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MOTIOGRAPH - MIRROPHONIC
SOUND SYSTEMS

EQUIPMENT BULLETIN E-142 (Issue 1) (6-15-44) AMPLIFIERS, PA & MA-7505-A

1. ASSOCIATED DRAWINGS

APA-2637 PA-7505-A Amplifier, Schematic
APA-2638 PA-7505-A Amplifier, Wiring Diagram
LMA-2650 MA-7505-A Amplifier, Schematic
LMA-2649 MA-7505-A Amplifier, Wiring Diagram
LSS-7540 7505-A Type Amplifiers, Equalization Curves

2. DESCRIPTION

(a) The PA-7505-A Amplifier is a chassis-type preamplifier intended for use in motion picture sound systems. Individual input stages for two reproducers ("sound heads") are provided, and these work into a common output stage through a commutator type changeover switch and master volume control potentiometer. The input stages consist of 6SJ7 type vacuum tubes working as pentodes in the usual self-biased circuit. The plate circuits include auxiliary potentiometers to provide facilities for varying the gain of one stage with respect to the other for reproducer output balancing purposes. Coupling condensers are of a specially sealed type having exceptionally high insulation resistance.

The output stage is also a 6SJ7 type vacuum tube, triode connected, and self-biased. Its plate circuit is arranged to supply, via a low-capacity coaxial cable, signal voltage to the associated MA-7505-A Amplifier (in dual type systems, two such amplifiers). A.C. for tube heaters and D.C. for plate and screen circuits and for photocell polarizing currents are obtained from the associated MA-7505-A Amplifier.

The chassis is designed to be mounted in the associated cabinet on one side; tubes and auxiliary balancing controls occupy the opposite, or upper side, and the conventional "bottom" of the chassis faces outward so that all components are easily accessible for tests or servicing. The changeover switch and main volume control are mounted on an upright bracket at one corner of the chassis with shafts horizontal so they may be controlled from either projector operating position by means of extension control shafts.

(b) The MA-7505-A Amplifier is also a chassis-type unit intended for use as an output or intermediate power amplifier in motion picture sound systems. The chassis is mounted on one side in the associated cabinet, with tubes occupying the opposite, or upper side, as in the case of the PA-7505-A Amplifier. Likewise,

the conventional chassis "bottom" faces outward, but in the MA-7505-A Amplifier it is provided with a hinged metal cover plate which thus serves as a front panel, and carries the monitor volume control and the plate current meter and switches. The hinge arms are designed to allow the panel to be swung outward and upward to a rest position exposing the entire interior of the chassis, thus permitting ready access for inspection and servicing.

Electrically, the amplifier consists of a triode connected 6SJ7 type vacuum tube as an input stage driving one of the 6L6 type push-pull output tubes through a resistance-capacity coupling circuit. A suitable proportion of this driving voltage is applied to the grid of another triode connected 6SJ7 type vacuum tube acting as a phase invertor to drive the remaining 6L6 type push-pull output tube via another resistance-capacity circuit.

Separate plate windings for each 6L6 tube are provided in the output transformer so that plate currents may be individually metered for balancing purposes. The transformer secondary provides nominal output impedances of 16 and 32 ohms to permit one, or two amplifiers in parallel, to be directly connected to stage loudspeaker systems of 16 ohms input impedance. An extension of the secondary winding to nominal 500 ohm impedance provides signal voltage, via a grid potentiometer, to an auxiliary 6K6 type vacuum tube operating as a pentode amplifier to serve the associated projection room monitor loudspeaker, which includes the output transformer for this stage.

All amplifier stages are self-biased. Feedback voltage from the output transformer secondary is introduced into the grid circuit of the input tube across its bias resistor to stabilize and improve amplifier performance, and to provide some of the facilities for equalizing the frequency response of the sound system to suit auditorium acoustical characteristics. The feedback circuit includes for the latter purpose a resistance-capacity network which may be connected in various ways to vary the feedback voltage with respect to frequency, and this in turn causes the amplifier frequency response characteristic to change in an inverse manner as required. Sharp cutoff of the amplifier frequency response beyond the range needed for motion picture service is provided by the rather large capacity across the plates of the 6L6 type tubes in combination with the leakage reactance of the output transformer. Other circuit elements involved in frequency response adjustments include an undersize coupling condenser in the grid circuit of the input tube for reducing low frequency response, and an adjustable resistance-capacity network in its plate circuit for providing various amounts of high frequency attenuation. Use of these elements and of those in the feedback circuit is discussed in greater detail in section 5.

The amplifier power circuit consists of a heavily filtered choke-input full wave rectifier using a 5Z3 vacuum tube. Except for the input choke, all filter circuits are of the resistance-capacity type, and all major filter condensers, including those in the PA-7505-A Amplifier, are standard double 8 MF, 475 volt units operating well under their rated voltage. The power transformer primary has taps to accommodate line voltages from 105 to 125 volts. The primary circuit includes a switch located on the top of the amplifier chassis for convenience in servicing, and a special fuse block and fuse, with spare fuse holder, to protect the amplifier against overloads caused by tube or other component failures. One low voltage secondary serves the heaters of the MA-7505-A Amplifier tubes, and another is connected to terminals on the main terminal strip for the extension heater circuit to the tubes of the associated PA-7505-A Amplifier. High voltage D.C. for this amplifier is also provided from the rectifier-filter circuits.

Gain adjustment over a range of 6 db for balancing paralleled MA-7505-A Amplifiers is provided by the multi-unit grid resistance and movable grid lead in the input stage. This adjustment may also be used, in single amplifier systems, to adjust the system gain so that average recordings will run at a PA-7505-A Amplifier volume control setting near the middle of its range.

3. COMPONENTS AND CHARACTERISTICS

(a) Major components and their Motiograph part numbers are shown on the respective circuit diagrams of the PA and MA-7505-A Amplifiers.

(b) The PA-7505-A Amplifier requires as associated equipment the following items. When the amplifier is supplies as part of a Motiograph-Mirrophonic Sound System, these items are automatically included; otherwise they must be separately ordered.

3 - 6SJ7 type (metal preferred but GT type acceptable) Vacuum Tubes
1 - PA-7015 Cabinet
1 - PA-7016 Set Extension Controls

(c) The MA-7505-A Amplifier requires as associated equipment the following items. When the amplifier is supplied as part of a Motiograph-Mirrophonic Sound System, these items are automatically included; otherwise they must be separately ordered.

2 - 6SJ7 type (metal preferred but GT type acceptable) Vacuum Tubes
2 - 6L6 type Vacuum Tubes (metal or glass)

1 - 5Z3 Vacuum Tube
1 - 6K6 type Vacuum Tube (metal or glass)
1 - MA-7000 Cabinet (To mount cabinet on standard amplifier racks, one set of MA-7018 Rack Mounting Angles is required.)
1 - SE-7501 Monitor Loudspeaker

(d) Characteristics of the PA-7505-A Amplifier are as follows:

Dimensions	- 9" W. x 9" H. x 6¾" D.
Weight	- 5¼ lbs. (without tubes)
Input Impedance (either input)	- Nominal - works from 2 megohm photocell circuit load resistance of SH-7500 Reproducer. Actual - 110,000 ohms.
Output Impedance	- Nominal - works into 15,000 ohm input impedance of MA-7505-A Amplifier. Actual - 17,000 ohms.
Volume Control	- Step-type grid potentiometer for output stage. Continuously variable plate circuit potentiometers (range - 8 db) for balancing input stages. Main volume control loss is zero on step 20, 38 db on step 1, and infinite on step 0. Intervening steps between 1 and 20 are approximately 2 db apart; for example, loss on step 10 is 20 db.
Power Supply Required (from associated MA-7505-A Amplifier)	6.3 V. A.C., 0.9 ampere. 200 V. D.C., 0.005 ampere.
Power Supply Furnished (to two SH-7500 Reproducers)	90 V. D.C., approximately 10 microamperes, to two reproducer photocell circuits.

(e) Characteristics of the MA-7505-A Amplifier are as follows:

Dimensions	- 17" W. x 8" H. (without tubes) x 7" D.
Weight	- 28 lbs. (without tubes)

Input Impedance	- Nominal - works from output of PA-7505-A Amplifier. Actual - 70,000 ohms.
Output Impedance	- Nominal - 16 or 32 ohms. As measured at 16 ohm output terminals by resistance addition method at 500 cycles -- 16 ohms. Formula is $Z = \frac{R1 \times Rh}{R1 - Rh}$. R1 is resistance equal to nominal output impedance (16 ohms), and Rh is the amount of additional resistance required to be connected in parallel with R1 to reduce output by 6 db.
Volume Control	- Multi-unit grid resistance and moveable grid lead in input stage. Range - 6 db in three 2 db steps.
Power Output	- 20 watts (35.2 db/.006 W.), 2% total distortion, 50 - 5000 cycles. Two amplifiers may be operated with input and output circuits paralleled to provide twice this power.
Power Supply Required	- 105-125 volts 60 cycle, 150 watts.
Fuse Required	- 2 ampere, 4 AG ($1\frac{1}{4}$" x 9/32") Glass Tubular, Motiograph Part #MA-2681.
Power Supply Furnished (To PA-7505-A Amplifier)	- 6.3 V. A.C., 0.9 ampere. 200 V. D.C., 0.005 ampere.

(f)
(f) The following characteristics apply to the combined PA and MA-7505-A Amplifiers mounted in their cabinets and with 20 feet of connection cable between them:

Total Maximum Rated Gain (IKC)	- 98 db as measured with PA-7505-A Amplifier input terminals terminated with a 1 megohm resistor in series with a 100 ohm resistor on the grounded side across which a signal voltage of 0.040 volt is applied.
Noise Level	- PA-7505-A Amplifier changeover switch in OFF position and volume control at 0: -45 db/.006 W. At operating gain (volume control step 10, open PA-7505-A Amplifier input terminals): -35 db/.006 W.

4. INSTALLATION

(a) Detailed installation information for the PA and MA-7505-A Amplifiers is included in the instructions for the various sound systems in which they are components. Since this information varies with the type of system, it is not repeated in this equipment bulletin.

(b) Input Belden #8401 cables to the PA-7505-A Amplifier should enter the chassis through the rubber grommets at the sides of the terminal strip. Best shielding is afforded by exposing only the final inch of inner conductor. The shield wires may be unbraided and twisted together after cleaning to form a pigtail capable of being soldered directly to the long input lugs at the bottom of resistors R1 and R2 in such a manner that the fine wires of the inner conductor ("core") are relieved of all strain. The inner conductor wires, after cleaning and dressing to the required length, are soldered securely to the long lugs at the bottom of condensers C1 and C2 respectively.

Other leads to the PA-7505-A Amplifier enter the chassis via the holes in the terminal strip and chassis in front of the appropriate terminals. The output Belden #8401 cable is preferably dressed and connected in the same manner as the input cables. The cut end of the braided shielding on the KS-7133 cordage to the "6.3 V." tube heater circuit terminals should be insulated with friction tape to prevent accidental grounds to terminals or chassis.

At MA-7505-A Amplifier terminals, and at the terminals of amplifier switching panels in dual type sound systems, Belden #8401 cables are dressed and connected also in the manner outlined for PA-7505-A Amplifier input connections. Grounds called for on the shielding of KS-7133 cordage runs, are usually more easily provided by soldering suitable connection wires to the shielding, although this shielding may likewise be unbraided and twisted together to form grounding pigtails where ground connections are close to conductor terminals.

Connections to MA-7505-A Amplifier terminals may be soldered or fastened under terminal screws at the discretion of the installation engineer. Soldered connections are more reliable, but since the terminals are all in relatively high power level circuits, screw connections usually prove satisfactory, and they are certainly more convenient from the viewpoint of ease in testing and servicing.

(c) If one side of the A.C. supply circuit to the MA-7505-A Amplifier is grounded, as is usually the case, it should be connected to the left "A.C." terminal so that the chassis switch and internal fuse will be in the ungrounded, or "hot" side of the line. Before amplifiers are operated, the average A.C. line voltage prevailing in the projection room at the amplifier terminals should be ascertained by measurement or otherwise, and the power transformer primary tap connected accordingly. Better tube life, at the expense of a slight reduction in maximum amplifier output power, will be secured by connecting the tap to accommodate the maximum rather than the average line voltage.

5. OPERATION AND ADJUSTMENTS

(a) Install vacuum tubes in the amplifiers in accordance with the stamped designations near the tube sockets on the chassis and as called for on the circuit diagrams. Turn the balancing control knobs between input tubes and center tube on the PA-7505-A Amplifier to their maximum clockwise rotation (full input stage gain). See that the small switch, D-1, between the 6K6 and 5Z3 tubes on the MA-7505-A Amplifier chassis is in its ON position, and then turn on the A.C. power circuit to the amplifiers. Allow about 30 seconds for tube cathodes to reach operating temperature, and then proceed with the various sound circuit checks outlined in the sound system instructions. If suitable meters are available, it is advisable to check the voltages being delivered by the MA-7505-A Amplifier at the PA-7505-A Amplifier terminals, and the voltage between the "90 V." and "SH" terminals of the SH-7500 Reproducers. The latter voltages may measure considerably under the rated 90 volts depending upon the internal resistance of the voltmeter used, since they are supplied from amplifier filter circuits incorporating relatively large series resistances.

(b) The milliammeter on the meter panel of the MA-7505-A Amplifier indicates the plate current in the push-pull output stage. The meter normally indicates the sum of the plate currents of the two tubes comprising this stage. When D-2 push button is operated, the plate current of V-4 is bypassed around the meter, and the indication is therefore that of V-3 alone. When D-3 button is operated, the indication is similarly that of V-4 alone. With both tubes in good condition and with the power transformer primary strap connected to the tap most nearly corresponding to the actual line voltage at the amplifier terminals, the total plate current should be between 150 and 160 milliamperes. Normal current for either tube alone should be 75 to 80 milliamperes. For best amplifier performance, plate currents should be balanced within 10 milliamperes by selection of 6L6 type tubes from those in use and from spares on hand.

(c) Input tubes in the PA-7505-A Amplifier are followed by considerable amplification. It is therefore necessary that tubes for operation in these positions be selected to have the lowest possible microphonic tendencies. Tubes producing low frequency rumbles, clicks, or frying noises when lightly tapped, with main and monitor volume controls well advanced, should be rejected as unsuitable for service.

(d) As shipped, the various frequency response and gain adjustment connections in the MA-7505-A Amplifier are as shown on the amplifier schematic and wiring diagrams. Use of the input stage balancing controls of the PA-7505-A Amplifier is discussed in the various sound system instruction bulletins, as is the use of the MA-7505-A Amplifier gain adjustment afforded by moving the green-white grid lead for V-1 from its normal connection at the top of R-1 to the top of R-2 (2 db gain loss), or to the top of R-3 (4 db gain loss), or to the top of R-4 (6 db gain loss).

(e) The frequency response curves LA-HA shown on drawing LSS-7540 represent the response relative to the IKC response of the PA and MA-7505-A Amplifiers connected to SH-7500 Reproducers with 12 ft. of Belden #8401 cable between reproducers and PA-7505-A Amplifier input terminals, 20 ft. of the same cable in the sound circuit between amplifiers, and with a 16 ohm resistance load connected to the "0" and "16" output terminals of the MA-7505-A Amplifier. The curves were taken using a standard multi-frequency test film, equalization connections in accordance with MA-7505-A Amplifier diagrams, all gain adjustments at maximum except the PA-7505-A Amplifier main volume control, which was on step 6, and with a rectifier-type volume indicator meter connected across the load resistance. Runs at other volume control settings may be made, but care should be taken that at no frequency does the meter indication in db, plus the meter correction factor (15.0 db for meters calibrated to indicate power level relative to 0.006 watt in a 500 ohm load when connected to a 16 ohm load) approach the rated power output of the MA-7505-A Amplifier (35.2 db/.006 W.) closer than 3 db. For paralleled amplifiers in dual type sound systems with the 16 ohm load resistor connected to the paralleled 32 ohm output terminals, the rated power output is 38.2 db/.006 W. In terms of output power in watts, this merely means that the amplifier system gain must be kept low enough to insure that the system is not overloaded at any test frequency, as overloading destroys the significance of the meter indications.

(f) The LA-HA response curve is approximately right for PA and MA-7505-A Amplifiers associated with SE-7508, SE-7511 and SE-7522 loudspeaker systems in auditoriums of average acoustical characteristics. The H.F. response may be lowered in small steps by connecting resistors R-11 and R-12 in series, singly, or in parallel to

ground, thus varying the HF attenuation provided by the plate circuit shunt condenser C-6. A pronounced rise in middle H.F. response (2 KC to 5 KC), useful in improving speech intelligibility and screen presence in auditoriums with excessive reverberation, is produced by connecting either or both of condensers C-7 and C-8 to ground from the junction of R-9 and R-10. C-7 produces a small rise, C-8 a considerably greater one with both 3 KC and 5 KC responses going above the 1 KC reference level, and the two in parallel cause the response peak to move slightly downward in frequency. The H.F. response curves resulting from the use of C-7 and C-8 may be individually modified downward with the H.F. attenuator combination, C-6 and R-11 and R-12 to provide a large family of H.F. response curves. Some of the possibly most useful of these are shown and the corresponding equalization connections tabulated on drawing LSS-7540 along with the basic H.F. curves.

The LA-HA response curve is virtually flat from 1 KC to 100 cycles. Increasing amounts of L.F. rising response are available by connecting condensers C-9 and C-10 into the feedback circuit in parallel, C-9 only, C-10 only, or in series. Such rising L.F. response characteristics might be called for in a very small or in an over-treated auditorium with a reverberation time well below optimum value, and would aid in adding "depth" or "body" to the reproduced sound.

A falling L.F. response is secured by connecting the undersize coupling condenser C-2 into the input circuit in place of C-1. The L.F. drooping characteristic thus produced may be modified upward as desired by combining it with the L.F. rising characteristics produced by the various arrangementsof C-9 and C-10. Some of the resulting curves are shown and the required connections tabulated on drawing LSS-7540. Reducing the amplifier L.F. response is one of the common ways of combating such auditorium acoustical defects as excessive reverberation, but it is one of the least desirable because of the resulting contraction in the overall frequency response range of the sound system. Correction of the defects by application of suitable acoustical treatment is a far better, though admittedly more expensive method. Before resorting to reduction of amplifier L.F. response, all expedients outlined in stage loudspeaker system equipment bulletins should be carried out as well as possible, and the maximum tolerable system H.F. response (to improve speech intelligibility) should be determined by trial.

(g) Correction factors for transmission tests are obtained by noting the relative frequency response shown on drawing LSS-7540 at the desired test reel frequencies for the equalization connections in use, and then reversing the signs on these values. Such factors

added algebraically to those for the test film used, and then to the measured deviations of volume indicator readings from the 1 KC reading should result in a deviation from normal not greater than plus or minus 3 db at any particular frequency. Larger deviations should be investigated and corrected if possible.

(h) For amplifier gain measurements during transmission tests using calibrated test films in SH-7500 Reproducers, the following tabulation of pickup losses corresponding to various reproducer exciter lamp currents is useful. The "relative sensitivity" figures relate the output signal of the SH-7500 Reproducer to certain other older Western Electric reproducers.

Exciter Lamp Current	Relative Sensitivity
4.0 amperes	-4.0 db
3.8 amperes	-6.0 db
3.6 amperes	-8.0 db
3.4 amperes	-10.0 db

6. MAINTENANCE

(a) The PA and MA-7505-A Amplifiers require little maintenance other than routine testing of tubes, checking of connections, and periodical power output, gain, noise level, and frequency response measurements. Continuous check on the condition of the MA-7505-A Amplifier output tubes and rectifier tube is afforded by the panel meter and switches. These tubes as well as all other tubes in both amplifiers may be tested in any standard tube testing instrument. As all tubes used for voltage amplification are of the same type, the spare tube problem is considerably simplified. Much of the information given under the "Maintenance" heading in instruction bulletins for sound systems applies to the 7505-A type amplifiers when they are components of such systems, and hence need not be repeated here.

(b) The changeover switch and main volume control of the PA-7505-A Amplifier are of the commutator type, and require no maintenance so long as operation is positive and noise free. When cleaning becomes necessary, old lubricant and dirt may be taken off with a clean cloth and a solvent such as carbon-tetrachloride, taking care that the contact fingers are not broken off or deformed in the process.

Field reports indicate that in localities where humidity is low, with considerable dust in the atmosphere, longer periods between cleanings of volume control and changeover switch are obtained by omitting lubrication. This is probably due to the fact that dust particles are easily dislodged from, or fall off of a clean dry surface, whereas they stick to even a lightly lubricated surface.

In localities having considerable contamination of the atmosphere by smoke, industrial gases, salt spray, etc., the opposite is true. The hard drawn copper contact segments and beryllium copper contact fingers are exceptionally resistant to corrosion, but such action is still further retarded by a light film of good quality lubricant such as a good grade of watch or clock oil, or a contact lubricant such as DAVENOIL.

It is suggested that in each case the best maintenance procedure be determined by trial, noting the intervals between required cleanings. In all cases, the dust covers should be kept in place since they provide electrostatic shielding as well as protection from dust and dirt accumulation in the interior of the controls.

(c) After long use, electrolytic filter and by-pass condensers may require replacement. Condensers may be checked for capacity, power factor and leakage with suitable testing devices, or by substitution of a unit of the same rating known to be in satisfactory condition.

Intermittently open cathode by-pass condensers are one of the most common causes for unstable amplifier gain. They can be located by observing the magnitude of the gain change in db (count volume control steps required to restore gain to normal, and multiply by two), and then, during non-show time, going through the amplifier circuits one by one opening the condenser leads until one producing the same gain change is encountered. Much watching and waiting time can be saved in this manner.

Leaking plate to grid coupling condensers, often responsible for severe distortion or noise, particularly when the main volume control or changeover switch is operated, are best checked by inserting a milliammeter in the plate circuit of the following tube and noting whether there is any change in plate current as the condenser circuit is opened and closed. Any change indicates sufficiently low condenser insulation resistance to warrant replacement. As has been noted, all plate-grid coupling condensers in 7505-A type amplifiers are of a specially insulated and sealed type having over 1500 megohms insulation resistance, and it is hoped that they will be the answer to this particular problem.

(d) Amplifier servicing is greatly facilitated by a knowledge of normal voltages and currents as measured at vacuum tube socket connections. The following tabulation gives data of this kind. The readings are averages of those taken on a number of different amplifiers, though in each instance the line voltage applied to the MA-7505-A Amplifier

was adjusted to the value specified for the power transformer primary tap used (115 V.). Readings were taken, using meter scales noted, with TA-4145 and TA-4147 meters. Indicated voltages will, of course, be different using meters of other sensitivities. All readings were taken with volume controls at zero and changeover switch in the OFF position. Voltage readings are with respect to tube cathode except as noted. Grid voltages are measured cathode to ground.

PA-7505-A Amplifier: 6SJ7 Input Tubes (pentode connected)

Ep	61 V.	(1000 V. scale)
Es	35 V.	(1000 V. scale)
Eg	1.0 V.	(25 V. scale)
Eh	5.9 V.	(15 V. A.C. scale)
Ip	0.82 MA	(10 MA scale)
Is	0.2 MA	(10 MA scale)

PA-7505-A Amplifier: 6SJ7 Output Tube (triode connected)

Ep	75 V.	(1000 V. scale)
Eg	3 V.	(25 V. scale)
Eh	5.9 V.	(15 V. A.C. scale)
Ip	.9 MA	(10 MA scale)

MA-7505-A Amplifier: 6SJ7 Input Tube (triode connected)

Ep	110 V.	(1000 V. scale)
Eg	5.2 V.	(25 V. scale)
Eh	6.4 V.	(15 V. A.C. scale)
Ip	1.0 MA	(10 MA scale)

MA-7505-A Amplifier: 6SJ7 Phase Inverter Tube (triode connected)

Ep	120 V.	(1000 V. scale)
Eg	5.2 V.	(25 V. scale)
Eh	6.4 V.	(15 V. A.C. scale)
Ip	1.0 MA	(10 MA scale)

MA-7505-A Amplifier: 6L6 Output Tubes

Ep	300 V.	(1000 V. scale)
Es	290 V.	(1000 V. scale)
Eg	20.4 V.	(25 V. scale)
Eh	6.4 V.	(15 V. A.C. scale)
Ip	75 MA	(500 MA scale)
Is	3 MA	(10 MA scale)

MA-7505-A Amplifier: 6K6 Monitor Tube

Ep	290 V.	(1000 V. scale)
Es	260 V.	(1000 V. scale)
Eg	19.2 V.	(25 V. scale)
Eh	6.4 V.	(15 V. A.C. scale)
Ip	24 MA	(500 MA scale)
Is	4 MA	(10 MA scale)

MA-7505-A Amplifier: 5Z3 Rectifier Tube

Ep 1 (to gnd.)	410 V.	(1200 V. A.C. scale)
Ep 2 (to gnd.)	410 V.	(1200 V. A.C. scale)
E Output (to gnd.)	350 V.	(1000 V. D.C. scale)
I Output	190 MA	(500 MA scale)
Eh	5.0 V.	(15 V. A.C. scale)

7. REPLACEMENT PARTS

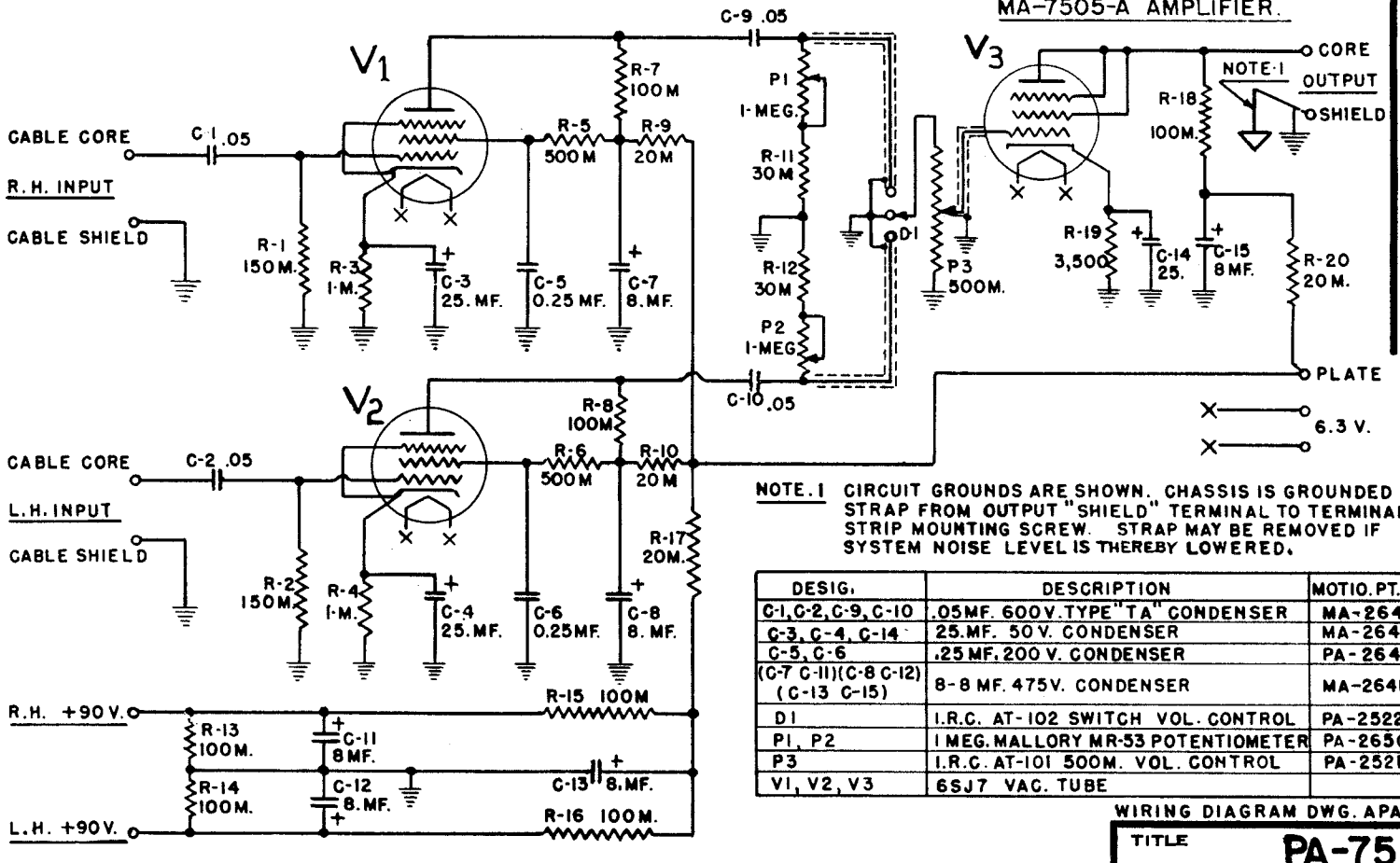
(a) Ordering information for the component parts of the amplifiers is given on the circuit diagrams. Parts not listed by part number may be ordered by description or by referring them to a listed item. It is always helpful to state what the part is for; as an example, "PA-2641 Resistor for PA-7505-A Amplifier", or "15 position terminal strip assembly for MA-7505-A Amplifier."

M O T I O G R A P H
4431 W. Lake St.
Chicago 24, Ill.

APA-2637

CHANGES
ISSUE NO. 1 8-15-44

THIS AMPLIFIER FOR USE WITH MA-7505-A AMPLIFIER.



NOTE. 1 CIRCUIT GROUNDS ARE SHOWN. CHASSIS IS GROUNDED BY STRAP FROM OUTPUT "SHIELD" TERMINAL TO TERMINAL STRIP MOUNTING SCREW. STRAP MAY BE REMOVED IF SYSTEM NOISE LEVEL IS THEREBY LOWERED.

DESIG.	DESCRIPTION	MOTIO. PT. NO.
C-1, C-2, C-9, C-10	.05MF. 600V. TYPE "TA" CONDENSER	MA-2642
C-3, C-4, C-14	25.MF. 50 V. CONDENSER	MA-2640
C-5, C-6	.25 MF. 200 V. CONDENSER	PA-2640
(C-7 C-11)(C-8 C-12) (C-13 C-15)	8-8 MF. 475V. CONDENSER	MA-2641
D1	I.R.C. AT-102 SWITCH VOL. CONTROL	PA-2522
P1, P2	1 MEG. MALLORY MR-53 POTENTIOMETER	PA-2650
P3	I.R.C. AT-101 500M. VOL. CONTROL	PA-2521
V1, V2, V3	6SJ7 VAC. TUBE	

DESIG.	DESCRIPTION	MOTIO. PT. NO.
R-1, R-2	150,000 OHM 1/2 WATT RESISTOR	PA-2645
R-3, R-4	1,000 " " " "	MA-2641
R-5, R-6	500,000 " " " "	PA-2535
R-7, R-8, R-13, R-14 R-15, R-16, R-18	100,000 " " " "	MA-2534
R-9, R-10, R-17, R-20	20,000 " " " "	PA-2643
R-11, R-12	30,000 " " " "	PA-2644
R-19	3,500 " " " "	PA-2642

WIRING DIAGRAM DWG. APA-2638

TITLE **PA-7505-A**

AMPLIFIER SCHEMATIC

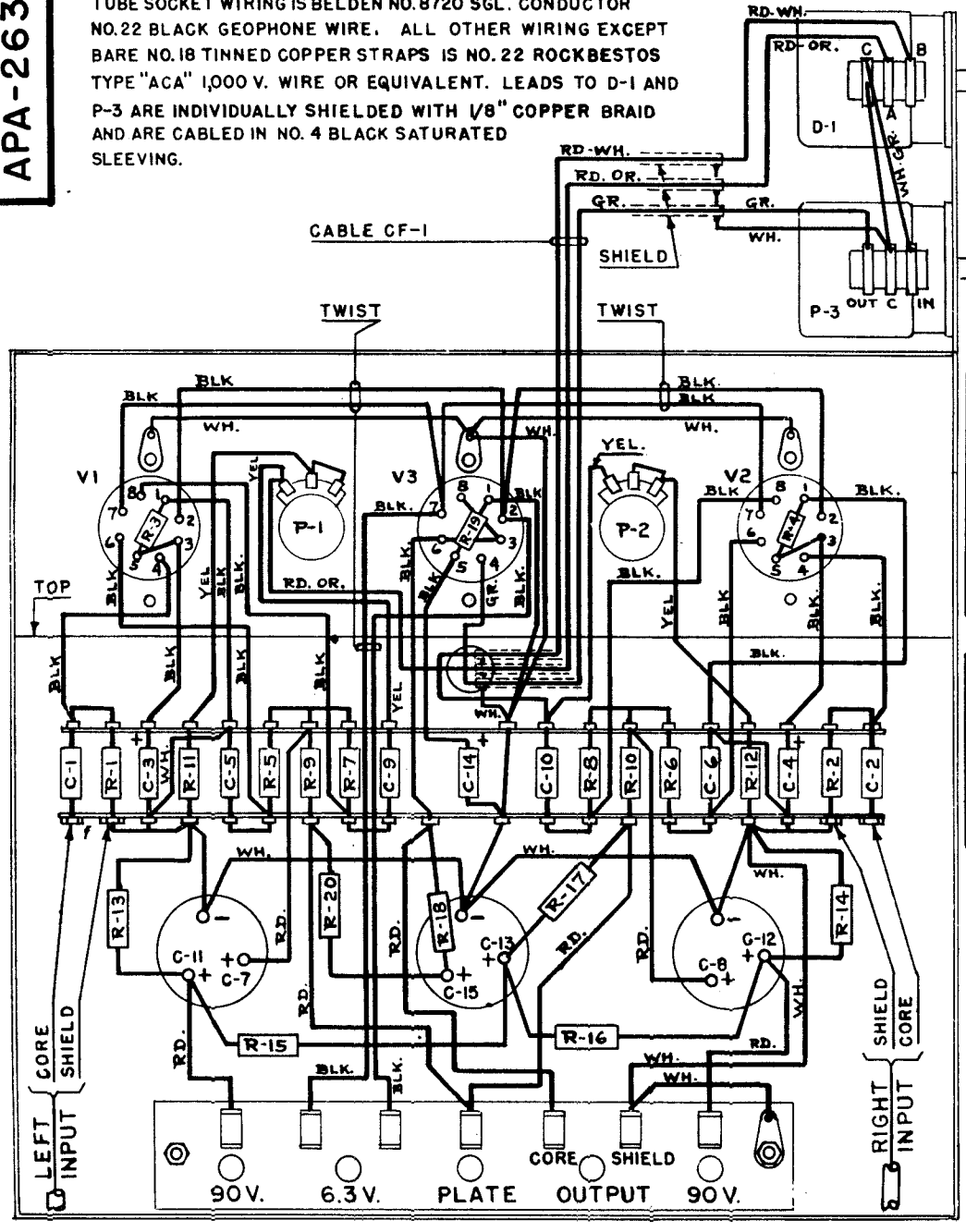
MATERIAL		FINISH	
DRAWN H.M.C.	CHKD. R.T.V.	APPVD. R.T.V.	DATE 8-15-44

DRWG. NO. **APA-2637**

MOTIOGRAPH
CHICAGO, ILL.

APA-2638

TUBE SOCKET WIRING IS BELDEN NO. 8720 SGL. CONDUCTOR NO. 22 BLACK GEOPHONE WIRE. ALL OTHER WIRING EXCEPT BARE NO. 18 TINNED COPPER STRAPS IS NO. 22 ROCKBESTOS TYPE "ACA" 1,000 V. WIRE OR EQUIVALENT. LEADS TO D-1 AND P-3 ARE INDIVIDUALLY SHIELDED WITH 1/8" COPPER BRAID AND ARE CABLED IN NO. 4 BLACK SATURATED SLEEVING.



THIS AMPLIFIER FOR USE WITH MA-7505-A AMPLIFIER.

DESIG.	DESCRIPTION	MOTIO. PT. NO.
C-1, C-2, C-9, C-10	.05 MF. 600V. TYPE "TA" CONDENSER	MA-2642
C-3, C-4, C-14	25 MF. 50V. CONDENSER	MA-2640
C-5, C-6	.25 MF. 200V. CONDENSER	PA-2640
(C-7, C-11) (C-8, C-12) (C-13, C-15)	8-8 MF. 475V. CONDENSER	MA-2641
D-1	I.R.C. AT-102 SWITCH	PA-2522
P-1, P-2	1-MEG. MALLORY MR-53 POTENTIOMETER	PA-2650
P-3	I.R.C. AT-101 500M. VOL. CONTROL	PA-2521
V1, V2, V3	6SJ7 VAC. TUBE	
CF-1	VOL. CONTROL CABLE FORM	PA-2652

DESIG.	DESCRIPTION	MOTIO. PT. NO.
R-1, R-2	150,000 OHM 1/2 WATT RESISTOR	PA-2645
R-3, R-4	1,000 " " " "	PA-2641
R-5, R-6	500,000 " " " "	MA-2535
R-7, R-8, R-13, R-14 R-15, R-16, R-18	100,000 " " " "	MA-2534
R-9, R-10, R-17, R-20	20,000 " " " "	PA-2643
R-11, R-12	30,000 " " " "	PA-2644
R-19	3,500 " " " "	PA-2642

CHANGES

ISSUE NO. 1 8-15-44 RT
SOCKET WIRING WAS RUNZEL CODE 415 # 26 (24 STRANDS #40 BRAIDED) WAXED RAYON BRAID. OTHER WIRING WAS #22 SOLID TINNED COPPER, TWO COTTON WAXED BRAID EXCEPT LEADS TO D-1 AND P-3 WHICH WERE SAME, STRANDED
ISSUE. 2 6-15-46 RT

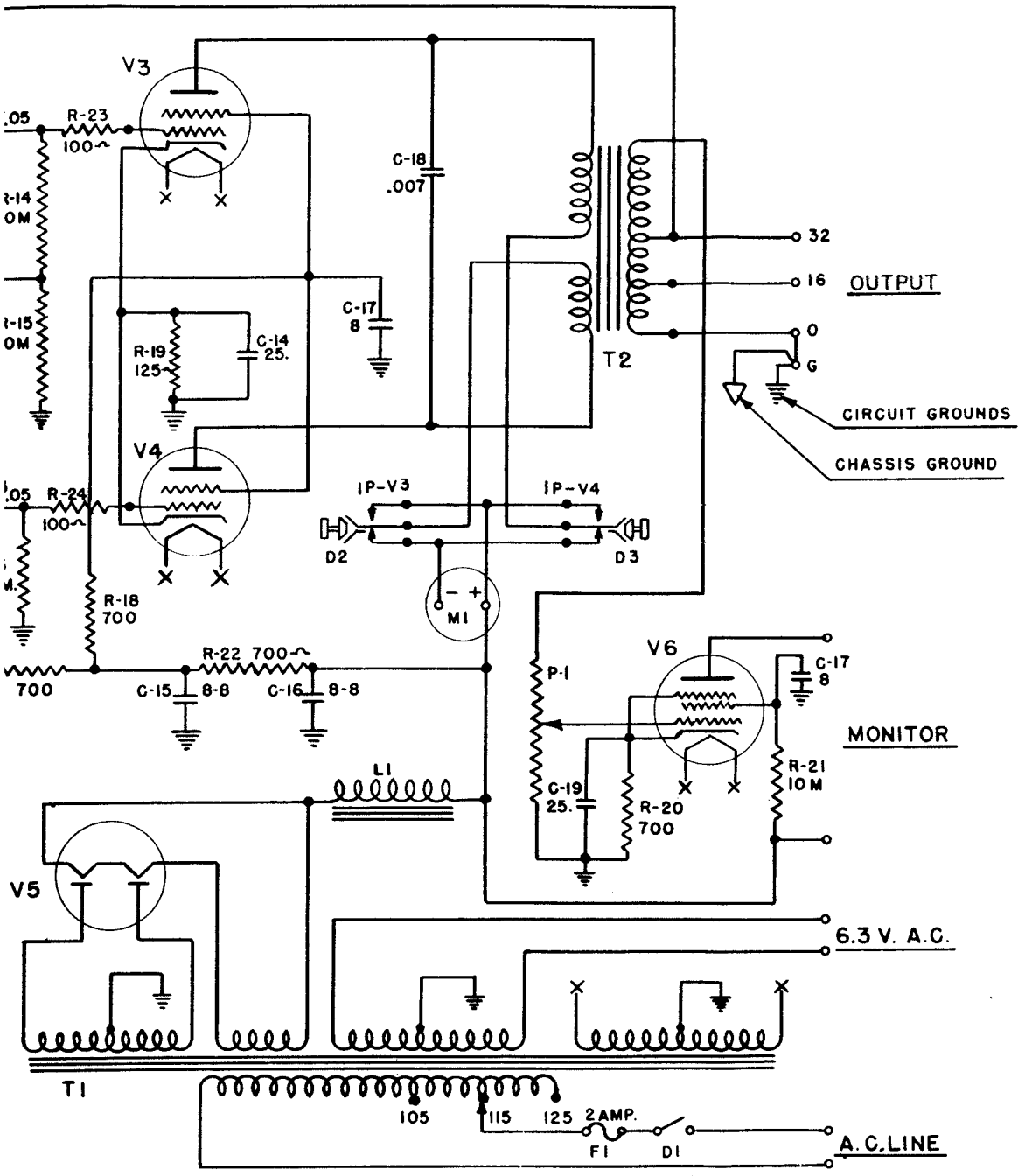
SCHEMATIC DIAGRAM DWG. APA-2637

TITLE
PA-7505-A AMPLIFIER WIRING DIAGRAM.

MATERIAL	FINISH		
DRAWN H.M.C.	CHKD. RT	APPVD. RT	DATE 8-15-44

DRWG. NO. APA-2638

MOTIOGRAPH
CHICAGO, ILL.



CHANGES

ISSUE NO. 1 8-15-44
BOTH SECTIONS OF C-17 WERE SCREEN BY-PASS FOR V-3 & V-4. NO SCREEN BY-PASS WAS SHOWN ON V-6

ISSUE NO. 2 8-25-44
C-1 WAS MA-2613
COND. C-9 WAS MA-2642

ISSUE NO. 3 9-12-44
R-23 & R-24 ADDED
T-1 WAS MA-2637

ISSUE 4 6-15-46

	MOTIO. PT. NO.
~	MA-2525
	MA-2636
	MA-7028
	MA-2638
	MA-2639
	MA-2681

NOTES

1: WIRES ENDING THUS ⟶ ARE TO BE CONNECTED IN FIELD AS REQUIRED. SEE INSTALLATION INSTRUCTIONS.

WIRING DIAGRAM DWG. LMA-2649

TITLE: MA-7505-A AMPLIFIER SCHEMATIC DIAGRAM

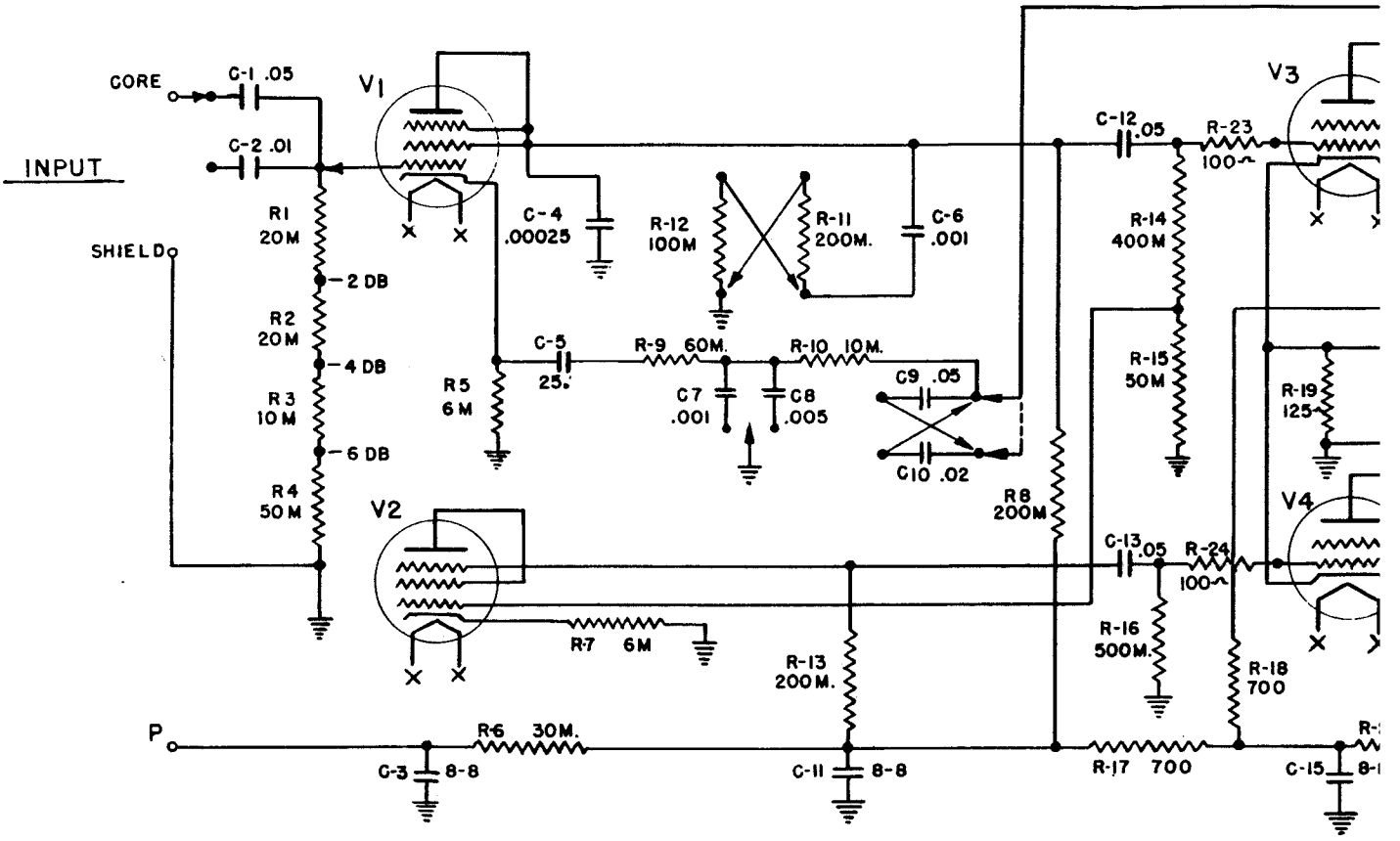
MATERIAL | FINISH

DRAWN H.M.C. | CHKD. RTV | APPVD. RTV | DATE 8-15-44

DRWG. NO. LMA-2650

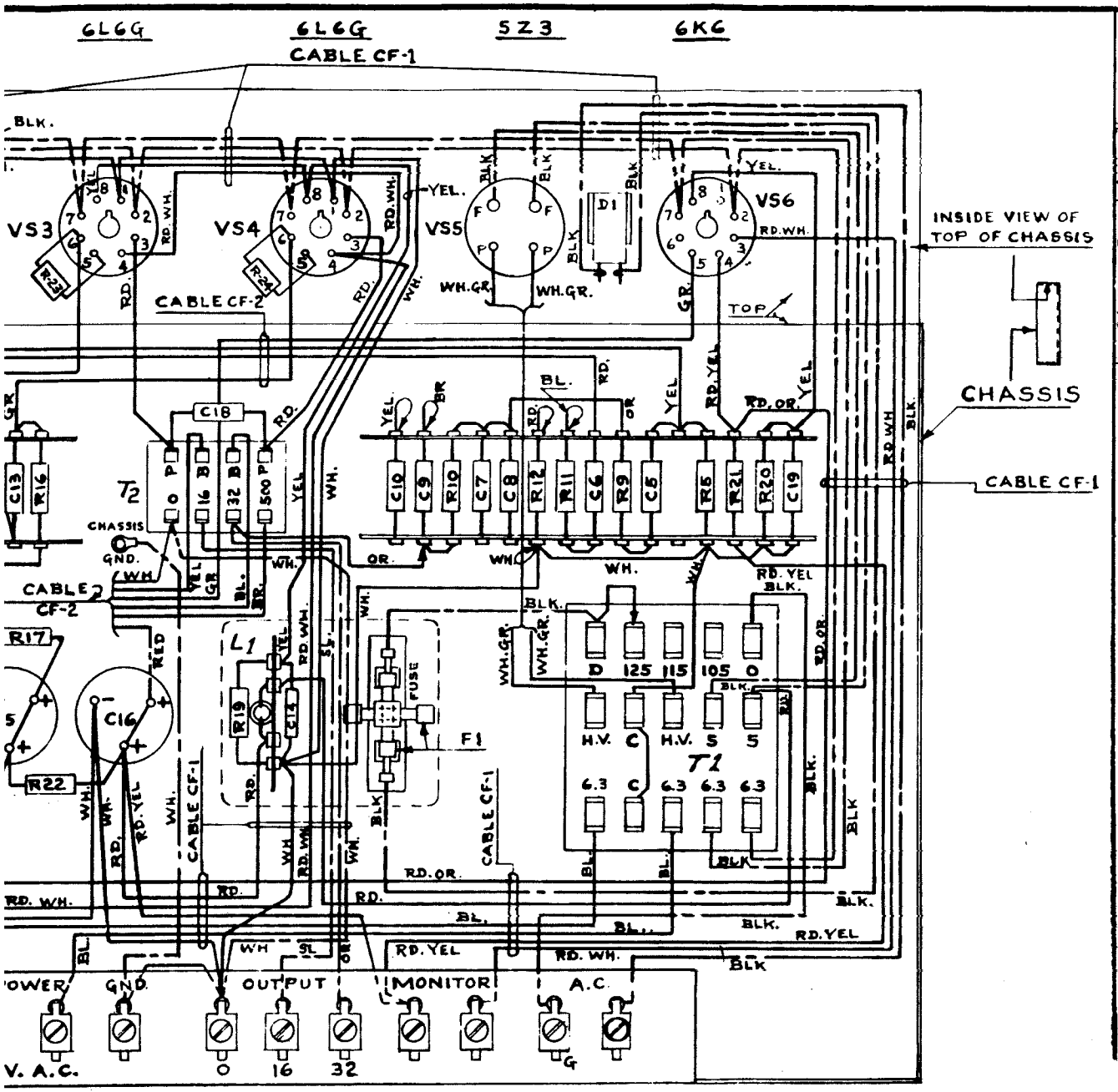
MOTIOGRAPH
CHICAGO, ILL.

LMA-2650



DESIG.	DESCRIPTION	MOTIO. PT. NO.
C-1, C-12, C-13	.05 MF. 600V. TYPE "TA" CONDENSER.	MA-2642
C-2	.01 MF. 600V. TYPE "TA" CONDENSER	MA-2643
C-3, C-11, C-15 C-16, C-17	8-8 MF. 475V. CONDENSER	MA-2641
C-4	.00025 MF. 1000V. CONDENSER	MA-2645
C-5, C-14, C-19	25. MF 50V. CONDENSER	MA-2640
C-6, C-7	.001 MF. 1000V. CONDENSER	MA-2616
C-8	.005 MF. 1000V. CONDENSER	MA-2646
C-9	.05 MF. 600V. CONDENSER	MA-2613
C-10	.02 MF. 600V. CONDENSER	MA-2647
C-18	.007 MF. 1500V. CONDENSER	MA-2644
R-1, R-2	20,000 Ω 1-WATT RESISTOR	MA-2546
R-3, R-10	10,000 Ω 1-WATT RESISTOR	MA-2526
R-4, R-15	50,000 Ω 1-WATT RESISTOR	PA-2602
R-5, R-7	6,000 Ω 1-WATT RESISTOR	MA-2655
R-6	30,000 Ω 1-WATT RESISTOR	PA-2605
R-8, R-11, R-13	200,000 Ω 1-WATT RESISTOR	MA-2657
R-9	60,000 Ω 1-WATT RESISTOR	MA-2656
R-12	100,000 Ω 1-WATT RESISTOR	MA-2542
R-14	400,000 Ω 1-WATT RESISTOR	MA-2656
R-16	500,000 Ω 1-WATT RESISTOR	MA-2659
R-17, R-18, R-22	700 Ω 1-WATT RESISTOR	MA-2654
R-19	125 Ω 20-WATT RESISTOR	MA-2651
R-20	700 Ω 10-WATT RESISTOR	MA-2652
R-21	10,000 Ω 10-WATT RESISTOR	MA-2653
R-23 & R-24	100 Ω 1/2-WATT RESISTOR	MA-2688
D-1	S.P.S.T. TOGGLE SWITCH	MA-2521
D-2, D-3	PUSH BUTTON SWITCH	MA-2605

DESIG.	DESCRIPTION	MOTIO. PT. NO.
P1	POTENTIOMETER 200,000 Ω	MA-2525
M1	METER 0-200 MA.	MA-2636
T1	POWER TRANSFORMER	MA-7028
T2	OUTPUT TRANSFORMER	MA-2638
L1	CHOKE COIL	MA-2639
V1, V2	6SJ7 VAC. TUBE	
V3, V4	6L6G VAC. TUBE	
V5	5Z3 VAC. TUBE	
V6	6K6 VAC. TUBE	
F1	FUSE 2-AMP.	MA-2681



FRONT VIEW OF CHASSIS

	MOTIO. PT. NO.
DO~	MA-2525
	MA-2636
R	MA-7028
R	MA 2638
	MA-2639
	PA-2612
	MA-2604
	MA-2681
1	MA-2665
FORM.	MA-2667

NOTES.

1. WIRES SHOWN THUS ——— ARE #22 GA. STRANDED ROCKBESTOS TYPE "ACA" 1000 V. WIRE.
2. WIRES SHOWN THUS — - — ARE #16 GA. STRANDED ROCKBESTOS TYPE "ACA" 1000V. WIRE.
3. WIRES ENDING THUS ——→ ARE TO BE CONNECTED IN FIELD AS REQUIRED. SEE INSTALLATION INSTRUCTIONS
4. WIRES NOT OTHERWISE SPECIFIED ARE #18 GA. SOLID TINNED BARE COPPER WIRE.

CHANGES

ISSUE NO 4. 12-15-44
T1 WAS MA-2637.
REDRAWN FOR ISSUE 5 TO SHOW REARRANGED WIRING AT T1. CHANGE EFFECTIVE ON AMP'S SER. "GJ" AND ON. CN 620

ISSUE NO 5. 7-18-45
R-23 AND R-24 ADDED. NOTES CALLED FOR SOLID, TWO COTTON WAX BRAID WIRE EXCEPT FORMER NOTE 2 SPECIFIED STRANDED WIRE FOR CF-2 AND METER PANEL WIRING. NOTES 2, 3 AND 4 WERE 3, 4 AND 5

ISSUE 6 6-15-46

SCHEMATIC DIAGRAM DWG. LMA-2650

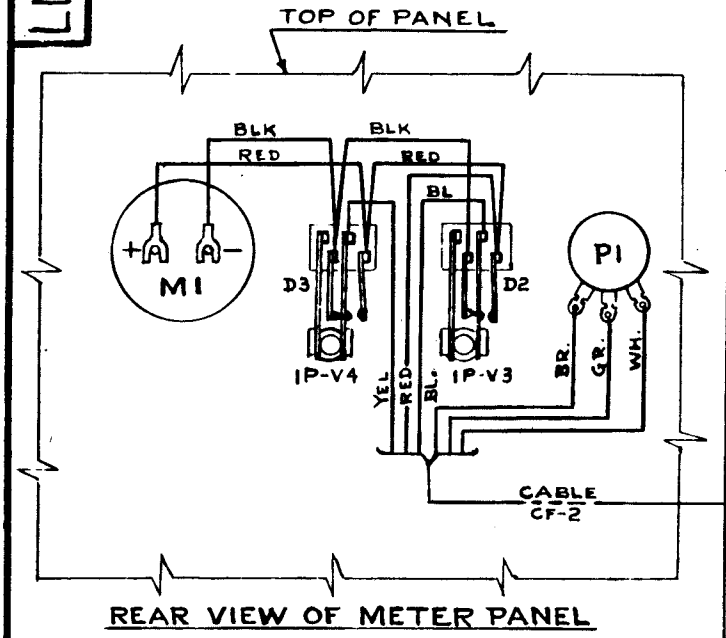
TITLE
MA-7505-A
AMPLIFIER
WIRING DIAGRAM

MATERIAL	FINISH		
DRAWN	CHKD.	APPVD.	DATE
H.M.C.	RTJ	RTJ	8-15-44

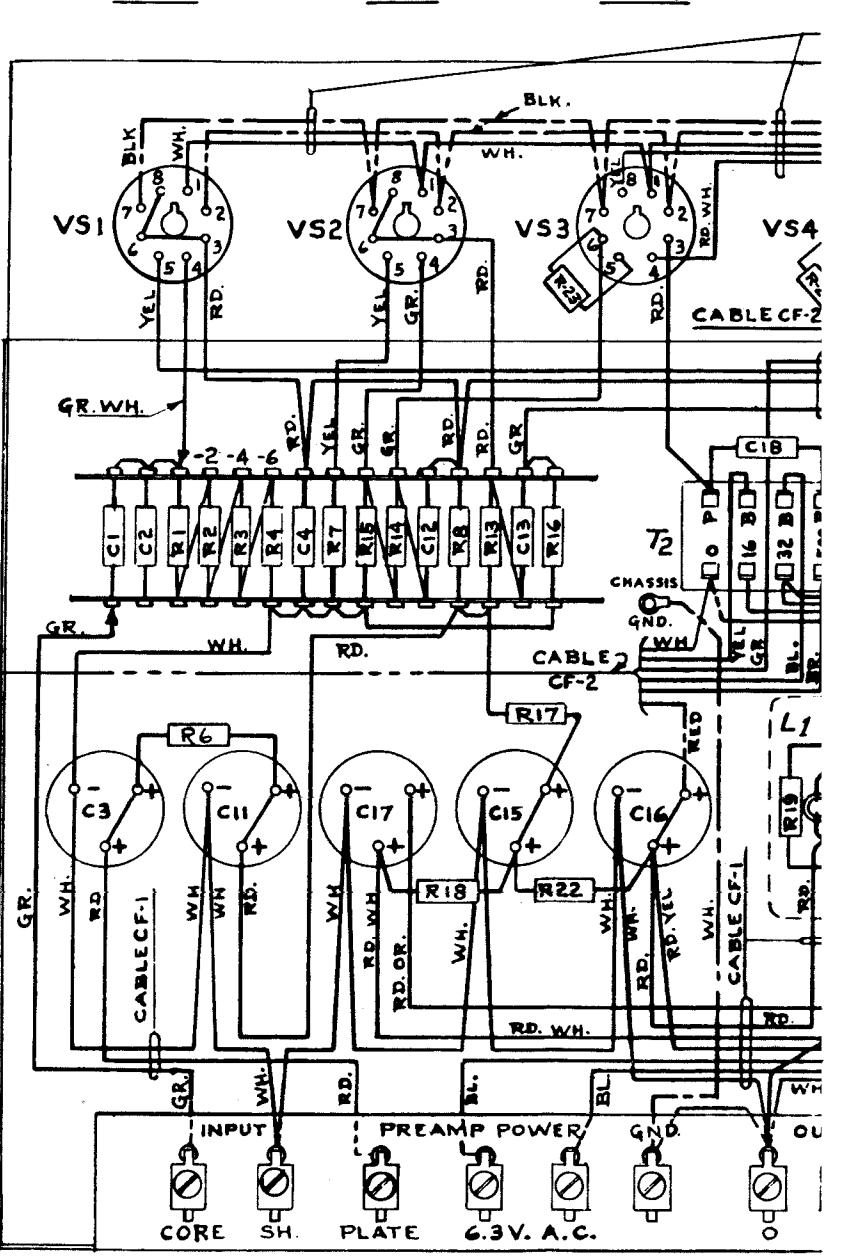
DRWG. NO LMA-2649

MOTIOGRAPH
CHICAGO ILL.

LMA-2649



REAR VIEW OF METER PANEL



FRONT VIEW OF

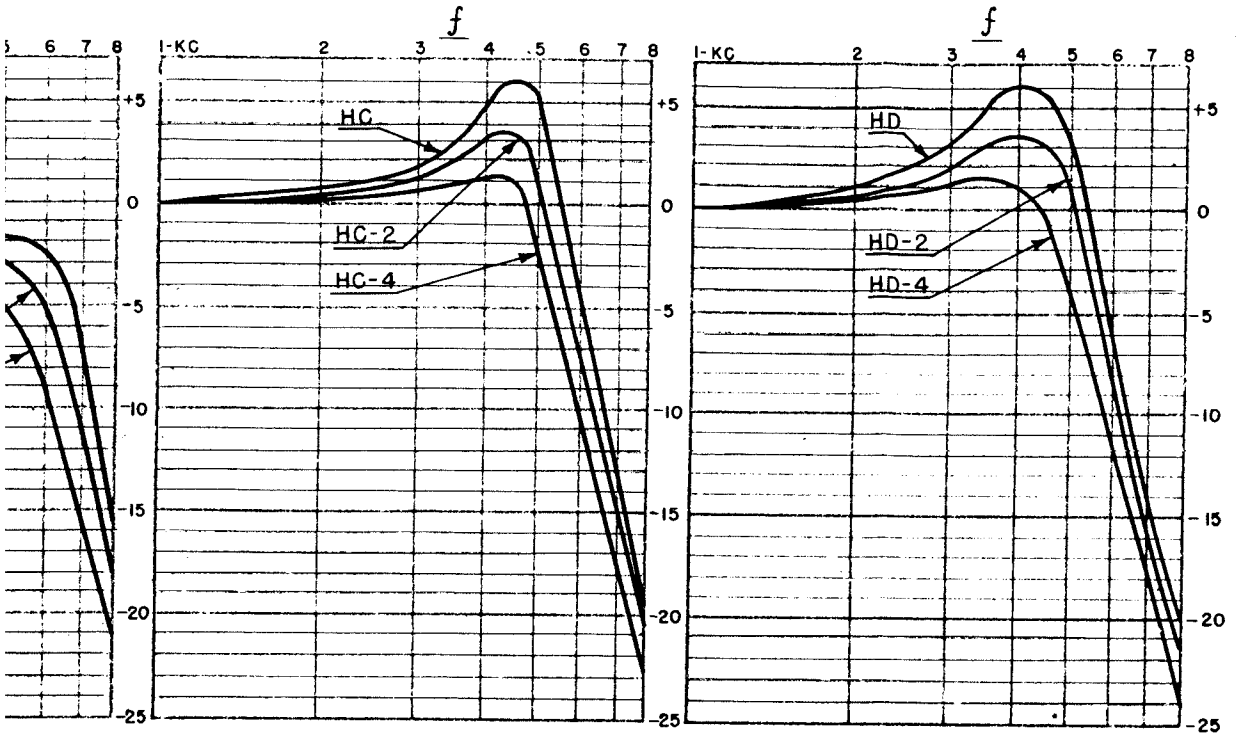
DESIG.	DESCRIPTION	MOTIO.PT.NO.
C1, C12, C13	.05 MF. 600V. TYPE "TA" CONDENSER	MA-2642
C2	.01 MF. 600V. TYPE "TA" CONDENSER	MA-2643
C3, C11, C15 C16, C17	8-8 MF. 475V. CONDENSER	MA-2641
C4	.00025 MF. 1000V. CONDENSER	MA-2645
C5, C14 C19	25 MF. 50V. CONDENSER	MA-2640
C6, C7	.001 MF. 1000V. CONDENSER	MA-2616
C8	.005 MF. 1000V. CONDENSER	MA-2646
C9	.05 MF. 600V. CONDENSER	MA-2613
C10	.02 MF. 600V. CONDENSER	MA-2647
C18	.007 MF. 1500V. CONDENSER	MA-2644
R1, R2	20,000 Ω 1 WATT RESISTOR	MA-2546
R3, R10	10,000 Ω 1 WATT RESISTOR	PA-2526
R4, R15	50,000 Ω 1 WATT RESISTOR	PA-2602
R5, R7	6,000 Ω 1 WATT RESISTOR	MA-2655
R6	30,000 Ω 1 WATT RESISTOR	PA-2605
R8, R11, R13	200,000 Ω 1 WATT RESISTOR	MA-2657
R9	60,000 Ω 1 WATT RESISTOR	MA-2656
R12	100,000 Ω 1 WATT RESISTOR	MA 2542
R14	400,000 Ω 1 WATT RESISTOR	MA 2658
R16	500,000 Ω 1 WATT RESISTOR	MA-2659
R17, R18, R22	700 Ω 1 WATT RESISTOR	MA-2654
R19	125 Ω 20 WATT RESISTOR	MA-2651
R20	700 Ω 10 WATT RESISTOR	MA-2652
R21	10,000 Ω 10 WATT RESISTOR	MA-2653
R23, R24	100 Ω ½ WATT RESISTOR	MA-2688
D-1	S.P.S.T. TOGGLE SWITCH	MA-2521
D2, D3	PUSH BUTTON SWITCH	MA-2605

DESIG.	DESCRIPTION	MOTIO.PT.NO.
P1	POTENTIOMETER, 200,000 Ω	MA-2525
M1	METER 0-200 MA	MA-2636
T1	POWER TRANSFORMER	MA-7028
T2	OUTPUT TRANSFORMER	MA 2638
L1	CHOKE COIL	MA-2639
VS1, VS2 VS3, VS4, VS6	OCTAL SOCKET	PA-2612
VS5	4-PRONG SOCKET	MA-2604
F1	FUSE 2AMP.	MA-2681
CF-1	MAIN CABLE FORM	MA-2665
CF-2	METER PANEL CABLE FORM.	MA-2667

N
1.
2.
3
4

UNLESS OTHERWISE SPECIFIED
DECIMAL DIMENSIONS ± .005"
FRACTIONAL DIMENSIONS ± 1/64"
ANGULAR DIMENSIONS ± 1°

CHANGES
ISSUE NO. 1 12-15-44



-7 GROUNDED. HC — SAME AS HA EXCEPT LOWER END C-8 GROUNDED.

SERIES TO HC-1 — SAME AS HC EXCEPT R-11 & R-12 IN SERIES TO GND. FROM C-6 (NOT DRAWN.).

SERIES TO HC-2 — SAME AS HC EXCEPT R-11 ONLY IN SERIES TO GND. FROM C-6.

SERIES TO HC-3 — SAME AS HC EXCEPT R-12 ONLY IN SERIES TO GND. FROM C-6 (NOT DRAWN).

PARALLEL HC-4 — SAME AS HC EXCEPT R-11 & R-12 IN PARALLEL TO GND. FROM C-6.

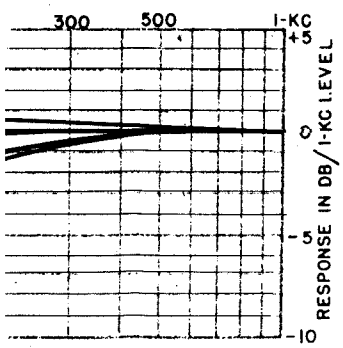
HD — SAME AS HA EXCEPT LOWER ENDS OF BOTH C-7 & C-8 GROUNDED.

HD-1 — SAME AS HD EXCEPT R-11 & R-12 IN SERIES TO GND. FROM C-6 (NOT DRAWN).

HD-2 — SAME AS HD EXCEPT R-11 ONLY IN SERIES TO GND. FROM C-6.

HD-3 — SAME AS HD EXCEPT R-12 ONLY IN SERIES TO GND. FROM C-6 (NOT DRAWN).

HD-4 — SAME AS HD EXCEPT R-11 & R-12 IN PARALLEL TO GND. FROM C-6.



FEEDBACK CIRCUIT. C-2
GRID CIRCUIT OF V-1.
IRCUIT. C-2 IN PLACE OF C-1
CIRCUIT. C-2 IN PLACE OF C-1
IN FEEDBACK CIRCUIT. C-2 IN
IRCUIT.
T OF FEEDBACK CIRCUIT.
GRID CIRCUIT.

NOTES:

1. THESE CURVES REPRESENT THE AVERAGE SYSTEM FREQUENCY RESPONSE FOR VARIOUS EQUALIZATION CONNECTIONS FROM CONSTANT LEVEL FREQUENCY TEST FILM OF PA AND MA-7505-A AMPLIFIERS OPERATING FROM SH-7500 REPRODUCERS WITH 12' BELDEN NO. 8401 CABLE CONNECTING REPRODUCERS TO PA-7505-A AMPLIFIER AND WITH 20' BELDEN NO. 8401 CABLE BETEEN THIS AMPLIFIER AND THE MA-7505-A AMPLIFIER(S). CURVES WERE TAKEN WITH 16 OHM RESISTANCE LOAD IN PLACE OF SPEAKER NETWORK, AND WITH MAIN VOLUME CONTROL ON STEP 6 AND ALL OTHER GAIN ADJUSTMENTS AT MAXIMUM. FOR 40' OF CABLE BETEEN AMPLIFIERS RESPONSE IS LOWERED APPROXIMATELY 0.5 DB AT 3 KC, 1.5 DB AT 5 KC, 2 DB AT 7 KC, AND 2.5 DB AT 8 KC.

2. CORRECTION FACTORS FOR TRANSMISSION TESTS ARE OBTAINED FROM THESE CURVES BY NOTING THE RESPONSE AT THE DESIRED TEST REEL FREQUENCIES, AND THEN REVERSING THE SIGNS ON THESE VALUES.

DO NOT SCALE DRAWING

ASSOCIATED DRAWINGS

LMA-2649 "MA-7505-A AMPLIFIER WIRING DIAGRAM"

LMA-2650 "MA-7505-A AMPLIFIER SCHMATIC DIAGRAM."

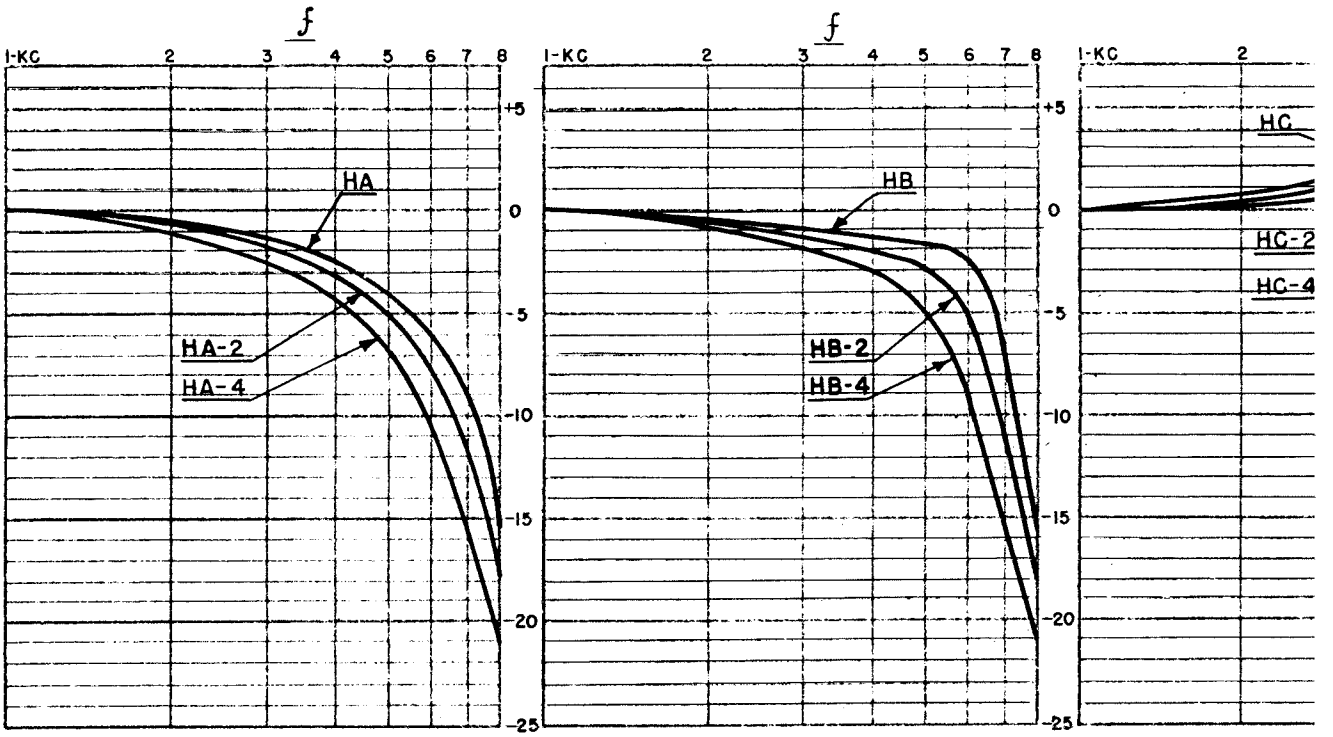
TITLE
7505-A TYPE AMPLIFIERS EQUALIZATION CURVES

MATERIAL		FINISH	
DRAWN H.M.C.	CHKD. RW	APPVD. RW	DATE 12-15-44

DRWG. NO. LSS-7540

MOTIOGRAPH
CHICAGO, ILL.

LSS-7540



HA— CONNECTIONS TO C-7, C-8, R-11 & R-12 PER LMA-2549 & LMA-2550.

HA-1 – SAME, EXCEPT R-11 & R-12 IN SERIES TO GND. FROM C-6 (NOT DRAWN-BETWEEN HA-1 & HA-2).

HA-2 – SAME, EXCEPT R-11 ONLY IN SERIES TO GND. FROM C-6.

HA-3 – SAME, EXCEPT R-12 ONLY IN SERIES TO GND. FROM C-6 (NOT DRAWN-BETEEN HA-2 & HA-4).

HA-4 - SAME, EXCEPT R-11 & R-12 IN PARALLEL TO GND. FROM C-6.

HB — SAME AS HA EXCEPT LOWER END C-7 GROUNDED.

HB-1- SAME AS HB EXCEPT R-11 & R-12 IN SERIES TO GND. FROM C-6 (NOT DRAWN).

HB-2- SAME AS HB EXCEPT R-11 ONLY IN SERIES TO GND. FROM C-6.

HB-3—SAME AS HB EXCEPT R-12 ONLY IN SERIES TO GND. FROM C-6 (NOT DRAWN).

HB-4-SAME AS HB EXCEPT R-11 & R-12 IN PARALLEL TO GND. FROM C-6.

HC —SAME AS HA EXCEPT

HC-1—SAME AS HC EXCEPT

GND. FROM C-6 (N

HC-2—SAME AS HC EXCEP

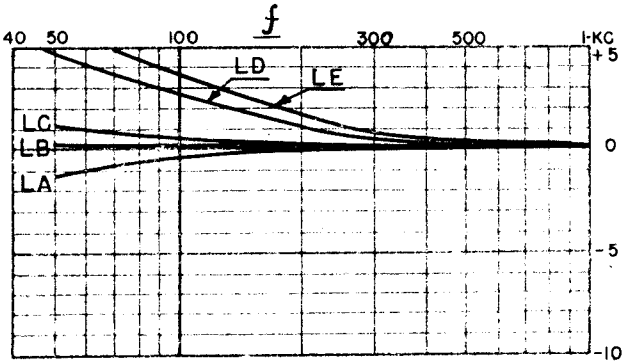
GND. FROM C-6.

HC-3—SAME AS HC EXCEP

GND. FROM C-6 (N

HC-4-SAME AS HC EXCEP

TO GND. FROM C-6



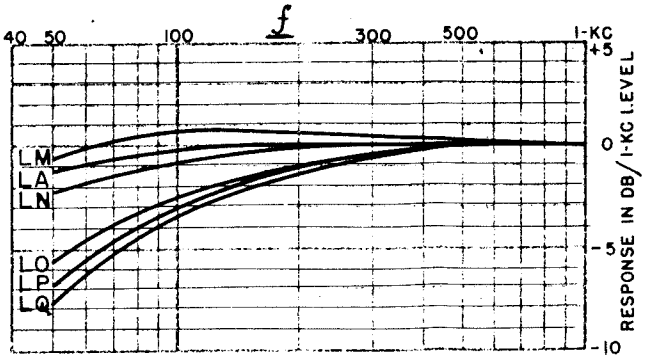
LA— CONNECTIONS TO C-1, C-2, C-9, C-10 PER LMA-2549 AND LMA-2550.

LB —C-9 & C-10 PARALLELED IN FEEDBACK CIRCUIT.

LC —C-9 ONLY IN FEEDBACK CIRCUIT.

LD — C-10 ONLY IN FEEDBACK CIRCUIT.

LE — C-9 & C-10 IN SERIES IN FEEDBACK CIRCUIT.



LM— C-9 & C-10 IN SERIES IN FEEDBACK CIRCUIT. C-2 SUBSTITUTED FOR C-1 IN GRID CIRCUIT OF V-1.

LN — C-10 ONLY IN FEEDBACK CIRCUIT. C-2 IN PLACE OF C-1 IN GRID CIRCUIT.

LO— C-9 ONLY IN FEEDBACK CIRCUIT. C-2 IN PLACE OF C-1 IN GRID CIRCUIT.

LP —C-9 & C-10 PARALLELED IN FEEDBACK CIRCUIT. C-2 IN PLACE OF C-1 IN GRID CIRCUIT.

LQ — C-9 & C-10 SHORTED OUT OF FEEDBACK CIRCUIT. C-2 IN PLACE OF C-1 IN GRID CIRCUIT.

NO

1. TH

RES

LEV

OPE

CAB

20'

AMP

IN P

ON

40'

APP

2.5

2. C

FRO

REE

VALI