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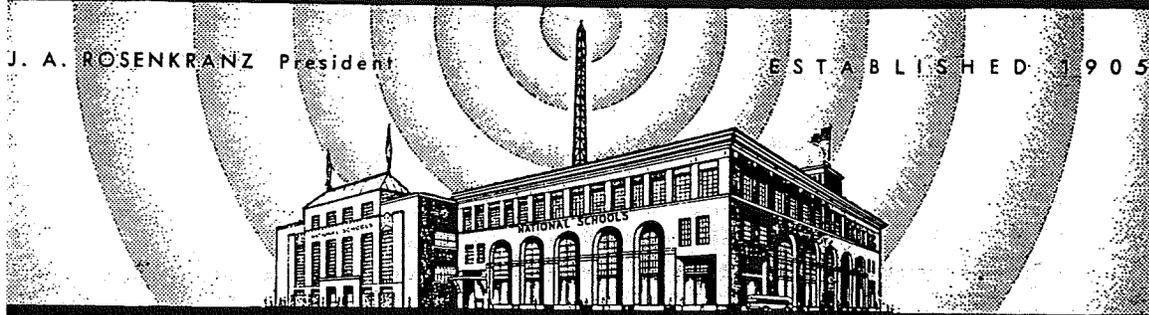
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Practical Technical Training In **RADIO-TELEVISION** AND ALLIED ELECTRONICS

J. A. ROSENKRANZ President

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SOUND PICTURES

LESSON NO. SP-4

THEATER SOUND EQUIPMENT

THE PURPOSE OF THIS LESSON IS TO FAMILIARIZE YOU WITH THE VARIOUS AMPLIFIER CIRCUITS AND SYSTEM HOOK-UPS AS USED IN THE CONVENTIONAL THEATER.

YOU WILL FIND THE FIRST PART OF THIS PARTICULAR LESSON TO BE BASED UPON WESTERN ELECTRIC EQUIPMENT WHICH IS MANUFACTURED AND INSTALLED BY ELECTRICAL RESEARCH PRODUCTS, INC. WESTERN ELECTRIC EQUIPMENT IS VERY POPULAR IN THE SOUND PICTURE FIELD, AND CAN BE USED WITH ALL TYPES OF WELL KNOWN PROJECTORS. THE LATTER PORTION OF THIS LESSON IS DEVOTED TO

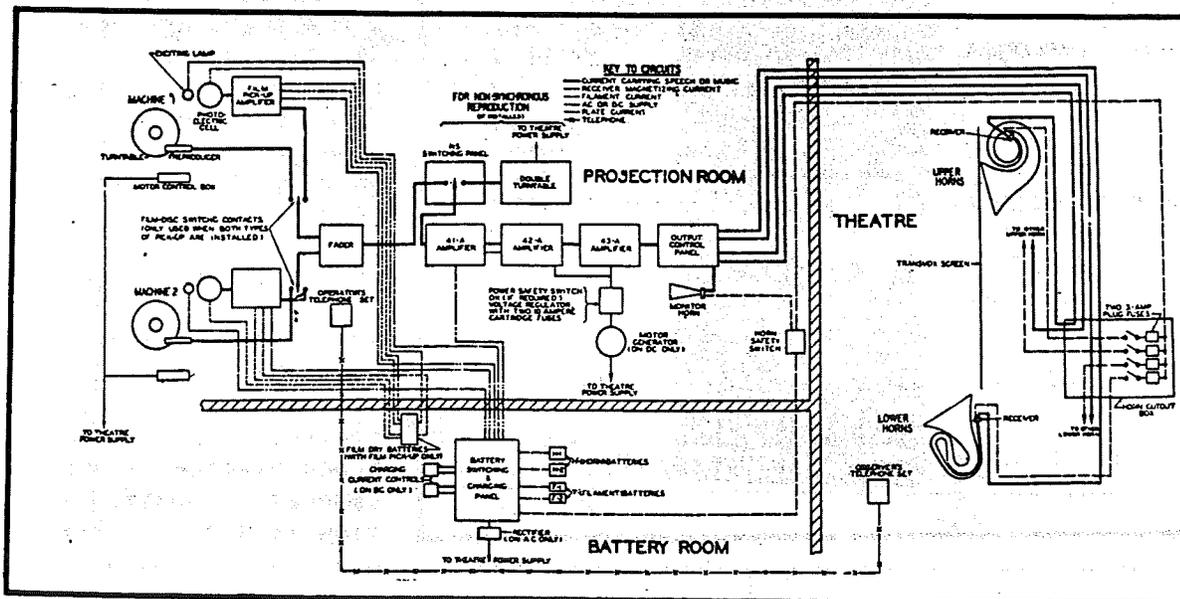


FIG. 1
GENERAL LAYOUT OF THE WESTERN ELECTRIC SOUND PROJECTOR SYSTEM

R.C A. PHOTOPHONE SOUND EQUIPMENT AND WHICH ALSO IS USED A GREAT DEAL.

DURING THE FEW YEARS WE HAVE HAD SOUND MOTION PICTURES, PRACTICALLY ALL SOUND SYSTEMS WERE DEVELOPED MERELY WITH THE IDEA OF SOUND REPRODUCTION IN MIND, GIVING LITTLE OR NO CONSIDERATION TO THE QUALITY OF SOUND PRODUCED. UNTIL RECENTLY, A SERVICE ENGINEER WAS CALLED UPON TO REPAIR SOUND EQUIPMENT WHENEVER TROUBLE OCCURRED. THIS WAS VERY EXPENSIVE AND LED TO MANY DELAYS AND POOR PERFORMANCE. THE PUBLIC NOW DEMANDS THE BEST IN BOTH EQUIPMENT AND OPERATORS. IT IS FOR THIS REASON THAT WE ARE GIVING YOU A THOROUGH TRAINING IN SOUND AND REPRODUCTION. BEFORE WE TAKE UP THE PRACTICAL WORK AND TRAINING, IT IS NECESSARY TO ACQUAINT YOU WITH THE DIFFERENT SYSTEMS AND EQUIPMENT USED IN MOTION PICTURE WORK. WE SHALL START WITH WESTERN ELECTRIC EQUIPMENT, GIVING YOU A BRIEF DESCRIPTION AND DISCUSSION OF SELECTED WESTERN ELECTRIC MATERIAL.

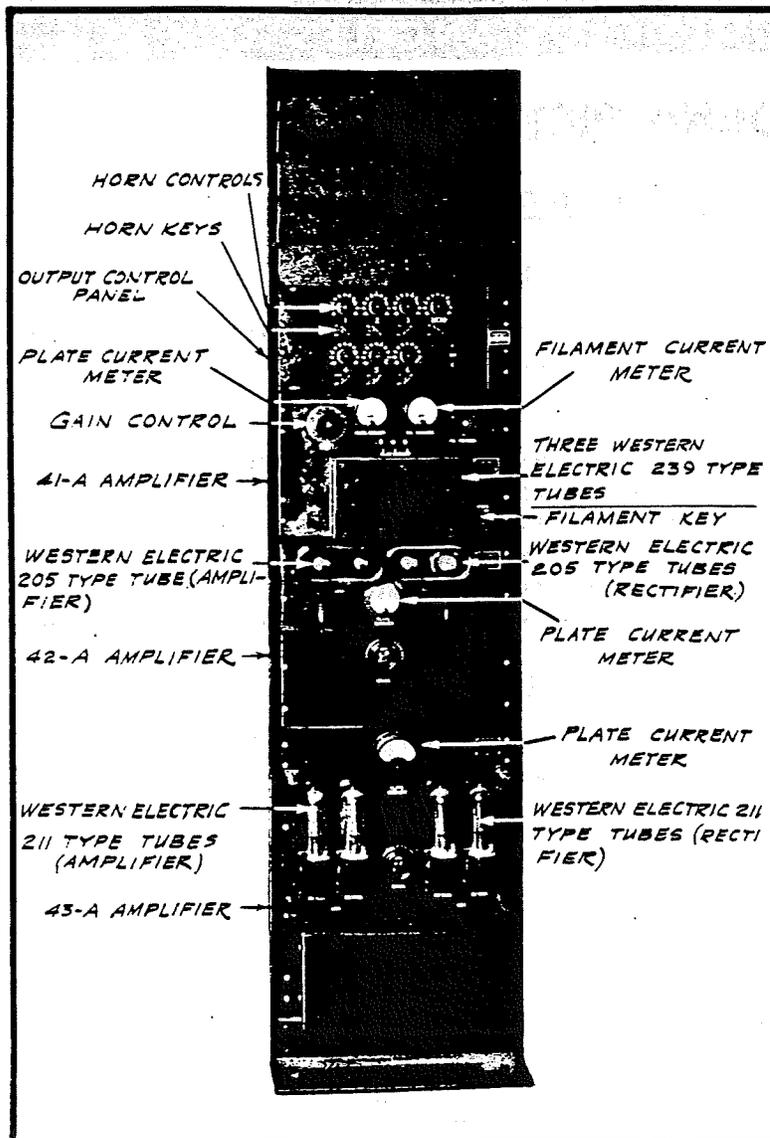


FIG. 2

Western Electric Amplifier Rack Assembly.

WESTERN ELECTRIC EQUIPMENT CAN BE USED WITH ANY POPULAR TYPE PROJECTOR, AS SIZES ARE AVAILABLE FOR ALL INSTALLATIONS.

A WESTERN ELECTRIC INSTALLATION

ONE OF THE MOST USED, AS WELL AS ONE OF THE MOST MODERN INSTALLATIONS, FOR USE WITH MOTOR GENERATORS OR SOCKET POWER, CONSISTS OF A PHOTO-ELECTRIC CELL (P.E. CELL) AMPLIFIER KNOWN AS THE D-85943 OR D-86729 AND WHICH FEEDS INTO THE 41A LOW LEVEL STAGE. THIS AMPLIFIER IS COUPLED TO A 42A HIGH LEVEL AMPLIFIER WHICH DRIVES A 43A POWER AMPLIFIER, AND AN OUTPUT CONTROL PANEL. A BLOCK DIAGRAM OF THE COMPLETE INSTALLATION IS SHOWN IN FIG. 1.

BY STUDYING

THIS ILLUSTRATION VERY CLOSELY, YOU WILL DISCOVER MANY IMPORTANT FACTS. FIRST, YOU WILL FIND THAT AT LEAST TWO PROJECTORS WITH BUILT-IN P.E. CELL AMPLIFIERS ARE REQUIRED IN ORDER TO OBTAIN CONTINUITY OF REPRODUCTION. A METHOD OF SWITCHING THE OUTPUT OF EITHER MACHINE TO THE 41A AMPLIFIER MUST ALSO BE USED.

THE POWER SUPPLY

AS ALL SYSTEMS REQUIRE A SOURCE OF POTENTIAL, IT WILL BE WELL FOR US TO SEE HOW AND WHERE WE OBTAIN OUR VARIOUS OPERATING VOLTAGES.

GOING INTO THE PROJECTION ROOM (FIG. 1), WE FIND A CHARGING AND SWITCHING PANEL TO WHICH BATTERIES ARE CONNECTED WHEN THEY ARE

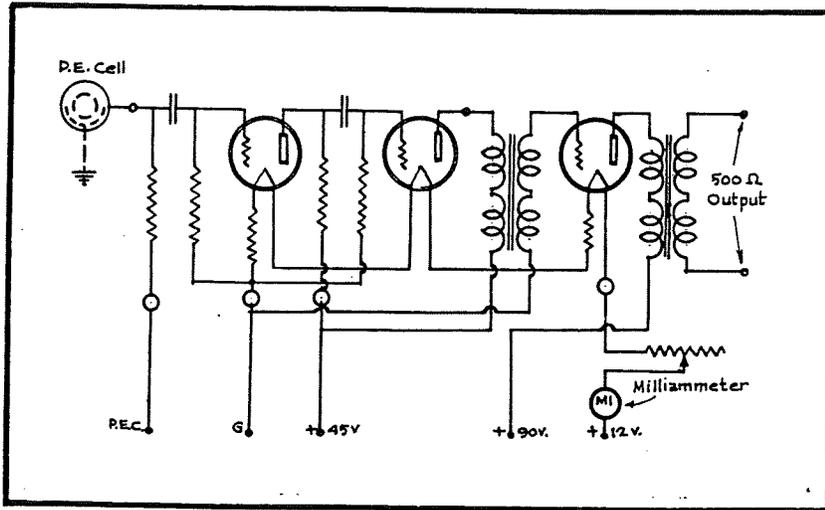


FIG. 3
The P.E. Cell Amplifier.

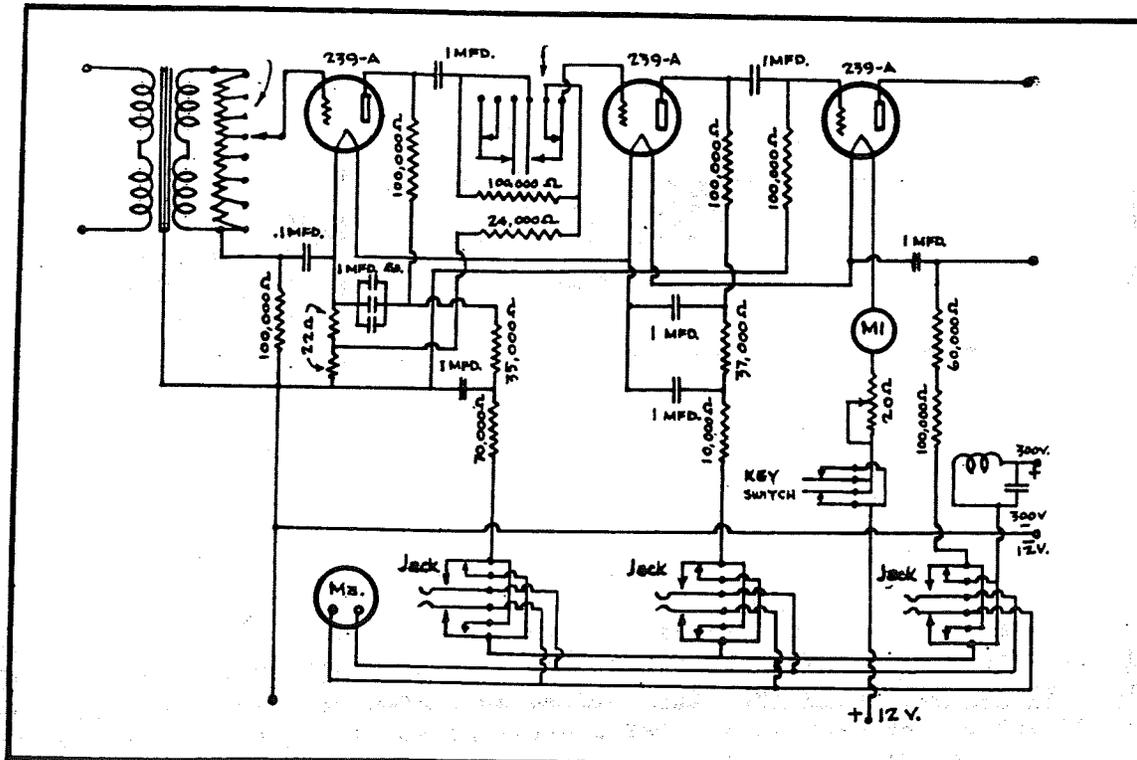


FIG. 4
The W.E. 41-A Amplifier.

D-85943 OR D-86729 AND ITS DIAGRAM APPEARS IN FIG. 3. UPON LOOKING AT THIS DIAGRAM, YOU WILL FIND THAT THE P.E. CELL IS RESISTANCE-CAPACITY COUPLED TO THE FIRST STAGE. THE ACTIVE SURFACE OF THE CELL, WHICH IS THE FILM ON THE INNER SURFACE OF THE GLASS IS CONNECTED TO THE MINUS SIDE OF THE BATTERY AND THE COLLECTOR RING IS CONNECTED THROUGH A TWO MEGOHM RESISTOR TO B PLUS. ALL STAGES EMPLOY THE W.E. 239 TYPE TUBE AND THE FILAMENTS ARE WIRED IN SERIES. THE OUTPUT FEEDS INTO A 500 OHM LINE WHICH CONNECTS TO THE FADER.

A CIRCUIT DIAGRAM OF THE 41-A AMPLIFIER APPEARS IN FIG. 4.
THE 42-A AMPLIFIER

BY REFERRING TO FIG. 2 AGAIN, YOU WILL NOTICE THAT THE 42A AMPLIFIER IS MOUNTED DIRECTLY BELOW THE 41A AMPLIFIER. THIS 42A AMPLIFIER CONSISTS OF A SINGLE TRANSFORMER COUPLED PUSH-PULL OPERATED STAGE EMPLOYING A PAIR OF TYPE W.E. 205D TUBES. (THE CHARACTERISTIC OF THESE TUBES ARE GIVEN IN ONE OF YOUR TUBE CHARTS). THE FILAMENTS ARE OPERATED ON A.C. FROM STEP-DOWN TRANSFORMERS. PLATE VOLTAGES ARE OBTAINED FROM A PAIR OF 205D TUBES WHICH OPERATE AS RECTIFIERS WHEN CONNECTING THE GRID AND PLATE OF EACH TUBE TOGETHER. THIS AMPLIFIER HAS A GAIN OF 25 D.B. AND IS CAPABLE OF DELIVERING 2.4 WATTS OF UNDISTORTED OUTPUT POWER. SEE FIG. 5 FOR A CIRCUIT DIAGRAM OF THE 42A AMPLIFIER.

TO PERMIT THE FILAMENTS TO LIGHT BEFORE THE HIGH PLATE VOLTAGE IS APPLIED TO THE TUBES, THE CONTROL SWITCH IS SET SO THAT ITS FIRST POSITION, THE POINTS A-B AND D-E ARE CLOSED, THUS LIGHTING THE FILAMENTS OF

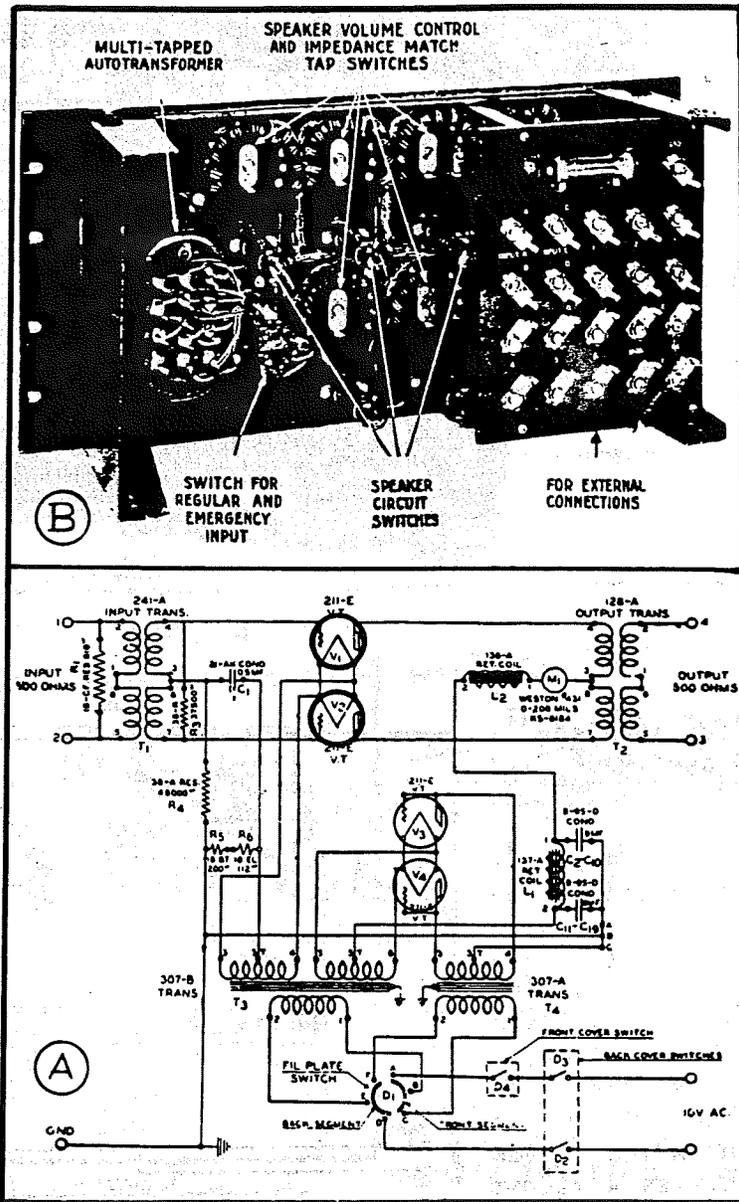


FIG. 6
The W.E. 43-A Amplifier.

THE TUBES. AFTER THE FILAMENTS ARE HOT, THE CONTROL IS MOVED TO POSITION NUMBER TWO AND THE AMPLIFIER THEN GOES INTO OPERATION

THE 43A AMPLIFIER

THIS AMPLIFIER IS SIMILAR TO THE 42A, AND CONSISTS OF A SINGLE TRANSFORMER COUPLED PUSH-PULL STAGE. THIS AMPLIFIER USES TWO 211E TYPE TUBES, GIVING A POWER OUTPUT OF ABOUT 12 WATTS, OR A GAIN OF 6 D.B. IT

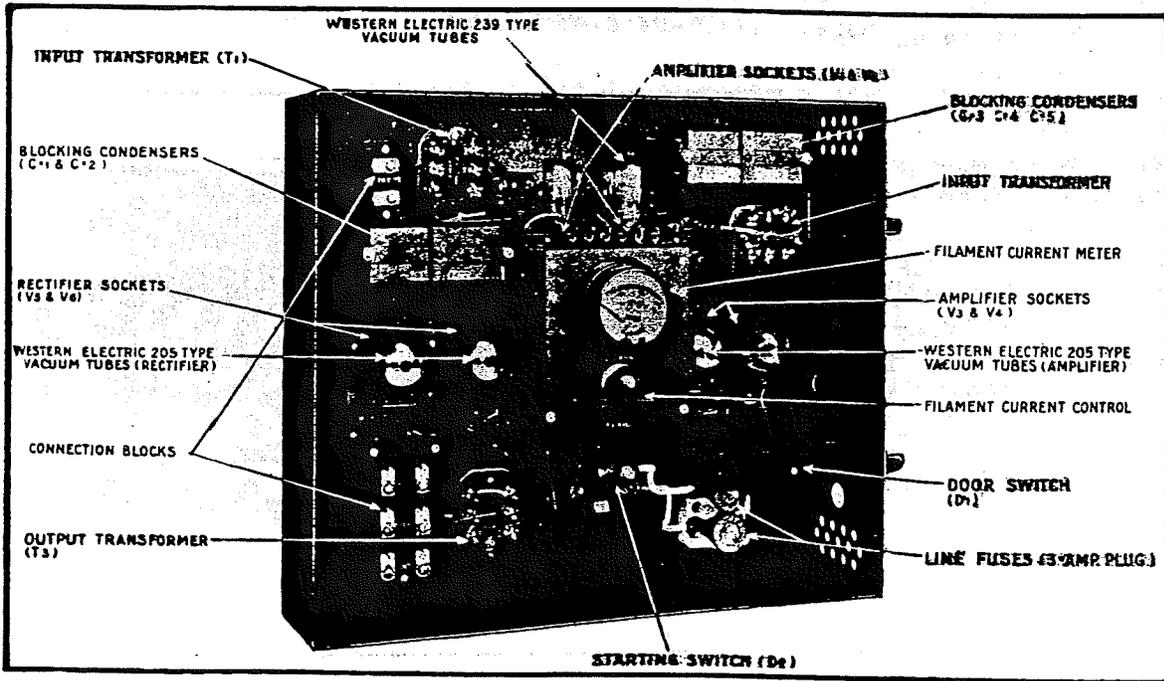


FIG. 7
Internal View of W.E. 46-A Amplifier.

IS DESIGNED FOR A 500 OHM INPUT AND OUTPUT IMPEDANCE.

THE RECTIFIER CONSISTS OF TWO 211E TUBES WITH THEIR PLATE AND GRID TIED TOGETHER IN A FULL-WAVE RECTIFYING CIRCUIT. THE SAME TYPE OF CONTROL SWITCH AS USED IN THE 42A AMPLIFIER A LIGT BEFORE THE PLATE VOLTAGES ARE APPLIED. A CIRCUIT DIAGRAM OF THE 43A

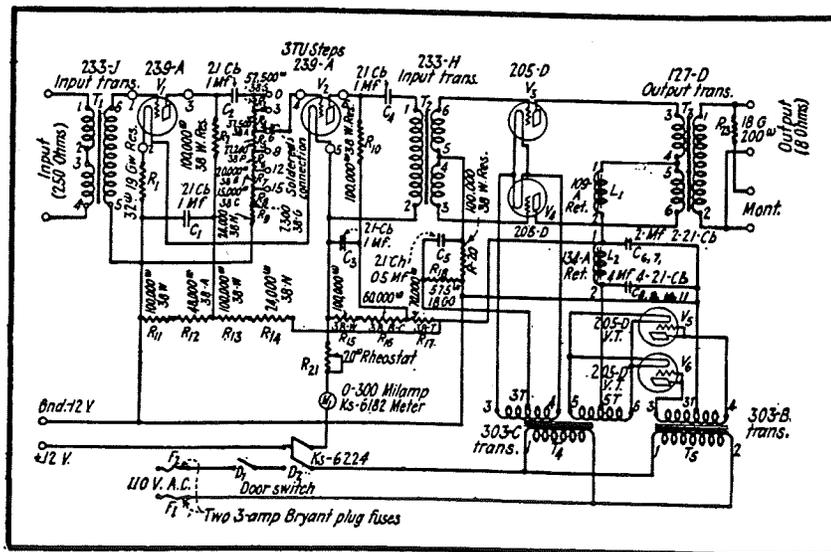


FIG. 8
Diagram of W.E. 46-A Ampl.

AMPLIFIER IS SHOWN IN FIG.6A AND WE ADVISE YOU TO STUDY IT THOROUGHLY BEFORE CONTINUING WITH THIS LESSON.

OUTPUT CONTROL PANEL

THE OUTPUT OF THE 43A AMPLIFIER GOES TO THE 200A CONTROL PANEL THIS UNIT IS THE DISTRIBUTING SYSTEM AND IS SHOWN AT THE TOP OF THE RACK IN FIG.2 A REAR-VIEW OF THE 200A CONTROL PANEL IS SHOWN IN FIGURE 6B.

THE PRINCIPLE PART OF THIS CONTROL PANEL CONSISTS OF A STEP-DOWN AUTO-TRANSFORMER WITH A NUMBER OF INTERMEDIATE TAPS, WHICH ARE CONNECTED TO SEVEN DIAL SWITCHES. THIS PERMITS THE CONTROL OF SIX SPEAKERS AND ONE MONITOR SPEAKER. THE MONITOR SPEAKER HAS A PAD WHICH DROPS THE POWER TO A COMFORTABLE HEARING VALUE.

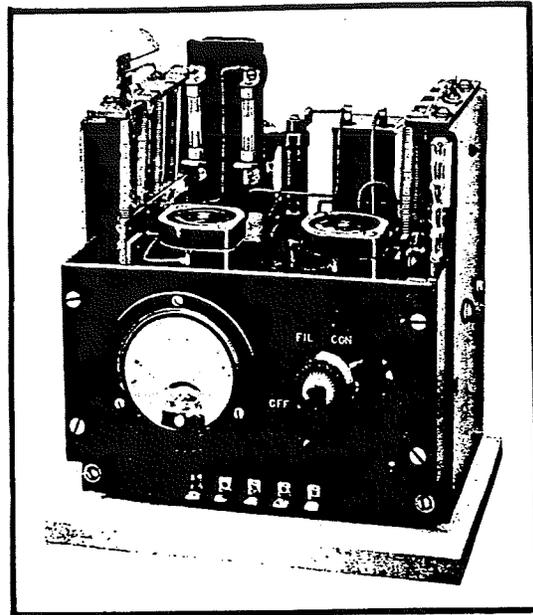


FIG. 9
The W.E. 49-A Amplifier.

OTHER W.E. INSTALLATIONS

THERE ARE SEVERAL OTHER COMPLETE WESTERN ELECTRIC INSTALLATIONS USED FOR VARIOUS PURPOSES. ONE OF THEIR PRODUCTS, THE 46A SYSTEM, IS VERY POPULAR AND USED EXTENSIVELY IN THE SMALLER THEATERS. FOR THE LARGER SHOW HOUSES THERE IS A CHOICE OF SEVERAL INSTALLATIONS, EACH BUILT UP FROM STOCK AMPLIFIERS. THESE STOCK AMPLIFIERS ARE THE 8B, 9A AND 10A ALL OF WHICH WILL BE DISCUSSED IN THE FOLLOWING PAGES.

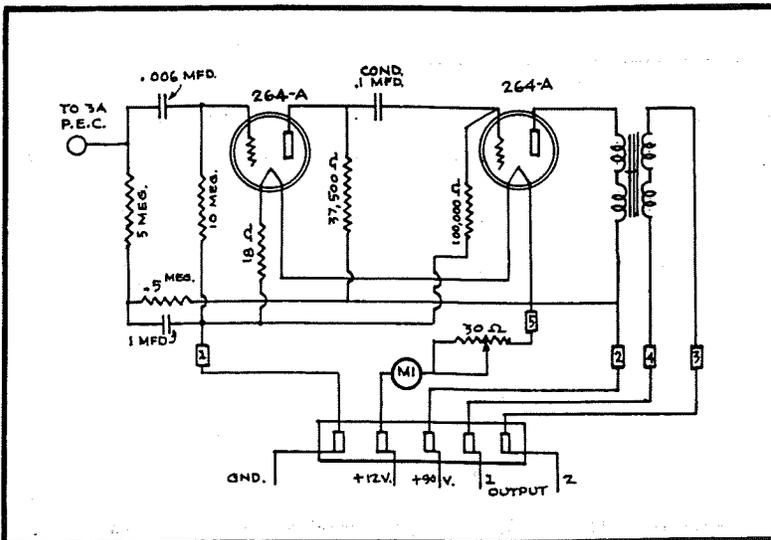


FIG. 10
Circuit of W.E. 49-A Amplifier.

THE 46A SYSTEM

THIS IS A VERY COMPACT SYSTEM AS MAY BE SEEN FROM FIG.7. IT IS A.C. OPERATED, USING SIX AMPLIFYING TUBES, TWO OF WHICH ARE USED AS RECTIFIERS. THE FIRST TWO STAGES EMPLOY W.E. 239A TYPE TUBES AND THE THIRD IS A PUSH-PULL STAGE USING 205D TUBES. THE CIRCUIT DIAGRAM IN FIG.8 CLEARLY ILLUSTRATES THE TYPES OF COUPLING, AND THE POWER SUPPLY SYSTEM.

THE 49A AMPLIFIER

THE 49A, A NEW HIGH-GAIN AMPLIFIER, HAS BEEN BUILT FOR USE WITH THE 46A AMPLIFIER. IT USES THE 3A PHOTO-ELECTRIC CELL AND TWO STAGES OF W.E. 264A TUBES. THE 49A IS USED BETWEEN THE PHOTO-ELECTRIC CELL AND THE MAIN VOLTAGE AMPLIFIER. IT IS MOUNTED IN A RUBBER CUSHIONED CRADLE ON THE PROJECTOR. THE ESSENTIAL PARTS ARE MOUNTED ON A PLATE SUSPENDED BY TEN SPIRAL SPRINGS. (SEE FIG. 9). THE AMPLIFIER USES 264A TUBES IN BOTH STAGES AND IS OPERATED ON D.C. VOLTAGE. A CIRCUIT DIAGRAM IS SHOWN IN FIG. 10.

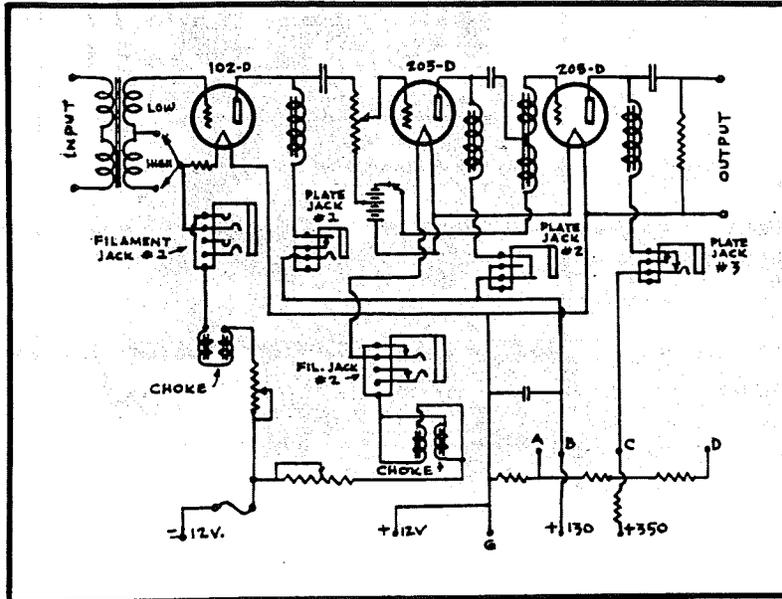


FIG. 11

Circuit of W.E. 8-B Amplifier.

THE FIRST STAGE AND 205D TUBES IN THE SECOND AND THIRD STAGES. AS IT IS CAPABLE OF A GAIN OF 81 D.B., THIS AMPLIFIER CAN BE USED EITHER IN CONJUNCTION WITH A 9A OR A 10A POWER AMPLIFIER. THE GAIN CONTROL FOR THE ENTIRE SYSTEM IS A 22 STEP D.B. VOLUME CONTROL, HAVING AN ATTENUATION OF 3 D.B. PER STEP.

BESIDES BEING EXTENSIVELY USED IN MOTION PICTURE INSTALLATIONS, THE 8B AMPLIFIER IS ALSO VERY POPULARLY EMPLOYED FOR RECORDING AND PUBLIC ADDRESS WORK. WE FREQUENTLY FIND IT USED IN BROADCASTING STUDIOS AND SOUND SYSTEMS ALSO.

THE 9A AMPLIFIER

THIS IS A LOWER POWER AMPLIFIER FOR SMALL THEATERS. IT CONSISTS OF A SINGLE PUSH-PULL STAGE OF 205D TUB

THE 8B AMPLIFIER, SHOWN IN CIRCUIT FORM IN FIG. 11, IS USED AS A HIGH-GAIN VOLTAGE AMPLIFIER, CONSISTING OF A W.E. 102D TUBE IN

THE 8B AMPLIFIER

THE 8B AMPLIFIER, SHOWN IN CIRCUIT FORM IN FIG. 11, IS USED AS A HIGH-GAIN VOLTAGE AMPLIFIER, CONSISTING OF A W.E. 102D TUBE IN

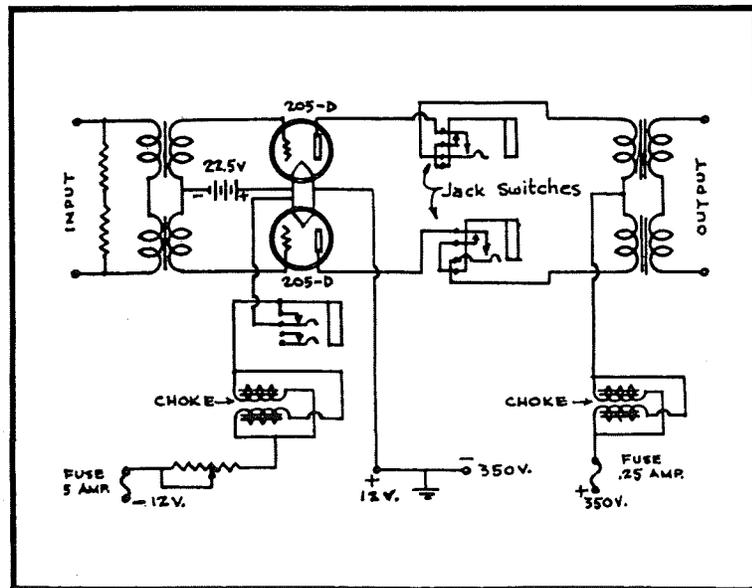


FIG. 12

The W.E. 9-A Amplifier.

ES OPERATING AT A PLATE VOLTAGE OF 350 VOLTS AND A GRID VOLTAGE OF -21 VOLTS. IT HAS A GAIN OF 16 D.B. AND WILL PRODUCE 1.36 WATTS OF UNDISTORTED POWER. OTHER FEATURES OF THIS AMPLIFIER ARE SHOWN IN THE CIRCUIT DIAGRAM OF FIG.12.

THE 10A AMPLIFIER

THIS IS A HIGH-POWER AMPLIFIER USING FOUR 211E TUBES IN A SINGLE PUSH-PULL STAGE, OPERATING AT A PLATE POTENTIAL OF 750 VOLTS FROM A SPECIAL RECTIFIER OR MOTOR GENERATOR, AND A GRID BIAS OF -36 VOLTS OBTAINED FROM BATTERIES. A BLOCK DIAGRAM OF A HIGH POWER INSTALLATION USING THE 8B AND 10A AMPLIFIERS IS SHOWN IN FIGURE 13. THE SAME SYSTEM IN RACK AND PANEL FORM IS SHOWN IN FIGURE 14.

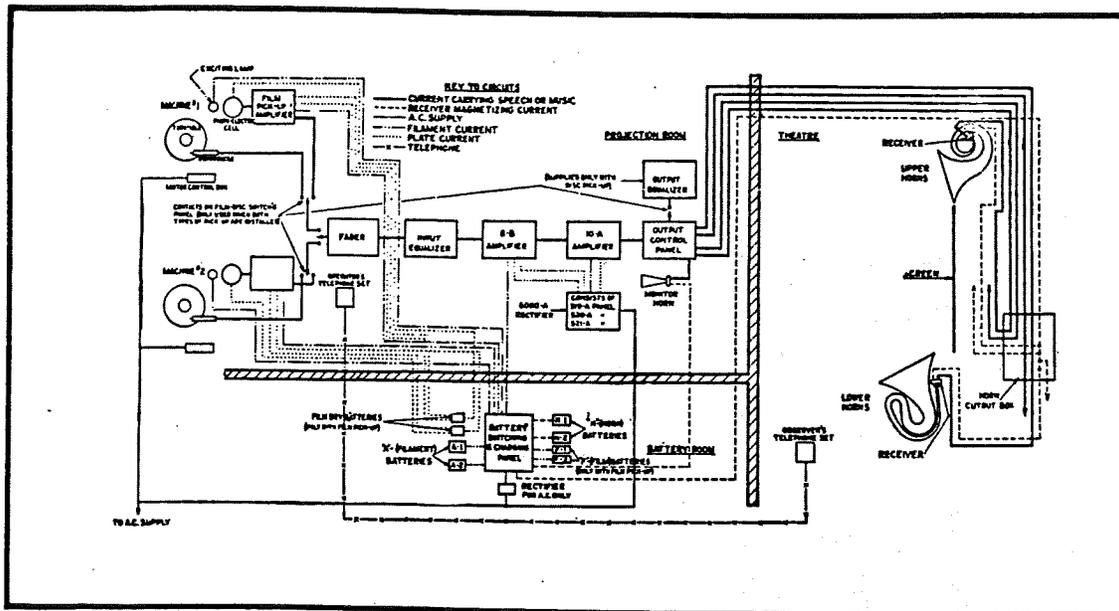


FIG.13

Layout of W.E. Sound Projector System

THE 6000A RECTIFIER

THIS IS THE UNIT THAT SUPPLIES THE PLATE AND FILAMENT VOLTAGE FOR THE LARGE INSTALLATIONS. AS MAY BE SEEN FROM FIGURE 14, IT CONSISTS OF THREE DISTINCT PANELS, WHICH ARE THE 519A, OR FILTER UNIT FOR THE HIGH VOLTAGE RECTIFIER 520A, AND THE PANEL CONTAINING THE PLATE CURRENT METERS.

THE 520A PANEL SUPPLIES 130; 350; AND 750 VOLTS FOR THE VARIOUS AMPLIFIERS. IT EMPLOYS TWO TYPES W.E. 219 RECTIFIER TUBES IN A FULL-WAVE RECTIFYING CIRCUIT. A THREE POSITION SWITCH ENABLES THE FILAMENTS OF ALL TUBES TO LIGHT BEFORE THE PLATE VOLTAGE IS APPLIED.

FILAMENT VOLTAGE FOR THE VARIOUS AMPLIFIERS IS OBTAINED FROM THE 521A PANEL WHICH IS ONLY A STEP-DOWN TRANSFORMER FOR EITHER 110 OR 220 VOLTS A.C. THIS PANEL ALSO CONTAINS A METER FOR MEASURING FILAMENT CURRENT.

W.E. MISCELLANEOUS EQUIPMENT

THERE IS STILL ANOTHER VERY IMPORTANT ITEM TO COMPLETE OUR INSTALLATION, AND THAT IS THE FADER. FIGURE 15 SHOWS A FRONT VIEW OF THE FADER AND FIG. 16 A CIRCUIT DIAGRAM. BY STUDYING THE DIAGRAM YOU WILL FIND THAT THIS FADER IS A D.B. VOLUME CONTROL THAT WILL ATTENUATE THE SIGNAL FROM TWO CHANNELS. THE RESISTANCE NETWORK ON THE INPUT AND OUTPUT SIDES OF THE FADER ARE H PADS.

SOUND HEAD

THE SUBJECT OF THE SOUND HEAD WAS TAKEN UP IN A PREVIOUS LESSON, BUT TO MAKE OUR DISCUSSION COMPLETE WE ARE SHOWING YOU THE W.E. SOUND HEAD IN FIGURE 17. BY LOOKING AT THIS PICTURE WE CAN TRACE THE PATH OF

THE FILM THROUGH THE PROJECTOR AND SOUND HEAD. NOTICE THE SCREWS ON THE EXCITING LAMP WHICH ENABLE ONE TO ADJUST THE LAMP TO ANY DESIRED POSITION.

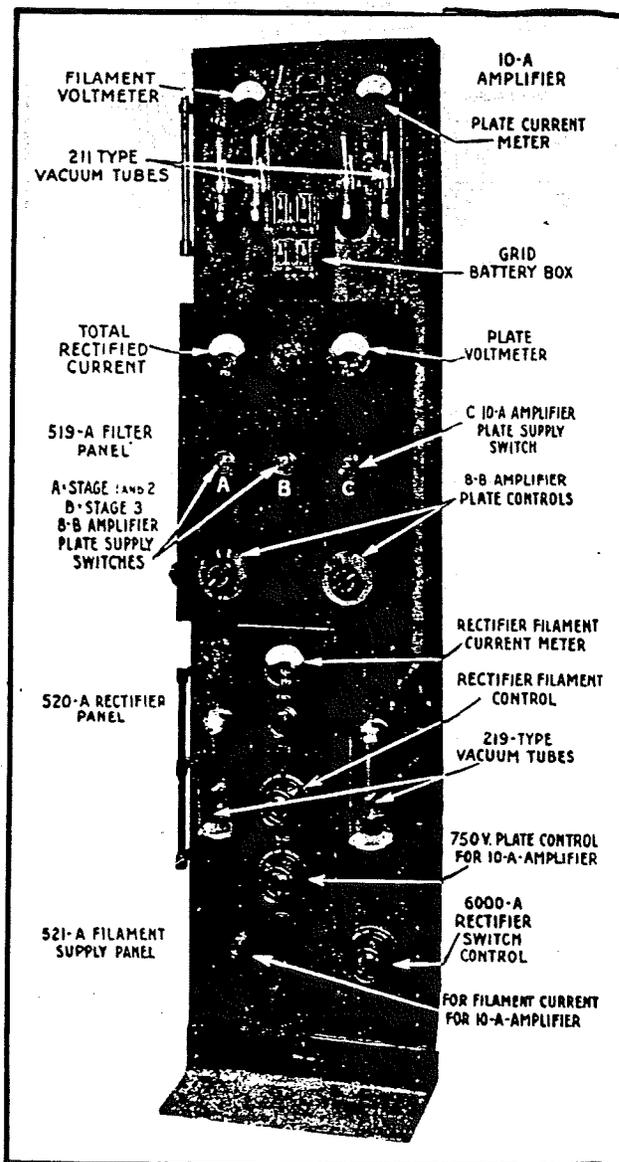


FIG. 14
The Complete Panel.

R.C.A. PHOTOPHONE
SOUND EQUIPMENT

LIKE THE ELECTRIC RESEARCH PRODUCTS CO., THE R.C.A. PHOTOPHONE CO. BUILDS AND INSTALLS SEVERAL TYPES OF SOUND SYSTEMS. THESE ARE CLASSIFIED INTO THE A TYPE, WHICH IS NO LONGER MANUFACTURED, THE B SYSTEM WHICH IS USED FOR HOUSES OF 2,500 OR MORE SEATS AND THE FUNDAMENTAL UNIT FOR THE SMALLER INSTALLATIONS SUCH AS C SYSTEM FOR HOUSES BETWEEN 800 AND 2,500; D SYSTEMS FOR HOUSES OF 800; F SYSTEMS FOR HOUSES OF 700; AND G SYSTEMS FOR HOUSES OF 500 OR LESS. AMONG THE NEWEST R.C.A. INSTALLATIONS IS THE HIGH FIDELITY SOUND SYSTEM WHICH WILL BE DISCUSSED ON THE FOLLOWING PAGES. ALL OF THESE NEW SYSTEMS OPERATE FROM THE A.C. POWER SUPPLY LINE.

TYPE A AMPLIFIERS

THE TYPE A AMPLIFIER IS A VERY LARGE UNIT, CONSISTING OF TWO COMPLETE SYSTEMS IN RACKS, SIDE BY SIDE, AS SHOWN IN FIG. 18. THE AMPLIFIERS WOULD BE IDENTICAL WERE IT NOT

LIFIER CONSISTS OF SIX TYPE 210 TUBES IN 3 STAGES OF PUSH-PULL OPERATION. A CIRCUIT DIAGRAM IS SHOWN IN FIG.20. ALL OPERATING VOLTAGES ARE OBTAINED FROM BATTERIES USING 135 VOLTS FOR THE PLATE, -9 VOLTS FOR GRID BIAS, AND 7.5 VOLTS FOR THE FILAMENTS. THIS AMPLIFIER IS ALSO USED FOR THE B AND C INSTALLATIONS

POWER AMPLIFIER

THE VOLTAGE AMPLIFIER DRIVES FOUR POWER AMPLIFIERS THAT ARE IN USE ALL THE TIME. EACH POWER AMPLIFIER CONSISTS OF A STAGE OF PUSH-PULL USING 250 TYPE TUBES. "B" VOLTAGE IS OBTAINED FROM A FULL WAVE RECTIFIER EMPLOYING TYPE 81 TUBES.

BY LOOKING AT FIG. 21 YOU CAN FORM A GOOD MENTAL PICTURE OF THE CIRCUIT DIAGRAM. THE LARGE RECTIFIER SUPPLIES THE VOLTAGE AND CURRENT FOR THE MAGNETIZING OF THE SPEAKER FIELDS.

TYPE C SYSTEM

THIS INSTALLATION CONSISTS OF THE SAME VOLTAGE AND POWER AMPLIFIERS THAT ARE USED IN TYPE B SYSTEMS, EXCEPT ONLY TWO POWER AMPLIFIERS ARE USED.

TYPE D SYSTEM

THIS SYSTEM IS ALMOST IDENTICAL TO THE TYPE C SYSTEM, THE ONLY DIFFERENCE BEING THAT TYPE D EMPLOYS ONLY ONE VOLTAGE AND POWER AMPLIFIER, AND IT DOES NOT EMPLOY THE TONE COMPENSATION THAT IS USED IN TYPE C.

TYPE F AMPLIFIERS

THIS SYSTEM IS SIMILAR

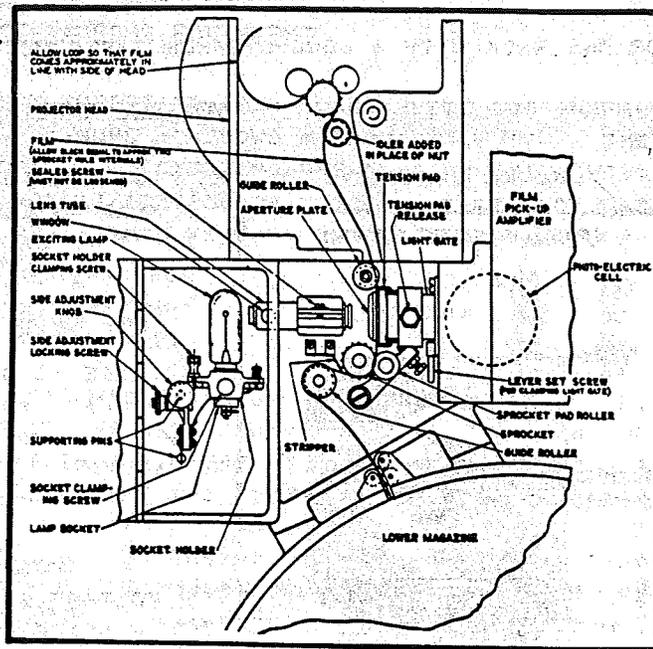


FIG. 17
The W.E. Sound Head.

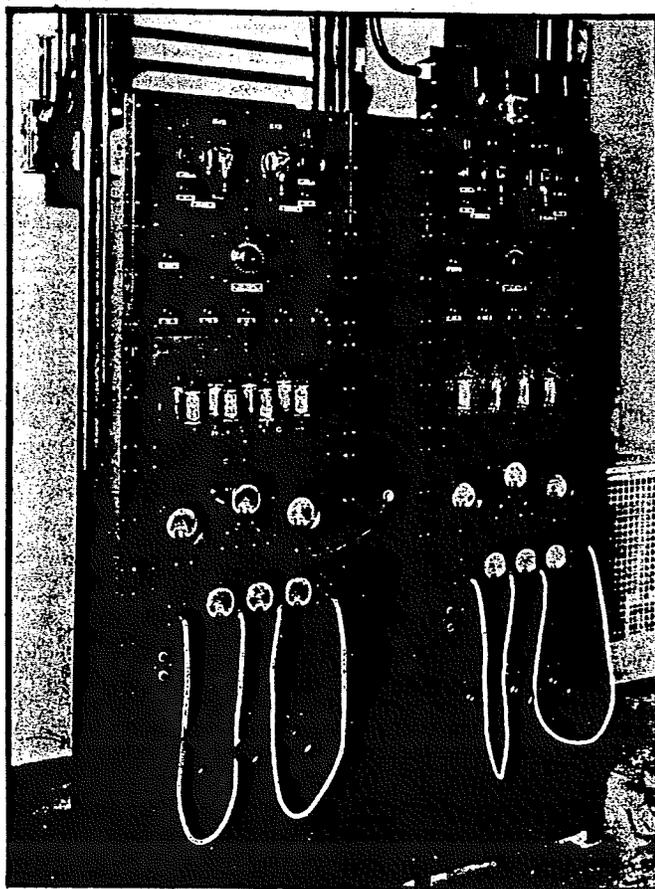


FIG. 18
Type "A" R.C.A. Amplifier Rack.

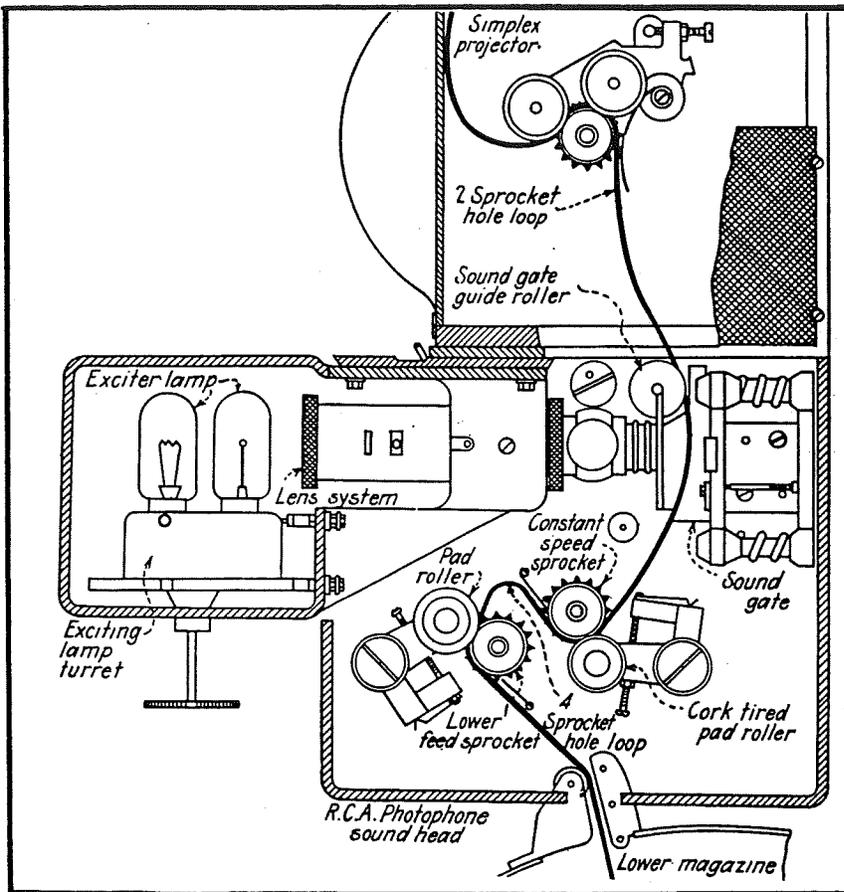


FIG. 19
The Simplex Sound Head.

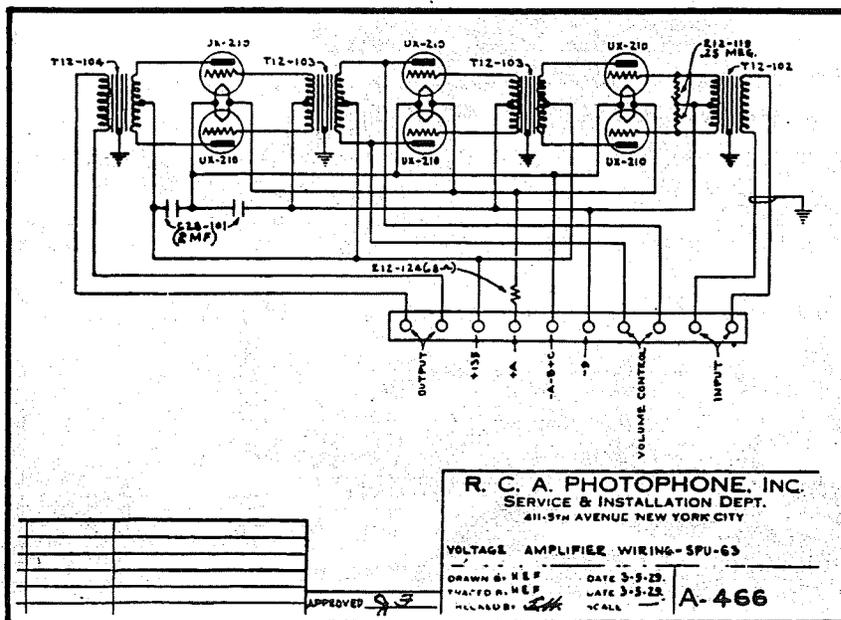


FIG. 20
R.C.A. Voltage Amplifier.

TO TYPE D IN THAT ONE VOLTAGE AND ONE POWER AMPLIFIER IS USED. THE SAME POWER AMPLIFIER IS EMPLOYED BUT THE VOLTAGE AMPLIFIER IS DIFFERENT, CONSISTING OF THREE PUSH-PULL STAGES OF 112A TYPE TUBES OPERATING FROM BATTERIES. THE CIRCUIT DIAGRAM IS SHOWN IN FIG. 22.

TYPE G SYSTEM

THIS IS ONE OF THE NEWER TYPE INSTALLATIONS, CONSISTING OF A VOLTAGE AMPLIFIER OF THREE STAGES OF IMPEDANCE COUPLED 112A TUBES AND A POWER AMPLIFIER OF FOUR 250 TYPE TUBES IN A PUSH-PULL PARALLEL STAGE. ALL OPERATING VOLTAGES, EXCEPT THREE C BATTERIES FOR GRID BIAS, ARE OBTAINED FROM A THREE-UNIT MOTOR GENERATOR SET CONSISTING OF A MOTOR, A 12 VOLT GENERATOR, AND A 600 VOLT GENERATOR.

THE SOUND HEAD FOR TYPE G EQUIPMENT IS DIFFERENT FROM THE ONE USED IN THE OTHER SYSTEMS. A NEW TYPE GATE, KNOWN AS THE "IMPEDANCE GATE" IS EMPLOYED AND THE DAMPING

POTATE, CAUSING THE FLYWHEEL TO TURN DUE TO THE VISCOSITY OF THE OIL. THIS NEW SOUND HEAD IS SHOWN IN FIG. 24, WITH ALL PARTS LABELED. AS THE MOTOR IS BUILT INTO THE SOUND HEAD CASTING, IT ELIMINATES THE USE OF BELTS OR CHAINS FOR DRIVING PURPOSES.

TYPE PG-32 SYSTEM

THIS SYSTEM, IS COMPLETE FROM PROJECTORS TO SPEAKERS AND IS USED ONLY WITH SIMPLEX MACHINES. THE SYSTEM INCLUDES SEVERAL NOVEL CHANGES FROM OLDER EQUIPMENT, A SEPARATE EXCITER LAMP SUPPLY VOLTAGE, PHOTO-CELL EQUALIZING POTENTIOMETER, REMOTE VOLUME CONTROLS AND THE NEW SOUND HEAD JUST DESCRIBED. A SCHEMATIC DIAGRAM OF THE COMPLETE INSTALLATION IS SHOWN IN FIG. 25. BY STUDYING FIG. 25, YOU WILL FIND THAT THE 868 P.E. CELL IS COUPLED TO THE VOLTAGE AMPLIFIER BY AN IMPEDANCE MATCHING TRANSFORMER THROUGH THE SWITCHING PANEL AND FADER.

THE FIRST STAGE EMPLOYS A TYPE 224-A TUBE WHICH IS RESISTANCE COUPLED TO THE 56 TUBE IN THE SECOND STAGE. THE FILTER UNIT IN THE PLATE CIRCUIT OF THIS STAGE PROVIDES A SHARP CUT-OFF AT 9500 CYCLES. BY PARALLELING THE 950 MMFD. CONDENSER WITH A 550 MMFD. CONDENSER AND CHANGING TAPS ON THE COIL, A CUT-OFF OF 7000 CYCLES MAY BE HAD. THE 56 STAGE IS COUPLED TO A PUSH-PULL STAGE EMPLOYING TWO 245 TUBES AS A VOLTAGE AMPLIFIER.

THE POWER AMPLIFIER IS A PUSH-PULL STAGE USING 845 TYPE TUBES. A PICTURE OF OUR COMPLETE AMPLIFYING SYSTEM MAY BE FOUND IN FIG. 26. THIS AMPLIFIER SYSTEM IS ALSO KNOWN AS TYPE PA-52. PLATE VOLTAGE FOR THE VOLTAGE AMPLIFIER AND POLARIZING VOLTAGE FOR THE PHOTO ELECTRIC CELL IS

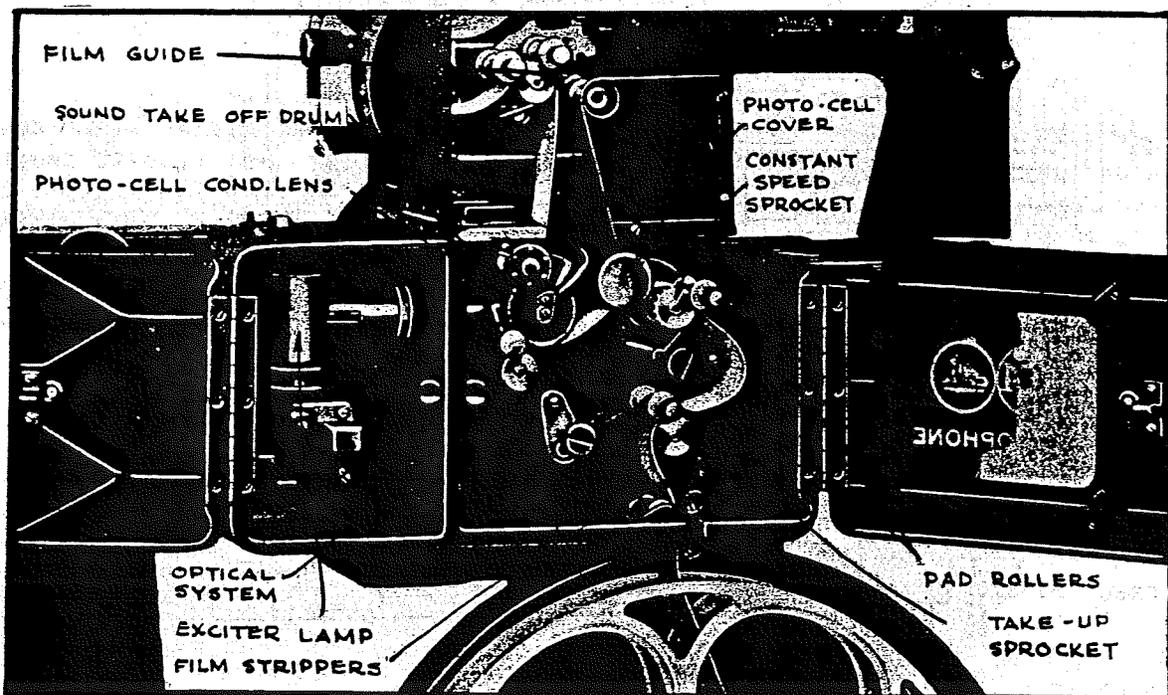


FIG. 24

Sound Head for Type G. System.

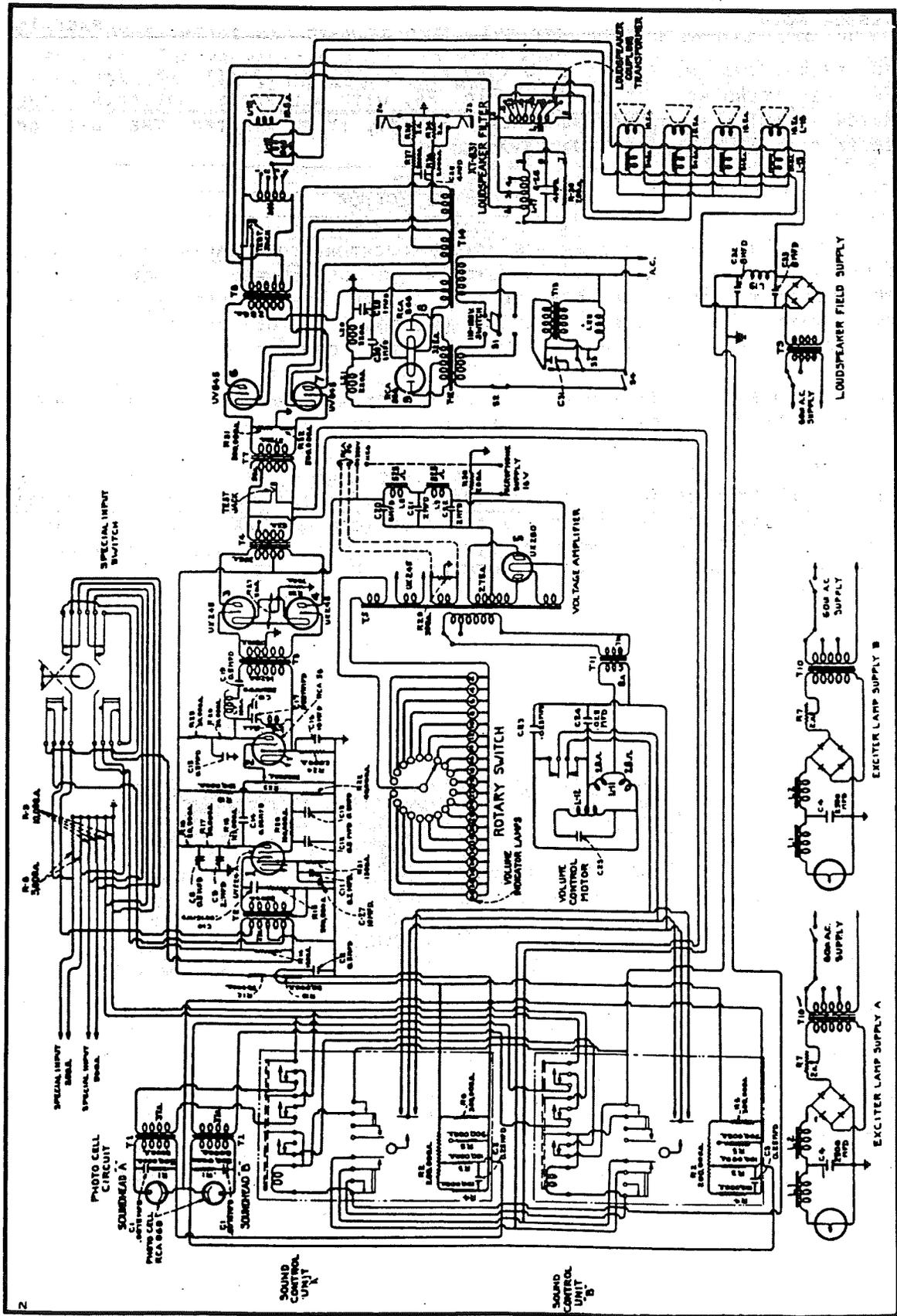


FIG. 25
Circuit Diagram

OBTAINED FROM A WELL FILTERED RECTIFIER EMPLOYING A TYPE 80 TUBE. THE POWER AMPLIFIER RECEIVES ITS PLATE SUPPLY FROM A HIGH VOLTAGE RECTIFIER CONTAINING TWO TYPE 866 MERCURY VAPOR TUBES. TO PREVENT DAMAGE TO THE TUBES, A TIME DELAY CIRCUIT PERMITS THE FILAMENT TO HEAT UP BEFORE THE HIGH PLATE VOLTAGE IS EMPLOYED.

BECAUSE OF THE HIGH VOLTAGE, EXTREME CARE MUST BE TAKEN TO PREVENT PERSONAL INJURY. A SAFETY SWITCH IS CONNECTED IN THE CIRCUIT WHICH TURNS OFF THE HIGH VOLTAGE, WHENEVER THE COVERING FOR THE POWER AMPLIFIER IS REMOVED.

THE EXCITER LAMPS RECEIVE DIRECT CURRENT FROM SEPARATE DISC RECTIFIERS, ONE BEING EMPLOYED FOR EACH LAMP. THE CURRENT IS VERY WELL FILTERED TO OBTAIN A PURE DIRECT CURRENT.

OPERATING INSTRUCTIONS

TO START THE EQUIPMENT, TURN "ON" THE A.C. LINE SWITCH AT THE TOP OF THE RACK ONE MINUTE BEFORE THE SYSTEM IS TO BE USED. AFTER 30 SECONDS, THE TIME DELAY APPLIES THE PLATE VOLTAGE TO THE TUBES AND A BLUISH GLOW WILL APPEAR AROUND THE PLATES OF THE 866 RECTIFIER TUBES.

AFTER THE MACHINES HAVE BEEN CLEANED AND OILED, THREAD THE FILM THROUGH THE PROJECTOR AND SOUND HEAD, LEAVING THE REQUIRED LOOPS. TURN ON THE EXCITER LAMP BY THROWING THE SWITCH ON THE BACK OF THE SOUND HEAD TO THE "ON" POSITION. START THE PROJECTOR BY TURNING THE MOTOR SWITCH TO THE "ON" POSITION. AFTER THE MOTOR HAS GAINED SPEED (ABOUT TWO SECONDS) FADE THE SOUND CIRCUIT ON THIS PROJECTOR BY DEPRESSING AND RELEASING THE FADER SWITCH HANDLE ON THE SOUND CONTROL UNIT. WHEN THE SOUND CIRCUIT IS COMPLETE, THE INDICATOR LAMP ON THE CONTROL UNIT WILL LIGHT. THE INPUT CONTROL UNIT IS NOT USED AS THE VOLUME CONTROL. INSTEAD, A GAIN CONTROL IS EMPLOYED FOR EACH AMPLIFIER AND IS CONTROLLED BY REMOTE CONTROL BUTTONS. TO STOP THE EQUIPMENT, IT IS ONLY NECESSARY TO TURN "OFF" THE A.C. LINE SWITCH ON THE AMPLIFIER RACK.

THE PG-65 SYSTEM

THIS IS A SMALLER INSTALLATION THAN THE PG-32 EQUIPMENT. IT IS SUITABLE FOR HOUSES HAVING A CAPACITY OF 800 SEATS. A PS-24 TYPE SOUND HEAD IS EMPLOYED, THE OUTPUT OF WHICH IS IMPEDANCE MATCHED TO THE GRID OF A 57 TYPE TUBE. THE 57 TUBE IS RESISTANCE COUPLED TO A 56 TUBE EMPLOYING A 500,000 OHM VOLUME CONTROL IN THE GRID CIRCUIT. THIS IS USED AS THE MAIN GAIN CONTROL.

FROM THE 56 STAGE, THE SIGNAL FEEDS TO TWO 56'S IN A PUSH-PULL STAGE WHICH IN TURN DRIVES A PUSH-PULL POWER STAGE OF 2A3'S DELIVERING APPROXIMATELY 10 WATTS OF UNDISTORTED POWER. A PANEL WIRING DIAGRAM OF THE AMPLIFYING SYSTEM, KNOWN ALSO AS TYPE PA-96A1, IS SHOWN IN FIG. 27.

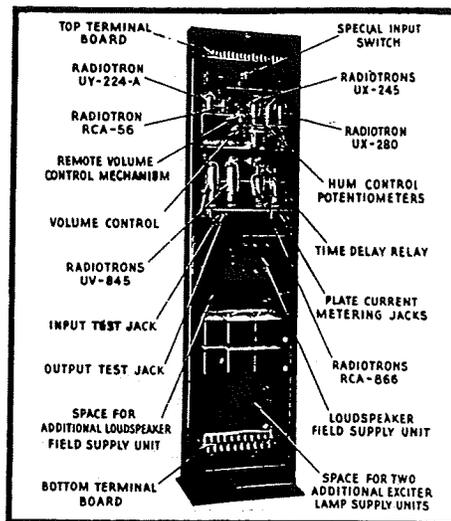


FIG. 26

Rear View of Ampl. Rack

PLATE VOLTAGES FOR THE AMPLIFIER AND THE POLARIZING VOLTAGE FOR THE P.E. CELL ARE OBTAINED FROM A FULL WAVE RECTIFIER CONSISTING OF TWO TYPE 80 TUBES IN PARALLEL. THE STAGE LOUDSPEAKERS ARE ENERGIZED BY USING THE FIELD COILS AS THE FILTER CHOKES IN THE RECTIFIER SYSTEM.

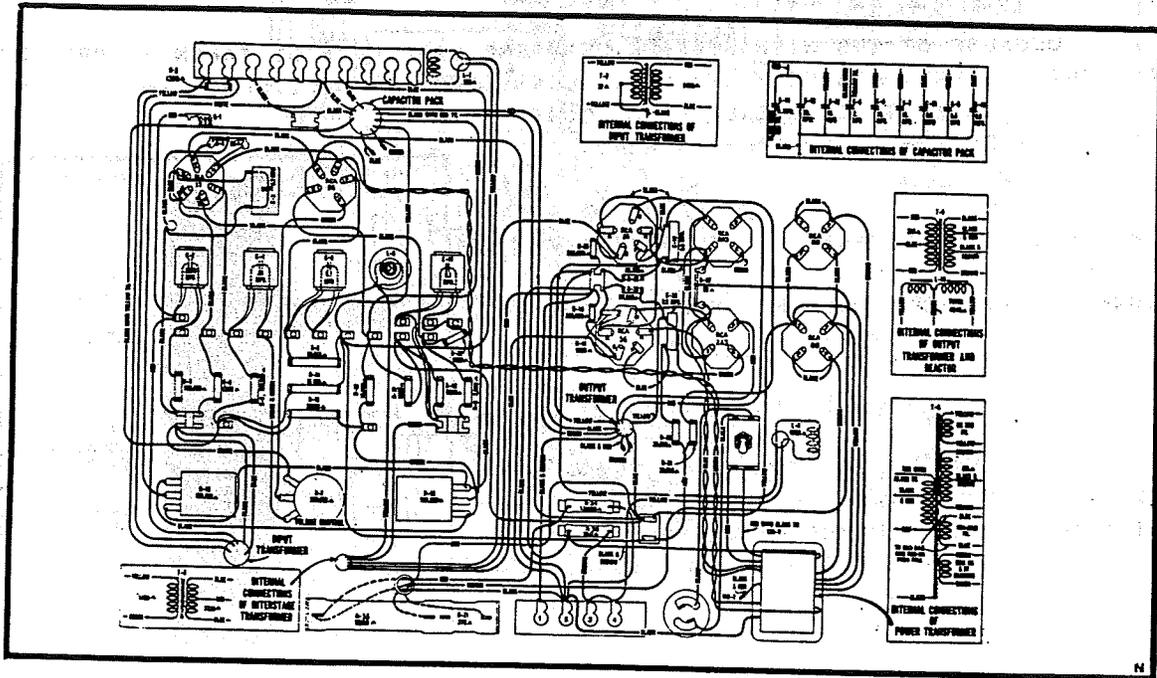


FIG. 27

Amplifier Panel Wiring

DIRECT CURRENT FOR THE EXCITER LAMPS IS OBTAINED FROM A WELL FILTERED DISC TYPE RECTIFIER, ONE BEING EMPLOYED FOR EACH LAMP. AS THERE IS NOT SUFFICIENT POWER FROM THE MAIN AMPLIFIER TO OPERATE A MONITOR SPEAKER BESIDES THE STAGE SPEAKERS, A SPECIAL POWER AMPLIFIER IS PROVIDED TO SUPPLY POWER TO THE MONITOR SPEAKER. THIS AMPLIFIER CONSISTS OF A PUSH-PULL STAGE EMPLOYING 45 TYPE TUBES. THE OPERATING VOLTAGE IS OBTAINED FROM A 80 TYPE RECTIFIER, WHICH TOGETHER WITH THE AMPLIFIER STAGE AND SPEAKER IS MOUNTED IN A STEEL CABINET. THE OPERATING VOLTAGE AND CURRENT ARE:

TUBE	GRID VOLTAGE	SCREEN VOLTAGE	PLATE VOLTAGE	PLATE CURRENT	FILAMENT VOLTAGE
57	1.4	40	120	1.2	2.5
56's	8.4	--	180	4.3	2.5
2A3's	40	--	260	60	2.5

THE TOTAL PLATE CURRENT DRAIN IS ABOUT 140 MILLIAMPERES. THE FIDELITY CURVE EXTENDS FROM 50 TO 10,000 CYCLES. THE AMPLIFIER IS CONNECTED WHEN BUILT SO THAT IT COVERS THE RANGE WITH A RISING CHARACTERISTIC TO 3000 CYCLES AND THEN DROPS OFF AT 5000 CYCLES. THIS CURVE MAY BE VARIED BY MAKING MINOR CIRCUIT CHANGES, A FLAT RESPONSE BEING OBTAINED

WHEN THE BYPASS CONDENSER ACROSS THE BIAS RESISTORS OF THE FIRST TWO STAGES IS REMOVED. A SLIGHT RISE UP TO 3000 CYCLES MAY BE HAD BY SHUNTING THE BIAS RESISTOR OF THE SECOND STAGE WITH A .1 MFD CONDENSER AND 1,000 OHM RESISTOR IN SERIES. HIGH FREQUENCY RESPONSE MAY BE OBTAINED BY SHORTING OUT RESISTOR R-27, OR REMOVING THE BYPASS CONDENSER FROM THE BIAS RESISTOR OF THE SECOND STAGE AND SHUNTING THE 57 TUBE'S BIAS RESISTOR WITH A .2 MFD CONDENSER. AN INCREASE IN LOW FREQUENCY RESPONSE MAY BE OBTAINED BY REMOVING THE 60,000 OHM RESISTOR R-32 AND R-33 IN THE GRID CIRCUIT OF THE 2A3's.

TABLE I							
CHARACTERISTICS OF WESTERN ELECTRIC TUBES							
	PLATE VOLTAGE	PLATE CURRENT	FILAMENT VOLTAGE	FILAMENT CURRENT	MU.	PLATE RESISTANCE	BIAS VOLTAGE
239-A	100	1.9 MA	1.	.25A	5.6	14,800	-6
264-A	100	2.6 "	1.5	.20	7	11,800	-7
205-D	370	21 "	4.5	1.6	7.3	4,450	-30
211-DE	1000	65 "	10	3	12.5	3,200	
219	5000	400 "	14	6	RECTIFIER.....		
102-D	160	.75 "	2	.97	30	60,000	-1.5
215-A	100	2	1	.25	6	20,000	-6

WESTERN ELECTRIC TUBES

IN TABLE I YOU ARE GIVEN THE MORE IMPORTANT OPERATING CHARACTERISTICS OF THE MOST POPULAR SERIES OF WESTERN ELECTRIC TUBES.

FROM WHAT YOU HAVE ALREADY LEARNED FROM YOUR PREVIOUS STUDIES IN THIS COURSE, YOU SHOULD EXPERIENCE NO DIFFICULTY IN ACQUIRING A GOOD UNDERSTANDING OF THE EQUIPMENT WHICH IS DESCRIBED IN THIS LESSON. MUCH OF THIS SOUND PICTURE AMPLIFYING EQUIPMENT IS IDENTICAL TO THAT USED FOR OTHER PURPOSES, WITH CERTAIN CHANGES AND ADDITIONS WHICH SERVE TO BEST ADAPT IT TO SOUND PICTURE WORK.

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EXAMINATION QUESTIONS

LESSON NO. SP-4

Open ears, a free mind and
a closed mouth are a blessing to their
owner.

J. A. ROSENKRANZ

1. - DRAW A DIAGRAMMATIC SKETCH WHICH ILLUSTRATES THE LAYOUT OF THE SOUND PICTURE EQUIPMENT IN A TYPICAL THEATER, NAMING ALL OF THE VARIOUS UNITS.
2. - DESCRIBE A WESTERN ELECTRIC SOUND INSTALLATION FOR A MOTION PICTURE THEATER.
3. - DESCRIBE AN R.C.A. PHOTOPHONE SOUND INSTALLATION FOR A MOTION PICTURE THEATER.
4. - MAKE A SKETCH OF A TYPICAL SOUND HEAD AS EMPLOYED ON A MOTION PICTURE PROJECTOR AND NAME ITS PARTS.
5. - DESCRIBE SOME OF THE MORE IMPORTANT FEATURES OF THE 43A WESTERN ELECTRIC AMPLIFIER.
6. - EXPLAIN HOW YOU WOULD OPERATE THE TYPE PG-32 PHOTOPHONE EQUIPMENT.
7. - WHAT ARE THE OPERATING CHARACTERISTICS OF SOME OF THE MORE IMPORTANT TYPES OF WESTERN ELECTRIC TUBES?
8. - DRAW A CIRCUIT DIAGRAM OF THE 46-A WESTERN ELECTRIC AMPLIFIER AND EXPLAIN HOW IT IS USED.
9. - DRAW A CIRCUIT DIAGRAM OF THE R.C.A. VOLTAGE AMPLIFIER.
10. - DRAW A CIRCUIT DIAGRAM OF THE R.C.A. POWER AMPLIFIER.