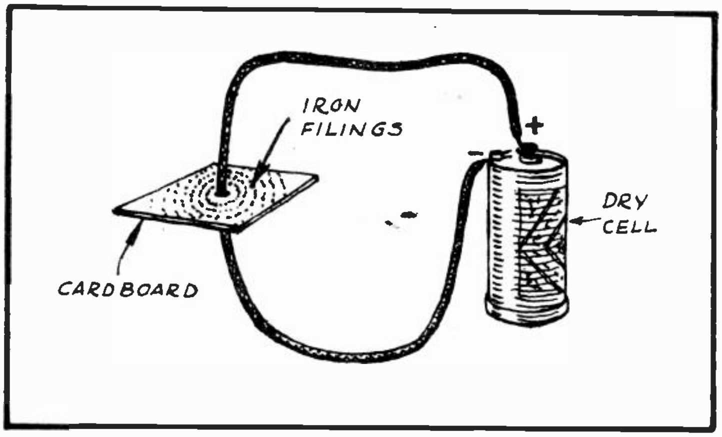

Fig. 6
Lines Of Force Encircle The Conductor.

NATURALLY, THIS WAS ACCOMPLISHED IN ONLY A SMALL WAY IN THIS SIMPLE EXPERIMENT BUT THESE SAME PRINCIPLES ARE EMPLOYED MORE PRACTICALLY IN THE POPULAR LEAD-ACID TYPE STORAGE BATTERY, WHERE THE POSITIVE PLATES ARE IN THE FORM OF LEAD PEROXIDE, THE NEGATIVE PLATES BEING SPONGY LEAD AND A DILUTE SULPHURIC ACID SOLUTION SERVING AS THE ELECTROLYTE.

EXPERIMENT #3: - DETERMINING D.C. POLARITY

THE HUMBLE POTATO ALSO OFFERS A MEANS WHEREBY ONE CAN DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE AND THIS CAN BE ACCOMPLISHED IN THE FOLLOWING MANNER: INSERT TWO PIECES OF BARE COPPER WIRE INTO THE POTATO AND CONNECT THE SOURCE OF VOLTAGE ACROSS THEM THE SAME MANNER AS WAS ALREADY SHOWN YOU IN FIG. 3 OF THIS LESSON.

THE GREEN COPPER NITRATE WILL THEN FORM AROUND THE COPPER ELECTRODE WHICH IS CONNECTED TO THE POSITIVE TERMINAL OF THE VOLTAGE SOURCE AND IN THIS WAY INDICATES THE POLARITY.

EXPERIMENT #4: - THE WATER RHEOSTAT

FILL A GLASS CONTAINER ABOUT 3/4 FULL WITH ORDINARY WATER AND ADD A LITTLE TABLE SALT TO IT. NOW IMMERSE TWO BARE PIECES OF COPPER WIRE IN THE SALT WATER SO THAT THEY WILL SERVE AS ELECTRODES.

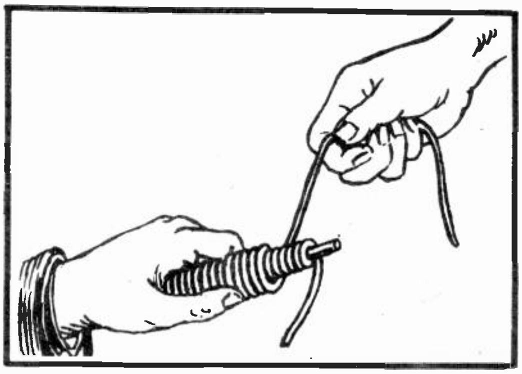

Fig. 7
The Electromagnet.

CONNECT A DRY CELL WITH THE HEADPHONES IN SERIES ACROSS THE ELECTRODES AS IN FIG.5. VARY THE DISTANCE BETWEEN THE ELECTRODES AND MAKE AND BREAK THE THE HEADPHONE CIRCUIT. AS YOU DO SO YOU WILL FIND THAT THE CLICK IN THE PHONES WILL INCREASE AS THE DISTANCE BETWEEN THE ELECTRODES IS DECREASED, THUS SHOWING THAT THE CURRENT FLOW THROUGH THE HEADPHONES INCREASES AS THE ELECTRODES

ARE BROUGHT CLOSER TOGETHER. IN OTHER WORDS, THE POSITION OF THE ELECTRODES WILL CONTROL THE RESISTANCE OF THE CIRCUIT AND THE ARRANGEMENT THEREFORE SERVES AS AN EFFECTIVE RHEOSTAT. WE CALL SUCH A DEVISE A "WATER RHEOSTAT."

REPEAT THE ABOVE EXPERIMENTS BY INCREASING THE SALT CONTENT OF THE SOLUTION. YOU WILL FIND THAT AS THE AMOUNT OF SALT IS INCREASED FOR A GIVEN QUANTITY OF WATER, THE BETTER WILL BE THE ELECTRICAL CONDUCTING QUALITIES OF THE SOLUTION.

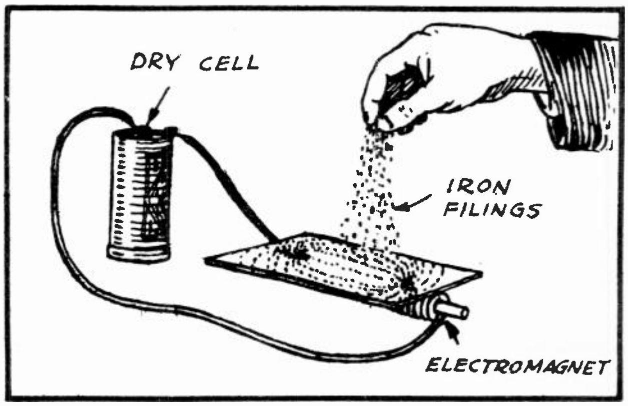

Fig. 8
Demonstration Of The Magnetic Field.

BY MEANS OF THIS SAME "SET UP", IT IS ALSO POSSIBLE FOR YOU TO DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE DUE TO THE FACT THAT BUBBLES WILL COLLECT AROUND THE ELECTRODE WHICH IS CONNECTED TO THE NEGATIVE POLE OF THE VOLTAGE SOURCE. THESE BUBBLES ARE DUE TO THE DECOMPOSITION OF THE WATER BROUGHT ABOUT BY THE ELECTRICAL CURRENT WHICH IS FLOWING THROUGH IT.

EXPERIMENT #5: - MAGNETIC FIELD SURROUNDING A CONDUCTOR

TAKE A PIECE OF LIGHT CARDBOARD AND PASS A LENGTH OF WIRE THROUGH ITS CENTER, CONNECTING THE ENDS OF THIS WIRE ACROSS THE TERMINALS OF A DRY CELL AS SHOWN IN FIG.6.

SPRINKLE SOME IRON FILINGS UPON THE SURFACE OF THE CARDBOARD AND TAP THE CARDBOARD LIGHTLY WITH YOUR FINGERS. YOU WILL FIND THE IRON FILINGS TO ARRANGE THEMSELVES INTO A DEFINITE PATTERN ENCIRCLING THE CONDUCTOR, THEREBY ACTUALLY SHOWING YOU HOW THE LINES OF FORCE SURROUND A CONDUCTOR THROUGH WHICH AN ELECTRICAL CURRENT IS FLOWING.

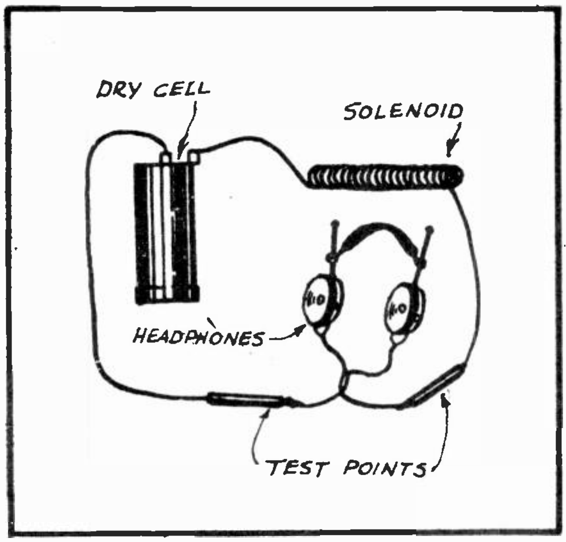

Fig. 9
A Continuity Test With Headphones.

(YOU CAN OBTAIN THE NECESSARY IRON FILINGS FOR THIS EXPERIMENT BY SIMPLY FILING A LARGE NAIL AND GATHERING TOGETHER THE FILINGS WHICH WILL THUS BE PRODUCED).

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WRAP A LAYER OF HEAVY PAPER AROUND A LARGE NAIL AND THEN WIND SEVERAL LAYERS OF INSULATED WIRE OVER THE PAPER AND ACROSS THE GREATER PORTION OF THE NAIL'S LENGTH AS ILLUSTRATED IN FIG.7. CONNECT THE FINISHED WINDING ACROSS A DRY CELL AND TEST THE MAGNETIC PROPERTIES OF THIS ELECTROMAGNET BY OBSERVING ITS ATTRACTION UPON SMALL PIECES OF IRON, NAILS, TACKS ETC. ALSO NOTICE HOW THE POWER OF ATTRACTION IS LOST THE

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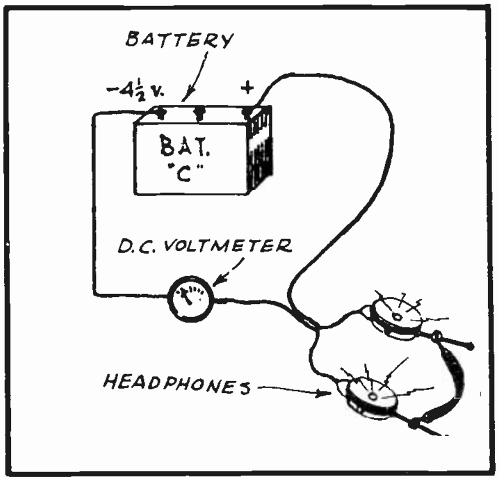

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A Voltmeter Continuity Test.

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TO DO THIS, CONNECT THE HEADPHONES IN SERIES WITH A CELL OR BATTERY. THEN TOUCH THE ENDS OF THIS TEST CIRCUIT ACROSS THE UNIT OR CIRCUIT TO BE TESTED. FOR INSTANCE, IN FIG.9 THE SOLENOID WINDING IS BEING TESTED FOR CONTINUITY.

IF THE WINDING OF THE SOLENOID IS COMPLETE THEN A CLICK WILL BE HEARD IN THE PHONES UPON TOUCHING THE TEST POINTS TO THE CIRCUIT UNDER TEST. HOWEVER, IF THE WINDING OF THE SOLENOID SHOULD BE BROKEN OR OPEN CIRCUITED, THEN NO CLICK WILL BE EXPERIENCED DURING THIS TEST.

PRACTICALLY ANY PIECE OF ELECTRICAL EQUIPMENT CAN BE TESTED FOR CONTINUITY IN THIS WAY, PROVIDED THAT ITS NORMAL RESISTANCE IS NOT EXCESSIVE SO THAT THE CELL OR BATTERY COULD NOT POSSIBLY FORCE SUFFICIENT CURRENT THROUGH THE SYSTEM TO ACTUATE THE HEADPHONE DIAPHRAGMS EVEN THOUGH THE CIRCUIT OR COMPONENT BEING TESTED WERE FREE FROM DEFECTS.

EXPERIMENT #8: - A VOLTMETER TYPE CONTINUITY TESTER

A VERY EFFECTIVE VISUAL TYPE OF CONTINUITY TESTER CAN BE MADE BY CONNECTING A BATTERY IN SERIES WITH A D.C. TYPE VOLTMETER HAVING A RELATIVELY LOW VOLTAGE SCALE. THE BATTERY MAY CONSIST OF ABOUT TWO OR THREE SERIES CONNECTED DRY CELLS, OR ELSE A $4\frac{1}{2}$ VOLT RADIO "C" BATTERY CAN BE USED SATISFACTORILY.

WHENEVER, THE FREE ENDS OF THIS TEST CIRCUIT ARE TOUCHED TOGETHER, THE VOLTMETER WILL INDICATE THE FULL VOLTAGE OF THE BATTERY BUT WHEN THESE SAME ENDS ARE HELD APART OR SEPARATED, THE VOLTMETER WILL OFFER A ZERO READING.

Fig. 10 shows you how the windings of a pair of headphones may be tested for continuity. Notice how the test points of the testing circuit are connected to the tips of the headphones. If the windings are in good condition, the meter will indicate very nearly the voltage of the battery being used, whereas a zero reading would indicate the headphone windings as being open circuited.

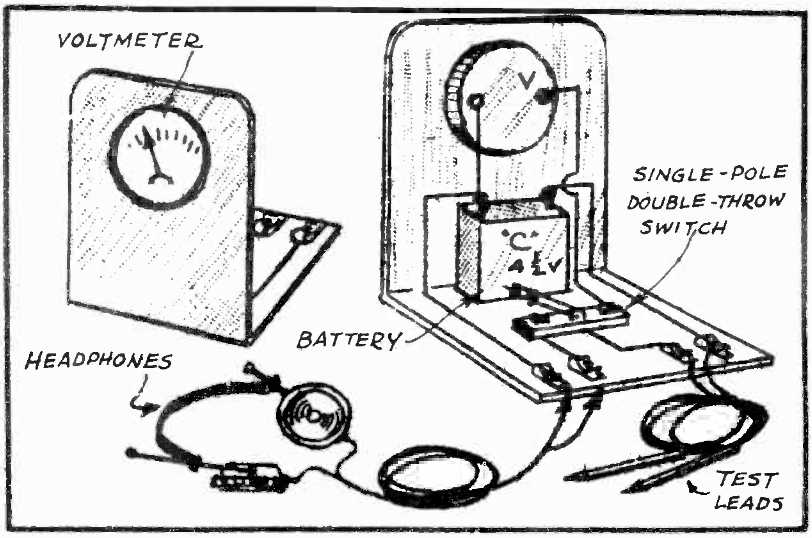

Fig. 11
The Continuity Tester.

This same test can be applied to various types of electrical equipment, responding in the same manner as just described. However, when testing with this apparatus thru circuits having considerable resistance, the meter reading will vary with the amount of resistance through which the test is being made. In other words, the greater the resistance of the circuit, the lower will be the meter reading. This fact must be taken into consideration when making a test of this kind. You will have ample opportunity of becoming familiar with this test as you apply it to the various receiver circuits and parts while experimenting with the equipment which is going to be sent you in the future.

The voltmeter also offers you a means for determining the polarity of a D.C. voltage source, provided that the voltage does not exceed the maximum voltage value for which the particular instrument is calibrated. In this case, it is only necessary to connect the voltmeter across the terminals of the voltage source being tested. Then if the meter needle swings across its scale in the proper direction, that side of the circuit which is connected to the (+) meter terminal will be the positive side of the circuit.

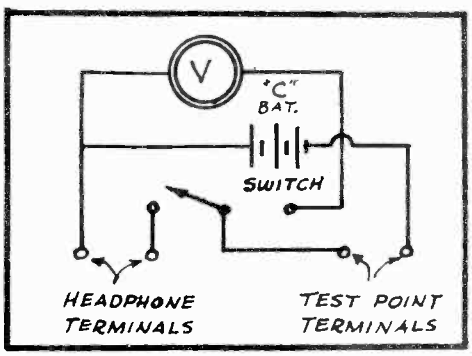

Fig. 12
Circuit Of The Tester

Should the meter needle tend to move across its scale in the wrong direction when making this test, then the meter connections will have to be reversed. The same rule concerning polarity, which was just given you, can then be applied.

CONSTRUCTION OF A CONTINUITY TESTER

Should you wish to construct a compact continuity tester which will be quite handy in your work from now on, you can use the headphones, voltmeter and "C" battery

WHICH YOU NOW HAVE ON HAND AND BUILD A UNIT SOMEWHAT AS THAT ILLUSTRATED IN FIG. II.

THE VOLTMETER CAN BE MOUNTED FLUSH WITH THE PANEL BY CUTTING A HOLE IN THE PANEL EQUAL TO THE DIAMETER OF THE VOLTMETER BODY. THE MOUNTING RING SHOULD THEN BE REMOVED FROM THE VOLTMETER AND THE METER INSERTED IN ITS MOUNTING HOLE WITH ITS FACE TOWARD THE FRONT. THE MOUNTING RING CAN THEN BE REPLACED FROM THE BACK OF THE METER AND LOCKED IN POSITION SO AS TO HOLD THE METER FIRMLY IN PLACE.

ANOTHER SMALLER HOLE SHOULD BE DRILLED IN THE PANEL BELOW THE VOLTMETER TO ACCOMMODATE THE SWITCH. THE "C" BATTERY CAN BE HELD IN PLACE WITH A METAL STRAP AND A PAIR OF WOOD-SCREWS. THE CIRCUIT DIAGRAM FOR THIS CONTINUITY TESTER IS SHOWN IN FIG. 12 SO THAT YOU MAY BECOME MORE FAMILIAR WITH IT.

WHEN THE DOUBLE-THROW SWITCH IS CLOSED TO POSITION "V", THE VOLTMETER WILL OFFER A READING WHENEVER THE TEST POINTS ARE TOUCHED TOGETHER, WHEREAS CLOSING THIS SWITCH TO POSITION "H" WILL CAUSE A CLICK TO BE HEARD IN THE HEADPHONES WHENEVER THE TEST POINTS ARE TOUCHED TOGETHER. IN THIS MANNER, EITHER OF THESE TWO TESTING METHODS CAN BE EMPLOYED SIMPLY BY CLOSING THE SWITCH IN THE PROPER DIRECTION.

THIS SAME TESTER CAN ALSO BE HOUSED IN A BOX IF SO DESIRED AND MORE ELABORATE TERMINALS MOUNTED ON ITS FRONT PANEL FOR THE HEADPHONE AND TEST POINT CONNECTIONS. THIS IS A MATTER OF PERSONAL CHOICE. YOU ARE NOT REQUIRED TO BUILD THIS TESTER IN THAT NOT ALL OF THE NECESSARY PARTS ARE INCLUDED IN YOUR EXPERIMENTAL EQUIPMENT. HOWEVER, IF YOU SHOULD WISH TO DO SO, YOU WILL NO DOUBT FIND THESE SUGGESTIONS HELPFUL.

Examination Questions

EXPERIMENT LESSON NO. 1

1. – WHY IS THAT AN E.M.F. IS PRODUCED WHEN ONE IRON AND ONE COPPER ELECTRODE ARE STUCK INTO THE POTATO BUT NOT WHEN TWO COPPER OR TWO IRON ELECTRODES ARE USED TOGETHER. (AS ILLUSTRATED BY EXPERIMENT #1)
2. – WHAT OCCURS IN YOUR EXPERIMENT #2 WHICH ENABLES AN E.M.F. TO BE PRODUCED EVEN THOUGH TWO COPPER ELECTRODES ARE USED?
3. – DESCRIBE ONE SIMPLE METHOD WHEREBY YOU CAN DETERMINE THE POLARITY OF A D.C. VOLTAGE SOURCE WITHOUT THE USE OF A METER.
4. – DESCRIBE YOUR OBSERVATIONS WHILE CONDUCTING EXPERIMENT #4.
5. – HOW WERE YOU ABLE TO DEMONSTRATE THE FACT THAT LINES OF FORCE SURROUND A CONDUCTOR THROUGH WHICH AN ELECTRIC CURRENT IS FLOWING?
6. – DURING YOUR EXPERIMENTS WITH THE ELECTROMAGNET, HOW DID THE PRESENCE OF AN IRON CORE AFFECT THE MAGNETIC STRENGTH AS COMPARED TO THE PERFORMANCE OF THE UNIT WHEN NO IRON CORE WAS USED?
7. – DESCRIBE HOW YOU CAN USE A SET OF HEADPHONES IN ORDER TO TEST THE CONTINUITY OF A CIRCUIT.
8. – DESCRIBE HOW YOU CAN TEST A CIRCUIT FOR CONTINUITY WITH A D.C. VOLTMETER HAVING A LOW VOLTAGE RANGE.
9. – DESCRIBE AND ILLUSTRATE BY MEANS OF A DIAGRAM A SIMPLE CONTINUITY TESTER.
10. – HOW DOES THE NUMBER OF TURNS USED ON THE WINDING OF AN ELECTROMAGNET AFFECT ITS MAGNETIC STRENGTH?

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BUSINESS LESSON #1

How to Earn Money in Spare Time Radio Work

Up to this point of your training, you have learned considerable about radio and should by this time have built for yourself a most substantial foundation upon which to build your future work.

Probably since starting your studies, it appeared as taking you quite awhile until you finally got into the actual practical trouble shooting work and it is possible that you expected to get into this work sooner. Bear in mind, however, that many years of experience in training men has proved to us that before any man can INTELLIGENTLY perform any kind of service work on even the simplest types of receivers, he must first have a definite amount of technical knowledge to back him up. It is for this reason that we have carefully planned our course of training the way you have found it.

As you know, lessons #19 to 23 inclusive provide you with an excellent series of informative lessons dealing directly with practical service problems. We urge you now to apply this knowledge to commercial use immediately for two important reasons: First, it offers you an excellent opportunity for turning your leisure hours into profit. You can still continue with your studies and any other work which you may now be doing to earn a living and in addition commence earning money on the side thru doing radio work among your neighbors, relatives and acquaintances. The second important reason why you should commence doing service work NOW is that thru doing so, you will obtain actual PRACTICAL EXPERIENCE working with commercial equipment and this will in itself be of tremendous value to you. In other words, if you go about this spare-time work in the

Earn While You Learn.

RIGHT WAY, YOU WILL ALREADY HAVE A SATISFACTORY AMOUNT OF EXPERIENCE OUT IN THE FIELD BY THE TIME YOU GRADUATE AND AT THE SAME TIME BE AHEAD OF THE GAME FROM A FINANCIAL STANDPOINT.

FURTHERMORE, BY BREAKING INTO THE SERVICE GAME NOW IN A RATHER SMALL WAY, YOU WILL HAVE THE OPPORTUNITY OF CONTACTING A GREAT MANY PEOPLE---- ALL OF WHOM WILL REMAIN AS YOUR STEADY CUSTOMERS WHEN YOU FINALLY ARE PREPARED TO ENTER THE RADIO BUSINESS ON A LARGER SCALE. BY STARTING NOW IN YOUR SPARE TIME, YOU SHOULD IN A FEW MONTHS HAVE ALL THE BUSINESS YOU CAN HANDLE.

YOU CERTAINLY COULDN'T FIND A BETTER INVESTMENT ANYWHERE THAN HONEST TO GOODNESS RADIO TRAINING WHICH ALREADY PAYS DIVIDENDS LONG BEFORE YOU HAVE COMPLETED IT AND WHICH PAYS FOR ITSELF SO QUICKLY.

GETTING STARTED

Radio Service & Construction Installation of Antennas
Installation, Adjustment & Repair . . all types Receivers

(YOUR NAME HERE)

EXPERT RADIO TECHNICIAN

Endorsed by National Radio & Electrical School
Los Angeles, Calif.

(Your address and phone No. Here) (your city here)

Sample Business Card.

IN ORDER TO BUILD UP A CLIENTELE, THE FIRST THING WHICH YOU WILL HAVE TO DO IS TO LET PEOPLE KNOW THAT YOU ARE IN THE RADIO BUSINESS AND QUALIFIED TO TAKE CARE OF THEIR RADIO NEEDS. ONE WAY OF SPREADING THE NEWS IS TO HAVE SOME ATTRACTIVE BUSINESS CARDS PRINTED, BASED UPON THE SAMPLE WHICH WE ARE SHOWING YOU HERE. THESE CARDS ARE INEXPENSIVE AND OFFER A MOST EFFECTIVE MEANS TOWARDS BRINGING ABOUT AN INTRODUCTION BETWEEN YOU AND YOUR PROSPECTIVE CUSTOMER.

YOU CAN DISTRIBUTE THESE CARDS TO THE HOMES IN YOUR NEIGHBORHOOD, AS WELL AS TO FURNISH FRIENDS WITH A SUPPLY SO THAT THEY CAN IN TURN DISTRIBUTE THEM AMONG ACQUAINTANCES AND PEOPLE WHOM THEY CONTACT DURING THEIR ROUTINE OF BUSINESS AND SOCIAL ACTIVITIES.

ANOTHER METHOD WHICH WILL FREQUENTLY BRING RESULTS IS TO CANVASS THE COMMUNITY IN PERSON AND THUS CONTACT THE SET OWNER DIRECTLY.

A SIMPLE WAY TO STRIKE UP AN ACQUAINTANCE WITH PROSPECTIVE CUSTOMERS IS TO TAKE NOTE OF ALL ANTENNA INSTALLATIONS IN YOUR VICINITY--THE MAJORITY OF THEM WILL BE CRUDE IN CONSTRUCTION, INEFFICIENT, AND THEREBY OFFERING YOU AN IDEAL OPPORTUNITY FOR ENGAGING THE SET OWNER IN WORTH-WHILE CONVERSATION.

APPROACH THE PROSPECTIVE CUSTOMER IN A BUSINESS-LIKE MANNER, BEING CERTAIN THAT YOUR APPEARANCE IS INVITING. BE PLEASANT AND MENTION THE FACT THAT YOU ARE ACTIVELY ENGAGED IN THE SERVICE BUSINESS IN THIS VICINITY AND IN PASSING HAVE NOTICED THE APPEARANCE OF HIS ANTENNA. THEN CONTINUE AND SUGGEST THAT YOU CAN IMPROVE HIS RECEPTION TREMENDOUSLY BY INSTALLING AN EFFICIENT ANTENNA SYSTEM DESIGNED ESPECIALLY TO BEST MEET HIS PARTICULAR REQUIREMENTS.

IF HE IS BOTHERED BY INTERFERENCE NOISES, INFORM HIM THAT YOU ARE IN A POSITION TO CLEAR UP THE DISTURBANCE FOR HIM. TELL HIM ABOUT THE MANY FEATURES OF STATIC-REJECTING ANTENNA SYSTEMS WHICH WERE BROUGHT TO YOUR

ATTENTION IN A PREVIOUS LESSON AND EXPLAIN HOW HIS RECEPTION WILL BE IMPROVED THEREBY. LET HIM KNOW THAT THIS IS SOMETHING NEW BUT BACKED UP BY RECOGNIZED MANUFACTURERS AND IS BASED UPON SCIENTIFIC PRINCIPLES.

SHOULD THE SET OWNER RESIDE IN A DISTRICT FREQUENTED BY ELECTRIC STORMS AND NO LIGHTNING ARRESTER IS INSTALLED IN HIS ANTENNA SYSTEM, THEN POINT OUT TO HIM THE PROTECTION WHICH SUCH A UNIT WILL AFFORD.

IN PLAIN WORDS, THE THING FOR YOU TO DO IS TO CONVINCE THE SET OWNER THAT HE NEEDS A FIRST CLASS ANTENNA SYSTEM AND THAT YOU ARE THE MAN TO DO THE JOB.

HAVING "LANDED THE JOB", YOUR FIRST STEP WILL BE TO PROVIDE YOURSELF WITH THE NECESSARY MATERIALS, SUCH AS THE ANTENNA WIRE, INSULATORS, LIGHTNING ARRESTER, ETC. AND A COMPLETE NOISE REDUCING KIT IF THIS TYPE OF JOB IS SOLD. ALL OF THIS EQUIPMENT CAN OF COURSE BE PURCHASED READY FOR USE AND IT IS ADVISABLE THAT YOU BUY IT FROM A LARGE RADIO SUPPLY HOUSE WHOSE CHIEF BUSINESS LIES IN SUPPLYING EQUIPMENT TO THE RADIO TRADE.

SUCH CONCERNS ARE ESTABLISHED IN ALL OF THE LARGER CITIES AND BY MAKING IT KNOWN TO THEM THAT YOU ARE A RADIO SERVICEMAN, THEY WILL ALLOW YOU AN APPRECIABLE DISCOUNT. AS A RULE, YOU WILL BE ABLE TO PURCHASE YOUR EQUIPMENT FROM THEM AT ABOUT 40% LESS THAN THE LIST PRICE.

THUS YOU CAN CHARGE THE CUSTOMER THE LIST PRICE FOR THE EQUIPMENT AND THEREBY REALIZE A RIGHTEOUSLY EARNED 40% FROM THE SALE OF PARTS ALONE. THEN IN ADDITION, FIGURE YOUR LABOR CHARGES AT AN AVERAGE RATE OF ABOUT $1.00 PER HOUR. SO ALTOGETHER THEN, YOU CAN SEE THAT YOU WILL MAKE A FAIR PROFIT ON THE DEAL AND AT THE SAME TIME BE ASSURED OF A SATISFIED CUSTOMER.

SERVICING RECEIVERS

IN THE EVENT THAT A NEW ANTENNA ISN'T ABSOLUTELY ESSENTIAL OR YOU FIND IT IMPOSSIBLE TO INTEREST THE SET OWNER IN ONE, THEN INQUIRE ABOUT THE GENERAL PERFORMANCE OF HIS SET. PERHAPS HE WILL COMPLAIN ABOUT WEAK RECEPTION, FADING, NOISY RECEPTIONS, LACK OF SELECTIVITY ETC. IN FACT, IF ANY THING AT ALL IS PREVENTING HIM FROM ENJOYING GOOD PROGRAMS, HE WON'T HESITATE TO MAKE THIS FACT KNOWN, ESPECIALLY SO WHEN HE HAS THE CHANCE TO TALK ABOUT IT TO A MAN WHOM HE IS CONFIDENT OF BEING CAPABLE TO OFFER SOUND ADVICE AND ASSISTANCE.

AT ANY RATE, YOU CAN OFFER TO CHECK AND TEST HIS RECEIVER FREE OF CHARGE AND HONESTLY ADVISE HIM AS TO THE RECEIVER'S TRUE CONDITION. THEN IF YOUR INSPECTION THEREOF SHOULD DISCLOSE ANY DEFECTS OR ANY FORM OF OBJECTIONABLE PERFORMANCE, POINT OUT THIS FACT TO THE OWNER AND EXPLAIN TO HIM HOW YOU CAN CORRECT THE CONDITION.

QUITE OFTEN, YOU WILL COME ACROSS SOME MINOR JOBS, SUCH AS RENEWING A CONNECTION HERE OR THERE, INSTALLING NEW TUBES, ALIGNING A TUNING CONDENSER GANG, REPLACING A NOISY VOLUME CONTROL OR DEFECTIVE SWITCH ETC. ALL OF THESE ARE SIMPLE JOBS BUT DO THEIR PART TO INCREASE YOUR INCOME, AS WELL AS OFFERING YOU AN OPPORTUNITY TO LOOK INTO ALL OF THE DIFFERENT TYPES OF COMMERCIAL RECEIVERS SO AS TO FAMILIARIZE YOURSELF WITH THE MANY DIFFERENT CONSTRUCTIONAL FEATURES INCORPORATED IN THEM.

WHENEVER YOU COME ACROSS A JOB WHICH REQUIRES THE REMOVAL OF THE CHASSIS FROM THE CABINET, SUCH AS WHEN REPLACING A TRANSFORMER, CONDENSER, RESISTOR ETC., THEN MAKE IT A POINT TO TAKE THE CHASSIS TO YOUR HOME WORK SHOP WHERE YOU HAVE EVERYTHING AVAILABLE FOR DOING A FIRST CLASS JOB. IT IS NEVER ADVISABLE TO CONDUCT ANY FORM OF RECONSTRUCTION JOB IN THE SET OWNERS HOME FOR SEVERAL REASONS. (1) ALL TOOLS ETC. ARE NOT GENERALLY AVAILABLE. (2) THERE IS A POSSIBILITY OF SCRATCHING FURNITURE AND CLUTTERING UP THE ROOM WITH DIRT. (3) A PARTIALLY DISASSEMBLED RECEIVER DOESN'T MAKE A FAVORABLE IMPRESSION UPON THE OWNER.

NATURALLY, WHEN YOU ARE CANVASSING A NEIGHBORHOOD IN PERSON, YOU SHOULD HAVE YOUR SERVICE EQUIPMENT WITH YOU OR AT LEAST WITHIN EASY REACH SO THAT WHEN YOU DO GET A JOB, YOU CAN TAKE CARE OF IT IMMEDIATELY INSTEAD OF STALLING OFF THE CUSTOMER UNTIL YOU GET YOUR EQUIPMENT. REMEMBER THAT IF YOU KEEP A CUSTOMER WAITING TOO LONG, HE IS LIKELY TO CHANGE HIS MIND IN THE MEAN TIME ABOUT HAVING THE WORK DONE.

IN THE EVENT THAT YOU CONTACT THE SET OWNER THROUGH ONE OF YOUR BUSINESS CARDS AND HE COMMUNICATES WITH YOU BY PHONE, QUESTION HIM CONCERNING THE MAKE OF HIS RECEIVER AND HOW IT ACTS. THIS WILL ENABLE YOU TO JUDGE WHAT MIGHT BE WRONG BEFORE YOU EVEN SEE THE SET AND YOU CAN THEREBY ESTIMATE WHAT EQUIPMENT IT WILL BE BEST FOR YOU TO TAKE TO THE JOB.

INSTALLING RECEIVERS

MANY DEPARTMENT STORES ETC. SELL RECEIVERS BUT DO NOT INCLUDE A RADIO TECHNICIAN AMONG THEIR EMPLOYEES. THEY SIMPLY SELL THE SET TO THE CUSTOMER AND LET HIM INSTALL IT HIMSELF AS BEST HE CAN OR ELSE EXPECT THE DRIVER OF THE GENERAL DELIVERY TRUCK TO HOOK IT UP FOR HIM. IN SUCH CASES, THE ANTENNA GENERALLY CONSISTS OF A PIECE OF HOOK UP WIRE AND SOMETIMES THE SET ISN'T EVEN BALANCED UP CORRECTLY. THE PROPER USE OF A LONG AND SHORT ANTENNA TERMINAL IS NOT HEEDED ETC.

ANY NEW RECEIVER, EVEN THOUGH IT LEAVES THE FACTORY IN PERFECT CONDITION, IS LIKELY TO REACH THE FINAL OWNER SLIGHTLY OUT OF ADJUSTMENT DUE TO SHOCKS RECEIVED DURING SHIPMENT AND IT ISN'T REALLY FAIR TO THE FINAL OWNER IF THE SET ISN'T FIRST SERVICED PROPERLY BEFORE TURNING IT OVER TO HIM.

HERE IS ANOTHER OPPORTUNITY FOR YOU.

THE THING FOR YOU TO DO IS TO CONTACT THESE CONCERNS WHICH SELL RADIOS WITHOUT OFFERING TECHNICAL SERVICE. MANY MEN HAVE MADE AN AGREEMENT WITH THESE CONCERNS WHEREBY THEY TAKE OVER THE RESPONSIBILITY OF TESTING THE SET BEFORE DELIVERY, MAKE ANY NECESSARY SERVICE ADJUSTMENTS AND INSTALL THE SET IN THE NEW OWNER'S HOME IN EXPERT FASHION. FOR THIS, THEY RECEIVE A DEFINITE FEE FROM THE STORE FOR EACH SET INSTALLED OR ELSE THE CUSTOMER IS QUOTED A CERTAIN PRICE FOR THE RECEIVER AND CAN AT HIS OWN CHOICE HAVE THE SET PROPERLY INSTALLED FOR AN ADDITIONAL REASONABLE FEE.

YOU CAN DO THE SAME THING AND MANY SALES ORGANIZATIONS WILL BE ONLY TOO GLAD TO MAKE SOME SUCH A DEAL WITH YOU.

IN FACT, SUCH AN ASSOCIATION WITH ANY SALES ORGANIZATION WILL PLACE YOU IN AN ADVANTAGEOUS POSITION TO EVEN SERVICE RECEIVERS SOLD BY THEM AND WHICH DEVELOPE DEFECTS AFTER BEING IN OPERATION FOR SOME TIME. IF THIS

HAPPENS, IT SEEMS TO BE THE NATURAL THING FOR THE SET OWNER TO "AIR HIS TROUBLES" TO THE FIRM FROM WHICH HE PURCHASED THE RECEIVER, AND THE FIRM CAN THEN IN TURN PLACE THE SERVICE JOB IN YOUR HANDS. SUCH A PRACTICE IS BENEFICIAL TO BOTH YOU AND THE CONCERN WHO DOESN'T HAVE SUFFICIENT CALLS FOR SERVICE WORK TO WARRANT EMPLOYING A MAN SOLELY FOR THIS PURPOSE.

WORK OF THIS NATURE IS GENERALLY HANDLED ON A PERCENTAGE BASIS IN WHICH THE SERVICE MAN IS GIVEN A DEFINITE PERCENTAGE OF THE MONEY RECEIVED FOR THE JOB, THE BALANCE BEING RETAINED BY THE DEALER. IN THE EVENT THAT THE SERVICEMAN SELLS SOME ADDITIONAL EQUIPMENT DURING A SERVICE CALL, HE ALSO RECEIVES A PERCENTAGE FROM THE DEALER FOR HIS EFFORT.

FOR MOST SERVICE WORK, YOU WILL GENERALLY FIND IT THE PRACTICE AMONG SERVICEMEN TO PURCHASE THE REPLACEMENT PARTS AND ANY OTHER EQUIPMENT AT A 40% DISCOUNT OFF THE LIST PRICE AND TO CHARGE THE CUSTOMER THE LIST PRICE OF THE UNIT. FOR EACH SERVICE CALL REQUIRING ONE-HALF HOUR OF YOUR TIME, A FEE OF $1.00 SHOULD BE SATISFACTORY WHILE LABOR CHARGES CAN BE FIGURED AT THE RATE OF $1.00 PER HOUR.

NATURALLY, CIRCUMSTANCES ARISE WHERE YOU MAY HAVE TO ADJUST THE PRICE SO AS TO MEET CERTAIN SPECIAL REQUIREMENTS AND IN THIS RESPECT YOU CAN USE YOUR OWN JUDGEMENT.

UPON COMPLETING A JOB, ALWAYS BE SURE TO LEAVE YOUR BUSINESS CARD WITH THE SET OWNER UPON TAKING LEAVE. SOME SERVICEMEN TACK THEIR CARD INSIDE THE RECEIVER CABINET SO THAT THERE WILL BE NO POSSIBILITY OF THE CUSTOMER'S MISPLACING IT.

IF YOU CONTACT A PROSPECTIVE CUSTOMER WHO DOESN'T REQUIRE ANY WORK AT THE TIME, THEN LEAVE YOUR CARD WITH HIM AND TELL HIM THAT YOU WILL APPRECIATE HIS CALLING YOU BY TELEPHONE WHEN IN NEED OF SERVICE AT ANY FUTURE TIME.

ADOPT THE PRACTICE OF DOING YOUR BEST REGARDLESS OF HOW SMALL THE JOB. A SATISFIED CUSTOMER WILL CALL YOU AGAIN WHEN HE NEEDS YOU AND WILL BE MORE THAN WILLING TO RECOMMEND YOU TO HIS ACQUAINTANCES.

GIVE THE CUSTOMER A SQUARE DEAL, FOR HONESTY IN SERVICE AND WORKMANSHIP ALWAYS PAYS BIGGER DIVIDENDS IN THE LONG RUN.

SHOULD YOU BY ANY CHANCE RUN INTO A JOB WHICH YOU CANNOT SATISFACTORILY HANDLE, YOU MAY FEEL FREE TO WRITE TO US FOR ADDITIONAL ADVICE. IF YOU DO, PLEASE GIVE US AS MUCH INFORMATION AS POSSIBLE CONCERNING THE JOB SO THAT WE WILL BE BETTER ABLE TO GIVE YOU A MOST HELPFUL ANSWER.

NATURALLY, DO NOT DELIBERATELY TAKE UPON YOURSELF A JOB OF AN ADVANCED NATURE WHICH INVOLVES EQUIPMENT AND WORK ABOUT WHICH YOU HAVE NOT YET HAD A CHANCE TO STUDY. IT IS NO MORE THAN FAIR THAT YOU TAKE THIS INTO CONSIDERATION BECAUSE YOU ARE STILL IN AN EARLY STAGE OF YOUR TRAINING AND MUST THEREFORE KEEP YOUR ACTIVITIES IN THE FIELD WITHIN THESE LIMITS.

EXPERIENCE

PERHAPS YOU INTEND TO ULTIMATELY SPECIALIZE IN SOME BRANCH OF THIS WONDERFUL INDUSTRY OTHER THAN RADIO SERVICING SUCH AS BROADCASTING, COMM-

ERCIAL OPERATING, TALKING PICTURES, OR TELEVISION. EVEN IF THIS BE THE CASE, YOU STILL SHOULD MAKE IT A POINT TO ENGAGE IN SERVICING RECEIVERS FOR THE TIME BEING AT LEAST BECAUSE OF THE VALUABLE EXPERIENCE IT WILL GIVE YOU.

HERE IS A CHANCE FOR IMMEDIATE FINANCIAL RETURNS, WHEREAS YOU WILL REQUIRE CONSIDERABLY MORE TRAINING BEFORE BECOMING QUALIFIED TO ACCEPT A POSITION IN THE OTHER BRANCHES OF THE INDUSTRY. FURTHERMORE, THE PEOPLE WHOM YOU CONTACT NOW THROUGH SERVICE WORK, MAY BE PROSPECTS FOR A TELEVISION RECEIVER LATER ON. THEN TOO, SOME CONCERNS WITH WHICH YOU ESTABLISH DEALINGS NOW, MAY BE IN A POSITION TO OFFER YOU FUTURE OPPORTUNITIES IN SOME OTHER PROFITABLE FIELD OF RADIO. YOU SIMPLY MUST MEET THESE PEOPLE SOMETIME OR OTHER -- SO WHY NOT NOW?

MAYBE YOU FIND YOURSELF IN SUCH A FORTUNATE POSITION THAT YOU HAVE NO SPECIAL NEED FOR SPARE-TIME MONEY. ALTHOUGH THIS MAY BE TRUE, YET YOU DO NEED EXPERIENCE, SO IT IS UP TO YOU TO MAKE THE MOST OF THE OPPORTUNITIES WHICH WE ARE EXTENDING TO YOU IN THIS RESPECT.

THE EXPERIENCE WHICH YOU OBTAIN NOW WILL ENABLE MY EMPLOYMENT DEPARTMENT TO HELP YOU MORE EFFECTIVELY WHEN YOU GRADUATE. IT IS FOR THIS REASON THAT I WANT YOU TO MAIL ME A COMPLETE REPORT OF EVERY SPARE-TIME JOB YOU DO -- DESCRIBING THE JOB IN DETAIL AND THE PRICE YOU CHARGED. I EXPECT THIS REPORT FROM YOU AND AM FRANK TO TELL YOU THAT ALL SUCH REPORTS WILL FORM A PART OF MY EMPLOYMENT DEPARTMENT RECORDS. IN THIS WAY I CAN TELL AT A GLANCE JUST EXACTLY WHAT PRACTICAL EXPERIENCE YOU HAVE ACQUIRED DURING YOUR PERIOD OF TRAINING AND CAN THEREFORE RECOMMEND YOU ACCORDINGLY TO YOUR PROSPECTIVE EMPLOYER. THIS IS AN IMPORTANT MATTER AND I AM CERTAIN THAT YOU REALIZE ITS VALUE TO YOURSELF.

WHEN YOU GET A SERVICE JOB, BY ALL MEANS DO THE WORK YOURSELF. THIS IS YOUR EXPERIENCE AND ALTHOUGH YOU MIGHT MAKE A LITTLE MONEY ON THE DEAL BY ONLY "SELLING THE JOB" AND LETTING SOMEONE ELSE DO THE ACTUAL WORK, YET SUCH A PRACTICE WOULD BE OF NO SPECIAL BENEFIT TO YOU. REMEMBER THAT WE ARE WILLING TO HELP YOU THROUGH SPECIFIC SUGGESTIONS AND ADVICE.

BEAR IN MIND THAT IN THIS LESSON, OUR SUGGESTIONS APPLY PARTICULARLY TO SPARE-TIME WORK, CONSIDERING THE FACT THAT YOU ARE NOT YET FULLY TRAINED. HOWEVER, AS YOU ADVANCE WITH YOUR STUDIES, YOU WILL RECEIVE ADDITIONAL BUSINESS SUGGESTIONS WHICH WILL ASSIST YOU MATERIALLY IN CONDUCTING A PROFITABLE RADIO BUSINESS TO WHICH YOU WILL DEVOTE YOUR FULL-TIME.

WE HOPE THAT YOU WILL FIND THE INFORMATION CONTAINED IN THIS SPECIAL LESSON OF THE BUSINESS SERIES TO BE OF VALUE TO YOU AND THAT YOU WILL TAKE IT UPON YOURSELF TO MAKE THE MOST OF YOUR OPPORTUNITIES.

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RADIO EXPERIMENT

LESSON AC-3

THIS LESSON CONCERNS RADIO EXPERIMENTS DESIGNED TO FIX IN YOUR MIND SOME OF THE PRINCIPLES THUS FAR EXPLAINED TO YOU.

IN ORDER TO OPERATE THE 8-TUBE A-C RECEIVER WHICH WAS PROMISED YOU, IT IS NECESSARY THAT YOU FIRST HAVE A SOURCE OF ELECTRIC POWER. THIS WILL BE THE 110-VOLT A-C LIGHTING CIRCUIT OF YOUR HOME, TRANSFORMED TO THE REQUIRED VOLTAGES BY THE POWER TRANSFORMER WHICH IS NOW BEING SENT.

BEFORE ATTEMPTING TO CONNECT THIS TRANSFORMER TO YOUR LIGHTING CIRCUIT, IT IS ADVISABLE THAT YOU FIRST READ ALL OF THIS LESSON VERY CAREFULLY TO AVOID BLOWING OUT FUSES IN YOUR LIGHTING CIRCUIT, INJURING THE TRANSFORMER, AND TO PREVENT POSSIBLE ELECTRICAL SHOCKS TO YOURSELF.

THE POWER TRANSFORMER IS OF THE HIGHEST QUALITY, CAPABLE OF OPERATING YOUR RECEIVER AT MAXIMUM EFFICIENCY, SO TREAT IT WITH CARE AND CONSIDERATION, TO MAINTAIN IT IN PROPER CONDITION.

POWER TRANSFORMER TERMINAL MARKINGS

TO AVOID ANY POSSIBILITY OF A MISTAKE IN IDENTIFYING THE TERMINALS ON THIS TRANSFORMER, THEY ARE ALL MARKED AS ILLUSTRATED IN FIG. 1, WHICH SHOWS THE TERMINAL ARRANGEMENT OF A TYPICAL UNIT. THE TERMINAL CONNECTED TO ONE END OF THE PRIMARY WINDING IS MARKED "C", INDICATING THE COMMON CONNECTION FOR THIS WINDING. THE TERMINAL CONNECTED TO THE OTHER

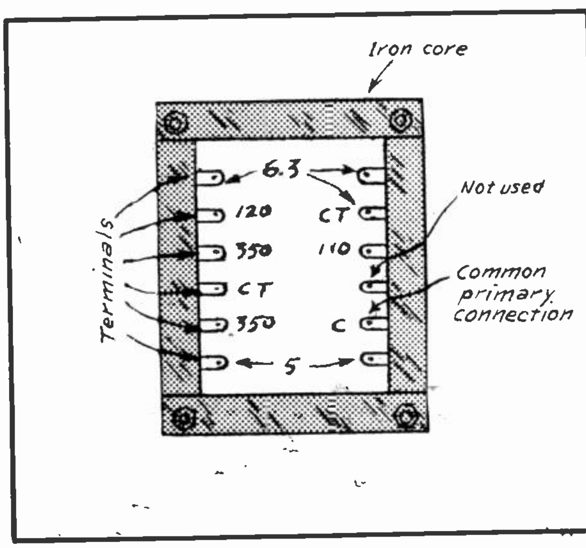

Fig. 1
Power Transformer Terminal Identification

end of the primary winding is marked "120" and a tap from this same winding is connected to the terminal marked "110".

If the line voltage of the lighting circuit is within 4 or 5 volts of 110 volts, connect "C" and "110" terminals of your power transformer across this circuit. Should the line voltage exceed 115 volts and approach 120, connect the "C" and "120" terminals of the transformer across the lighting circuit. This will be explained more fully in a later lesson.

The two terminals marked "6.3", located opposite each other and interconnected by the line, are connected to the 6.3-volt secondary winding. The center-tap from this winding connects to the terminal indicated in Fig. 1 as C.T. The two terminals marked "5" connect to the ends of the 5-volt secondary winding, and the terminals marked "350" connect to the ends of the high-voltage secondary winding. The center-tap from this same winding is located between the high-voltage terminals, and is marked C.T.

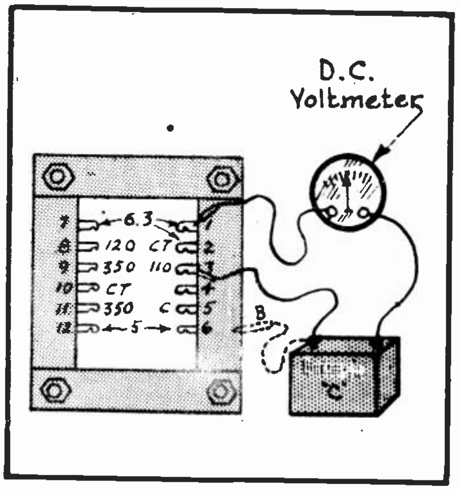

Fig. 2
Continuity Tests With
Voltmeter Method

Some types of power transformer do not have marked terminals, and in such cases the terminals must be identified by means of tests as explained later in this course.

Before attempting to make test connections to any of the transformer terminals, be sure to scrape off the varnish baked on the terminals while the unit was constructed. This varnish is an insulator and will prevent a good electrical contact on the solder lugs. For this reason, it is necessary that it first be scraped off the terminals. Scrape them bright before soldering or otherwise making electrical connections.

EXPERIMENT #1 -- VOLTMETER METHOD FOR TESTING THE CONTINUITY OF TRANSFORMER WINDINGS

Your first experiment will be the continuity test on the transformer windings, by aid of your voltmeter. To do this, connect the voltmeter in series with a 4 1/2-volt "C" battery and a pair of test leads, and test between the various terminal lugs of the transformer in the manner illustrated in Fig. 2. Begin by placing test point "A" on the terminal indicated as #1 in Fig. 2, and then touch the other test point "B" successively to the terminals indicated as #2, 3, 4, etc. Then place test point "A" on terminal #2, and test point "B" successively on terminals 3, 4, 5, etc. Continue by placing test point "A" on terminal #3, and test point "B" successively on terminals #4, 5, 6, etc. Proceed in this manner until you have tested between every pair of terminals. Also, test in this manner between every terminal and ground (ground in this case is the iron core of the transformer).

Each time that you test through a complete circuit, the voltmeter

WILL SHOW A READING. WITH THE PARTICULAR TRANSFORMER CONNECTIONS ILLUSTRATED IN FIG. 2, FOR EXAMPLE, THE METER READING SHOULD BE AS FOLLOWS:

BETWEEN TERMINALS 1, 2, AND 7 YOU SHOULD OBTAIN A READING EQUIVALENT TO BATTERY VOLTAGE, BUT FROM THESE TERMINALS TO ALL OTHERS A ZERO READING SHOULD BE OBTAINED. OTHER READINGS SHOULD BE AS FOLLOWS: BETWEEN TERMINALS 6 TO 12, BATTERY VOLTAGE; TERMINALS 6 OR 12 TO ALL OTHER TERMINALS, ZERO; BETWEEN TERMINALS 9, 10, AND 11, BATTERY VOLTAGE; FROM TERMINALS 9, 10, AND 11 TO ALL OTHERS, ZERO; BETWEEN TERMINALS 5, 3, AND 8, BATTERY VOLTAGE; FROM TERMINALS 5, 3, AND 8 TO ALL OTHERS, ZERO; FROM ALL TERMINALS TO THE TRANSFORMER CORE, ZERO, FOR NONE OF THE WINDINGS SHOULD BE GROUNDED WITHIN THE TRANSFORMER ITSELF.

IF NO READING IS OBTAINED BETWEEN A PAIR OF TERMINALS, WHERE A READING SHOULD BE OBTAINED, THAT PARTICULAR WINDING IS OPEN-CIRCUITED.

WITH A VERY SENSITIVE VOLTMETER YOU WOULD NOTICE THAT WHEN TESTING THROUGH EITHER HALF OF THE HIGH-VOLTAGE WINDING, OR THROUGH THIS ENTIRE WINDING, THE READING WOULD BE SLIGHTLY LESS THAN BATTERY VOLTAGE, BECAUSE THE WIRE USED IN THIS WINDING IS SO SMALL AND THE NUMBER OF TURNS SO GREAT, THAT THE OHMIC RESISTANCE OF THE WINDING IS COMPARATIVELY HIGH.

IT IS A GOOD PLAN TO MAKE AN ELECTRICAL DIAGRAM OF YOUR TRANSFORMER SOMEWHAT AS SHOWN IN FIG. 3. REMEMBER, HOWEVER, THAT THE TERMINAL ARRANGEMENTS ON ALL COMMERCIAL POWER TRANSFORMERS ARE NOT ALIKE, AND THEREFORE THE CONTINUITY TESTS DO NOT NECESSARILY HAVE TO BE THE SAME AS OBTAINED WITH THE EXAMPLE OF FIG. 2.

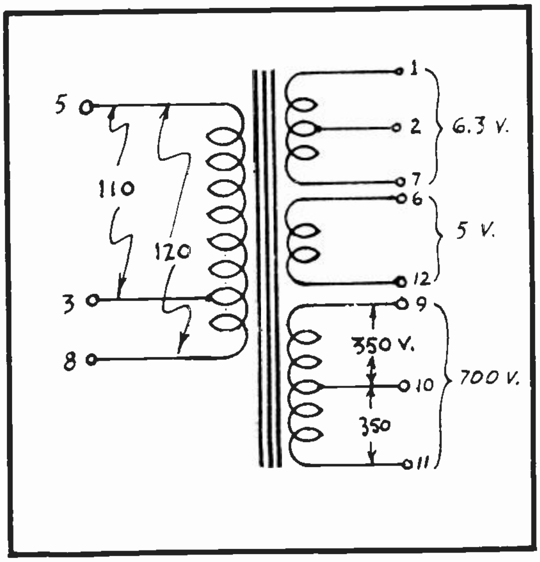

Fig. 3
Diagram of the Power Transformer

EXPERIMENT #2 -- TESTING THE TRANSFORMER WINDINGS FOR CONTINUITY USING HEADPHONES

HEADPHONES CAN BE USED IN PLACE OF THE VOLTMETER, AS SHOWN IN FIGURE 4, AND THE RESULTS AS OBTAINED WITH THIS EXPERIMENT SHOULD CORRESPOND WITH THOSE OBTAINED IN THE PREVIOUS EXPERIMENT. THAT IS, ACROSS THOSE CONNECTIONS WHERE THE VOLTMETER INDICATED BATTERY VOLTAGE, YOU SHOULD NOW HEAR A DISTINCT "CLICK" IN YOUR HEADPHONES, BUT NONE WHERE THERE IS NO CIRCUIT CONTINUITY.

MAKE THIS HEADPHONE CLICK TEST ACROSS ALL PAIRS OF CONNECTIONS, AS YOU DID WITH YOUR VOLTMETER TESTS. CHECK THE RESULTS CAREFULLY AGAINST THOSE OBTAINED IN THE FIRST EXPERIMENT, AND NOTE HOW THEY COMPARE.

EXPERIMENT #3 -- 110-VOLT LAMP TESTING ACROSS WINDINGS

ARRANGE A 110-VOLT LAMP IN SERIES WITH ONE OF A PAIR OF TEST LEADS AS ILLUSTRATED IN FIG. 5. THE LAMP MAY BE AN INCANDESCENT LAMP OF ANY

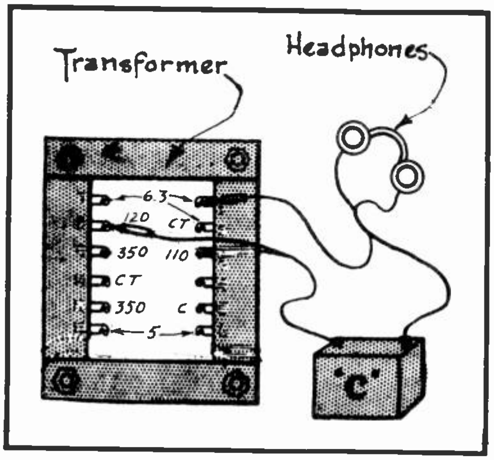

Fig. 4
Continuity Tests With
Headphone Method

RATING BETWEEN 25 AND 100 WATTS--WHATEVER YOU HAPPEN TO HAVE ON HAND--BUT A 25-WATT LAMP IS PREFERABLE. CONNECT THE TEST LEADS TO THE 110-VOLT A-C LIGHTING CIRCUIT BY MEANS OF AN ATTACHMENT PLUG, AS SHOWN, AND PLUG-IN AT ANY SOCKET OR PLUG RECEPTACLE.

THUS CONNECTING A LAMP IN SERIES WITH THE TEST LEADS MAKES IT IMPOSSIBLE TO BLOW OUT A FUSE IN THE LIGHTING CIRCUIT IN CASE THAT THE TEST PRODS ARE ACCIDENTALLY TOUCHED TOGETHER OR OTHERWISE SHORT-CIRCUITED. THE LAMP WILL BURN AT FULL BRILLIANCE WHENEVER THE TEST-LEADS ARE SO SHORTED.

UPON CONNECTING THE TEST LEADS ACROSS 6.3 VOLT WINDINGS, OR ACROSS THE 5-VOLT WINDING, THE LAMP WILL BURN QUITE BRIGHTLY, BECAUSE THESE ARE LOW RESISTANCE WINDINGS HAVING A RELATIVELY SMALL NUMBER OF TURNS OF FAIRLY LARGE WIRE.

UPON CONNECTING THE TEST LEADS ACROSS THE HIGH-VOLTAGE SECONDARY WINDING THE LAMP WILL FAIL TO BURN,BECAUSE THIS WINDING CONTAINS A GREAT NUMBER OF TURNS OF VERY FINE WIRE, AND OFFERS GREAT OPPOSITION TO THE CURRENT FLOW--IN FACT, SO MUCH OPPOSITION THAT 110 VOLTS WILL NOT FORCE ENOUGH CURRENT THROUGH IT TO HEAT THE LAMP FILAMENT TO INCANDESCENCE.

IF THE TEST LEADS ARE CONNECTED ACROSS THE "C" AND "110" PRIMARY TERMINALS, A 25-WATT LAMP WILL BURN DIMLY, A 50-WATT LAMP STILL MORE DIM AND A 100-WATT LAMP WILL NOT SHOW LIGHT AT ALL. THE PURE RESISTANCE OF THE PRIMARY WINDING DOES NOT NECESSARILY PREVENT THE LAMP FROM LIGHTING, BUT IN ADDITION, THE PRIMARY WINDING IS DESIGNED TO PRODUCE A COUNTER-ELECTROMOTIVE FORCE, WHEN THE LIGHTING CIRCUIT IS CONNECTED ACROSS IT, THAT PRACTICALLY COUNTER BALANCES THE LINE VOLTAGE. CONSEQUENTLY, IF LINE VOLTAGE AND THIS COUNTER-ELECTROMOTIVE FORCE EXACTLY OR NEARLY BALANCE EACH OTHER, VERY LITTLE CURRENT WILL FLOW THROUGH THE WINDING, WITH WHICH TO LIGHT THE LAMP.

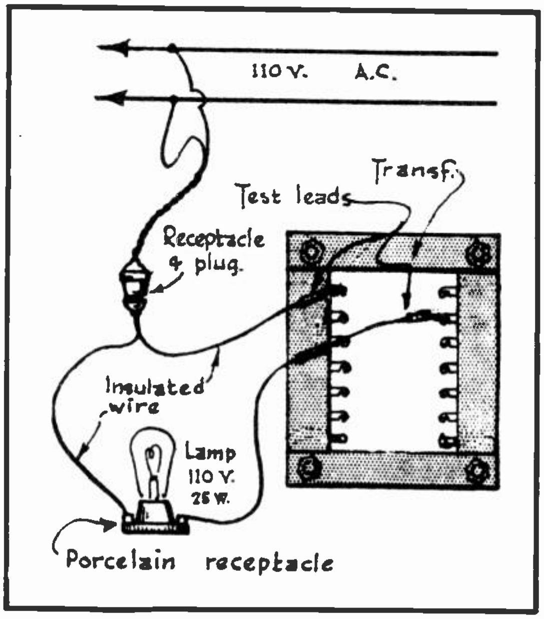

Fig. 5
Testing Across Windings
With a 110-V Lamp

EXPERIMENT #4 -- EXPERIMENTS WITH 60-CYCLE HUM

CONNECT THE LAMP-TEST LEADS ACROSS THE PRIMARY TERMINALS OF THE POWER TRANSFORMER, AS ILLUSTRATED IN

NATIONAL SCHOOLS
LOS ANGELES, CALIFORNIA

Examination Sheet

GRADE

CORRECTED BY

PRINT YOUR NAME AND ADDRESS PLAINLY

William Lieske
1346 Hoyt
Salem, Oregon

DATE Feb 3, 1941

LESSON NO. Ac 3

STUDENT NO. RB-1712

WHAT OTHER LESSONS HAVE YOU? "

ANS. NO.	USE THIS SHEET FOR YOUR EXAMINATION ANSWERS ONLY - DO NOT COPY OUT THE QUESTIONS
1.	Simply because greater voltage provides greater actuation of the 'phone's diaphragms, thus louder clicks
2	No indication would be noted on volt-meter.
3	The primary of the power-transformer is for 220 volts instead of 110, as on the lower voltage model. In AC-DC sets, a larger dropping resistor or a special adapter is needed.
4	It is open circuited.
5	Clicks can be heard on all windings. On the high voltage windings the meter deflection will be less than on lower voltage ones due to the greater resistance of the H.V. windings
6.	In case of a short, the fuses will not be blown, or the transformer overloaded.
7	The counter-electromotive force in the transformer almost counter balances the line voltage when no load is put on the transformer. But when a load is put on the transformer, that is, current is drawn from one of the secondaries, this power must be supplied thru the medium of the primary.

240-RD.

USE OTHER SIDE

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ANS. NO. Thus the effective resistance of the primary is greatly reduced.

8. It means that the primary is shorted to the core.

9. The low voltage windings have very low resistance: a comparitively small number of turns of comparitively larger wire than the secondary.

10. If the winding is continous, when the prods are connected across it, the voltage is connected across the phones, thus causing the click. Not continous, no click.

IMPORTANT -- IF NECESSARY, USE ANY SIMILAR PLAIN PAPER TO COMPLETE YOUR ANSWERS.

Fig. 6. To avoid an electrical shock when handling this 110-volt circuit, be careful that you do not touch both bare ends of the 110-volt test circuit with both hands at the same time. Never touch one terminal of any lighting circuit while standing on a wet floor, on the ground, or in contact with any metal connected to ground-- such as a water pipe.

Having made the connections across the primary circuit, connect your headphones across the 6.3-volt secondary winding, as also shown in Fig. 6. Upon doing this you will hear the characteristic 60-cycle a-c hum. Also connect your headphones across the 5-volt secondary, between the center tap and each extremity of the 6.3 volt secondary, and between the iron core and each end of the 6.3-volt winding. DO NOT CONNECT YOUR HEADPHONES ACROSS THE HIGH-VOLTAGE SECONDARY WINDING DURING THIS TEST. ALSO, BE SURE NOT TO TOUCH THE TERMINALS OF THE HIGH-VOLTAGE SECONDARY WHILE THE PRIMARY IS CONNECTED ACROSS THE 110-VOLT LIGHTING CIRCUIT, OR YOU WILL RECEIVE A PAINFUL SHOCK.

Upon the completion of this test, you will find that with the headphones connected across the ends of the 6.3-volt secondary, the hum intensity will appear to be about twice as great as with the headphones connected across only one-half of this winding.

EXPERIMENT #5 - EFFECT OF POWER DEMAND UPON THE TRANSFORMER

With the 110-volt lamp circuit connected across the primary terminals of the power transformer, take a short piece of hook-up wire and momentarily touch its ends across the terminals, as illustrated in Fig. 7. Upon so short-circuiting the 6.3-volt winding, the lamp will burn at full brilliance.

The lamp can also be made to burn at full brilliance by momentarily short-circuiting the 5-volt secondary. Do not short-circuit the high voltage secondary winding during this experiment.

It should be of special interest to you to note that with only the lamp circuit connected across the transformer's primary winding, it will only burn very dimly; whereas, it shows full brilliance upon short-circuiting any of the low-voltage secondary windings. This test shows how a secondary load affects the amount of power which the transformer draws from the lighting circuit. What really happens is that with only the primary winding connected across the 110-volt circuit, and no complete circuit provided for either of the secondary voltages, the counter-electromotive force generated by the primary winding practically counter-balances the line voltage, with the result that almost no power is consumed by the transformer. The small amount of a-c current flowing

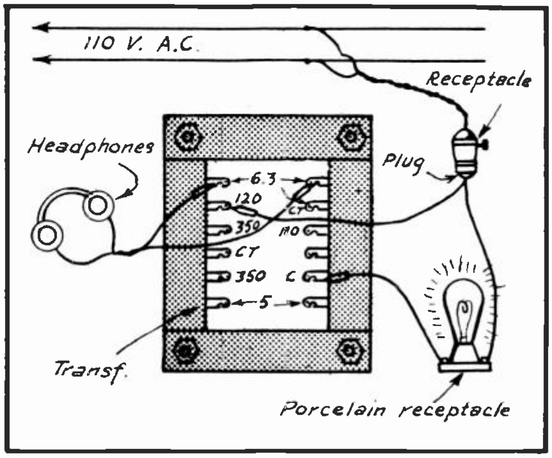


Fig. 6
Listening for 60 Cycle Power Hum

IN THE PRIMARY WINDING UNDER SUCH CONDITIONS, WHICH SERVES ONLY TO ESTABLISH THE FLUX OR LINES OF FORCE GENERATING THE COUNTER-ELECTROMOTIVE FORCE, IS OFTEN SPOKEN OF AS WATTLESS CURRENT.

SHORT-CIRCUITING ONE OF THE LOW-VOLTAGE SECONDARY WINDINGS COMPLETES THAT CIRCUIT AND PERMITS CURRENT TO FLOW. THIS PARTICULAR WINDING THEN CONSUMES ELECTRICAL POWER WHICH MUST BE SUPPLIED BY THE 110-V. CIRCUIT BY SIMPLE TRANSFORMER ACTION. THE ADDITIONAL CURRENT DRAWN FROM THE LIGHTING CIRCUIT TO MEET THIS POWER DEMAND, IS SUFFICIENT TO CAUSE THE LAMP TO BURN AT FULL BRILLIANCE. IN OTHER WORDS, THE GREATER THE LOAD IMPRESSED UPON THE SECONDARY WINDINGS, OR THE LESS THE OPPOSITION OF A COMPLETED SECONDARY CIRCUIT--THE GREATER WILL BE THE CURRENT FLOW THROUGH THE SECONDARY AS WELL AS THROUGH THE PRIMARY WINDING. IN YOUR PRESENT EXPERIMENTS, HOWEVER, THE 25-WATT LAMP LIMITS THE PRIMARY CURRENT TO AN AMOUNT WHICH WILL NOT INJURE THE WINDINGS DURING THESE SHORT-CIRCUITING TESTS.

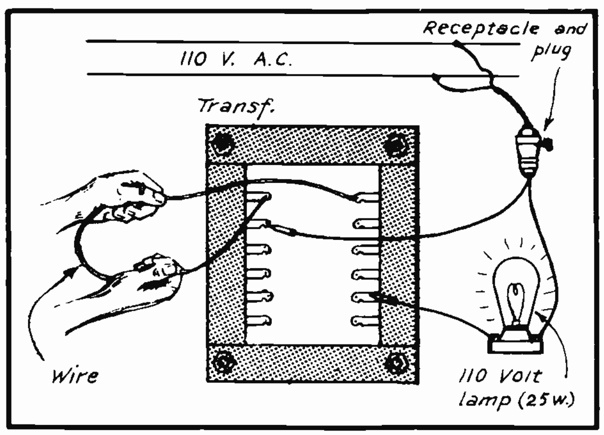


Fig. 7
Putting a Load on the Transf.

SPECIAL NOTICE TO STUDENTS HAVING 220-VOLT A-C SERVICE

AS YOU WILL HAVE NOTICED IN THE STUDY OF THIS LESSON, IT CONCERNS ONLY POWER TRANSFORMERS DESIGNED FOR CONNECTION TO 110-VOLT A-C LIGHTING CIRCUITS, SINCE THIS POWER SUPPLY IS MOST COMMON. HOWEVER, TO THOSE STUDENTS WHO REQUEST THAT THEIR EXPERIMENTAL OUTFITS BE DESIGNED FOR 220-VOLT A-C OPERATION, WE SEND A POWER TRANSFORMER DESIGNED FOR THIS LINE VOLTAGE. OTHER THAN THE DESIGN OF THE POWER TRANSFORMER, THE DESIGNS OF THE 8-TUBE 110-VOLT AND 220-VOLT A-C RECEIVERS ARE EXACTLY ALIKE.

IN CONDUCTING THE EXPERIMENTS OUTLINED IN THIS LESSON, BUT WITH A 220-VOLT TRANSFORMER, YOU WILL PROCEED EXACTLY AS SPECIFIED FOR THE 110-VOLT TRANSFORMER, EXCEPT THAT YOU WILL CONNECT THE 220-VOLT PRIMARY WINDING OF THE TRANSFORMER TO THE 220-VOLT LIGHTING CIRCUIT, AND WHEN USING A LAMP IN ANY OF THE EXPERIMENTS, A 220-VOLT LAMP MUST BE USED INSTEAD OF THE 110-VOLT LAMP SPECIFIED IN THIS LESSON. YOUR METHODS OF PROCEDURE, AND THE RESULTS IN CONNECTION WITH THE EXPERIMENTS, WILL THEN BE THE SAME AS STATED IN THIS LESSON WITH RESPECT TO THE 110-VOLT TRANSFORMER.

SPECIAL TRANSFORMER INFORMATION FOR GLASS-TUBE RECEIVER

THE ILLUSTRATIONS AND EXPLANATIONS THUS FAR GIVEN IN THIS LESSON APPLY TO THE POWER TRANSFORMER WHICH WE FURNISH TO OUR STUDENTS FOR USE IN CONSTRUCTING THE A-C RECEIVER EQUIPPED WITH METAL TUBES. FOR THE GLASS-TUBE RECEIVER, HOWEVER, A CHANGE IN THE DESIGN OF THE POWER TRANSFORMER IS NECESSARY.

THE TERMINAL ARRANGEMENT OF THE TRANSFORMER FOR THE GLASS-TUBE RE-

CEIVER IS ILLUSTRATED IN FIG. 8, AND ITS CIRCUIT DIAGRAM APPEARS IN FIGURE 9. AS YOU WILL NOTE, TWO 2 1/2-VOLT SECONDARIES REPLACE THE SINGLE 6.3-VOLT WINDING OF THE GLASS-TUBE TRANSFORMER.

ALTHOUGH THESE CHANGES HAVE BEEN MADE, YOU CAN NEVERTHELESS PERFORM THE SAME EXPERIMENTS AS OUTLINED IN THIS LESSON, BY SIMPLY BEARING IN MIND THE CHANGE IN THE TRANSFORMER'S TERMINAL ARRANGEMENT, AND SUBSTITUTING TESTS ON THE 2.5-VOLT WINDINGS FOR THE PRESCRIBED TESTS ON THE 6.3-VOLT WINDING.

IDENTIFYING TERMINALS

WHEN TESTING OUT TRANSFORMERS ON WHICH THE SEVERAL TERMINALS ARE NOT MARKED, IT IS WELL TO MARK THEM FOR FUTURE INFORMATION. THE MARKS MAY BE ON ADJACENT MATERIAL, OR ON TAGS ATTACHED TO EACH TERMINAL, OR A STRIP OF WHITE PAPER MAY BE ATTACHED TO ADJACENT MATERIAL BY MEANS OF SHELLAC (NOT GLUE) AND THE MARKS MADE THEREON. IF WIRE ENDS ARE THE ONLY TERMINALS, A SHORT PIECE OF WHITE ADHESIVE TAPE BENT OVER THE WIRE CAN BE MARKED WITH INK.

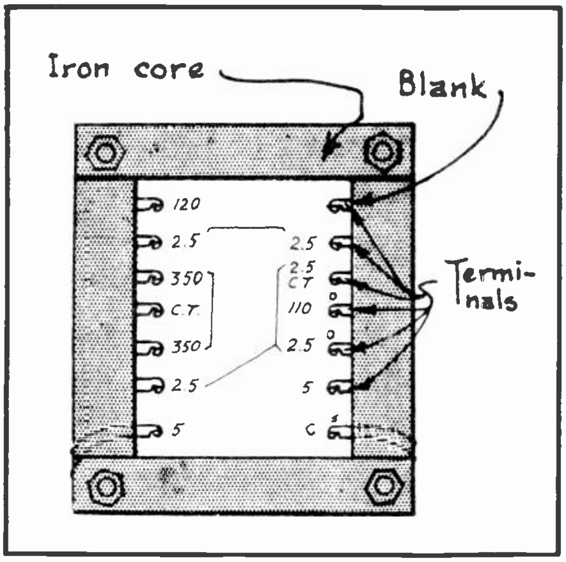


Fig. 8
Terminal Arrangement

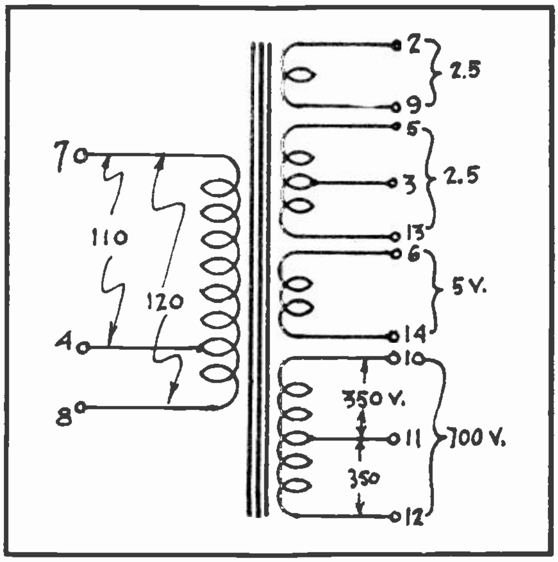


Fig. 9
Transformer Diagram

WEAKENED INSULATION

IF ANY TRANSFORMER APPEARS DAMP WHEN RECEIVED, DO NOT CONNECT IT TO THE A-C LINE UNTIL IT HAS BEEN WELL DRIED BY HANGING IT THREE OR FOUR FEET ABOVE A HEATING STOVE FOR TWO OR THREE DAYS, OR BAKING IT FOR AT LEAST 12 HOURS AT 180 - 190°F.

WHEN FIRST CONNECTING A TRANSFORMER, DISCONNECT IT FROM THE A-C LINE QUICKLY IF IT BEGINS TO STEAM, SMOKE, OR SMELL LIKE BURNING PAINT OR VARNISH. DISCONNECT ALL LOAD, AND RETEST FOR SHORTS AND GROUNDS.

EXAMINATION QUESTIONS

RADIO EXPERIMENT LESSON AC-3

Ans Feb 3, 41

1. - WHEN MAKING THE "HUM TEST," WHY IS IT THAT THE HUM INTENSITY, AS HEARD IN THE PHONES, APPEARS GREATER WITH THE PHONES CONNECTED ACROSS THE 6.3-VOLT SECONDARY WINDING THAN WHEN CONNECTED ACROSS THE 5-VOLT WINDING?

2. - IF A TRANSFORMER WINDING SHOULD BE OPEN-CIRCUITED, HOW WOULD THIS REACT UPON THE VOLTMETER WHEN THE CONTINUITY TEST IS MADE ACROSS THE EXTREMITIES OF THIS WINDING?

3. - WHAT IS THE ESSENTIAL DIFFERENCE BETWEEN A 110-VOLT RECEIVER AND A 220-VOLT RECEIVER?

4. - UPON MAKING A CONTINUITY TEST ACROSS TERMINALS 1 AND 7 OF THE TRANSFORMER ILLUSTRATED IN FIG. 2, WITH YOUR VOLTMETER CONNECTED IN SERIES WITH A 4 1/2-VOLT "C" BATTERY, IF THE METER NEEDLE INDICATES "ZERO", WHAT IS THE CONDITION OF THE WINDING CONNECTED BETWEEN THESE TERMINALS?

5. - HOW DO THE RESULTS OBTAINED WITH THE HEADPHONE "CLICK" TESTS COMPARE WITH THE VOLTMETER TESTS ON THE SAME CIRCUITS?

6. - WHAT IS ONE OF THE CHIEF ADVANTAGES OF CONNECTING A LAMP IN SERIES WITH THE 110-VOLT LIGHTING CIRCUIT WHILE TESTING YOUR POWER TRANSFORMER?

7. - WHY DOES THE TEST LAMP IN THE SYSTEM OF FIG. 7 BURN BRIGHTLY WHEN A LOW-VOLTAGE SECONDARY WINDING IS SHORT-CIRCUITED, BUT BURNS DIMLY WHEN NONE OF THE SECONDARY WINDINGS ARE SHORT-CIRCUITED?

8. - IF YOU SHOULD TEST THE TRANSFORMER ACCORDING TO THE VOLTMETER METHOD, AND FIND THE METER TO INDICATE FULL "C"-BATTERY VOLTAGE UPON CONTACTING ONE TEST POINT ON TERMINAL #5 AND THE OTHER TEST POINT ON THE IRON CORE OF THE TRANSFORMER (FIG. 2) WHAT WOULD THIS TEST INDICATE?

9. - WHY IS IT THAT THE 25-WATT TEST LAMP BURNS AT FULL BRILLIANCE WHEN THE 110-VOLT TEST LEADS ARE CONNECTED ACROSS THE ENDS OF A LOW-VOLTAGE SECONDARY WINDING, BUT BURNS VERY DIMLY WHEN THE TEST LEADS ARE CONNECTED ACROSS THE ENDS OF THE TRANSFORMER'S PRIMARY WINDING?

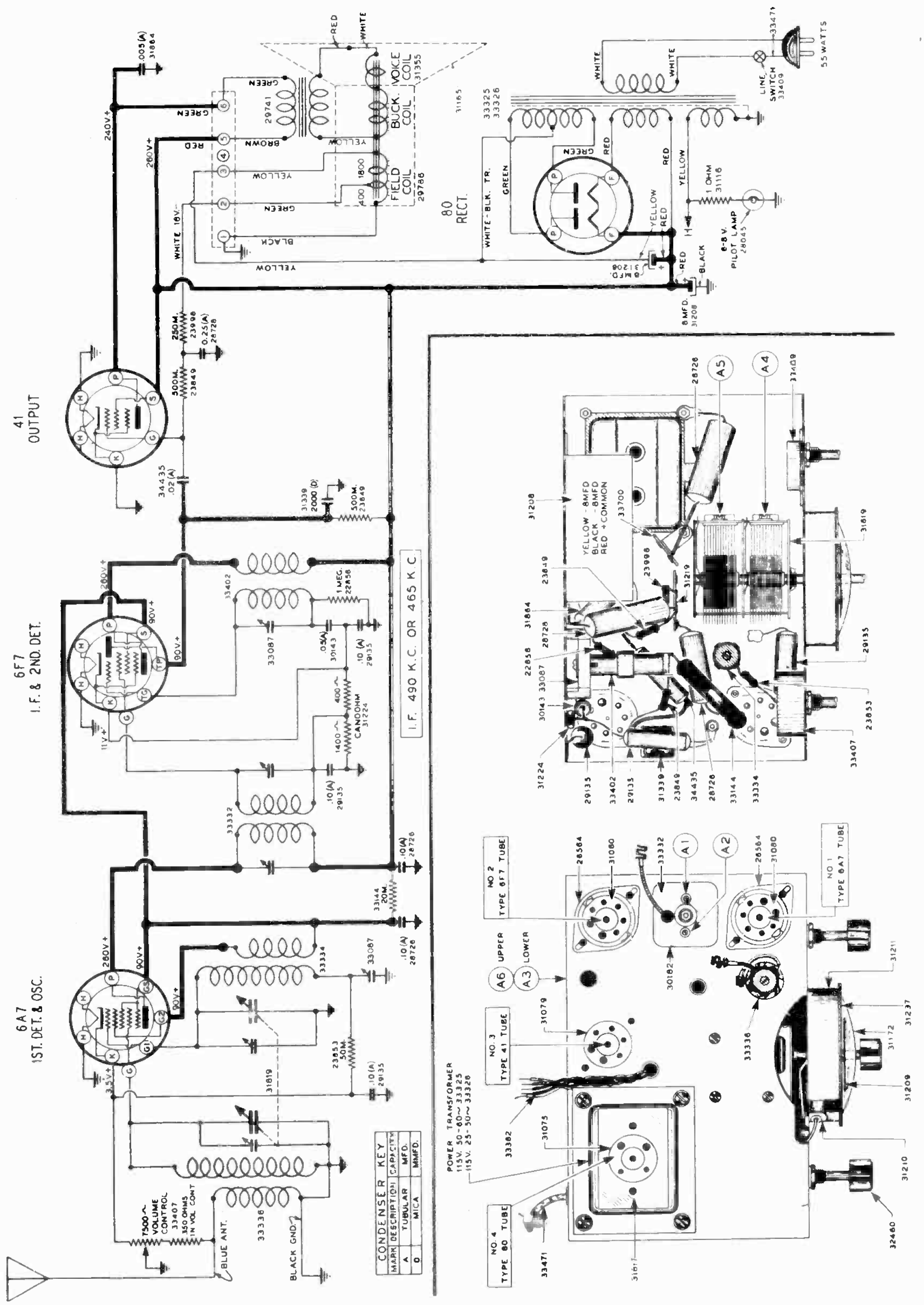
10. - WHY IS IT THAT A "CLICK" IS HEARD IN THE HEADPHONES WHEN TESTING THRU A GOOD TRANSFORMER WINDING, ACCORDING TO THE METHOD ILLUSTRATED IN FIG. 4 OF THIS LESSON?

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODEL 470 (Chassis 4C)

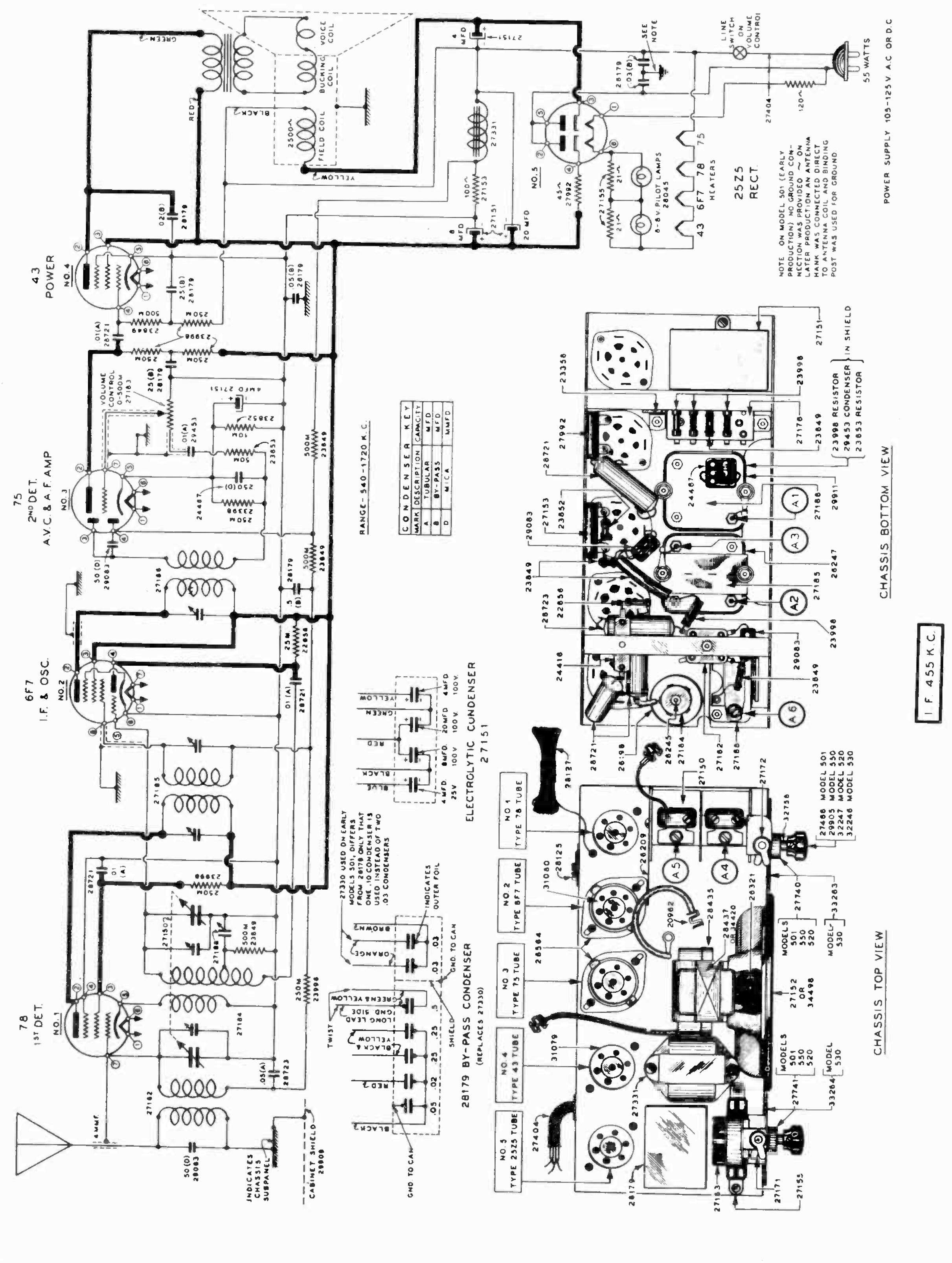


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODELS 501-520-530-550 (Chassis 5B)



NATIONAL SCHOOLS
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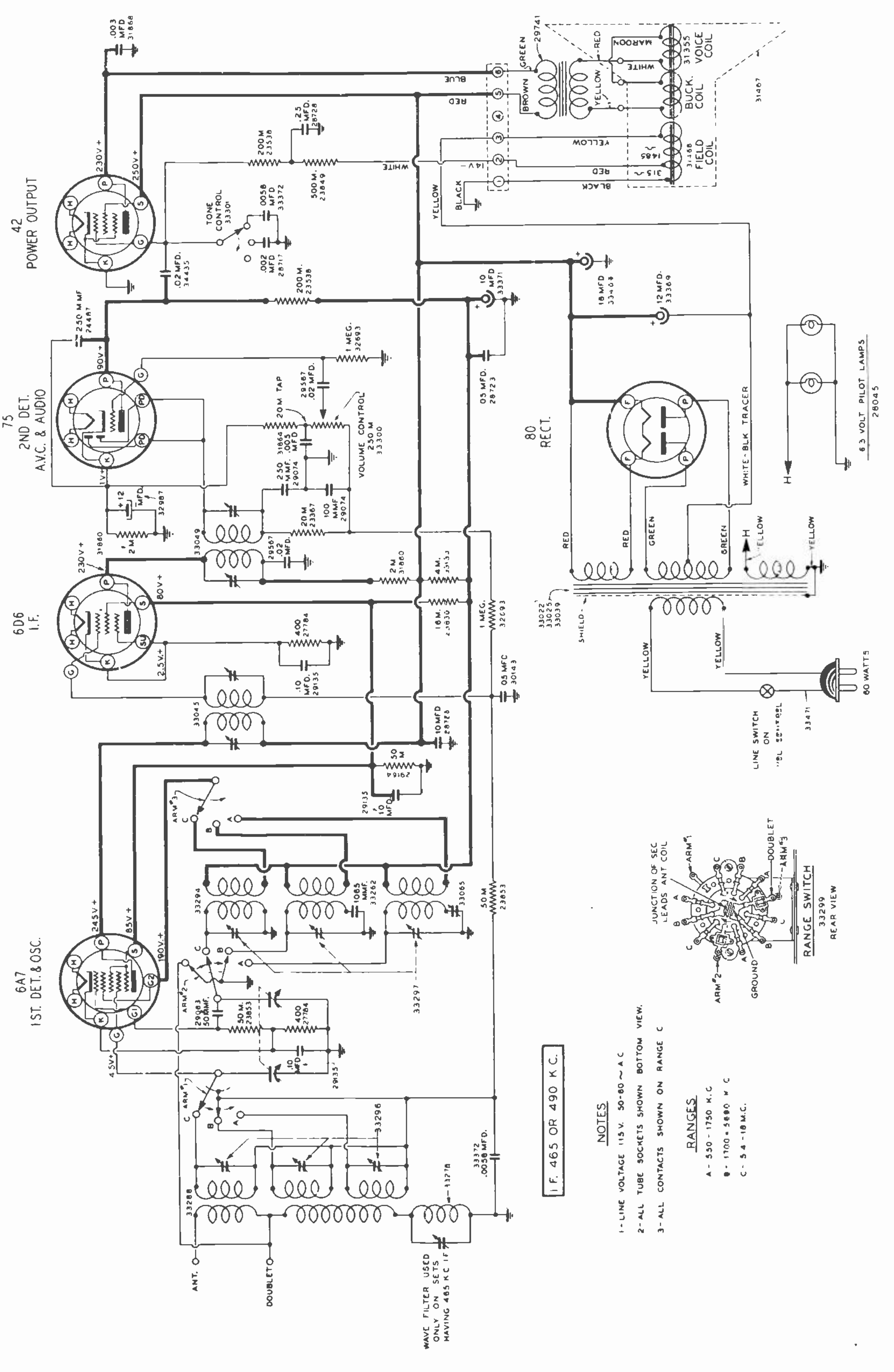
COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODELS 580 - 581 (Chassis 5G)



NATIONAL SCHOOLS
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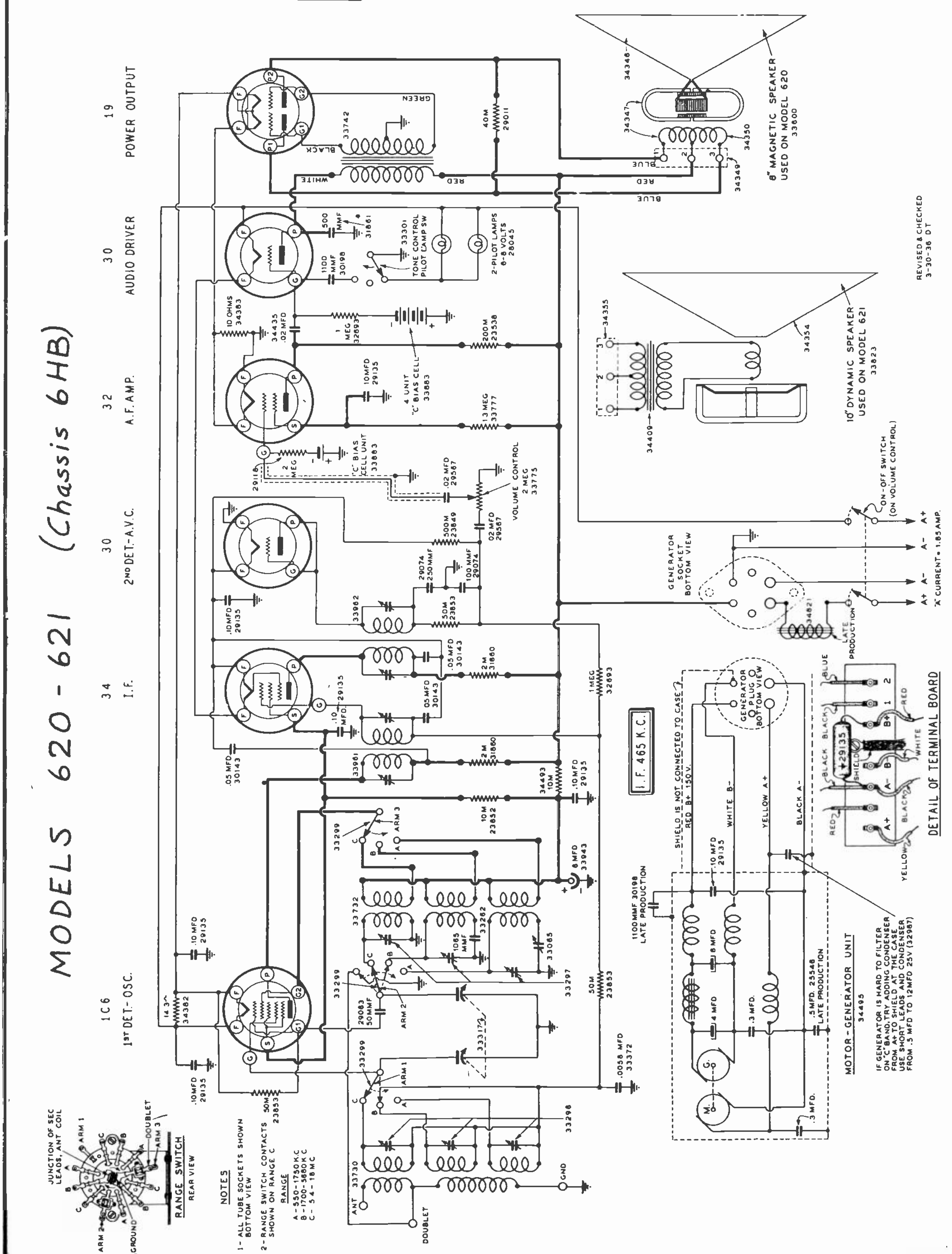
COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

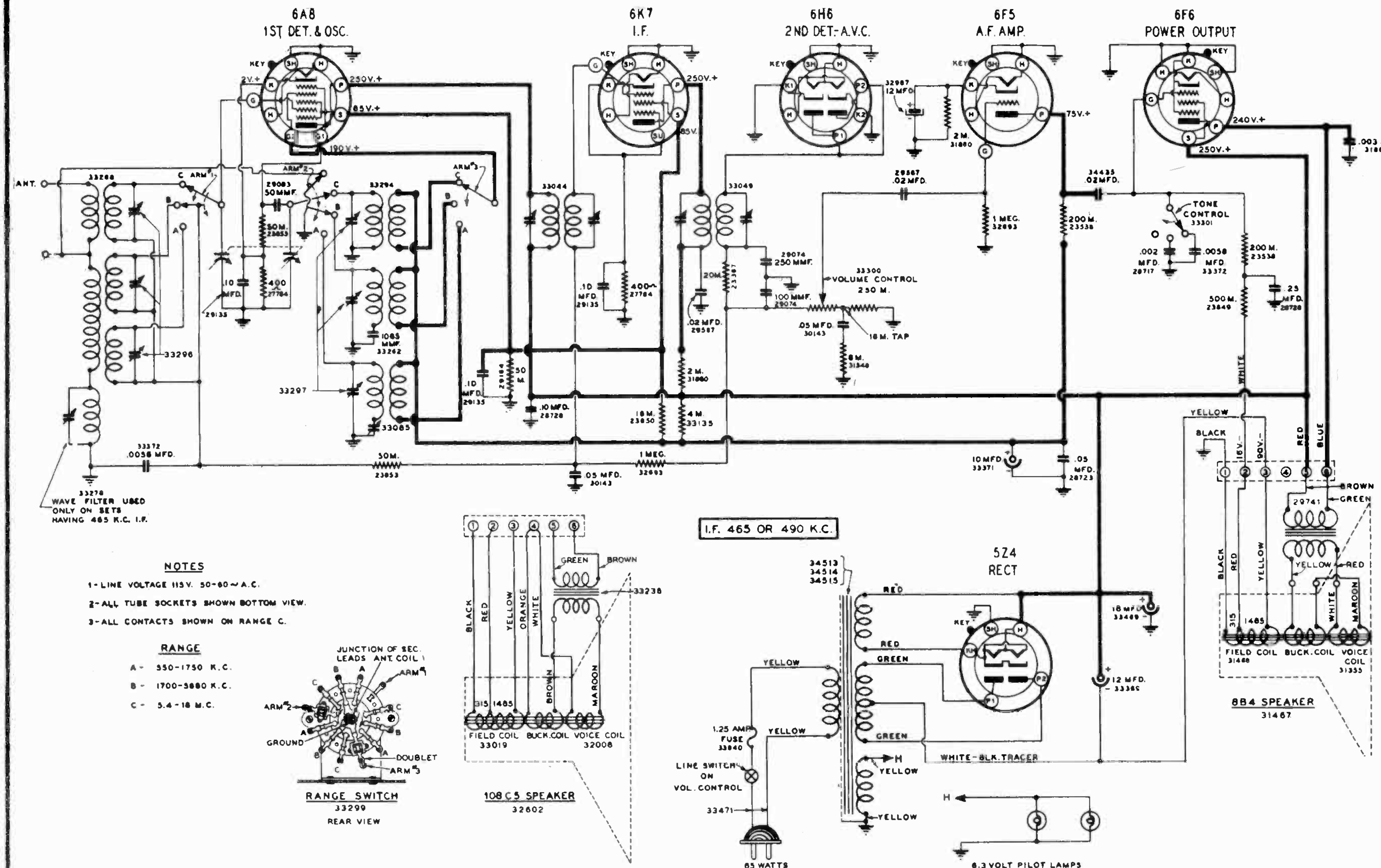


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODELS 680 - 681 (Chassis 6G)



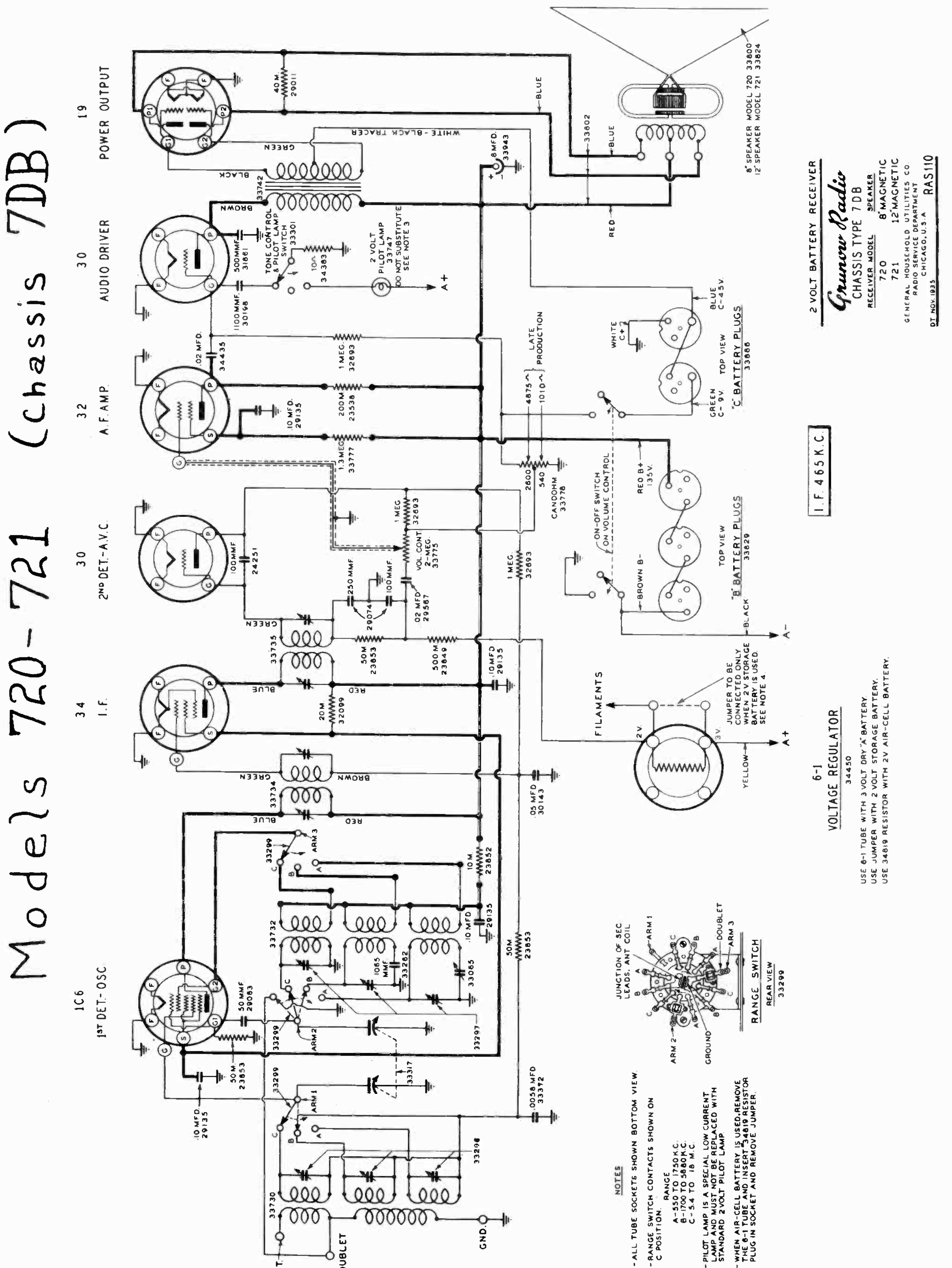
The GRUNOW 6G Chassis is a six tube, 115 V -50-60 cycle A.C., three band receiver with A.V.C., Tone Control and a "Band Spread" dial. The tubes used are: 6A8 1st Detector and Oscillator, 6K7 I.F. Amplifier, 6H6 2nd Detector and A.V.C., 6F5 1st Audio Amplifier, 6F6 Power Output tube and a 5Z4 Rectifier tube.

The frequency range is divided into three bands or divisions, one covering the band of 550 to 1750 K.C. (A), one the band from 1700 to 5680 K.C. (B), and the other from 5.4 to 18 megacycles (C).

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

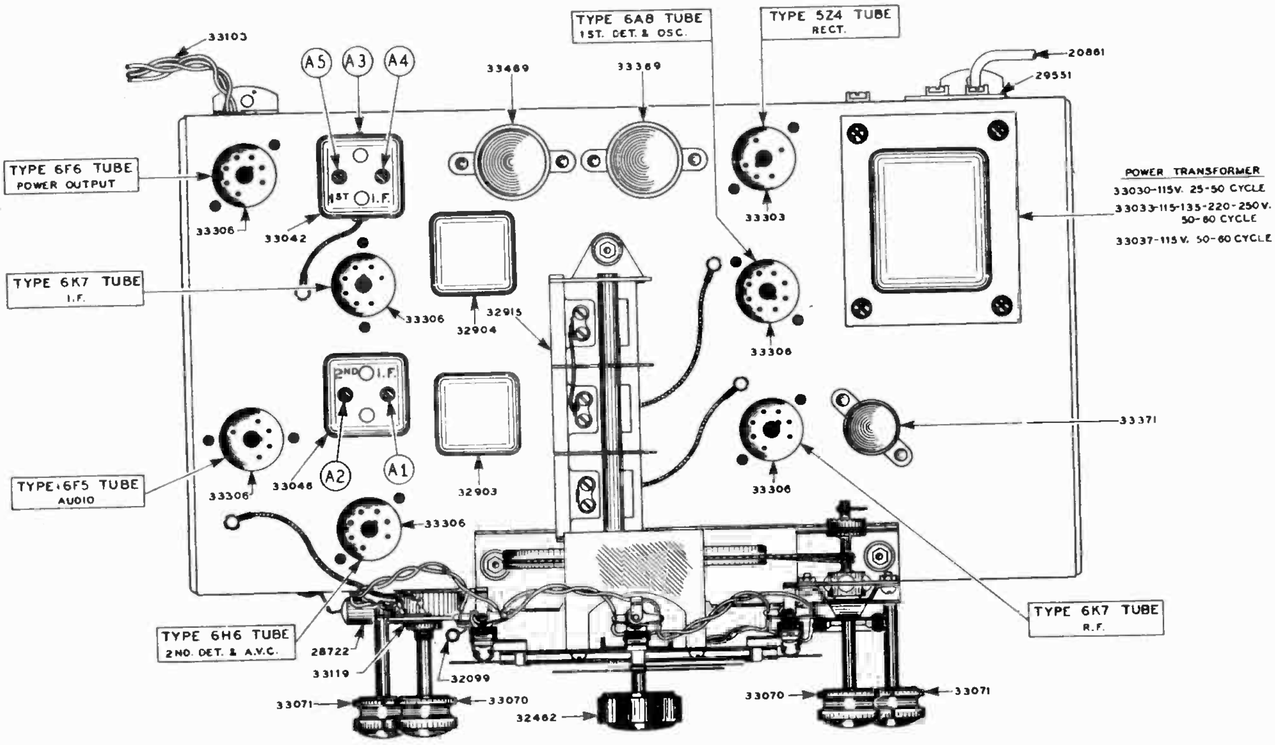


NATIONAL SCHOOLS
Los Angeles, California

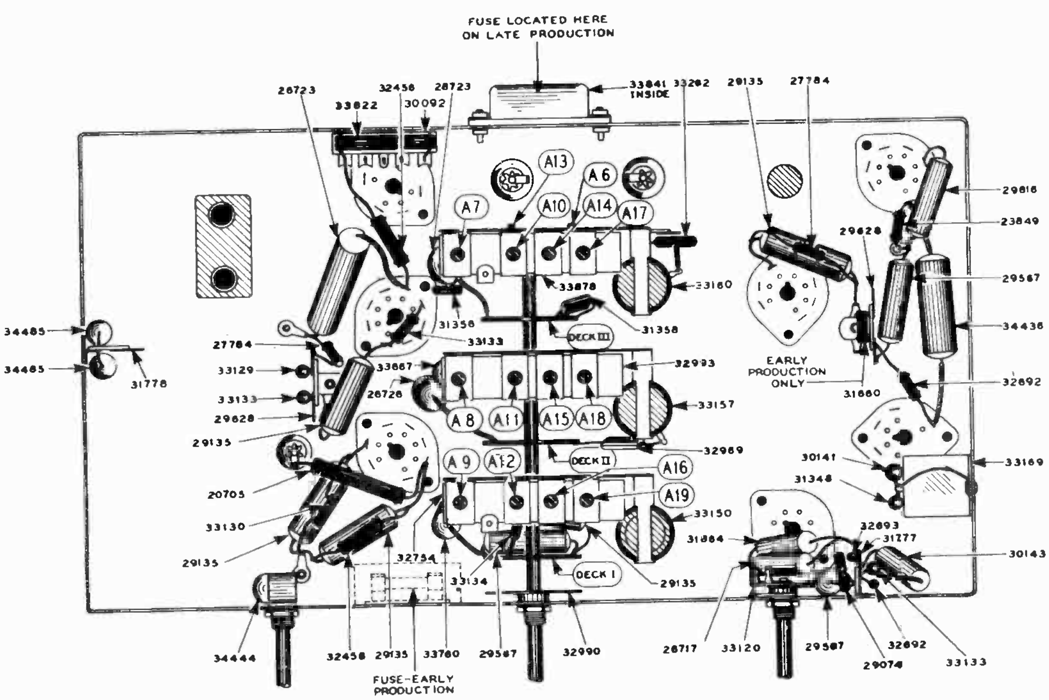
COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODELS 760-761 (Chassis 7C)



TOP VIEW



BOTTOM VIEW

CHASSIS 7C
NOV. 1935
RAS 111

NATIONAL SCHOOLS
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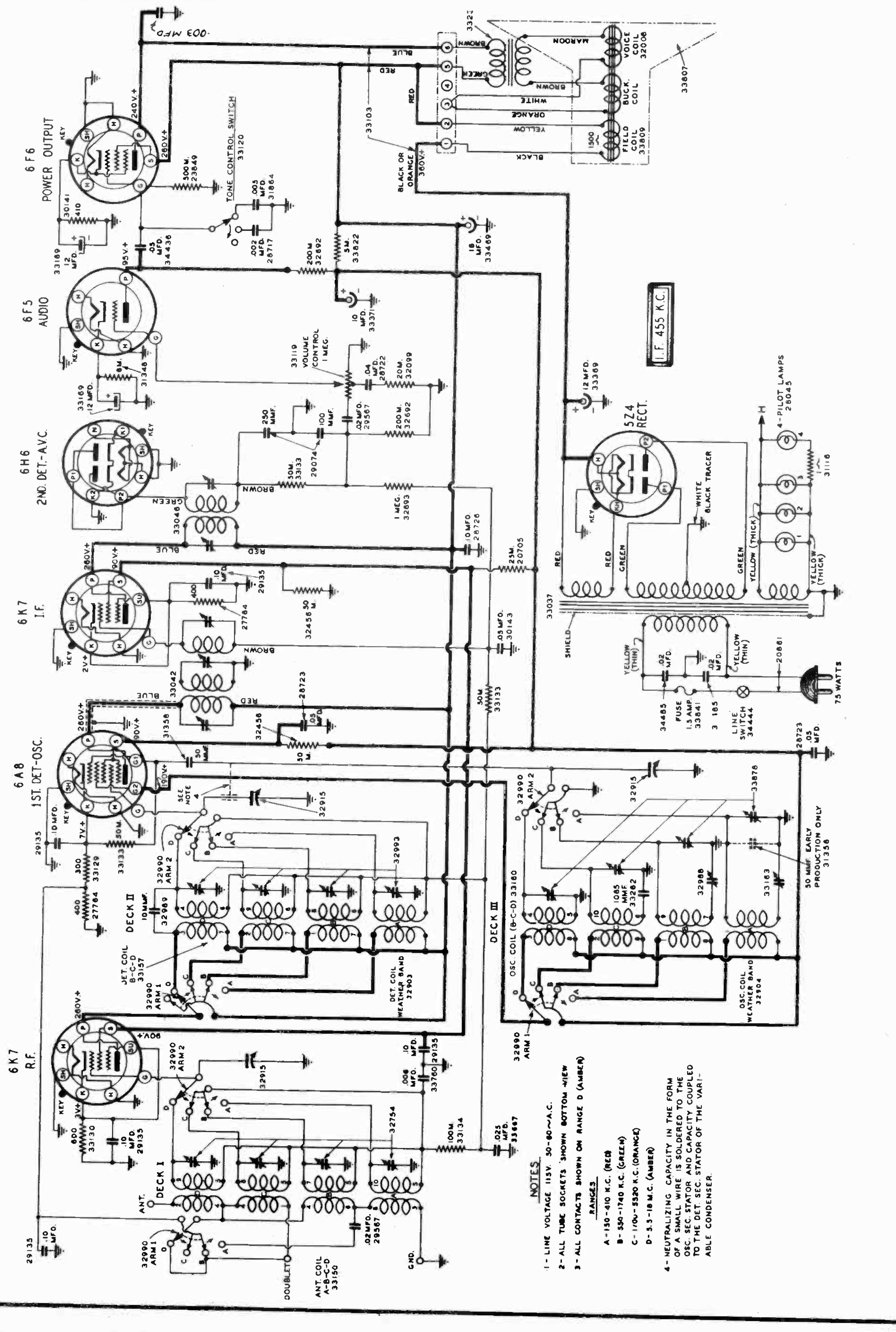
COMMERCIAL CIRCUIT DIAGRAM

GRUNOW

MODELS 760 - 761 (Chassis 6G)



NATIONAL SCHOOLS
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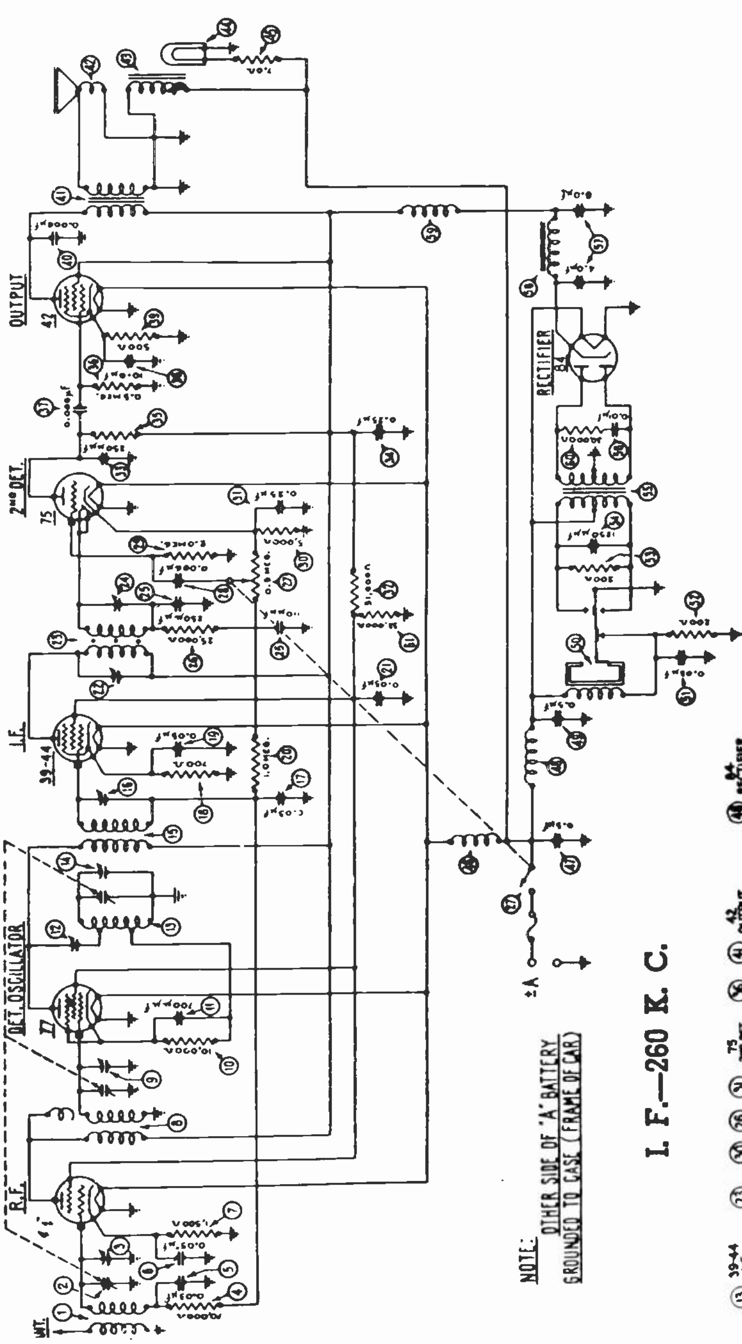
COMMERCIAL CIRCUIT DIAGRAM
PHILCO

MODEL 11
(Auto Radio)

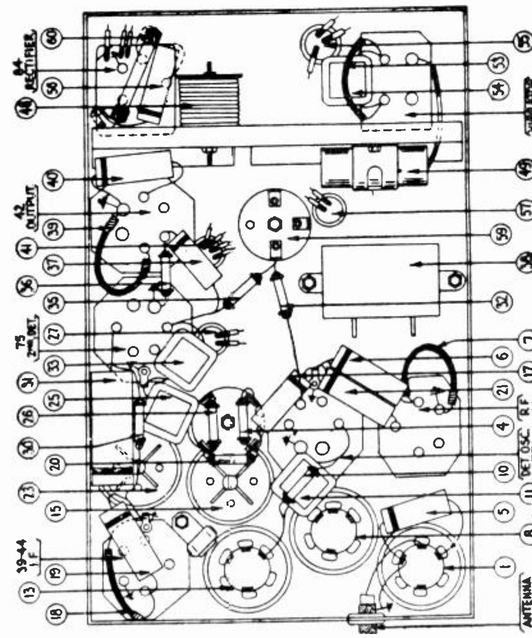
PARTS LIST

(1) Antenna Transformer 32-1331
(2) Tuning Condenser 31-1149
(3) 1st Padder (on tun. cond.) ....
(4) Resistor (70,000 ohms) 33-1115
(5) Condenser (.03 mfd.) 30-4025
(6) Condenser (.05 mfd.) 30-4020
(7) Resistor (1500 ohms) 33-3047
(8) R. F. Transformer 32-1332
(9) 2nd Padder (on tun. cond.) ....
(10) Resistor (10,000 ohms) 33-1000
(11) Condenser (.0007 mfd.) 5863
(12) Padder (Prim. 1st I. F. Tran.) ....
(13) Oscillator Transformer 32-1333
(14) 3rd Padder (on tun. cond.) ....
(15) 1st I. F. Transformer 32-1329
(16) Padder (Sec. 1st I. F. Tran.) ....
(17) Condenser (.03 mfd.) 30-4025
(18) Resistor (700 ohms) 6443
(19) Condenser (.05 mfd.) 30-4020
(20) Resistor (1,000,000 ohms) 33-1096
(21) Condenser (.05 mfd.) 30-4020
(22) Padders (Prim. 2nd I. F.) ....
(23) 2nd I. F. Transformer 32-1237
(24) Padder (Sec. 2nd I. F. Tran.) ....
(25) Cond. (.00011-.00025 mfd.) 30-1020
(26) Resistor (25,000 ohms) 33-1013
(27) Vol. Con. and Switch Assm. 33-5058
(28) Condenser (.006 mfd.) 30-4125
(29) Resistor (2,000,000 ohms) 33-1025
(30) Resistor (5000 ohms) 6096
(31) Condenser (.25 mfd.) 30-4146
(32) Resistor (51,000 ohms) 5868
(33) Condenser (.00025 mfd.) 3082
(34) Condenser (.25 mfd.) 04380
(35) Resistor (100,000 ohms) 6099
(36) Resistor (500,000 ohms) 6097
(37) Condenser (.006 mfd.) 30-4125
(38) Condenser (10 mfd.) 7440
(39) Resistor (500 ohms) 33-3031
(40) Condenser (.008 mfd.) 30-4024
(41) Output Transformer 32-7214
(42) Cone and Voice Coil 02861
(43) Field Coil Assembly 36-3097
(44) Pilot Light 6608
(45) Resistor (7 ohms) 33-3035
(46) "A" Choke 32-1286
(47) Condenser (.5 mfd.) 30-4047
(48) Vibrator Choke 32-1235
(49) Condenser (.5 mfd.) 30-4147
(50) Vibrator Unit 38-5036
(51) Condenser (.05 mfd.) 30-4039
(52) Resistor (200 ohms) 7217
(53) Resistor (200 ohms) 7217
(54) Condenser (.00125 mfd.) 5886
(55) Power Transformer 32-7216
(56) Condenser (.01 mfd.) 30-4051
(57) Condenser (4.-8. mfd.) 30-2072
(58) "B" Choke 32-7215
(59) R. F. Choke 32-1281
(60) Resistor (30,000 ohms) 7836
(61) Resistor (32,000 ohms) 3525
Spark Plug Resistor 33-1015
Distributor Resistor 4546
Screw Type Resistor 4851
Interference Condenser 30-4007
Dial 27-5038
Studs 28-6036
Nuts (mounting) W55A
Knobs (tuning) 03334
Knobs (volume) 06886
Battery Cable 38-5296
Acorn Nut W821
Key 6091
Fuse 7227
Fuse Insulator 27-7131
4-Prong Socket 27-6006
5-Prong Socket 27-6014
6-Prong Socket 6417
Cont. Unit Assm. (Dir. Dr.) 42-5150
Shafts—Tuning 28-8139
Volume 28-8141
Cont. Unit Assm. (Gr. Dr.) 42-5157
Shafts—Tuning 28-8217
Volume 28-8217



NOTE: OTHER SIDE OF 'A' BATTERY GROUNDED TO CASE (FRAME OF CAR)

I. F.—260 K. C.



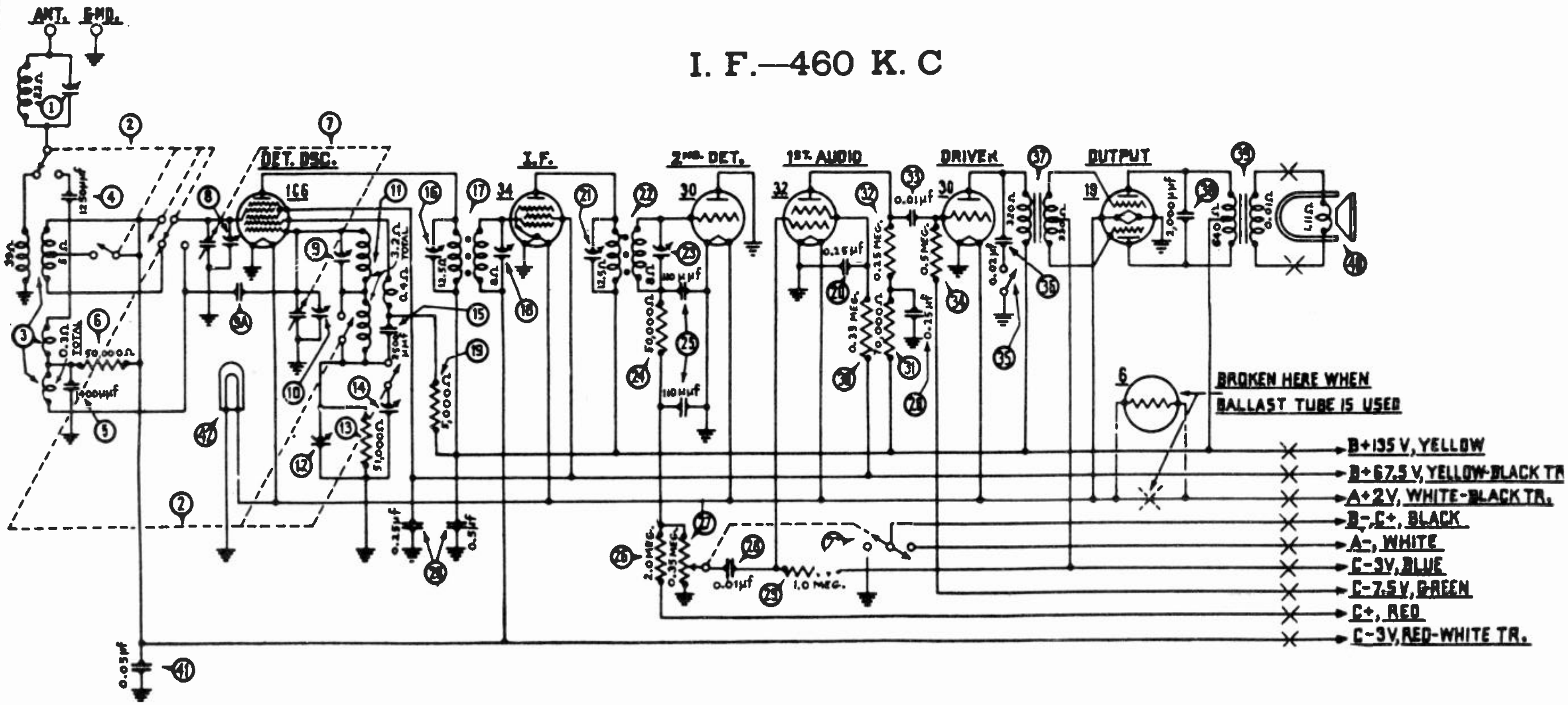
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 39
(Battery Operated)

I. F.—460 K. C



39 (Battery Operated) Two-Band: 550-1720 K.C. 5.5-16.0 M.C.	Fil. Cur. 670 M.A. Plate Cur. 19 M.A.	I.F. 460 K.C.	1-1C6, 1-34, 2-30, 1-32, 1-19 (Model 39-A uses also 1 type 6 ballast)	

Tube Voltages

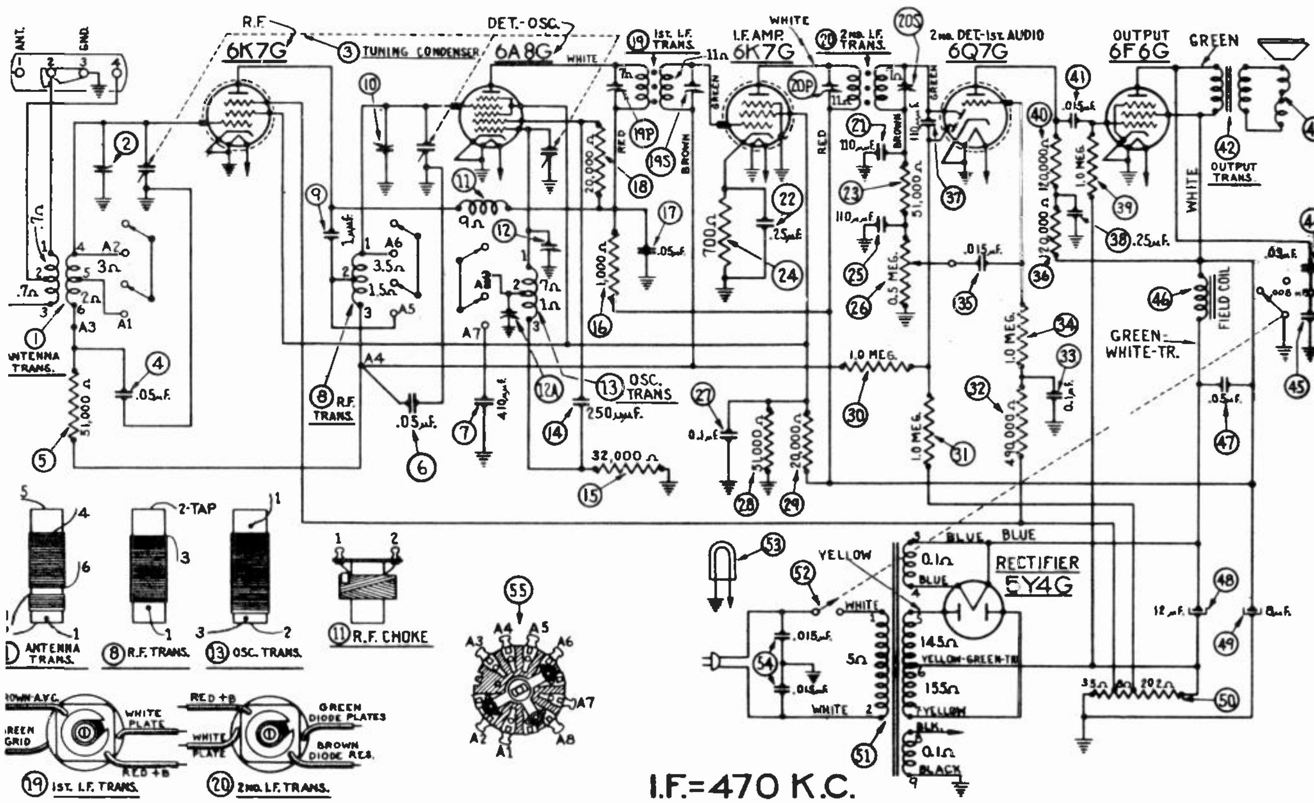
	1C6	34	30	32	30	19
Plate	130	130	...	45	130	130
Screen Grid	66	66	...	30	...	130
Osc. Plate	112	...	...	..	...	...

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 37-89



Replacement Parts — Model 37-89

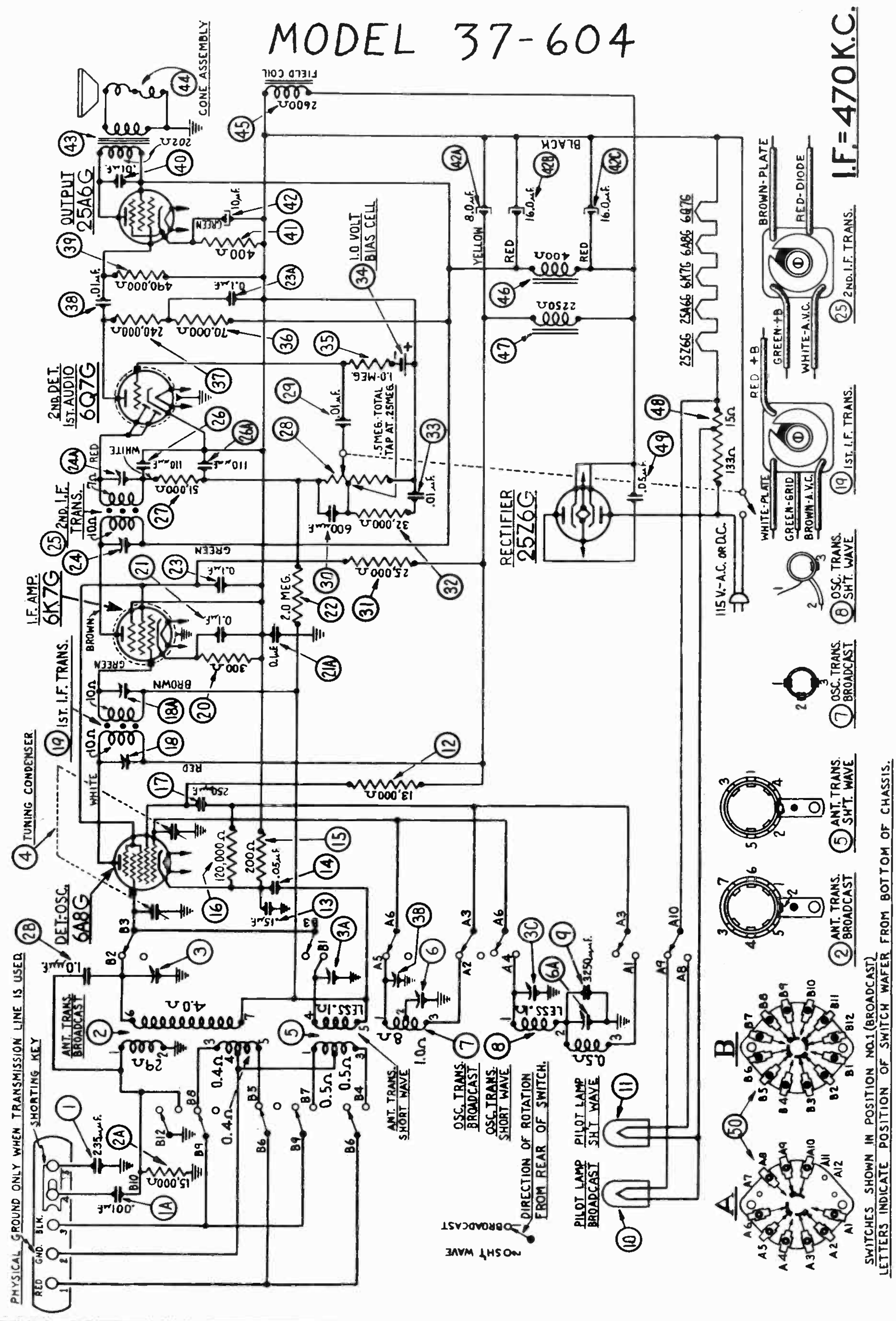
Schem. No.	Description	Part No.
1	Antenna Transformer	32-2127
2	Compensator	31-6100
3	Tuning Condenser	31-1833
4	Condenser (.05 mfd. tubular)	30-4020
5	Resistor (51000 ohms ½ watt)	33-351339
6	Condenser (.05 mfd. tubular)	30-4020
7	Condenser (410 mmfd.)	30-1000
8	R. F. Transformer	32-2128
9	Condenser Two Wires Twisted	
10	Compensator	31-6100
11	Choke	32-2139
12	Compensator	31-6101
13	Osc. Transformer	32-2120
14	Condenser (250 mmfd. mica)	30-1032
15	Resistor (32,000 ohms ½ watt)	33-351339
16	Resistor (1000 ohms, ½ watt)	33-210339
17	Condenser (.05 mfd. tubular)	30-4123
18	Resistor (20000 ohms, ½ watt)	33-320339
19	1st I. F. Transformer	32-2100
20	2nd I. F. Transformer	32-2102
21	Condenser (110 mmfd. mica)	30-1031
22	Condenser (.25 mfd. tubular)	30-4446
23	Resistor (51000 ohms, ½ watt)	33-351334
24	Resistor (700 ohm, ½ watt)	33-1220
25	Condenser (110 mmfd. mica)	30-1031
26	Volume Control	33-5157
27	Condenser (0.1 mfd. tubular)	30-4455
28	Resistor (51000 ohms, 1 watt)	33-351439
29	Resistor (20000 ohms, 2 watt)	33-320539
30	Resistor (1 meg. ½ watt)	33-510339
31	Resistor (1 meg. ½ watt)	33-510339
32	Resistor (490000 ohms ½ watt)	33-449339
33	Condenser (0.1 mfd. tubular)	30-4122
34	Resistor (1 megohm, ½ watt)	33-510339
35	Condenser (.015 mfd. tubular)	30-4358
36	Resistor (120000 ohms, ½ watt)	33-412339
37	Condenser (110 mmfd. mica)	30-1031
38	Condenser (.25 mfd. tubular)	30-4134
39	Resistor (1 megohm, ½ watt)	33-510[illegible]
40	Resistor (120000 ohms, ½ watt)	33-412339
41	Condenser (.015 mfd. tubular)	30-4226
42	Output Transformer	32-7019
43	Cone & Voice Coil	36-3157
44	Condenser (.03 mfd. bakelite)	8318-SU
45	Condenser (.008 mfd. tubular)	30-4112
46	Field Coil & Pot Assembly	36-3664
47	Condenser (.05 mfd. tubular)	30-4020
48	Electrolytic Condenser (12 mfd.)	30-2117
49	Electrolytic Condenser (8 mfd.)	30-2024
50	Bias Resistor (245 ohms, Taps 35 and 43 ohms)	33-3277
51	Power Transformer (115 volt, 50 to 60 cycle)	32-7583
52	Tone Control & A. C. Switch	42-1180
53	Pilot Lamp	34-2039
54	Condenser (.015, 015 mfd. bakelite)	3793-DG
55	Wave Switch	42-1194
	Dial	27-5204
	Dial Hub	28-7152
	Dial Clamp	28-2837
	Screen Bracket & Screen Assembly	31-1878
	Screw	W-650
	Vernier Drive	31-1844
	Pilot Lamp Assembly	38-7706
	Insulator Tone Control	27-8320
	Nut Tone Control	W-684
	Lock Washer	W-1624
	Volume Control Shaft	28-6498
	Shaft Spring	28-4117
	Washer	6717
	Washer	4436
	Shaft Retaining Clip	28-8610
	Mtg. Grommet	27-4317
	Mtg. Washer Sleeve	28-2257
	Mtg. Sleeve Bushing	27-8339
	Mtg. Screw	W-729
	Mtg. Washer	28-3927
	R. F. Unit Support	28-3856
	Support Locking Plate	28-3975
	Support Locking Plate	28-3889
	Screw	W-644
	Knobs Tuning	27-4321
	Knob Volume, Waveswitch, Tone	27-4332
	Baffle Silk Assembly B, Cabinet	40-5935
	Baffle Silk Assembly F, Cabinet	40-5933
	Speaker S-16	36-1225
	Screw Speaker Mtg.	W-1604
	Lockwasher Speaker Mtg.	W-291
	Washer Speaker Mtg.	W-410
	Nut Speaker Mtg.	W-124
	Screw Chassis Mtg.	
	Washer Chassis Mtg.	28-2089
	Besel Frame & Plate	40-5938
	Besel Gasket	27-8311
	Besel Glass	27-8298
	Besel Ring	28-3967
	Besel Screw	W-1644
	Bottom Shield Plate F, Cabinet	
	I. F. Coil Shield	38-7763
	Speaker S16 B, F Cabinets	36-1225

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 37-604



NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

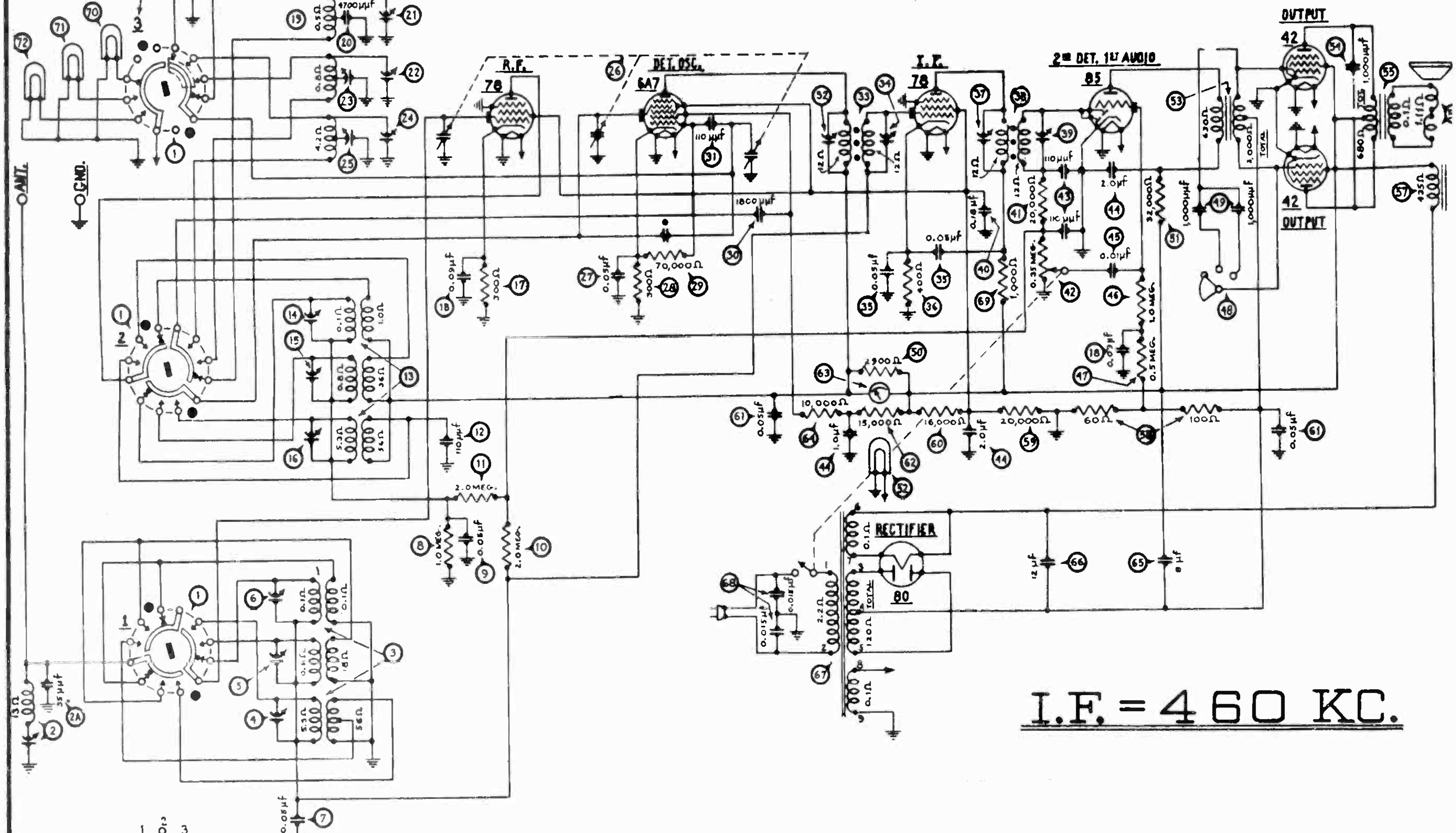
PHILCO

MODEL 97

Tube	78 R.F.	6A7 Det. Osc.	78 I.F.	85 2nd Det.	42 Output
Point P	257	257	265	105	260
SG	97	97	97		270
K	2.3	2.6	3		

6A7: G_1 = −14; G_2 = 179.

NOTE: FIGURES INDICATE RELATIVE POSITIONS OF SWITCH SECTIONS FROM FRONT OF CHASSIS



I.F. = 460 KC.

NOTE: ALL SWITCH SECTIONS SHOWN IN POSITION NO. 3

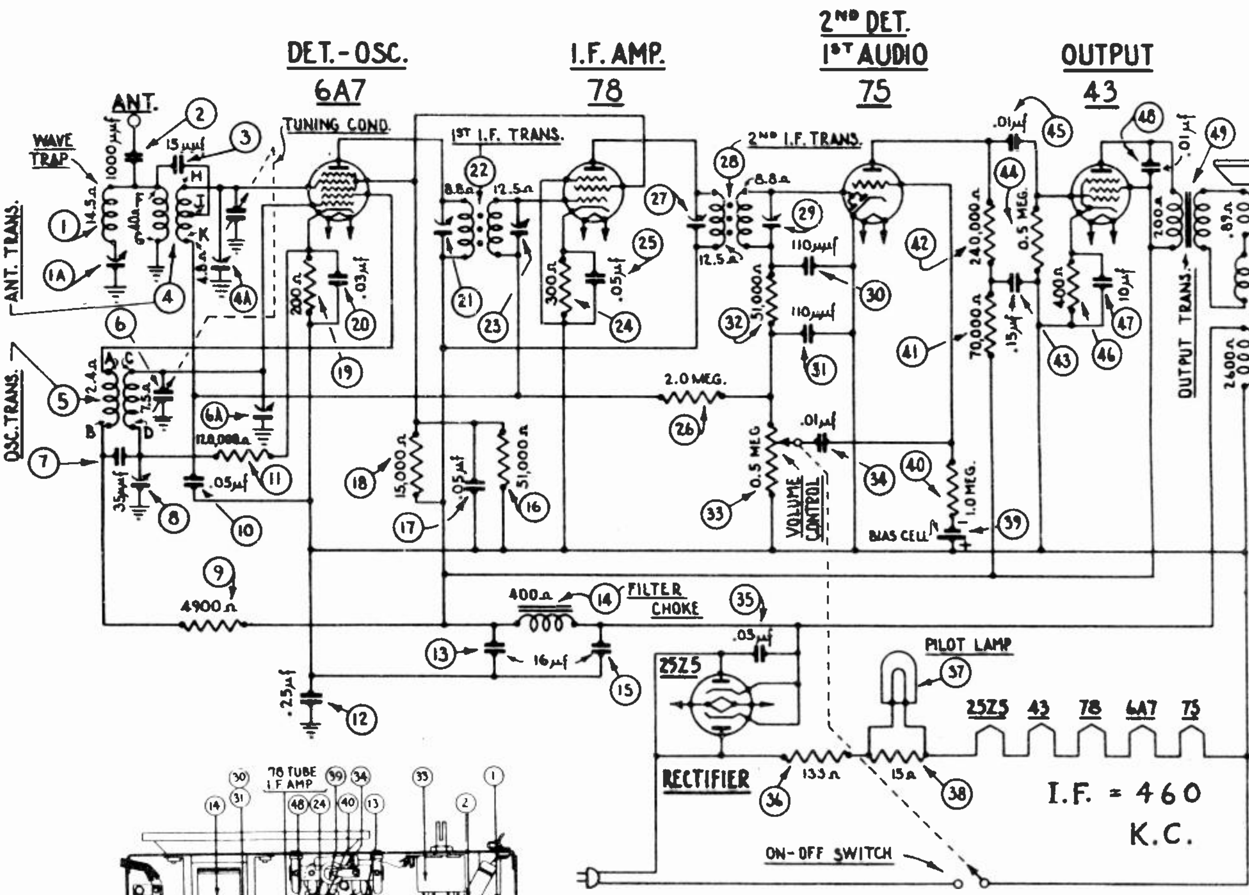
NOTE: Condenser marked with an asterisk (*) is not a separate part, but simply a capacity obtained by two wires twisted together.

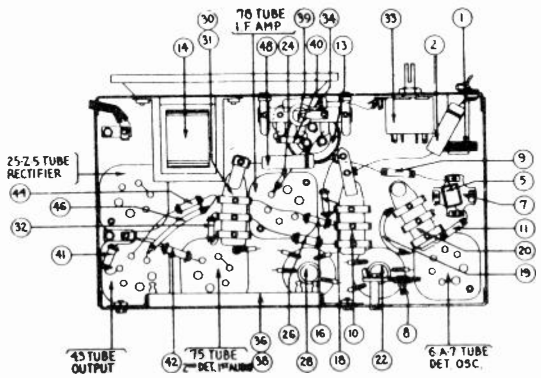
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 602





Point Tube→	6A7	78	75	43	25Z5
F.	6.3	6.3	6.3	25	25
P.	102	102	40	97	...
SG.	47	47	...	102	...
K.	0.7	0.9	...	12.5	...
G_2	94	...	...	...	...

Replacement Parts for Model 602

Schematic Number	Part and Description	Part No.
1	Wave Trap Coil	32-2007
1a	Wave Trap Compensator	04000D
2	Condenser (.001 Mf. Tubular)	30-4201
3	Condenser (15 mmf. Mica)	30-1030
4	Ant. Transformer	32-2003
4a	Compensater (Osc. 1800 KC.)	
5	Osc. Transformer	32-2041
6	Tuning Condenser	31-1794
6a	Compensater (Ant. 1800 KC.)	
7	Condenser (35 mmf. Mica)	30-1044
8	Compensator (Osc. Series) (600 Kc.)	04000S
9	Resistor (4900 ohm, ½ watt)	33-249333
10	Condenser (.05 Mf. Bakelite)	3615-OSU
11	Resistor (120,000, ½ watt)	33-412334
12	Condenser (.25-.05-.05-.05-.15-.01 mf)	30-4410
13	Elec. Condenser (16-16-10 mf.)	30-2148
14	Filter Choke	32-7544
15	Elec. Condenser (16 mf.)	Part of 13
16	Resistor (51,000 ohm, ¼ watt)	33-351143
17	Condenser (.05 mf.)	Part of 12
18	Resistor (15,000 ohm, ¼ watt)	33-315133
19	Resistor (200 ohm wirewound)	7217
20	Condenser (.03 mf. Bakelite)	8318-OSU
21	Compensator (1st I.F. Pri.)	Part of 22
22	1st I.F. Transformer	32-2005
23	Compensater (1st I.F. Sec.)	Part of 22
24	Resistor (300 ohm wirewound)	33-3010
25	Condenser (.05 mf.)	Part of 12
26	Resistor (2.0 meg., ¼ watt)	33-520143
27	Compensater (2nd I.F. Pri.)	Part of 28
28	2nd I.F. Transformer	32-2006
29	Compensator (2nd I.F. Sec.)	Part of 28
30	Condenser (.00011 mf. twin)	8035-ODU
31	Condenser (.00011 mf.)	Part of 30
32	Resistor (51,000 ohm, ¼ watt)	33-351143
33	Volume Control (0.5 meg.)	33-5145
34	Condenser (.01 mf. Tubular)	30-4145
35	Condenser (.05 mf.)	Part of 12
36	B. C. Resistor (133-15 ohm)	33-3225
37	Pilot Lamp	34-2068
38	Resistor (15 ohm)	Part of 36
39	Bias Cell	41-8009
40	Resistor (1.0 meg., ¼ watt)	33-510144
41	Resistor (70,000 ohm, ¼ watt)	33-370133
42	Resistor (240,000 ohm, ¼ watt)	33-424143
43	Condenser (.15 mf.)	Part of 12
44	Resistor (490,000 ohm, ¼ watt)	33-449143
45	Condenser (.01 mf.)	Part of 12
46	Resistor (400 ohm wirewound) (Flexible)	33-3122
47	Elec. Condenser (10 mf.)	Part of 13
48	Condenser (.01 mf. Tubular)	30-4169
49	Output Transformer	32-7566
50	Voice Coil Cone Assy.	36-3029
51	Field Coil Assy.	36-3040
	Volume Control Mtg. Nut	W-684-A
	B.C. Resistor Mtg. Screw	W-650-A
	B.C. Resistor Mtg. Nut	W-95-A
	Tube Shield Base	28-2725
	Tube Shield Body	28-2726
	Chassis Mtg. Screw	W-1587-A
	Chassis Mtg. Nut	W-124-A
	Chassis Mtg. Washer	W-410-A
	Chassis Mtg. Washer	W-291-A
	Speaker Baffle	40-5840
	Dial	27-5188
	Pointer	27-8236
	Shield Bottom Assy.	29-3605
	Shield Bottom Insulator	27-8182
	Tube Socket (6-prong)	27-6036
	Tube Socket (7-prong)	27-6037
	Knob (Volume, On-Off)	27-4273
	Knob (Station Selector)	27-4302
	Elec. Condenser Support	6440
	Elec. Condenser Insulator	27-7836
	Pilot Lamp Bracket Assy.	38-7513
	Ant. Coil Mfg. Bracket	28-3546
	Bias Cell Assy.	38-7436
	Coupling (For Tuning Knob)	28-6426

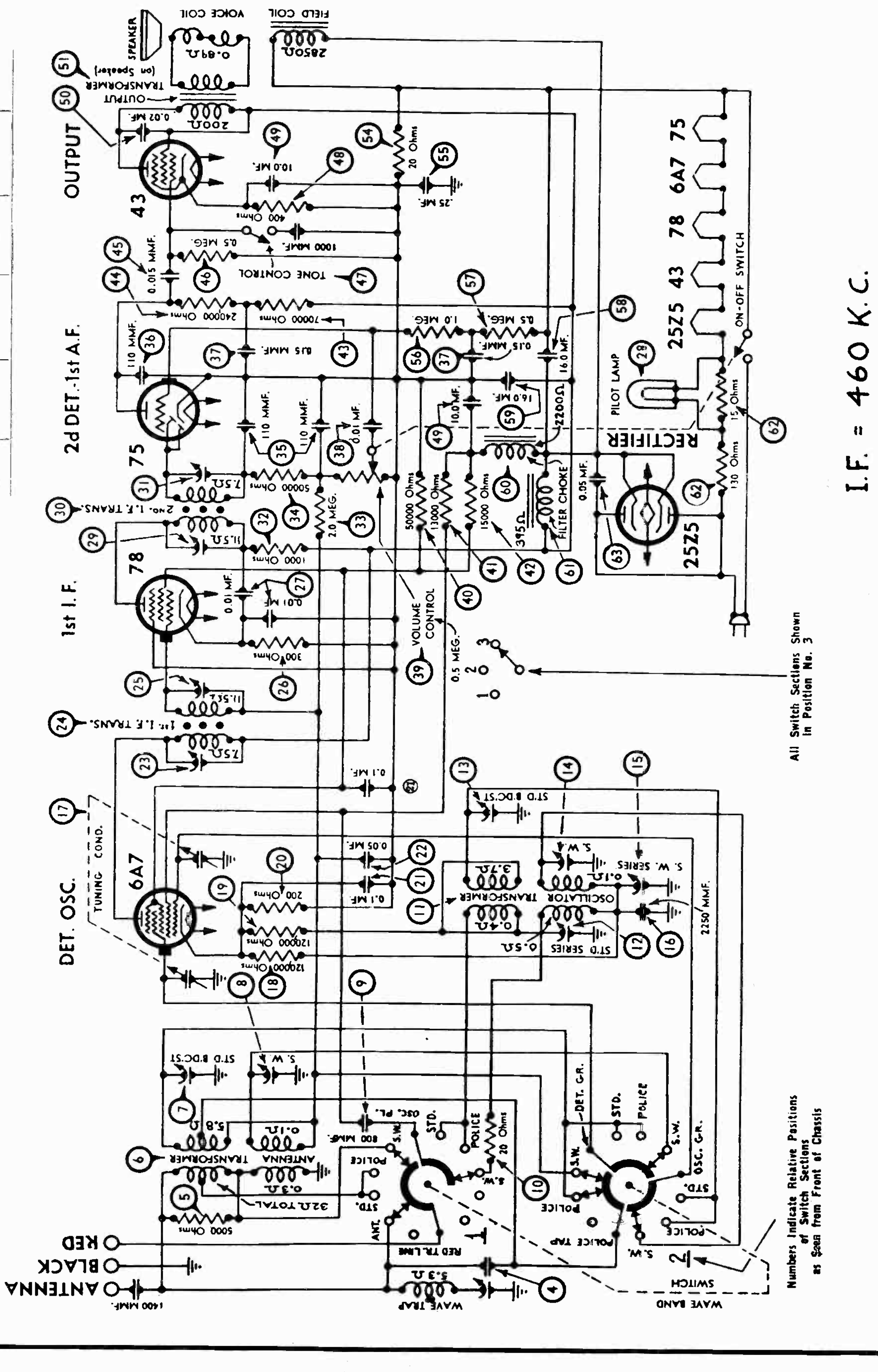
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 611
(A.C. - D.C.)

Tube	6A7 Det. Osc.	78 I.F.	75 2nd Det. A.F.	43 Output	25Z5 Rect.
Point P	106	102	41	101	121
SG	55	55		106	
K	0 8	1 1	0	12.5	

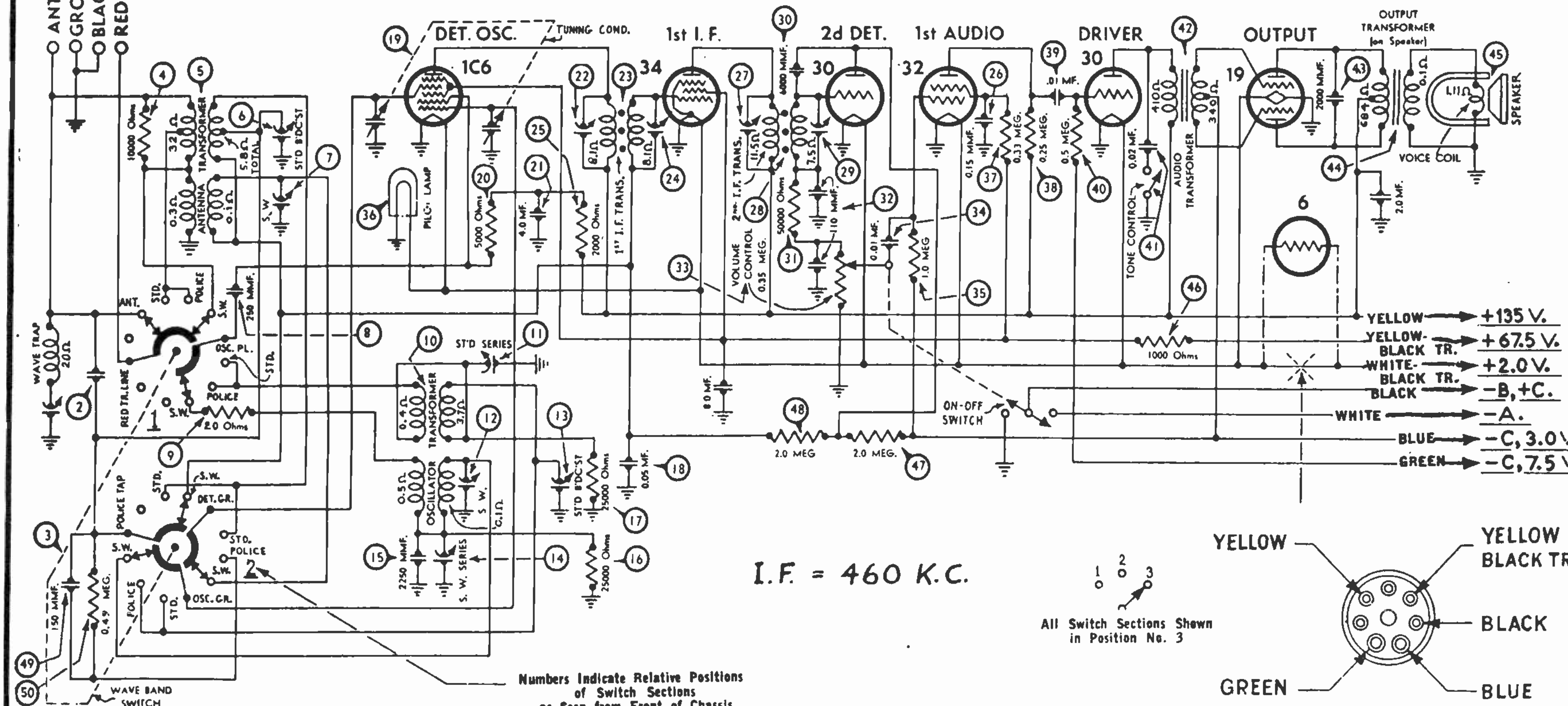


I.F. = 460 K.C.

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM
PHILCO

MODEL 623
(Battery Operated)



I.F. = 460 K.C.

All Switch Sections Shown in Position No. 3

Numbers Indicate Relative Positions of Switch Sections as Seen from Front of Chassis

PRODUCTION CHANGES

The Oscillator Circuit was changed to series feed.

Part	Remove Old Part No.	Schematic	Add New Part No.
Condenser	30-1033 (.00015 mf.)	[illegible]	30-1049 (.0006 mf.)
Resistor	6097 (490,000 ohm)	[illegible]	
Resistor	33-1013 (25,000 ohm)	[illegible]	
Oscillator Trans.	82-1831	[illegible]	32-1973
Resistor	33-1206 (20 ohm)	[illegible]	
Condenser	6359 (.006 mf.)	[illegible]	30-1031 (.00011 mf.)

S. W. SECTION OF OSC. TRANSFORMER

Condenser ㊾ and Resistor ㊿ were removed and the wires connected to the ends of these parts were connected together. The wires between the police tap at the left of Switch Section No. 2 and the joint in the wire just above that was broken and Condenser No. 30-1049 inserted.

The connection between the bottom (S. W.) primary and secondary of the Oscillator Transformer was broken and condensers ⑭ and ⑮ connected between the bottom of the secondary and ground. Resistor ⑯ removed. The lead connected to the top of the primary disconnected and brought down to the bottom of the secondary. Resistor ⑨ also removed.

A lead from the bottom of the primary was connected to the lead running from Condenser ⑧ to Resistor ⑳. The oscillator plate wire was disconnected from this lead and brought down to the top of the primary.

BROADCAST AND POLICE SECTION OF OSC. TRANSFORMER

Resistor ⑰ was disconnected from the bottom of the upper section of the Osc. Transformer and connected to the switch side of the Condenser ⑧

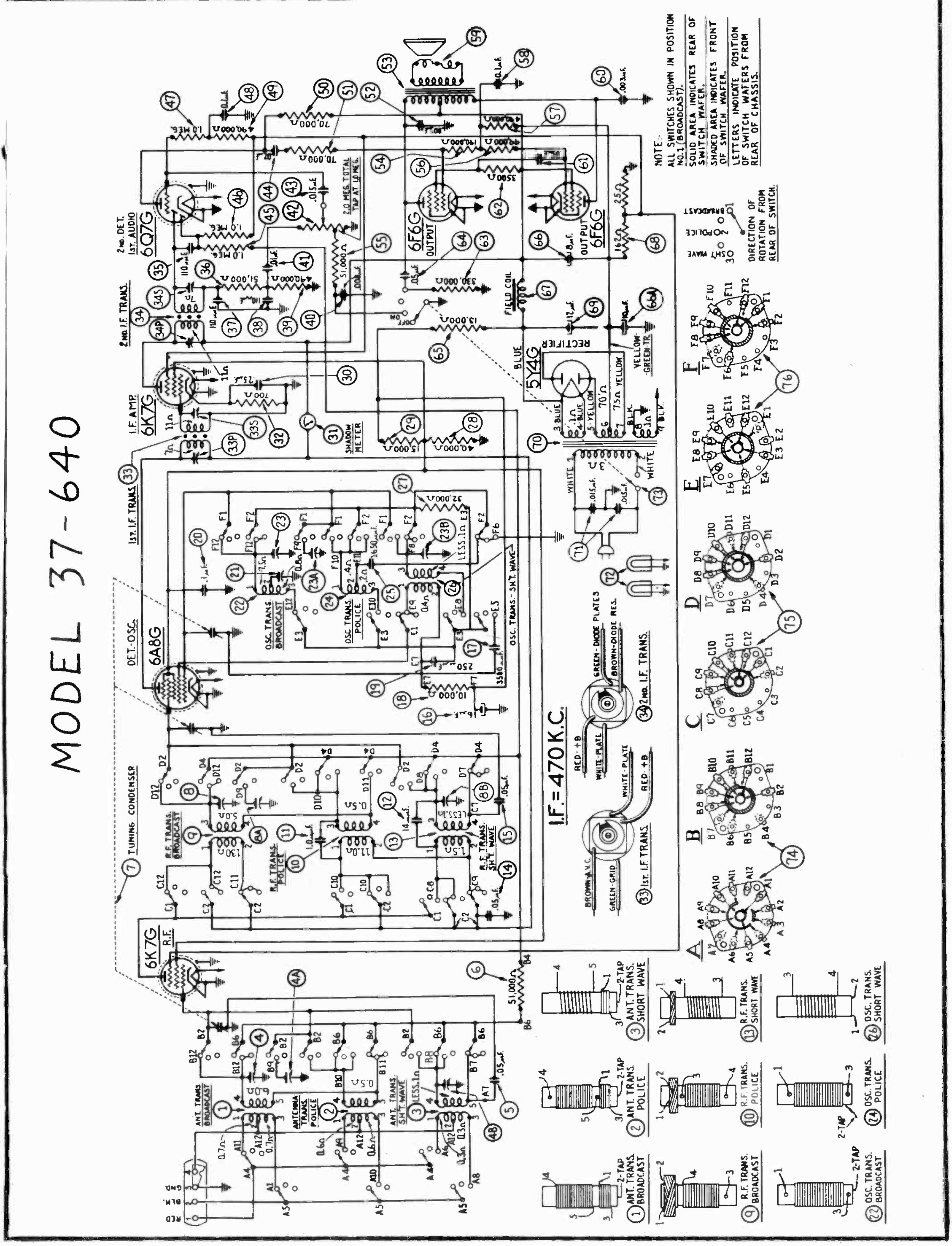
Tube	1C6 Det.-Osc.	34 I.F.	30 2nd Det.-A.V.C.	32 1st A.F.	30 Driver	19 Output
Point P	135	135	0	52	133	134
SG	64	64	...	24	...	...
G	...	0.2	0.1	..	0.18	3.0 ea.
Osc. Pl.	106	...	...	..	...	...

10,000 ohm Resistor, part ④, Part No. 33-1000, no longer necessary.

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

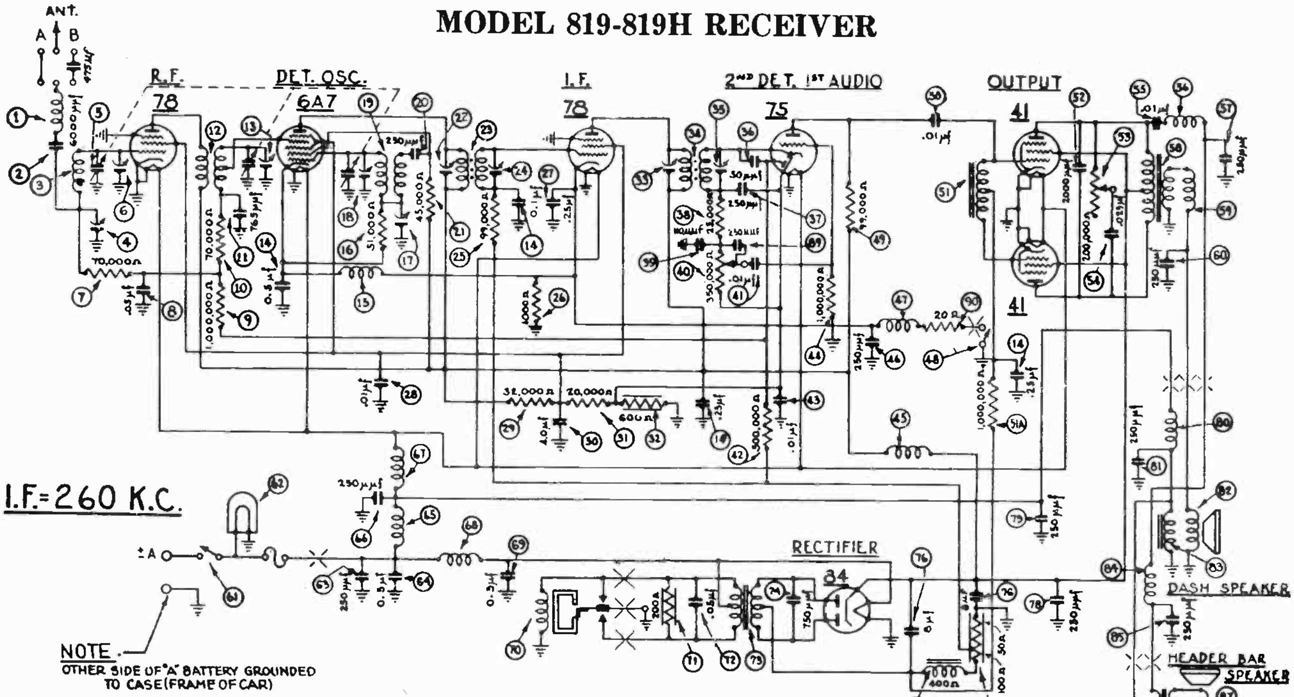


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

PHILCO

MODEL 819-819H RECEIVER



NOTE: When the Receiver is installed in a car having a top antenna, under-car antenna, spare wheel antenna or antenna having a similarly low relative capacitance (50 mmf. to 450 mmf.) use connector plug in "A".

When the Receiver is installed in a car having a metal insert top antenna, insulated door antenna, insulated trunk cover antenna or antenna having similarly high relative capacitance (450 mmf. to 2500 mmf.) use condenser plug in "B".

FIGURE 1

MODELS 819 AND 819H — PARTS LIST

No.	Description	Part No.
1	Antenna Choke	38-7516
2	Condenser (6000 mmfd.)	30-4125
3	Antenna Transformer	32-1984
4	Antenna Coupling Condenser	31-6082
5	Tuning Condenser	31-1769
6	First Padder (on tun. cond.)	....
7	Resistor (70,000 ohms)	33-370334
8	Condenser (.05 mfd.)	3615-OSG
9	Resistor (1,000,000 ohms)	33-510344
10	Resistor (70,000 ohms)	33-370334
11	Condenser (765 mmfd.)	30-1069
12	R. F. Transformer	32-1985
13	Second Padder (on tun. cond.)	....
14	Condenser (.1-.25-.25-.5 mfd.)	30-4415
15	Choke	32-2063
16	Resistor (51,000 ohms)	33-351344
17	Low Frequency Padder	31-6083
18	Third Padder (on tun. cond.)	....
19	Oscillator Transformer	32-1986
20	Condenser (250 mmfd.)	30-1032
21	Resistor (45,000 ohms)	33-345344
22	Padder (Pri. 1st I. F. Trans.)	....
23	First I. F. Transformer	32-2050
24	Padder (Sec. 1st I. F. Trans.)	....
25	Resistor (99,000 ohms)	33-399344
26	Resistor (1,000 ohms)	33-210334
27	Condenser (.25 mfd.)	30-4146
28	Condenser (.01 mfd.)	30-4124
29	Resistor (32,000 ohms)	33-332434
30	Condenser (4 mfd.)	30-2151
31	Resistor (20,000 ohms)	33-320334
32	Resistor (600 ohms)	33-1212
33	Padder (Pri. 2nd I. F. Trans.)	....
34	Second I. F. Transformer	32-2034
35	Padder (Sec. 2nd I. F. Trans.)	....
36	Condenser (50 mmfd.)	30-1029
37	Condenser (250 mmfd.)	30-1032
38	Resistor (25,000 ohms)	33-325344
39	Condenser (110 mmfd.)	30-1031
40	Volume Control (350,000 ohms)	33-5149
41	Condenser (.01 mfd.)	3903-OSU
42	Resistor (500,000 ohms)	33-449344
43	Condenser (.01 mfd.)	3903-OSG
44	Resistor (1,000,000 ohms)	33-510344
45	"B" Choke	32-1281
46	Condenser (250 mmfd.)	30-1032
47	Choke	32-2063
48	Local-Distance Switch	42-1160
49	Resistor (99,000 ohms)	33-309344
50	Condenser (.01 mfd.)	3903-OSU
51	Audio Choke	32-7547
51a	Resistor (1,000,000 ohms)	33-510344
52	Condenser (2000 mmfd.)	30-4177
53	Tone Control (200,000 ohms)	33-5150
54	Condenser (.025 mfd.)	7653-OSU
55	Condenser (.01 mfd.)	30-4381
56	Choke	32-1930
57	Condenser (250 mmfd.)	30-1032
58	Output Transformer	32-7551
59	Choke	32-1930
60	Condenser (250 mmfd.)	30-1032
61	On-Off Switch Assembly	42-1160
62	Pilot Lamp	34-2039
63	Condenser (250 mmfd.)	30-1032
64	Condenser (.5 mfd.)	30-4015
65	"A" Choke	32-1432
66	Condenser (250 mmfd.)	30-1032
67	Filament Choke	32-2038
68	Vibrator Choke	32-2039
69	Condenser (.5 mfd.)	30-4015
70	Vibrator	41-3170D
71	Resistor (200 ohms)	33-1210
72	Condenser (.05 mfd.)	30-4020
73	Power Transformer	32-7550
74	Condenser (750 mmfd.)	30-4420
75	Filter Choke	32-7545
76	Filter Condenser (8-8 mfd.)	30-2152
77	Resistor (100-50 ohms)	33-3238
78	Condenser (250 mmfd.)	30-1032
79	Condenser (250 mmfd.)	30-1032
80	Choke	32-1644
81	Condenser (250 mmfd.)	30-1032
82	Cone and Voice Coil	36-3159
83	Field Coil Assembly	36-3513
84	Choke	32-2038
85	Condenser (250 mmfd.)	30-1032
86	Output Transformer (overhead speaker)	32-7507
87	Cone and Voice Coil (overhead speaker)	36-3526
88	Field Coil Assembly (Overhead Speaker)	32-9236
89	Condenser (250 mmfd.)	30-1032
90	Resistor (20 ohms)	33-020133
	Four Prong Socket	27-6044
	Five Prong Socket	27-6035
	Six Prong Socket	27-6036
	Seven Prong Socket	27-6037
	Idler Gear	28-7176

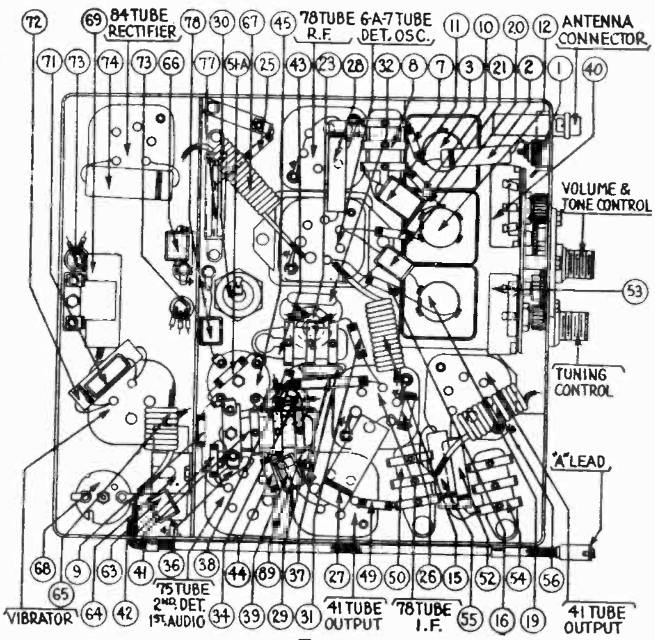


FIGURE 2

No.	Description	Part No.
	Pinion Gear	28-7178
	Dash Speaker Complete (A37)	36-1207
	Dash Speaker Only	36-1212
	Overhead Speaker (AD)	36-1211
	Control	42-5537
	Pilot Lamp Assembly	38-7213
	Tuning and Volume Knob	27-4288
	Tuning Shaft	28-8495
	Volume Shaft	28-8499
	Scale Assembly	42-5539

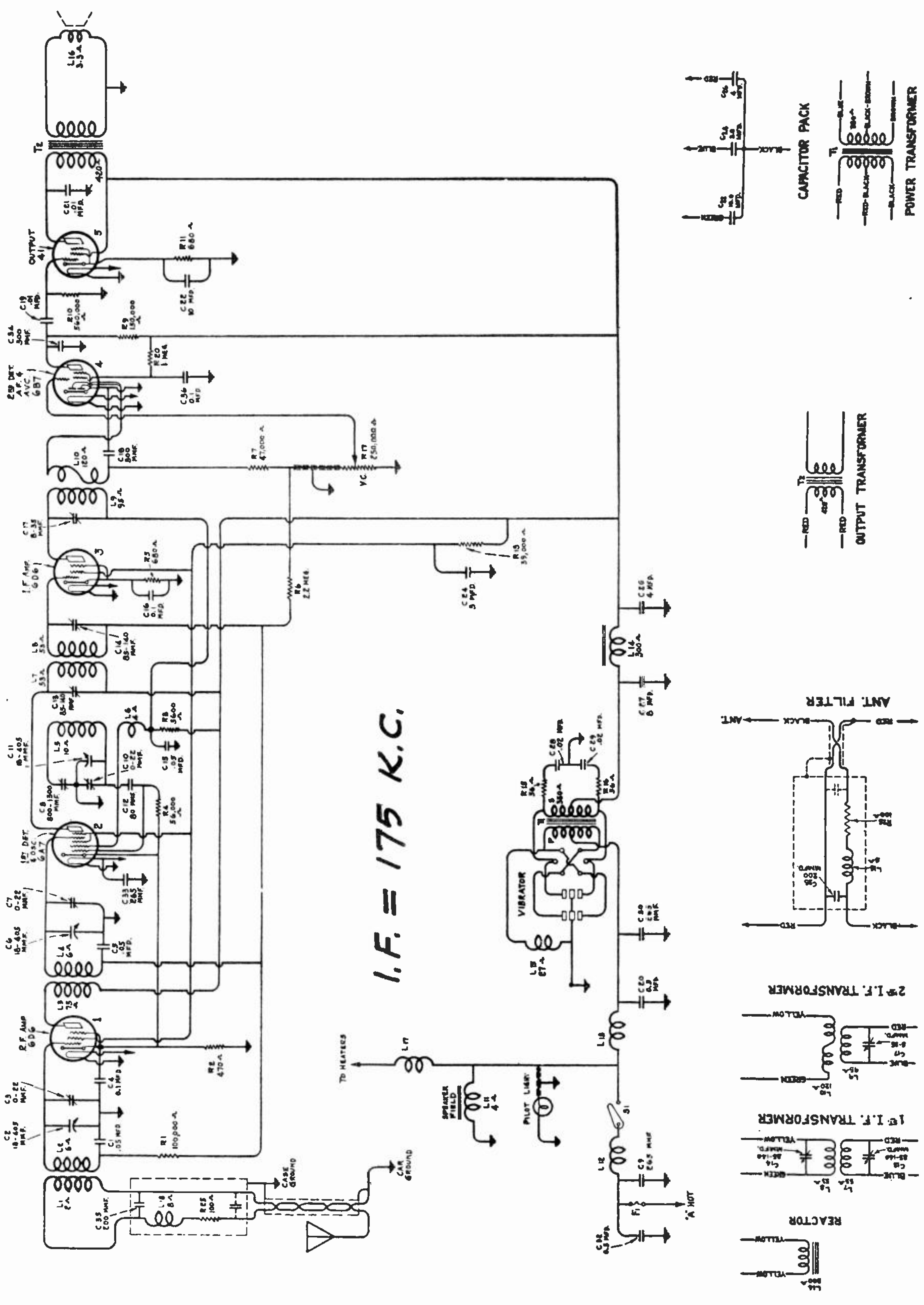
No.	Description	Part No.
	Distributor Resistor	33-1196
	Interference Condenser (.5 mfd.)	30-4007
	Condenser Connector	30-4412
	Connector Plug	29-6423
	Fuse	7227
	Fuse Insulator	27-7729
	"Tee" Bolt (Rec. Mtg.)	28-6161
	Nut (Rec. Mtg.)	W518A
	Stud (Speaker Mtg.)	6122
	Nut (Speaker Mtg.)	W55A

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODEL D-50

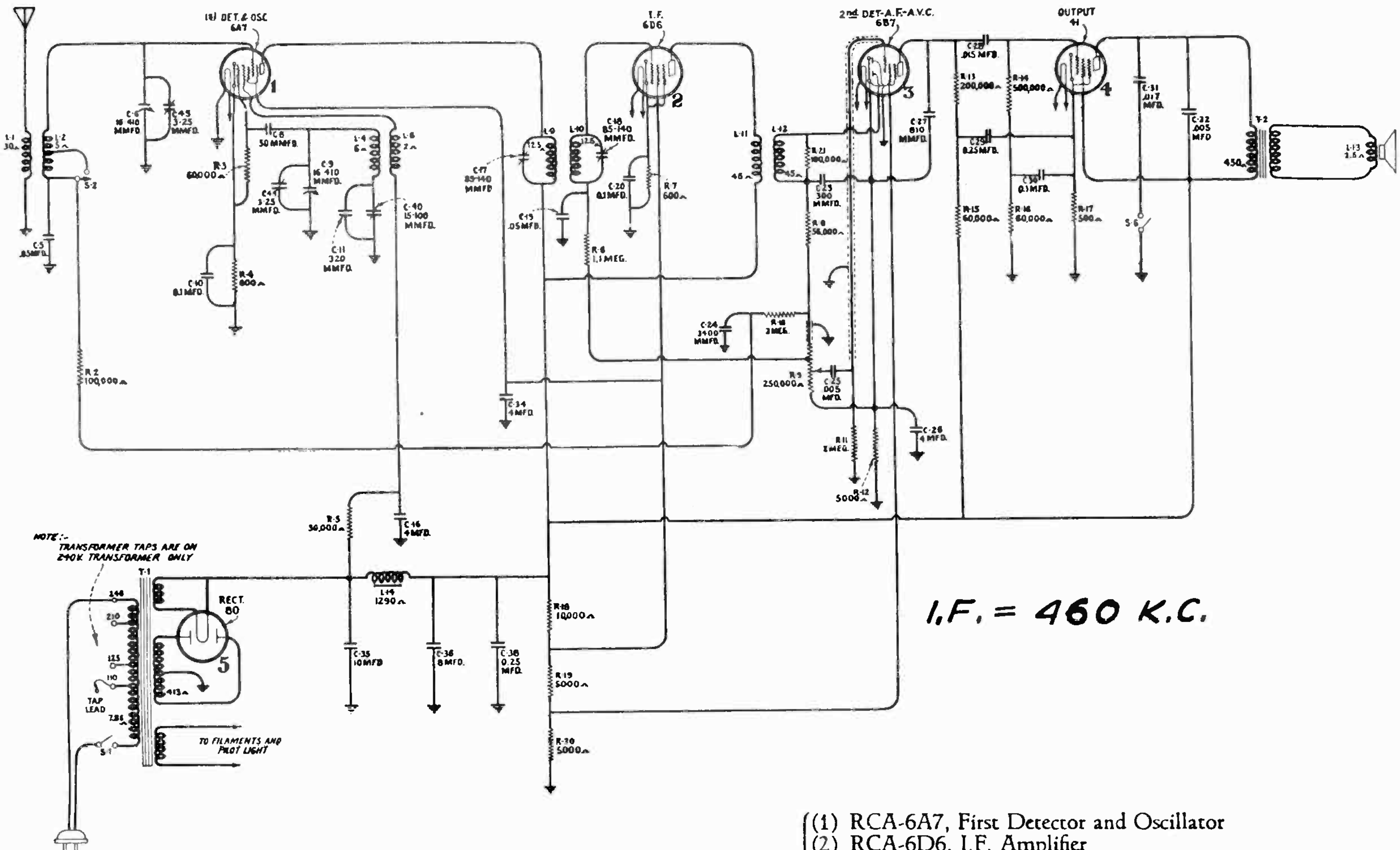


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODEL M-52



I.F. = 460 K.C.

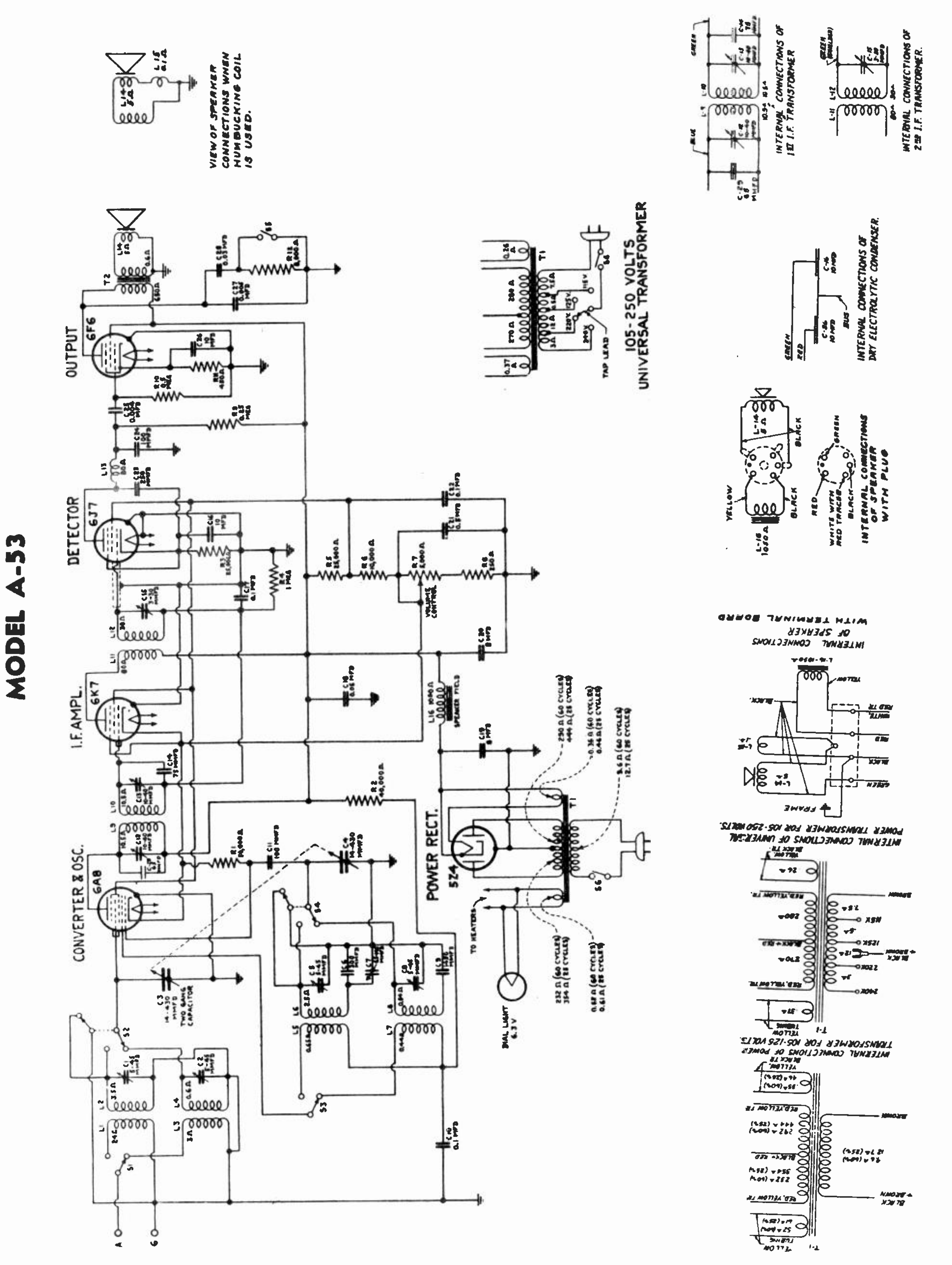
Radiotrons and Functions:
- (1) RCA-6A7, First Detector and Oscillator
- (2) RCA-6D6, I.F. Amplifier
- (3) RCA-6B7, Second Detector–Audio Amplifier–A.V.C.
- (4) RCA-41, Power Output
- (5) RCA-80, Rectifier

Tuning Frequency Ranges .... 540 KC. to 1720 KC. and 1600 KC. to 3500 KC.
Alignment Frequencies .... 460 KC. (I.F.), 1720 KC. (R.F. and Oscillator) 600 KC. (Oscillator)
Undistorted Output .... 1.75 Watts
Maximum Output .... 3.5 Watts
Loudspeaker .... 6-Inch, Electro-Dynamic

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

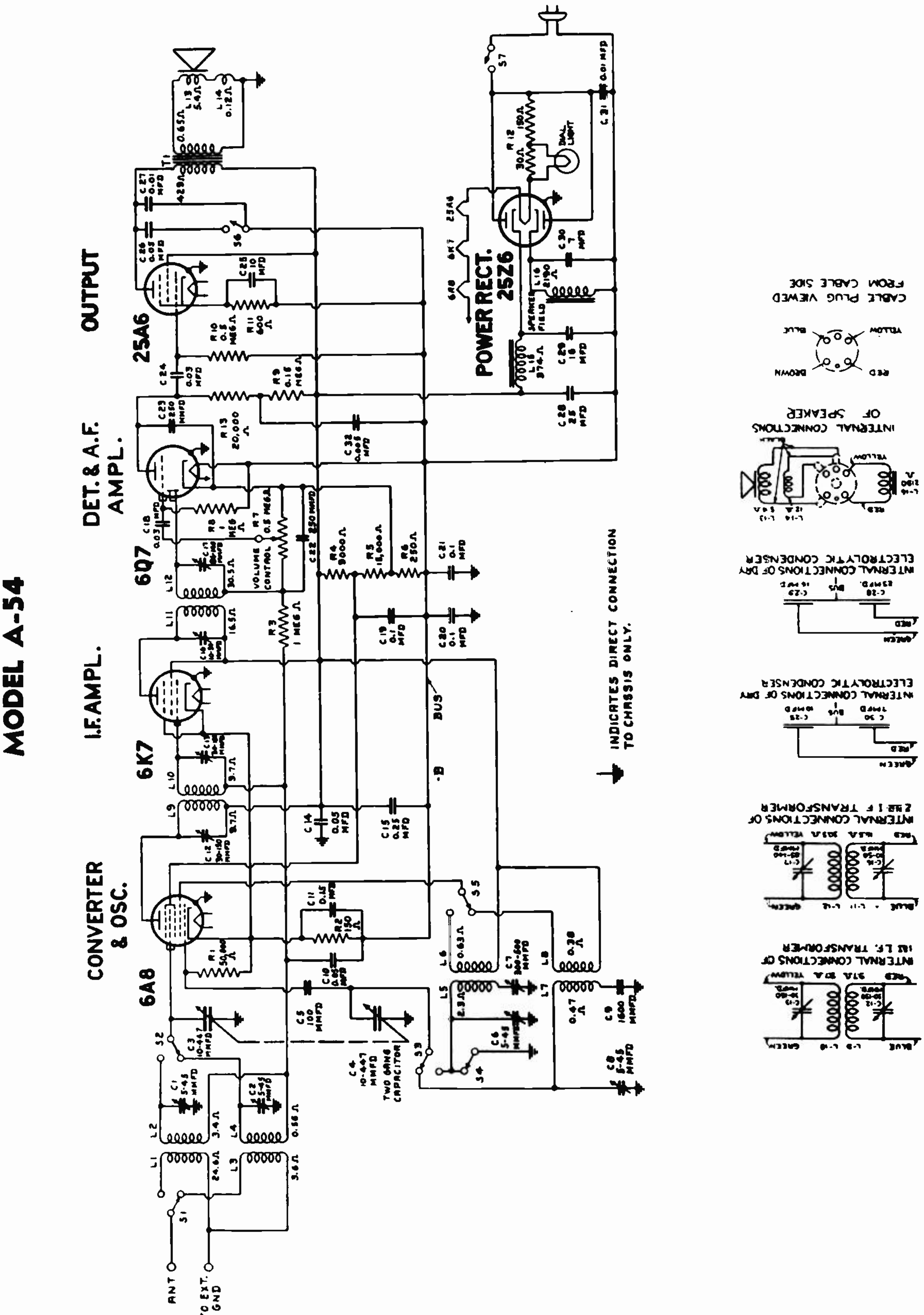
GENERAL ELECTRIC



NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

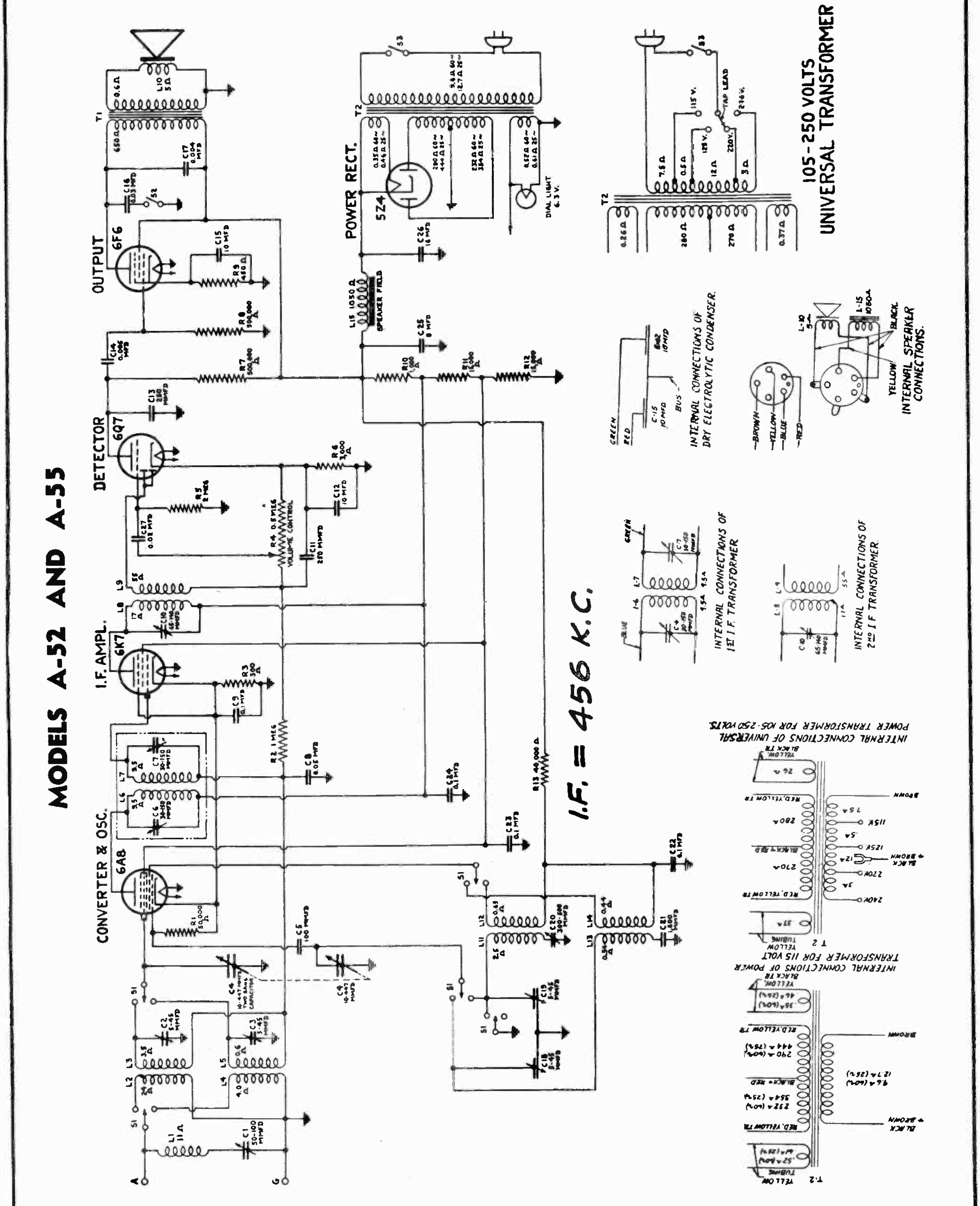
GENERAL ELECTRIC



NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

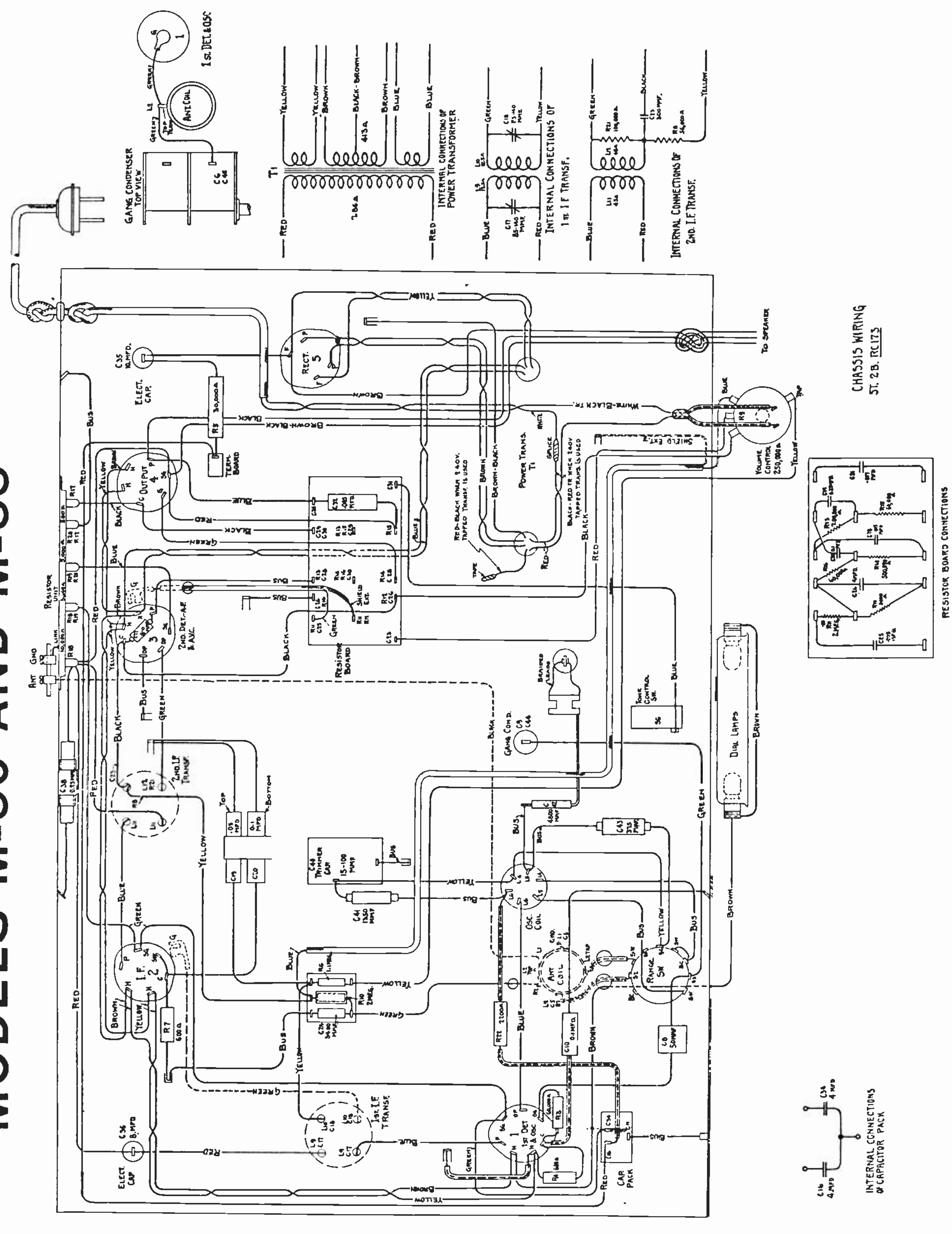


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODELS M-50 AND M-55



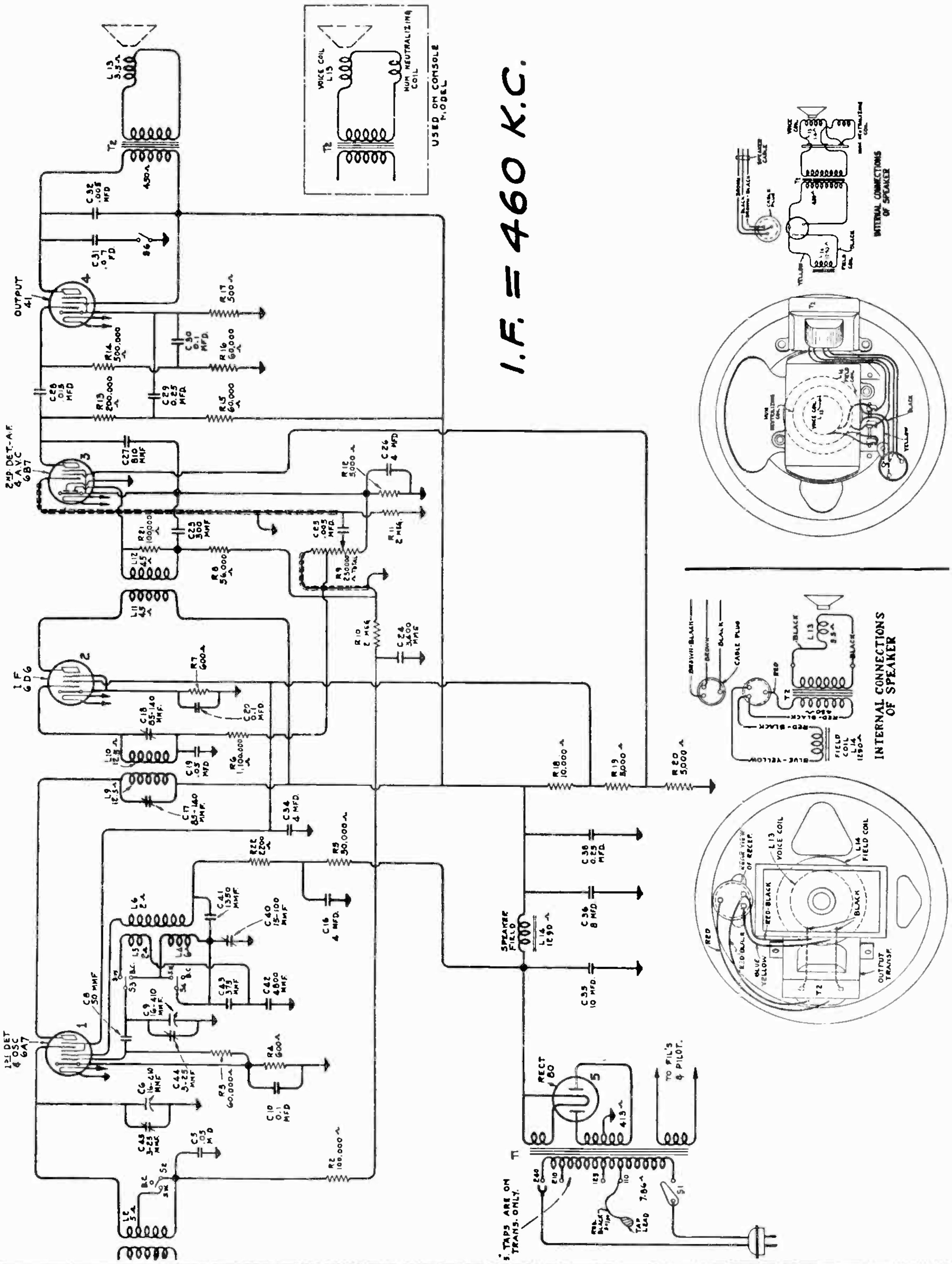
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

GENERAL ELECTRIC CO.

MODELS M-50 AND M-55



Loudspeaker Wiring (Console Model)

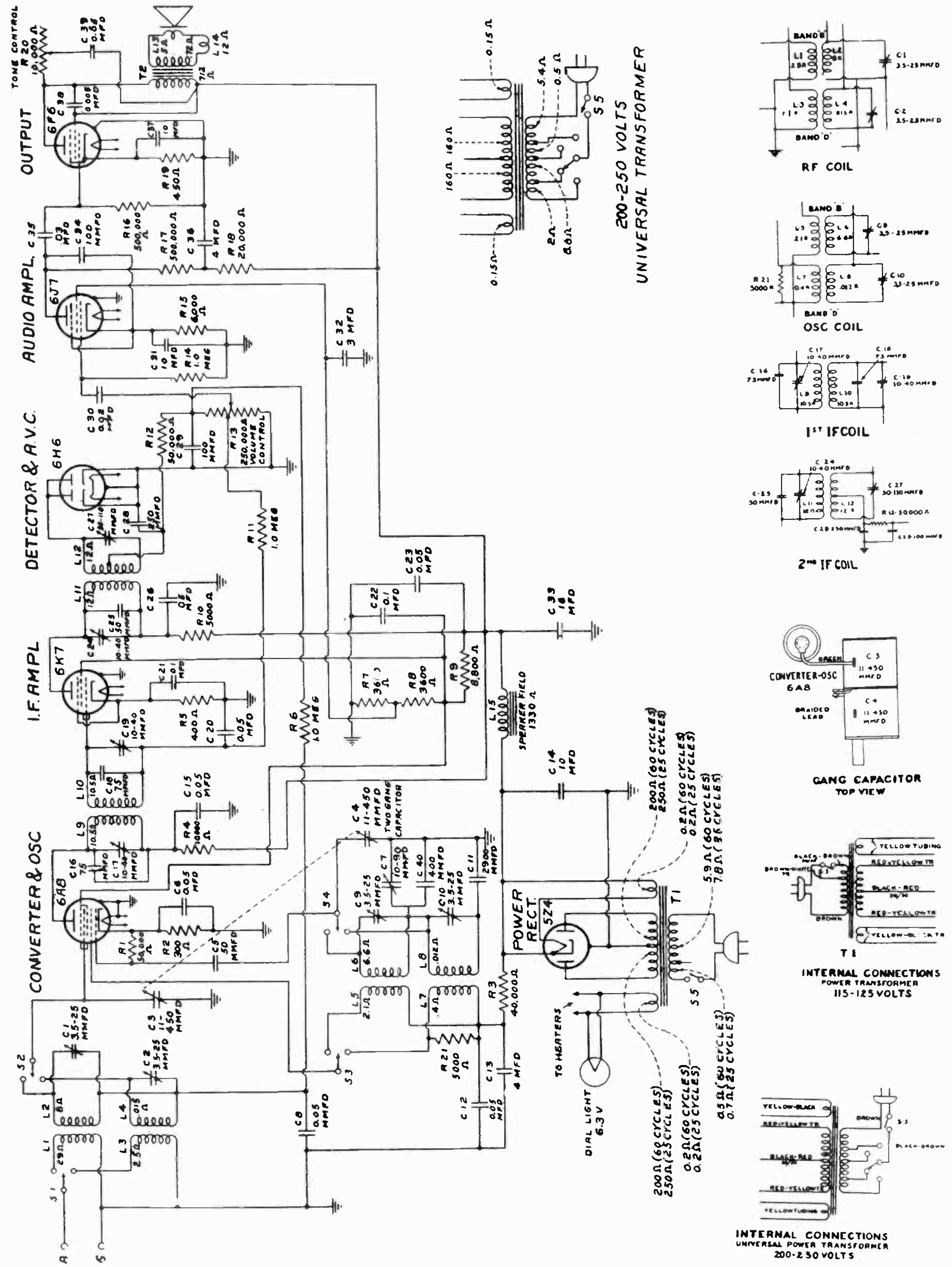
Loudspeaker Wiring (Table Model)

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODELS A-64 AND A-67

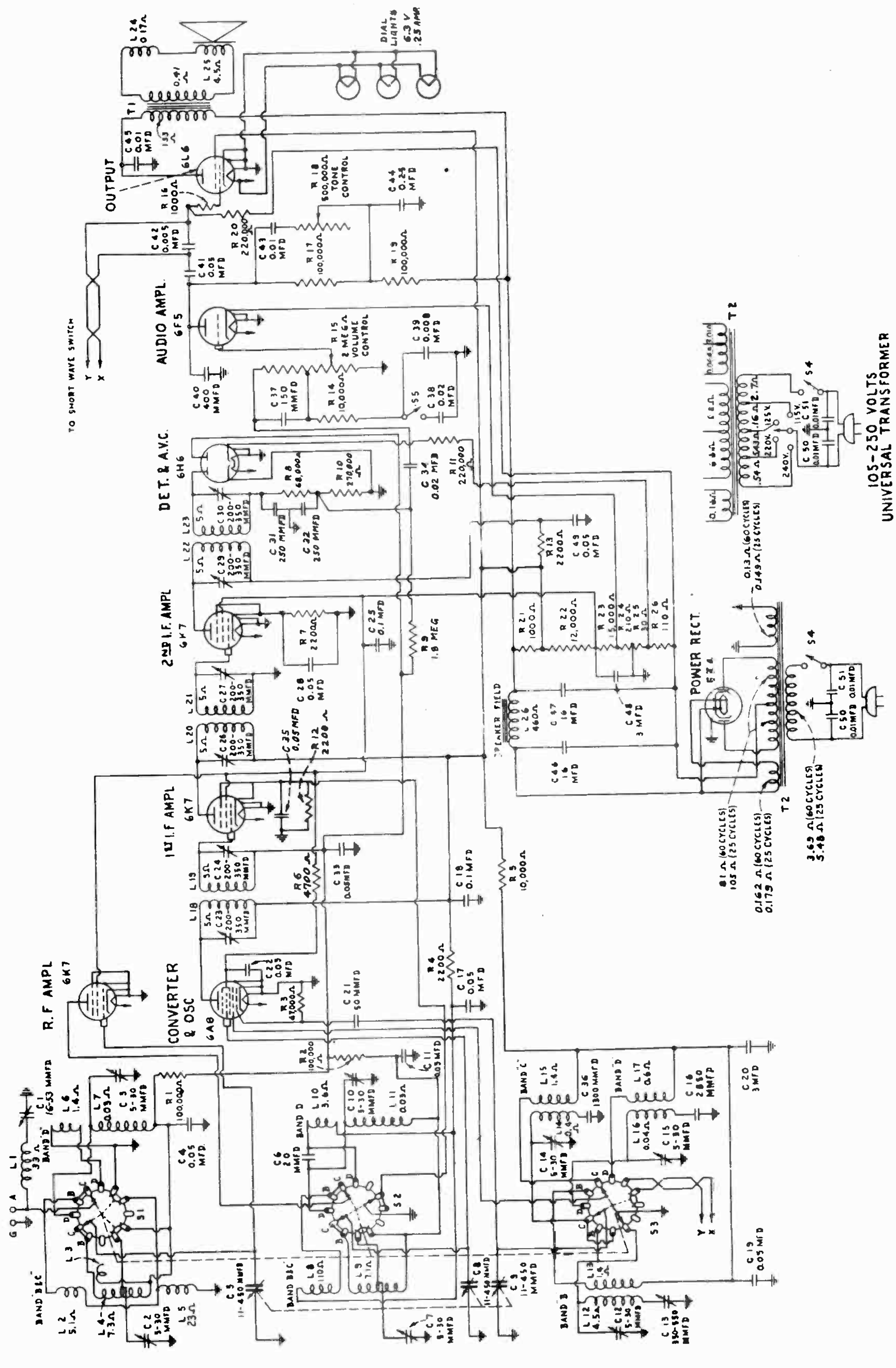


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

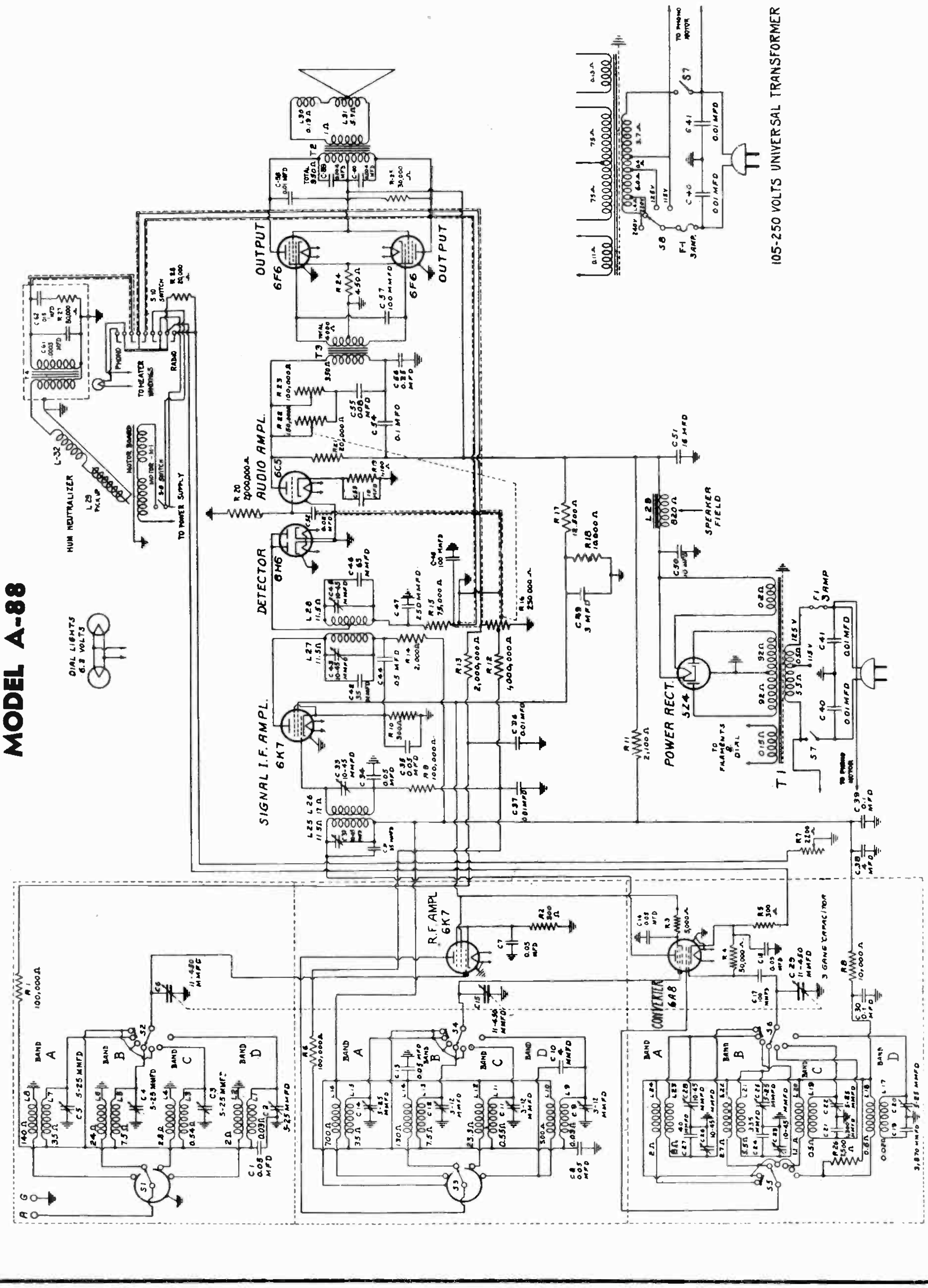
MODELS E-81 AND E-86



NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC



NATIONAL SCHOOLS

RADIO DIVISION

4000 South Figueroa St. · Los Angeles, California

Special Examination # 4

DEAR STUDENT:

YOU ARE PROGRESSING SPLENDIDLY WITH YOUR STUDIES AND IT IS INDEED MOST PLEASING TO ME TO SEE YOU TAKE SUCH A COMPLETE INTEREST IN YOUR WORK. FROM NOW ON, YOUR STUDIES ARE GOING TO BECOME MORE TECHNICAL AND IT MAY REQUIRE A LITTLE HARDER STUDY FOR YOU TO MASTER THEM. HOWEVER, YOU MUST BEAR IN MIND THAT THIS ADVANCED TYPE OF STUDY IS MOST NECESSARY IN ORDER THAT YOU MAY PREPARE YOURSELF FOR THE BETTER JOBS WHICH THE RADIO INDUSTRY HAS TO OFFER YOU.

IT IS NOW TIME FOR ANOTHER SPECIAL EXAMINATION. THIS PARTICULAR EXAMINATION IS BASED SOLELY UPON LESSONS #28 TO #36 INCLUSIVE AND SO BEFORE COMMENCING TO ANSWER THE FOLLOWING GROUP OF QUESTIONS, I SUGGEST THAT YOU FIRST REVIEW THESE LAST NINE LESSONS CAREFULLY, SO THAT YOU WILL BE SURE TO HAVE A PERFECT UNDERSTANDING OF EVERYTHING WHICH HAS BEEN EXPLAINED IN THEM.

I AM CERTAIN THAT YOU WILL FIND THIS EXAMINATION TO BE INTERESTING, AS WELL AS INSTRUCTIVE AND THAT YOU WILL DO YOUR BEST TO RECEIVE A SPLENDID GRADE UPON IT.

answered

SINCERELY YOURS,

J A Rosenkranz

PRESIDENT

EXAMINATION QUESTIONS

1. – DRAW A DIAGRAM OF A TYPICAL AUTOMATIC VOLUME CONTROL CIRCUIT, USING A SEPARATE A.V.C. TUBE AND EXPLAIN HOW IT OPERATES.

2. – WHY IS IT THAT RECEIVERS EMPLOYING AN AUTOMATIC VOLUME CONTROL SYSTEM HAVE A TENDENCY TO AMPLIFY BACK GROUND NOISE CONSIDERABLY WHEN TUNED TO SOME POINT BETWEEN STATIONS?

3. – DRAW A CIRCUIT DIAGRAM OF AN AUTOMATIC NOISE SUPPRESSION CIRCUIT, SHOWING HOW IT IS USED IN CONJUNCTION WITH AN AUTOMATIC VOLUME CONTROL SYSTEM OF A RECEIVER.

4. – EXPLAIN THE OPERATION OF THE CIRCUIT WHICH YOU HAVE DRAWN IN ANSWER TO QUESTION #3.

(OVER)

5. — ILLUSTRATE BY MEANS OF A DIAGRAM HOW A TYPE 2A6 TUBE CAN BE USED IN A SUPERHETERODYNE RECEIVER SO AS TO FUNCTION SIMULTANEOUSLY AS A SECOND DETECTOR, A.F. AMPLIFIER AND AN A.V.C. TUBE.

6. — WHEN USING A DUPLEX-DIODE TRIODE TUBE SO THAT IT WILL FUNCTION AS A HALF-WAVE DETECTOR, HOW WILL THE AMOUNT OF ITS RECTIFIED SIGNAL VOLTAGE COMPARE WITH THAT OBTAINED WHEN THIS SAME TUBE IS USED IN A FULL-WAVE DETECTOR ARRANGEMENT?

7. — EXPLAIN THE MECHANISM AND OPERATION OF THE SHADOW-TUNING INSTRUMENT.

8. — SHOW BY MEANS OF A DIAGRAM HOW IN A SERIES STORAGE BATTERY CHARGING CIRCUIT THE RATE OF CHARGE THROUGH ONE OF THE BATTERIES CAN BE REDUCED WITHOUT REDUCING THE RATE OF CHARGE THROUGH THE OTHER BATTERIES OF THE CIRCUIT.

9. — DRAW A CIRCUIT DIAGRAM SHOWING HOW A PHONOGRAPH PICK-UP UNIT CAN BE CONNECTED TO THE GRID CIRCUIT OF A RECEIVER'S DETECTOR STAGE.

10.— DRAW A CIRCUIT DIAGRAM SHOWING HOW A PHONOGRAPH PICK-UP UNIT CAN BE CONNECTED TO THE SECOND DETECTOR OF A SUPHETERODYNE RECEIVER IN WHICH A TYPE 2A6 TUBE IS EMPLOYED.

11.— DRAW A CIRCUIT DIAGRAM WHICH ILLUSTRATES A TONE-CONTROL CIRCUIT.

12.— WHAT IS AN IMPORTANT ADVANTAGE OF CONTROLLING REGENERATION IN SHORT WAVE RECEIVERS THROUGH VARIATION OF THE DETECTOR TUBE'S SCREEN-GRID POSITIVE POTENTIAL.

13.— EXPLAIN HOW YOU WOULD TEST A LEAD-ACID STORAGE BATTERY BY MEANS OF THE CADIMUM TEST.

14.— HOW DOES THE EDISON STORAGE CELL DIFFER FROM THE LEAD-ACID TYPE STORAGE CELL?

15.— EXPLAIN THE "SKIP-DISTANCE" PHENOMENA AS EXPERIENCED WITH SHORT-WAVE RECEPTION.

16.— DESCRIBE BRIEFLY HOW A RECEIVER DESIGNED FOR 110 VOLT D.C. OPERATION DIFFERS FROM A RECEIVER DESIGNED FOR 110 VOLT A.C. OPERATION.

17.— HOW DOES A 110 VOLT A.C. RECEIVER DIFFER FROM A 220 VOLT A.C. RECEIVER?

18.— DESCRIBE BRIEFLY ANY ONE UNIVERSAL RECEIVER CIRCUIT.

19.— DESCRIBE THE 25Z5 TUBE AND EXPLAIN HOW IT MAY BE USED.

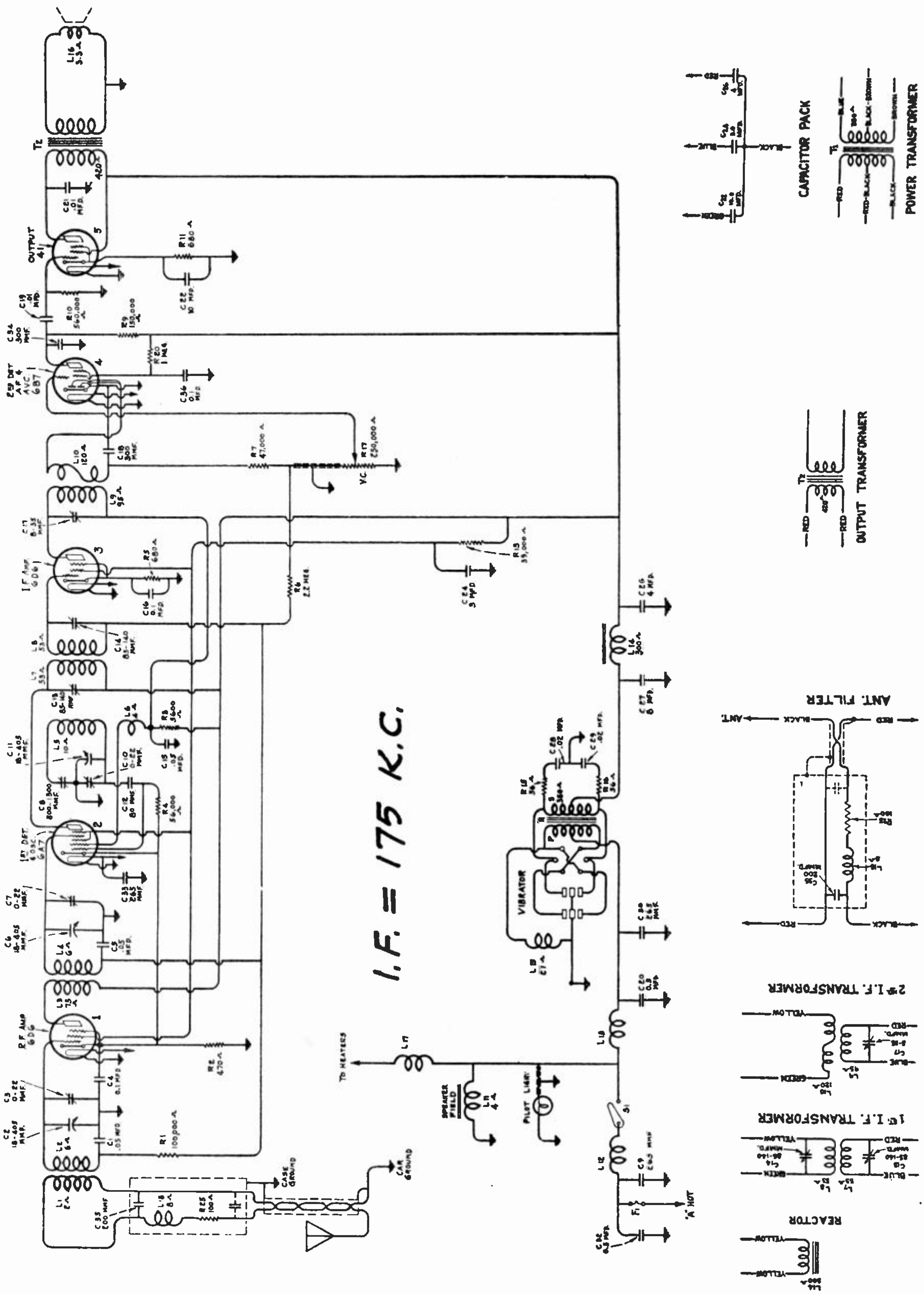
20.— WHAT ARE SOME OF THE MORE IMPORTANT POINTS WHICH SHOULD BE CONSIDERED AT THE TIME THE CONSTRUCTION OF ANY RECEIVER IS CONTEMPLATED?

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODEL D-50

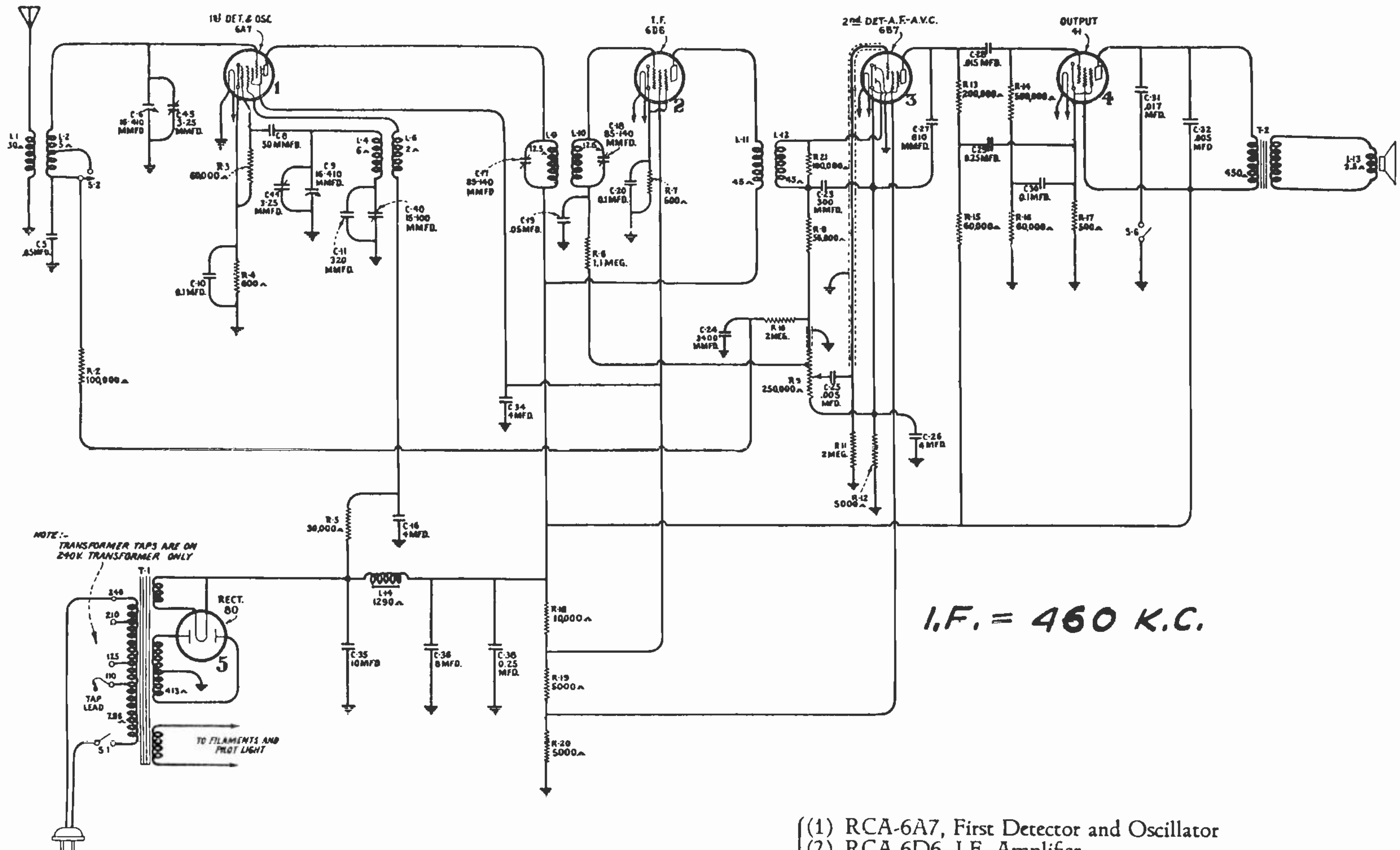


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODEL M-52



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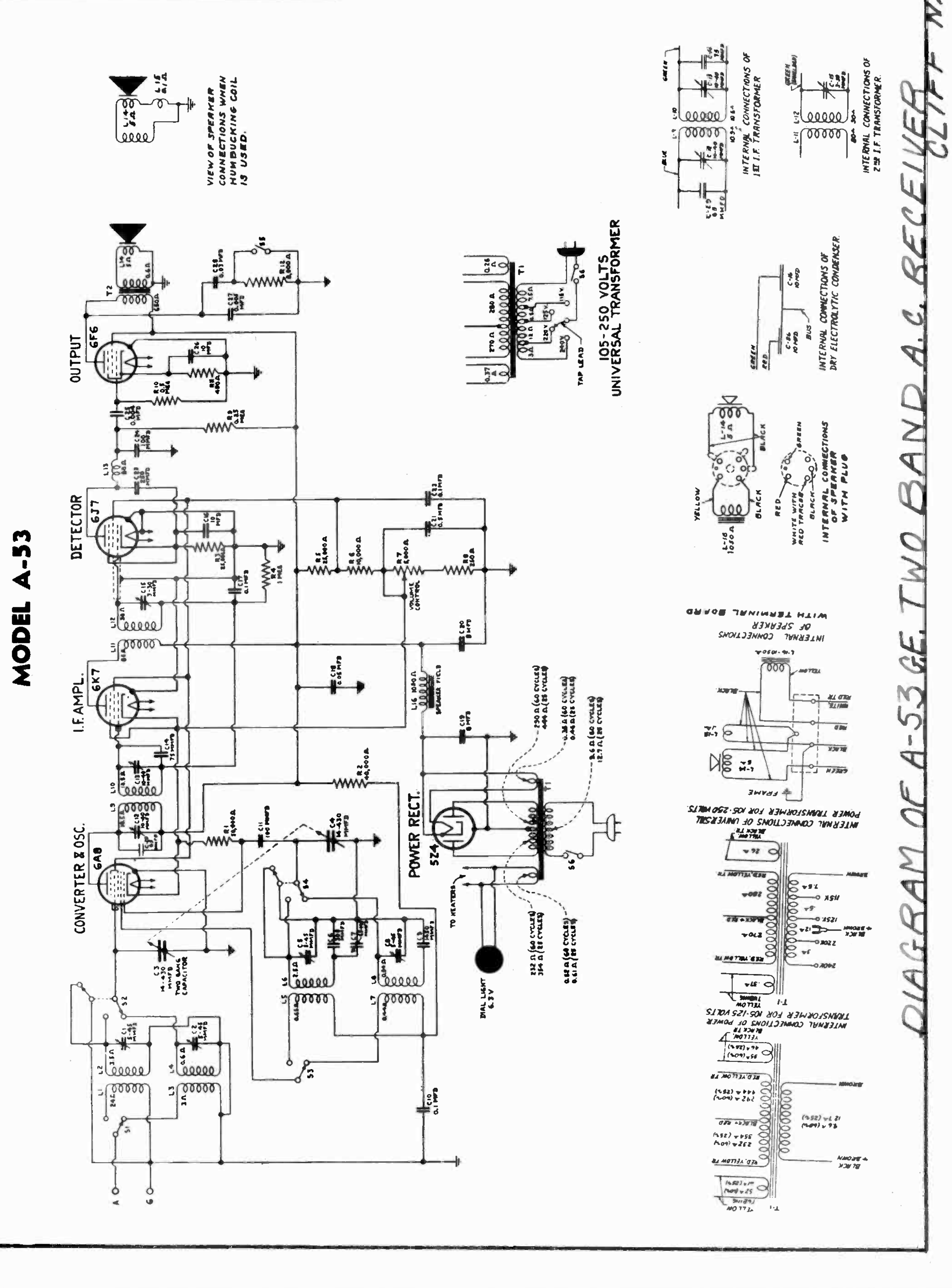
Loudspeaker..6-Inch, Electro-Dynamic

NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

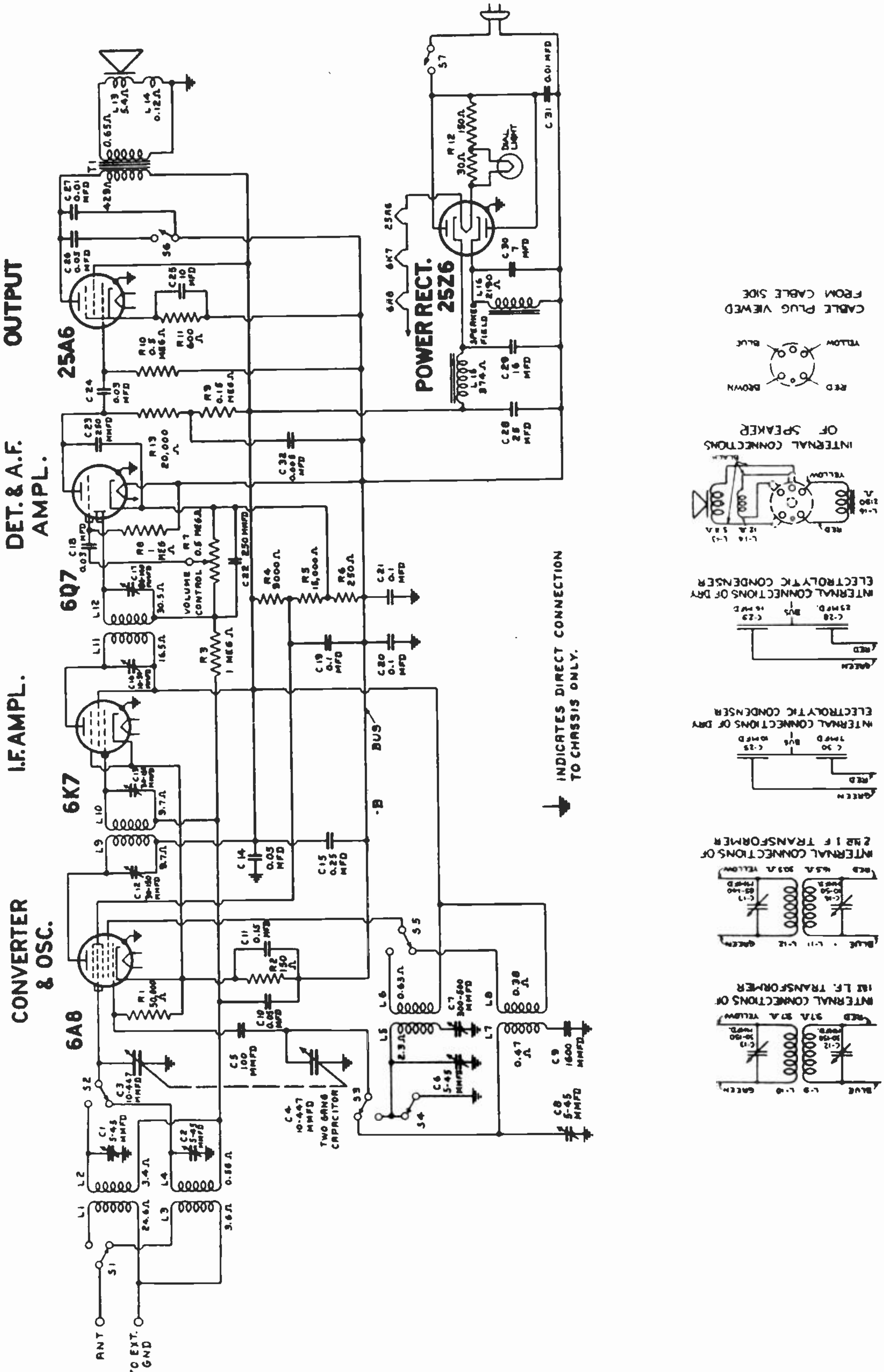


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

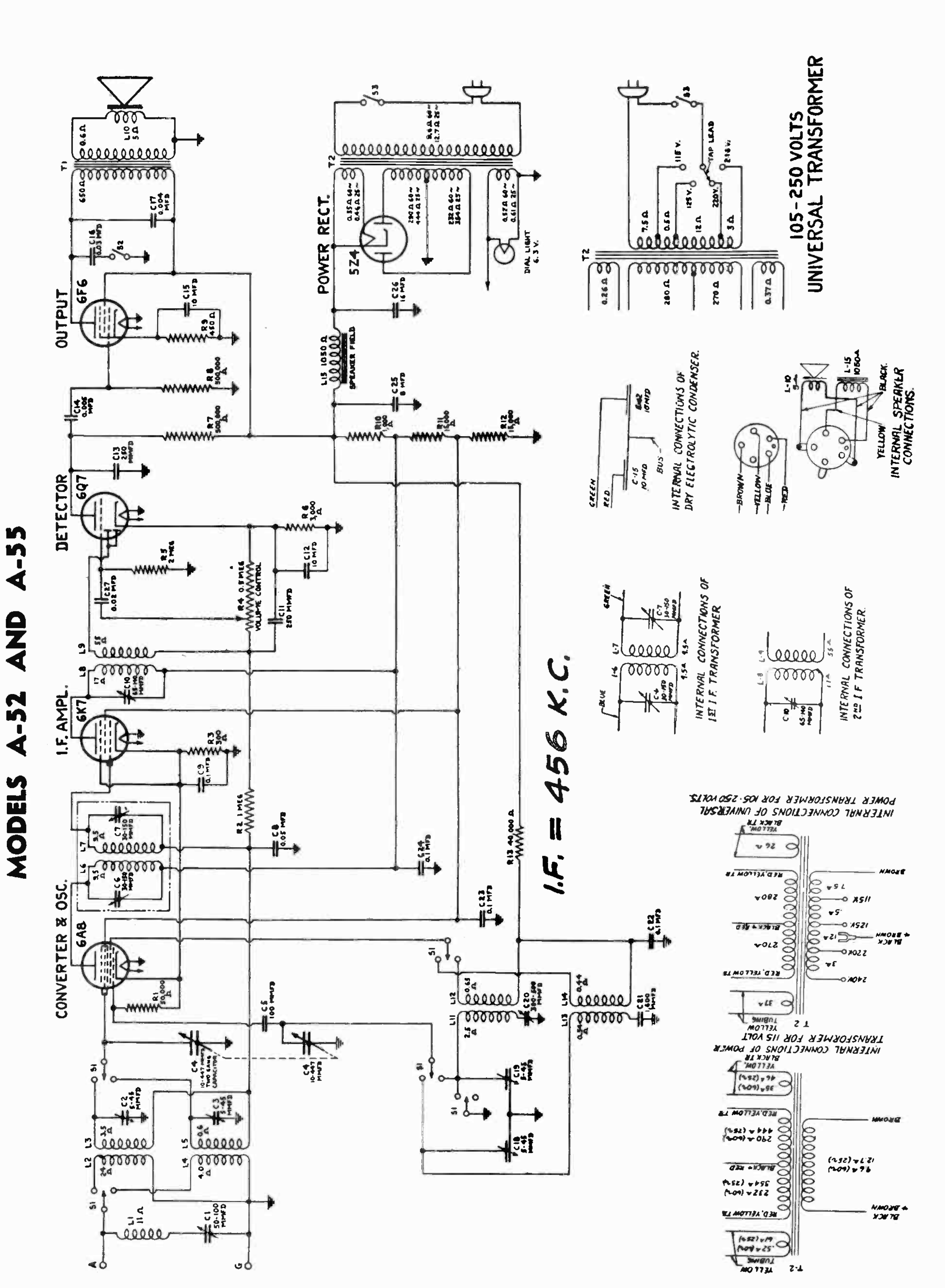
MODEL A-54



NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

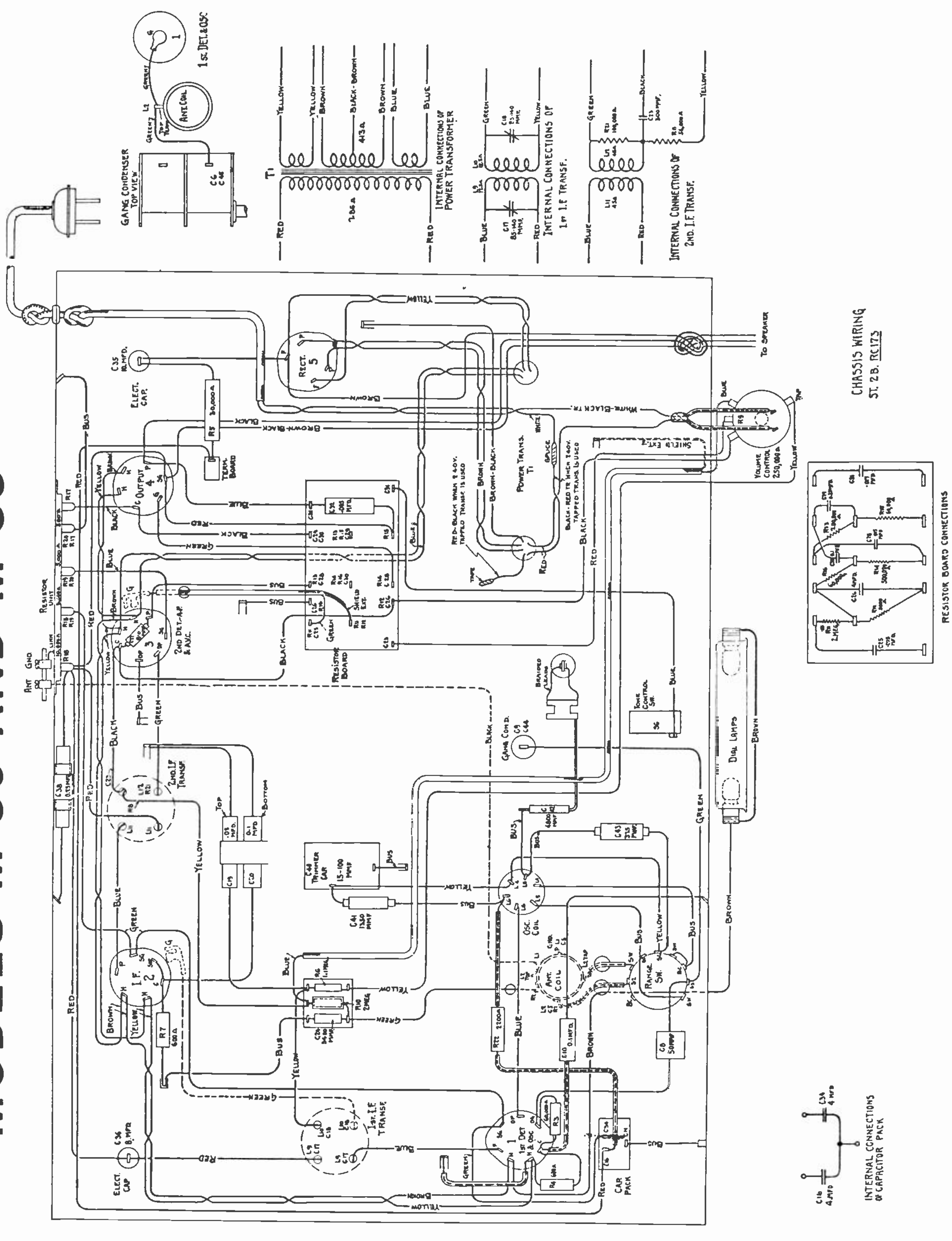


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODELS M-50 AND M-55



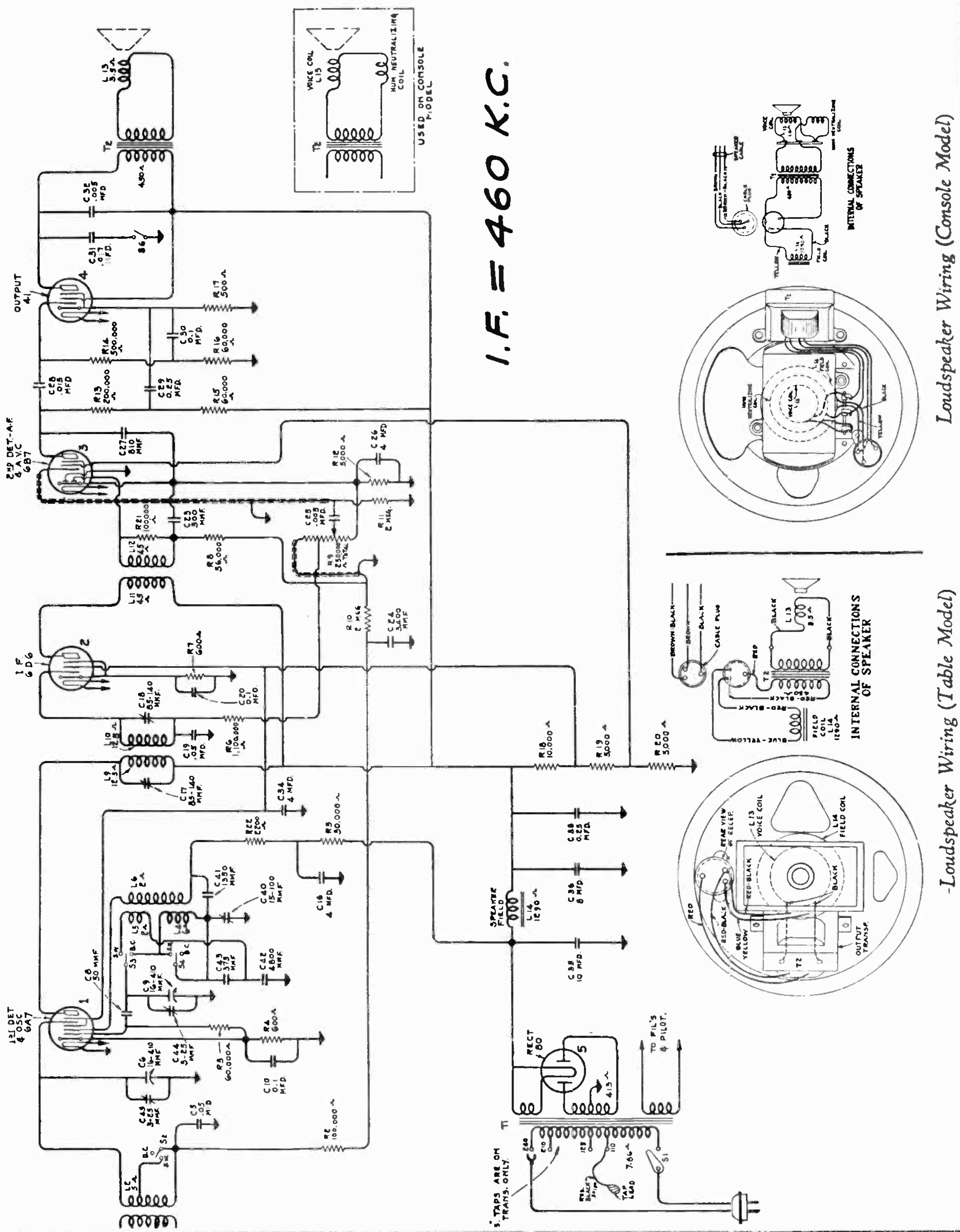
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

GENERAL ELECTRIC CO.

MODELS M-50 AND M-55

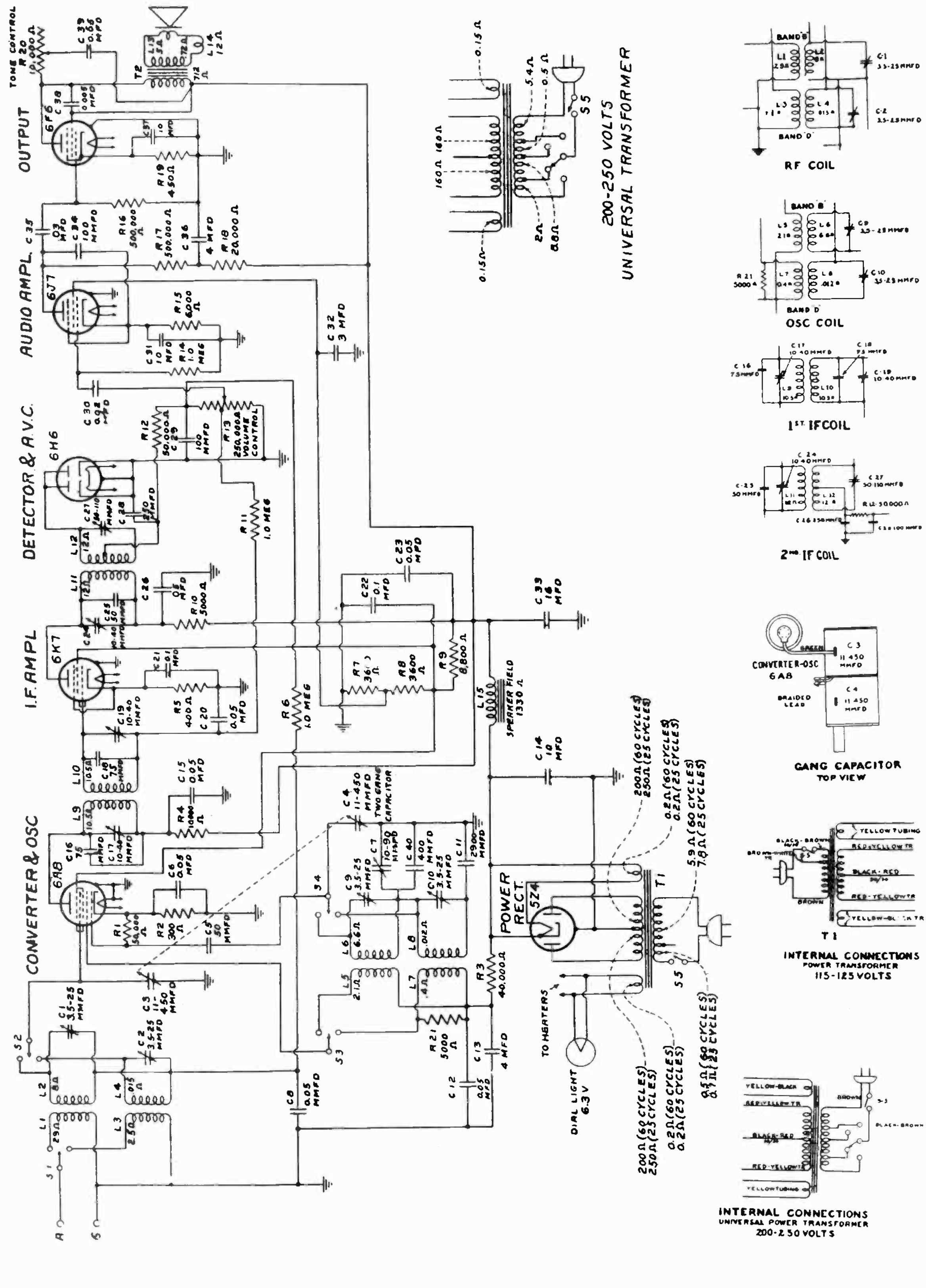


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

MODELS A-64 AND A-67

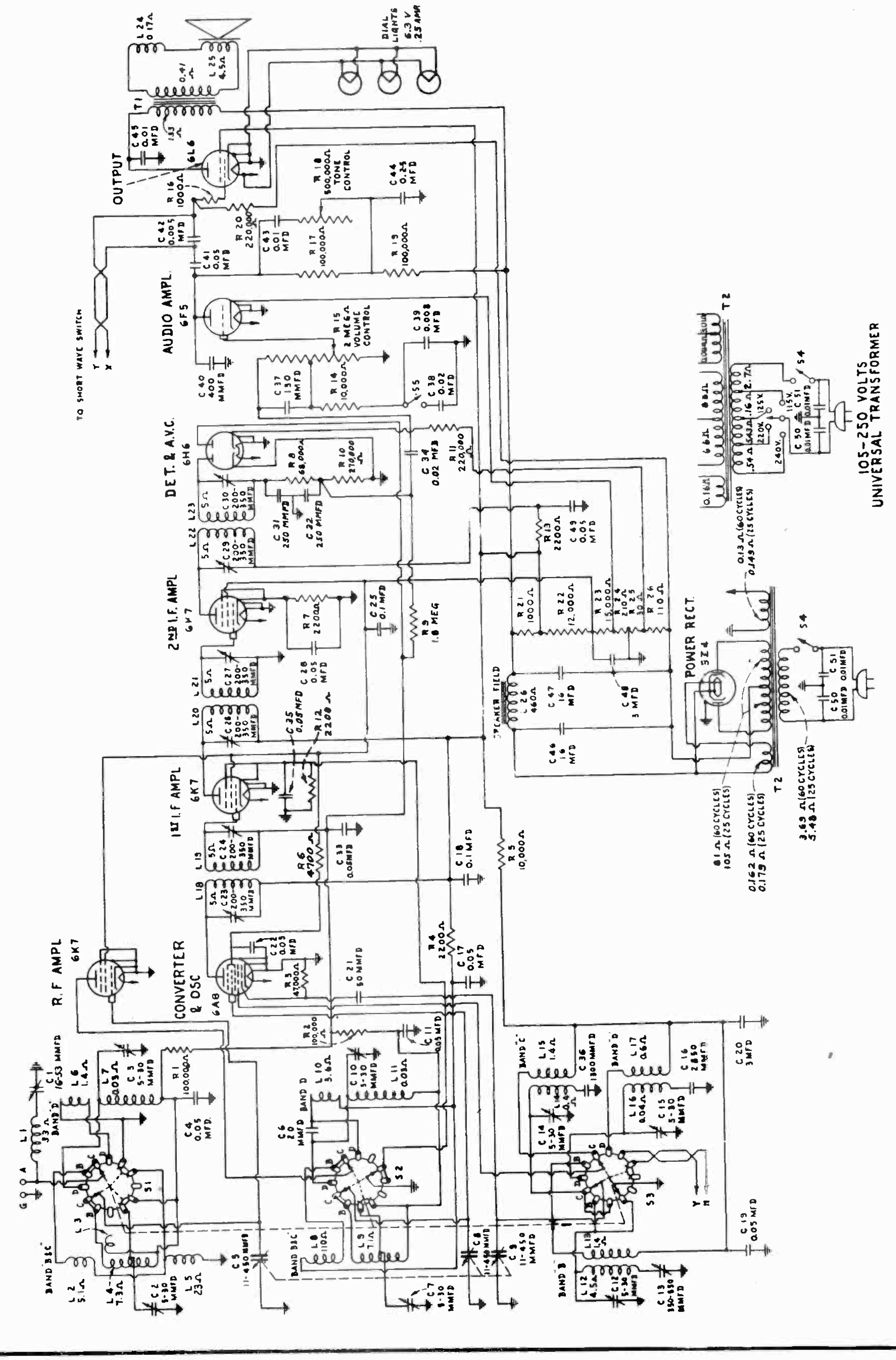


NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC

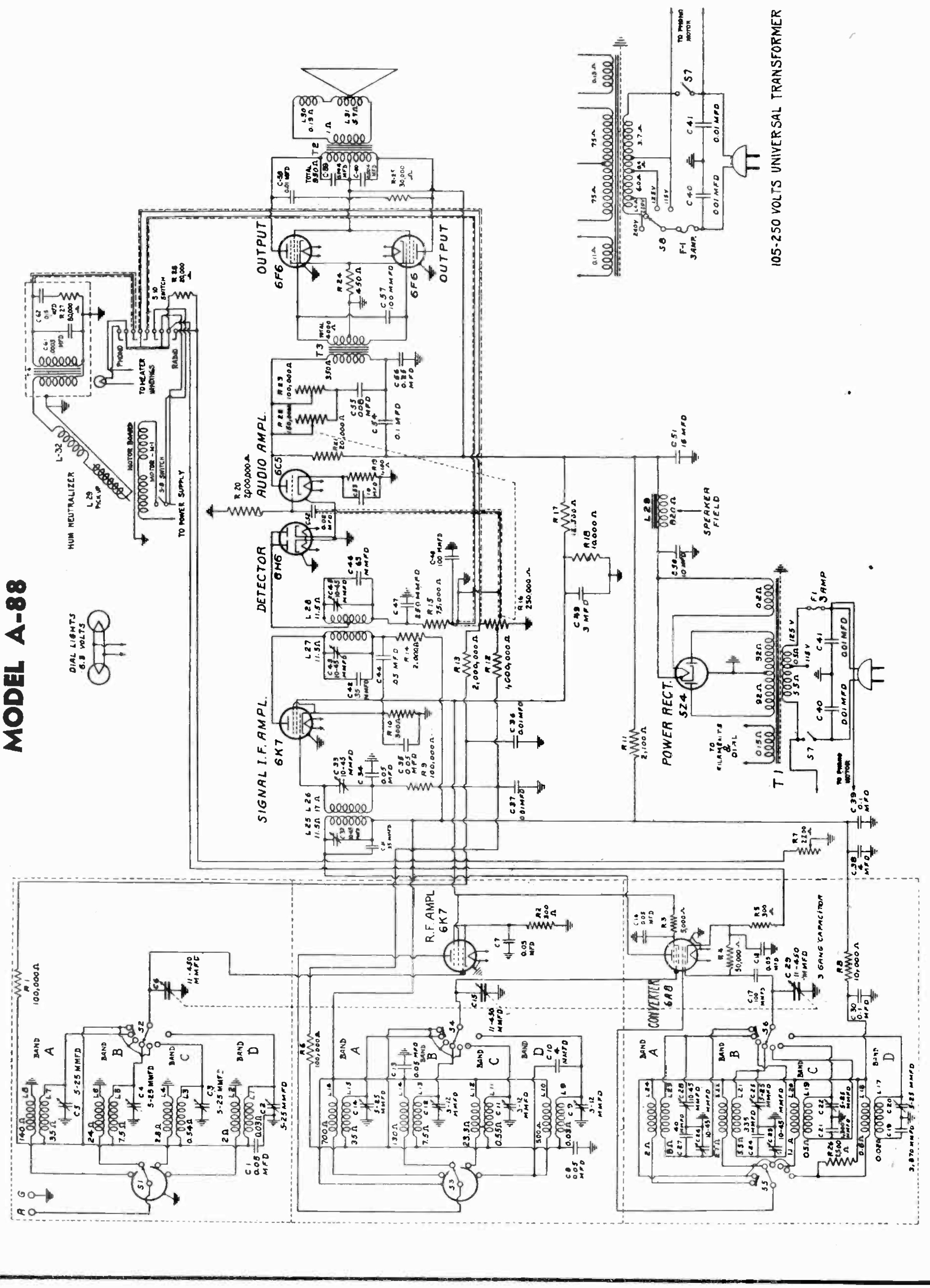
MODELS E-81 AND E-86



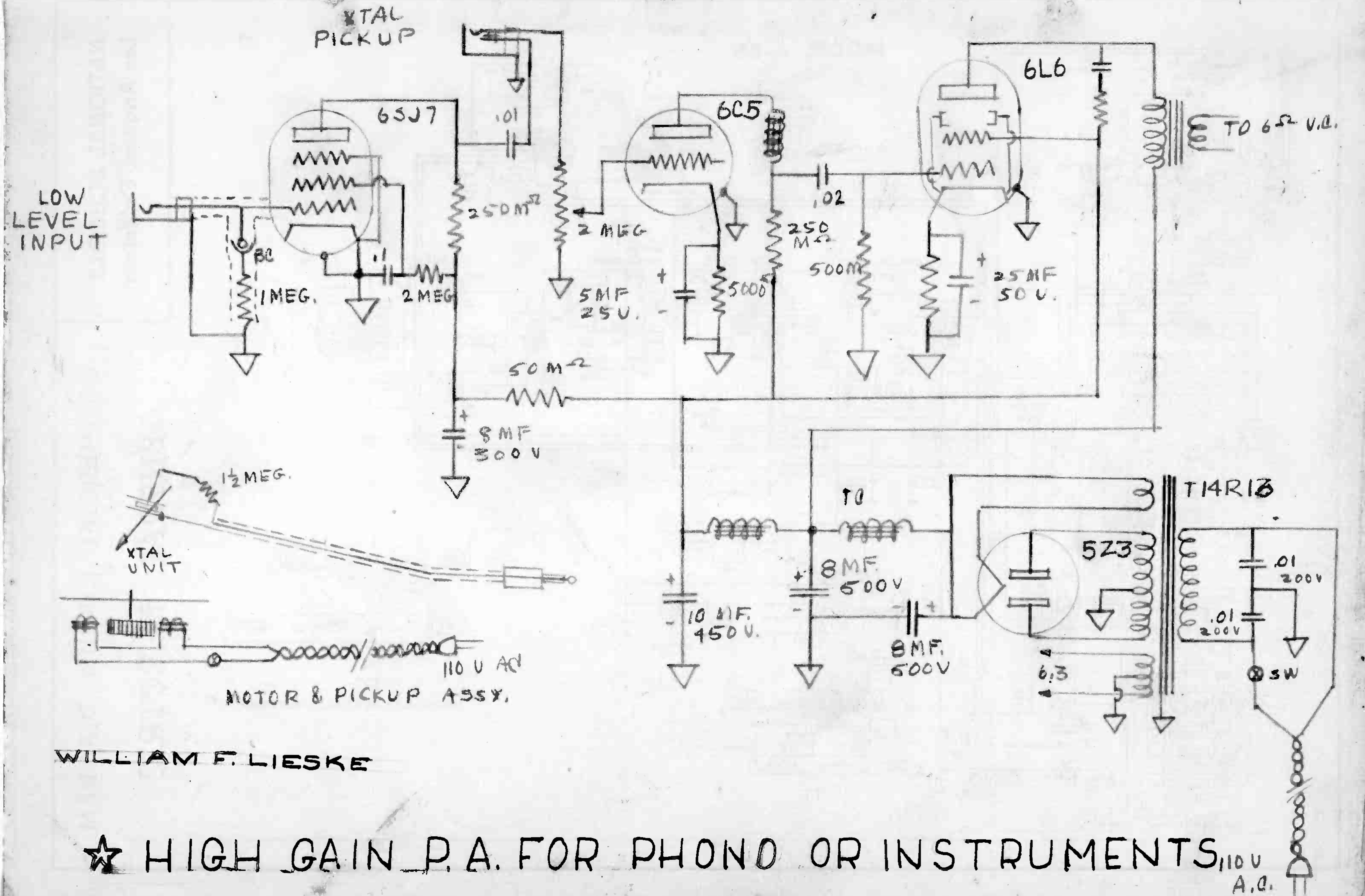
NATIONAL SCHOOLS
Los Angeles, California

COMMERCIAL CIRCUIT DIAGRAM

GENERAL ELECTRIC



☆ HIGH GAIN P.A. FOR PHONO OR INSTRUMENTS 110 V A.C.



WILLIAM F. LIESKE