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WAR DEPARTMENT

TECHNICAL MANUAL



ORDNANCE MAINTENANCE

BINAURAL TRAINING
INSTRUMENTS, M1 AND M2

July 8, 1941

ORDNANCE MAINTENANCE

BINAURAL TRAINING INSTRUMENTS, M1 AND M2

Prepared under direction of the
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SECTION I

GENERAL

Purpose	Paragraph 1
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1. Purpose.—This manual is published primarily for the information and guidance of ordnance maintenance personnel.

2. Scope.—This manual supplements the Technical Manuals which are prepared for the using arm. It contains descriptive matter and illustrations sufficient to provide a general working knowledge of the instruments and detailed instructions for inspection, maintenance, and repair by ordnance maintenance personnel.

3. References.—The appendix lists the Technical Manuals and Standard Nomenclature Lists for the equipment described herein.

SECTION II

DESCRIPTION

General	Paragraph 4
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4. General.—The binaural training instruments, M1 and M2, are designed as an aid to selecting and training sound-locator operators. The operation of these instruments is based on the use of phonograph records which closely reproduce the sound of different types of aircraft. The photograph transcription equipment issued with the M1 instrument is similar to the transcription unit furnished with the M2 instrument and performs similar functions. In the M1 instrument, binaural sense is introduced by a phase control unit which divides and directs the sound to the listener's ears through two separate acoustic paths. In the M2 instrument, an additional feature is provided in that a movable sound source may be employed in place of the phase control unit to permit training with the actual sound locator under conditions which very closely simulate those of actual aircraft tracking.

a. Binaural training instrument, M1.—This instrument includes the transcription equipment, a phase control unit, helmet, assembly, and accessories.

(1) *Transcription equipment.*—The source of sound is the transcription equipment. It consists essentially of an electrically driven turntable and a magnetic pick-up with an impedance matching network.

(a) The different types of transcription equipment as issued with instruments of various serial numbers are as follows:

1. For instruments, serial Nos. 1 to 19, inclusive—RCA turntable with universal electric motor and rubber-cushioned pick-up.
2. For instruments, serial Nos. 20 to 25, inclusive—Sonora turntable with universal electric motor and Audak electrochromatic pick-up and arm.
3. For instruments, serial Nos. 26 and up—RCA transcription equipment, type UZ4210.

(b) The magnetic pick-up, through an impedance matching network, is connected by a cord, assembly, B129354 (fig. 3), to the receiver and cap, assembly (fig. 2), of the phase control unit.

(2) *Phase control unit* (fig. 1).—The mechanical phase shifting is accomplished by the phase control unit.

(a) The sound from the receiver and cap, assembly, enters the wye, B129350 (fig. 3), and branches into two tubes, B129352 (fig. 3), one on the right and the other on the left-hand side of the receiver and cap, assembly. The sound in each branch proceeds through a slide, C44602 (fig. 2), into a tube, B129351 (fig. 2), and finally into a rubber tube, A38819 (figs. 1 and 11), which connects to the helmet of the operator.

(b) The operator's handwheel, C44601 (fig. 2), and instructor's handwheel, B16521 (fig. 4), are both connected by means of friction couplings to gears of a differential which move the two slides, C44602 (fig. 2). As the slides are mutually connected through the differential, a given movement of one slide is accompanied by a corresponding movement of the other slide in the opposite direction.

(c) The motion of the differential arm, B129348 (fig. 2), is transmitted to the slide by means of the link, A38803 (fig. 2), and caps, A38805 and A38806 (fig. 3).

(d) The pointer, A38810 (fig. 1), which is attached to the cap, B129349 (fig. 3), projects through a slot on the front of the instrument. A scale is attached above this pointer on which the error from the exact binaural balance can be read directly. Each division on this scale corresponds to 3.5 mils on a sound locator having its horns 110 inches apart.

(3) *Helmet, assembly*.—The helmet, assembly (fig. 5), Signal Corps, type HA1, modified for earpiece, is used with this equipment. The helmet is fitted with two earpieces, B129378 (fig. 5), one for each ear. Two rubber tubes, A38819 (fig. 11), provide the connecting medium between the earpiece of the helmet and the phase control unit.

(4) *Accessories*.—For a list of accessories refer to *b*(3) below.

b. Binaural training instrument, M2.—This instrument includes the transcription unit, the phase control unit, helmet, assembly, and accessories.

(1) *Transcription unit*.—The source of sound is the transcription unit (fig. 6). This unit consists essentially of an electric-driven turntable, a magnetic pick-up, cable reel with cable, and horn, assembly.

(a) The electric-driven turntable (fig. 9) is provided with a speed adjustment to insure satisfactory reproduction of the record. The output level of the unit can be varied by means of the volume control (fig. 7) of the amplifier.

(b) A cable and receptacle, assembly, B138121 (fig. 6), provides the electrical connection from the transcription equipment to the

horn (fig. 8). A reel, C70338 (fig. 10), and crank, B138087, are provided for winding up the cable when it is not being used.

(c) The horn, assembly, C70346 (fig. 6), is provided with a driver unit and a bracket. Two pulleys are attached to the bracket to be used for moving the horn along the suspended cable or small rope. A compartment is provided in the assembly chest, D29352, of the transcription unit to store the horn, assembly, when it is not being used.

(2) *Phase control unit and helmet, assembly.*—The phase control unit, D43135 (fig. 11), and the helmet, assembly (D43139), for the M2 instrument are identical to those used with the M1 instrument. By the installation of a suitable receiver (par. 8a(2)(e)), the unit can be used with either the M1 or M2 instrument. For a description see a(2) and (3) above.

(3) *Accessories.*—The accessories furnished for use with this instrument include a record album, hammer, phonograph oiler, pliers, wrenches, and screw drivers. Most of the items, such as screw drivers, etc., require no description as their uses are self-explanatory.

SECTION III

BINAURAL TRAINING INSTRUMENT, M1

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Inspection.....	6
Maintenance and repair.....	7

5. Operation.—In connection with the operating procedure, reference should be made to figure 1.

a. To set up equipment for operation.—(1) The transcription equipment which may be any of the three types as described in paragraph 4a(1)(a) is placed at a convenient height. This enables the instructor to watch the turntable.

(2) Place a record on the turntable and clamp a needle into the pick-up.

(3) Connect the transcription equipment to a suitable power source. Instruments equipped with RCA transcription equipment, type UZ-4210, are made to operate only on 105-120 volt, 60-cycle, single phase a. c. power. The other types will operate on 105-120 volt, a. c. or d. c. power.

(4) Plug the cord from the pick-up into the phase control unit.

(5) The operator adjusts the helmet to fit comfortably on his head. The instructor starts the transcription equipment by closing the motor switch and placing the pick-up on the record.

(6) The instructor turns his handwheel a fixed amount and permits the operator to reestablish a binaural balance. By watching the pointer on the scale, A38814 (fig. 1), the instructor can observe the degree of balance which has been obtained by the operator.

(7) By changing the records on the transcription unit, the listener may be taught to identify the various types of aircraft by their sound.

b. To remove equipment from service.—(1) Disconnect the electric power source from the transcription equipment.

(2) Remove the pick-up from the record. Place the record into the album.

(3) Remove the cord, assembly, B129354 (fig. 3), from the phase control unit and transcription equipment.

(4) Remove the rubber tubes from the instrument and wrap them around the helmet.

6. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required and the remedies necessary to insure serviceability and proper functioning. The following list will serve as a guide:

a. Phase control unit.—To carry out the following inspections the lid, C44604 (fig. 1), is removed from the body, D25605.

Parts to be inspected

(1) Pointer, A38810.

(2) Slides, C44602.

(3) Friction couplings of the handwheels.

Points to be observed

(1) Examine the pointer for any looseness. The screws, BCOX3DG (fig. 3), should be kept tight at all times.

(2) Turn the handwheels to the limit of their travel in either direction to see if the slides move freely on the tubes. If tubes show noticeable wear or are bent or dented they should be replaced.

(3) When either of the handwheels is turned there should be no slippage but when stops are encountered the couplings should permit slippage to prevent damage. Slippage under normal operating conditions indicates that either adjustment or replacement of parts in the couplings is necessary.

(4) Gear, A38794, and worm wheel, A38796.

(4) Turn either of the two handwheels slowly in one direction and then in another. By observing the pointer, A38810 (fig. 1), on the scale, the backlash in the gears can be noticed; if appreciable, the gears must be replaced.

(5) Receiver, assembly.

(5) The receiver (fig. 2) should function without rattling. If it does not function satisfactorily, replace the receiver.

(6) Rubber tubes from the operator's helmet.

(6) Examine the rubber tube for cracks or breaks. If these are noticed, the tubes should be replaced.

b. Transcription equipment.—The binaural training instrument, M1, is furnished with different types of transcription equipment (par. 4a(1)(a)). For an inspection of any of these types, the following will serve as a guide:

Parts to be inspected

Points to be observed

(1) Turntable motor.

(1) The motor should run without overheating and turn the turntable at a constant speed of 78 revolutions per minute as measured by a suitable speed-measuring device. If speed is not satisfactory after adjustment (where it is provided), the motor should be replaced.

(2) Pick-up arm.

(2) The sound reproduced should be clear without distortion and of sufficient intensity.

(3) Connecting cables, plugs, and jacks.

(3) Examine the plugs and jacks to see if the contact springs make firm contact. The cables should also be examined. If the insulation is badly cracked or worn, the cables should be replaced.

7. Maintenance and repair.—The assembled and sectioned views show the location of the various parts and the means by which they

are held in place. These figures should be carefully studied before attempting any assembling or disassembling operation.

a. Phase control unit.—For the following operations the lid, C44604 (fig. 1), is removed from the body, D25605. After completion of the operation the lid is to be replaced.

(1) *To disassemble slides, C44602* (sec. A-A-A-A-A-A, fig. 2).—

(a) Remove the cap, A38806 (fig. 3), by removing the two nuts, A35566A, and associated screws.

(b) Push the link, A38803, away from the slide and grasp the slide with one hand and pull horizontally to the left (fig. 2) until it clears the tubes, B129352 (fig. 3). Then pull up, thus removing the slide from the instrument.

(2) *To disassemble receiver and cap, assembly.*—Remove the two wires from the phone jack. Twist the tube, A38818 (fig. 2), slightly and pull horizontally to the left until clear of the wye, B129350 (fig. 3), then lift up on the receiver. When assembling, care should be exercised to have the rubber tube, A38818, make a tight connection between the receiver and wye.

(3) *To disassemble instructor handwheel coupling.*—(a) Remove the instructor handwheel, B16521 (sec. G-G, fig. 4), together with the adapter, A43159, by removing the three screws, BCLX3DD.

(b) Remove the flange nut, A43158, by first loosening the adapter screw, BCUX1ED.

(c) Extract the flange compression spring, A43157. Drive out the flange, taper pin. Extract the flange, A43155, with plate A43156.

(4) *To disassemble differential arms.*—Since the disassembly operation for the right and left arms, B129348 (sec. B-B-B-B, fig. 2), is similar, only the procedure for disassembling the left arm will be given.

(a) Drive out the pin, BFCX1L (sec. D-D, fig. 4), and push the shaft, A38808 (fig. 2) several inches to the right.

(b) Remove the link stud, A38804 (fig. 2), by first removing the cotter pin, BFA1BD, then push the link toward the base plate (fig. 2).

(c) Remove the gears, A38794 (sec. E-E, fig. 4), by removing the two nuts, BBAX1A, with associated washers and driving out the studs, A38795.

(d) Remove the four nuts, A35566A, and associated washers from the brackets, B129345 and B129346 (sec. B-B-B-B, fig. 2). Firmly grasp both brackets with one hand and with the other pull toward the right about 1 inch or enough to free them from the projecting bolts, then lift up vertically and carefully remove them from the instrument.

(e) Access can be had for disassembling the worm wheel shaft, A38799, differential arm and associated parts if necessary.

(5) *To assemble various parts.*—The procedure to be followed for reassembling is the same as for disassembling except in the reverse order.

b. *Transcription equipment.*—Three different types of transcription equipment are issued with this instrument. No detailed instructions relative to the repair and maintenance of any one type are given. By examining the equipment, the procedure as well as the screws, nuts, etc., necessary to be removed for the replacement of defective parts can readily be determined.

SECTION IV

BINAURAL TRAINING INSTRUMENT, M2

	Paragraph
Operation.....	8
Inspection	9
Maintenance and repair.....	10

8. Operation.—In connection with the operating procedure, reference should be made to figures 6 and 7.

a. *To set up equipment for operation.*—(1) *When used with horn, assembly C70346.*—(a) Set transcription equipment on an object of convenient height and open the lid of the chest, assembly, D29358 (fig. 6).

(b) Remove the horn, assembly, C70346 (fig. 6), from the chest. Suspend it from a steel cable or small rope which has previously been strung between two poles or trees. Plug in the cable and receptacle, assembly, B138121 (fig. 6), from the binaural training instrument, M2, to the horn, assembly, C70346 (fig. 6).

(c) Plug the cable, B138073, into a 110-volt, 60-cycle a. c. power source, place the desired record on the turntable, and turn the motor switch on.

(d) Place a needle in the pick-up and clamp it firmly with the clamp provided.

(e) Place the pick-up on the record and turn the amplifier switch on. Set the output level as required by means of the volume-control knob.

(f) Place the listening station in the immediate vicinity where the sound intensity is sufficiently high. The suspended horn can be moved to different positions along the cable. The listeners track the

target with their horns and corrector operators perform duties exactly as when tracking an actual airplane.

(2) *When used with phase control unit of M1 or M2 instrument.*—

(a) Place the transcription equipment on an object of convenient height and open the lid of the chest, assembly, D29358 (fig. 6).

(b) Plug the power cable, B138073, into a 110-volt, 60-cycle, a. c. power source. Place the desired record on the turntable and clamp a needle into the pick-up.

(c) Plug the cord, assembly, B129354 (fig. 3), into the output jack of the transcription equipment.

(d) Follow the procedure given in paragraph 5a(5) to (7).

(e) Phase control units employ different types of receivers to properly match the transcription units with which they are used. When first placing a phase control unit into service, it is advisable to verify that the proper receiver has been installed. The receivers to be used are as follows:

1. Western Electric Co.'s No. 528 type receiver for use with turntables, UZ4210 and 4814, with AZ4211-2 pick-up.
2. Brandes Superior type receiver for turntables other than UZ4210 and 4814 with AZ-4211-2 pick-up and Green Flyer turntable.
3. Trimm, Featherweight (24,000 ohms) receiver for Green Flyer turntable for use with binaural training instrument, M2, only.

b. To remove equipment from operation.—(1) *When used with horn, assembly, C70346.*—(a) Turn the motor and amplifier switch off and remove the cable, B138073, from the power source.

(b) Remove the pick-up from the record.

(c) Remove the needle from the needle clamp.

(d) Remove the record from the turntable and place it in the album.

(e) Remove the horn, assembly, from the suspension cable; disconnect the cable and receptacle, assembly, B138121 (fig. 6), and place the horn into the proper place in the chest.

(f) Wind up on the reel, C70338 (fig. 10), the cable connecting the horn and transcription equipment.

(g) Close the lid of the chest.

(2) *When used with the phase control unit of M1 or M2 instrument.*—Follow the procedure given in paragraph 5b(1) to (4).

9. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper

functioning. In addition to the inspections given in paragraph 6b, the following should also be made:

Parts to be inspected

a. Volume control.

b. Contact springs, A45869 (fig. 10).

Points to be observed

a. Gradually increase the volume by operating the volume control over the usable range. The output of the horn should increase in uniform steps. Scratching or "dead spots" indicate a defective volume control.

b. The contact springs should make good contact on the rings, A178173 and A178174, as the cable reel, C70338, is being revolved. If the output level does not stay constant as the reel is rotated, the springs should be replaced.

10. Maintenance and repair.—The transcription unit furnished with the binaural training instrument, M2, will require little maintenance. If a unit fails to function properly it should be replaced.

a. *To disassemble driver unit of horn, assembly* (fig. 8).—(1) Disconnect the electrical connections from the driver unit (fig. 8) and remove the two nuts, BBCX1C, on opposite sides of the horn. Remove the bracket, assembly, B138096, from the horn.

(2) Pull up on the driver unit and carefully remove it from the horn.

b. *To disassemble pick-up arm* (fig. 9).—(1) Remove the plug from the input jack. Remove the screws and clips holding the cable and plug, assembly, B138077, to the turntable plate.

(2) Carefully remove the pick-up by removing the three screws, BCNX3DN, by which it is secured to the turntable plate, C70339.

c. *To assemble various parts.*—The procedure to be followed for re-assembling is the same as for disassembling except in the reverse order.

SECTION V

CARE AND PRESERVATION

Procedure	Paragraph 11
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11. Procedure.—a. *General.*—(1) The nuts and screws holding the various parts of the phase control unit and transcription equip-

ment should be kept tight at all times to insure satisfactory operation of the equipment.

(2) When the transcription equipment is not being used the cable and receptacle, assembly, B138121 (fig. 6), should be disconnected from the horn and wound up on the reel provided and the horn, assembly, placed in its proper place in the chest.

(3) Care should be exercised to keep the connecting cables and rubber tubes free from oil and grease. Any grease should be removed with a cloth moistened with ethyl alcohol.

(4) Care should be exercised when plugging in the phase control unit of the binaural training instrument, M1, to the transcription equipment of the M2 instrument that the plug is put in the output jack shown in figure 7.

(5) The loud speaker cone of the horn, assembly, will warp if subjected to excessive humidity. The equipment should therefore not be used in the rain, and the horn, assembly, should not be left in the open overnight.

(6) The reel contact rings (fig. 10) should be kept clean and free from oil at all times; if necessary, they should be cleaned with fine flint paper.

b. Lubrication.—In the following procedure when oil is specified, oil, lubricating, for aircraft instruments and machine guns (U. S. A. Spec. 2-27) is to be used, and where grease is specified, grease, special, low temperature (Royco 6A), is to be used.

(1) The turntable motor must be oiled periodically with a few drops of oil through the oilholes located underneath the turntable.

(2) At frequent intervals the bearings of the instructor and operator handwheel shafts should be lubricated with a few drops of oil. These bearings are provided with oilholes.

(3) The gears and arms of the mechanical phase control apparatus should be periodically oiled to insure smooth and quiet operation.

(4) The worm wheel shafts, A38799 and A38800, should be oiled at frequent intervals. Oilholes are provided in the shaft brackets, B129345, B129346, and B129347 (fig. 2), for this purpose.

(5) Occasionally the pillow blocks of the cable reel, C70338 (fig. 10), should be oiled with a few drops of oil through the oilholes provided.

(6) The slides, C44602 (fig. 2), should periodically be given a light coating of grease.

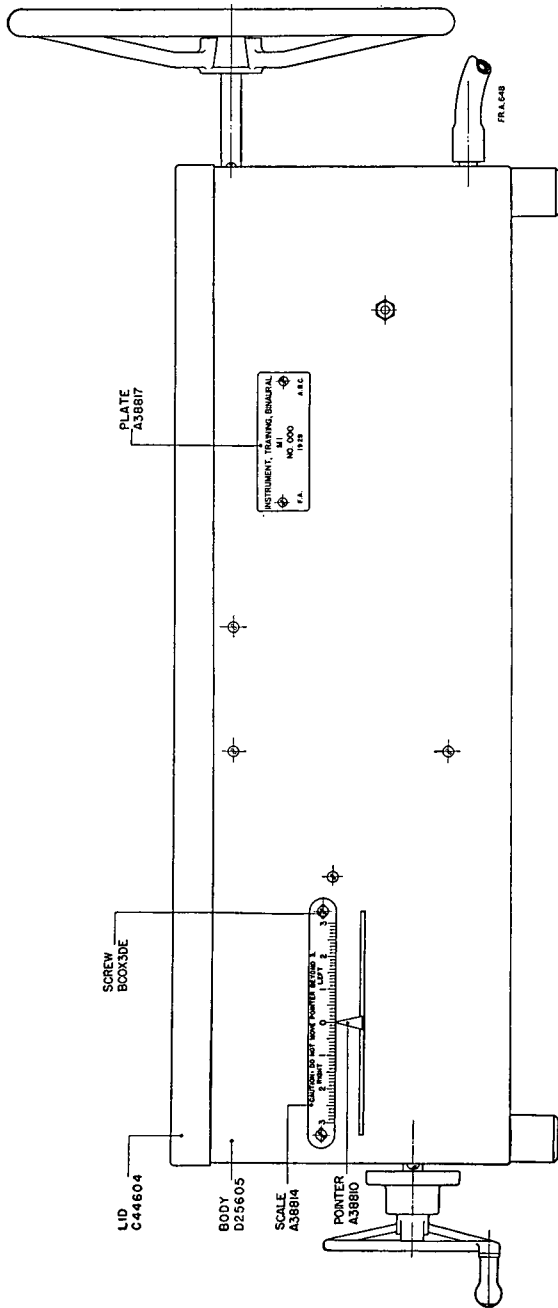


FIGURE 1.—Binaural training instrument, MI—phase control unit, front view.

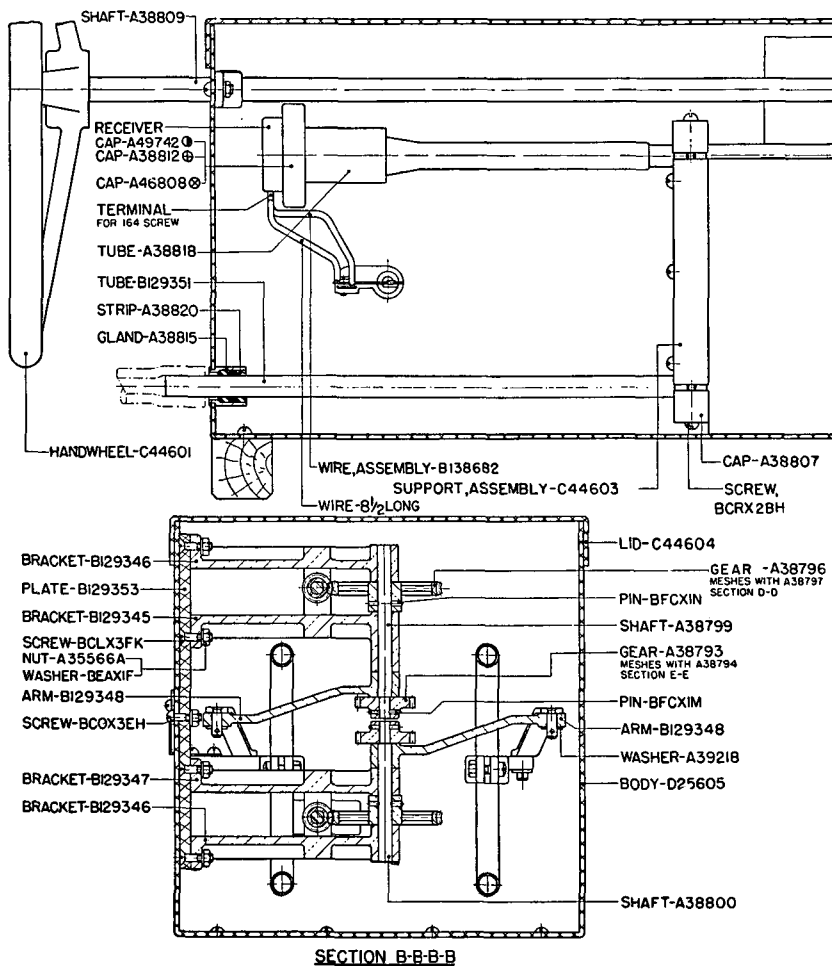
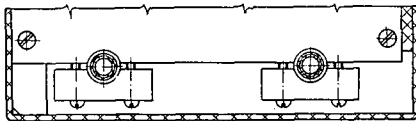
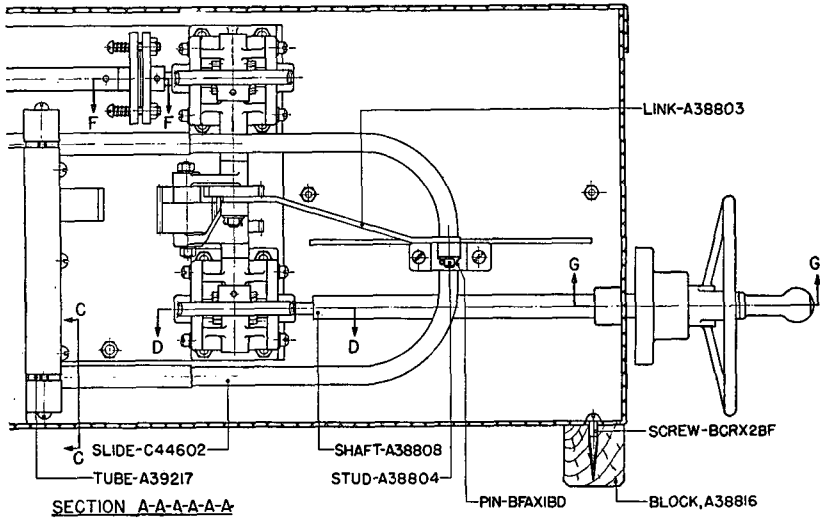


FIGURE 2.—Binaural training instrument, M1 or M2—phase control unit, sectioned views. (See fig. 3 for location of section planes A-A-A-A-A and B-B-B-B; secs. D-D, F-F, and G-G are shown on fig. 4.)



- ⊙ FOR GREEN FLYER TURNTABLE (BINAURAL TRAINING INSTRUMENT, M2 ONLY)
- ⊙ FOR TURNTABLE U2420 B 484 WITH A2421-2 PICK UP
- ⊙ FOR TURNTABLES OTHER THAN ⊙ AND ⊙

SECTION C-C

RA FSD-405

FIGURE 2.—Binaural training instrument, M1 or M2—phase control unit, sectioned views—Continued.

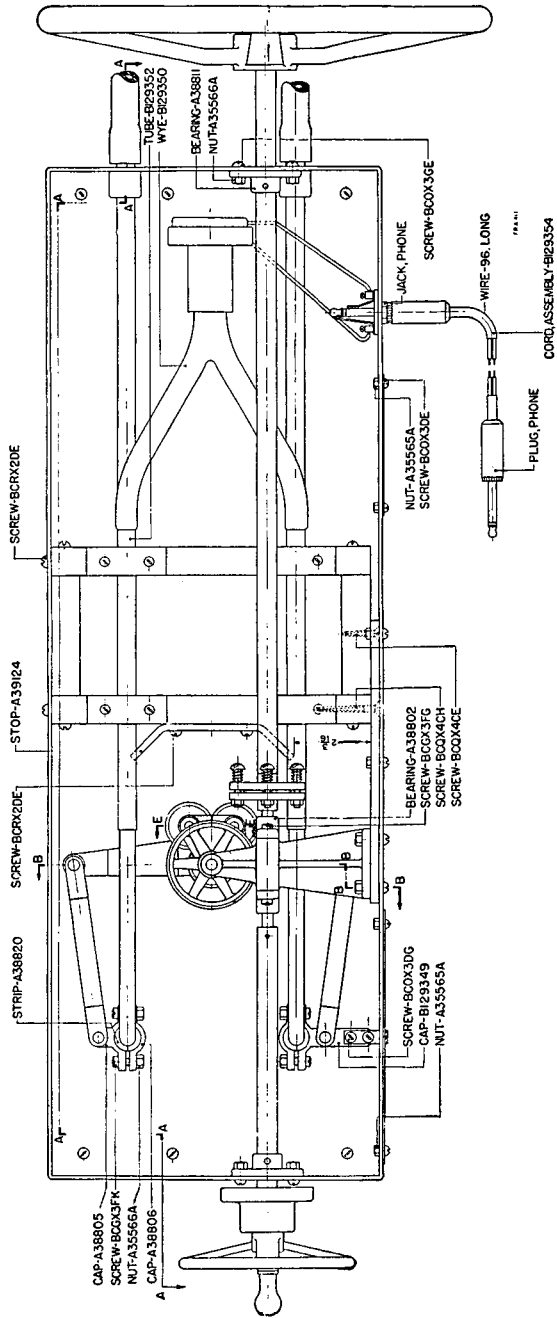


FIGURE 3.—Binaural training instrument, M1 or M2—phase control unit, top view, lid off.
 (Sec. A-A-A-A-A and B-B-B-B-B are shown in fig. 2 ; sec. E-E in fig. 4.)

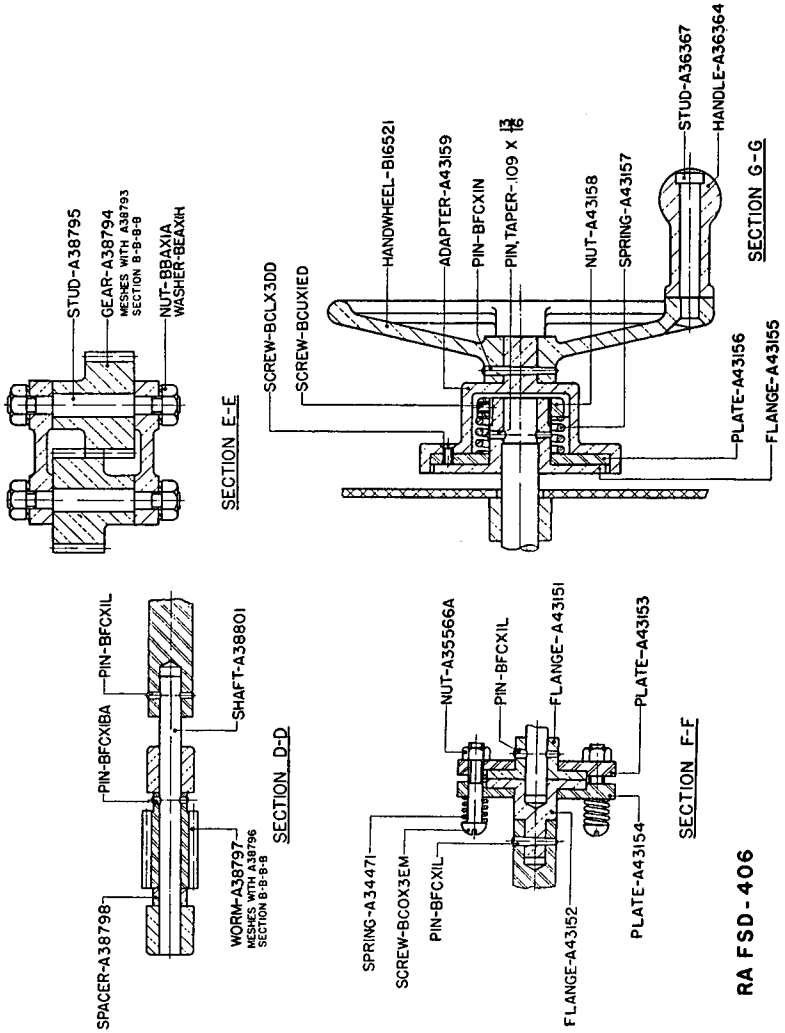


FIGURE 4.—Binaural training instrument, M1 or M2—phase control unit, sectional views. (See fig. 2 for location of section planes D-D, F-F, and G-G; fig. 3 for section plane E-E.)

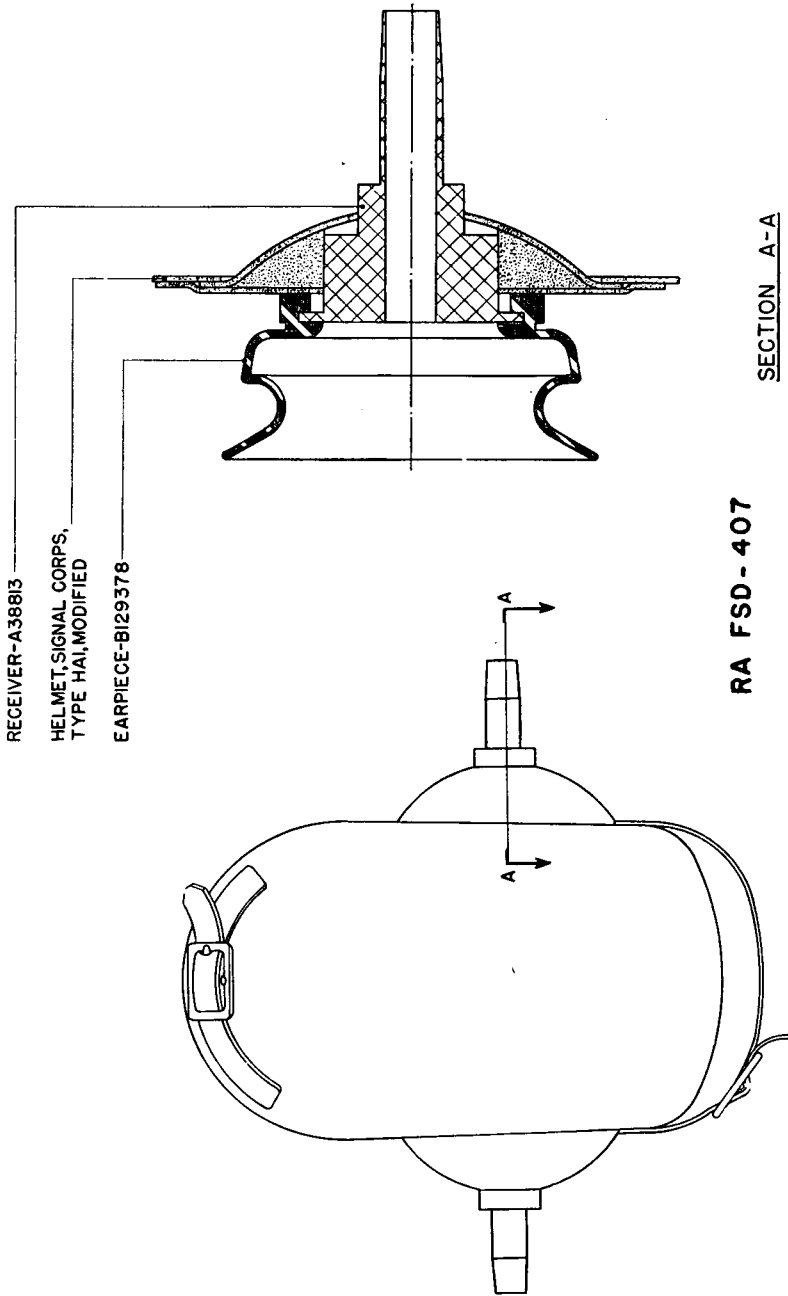


FIGURE 5.—Binaural training instrument, M1 or M2—helmet, assembly.

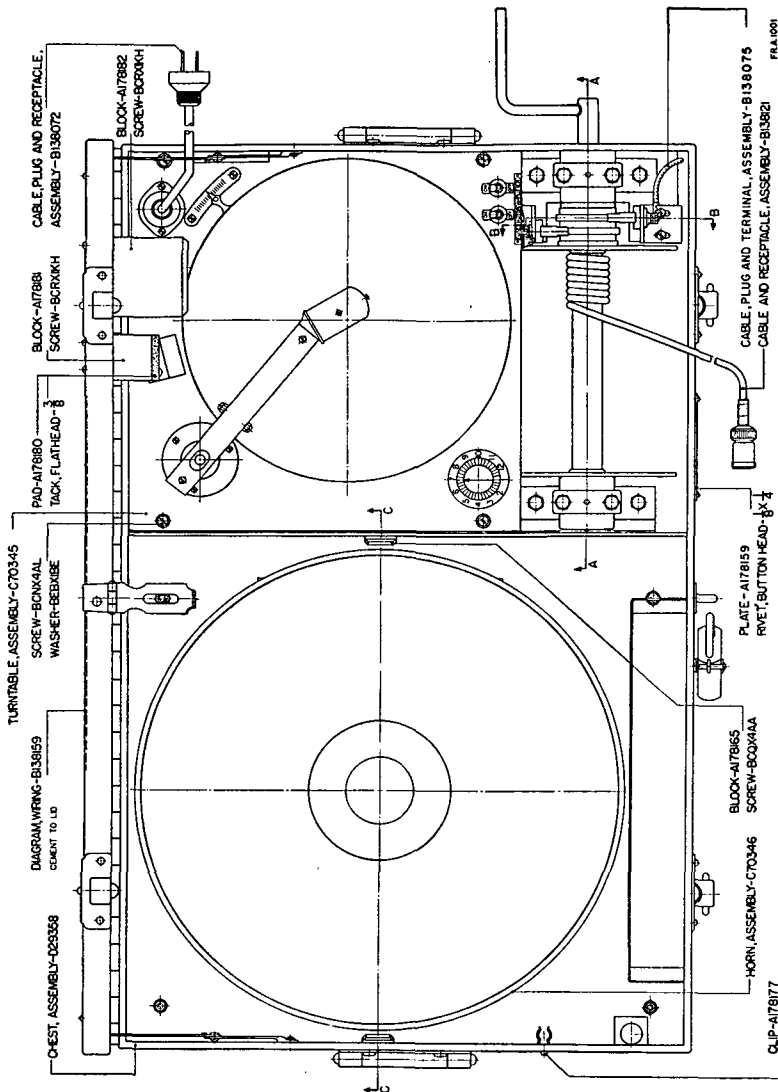
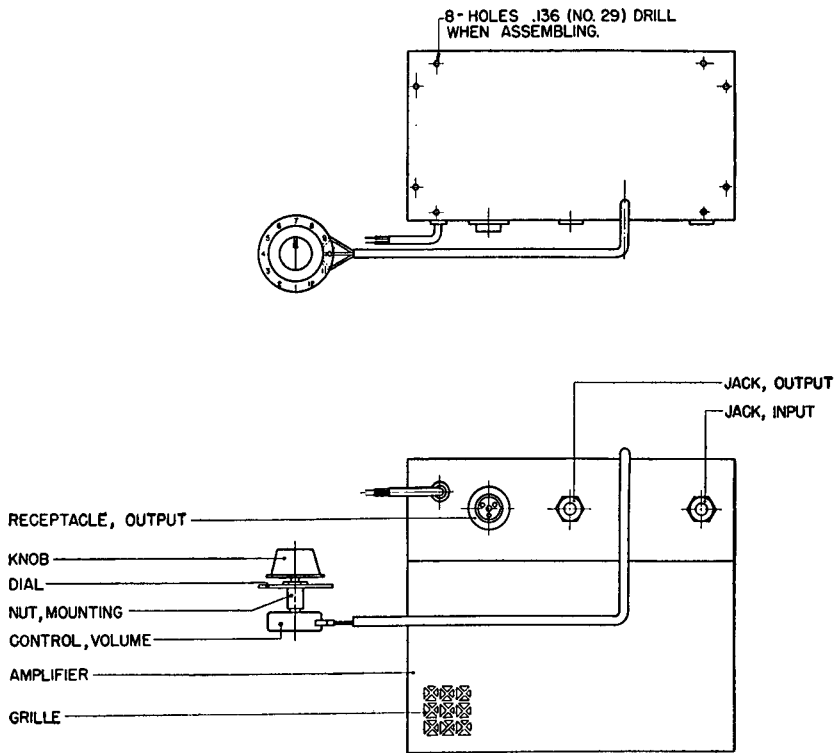
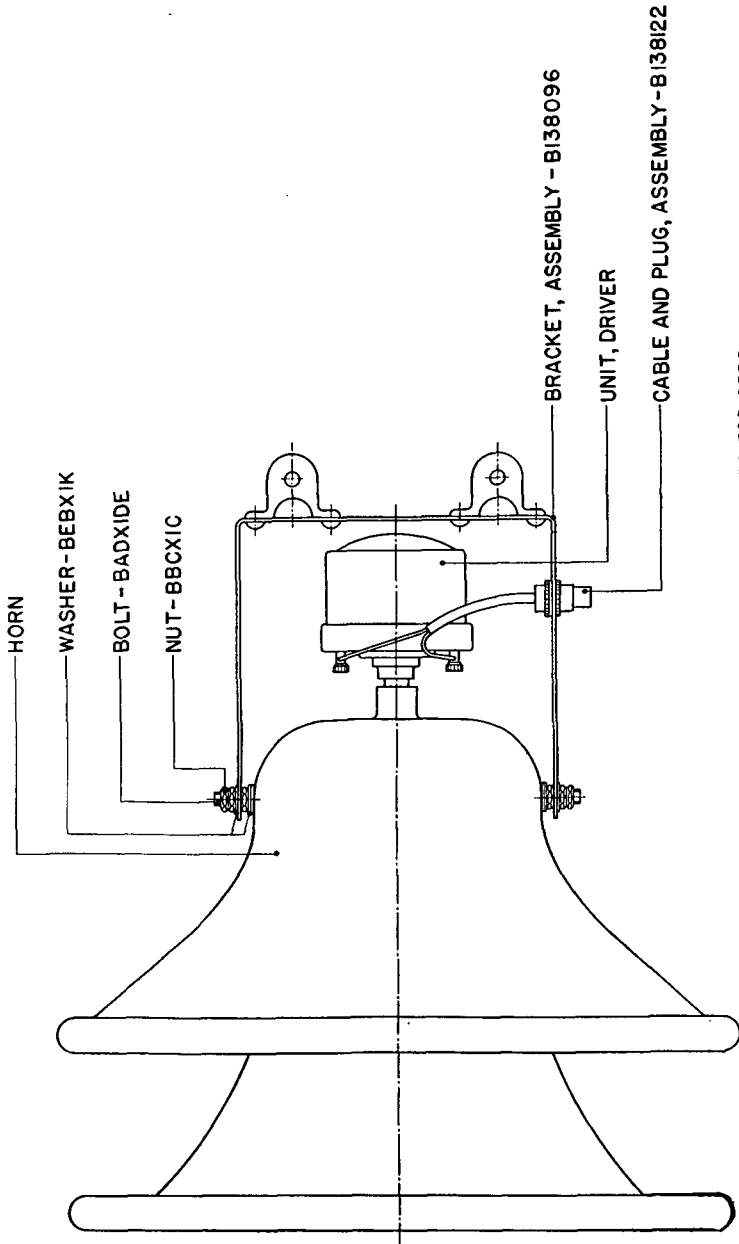


FIGURE 6.—Binaural training instrument, M2—transcription unit, plan view. (Secs. A-A, B-B, and C-C are shown on fig. 10.)



RA FSD 2529

FIGURE 7.—Binaural training instrument, M2—amplifier, assembly.



RA FSD 2530

Figure 8.—Binaural training instrument, M2—horn, assembly.

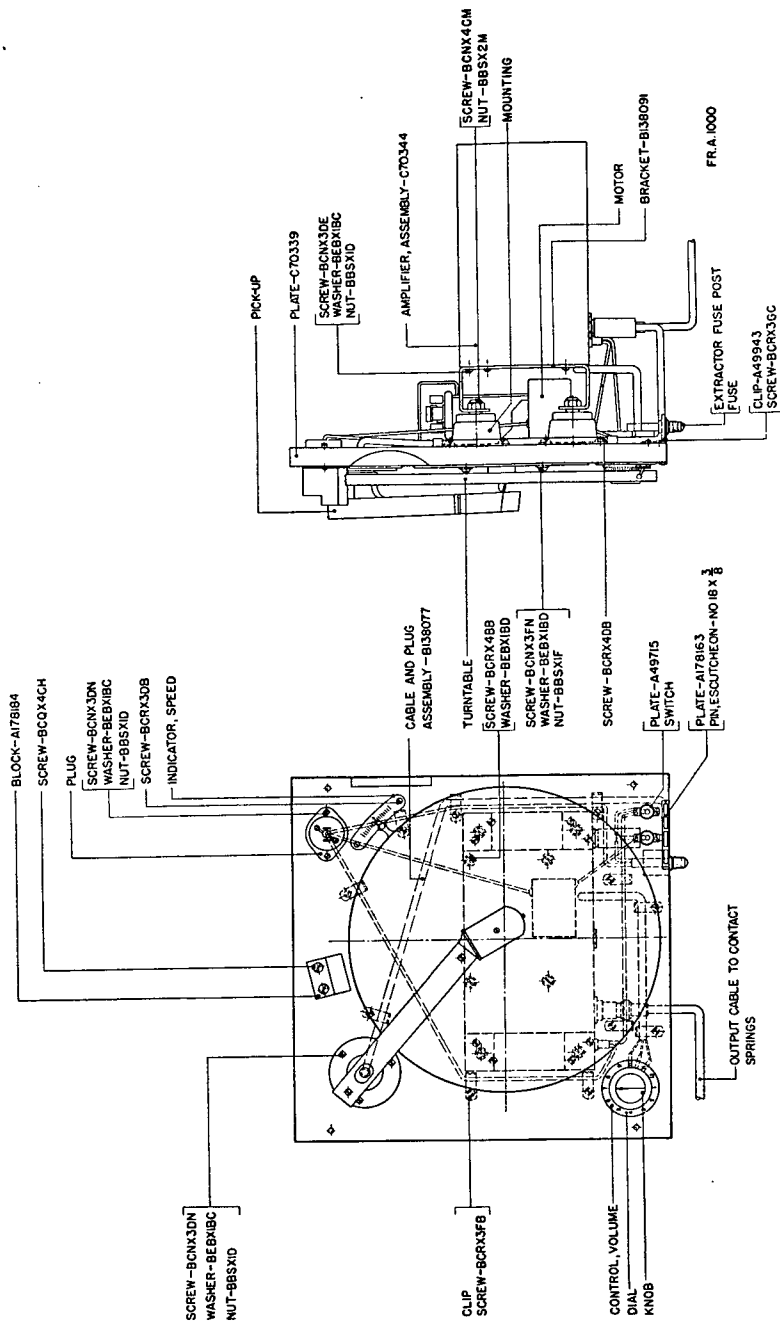


FIGURE 9.—Binaural training instrument, M2—turntable, assembly, plan and side views.

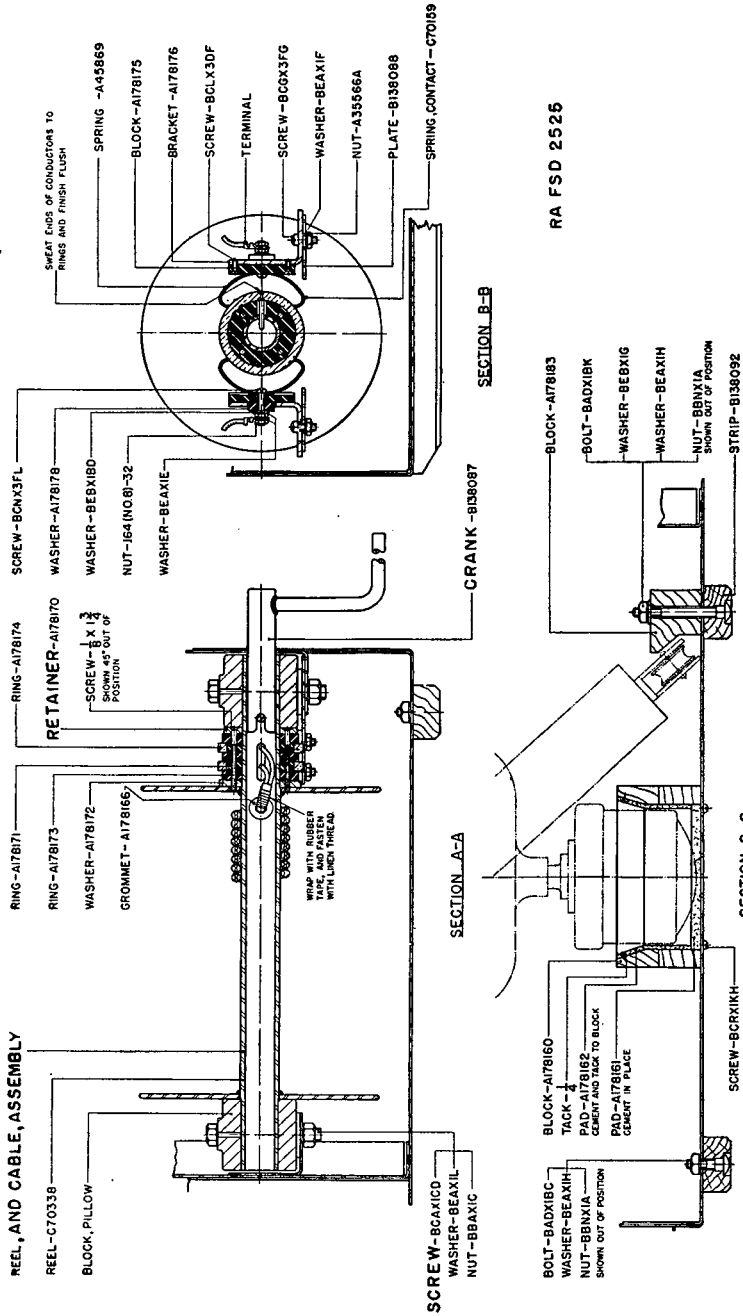


FIGURE 10.—Binaural training instrument, M2—transcription unit, sectioned views. (See fig. 6 for location of section planes A-A, B-B, and C-C.)

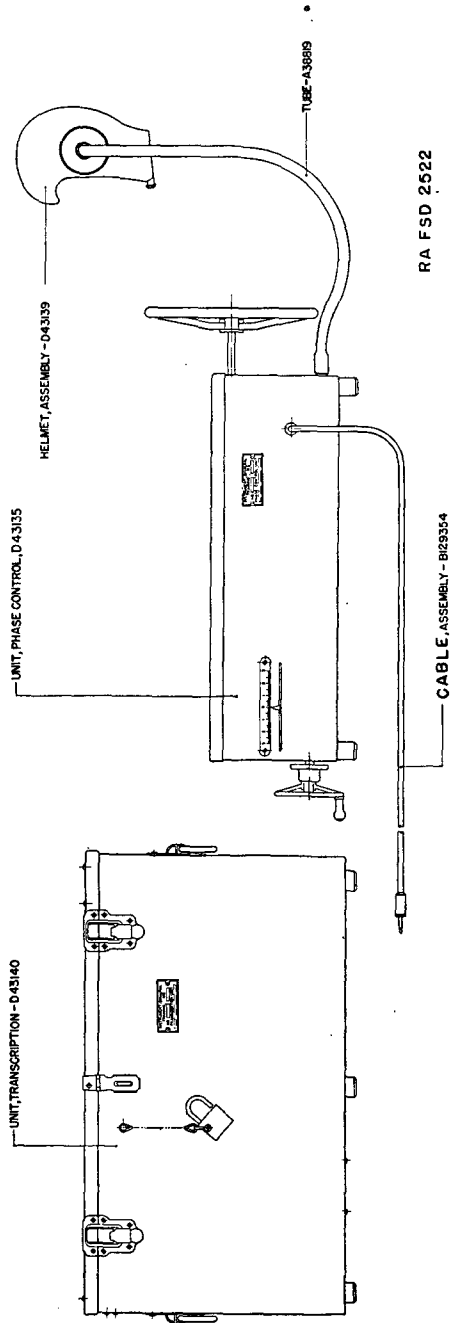


FIGURE 11.—Binaural training instrument, M2— assembled views.

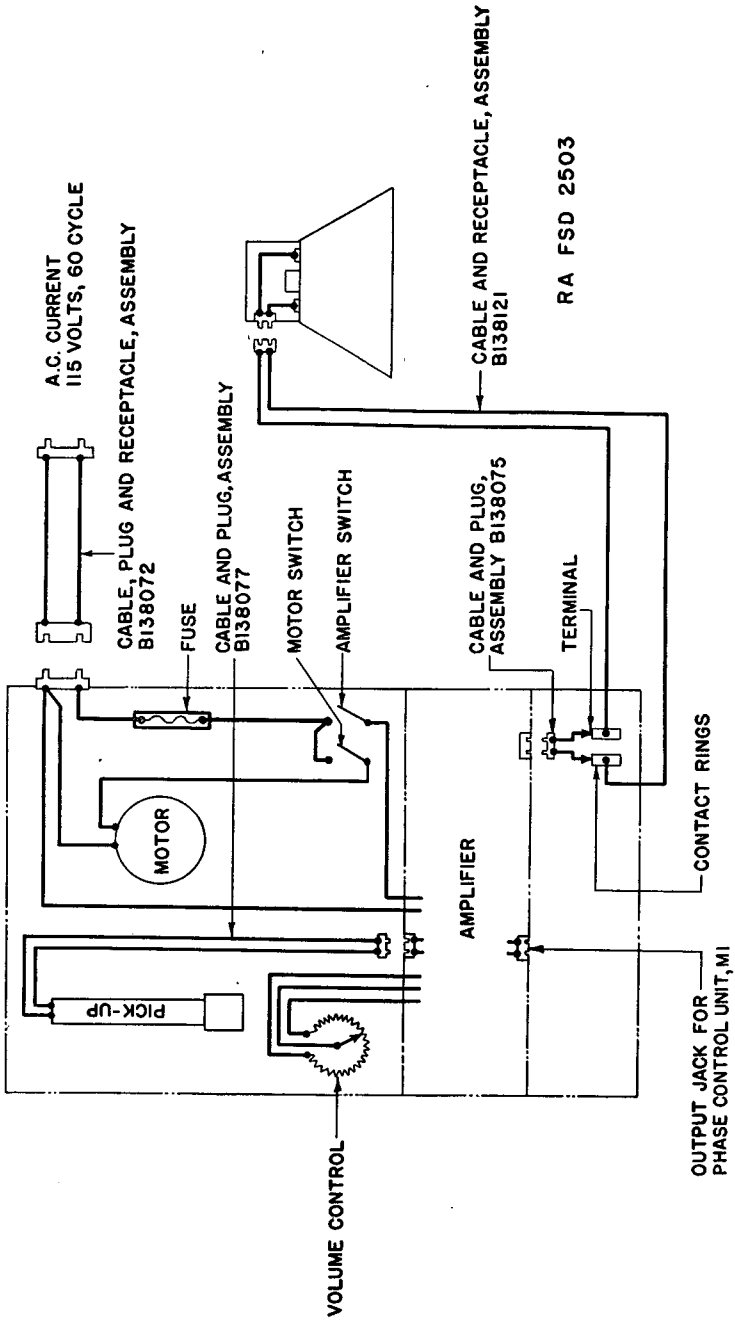


Figure 12.—Binaural training instrument, M2—wiring diagram.

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

Instrument, binaural training, M1----- SNL F-121.
Instrument, binaural training, M2----- SNL F-198.

2. Technical Manuals.

Cleaning and preserving materials----- TM 9-850
(now published as
TR 1395-A).
Matériel inspection and repair----- TM 9-1100.
Instruction Guide, binaural training instru- TM 9-2662.
ments, M1 and M2.

[A. G. 062.11 (5-14-41).]

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(For explanation of symbols, see FM 21-6.)