

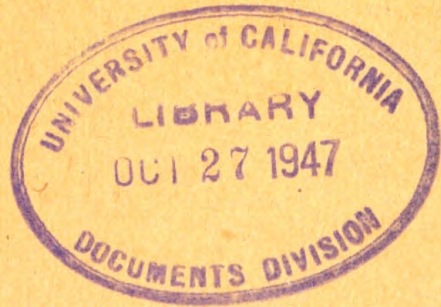
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1943

TM 9-657

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army

Director Trainer M8



WAR DEPARTMENT • 4 NOVEMBER 1943

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WAR DEPARTMENT TECHNICAL MANUAL

★ *TM 9-657*

Director Trainer M8



WAR DEPARTMENT

4 NOVEMBER 1943

★ This Technical Manual supersedes TM 9-657, dated 20 January 1943.

WAR DEPARTMENT
Washington 25, D. C., 4 November 1943

TM 9-657, Director Trainer M8, is published for the information and guidance of all concerned.

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Chief of Staff.

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*Major General,
The Adjutant General.*

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DIRECTOR TRAINER M8

Section I

INTRODUCTION

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1. PURPOSE.

a. This manual is published for the information and guidance of the using arms and service.

2. SCOPE.

a. In addition to a description of the Director Trainer M8, this manual contains technical information required for the identification, use, and care of the materiel.

b. Disassembly, assembly, and such repairs as may be handled by using arm personnel may be undertaken only under the supervision of an officer, or of the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the unit, the responsible ordnance service should be informed so that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

Section II

GENERAL DESCRIPTION

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3. GENERAL DESCRIPTION.

a. The Director Trainer M8 consists of three main parts: the sound equipment, the director, and the target.

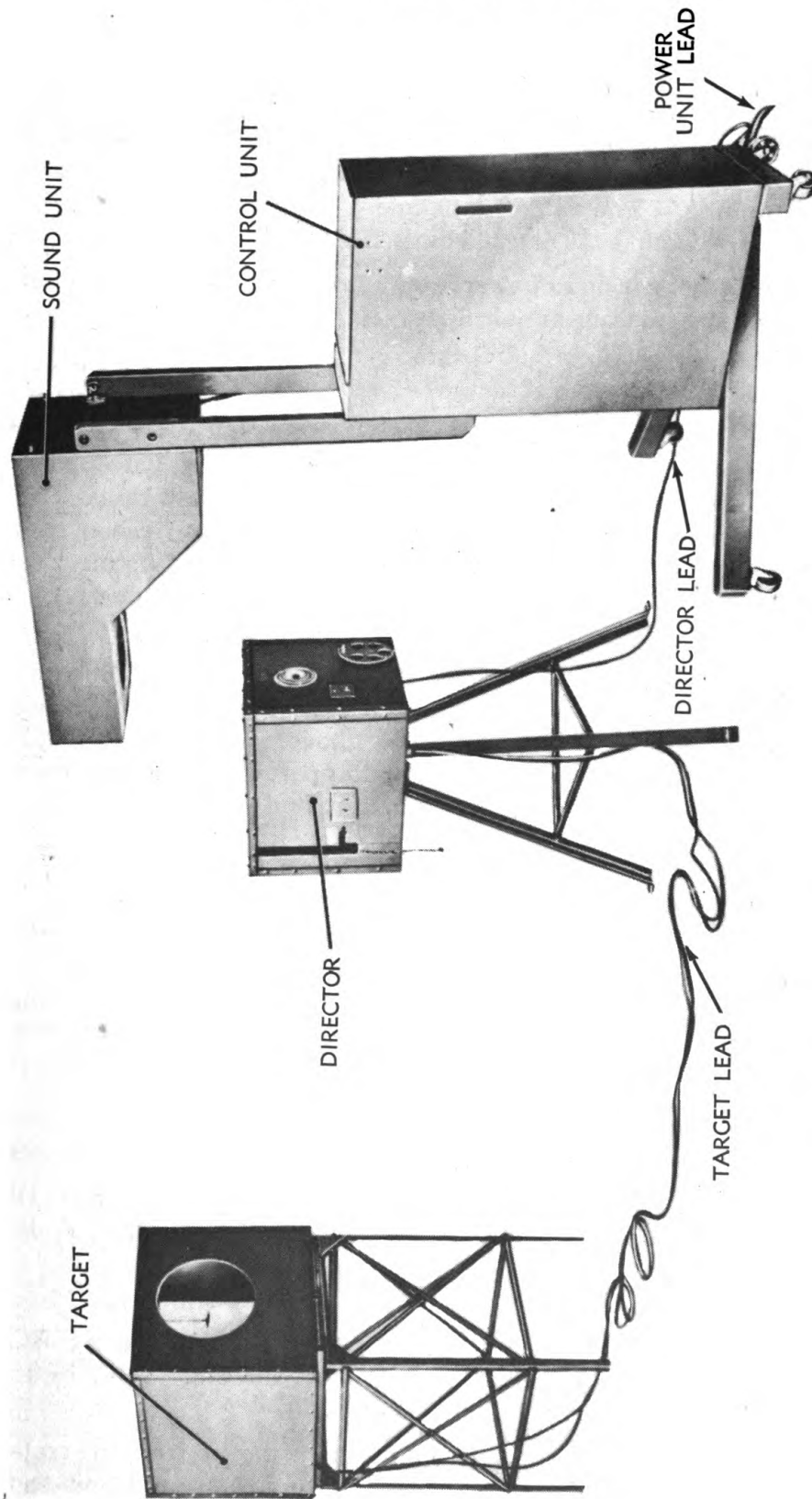
b. The Director Trainer M8 is equipped with eight removable airplane courses.

c. The Director Trainer M8, may be used in conjunction with the Hunt Trainer which, although available, is not furnished as a part of the Director Trainer M8.

4. IDENTIFICATION.

a. The sound equipment consists of a cabinet for the record changer,

GENERAL DESCRIPTION



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Figure 1 — Director Trainer M8 — Arrangement of Components

DIRECTOR TRAINER M8

amplifier, and the mechanism which produces the simulated 40-mm gun blast, and two large auditorium-type loud speakers.

b. The trainer is similar in dimension to the Directors M5, M5A1, and M6. It is controlled by either of two handwheels on opposite ends. One is for initial training or "dry" runs, and the other is for more advanced training. The range adjustment charts furnished represent different target courses as marked on each chart.

c. The target consists of a representation of moving clouds, a set of three tracer streams, and an airplane.

5. FUNCTION.

a. The Director Trainer M8 is used to train range setters for the Director M5 used to control the 40-mm anti-aircraft gun. The apparatus is particularly adapted to the selection and training of new range setters. It also serves to keep the experienced range setter refreshed on the functions and feel of the handwheel so that his range adjustments will be made automatically and subconsciously, thus insuring effective anti-aircraft fire.

b. The Hunt Trainer, when procured for use in conjunction with the Director Trainer M8, is used to train the range setter to estimate ranges by visual observation, in addition to the above. The range setter sees the airplane in its true observed size and apparent change of observed size as it is on its approaching leg, midpoint, and receding leg.

Section III

OPERATION

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6. UNCRATING.

a. The Director Trainer M8 will be delivered in five crates. Each crate contains one of the following: director, director target, director and target stands, director charts and sound.

b. When the control and sound units are removed from the crate, it will be necessary to remove two bolts holding the sound unit to the

OPERATION

control unit base, and the four bolts holding the sound unit supports to the top of the control unit and the sound unit. The sound unit supports should then be fastened to the front face of the control unit by means of two bolts through each. Two bolts are loosely mounted in the upper ends of the sound unit supports so that the hooks on the sound unit may be placed over the projecting ends of the screws. Nuts are then threaded on to the screws to clamp the sound unit supports firmly in position. The cord from the sound unit is then plugged into the right-hand outlet below and to the right side of the main switch. Packing supporting the record reproducing arm, and the end of the power input cord stored in the lower storage compartment, should then be removed. Two screws are used to hold the record changer mechanism during shipping; these two screws *must* be removed so that the changer floats freely on its mounting spring. If the turntable has been packed separately, it will be necessary to place it over the center spindle and gently press it down, taking care that the motor idler wheel is not damaged, and being sure that the turntable properly engages the drive pin.

c. The director and the target, when removed from their crates, are ready to be mounted on their respective supporting members. The director supports consist of three legs, which are attached to the under side of the director by means of nine cap screws with shakeproof lock washers. In order to facilitate the attachment of these legs, it is desirable to set the director in an inverted position. Use care not to injure the dial when rolling over the director. The legs are reinforced by means of three tie bars which are held in position by three cap screws, using shakeproof lock washers and hexagonal nuts. When the legs are firmly in position, set director upright. Use care not to throw undue strain on the projecting legs of the unit when turning it over. Attach handwheel on front and rear of director. A screw and washers are provided to hold it in place. Screw the pinion release lever handle in place (fig. 20). Drop the service door on the right side of the director by first releasing the holding thumbscrews (fig. 15). Insert a 7-watt bulb in each of the two sockets inside the range dial, and in the socket in the right front corner of the cabinet. Remove the block separating the "over-shot" and the "short-shot" electromagnets. (fig. 20).

d. Plug the director cord into the left-hand outlet on the lower right side of the control unit (figs. 1 and 10). The director is set so that the portion containing the dial, firing switch, and range setting handwheel is faced toward the control unit cabinet, and centered on it. The control cabinet in turn is arranged so that the sound unit tends to overhang the director. The distance between the front of the control unit and the back of the director should be such that a line dropped from the center of the forward overhead sound unit is approximately 18 inches from the back of the director cabinet. This will cause the stu-

DIRECTOR TRAINER M8

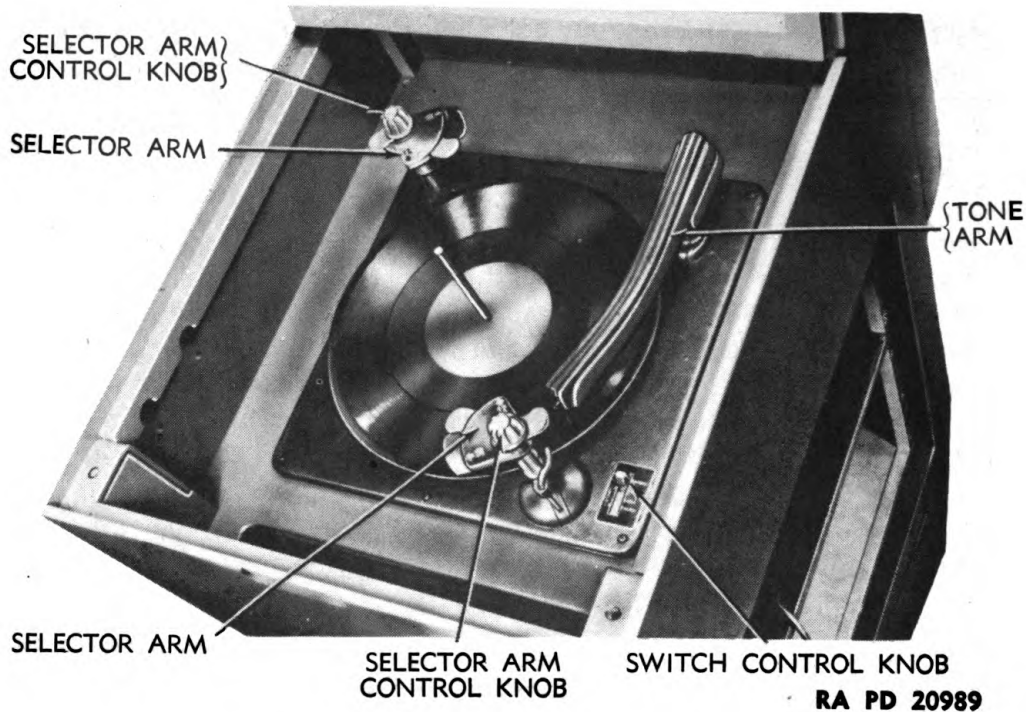


Figure 2 — Record Changer — Top View

dent range setter to stand directly under the explosion sound unit when he is in a convenient position for operating the range setting director handwheel.

e. The target base is made of two channel-iron end frames tied together by means of four bars on each side. These bars are placed in position to form upper and lower tie bars with cross braces. The unit is held together with cap screws equipped with shakeproof washers and hexagonal nuts. The target base should be placed about 15 to 25 feet in front of the director, and in line with the director and control unit cabinet. The base is placed so that the long dimension is in line with the director and control unit.

f. The target is set so that the viewing area showing the airplane and cloud scene is facing the director and centered on the director. The target is bolted to the base at opposite corners with two cap screws. The target airplane which is shipped separately must be mounted in the coupling attached to the overhead drive pulley (fig. 34). Loosen the set screw in the pulley shaft coupling, slip the airplane support wire in place, and tighten. The airplane wings should be set roughly at 70 degrees to the face of the target cabinet. Connect the lead wire to the lead hanging loosely from the pulley support, at the right of the pulley. The cable from the target is then plugged into the outlet on the under side of the director.

OPERATION

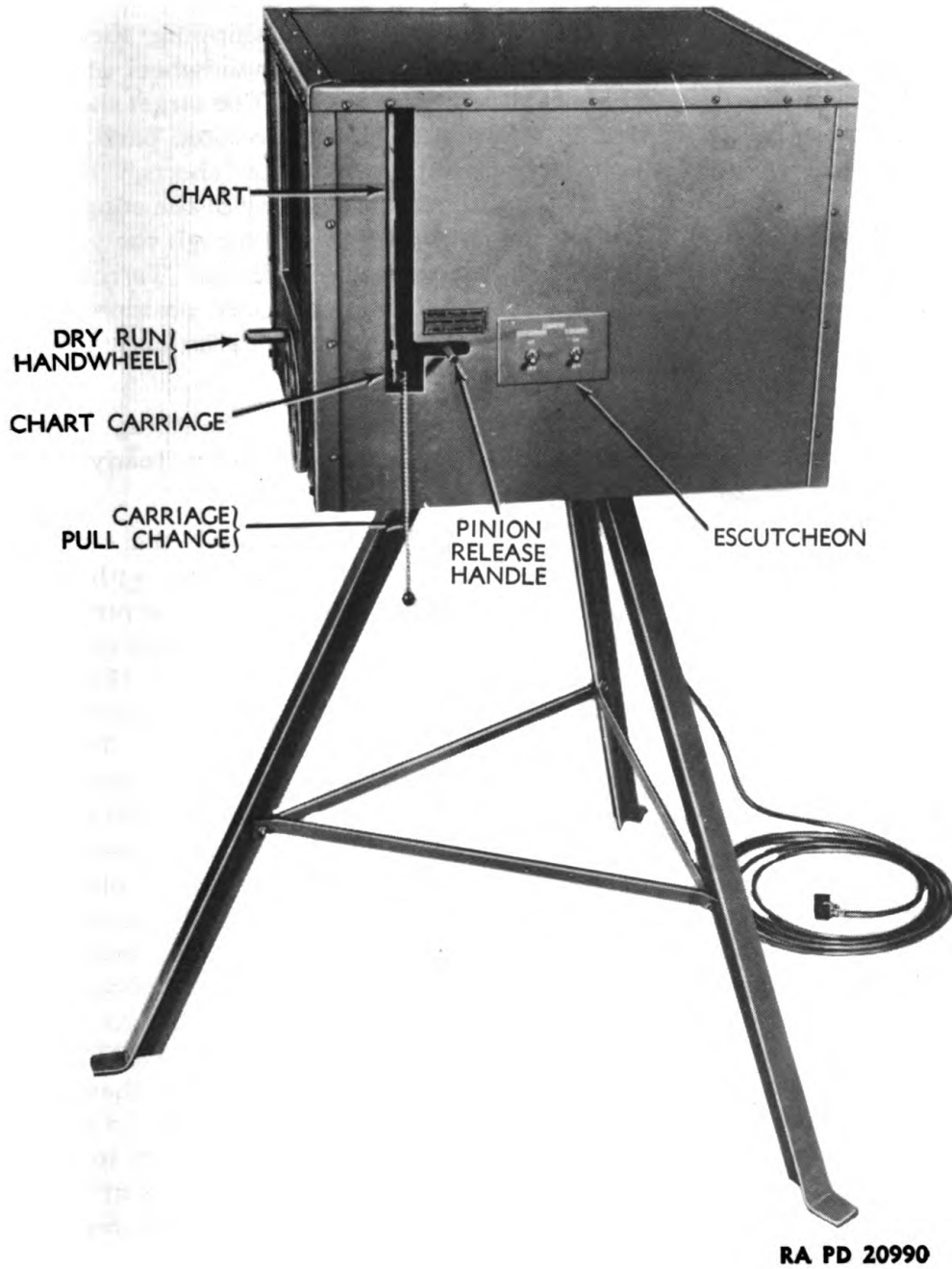


Figure 3 — Director Trainer M8 — Left Side View

DIRECTOR TRAINER M8

7. PREPARATION FOR USE.

a. With the equipment assembled as directed in paragraph 6, the assembly should be as seen in figure 1, showing a schematic outline of the Director Trainer M8. The equipment should be inspected to be sure that no major damage has been done to it in shipping, such as apparent loosening or breaking of parts, etc. The handwheel of the director should be tried to be sure that it turns freely. The target should be inspected to be sure that in addition to having no loose parts, the tracers, as indicated by three sets of rotating lights for "shorts," "hits," and "over-shots," will rotate freely without striking any of the supporting members. This can be determined by reaching through the viewing-opening and rotating each light individually by hand. To rotate, hold the proper electromagnet armature in the energized position. If the lights strike the framework at any point in their paths, adjust the wire slightly so this does not occur.

b. The battle sound record will be found packed in the storage cabinet of the control unit. It should be placed in position ready for operation on the reproducer.

c. Before proceeding with the trial of the equipment, the battle sound should be checked. It is desirable to become familiar with the procedure involved in operating the reproducing equipment for providing the battle sound. The changer plays up to fourteen 10-inch or ten 12-inch records at one loading. Figure 2 shows the setting for a 10-inch record. See that the selecting arms are both turned toward the center turntable and that both arms are set for the same size records. Place the stack of records of the size indicated on the arms over the center pin so that they will rest on the selecting arms. The reproducer should then be ready for operation. If a single record is to be used, as is intended for the normal operation of the battle sound, the single record is placed on top of the arms as would be the case for loading several records in position. The machine is then ready for operation. To produce the battle sound, plug the power input lead into a convenient 110-v, 60-cycle a-c outlet and turn on the main switch located on the control panel, then throw the record changer switch knob to the "REJECT" or "START" position, (fig. 6). The motor will start. The record changer will go into automatic operation. If at any time, it is desired to stop the reproducing equipment, move the switch knob on the changer to the "REJECT" and then to the "OFF" position. This can be done at any time after the needle comes in contact with the record. The reproducing equipment will not operate if the main switch on the outside of of the control cabinet is not in the "ON" position.

CAUTION: Always have the turntable control knob in the manual position when the tone arm is moved manually. Failure to do this will injure the tone arm mechanism.

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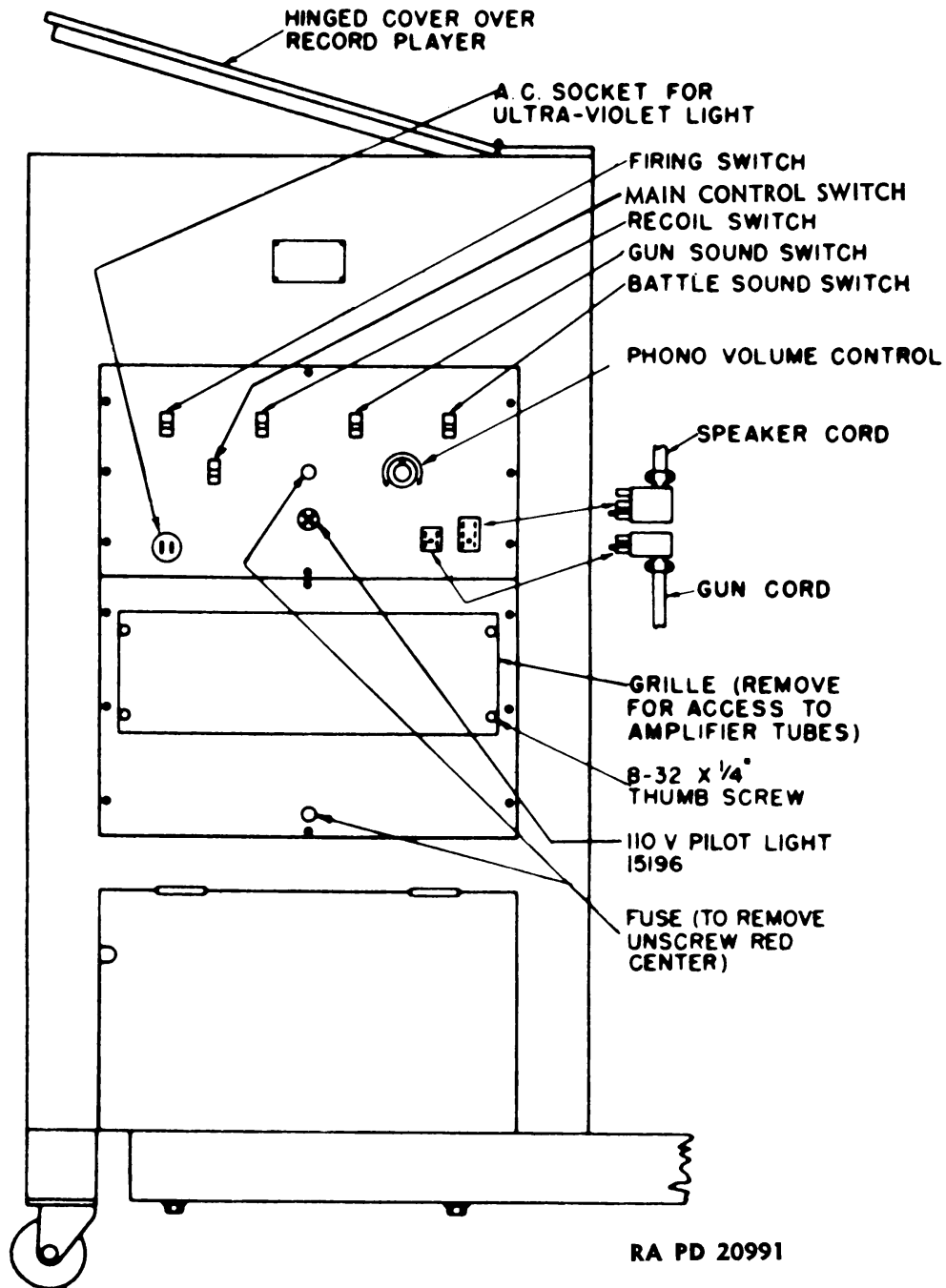


Figure 4 - Control Unit - Right Side View

DIRECTOR TRAINER M8

d. Eight charts made of bakelite sheet, with metal mountings, are supplied in a separate container-type crate. Select chart No. 1, for initial use in the director. Place the chart in the director through the slot in the left side of the cabinet (fig. 3). To do this, release the pinion on the chart rack by moving the hand lever to the left, and holding it in that position while pulling the chart carriage outward, by means of the chain attached to the end that extends through the slot. Slide the chart into position with the metal face toward the left, and with the metal binding and the locking pin, on the bottom. Slide the chart in until it engages the clip on the inner end of the carriage; then lift the bolt on the end of the chart and slide the chart slightly outward to permit engagement of the clip immediately below it; release the bolt, allowing it to lock the chart in position.

e. Drop the door on the right side of the director to the open position to inspect the movable lobes on the timing disk as shown on figures 16 and 17. All of the lobes on the left half of the disk, as viewed from the range setter's position behind the director, should be in the central or hitting position. If any are moved, either toward the center or toward the periphery of the disk, they should be moved to the central portion of the slots by hand. It is not important that the lobes on the right half of the disk, as viewed from the range setter's operating position, be centrally located. The lobes on the right half may be in any position.

f. Before using the equipment, the slides in which the movable lobes operate, should be lubricated with OIL, engine, SAE 30, for all temperatures above +32 F, and OIL, engine, SAE 10, for temperatures between +32 F and 0 F. Lubricate the bearings of the gear reducer, (fig. 48), using the same oil.

g. Check the control switches (fig. 4) to be sure that all are in the "OFF" position. This will include the main switch, the gun and the battle sound switches on the control cabinet, also the firing switch, and the target and director light switches on the director cabinet (figs. 3, 4, and 5).

8. TRIAL OPERATION.

a. When the inspection of the assembly of the various units has been completed, connect the input lead to a source of 110-v, 60-cycle a-c current. Turn the main switch on the control unit to the "ON" position. Snap on the target and director light switches located on the left side of the director cabinet. The target light switch should cause the light in the upper corner of the target cabinet to light. The director light switch will cause the illumination of the range setter's dial on the back of the director cabinet, and the chart on the front of the cabinet as viewed through the instructor's window (figs. 7 and 9).

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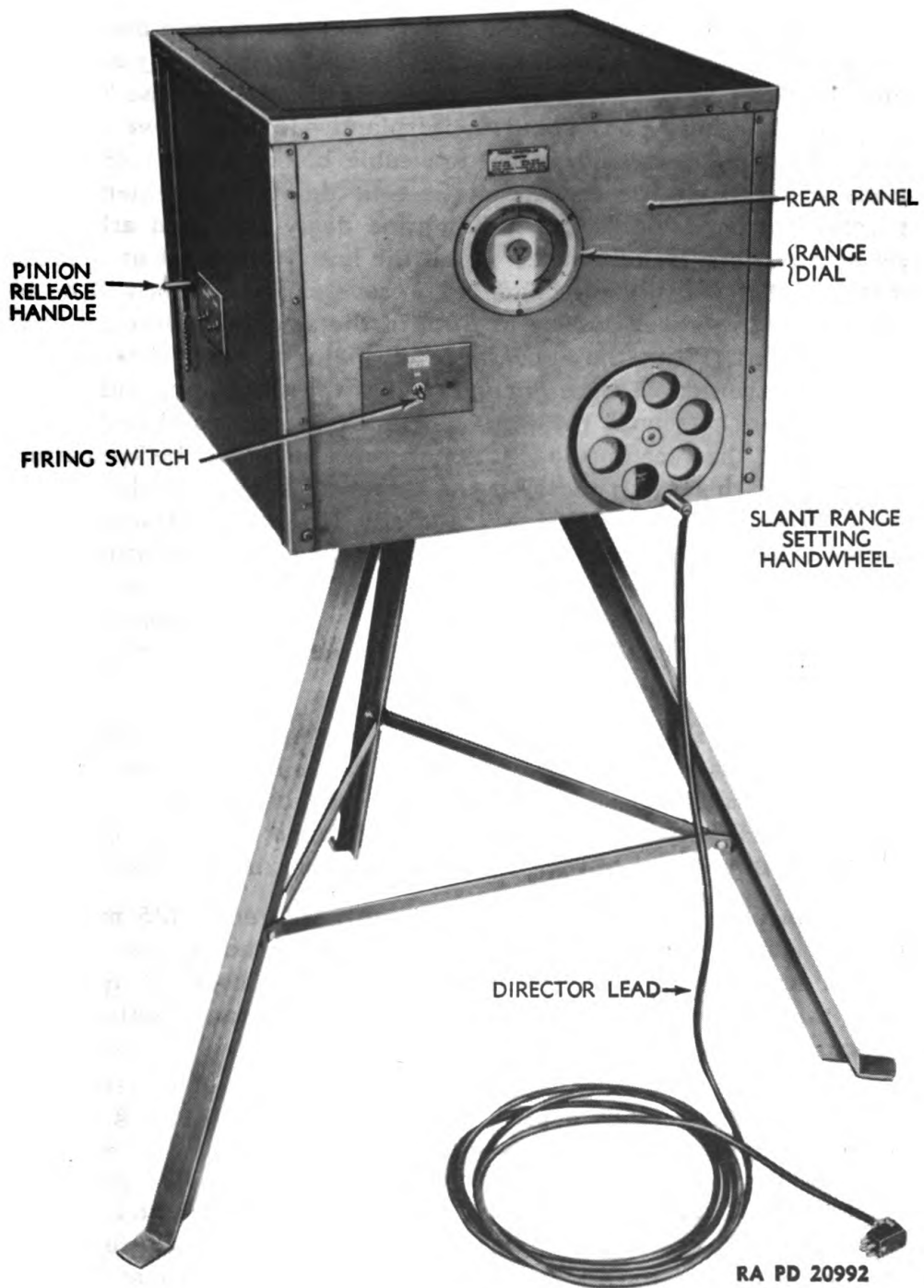


Figure 5 — Director Controls Used by Range Setter

DIRECTOR TRAINER M8

Set the range on the dial by means of the range setting handwheel to 1,000 yards and snap the firing switch to the "ON" position (fig. 5). When the firing switch is in the "ON" position, the impulse of the simulated shot will be noticeable, but without the muzzle blast. The chart will be carried into the director cabinet by the gear mechanism and the various tracer lights will appear in the target, passing either in front of, beneath, or behind the airplane. Initially, several clicks of the firing mechanism will be noticeable before any tracer indications are seen, due to the automatic time delay arrangement incorporated in the device. The initial time delay has been arbitrarily set at 3 seconds for all charts. With the initial range set at approximately 1,000 yards, using chart No. 1, several short-shots will be indicated by the tracer passing in front of the airplane before hit-shots are indicated. With the appearance of one or two hit-shots, the airplane will then come close enough so that the succeeding indications will be over-shots until the airplane passes the midpoint and makes progress on the receding leg, at which time there will be indications of hit-shots, then short-shots, as the target passes out of the field of fire. When "hit-shots" are indicated by the central tracer, which passes below the airplane, the light in the tracer will be extinguished as it approaches the airplane, and a light in the airplane will be lighted momentarily to indicate a hit. In the case of a short-shot, and an over-shot, the tracer indicator lamp will remain lighted throughout its entire path.

b. Chart No. 1 is the chart of the slant range of an airplane flying at 60 yards per second on a straight course at a constant altitude and at a constant speed. The initial range, that we are concerned with, is 1,710 yards. The midpoint slant range is 602 yards. The airplane will pass out of the field of fire at approximately 1,650 yards.

c. Since the range adjuster operating the Director M5 moves so that he is always viewing the target airplane immediately in front of him in actual firing, the Director Trainer M8 has been set up with a fixed target directly in the line of vision of the range setter. The director cabinet does not rotate. In order to give the range setter the illusion of airplane movement, the target airplane in the trainer is mounted on a rotatable support. Initially on the incoming leg, the wings are at an angle of approximately 70 degrees to the range setter's line of vision. At the midpoint or slant range of 602 yards, the fuselage of the airplane is perpendicular with the range setter's line of vision. As the airplane progresses on the receding leg, it turns so that the tail is toward the range setter. The airplane is set at a slight angle throughout the course to produce the illusion of altitude.

d. With the successful accomplishment of a preliminary run without sound equipment, snap the firing switch to the "OFF" posi-

OPERATION

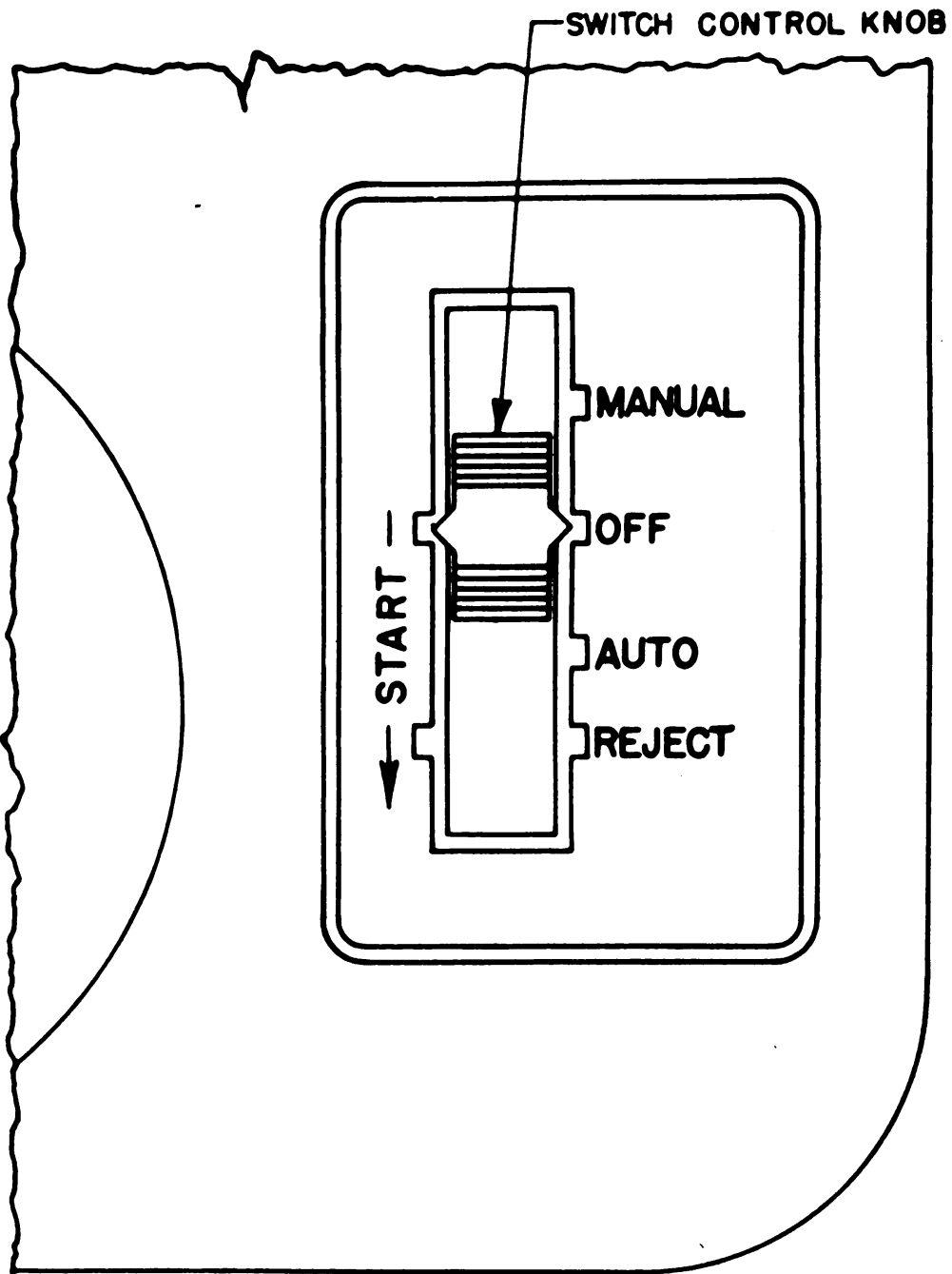


Figure 6 — Record Changer Control

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tion, and reset the chart for a repeat run. To reset the chart, move the pinion release lever extending out of the director cabinet on the left side toward the front of the cabinet, and pull the chart out until it strikes the stop, by means of the chain attached to the slide (fig. 13). With the initial range set as before, at approximately 1,000 yards, snap the gun sound switch to the "ON" position on the control cabinet, and then snap the firing switch on the director to the "ON" position. With this arrangement, each shot should be accompanied by the sound of the gun muzzle blast.

e. Repeat subparagraph d, above, utilizing the battle sound to be sure that this is operating correctly. To produce the battle sound, place the record on the turntable. With the main switch on the control cabinet turned to the "ON" position, move the turntable control knob to "REJECT" (fig. 6); then snap the battle sound switch to the "ON" position. The battle sound switch controls a shunt, which in the "OFF" position, cuts out the tone arm pick up cartridge so that the battle sound is not audibly reproduced. It is therefore possible to leave the record changer turntable running with the record in place. Thus the battle sound may be cut in and out of the system as desired, without the delay encountered in starting the turntable. With the repetition of subparagraph d, above, and the battle sound cut into the system, the complete equipment should be in operation, producing a simulated tracer stream, a muzzle blast indicative of 60 shots per minute, and an accompaniment of appropriate battle sounds. All of the sound effects are concentrated on the range setter, hence will not be quite as effective to anyone standing alongside the equipment.

CAUTION: Always have the record changer control knob in the manual position when the tone arm is moved manually. Failure to do this will injure the tone arm mechanism.

f. The volume of the sound may be modified by the volume knob mounted on the control cabinet panel (fig. 4).

9. DATA FOR INITIAL INSTRUCTION.

a. The chart has a metal face on the side which is seen through the window (fig. 7). It is divided into three sections. The curved path through the middle of the chart constitutes the graph of the slant range of the airplane which is the target that is being studied (fig. 28). Chart No. 1 is of an airplane going 60 yards per second at constant speed and constant altitude. The initial slant range is 1,710 yards. The minimum slant range is 602 yards and the receding slant range maximum is 1,650 yards. The curved path taken by the graph indicates the change in slant range. It does not indicate a diving path for the airplane target.

b. On the reverse side of the chart, is a channel-like section, which

OPERATION

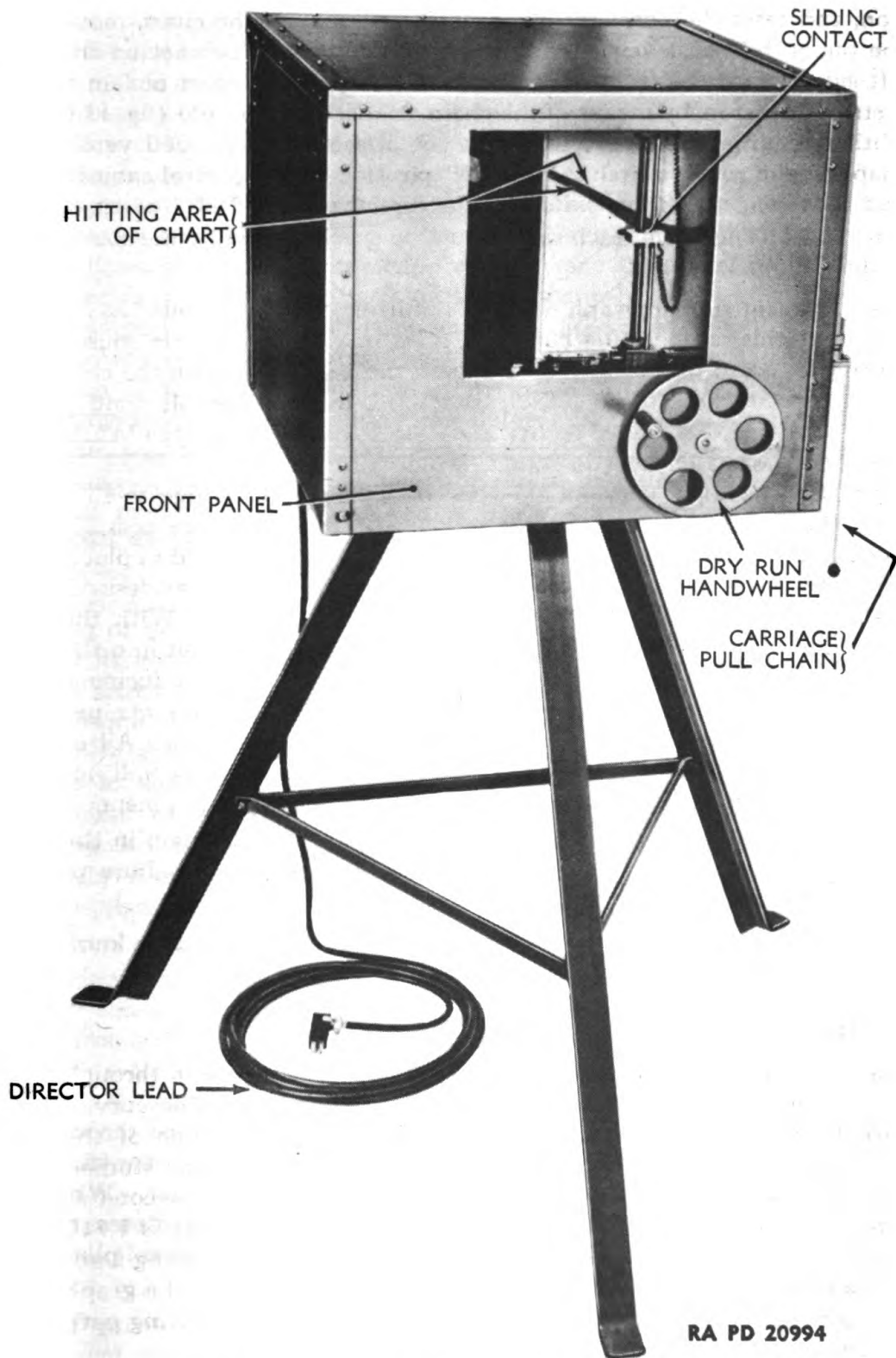
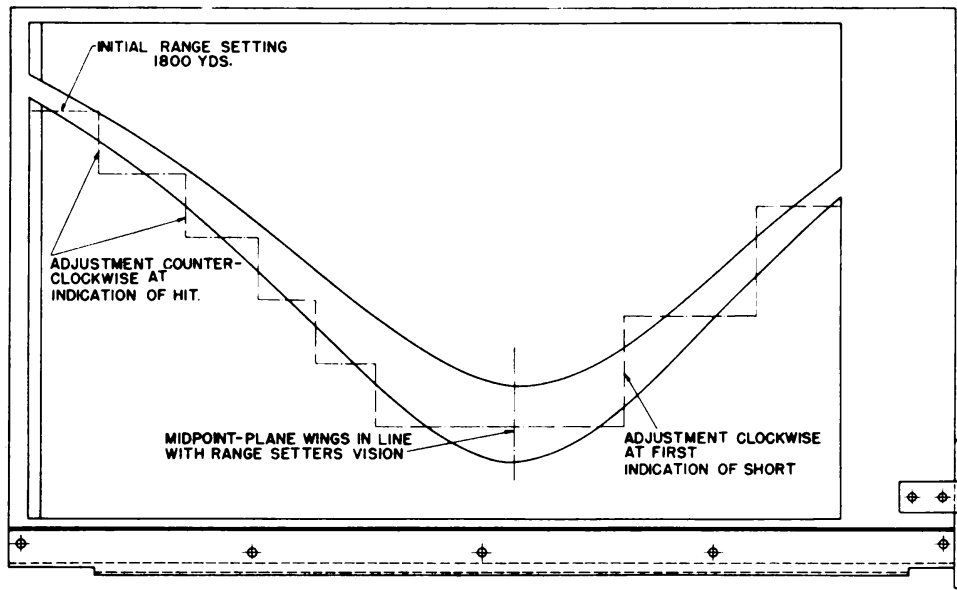


Figure 7 — Instructor's Viewing Window — Front View

DIRECTOR TRAINER M8



RA PD 20995

Figure 8 – Firing Pattern

is the shape of the graph of the time required for the bullet to pass from the muzzle of the gun to the target. The time varies with the range as the airplane, charted on the reverse side, passes across the horizon (fig. 27). The time in the case of chart No. 1 is approximately 3 seconds at the beginning point, and $1\frac{1}{2}$ seconds at the closest position of the airplane. The channel on the back of the chart thus causes the indicating mechanism in the target to indicate the range setter's activity at some period between $1\frac{1}{2}$ and 3 seconds after he has made his adjustment. Other charts, with other airplane courses, will be equipped with a time channel correspondingly different.

c. As the operator turns the handwheel, a sliding electric contact is raised or lowered on the vertical screw, which is just inside the viewing window (fig. 7). A fixed contact is located at the top and at the bottom of the worm. These contacts make electrical contact with the upper or lower sections of the metal plate on the chart. As the movable contact is raised and lowered, it makes a connection through the metal plate with either the upper contact for indicating over-shots, or the lower contact for indicating short-shots at the target. When the movable contact is in the hitting area, which constitutes the curved portion of the chart between the upper and lower metal plates, hits will be indicated at the target.

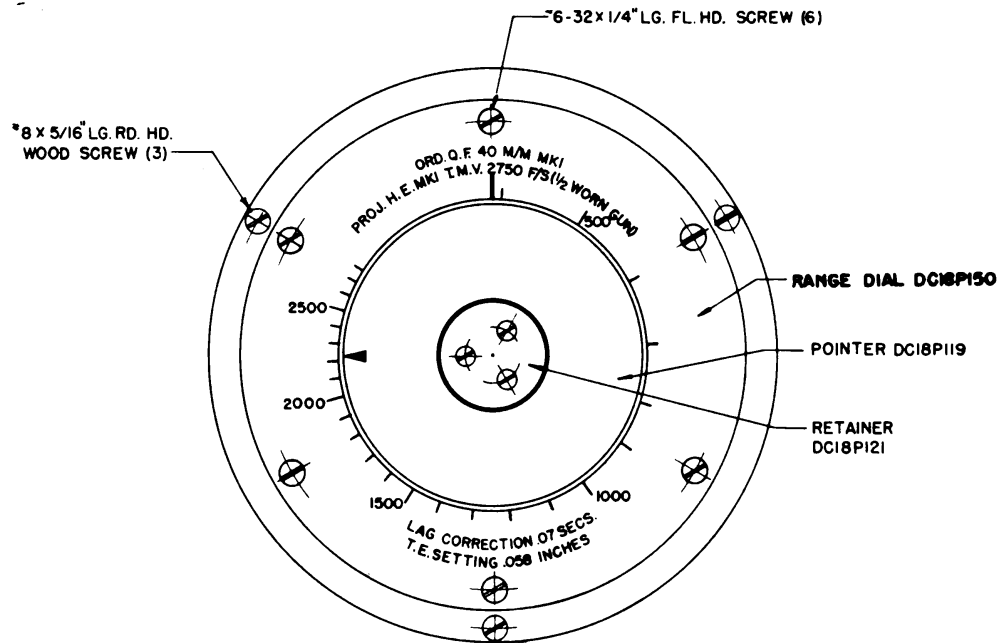
d. Repeated shots of each type can be viewed by moving the chart to any convenient position and holding the pinion release handle along left side of the chart, forward, or to the left, so that the pinion

OPERATION

does not engage the rack which carries the chart into the director. Hold the handle in this position and set the movable contact so that it makes contact with the lower portion of the metal chart. Snap the firing switch to the "ON" position. As long as the pinion is not allowed to engage the rack, the chart will remain stationary, permitting many short-shots to appear in the target. When sufficient short-shots have been shown to demonstrate their appearance, the movable contact can then be raised to the hitting area and the same procedure followed. Later, the movable contact may be raised to the upper section of the chart to indicate the appearance of the over-shots. It is important that the chart be set in the director sufficiently to engage the micro-switch that may be seen through the lower left-hand portion of the viewing window. The micro-switch in that position, is provided to give the initial time-delay. In the case of chart No. 1, this will be approximately 3 seconds if the chart is permitted to progress by means of the rack and pinion equipment. If the chart is not permitted to move into the director cabinet and make contact with the switch, there will be no indication of any kind of tracer stream of the target. One way to be sure that a tracer stream will appear, is to pull the chart only part way out toward the stop.

e. The firing pattern generally desired for guns utilizing remote controls is shown in figure 8. Through the viewing window in the front of director, while running through a course, attention can be called to the positions of the movable contact with reference to the short-, hit-, or over-shot positions as the chart progresses into the cabinet. To do this, set the chart in the extended position by releasing the pinion and pulling the chart out by means of the chart carriage chain (fig. 3). Set the dry run handwheel so that the movable contact is slightly below the lower edge of the hitting area. Snap the firing switch to the "ON" position. As the chart progresses, the movable contact will fall on the hitting area. Immediately this occurs, lower the movable contact by turning the handwheel counterclockwise, until it is approximately 1 inch below the hitting area in the short-shot section of the chart. Allow it to remain there until the chart progresses far enough again to make a contact in the hitting area. Repeat these operations until the midpoint is reached. The midpoint is indicated by the lowest point in the curve of the hitting area. Allow the contact to remain stationary until the chart progresses to a point where the contact falls into the short-shot area. At this time, immediately raise the contact until it is about 1 inch above the top line of the hitting area curve. Allow the chart to progress until the contact is again in the hitting area, at which time raise it again approximately 1 inch above the top of the hitting area. Repeat this process until the airplane has passed out of the field of fire.

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RA PD 20996

Figure 9 – Dial for Setting Initial Range

f. It may be pointed out that adjustments of the handwheel on the director trainer are the same on either end, and they, in turn, are identical with those required for the same adjustment in slant range on the Director M5.

10. DATA FOR ADVANCED INSTRUCTION.

a. More advanced instruction should be carried on by operating the device from the normal range setter's position at the back of the director. Set the initial range on the range dial at 1,500 yards. On the appearance of the first hit-shot, immediate correction should be made counterclockwise. Since the operator is not watching the position of the contact, there is some time-delay between the actual firing of the shot and the indication at the target. Therefore when a correction is made at the indication of a hit in the target, there may have been one or two shots fired, which will later be indicated as over-shots in the target.

b. When the wings of the airplane are parallel with the range setter's line of vision, the airplane is in the vicinity of the minimum range, and there is time for several hits at this point if the adjustment is correct. Since the airplane will then proceed to pass out of the field of fire at an increasing slant range, it is necessary for further adjustments of the handwheel to be made clockwise, rather than counterclockwise.

OPERATION

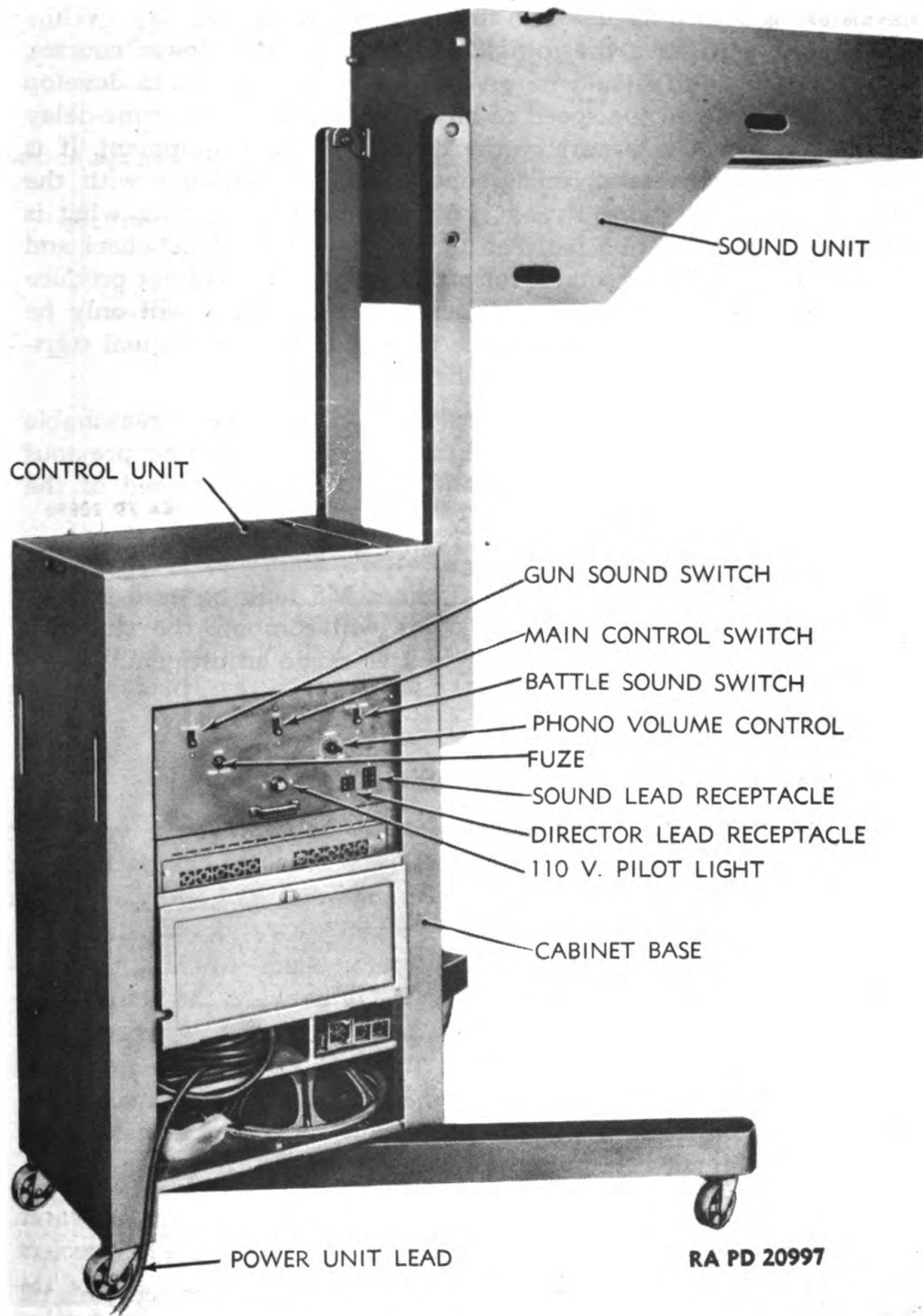


Figure 10 — Control and Sound Unit

DIRECTOR TRAINER M8

11. USE OF VARIOUS AIRPLANE CHARTS.

a. Eight charts covering varying types of flights and airplane speeds are provided for use with the director trainer (fig. 28). While it is desirable to have the initial work done on the slower courses, enough opportunity should be given with varied courses to develop quick adjustment to the speed of any target. Due to the time-delay mechanism which is a part of the director trainer equipment, it is difficult to be successful, unless operating in accordance with the appearance of the tracer stream. An attempt to memorize what is assumed to be a relation between the turning of the handwheel and the indicated explosion sounds for a particular chart will not produce uniformly good results. Such a memorized operation will only be successful when the starting point is identical with the original starting point. This does not occur regularly.

b. A proficient operator should be able to make a reasonable number of hits on any chart slipped into position without his previous knowledge; the number of hits being limited by the speed of the chart.

c. In order to add to the range setter's ability to estimate the range of an airplane, the Director Trainer M8 may be used in conjunction with the Hunt Trainer. This will combine the student's training in estimating the range, as well as range adjustment.

Section IV

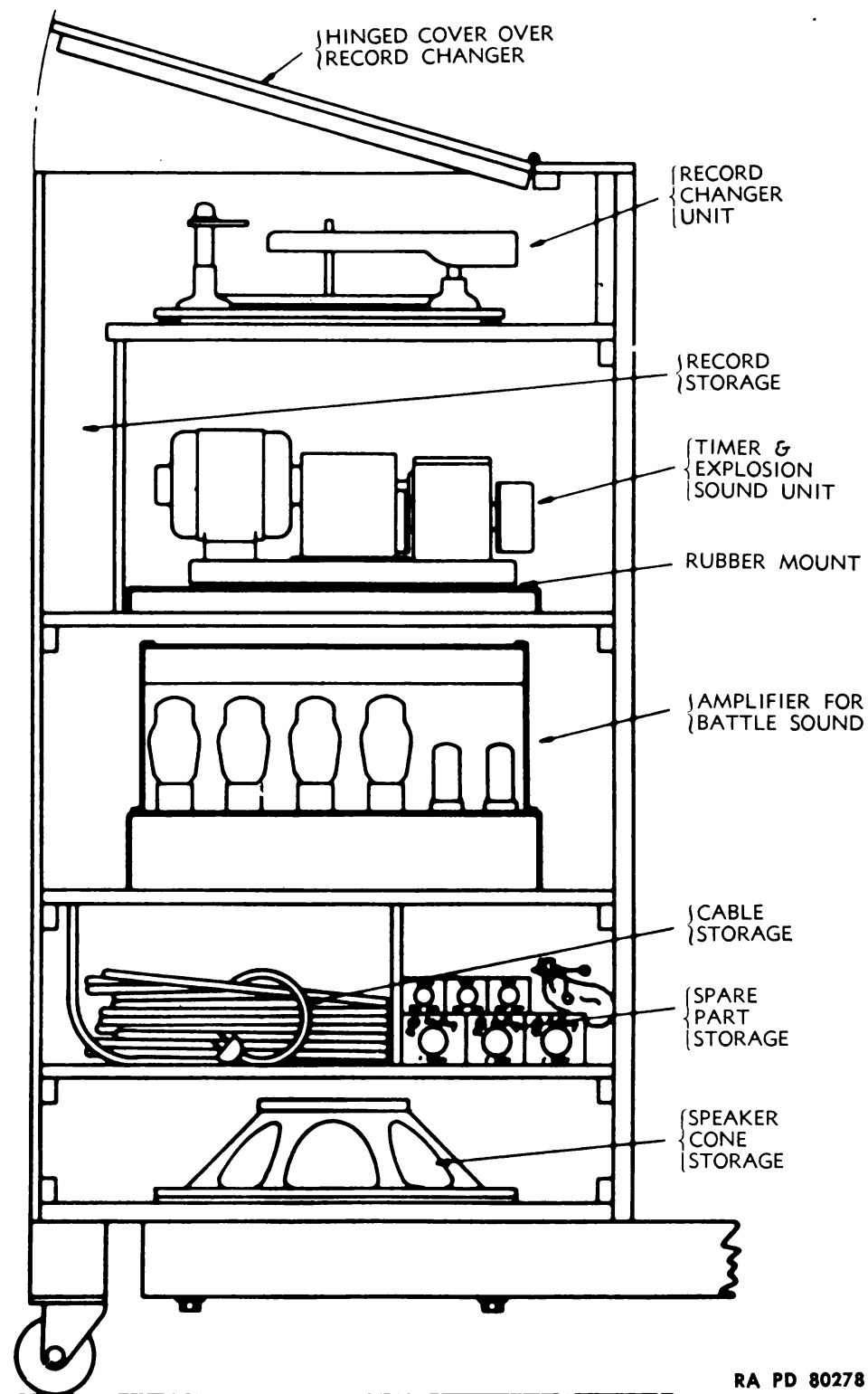
DESCRIPTION OF MAJOR ELEMENTS

	Paragraph
Control and sound equipment.....	12
Director	13
Target	14

12. CONTROL AND SOUND EQUIPMENT.

a. The control and sound equipment (fig. 10), consists of two major parts: the control cabinet and the sound unit cabinet. The control unit cabinet is mounted on a wooden base consisting of two strips of wood attached by means of four carriage bolts. These base strips serve as connection bars to hold the sound cabinet and control cabinet together during shipment. When the sound cabinet is removed by the removal of the two bolts through the extended ends of the base strips, these base members are pivoted on the central bolt connecting them to the control cabinet and the ends immediately under the cabinet are pulled together beneath the center of the cab-

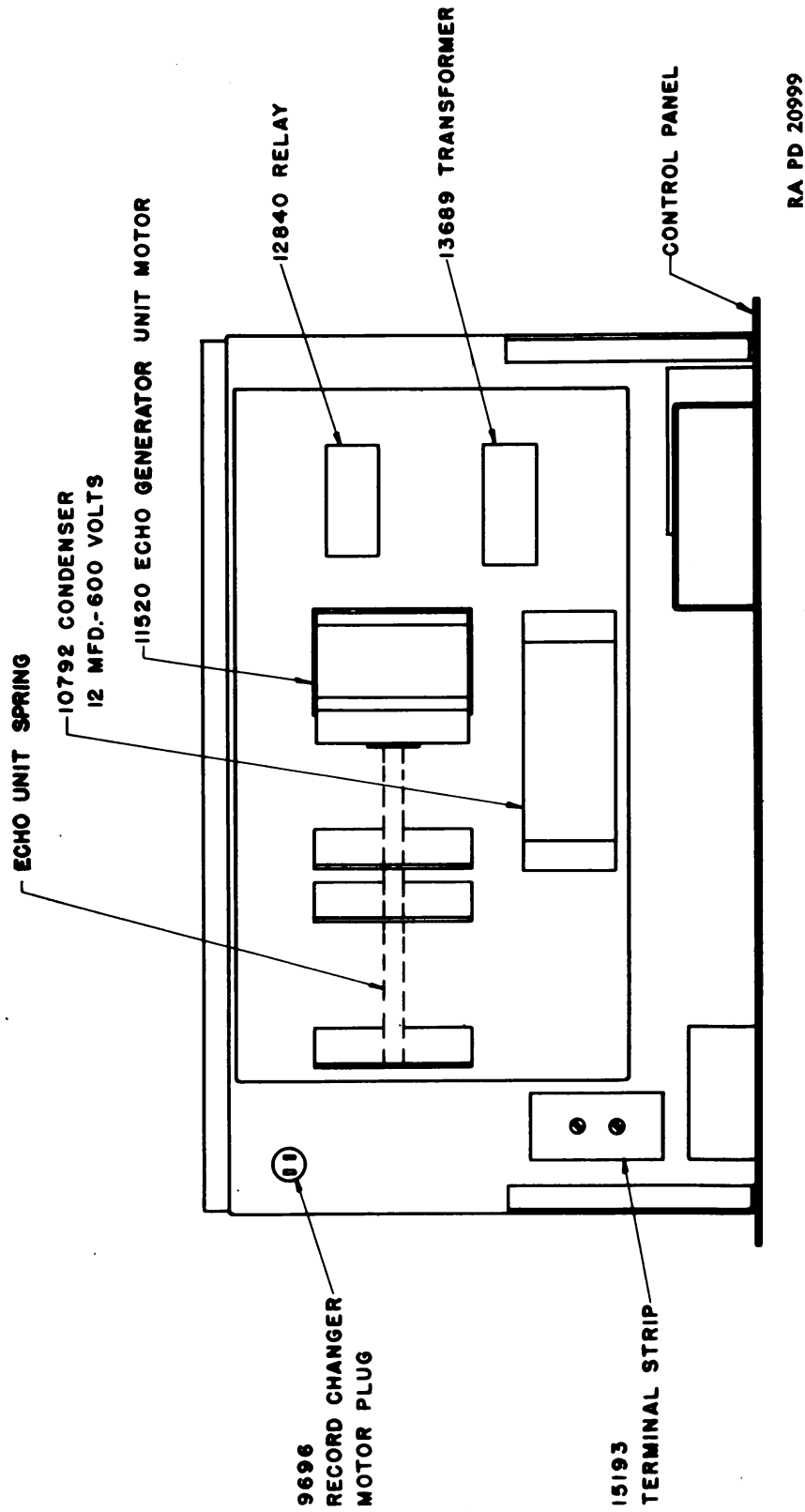
DESCRIPTION OF MAJOR ELEMENTS



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Figure 11 — Control Unit With Panels Removed — Right Side View

DIRECTOR TRAINER M8



RA PD 20999

Figure 12 — Explosion Sound Unit

DESCRIPTION OF MAJOR ELEMENTS

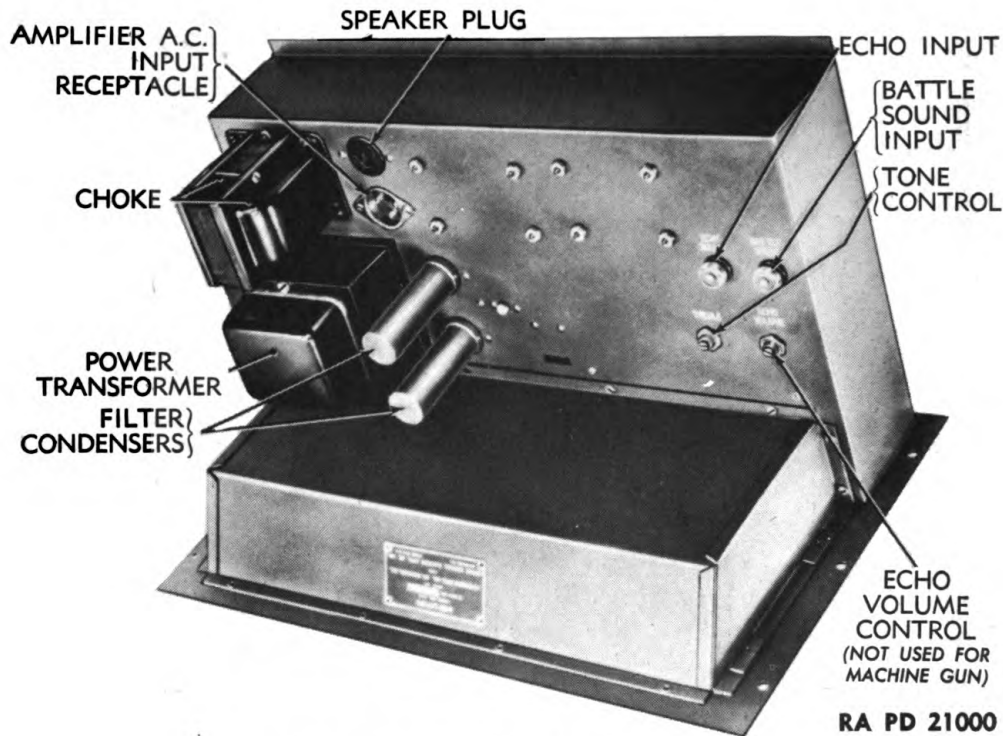


Figure 13 — Amplifier for Battle Sound

inet. This causes the two supports to take the form of a "V." The bolts removed from the sound cabinet in uncrating, are then used to connect the base strips in this position to the control cabinet. Two wood uprights are provided to support the sound cabinet above the student's head. These parts are utilized during the shipment to tie the top of the control unit and the sound cabinet together. Again, the bolts removed from holding the two uprights to the top of the control cabinet are used for the attachment of the uprights to the side of the control unit. Two carriage bolts are used in each support.

b. The sound cabinet is provided with two hook-shaped metal projections which support it on the uprights (fig. 14). These hooks engage two carriage bolts, which pass through the upper portion of the uprights. When the sound cabinet is in position, nuts are tightened against the hooks to hold the cabinet firmly in position.

c. Figure 4 indicates the appearance of the right side of the control cabinet. This is the portion of the cabinet in which all the controls are concentrated. Centrally located on the upper half of the side wall of the cabinet is the control panel, which includes three switches, a volume control, a fuse, a pilot light, and two convenience outlets. As the operator looks directly at the panel, the center switch is the main control switch, controlling the power to all parts of the

DIRECTOR TRAINER M8

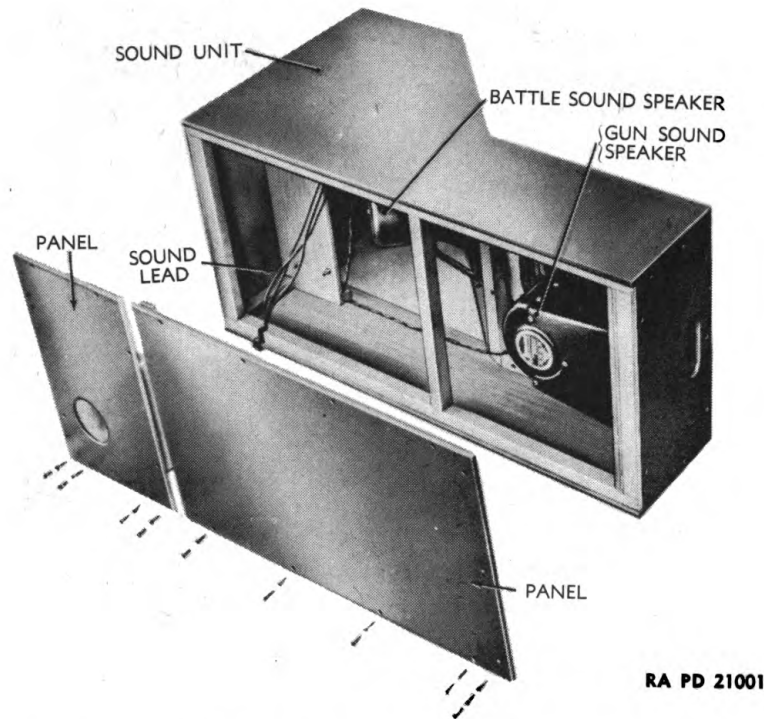


Figure 14 — Speaker Cabinet With Top Removed

assembly when the entire training equipment is assembled. This is the master switch. Nothing will operate unless it is turned to the "ON" position; there are, however, switches for the individual control of various elements of the equipment. To the left of the main switch is a toggle switch to control the sound used to simulate the gun blast. To the right of the main switch is a toggle switch used to control the battle sound. Below the main switch and to the left is a fuse which protects the assembly in the event of a short circuit in the system. Beneath the main switch is a pilot light to indicate whether or not the main switch is in the "ON" position. Below the main switch and to the right is a knob to control the volume of the battle sound. At the lower right of the panel are two polarized outlets. The one on the extreme right is to receive the plug from the sound cabinet. The left one of the two is to receive the plug from the director. At the bottom of the cabinet is a hinged door which opens into a storage compartment. The power "in-put" cord attached to the main a-c terminals is stored in the upper left-hand section of the cabinet. Any required length of cord up to 75 feet may be withdrawn in order to connect it to a convenient source of power. At the right is a small storage compartment for spare parts. Beneath the shelf on which the cord is stored is a compartment provided for the storage of the spare speaker cone for the gun sound speaker.

DESCRIPTION OF MAJOR ELEMENTS

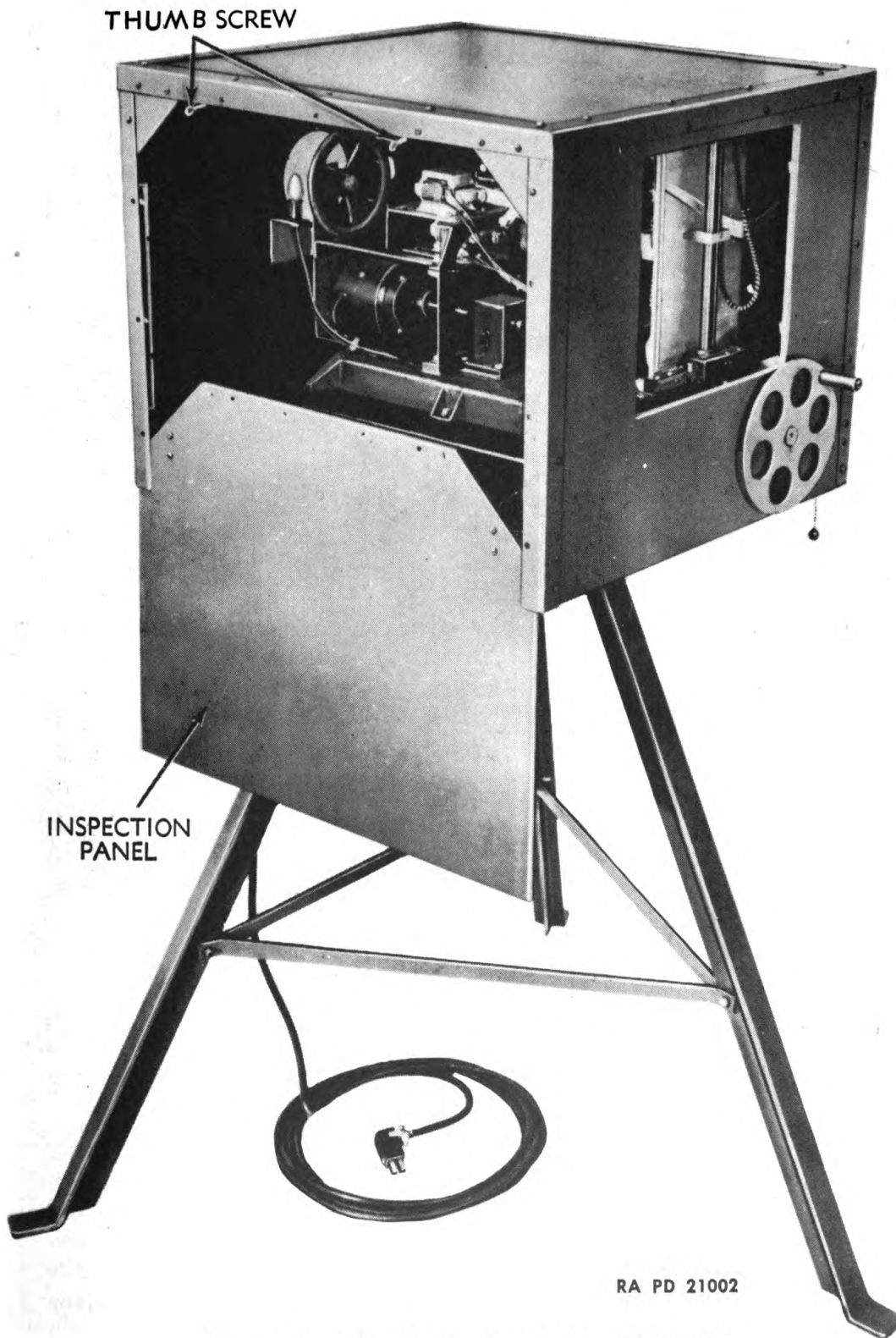


Figure 15 — Director Trainer M8 — Right Side

DIRECTOR TRAINER M8

d. The control cabinet is divided into four major sections as shown in figure 11 which indicates how the cabinet would appear if the right side, where the control panel is mounted, was removed. The upper compartment provides a space for an automatic record changer. The record changer control mechanism is also located there. Immediately beneath the record playing compartment is the equipment for producing the muzzle blast. In the compartment below that is the amplifying equipment which operates in conjunction with the record changer. Beneath the amplifying equipment is the storage compartment previously described.

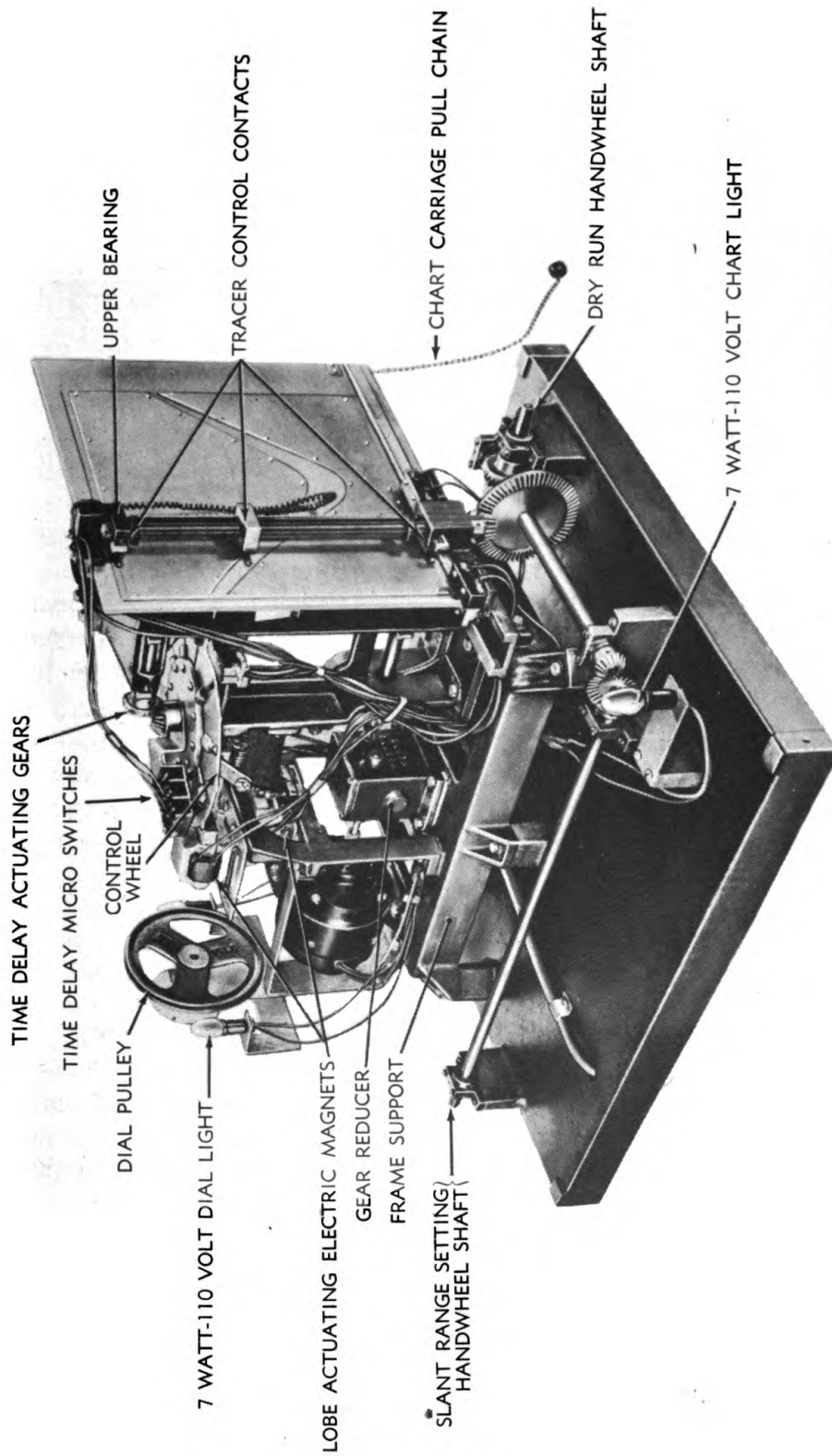
e. Figure 2 illustrates the position of the record player, turntable, and playing arm, with reference to the control. Records are placed on the turntable when the playing arm is raised and to the right of the table, and the selector arms are set for the correct record size. With the main control switch on the right-hand side of the cabinet snapped to the "ON" position, the player may be put in operation by moving the control knob in the direction indicated for start, that is, toward the back of the cabinet, or as viewed from the side of the cabinet on which the control switches are mounted, by moving the lever toward the left. The changer will operate continuously until stopped by snapping the main switch to the "OFF" position, or by stopping it with the record changer control rather than with the main switch. To do this, move the changer switch knob toward the position marked "REJECT" then to "OFF" (fig. 6). The mechanism will automatically lift the playing arm away from the record and carry it to the right.

f. The record changer turntable in the control unit operates at 75 revolutions per minute, and can be used for playing standard records of various types as well as the special battle sound records.

g. The mechanism involved in producing the explosion sound is shown in figure 12. The simulated explosion sound is produced by discharging a small electrical current through a 12-microfarad condenser. An echo motor coupled with a music wire spring, operates in conjunction with the condenser discharge to produce a more lifelike explosion sound.

h. The amplifying unit located in the compartment immediately above the storage section is of the usual 6-tube type. The type of the tubes utilized is shown in figure 13. The only volume control knob for the amplifier unit is the volume control mounted on the control panel on the outside of the cabinet. The main switch on the outside of the cabinet functions as a means of starting and stopping the operation of the amplifier. The amplifier unit is intended only for use on a 115-v, 60-cycle a-c circuit.

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21003

Figure 16 — Director With Cover Removed — Right Front View

DIRECTOR TRAINER M8

i. Access to the record playing compartment is obtained through the hinged cover on the control cabinet (fig. 4).

j. The sound unit cabinet houses two auditorium-type speakers and a power unit for supplying the speaker field coils (fig. 14).

k. The muzzle blast producing equipment is connected with the speaker mounted in the horizontal section of the sound cabinet. It is held in position by four screws, which connect it to supports attached to the framework at the front of the cabinet. A speaker is mounted on the angular section of the cabinet for use in conjunction with the record player. These two speakers are not interchangeable and do not have interchangeable internal mechanisms.

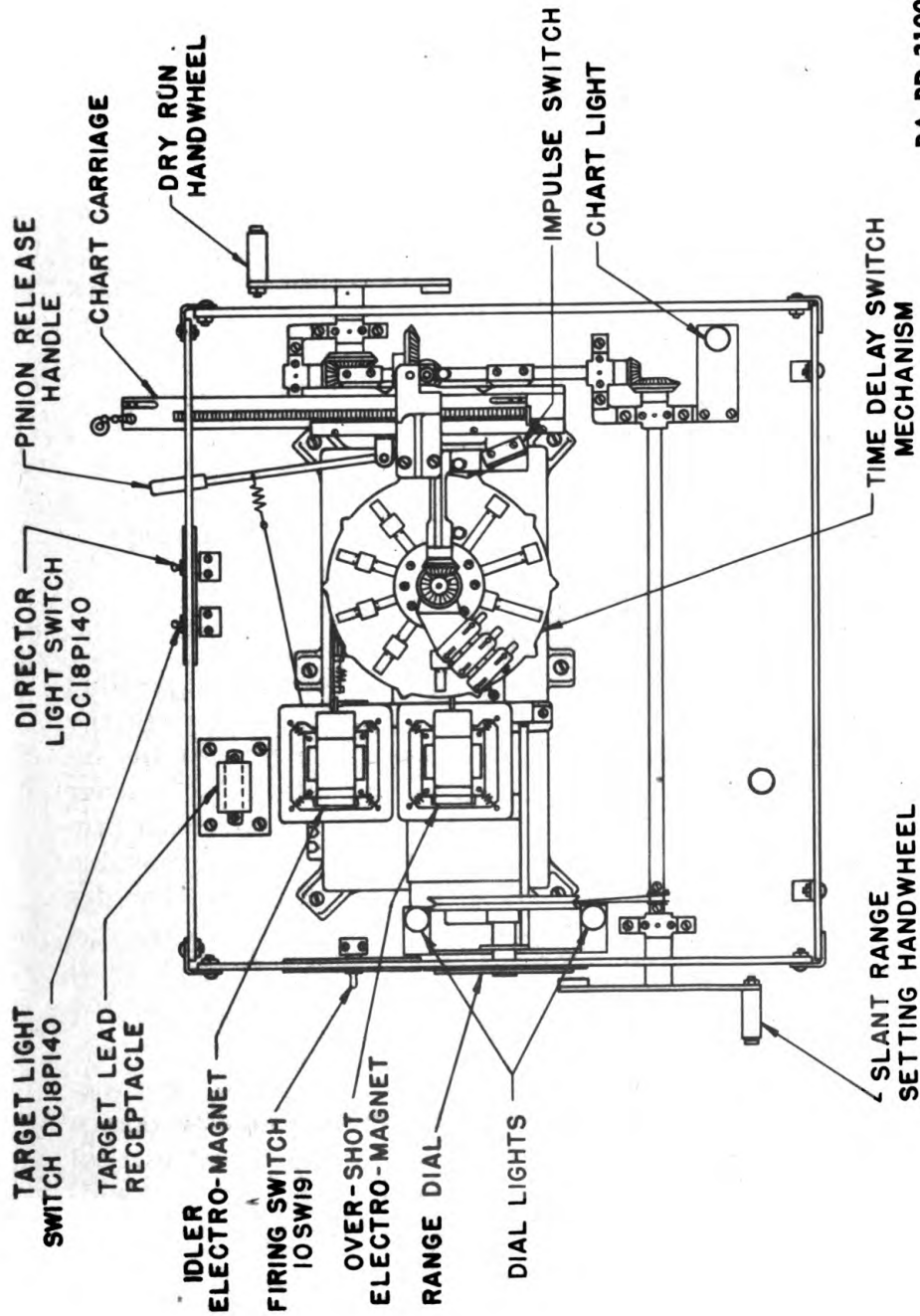
13. DIRECTOR.

a. The director is mounted on three legs simulating the appearance of the Director M5 for the 40-mm gun (fig. 15). A handwheel and an indicating dial for the use of the range setter are located on the back of the cabinet. In addition, there is a switch, which controls the operation of the director mechanism and which is designated as the "FIRING SWITCH" (fig. 5). The switch is so designated, since the range setter ordinarily instructs the gun crew when to commence firing. In this case, instead of giving an oral command, he snaps the switch.

b. On the left side of the cabinet are located two switches: one for lighting the range adjuster's dial and the interior of the front end of the cabinet, and one for controlling the illumination in the target (fig. 3). A vertical slot is provided in the left cabinet wall, in front of the switches, to permit the movement of the range adjustment chart. In the initial position, the chart extends out of the cabinet several inches, but as the chart moves forward on the course of the plane, it passes completely into the cabinet. Between the switches and the opening for the chart, is a small horizontal slot in which a lever handle is located, for releasing the chart pinion gear from the rack that carries the chart into the director. When this hand lever is moved toward the front of the cabinet, the pinion is disengaged from the rack and the slide on which the chart is mounted may be readily pulled to its initial position against a stop, by means of a chain attached to the outer end of the slide.

c. The front of the director is equipped with a window which makes it possible to see the position of the movable contact, which controls the operation of the tracer stream in the target (fig. 7). By watching the position of the movable contact with reference to the chart showing the curve of the slant range of the plane being considered, it is possible to determine immediately what type of indication will be given in the target at some future time, due to the time-

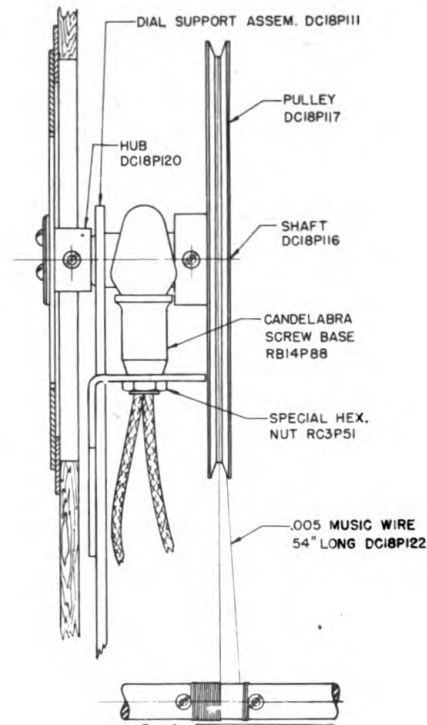
DESCRIPTION OF MAJOR ELEMENTS



RA PD 21004

Figure 17 — Director With Cover Removed — Top View

DIRECTOR TRAINER M8



RA PD 21005

Figure 18 – Dial and Dial Driver Mechanism

delay mechanism incorporated in the director. This makes it possible for the instructor to show the new student, by looking through the window, how adjustments should be made, and also permits the instructor to check on the student when he is operating the director from the normal position at the back. A handwheel has been provided on the front of the director so that adjustment of the movable contact can be made from either end of the box. The two handles are directly connected so that any change in the position of either one will make the same slant range adjustment, which in turn is identical with the slant range adjustment produced in the Director M5 by the same angular movement of the handwheel.

d. The right side and top of the director do not have any operating parts mounted on them (fig. 15). The purpose of this device is to train the range setter. It is assumed the horizontal and vertical trackers are to be trained by other means; therefore, neither the handwheels nor the scopes for the horizontal and vertical trackers are included on the director.

e. Internally, the director is quite simple (figs. 16 and 17). It consists principally of a motor-driven unit, which times the electrical impulse for indicating one muzzle blast or the firing of one shot per second and mechanically adjusts the time of actuation of the switch

DESCRIPTION OF MAJOR ELEMENTS

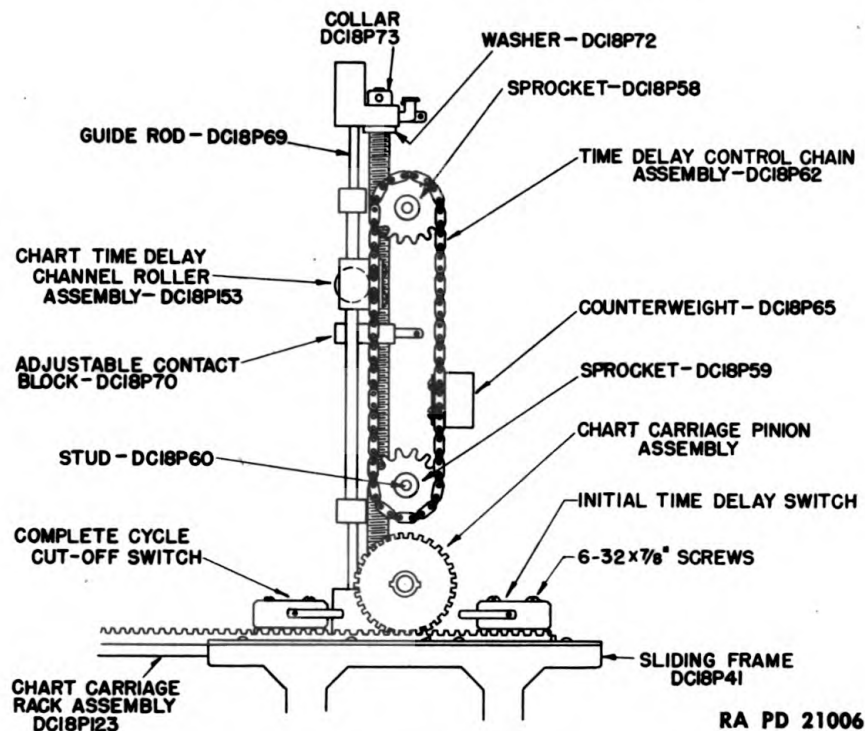


Figure 19 - Time-delay Switch Actuating Member

mechanism which controls the tracer indications in the target. There are three possible paths for a tracer bullet with reference to a target, when considering line shots; they are short-, hit-, or over-shots, depending on the accuracy of the slant range setting. Provision has been made in the director to adjust an electrical contact, by means of the range setter's handwheel, so that it will cooperate with a "course-chart" and a time-delay mechanism, causing either a hit-shot, short-shot, or over-shot, to be indicated in the target depending upon the assumed position of the airplane with reference to the simulated slant range setting.

f. The range adjustment dial on the back of the director carries the same notations as those on the Director M5 (fig. 9). The notations are on a stationary ring surrounding a movable disk on which an arrow or pointer is marked. The indicator disk is mounted on the shaft of a pulley which is driven by means of a 0.005-inch diameter music wire which is attached to the handwheel shaft. In order to be sure the indication on the disk is correct, chart No. 1 should be inserted in the slot ready for operation on the director. Be sure the chart is pulled out until it strikes the stop while the rack pinion is disengaged by means of the hand lever. Using the handwheel on the front of the director, raise the sliding contact until it is in the middle of the hitting area on the chart. With this adjustment, the dial should

DIRECTOR TRAINER M8

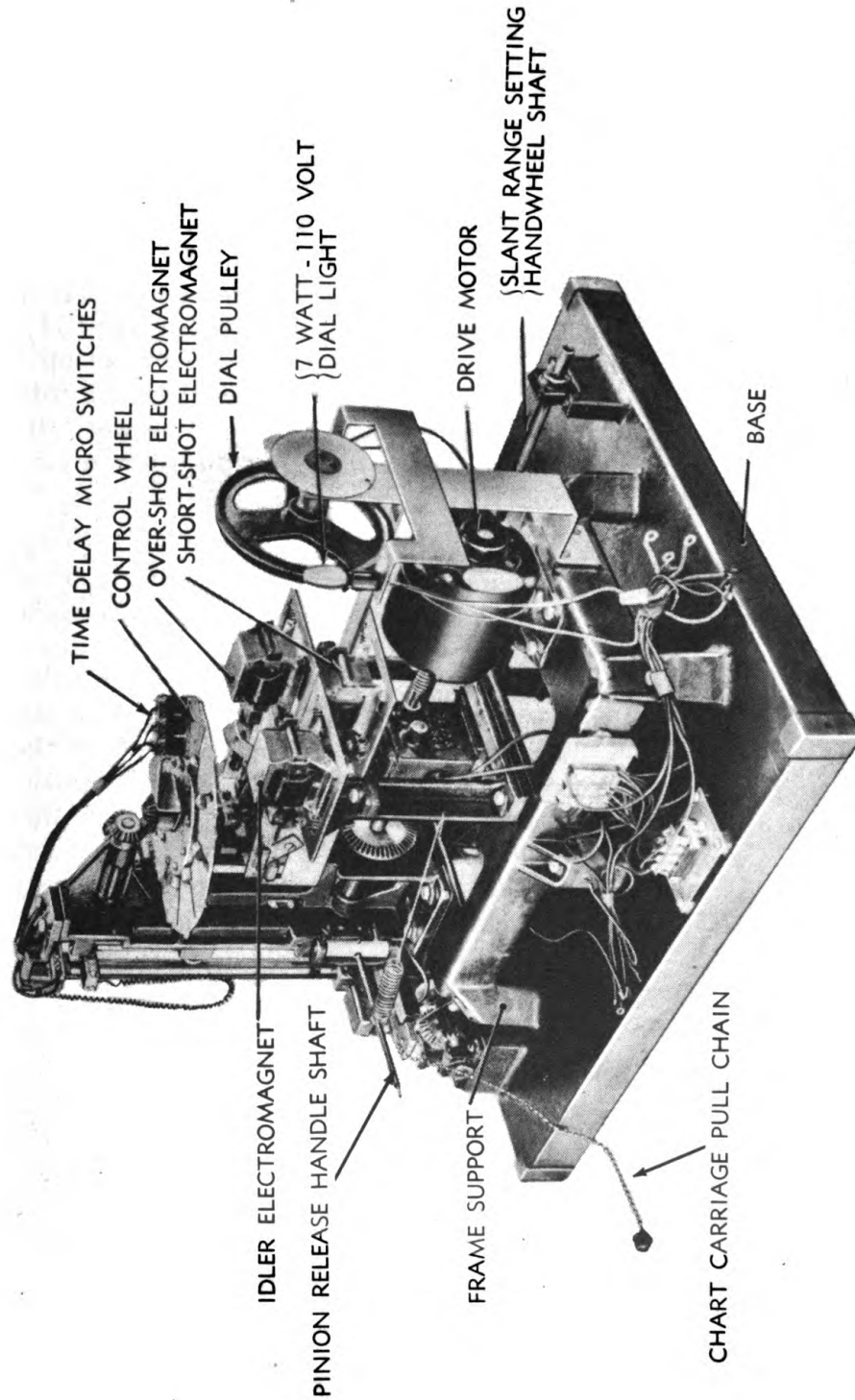
indicate 1,710 yards. If it does not do so, grip the pulley through the drop door of the right side of the director and move the pulley until the indication is 1,710 yards. There will be no difficulty in moving the pulley slightly with reference to the stainless steel driving wire.

g. If it becomes necessary to replace the wire (fig. 18), the movable contact should be raised to its extreme upper position. The new wire should then be fastened beneath the head of the screw on the handwheel shaft closer to the handwheel and three or four turns taken counterclockwise around the shaft. The wire is then fed around the pulley from the under side so that it will come over the top and back to the shaft, and while it is held taut, the handwheel should be turned counterclockwise until the movable contact is at its lower limit. Three or four turns of the wire should then be taken around the shaft in a clockwise direction and the ends of the wire secured under the second screw in the handwheel shaft. The indicating dial should then be checked as described in subparagraph f, above.

h. The movable contact, which can be seen through the instructor's window in front of the director (fig. 7), connects with one of two fixed contacts, also shown on figure 7, depending upon the position of the movable contact on the director chart. When the movable contact is in the upper or lower portion of the chart, it completes an electrical circuit through the metal on the chart and one of the fixed switches to energize an electromagnet within the director. There are three such electromagnets (fig. 20), mounted immediately above the driving motor and in front of the range dial driving mechanism. These electromagnets position movable lobes on a revolving disk; these in turn, actuate switches that cause selected tracer streams to appear in the target. When the movable contact is in the upper portion of the director chart, it causes the upper centrally located electromagnet to move a lever forward which in turn moves a switch actuating lobe into position to close the switch controlling the over-shot tracer light in the target (fig. 21).

i. When the movable contact is in the "hit" area, that is the middle curved section, no electrical contact is made and therefore no electrical adjustment is added to a previous mechanical location of the lobe as the timing control wheel rotates. Under these circumstances, the lobe is in position to close the switch, which indicates a hit-shot in the target. No electromagnet and lever are required for this operation; however, in order that the student will not be guided by the mechanical sound of the electromagnets when his adjustment causes the over-shot and short-shot electromagnets to operate, a third electromagnet, set to the left of the others, is caused to operate by the impulse switch each time a simulated shot is fired. By this means,

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21007

Figure 20 — Director With Cover Removed — Left Rear View

DIRECTOR TRAINER M8

noticeable changes in mechanical sound are avoided. The impulse switch is shown in figure 17.

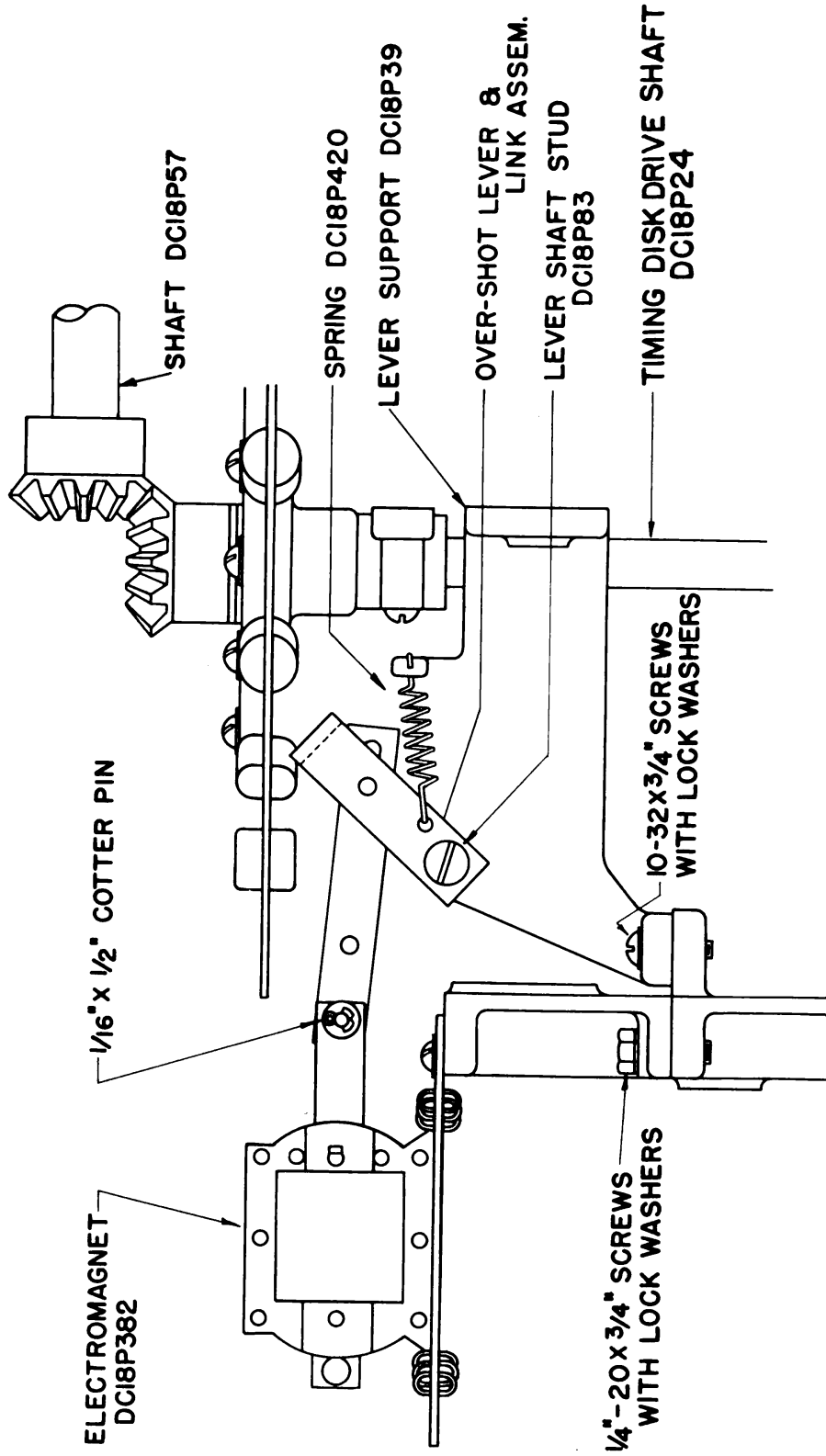
j. As the movable contact is brought into the lower section of the chart, the electromagnet for adjusting the mechanism to indicate short-shots in the target is energized. The short-shot electromagnet is mounted centrally immediately below the over-shot electromagnet (fig. 20).

k. The three electromagnets are identical. They are rated to develop a 50-ounce pull on a 110-v, 60-cycle, a-c circuit. Each electromagnet is supported by four springs, which are connected between four corners of the electromagnet base and a sheet metal frame (fig. 22). The frame in turn is mounted by means of two round-head machine screws passing through slotted holes in the frame, and threaded into the cast base on which the unit is supported. Connection between the armature and the lobe positioning lever is made by means of a connecting spring and link.

l. At the time the firing switch is snapped to the "ON" position, the electric motor and gear reducing mechanism is started in motion (fig. 48). This combination rotates a horizontal timing control wheel (fig. 17), and also actuates the chart carriage which carries the director chart on its path in front of the movable electrical contract. The horizontal timing control wheel is provided with 10 projections on the periphery, which contact the impulse switch mounted toward the front and to the right of the director, on the plane of the timing disk. The speed of rotation of the control wheel is such that the actuation of the impulse switch by means of the projections is once a second. The impulse switch causes the idler electromagnet, previously described, to operate once per second, and simultaneously energizes the unit which produces the muzzle blast simulation, in the event that the gun sound switch on the control cabinet is in the "ON" position.

m. The mechanically operated control wheel is provided with 10 radial slots in which are located sliding rods approximately $\frac{1}{2}$ inch in diameter and about $\frac{3}{4}$ inch in length (fig. 24). The sliding rods or movable lobes are utilized to actuate switches controlling the movement of the tracer indicators in the target. These movable cylinders are provided with two diametrically opposite radial slots, which act as guides to support them in the slots in the timing disk. There is one cylinder in each control wheel slot. The normal position for the movable switch actuating lobe on the wheel is midway between the extreme limits of the radial slots. As the control wheel rotates, a guide trough, mounted immediately behind the bracket supporting the movable contact worm, acts to locate the lobes in this position. They are then undisturbed during the rotation of the control wheel until they are immediately over the levers attached to the lobe set-

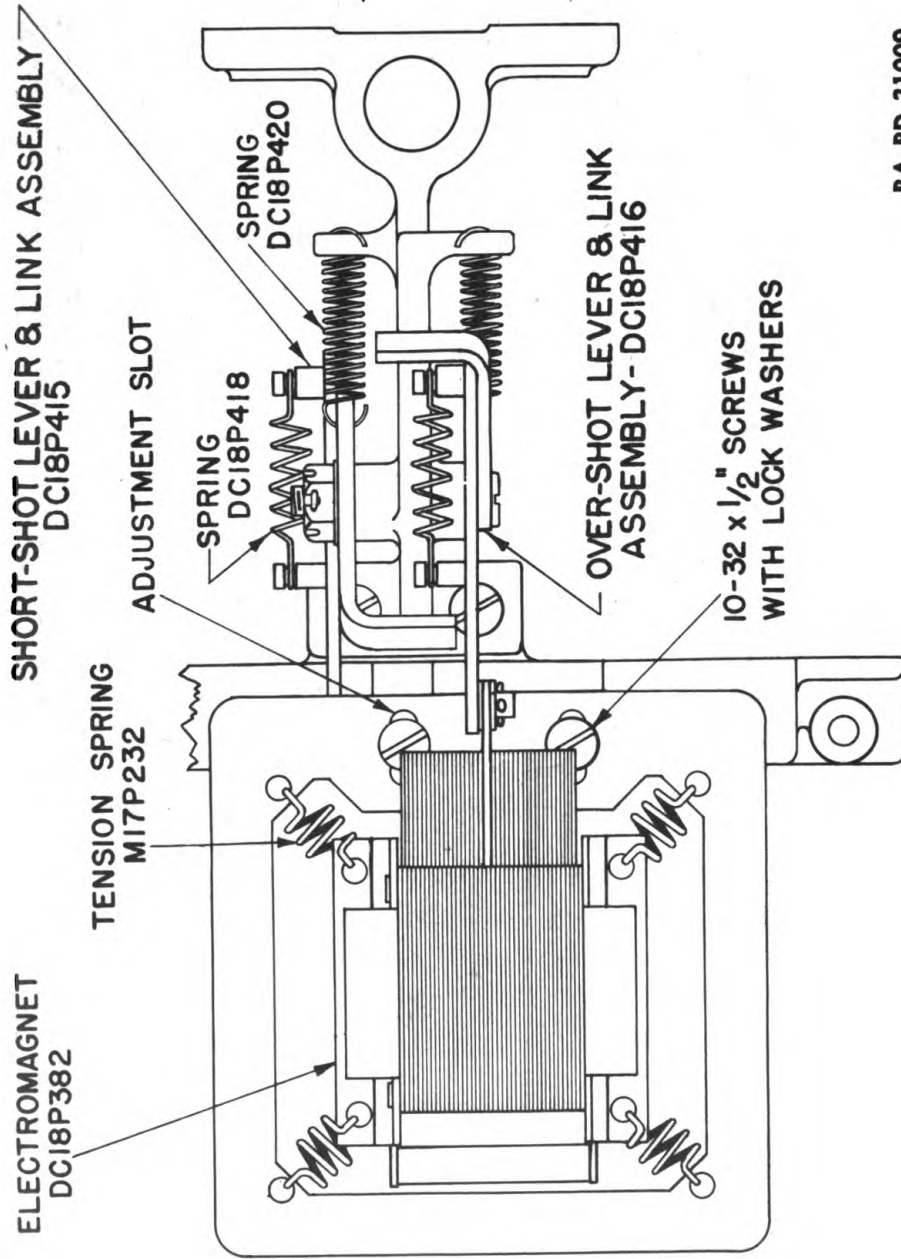
DESCRIPTION OF MAJOR ELEMENTS



RA PD 21008

Figure 21 — Over-shot Lobe Setting Mechanism

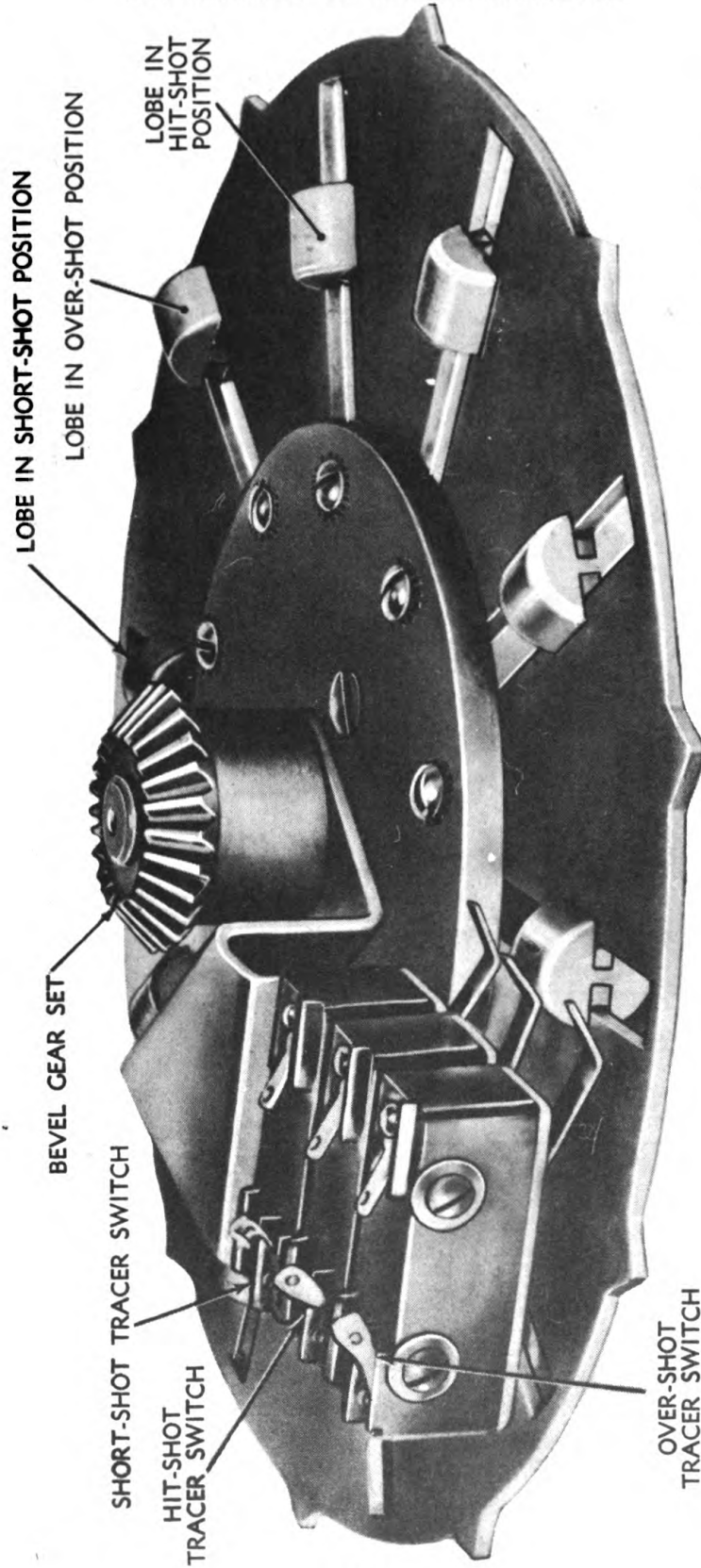
DIRECTOR TRAINER M8



RA PD 21009

Figure 22 — Lobe Actuating Electromagnet Mounting

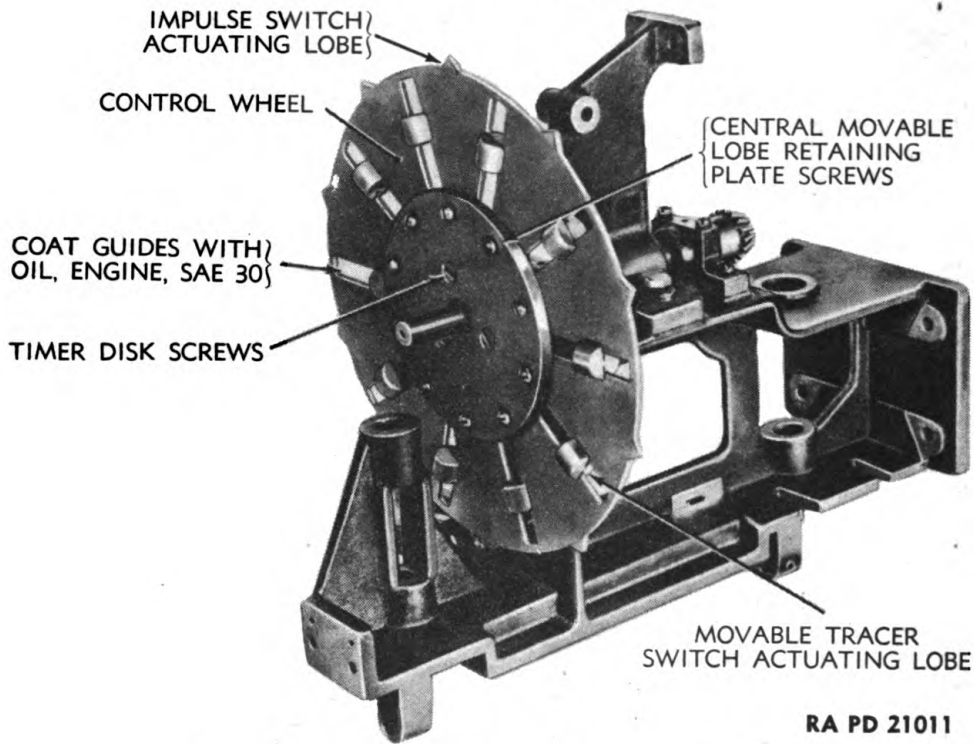
DESCRIPTION OF MAJOR ELEMENTS



RA PD 21010

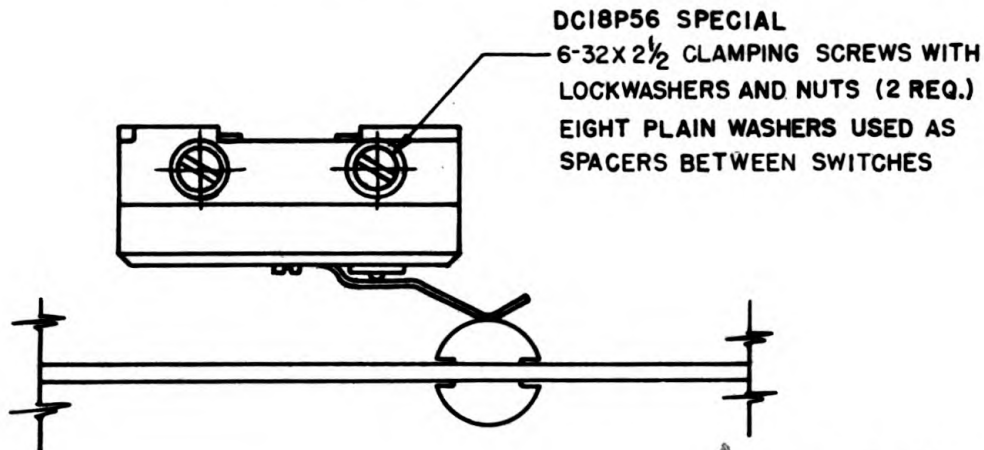
Figure 23 — Time-delay Assembly

DIRECTOR TRAINER M8



RA PD 21011

Figure 24 – Lobe Assembly to Timing Disk

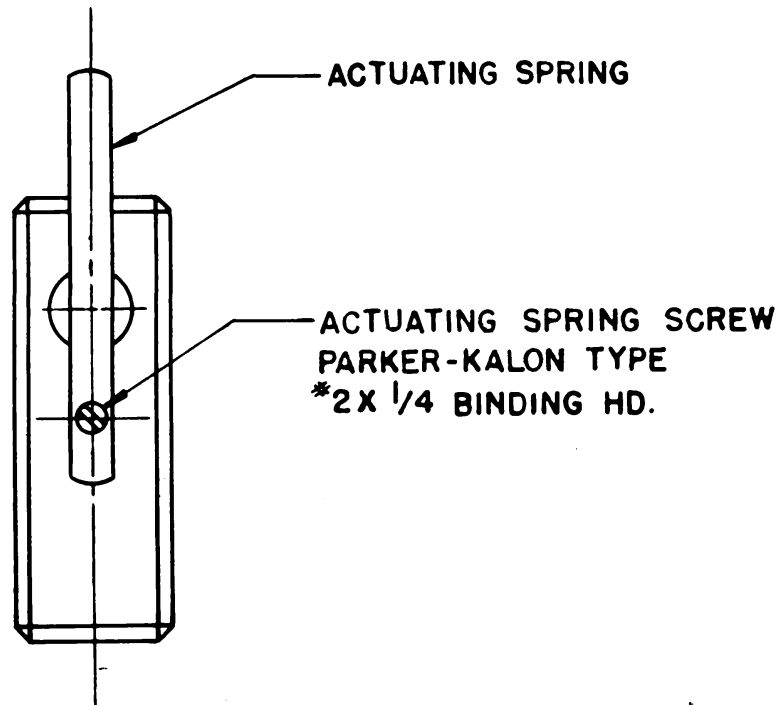


RA PD 21012

Figure 25 – Time-delay Switch Mounting

ting electromagnets at the rear center of the director. Here they are indexed in accordance with the handwheel adjustment of the range setter to produce an indication of a short-shot, a hit-shot, or an over-shot in the target. The electromagnets move the lobes to the periphery for indicating an over-shot, and toward the center of the wheel for a short-shot. If a hit-shot is to be indicated, the lobe is allowed to

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21013

Figure 26 – Micro-switch Actuating Spring Mounting

remain in the original position, midway between the extremities of the radial slot.

n. As previously mentioned, the movable cylindrical lobes actuate switches which control the movement of the tracer indicating lights in the target. These actuating switches are mounted on a rotatable bracket which is actuated through a gear train by means of a channel on the back of the range chart. The mounting for the switches is shown in figures 23 and 25. The switch nearest the center of rotation controls the short-shot, the center switch, the hit-shot, and the outer switch operates the over-shot tracer indication as shown in figure 23. In general, the arm moves slowly from a position approximately 120 degrees from the firing point, back toward the firing point, during the period in which the range chart and target indicate the airplane is on the incoming leg. At the midpoint, where the simulated range of the target is 602 yards, the switch supporting arm will move to within approximately 30 degrees of the firing point. As the airplane moves away from the midpoint causing the slant range to increase, the tracer control switches are carried away from the firing point. This change of position of the switches with relation to the firing point diminishes or increases the amount of travel of the adjusted cylindrical lobes before they contact the spring on one of the tracer releasing switches, thus simulating the change in the time of flight of the projectile to the target encountered in actual firing.

DIRECTOR TRAINER M8

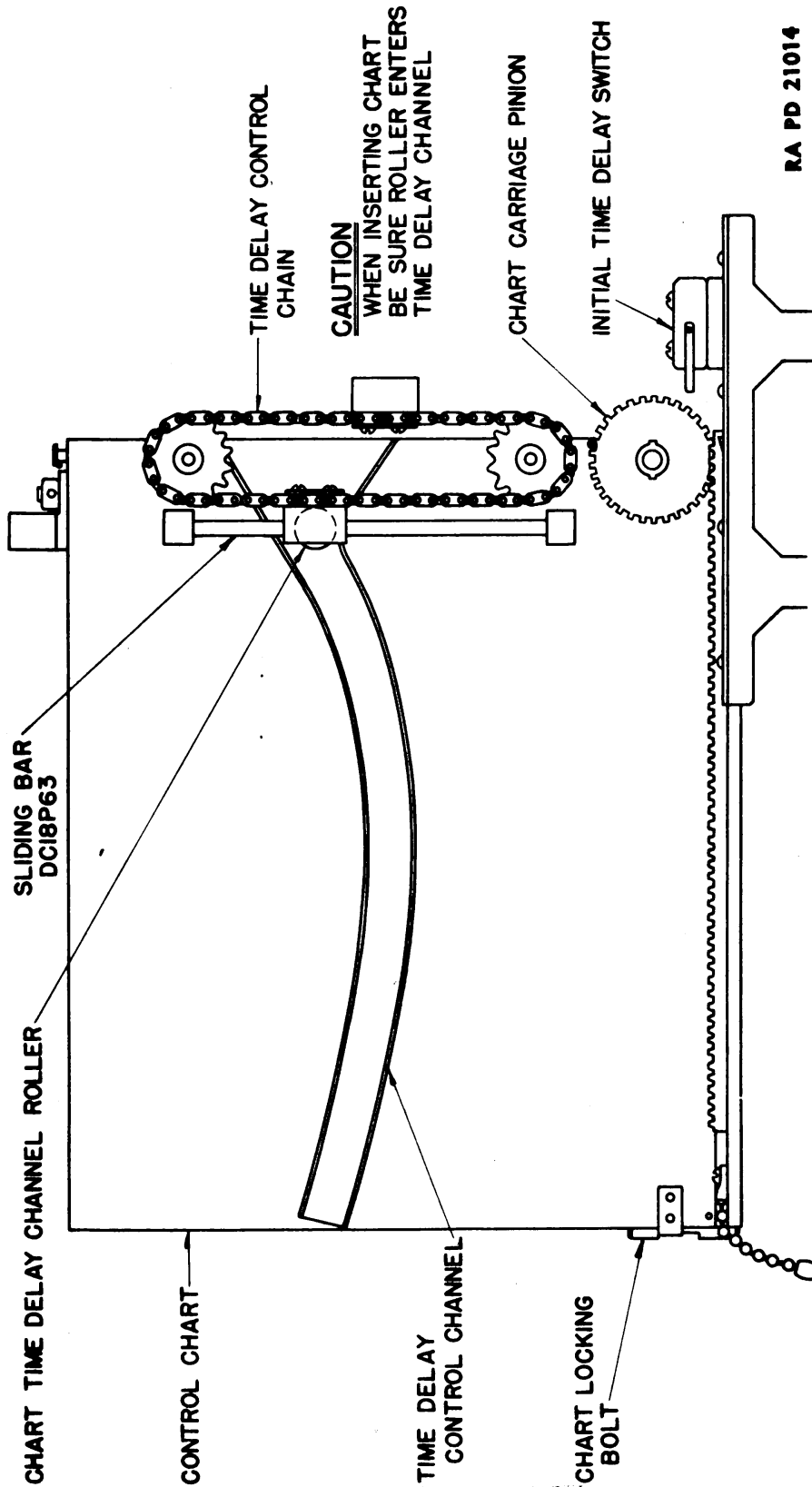


Figure 27 — Co-operation Between Time Channel on Rear of Chart and Time-delay Switch Actuating Member

DESCRIPTION OF MAJOR ELEMENTS

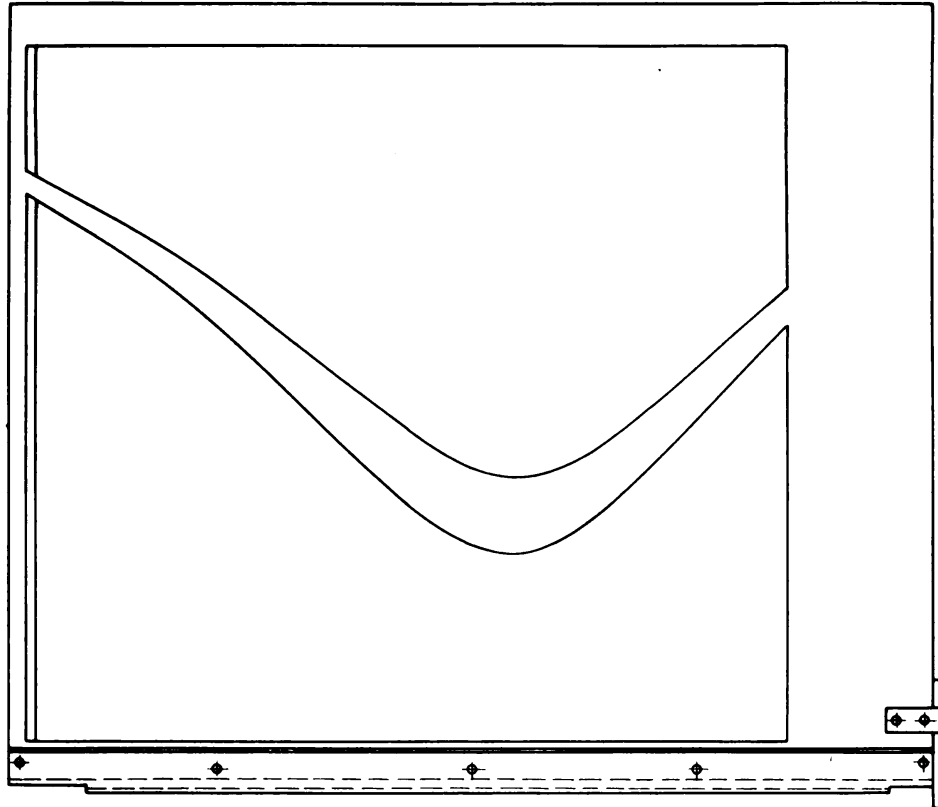


TABLE OF CHARACTERISTICS OF 8 CHARTS FURNISHED
F/T=40 AA-A-1

CHART NO.	H	R _m	S _g	D	D _m	D	-L _o	+L _o	
	ALTITUDE IN YARDS	HORIZONTAL RANGE AT MIDPOINT IN YARDS	SPEED IN YDS/SEC	INITIAL SLANT RANGE IN YARDS	MIDPOINT SLANT RANGE IN YARDS	FINAL SLANT RANGE IN YARDS	NEGATIVE LATERAL RANGE FROM MIDPOINT IN YDS.	POSITIVE LATERAL RANGE FROM MIDPOINT IN YDS.	TIME IN FIELD OF FIRE IN SECS
1	50	600	60	1710	602	1650	1600	1488	52
2	50	600	150	2250	602	1600	2250	1350	24
3	400	200	150	2195	447	1490	2260	1360	24
4	50	1000	150	2395	1005	1760	2280	1350	24
5	400	600	60	2050	707	1350	1980	1140	52
6	400	600	150	2250	707	1625	2250	1380	24
7	400	1000	60	1940	1080	1850	1680	1460	52
8	400	1000	150	2430	1080	1800	2310	1350	24

FLAG TARGET

DIRECTION OF FLIGHT LEFT TO RIGHT

Figure 28 – Range Adjustment Chart

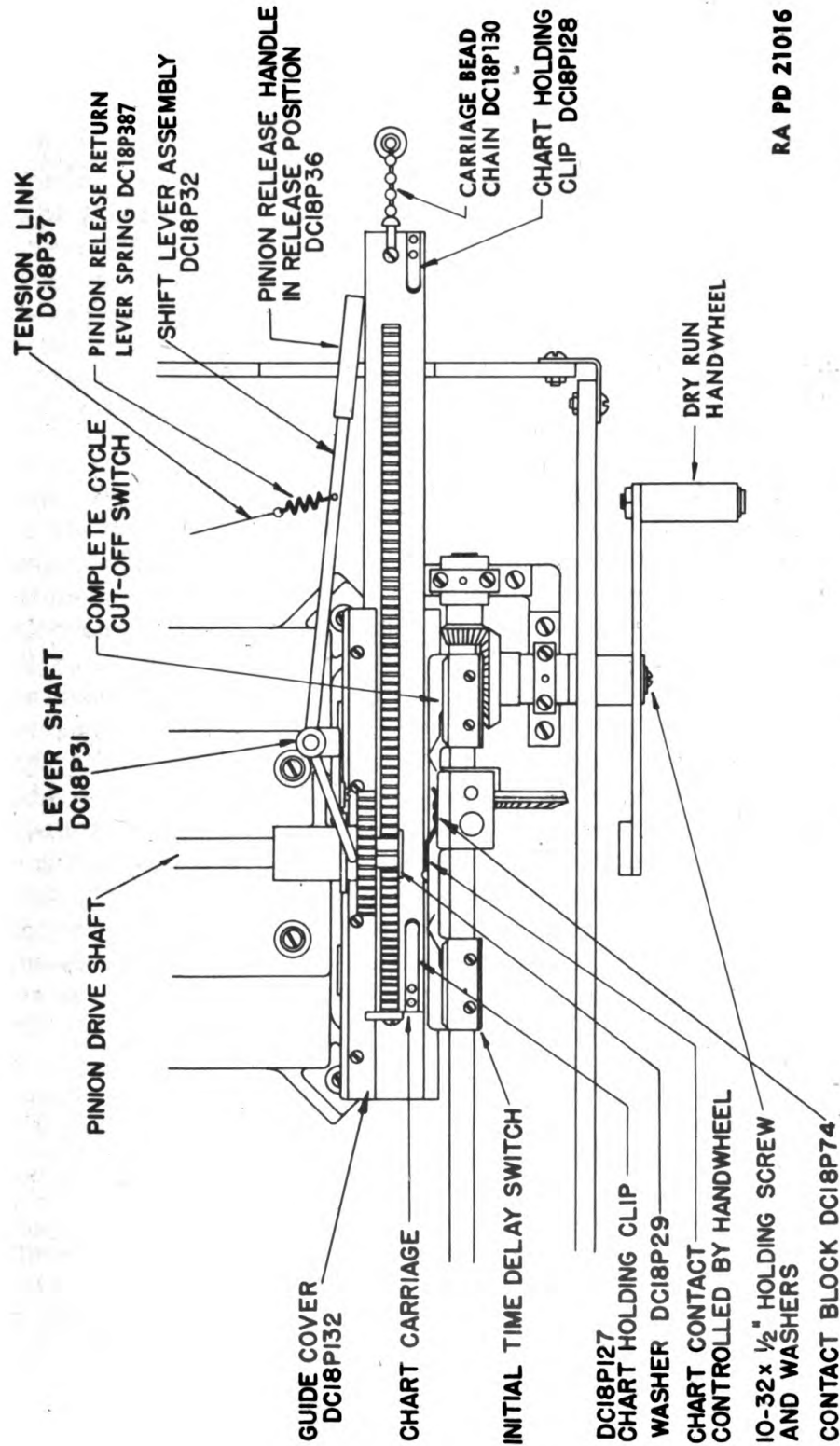
RA PD 21015

DIRECTOR TRAINER M8

o. The time-delay actuating gear train consists of a set of beveled gears for driving the switch supporting arm, a drive shaft, and a sprocket with a vertically mounted chain cooperating with it. One side of the vertical leg of the chain has a block attached to it on which is mounted a roller. The other side has a counterbalancing block attached to it (fig. 19). Each chart is provided with a channel-shaped member on the back, which is curved in the shape of the graph of the time of flight of a projectile traveling from the gun muzzle to the target being fired upon. The time channel must correspond to the slant range curve produced on the front side of the chart, for use in controlling the tracer indications. In order that the minimum of difficulty will be encountered in setting a chart in position for operating, the channel is provided with a guide to feed the roller into the channel. As the chart moves into the machine by means of the gear drive mechanism, the roller attached to the chain is gradually carried downward. This movement causes the time-delay switch arm to rotate clockwise toward the firing position at the center of the back of the director. When the midpoint or minimum slant range is reached on the range curve, the time channel is of such shape that it tends to carry the roller upward, rotating the switch arm counterclockwise and carrying it away from the firing point (fig. 27). The interval between the movable cylindrical lobes on the control wheel is such that it takes a second for the wheel to travel the angular distance between the lobes. The angular distance between the firing point and the movable time-delay switches is continually changed by the time channel on the chart. The result is a continual change in the time between the instant when the cylindrical lobes are adjusted, at the position for the firing of the gun, and the time when they pass under the time-delay switches to actuate the tracer stream in the target. The net result of his action is to cause the tracer indications in the target to take place at the same relative interval after firing that the tracer bullets would appear in the vicinity of a target when fired upon at the same slant range.

p. Eight charts are provided for use with each director. Basically, the charts are identical; the difference lies in the speed of the target, the horizontal range, and the altitude of the target (fig. 28). The front side of the target is the side that can be seen through the instructor's window in the front of the director. It consists of two pieces of brass mounted on a plastic insulating base. The central space between the brass sheets is shaped in accordance with the graph of the slant range of the target as it changes with the changing position of the target in the field of fire; for example, chart No. 1 is the slant range of an airplane traveling 60 yards per second and at constant altitude and speed. The midpoint horizontal range is 600 yards and the altitude is 50 yards. For the purpose of the director, the

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21016

Figure 29 — Chart Carriage — Plan View

DIRECTOR TRAINER M8

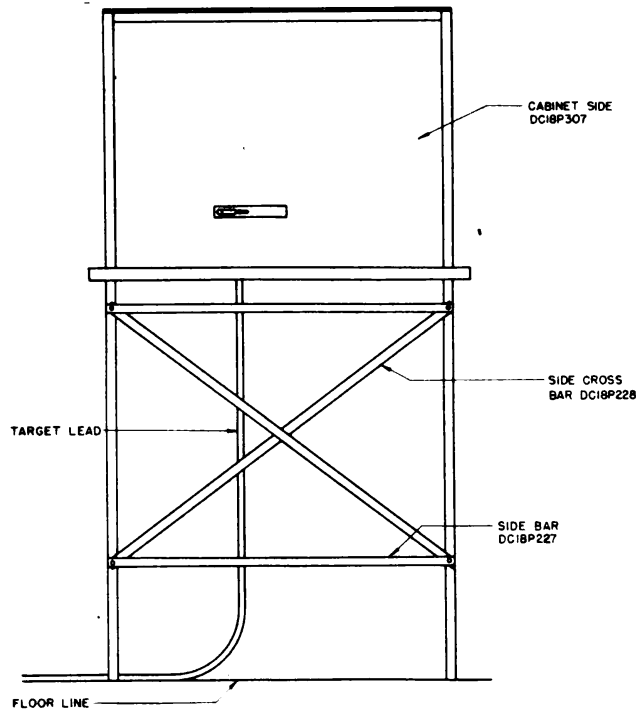
chart is built to assume that the airplane comes into the field of fire at a slant range of 1,710 yards. The midpoint slant range is 602 yards. The time in which the airplane will be within the field of fire is assumed to be approximately 52 seconds; thus the airplane passes out of range at approximately 1,650 yards.

q. The size of the hitting area, or the central curved section of the chart, varies to simulate the size of the target that is likely to be encountered in the path and at the speed on which the chart curve is based. In the case of chart No. 1, the area is relatively large, since airplanes traveling at 60 yards per second, which is approximately 125 miles per hour, are likely to be more easily hit. Chart No. 2, which is of an airplane traveling 150 yards per second, or approximately 300 miles per hour, has a hitting area that is relatively small due to the increased difficulty of producing a hit-shot.

r. A metal channel, not electrically connected to the two main contact plates on the chart, is mounted along the bottom of the insulating material. The lower edge of the channel is notched at either end and extends approximately $\frac{1}{8}$ inch below the insulating material to provide sockets for engaging the holding clips on the chart carriage. A slide bolt is attached to the lower right-hand edge of the chart for securing the chart in position after the carriage clips have been engaged. A small angle is attached to the side of this bottom channel, and projects about $\frac{1}{4}$ inch in front of the chart. This angle engages the actuating spring on an initial time-delay micro-switch, visible through the lower left-hand corner of the instructor's viewing window inside the front of the director (fig. 27 and 29). When the chart is in its starting position, it does not engage the micro-switch. The time required for the chart to move from the starting position to the micro-switch governs the initial delay between the firing of the first shot and the first indication by means of the tracer lights in the target. In the case of the eight charts, which are based on airplanes coming into the field of fire at a minimum slant range of 1,710 yards, the time required for the chart to reach the micro-switch is slightly in excess of 3 seconds. This should be kept in mind when demonstrating the various types of shots by the method explained in paragraph 9. The chart must move into the director far enough to actuate the micro-switch before any movement of the tracer lights in the target will take place. The back of each chart is provided with a channel for actuating the time-delay mechanism. The channel is shaped in accordance with the graph of the time of flight of the projectile as explained in subparagraph o, above.

s. A mechanically driven lateral slide or chart carriage is provided to carry the director chart (fig. 29). It is equipped with spring clips at each end for engaging the channel along the lower edge of the chart.

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21017

Figure 30 – Target

A rack is attached to the right side as viewed through the slot on the left-hand side of the director. The rack is driven at $\frac{1}{4}$ inch per second, by a pinion which in turn is driven by the electric motor, which constitutes the power source for driving the director mechanism. The pinion is free to slide laterally so that the gears may be manually disengaged at will by a hand lever. A spring causes the lever to return the pinion to engagement with the rack, when not prevented manually.

t. Manual lateral movement of the chart carriage to the left is limited by a stop. This causes the chart to be in the proper starting position to provide the correct time-delay for the first shot indication at the target. When the carriage and chart have been moved to the right a sufficient distance to simulate the target airplane passing out of the field of fire, the complete cycle cut-off micro-switch, which operates in conjunction with the metal surfaces of the angle on the front of the chart, snaps to the "OFF" position and thus breaks the electrical circuit (fig. 19). This causes the driving motor to stop, but does not extinguish the lights in the director or the flood light in the target, or make any change in the operation of the sound equipment with reference to the battle sound. Before the chart is returned to its initial position, snap the firing switch to the "OFF" position, otherwise the

DIRECTOR TRAINER M8

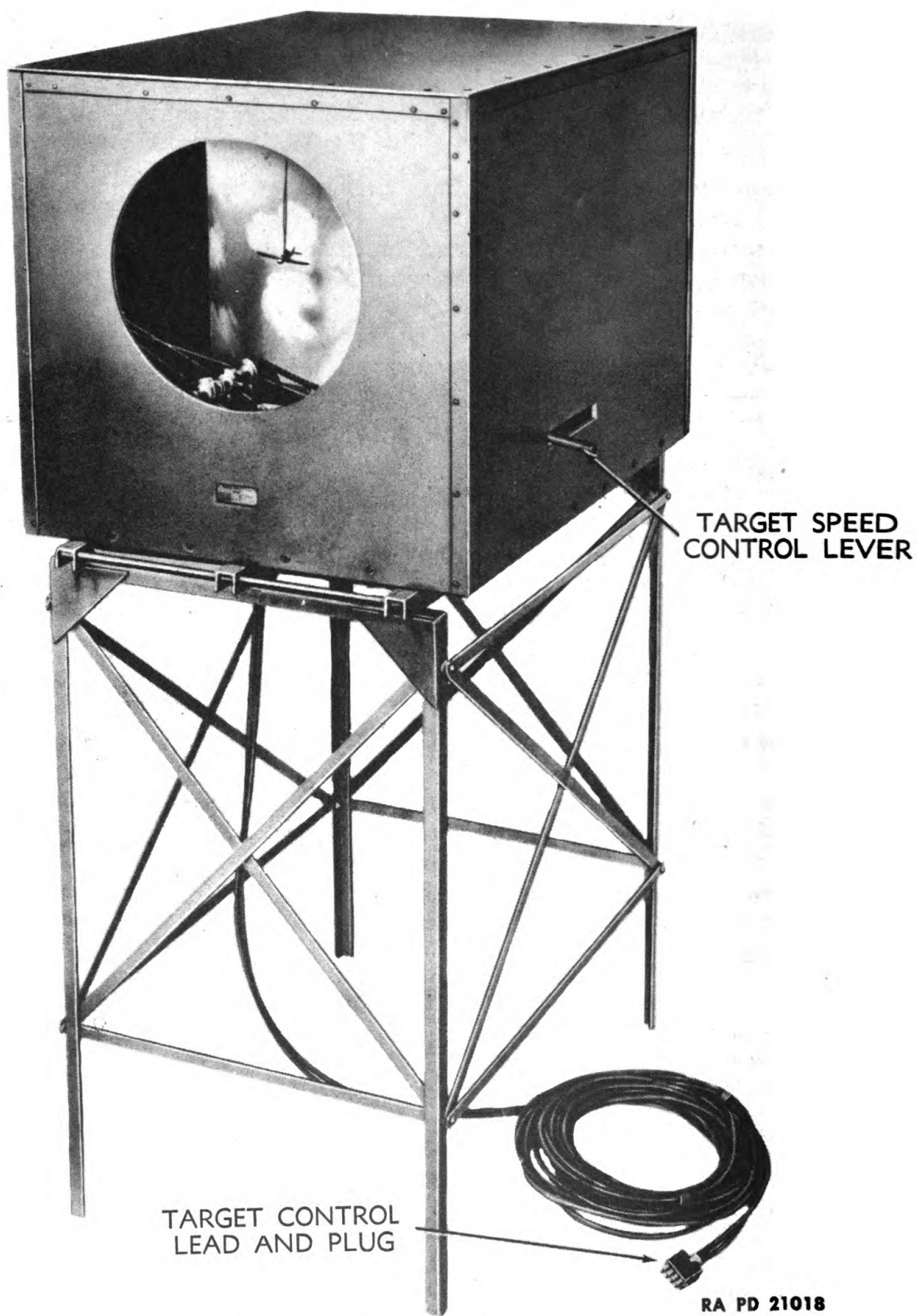


Figure 31 – Target as Seen by Range Setter

DESCRIPTION OF MAJOR ELEMENTS

director will start operation as soon as the complete cycle cut-off micro-switch is closed as the chart moves toward the stop, and the chart will not remain at rest.

14. TARGET.

a. The Director Trainer M8 has been equipped with a stationary target which is set immediately in front of the director. The target is intended to be set 15 or 20 feet from the front of the director, although it may be moved closer or farther away if desired. The only effect of moving the target will be to change the visibility of the target airplane and the tracer indications. The stationary target cabinet contains an airplane of small dimensions, mounted from above by means of a vertical support, approximately in the center of an 18-inch viewing window. At the distance the target is set from the director, a viewing window of this size is intended to represent the portion of the field of fire around the target on which the range setter should concentrate, that is, within an angle of about 6 degrees (fig. 31). Behind the airplane is a cloud scene, which is moved mechanically. The movement of the cloud scene together with the rotation of the target airplane, produces an illusion that the airplane is moving across the sky.

b. The top, back, and left side of the target are free of mechanism. A hand lever for adjusting the speed of the movement of the clouds and the rotation of the target airplane, projects from the right side of the cabinet.

c. Internally the target is quite simple. The largest element is a rotary drum on which the cloud scene is supported (fig. 32). A target airplane support mechanism is mounted in front of the cloud drum. A rotary tracer stream unit equipped with a driving motor to drive the drum and the tracer stream mechanism is mounted in the lower left corner. Reduced voltage for use with the tracer stream lights is provided by a transformer mounted in the lower right corner.

d. The target airplane is supported on a $\frac{1}{16}$ -inch diameter stainless steel wire. The top end of the wire is supported vertically in a sleeve attached to a drive pulley, and held in place by a set screw. The driving pulley is slightly above the top of the cloud drum and is driven from the shaft of the cloud drum by means of a 0.005-inch diameter stainless steel wire (fig. 33). As viewed from the open face of the cabinet, with the top of the cabinet removed, the steel wire is attached to the pulley through a small hole in the left side. In making the connection to the pulley, approximately 15 inches of wire should extend toward the open side of the cabinet to be carried around the groove in the pulley and back toward the shaft on the drum. The other end of the wire should be sufficiently long to pass around the hub of the drum and be available for the two ends of the wire to be connected

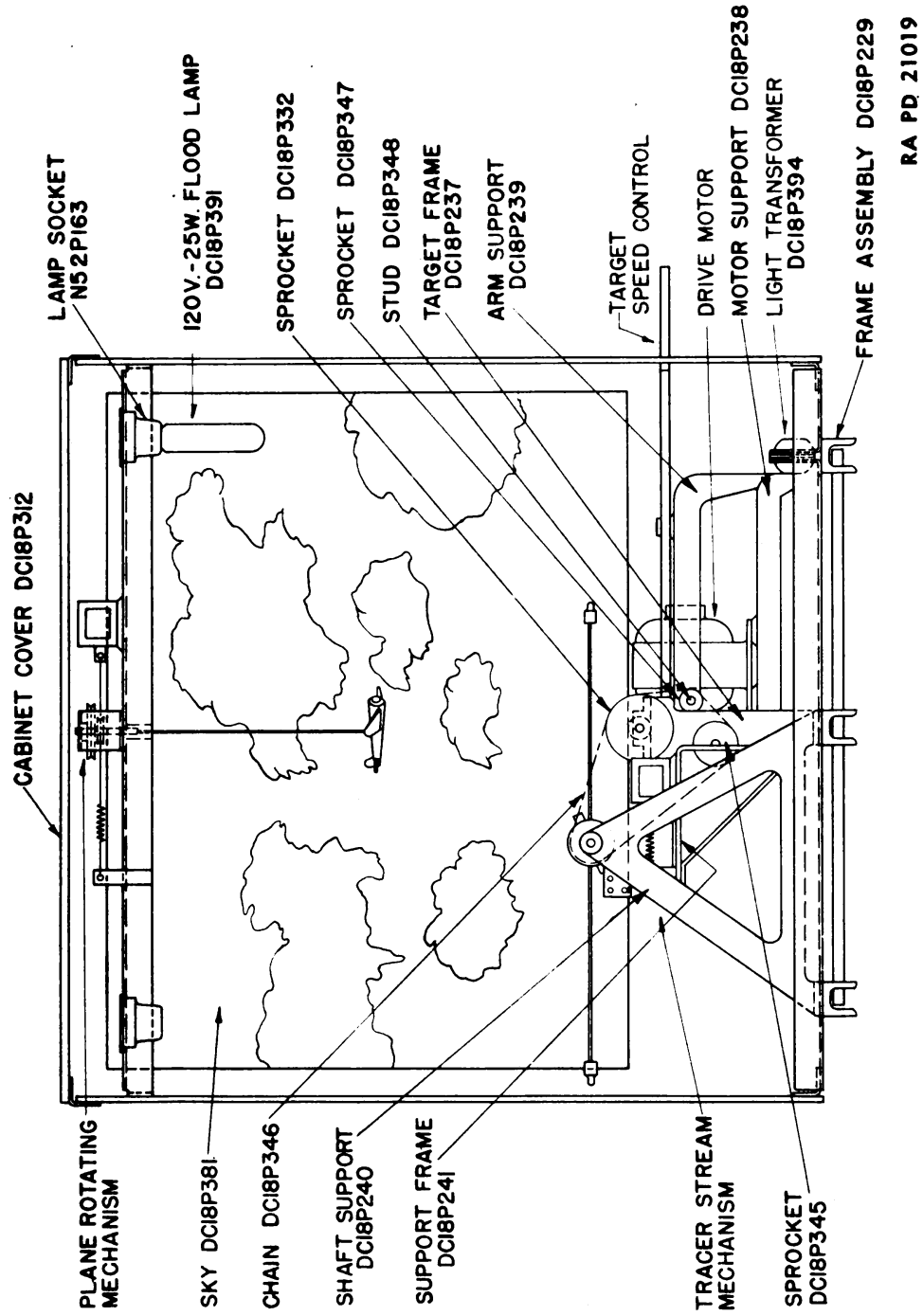
DIRECTOR TRAINER M8

together to form a driving belt. In order to provide sufficient tension on the wires to cause the target airplane to rotate the same amount each time over a considerable period of time, a small spring has been used to join the two ends of the driving wire (fig. 33). Since the drum rotates in a clockwise direction, as viewed from the top, and it is necessary for the airplane to rotate in a counter clockwise direction, as viewed from the top, the driving wire must be crossed to provide this change in motion. When the airplane has rotated approximately 120 degrees, it strikes a stop. If the cloud drum is permitted to rotate after this occurs, the driving wire will slide on the drum shaft. Under normal circumstances, the cloud drum will stop rotating at the time the switch mechanism on the director chart stops operation of the director. In some types of demonstrations, however, such as when an instructor is showing the various types of tracer indications by holding the director chart stationary, the cloud drum may rotate considerably longer than would be necessary to carry the airplane through its normal course. It is intended that the driving wire should slip, under these circumstances, and no damage will be done to the equipment.

e. At the time the firing switch is snapped to the "ON" position, an electromagnet, mounted to the right of the airplane target drive pulley, is energized. This electromagnet is attached to a pulley which rotates on the same center as the target airplane. A spring is connected to it and to the frame of the cabinet to the left of the target airplane pulley. The target airplane pulley is provided with a pin mounted on the under side, which is engaged by the electromagnet-actuated pulley at the time the electromagnet is de-energized and the spring returns the pulley to its normal position. This causes the airplane to be turned clockwise to its starting position. It is brought against a stop which locates it in the correct initial position.

f. The target airplane is made of die-cast metal, which, while serviceable for work it is to do, can not be readily bent without breaking. A 1.1-v, pencil-type, flashlight bulb, is mounted in the fuselage with the glass portion of the bulb projecting beyond the front of the body, in place of the propeller (fig. 34). A single lead wire is soldered to the center contact on the base of the lamp. The side contact to the bulb is made through the body of the airplane and the supporting wire. A sheet metal plate is provided to cover the under side of the fuselage. It is curved to fit closely against the base of the light bulb. The airplane support wire is provided with a right-angle bend, and then is passed through the sheet metal fuselage enclosure, and up through the top of the airplane. A small collar equipped with a set screw is slipped over the wire and pressed against the airplane to clamp the airplane, the lamp and the enclosing plate together. In order to insure the airplane turning with the wire, the wire is rigidly fastened to the under side of the enclosing plate.

DESCRIPTION OF MAJOR ELEMENTS



RA PD 21019

Figure 32 — Target With Front Removed

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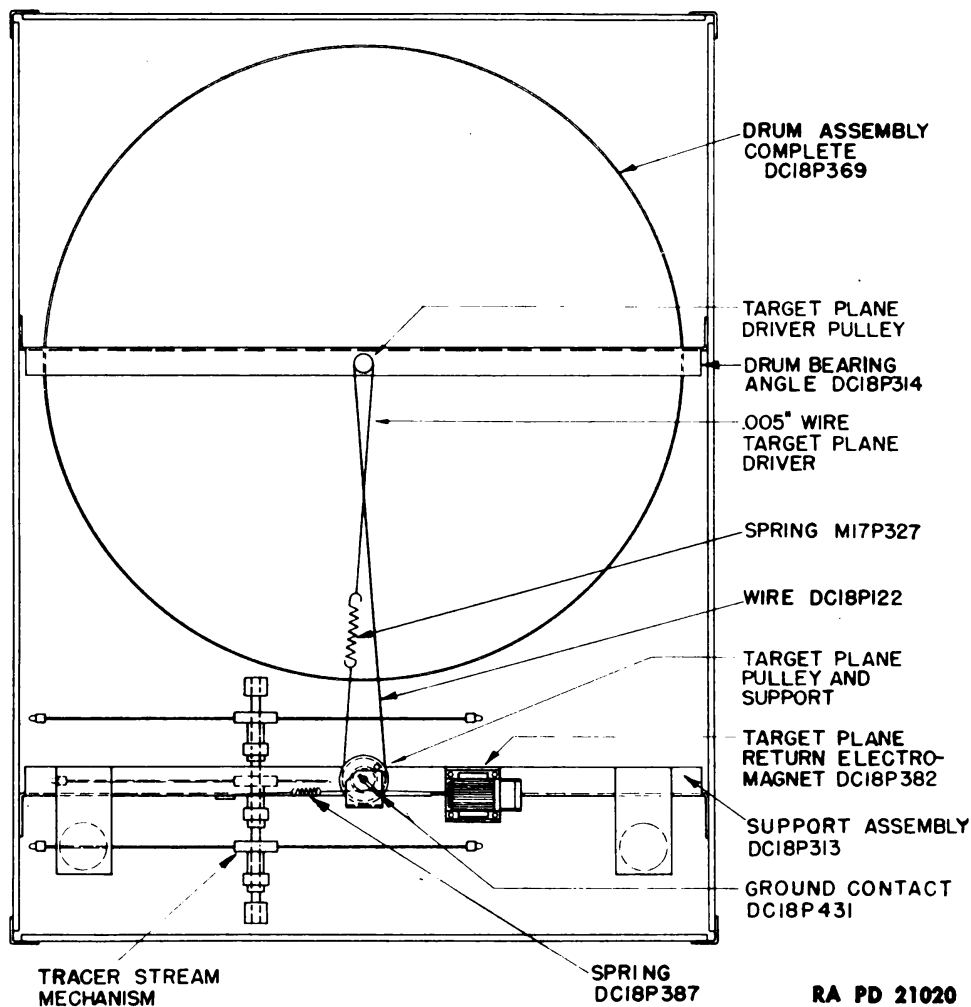
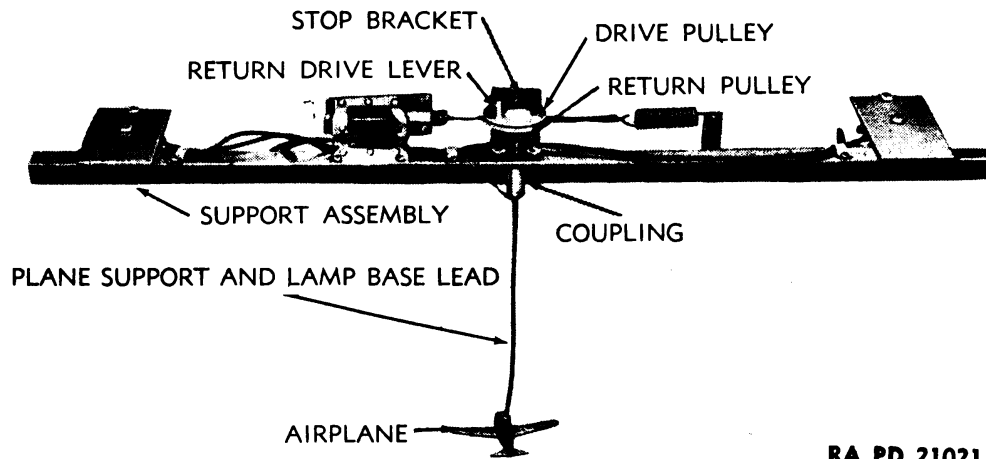


Figure 33 — Target With Top Removed

g. The light in the airplane cooperates with the contact mechanism in the hit-shot tracer so that as the hit-shot arrives immediately below the airplane, the tracer light is extinguished and the light in the airplane is caused to burn for an instant to indicate an explosion.

h. The speed of rotation of the airplane and the movement of the cloud scene must be varied in accordance with the speed of the airplane simulated on the particular chart in use. A hand lever, which actuates a friction drive mechanism, projects from the right-hand side of the cabinet (fig. 35). When the lever is pushed away from the open side of the cabinet so that the drive roller, which it locates, is toward the periphery of the drum, the speed of the cloud scene and the target airplane will be set for the slower courses. With lever pushed to its extreme position in this direction, the adjustment will be correct for

DESCRIPTION OF MAJOR ELEMENTS



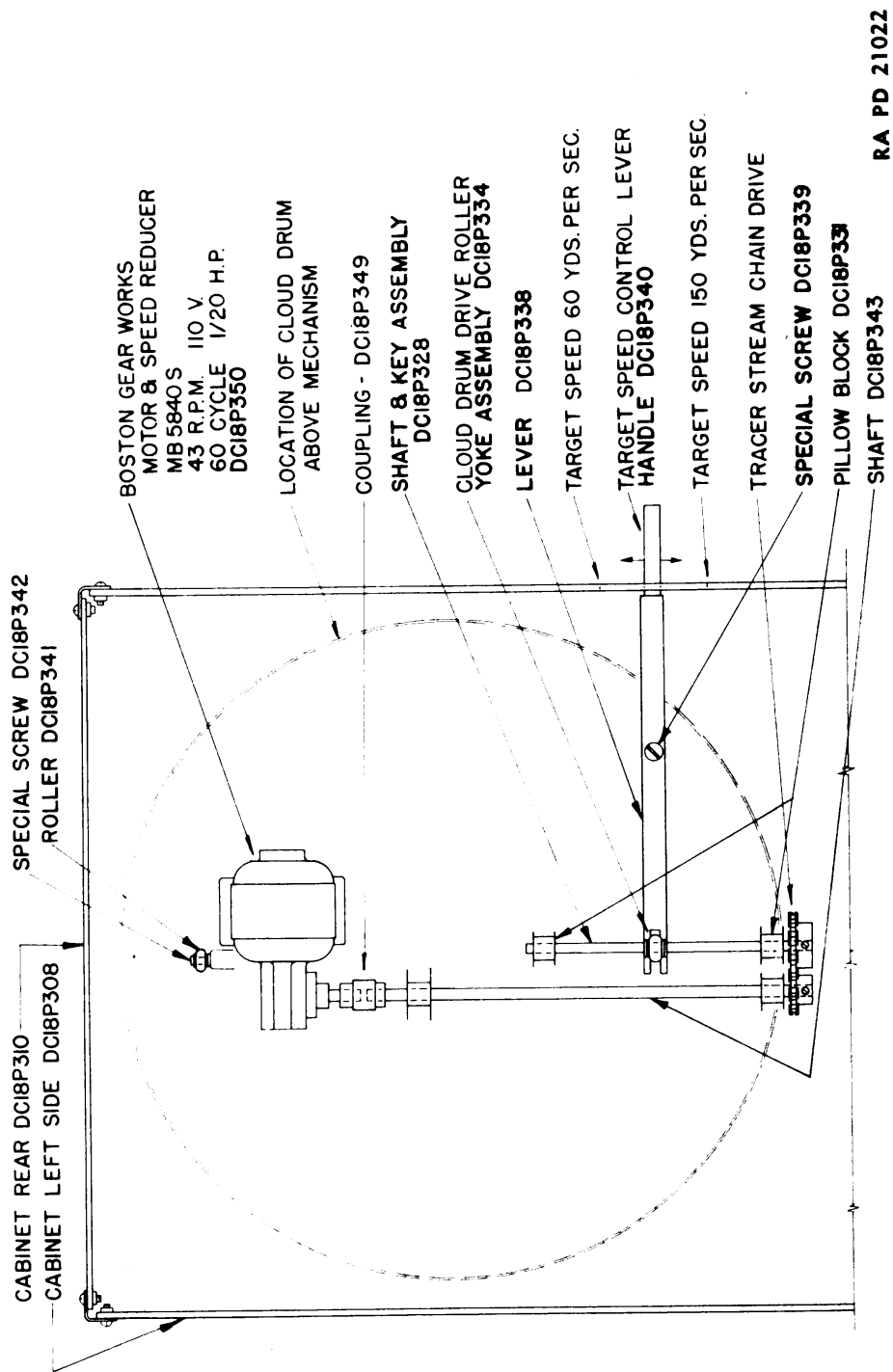
RA PD 21021

Figure 34 – Target Plane and Mounting

airplanes traveling 60 yards per second. When the hand lever is moved to its limit in the opposite direction so that the friction drive roller is near the center of the drum, the adjustment will be correct for airplanes traveling 150 yards per second. Obviously, speeds between 60 yards per second and 150 yards per second can be obtained by moving the hand lever to the proper proportioned distance from either of the limits, but intermediate speeds are not needed since range adjustment charts with intermediate speeds are not provided.

i. The mechanism for producing tracer indications in the target is located in the lower left-hand corner, just inside the open side of the target (figs. 32 and 33). It consists of a motor-driven shaft on which are mounted three brass slip rings that in turn are responsive to spring slip clutch drives attached to the moving shaft (figs. 36 and 37). These rings are spaced approximately 3 inches apart. Each is equipped with its own slip clutch. A 2.2-v lamp is mounted on the free end of a $\frac{1}{16}$ -inch diameter music wire approximately 9 or 10 inches long. Two wires are attached to each slip ring through diametrically opposite holes, and are held in position with set screws in the hub of the slip ring (fig. 37). Like the light in the airplane, one side of the pencil-type flashlight bulb is electrically connected to the music wire support. A single lead is attached to the other lamp contact and brought to the slip ring to complete the circuit. A wiper-type contact is provided to make a moveable electrical connection with the slip ring. The six tracer light bulbs, and the explosion light in the airplane are all connected to a 1.1-v secondary, 110-v primary transformer, which is mounted on the opposite side of the box (fig. 32). The slip ring shaft is driven by means of a chain and sprocket connected to a $\frac{1}{20}$ hp, 110-v,

DIRECTOR TRAINER M8



RA PD 21022

Figure 35 — Target Speed Control and Drive Under Drum

DESCRIPTION OF MAJOR ELEMENTS

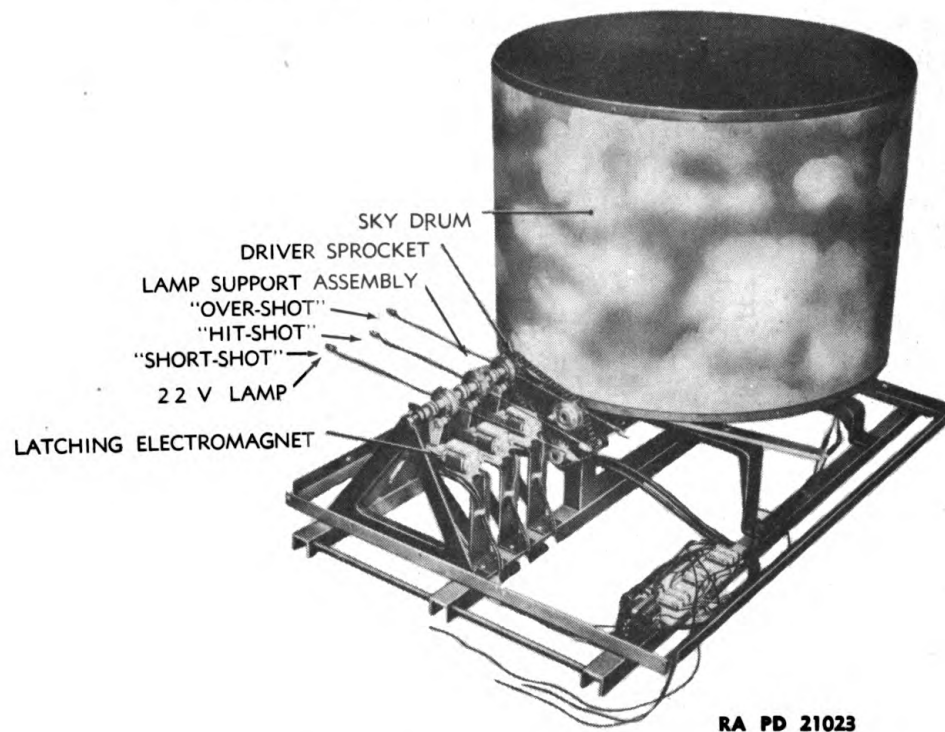


Figure 36 — Target Tracer — Stream Mechanism

60-cycle, a-c motor and gear reducer combination, mounted below the cloud drum. The motor and the tracer lights are controlled by the firing switch in the director (fig. 5).

j. The system of three slip rings each provided with lights that are diametrically opposite, constitutes the means of simulating the three major types of tracer streams. The first pair of lights, as viewed through the open side of the cabinet, indicate a short-shot (fig. 36). When the shot is fired, the tracer slip ring is permitted to make one-half revolution. When the one-half revolution takes place, one of the two tracer lights will travel through an arc, across the open section of the target cabinet. The short-shot tracer indicator will travel through a path of such a character that it will pass in front of the airplane fuselage.

k. The pair of lights on the center slip ring is to simulate the tracer of a hit-shot. The supports for these lights are somewhat shorter, since these tracer lights pass immediately beneath the center of the airplane when released. When a light of this tracer group approaches the airplane, it is extinguished and remains extinguished until it passes from view. At the instant it is extinguished, the small light in the air-

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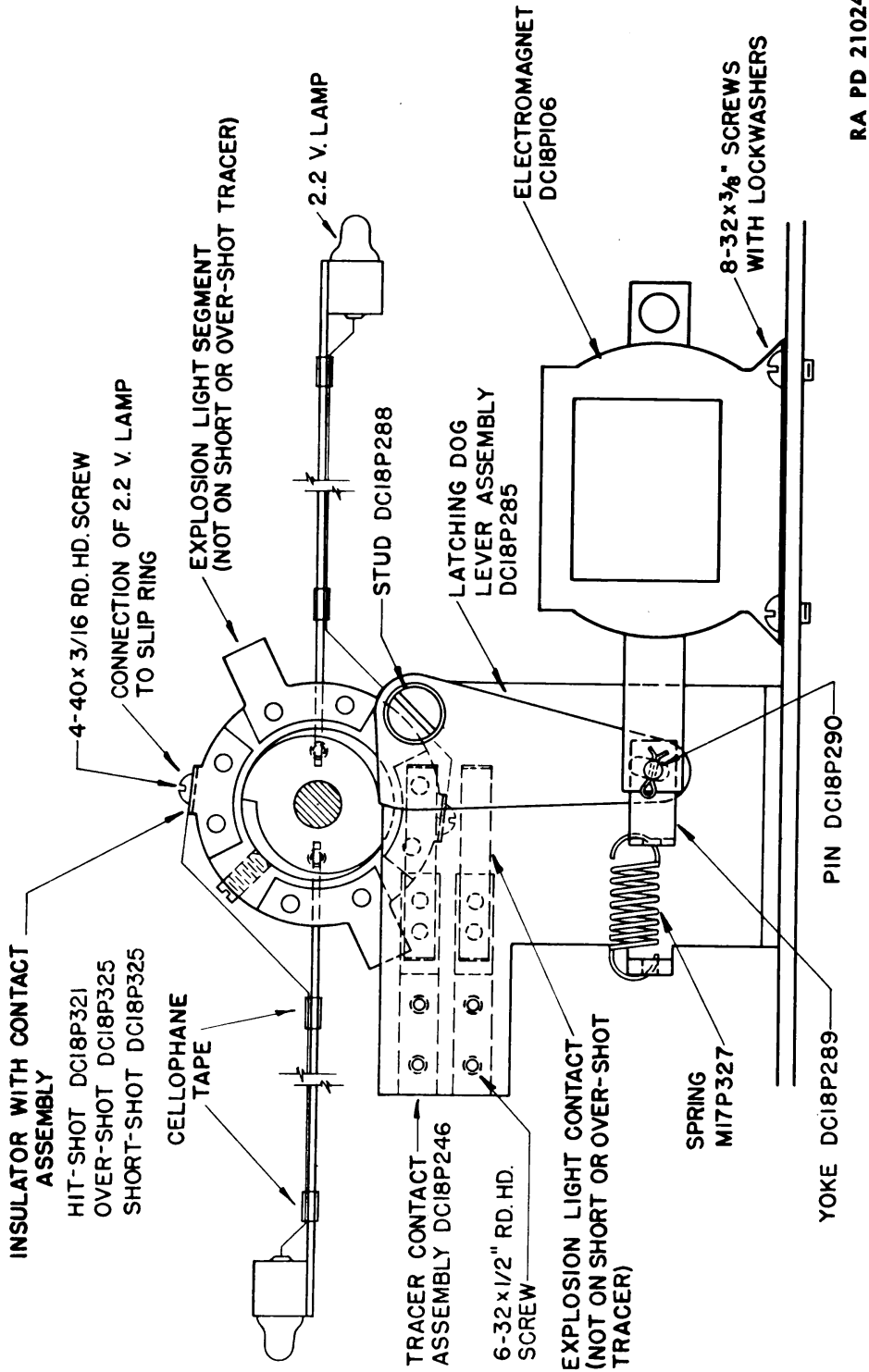


Figure 37 — Hit-shot Electromagnet and Dog

RA PD 21024

ADJUSTMENTS

plane is lighted for an instant to indicate the explosion of a hit. The slip ring farthest away from the open front of the cabinet carries the lights that indicate the tracers of over-shots. The path of these lights is such that as they travel through an arc in the viewing window of the target, they will pass behind the airplane. During the period in which they are passing behind the airplane, they will appear to be blanked out by the airplane, but will again appear lighted as they pass beyond the left limit of the airplane.

1. Each slip ring is provided with a ratchet arrangement operated by an electromagnet (fig. 37). When one of the control switches on the time-delay mechanism in the director is closed, one of the three electromagnets controlling the latching dogs on the tracer indicator mechanism is energized. When the selected electromagnet is energized, it withdraws the dog, permitting the particular slip ring involved to be rotated by means of the spring clutch drive on the rotating shaft. As soon as the moveable cylindrical lobe on the time-delay mechanism passes under the control switch, which only requires an instant, the electromagnet is immediately de-energized. This arrangement permits the dog spring to pull the dog back into the latching position immediately, thus stopping the continuous rotation of the slip ring carrying the tracer lights. This action is such that each time the electromagnet is energized, a slip ring is permitted to make a half-turn. The mechanisms for the short-shots and the over-shots are identical. The mechanism for the hit-shots, or the center group of lights, is slightly different, due to the necessity of extinguishing the hit-shot tracer light as it approaches the airplane and of lighting the explosion lamp in the airplane. Segments of insulating material are attached to the side of the slip ring to interrupt the wiping action of the contact, so as to extinguish the tracer light during a portion of the angular movement. Simultaneously, a second contact is closed by means of a projection attached to the periphery of the slip ring. This causes the lamp in the airplane to light for an instant (fig. 37).

Section V

ADJUSTMENTS

	Paragraph
Sound unit	15
Director	16
Target	17

NOTE: Adjustments requiring the removal of major parts must be performed under the supervision of competent personnel.

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15. SOUND UNIT.

a. The volume control knob located immediately below the main switch on the control panel is for use in adjusting the volume of battle sound (fig. 4).

b. Adjustments on the reproducing equipment involve such things as the needle pressure, the tone arm, height, the tone arm hinge, minimum circle diameter trip, the booster spring setting, and the tone arm retard lever adjustments.

c. The needle pressure, due to the weight of the arm, is controlled by the counterbalancing spring at the rear of the arm (fig. 38). Practically no spring tension is required to provide the needle pressure necessary for correct operation of the pick-up with the tone arm and alloy needle supplied on this record changer. Care should be taken to make sure that the counterbalancing spring does not rub against the inside of the tone arm skirt or any associated parts in such a way that it impedes or binds the free vertical movement of the tone arm. It is a popular fallacy that it is possible to prolong needle and record life by reducing the needle pressure on a given pick-up below the usual pressures used by the manufacturer. The correct needle pressure is related to the needle and tone arm design, and cannot be satisfactorily changed for a given set of parts. Further reduction of the needle pressure, by changing the spring tension, is therefore not possible. The tone arm height adjustment screw (fig. 38), controls only the height of the tone arm when it is in the playing position with no record on the turntable. With the correct setting of this adjustment screw, the tone arm should descend until the needle point is very slightly below the level of the turntable surface. The tone arm adjustment screw should not be used to adjust the height to which the tone arm rises during a change cycle; this height is controlled solely by the length of the tone arm lift pin (fig. 38). Should the tone arm hinge show evidence of binding or impeding the free vertical movement of the tone arm, it may be necessary to replace this part (58, fig. 39).

d. Adjustments of the automatic trip mechanism may be necessary. The changer incorporates a dual trip to insure positive cut-off on various types of records. After the tone arm has played in far enough so that the distance of the needle from the center spindle is approximately $1\frac{7}{8}$ inches, the record changer will trip regardless of whether or not there is a cut-off or eccentric groove on the record. This type of trip is known as a "minimum diameter circle trip." The diameter of the minimum circle is set at the factory to be approximately $3\frac{3}{4}$ inches. Variations in adjustment or readjustment of this operation can be obtained by moving the position of the trip shoe slightly (29, fig. 40). The trip shoe is locked in position by means

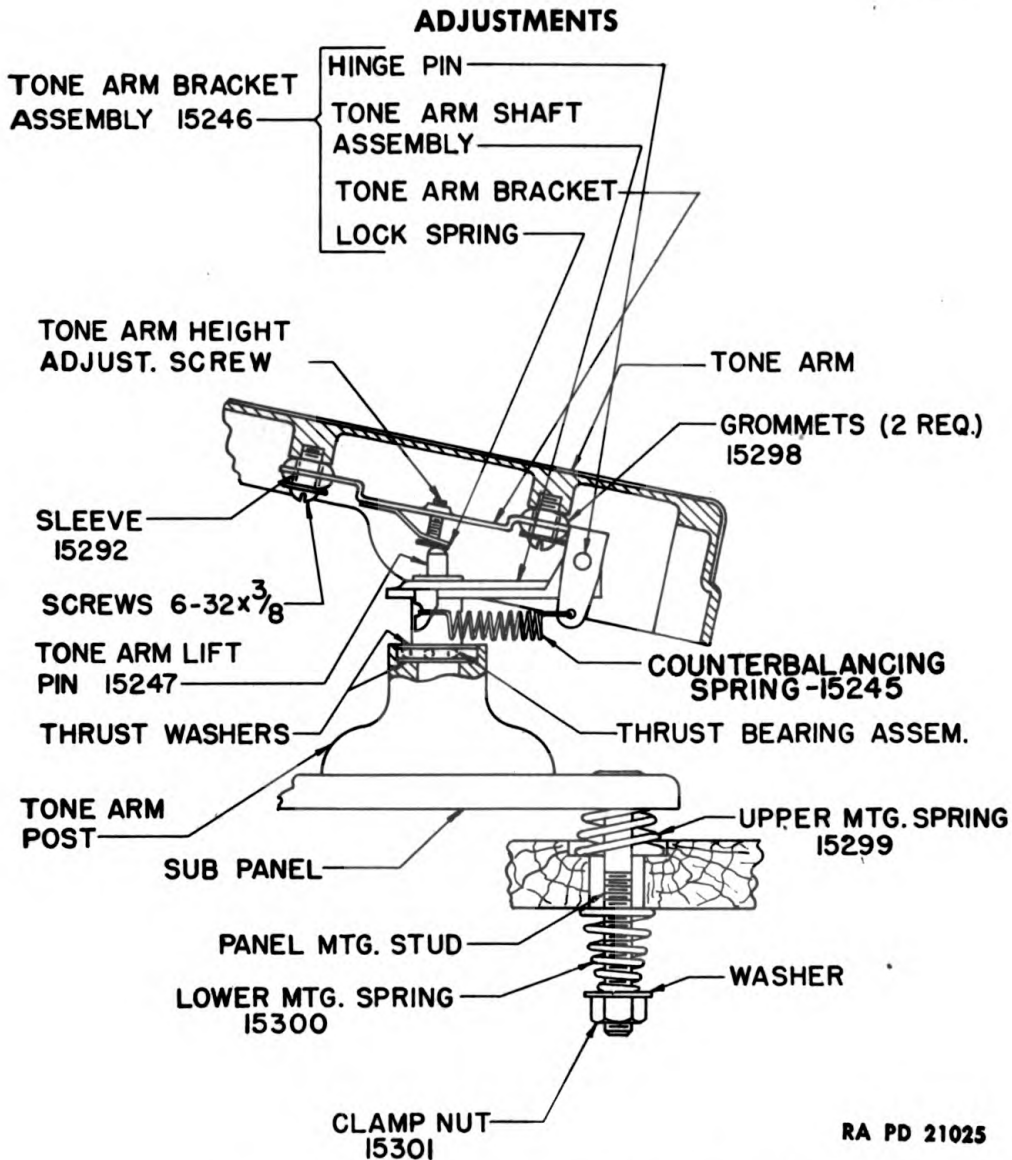


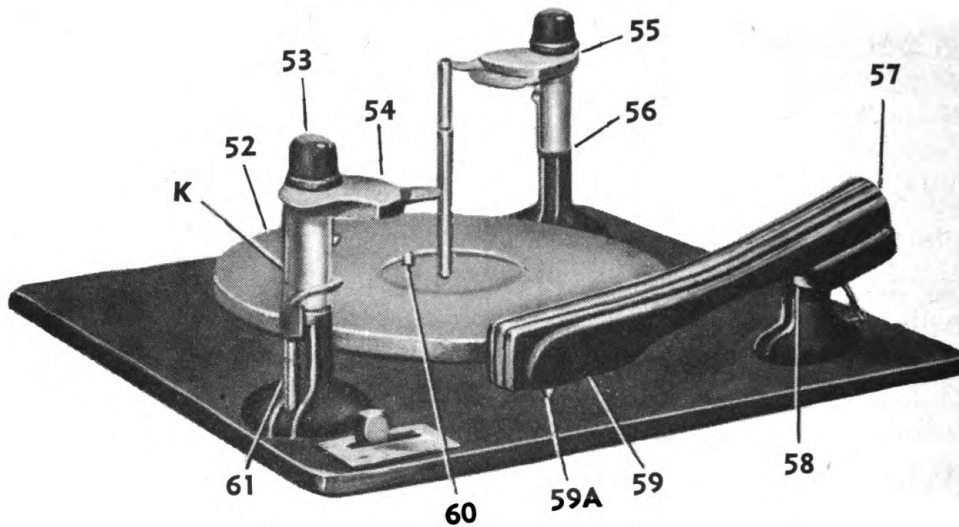
Figure 38 – Tone Arm Mounting Assembly

of a screw when the adjustment has been satisfactorily completed. This screw must be adjusted through a hole cut in the main drive gear when the machine is not in a change cycle (E, fig. 47).

e. In order to make the trip action of the changer mechanism operate under various conditions, a second tripping device has been included. This operates with any outward movement of the tone arm after it has played to within approximately 2½ inches of the center spindle. This trip is actuated by a small dog and ratchet combination, but requires no adjustment (fig. 40).

f. The function of the booster spring (30, fig. 40), is to move the needle from the margin of the record into the first groove auto-

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ITEM NO.	DESCRIPTION
52	TURNTABLE
53	CONTROL KNOB
54	{SELECTOR ARM & BLADE }ASSEMBLY NO. 1
55	{SELECTOR ARM & BLADE }ASSEMBLY NO. 2
56	THRUST WASHER
57	TONE ARM
58	TONE ARM MOUNTING ASSEMBLY*
59	TONE ARM CARTRIDGE
59A	ALLOY NEEDLE
60	RETRACTABLE PIN
61	12" SET ROD

(*) SEE FIG. 47 FOR DETAIL ASSEM.

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Figure 39 – Record Changer – Top View and Parts List

matically. Most present day records have what is known as a "lead-in groove" which automatically carries the needle from the margin of the record into the record grooves. In the case of older type records, and particularly those of the mechanically recorded type which have no lead-in groove, the booster spring supplies just enough pressure to move the needle across the margin to the record grooves. This booster spring which is built into the tone arm locator lever (31, fig. 40), consists of a single piece of light spring wire (30, fig. 40).

ADJUSTMENTS

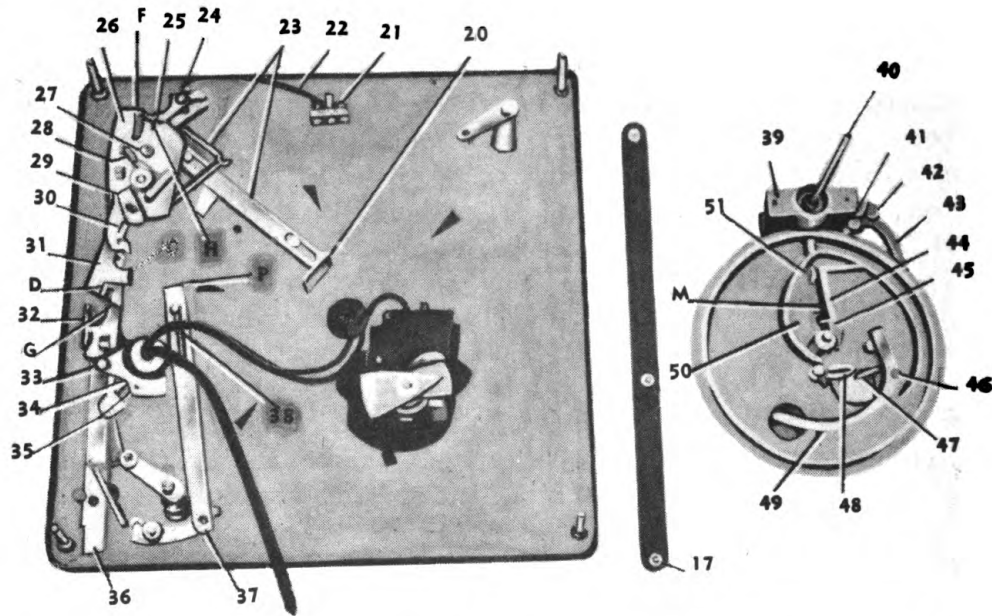
The side pressure exerted by this spring should be just sufficient to move the needle across the margin of a record which contains no lead-in groove. After any adjustment of the booster spring, check its operation on both 10-inch and 12-inch records to make sure that it functions properly. Do not increase the operating pressure of the booster spring to such a point that it tends to make the needle slide across the first few record grooves. Access to the booster spring can be obtained when the tone arm is in the "REST" position with the switch knob turned off, by moving the tone arm locator lever assembly out toward the edge of the changer subpanel with the finger. Adjustment of the spring tension should be made with a pair of light pliers or with the fingers. The tension, measured at the point of contact between the booster spring (30, fig. 40), and the tone arm lever (25, fig. 40), is set at the factory. The values range between 7 and 15 grams, depending upon the type of needle and cartridge used (cartridges requiring extremely light needle pressure also require a light booster spring tension). **CAUTION:** The shielded pick-up lead wire (22, fig. 40) must have sufficient slack between the tone arm, and the point where the tone arm lead enters the subpanel, to permit free sidewise movement of the tone arm; if sufficient, the action of the booster spring may be overcome, or be overemphasized. This lead must be checked before attempting any booster spring adjustments.

g. One function of the tone arm retard lever (49, fig. 40) is to provide a smooth motion of the tone arm as it moves from the outer edge of the panel in towards the edge of the record to be played during an automatic change cycle. An additional function is to prevent action of the booster spring until the needle has lowered on to the outer edge of the record to be played. *Insufficient* tension of the tone arm retard lever spring (47, fig. 40) will permit action of the booster spring before the needle comes to rest on the record, giving the effect of incorrect tone arm indexing. *Excessive* pressure of the tone arm retard lever spring will cause rough, jerky action of the tone arm as it moves from the outer edge of the changer panel.

16. DIRECTOR.

a. The indicator on the range adjusting dial on the back of the director may not correctly indicate the range setting as produced by the handwheel. In order to be sure that the indication on the dial is correct, place chart No. 1 on the carriage ready for operation. Be sure the chart is pulled out to strike the stop. By means of the handwheel on the front of the director, raise the movable contact until it is in the middle of the hitting areas. With this adjustment, the dial should indicate 1,710 yards. If it does not do so, grip the dial driving pulley through the drop door in the right side of the director (fig. 16) and move the pulley until the indication is 1,710 yards.

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ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
20	MANUAL & REJECT LEVER	38	12" RESET LEVER SPRING
21	TERMINAL STRIP	39	SPINDLE & PINION GEAR ASSEMBLY *
22	SHIELDED WIRE	40	TURNTABLE SPINDLE ASSEMBLY *
23	TONE ARM LOCATOR (& LATCH) SPRING	41	CLUTCH ENGAGEMENT LEVER
24	TONE ARM LATCH LEVER	42	STOP LEVER PIVOT PIN *
25	TONE ARM LEVER ASSEMBLY	43	DRIVE GEAR STOP LEVER ASSEMBLY *
26	CONNECTING LINK	44	TRIP LEVER ASSEMBLY
27	TONE ARM LIFT PIN	45	TRIP LEVER SHOULDER SCREW
28	CAP SCREW 1/4"-20	46	RETARD LEVER SHOULDER SCREW
29	TRIP SHOE	47	RETARD LEVER SPRING
30	BOOSTER SPRING	48	TRIP DOG SPRING
31	TONE ARM LOCATOR ASSEMBLY	49	TONE ARM RETARD LEVER
32	UPPER SLIDE SPRING	50	TRIP LEVER SPRING
33	LOWER SLIDE SPRING	51	CLUTCH ENGAGEMENT LEVER PIN
34	A.C. SWITCH		
35	SWITCH PLATE ASSEMBLY		
36	CONTROL LEVER ASSEMBLY		
37	12" RESET LEVER		

(* SEE FIG. 54 FOR DETAIL ASSEMBLY

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Figure 40 — Record Changer Disassembled — Under Side View and Parts List

ADJUSTMENTS

There will be no difficulty in sliding the pulley slightly with reference to the driving wire.

b. Small leaf springs are used to actuate the five micro-switches used in connection with the time-delay mechanism in the director. In the event that a switch fails to operate, it may be necessary to remove the switch, disconnect the leaf spring from the switch body, and shape the spring slightly to produce better contact (fig. 26). The leaf spring should be adjusted so that there will be approximately a $\frac{1}{8}$ -inch interference between the spring and the actuating surface.

c. The electromagnets which actuate the movable lobes on the time disk are mounted by means of screws through a sheet metal frame. Slotted holes are provided for adjustment (fig. 22). The electromagnet should be so located that the lever-like hammer will slide the movable lobe on the timing disk completely into position. It must not be adjusted in such a manner that the striking of the lobe by the hammer prevents the core of the electromagnet from going completely into the coil. If the electromagnet core is not permitted to travel its full stroke, the coil will tend to overheat. Under continuous use, this will cause the coil to burn out.

d. The service cabinet should be removed from the director periodically and all the nuts and screws checked to be sure that they are tight.

17. TARGET.

a. Whenever the charts are changed, the speed of the target simulated by the new chart should be noted. The eight charts provide targets traveling either at 60 yards or 150 yards per second. It is necessary that the control adjusting lever on the right side of the target, as viewed by the range setter, be correctly adjusted to correspond to the chart being used. The lever must be pushed back so that the driving roller is moved out toward the periphery of the drum when charts for targets traveling at 60 yards per second are used (fig. 35). When charts for targets traveling at 150 yards per second are utilized, the lever must be moved toward the range setter in order to position the drive roller toward the center of the cloud drum. In either direction, the lever should be pushed as far as it will go.

b. The target airplane must be so adjusted, that when the midpoint of any course is reached, as indicated by the low point on the chart, the wings of the airplane will be parallel with the line of vision of the range setter. It may be necessary occasionally to run a chart through and note the position of the airplane at the midpoint. If the airplane is not correctly located at the midpoint, the set screw, holding the supporting wire in the pulley sleeve should be loosened and the airplane rotated slightly in the proper direction.

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c. The three groups of wires, which produce the tracer stream indications, should be checked periodically to be sure they move freely between their supporting brackets. In testing their freedom of movement, hold the involved electromagnet core in its energized position by hand, and rotate the system of lights slowly counterclockwise. While doing this, be sure that none of the tracer lights strikes the target airplane at any point. A slight bend of the supporting wire will correct any minor maladjustment.

d. Check the spring contacts that travel on the slip rings of the tracer mechanism to be sure that every one makes proper contact at all times. In the event that one is not making proper contact, bend it slightly with a pair of pincers to produce the desired result. In order to do this, it may be necessary to remove the contact assembly by removing the two holding screws (fig. 37). NOTE: Keep faces of slip rings clean and well polished.

Section VI

CARE AND PRESERVATION

	Paragraph
Lubrication	18
Cleaning	19
Precautions	20

NOTE: Using arm personnel may perform the more intricate maintenance operations only under the supervision of competent personnel.

18. LUBRICATION.

a. With the exception of the record changer and turntable equipment, no lubrication is required on the sound equipment. The motor is equipped with oilless bearings and therefore requires no lubrication.

b. The turntable spindle bearings are lubricated at the factory and do not require any lubrication for 1 year. After 1 year, they should be oiled every 6 months with 1 or 2 drops of OIL, engine, SAE 10. *Do not overoil.* The top bearing can be oiled after lifting off the turntable. When replacing the turntable, make sure that the pin in the turntable spindle slips into the slot on the bottom surface of the turntable hub. Also, take care not to damage the motor idler pulley. Never, under any circumstance, allow oil to come in contact with the motor idler pulley.

c. The director and target will require oiling on all of the moving parts, weekly or monthly as prescribed, to promote smooth action

CARE AND PRESERVATION

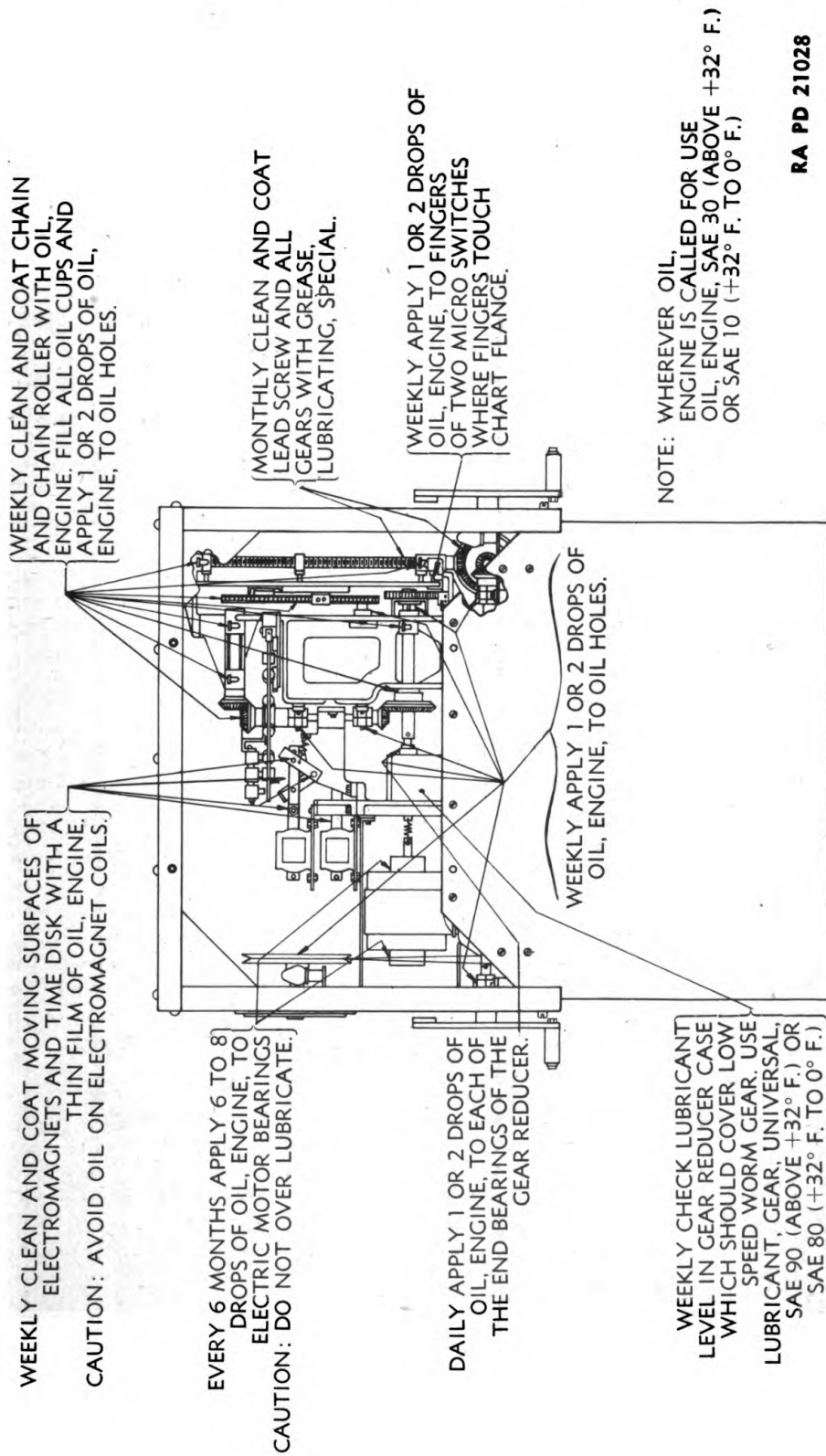


Figure 41 — Director Lubrication Guide — Side View

DIRECTOR TRAINER M8

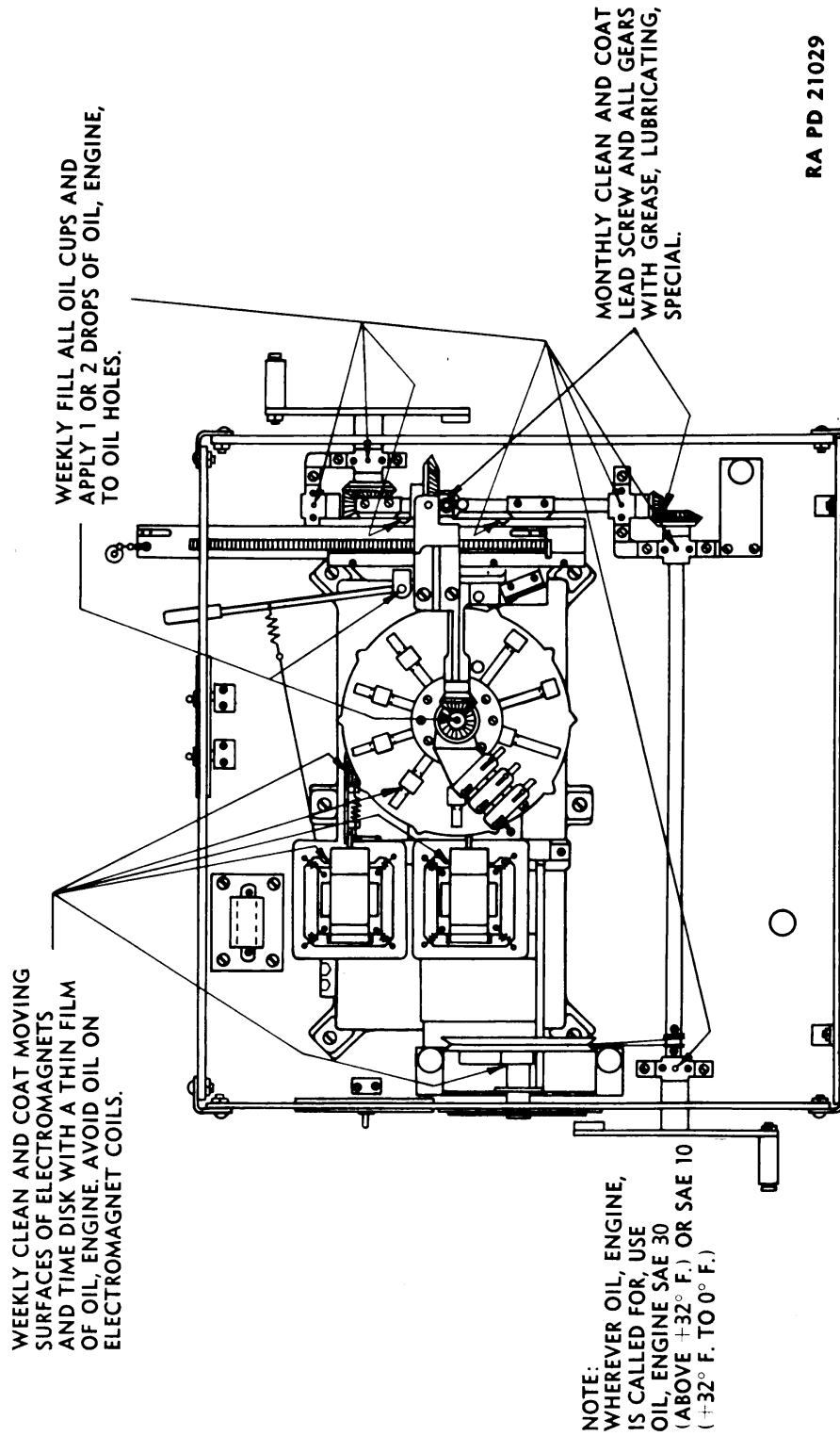


Figure 42 — Director Lubrication Guide — Top View

CARE AND PRESERVATION

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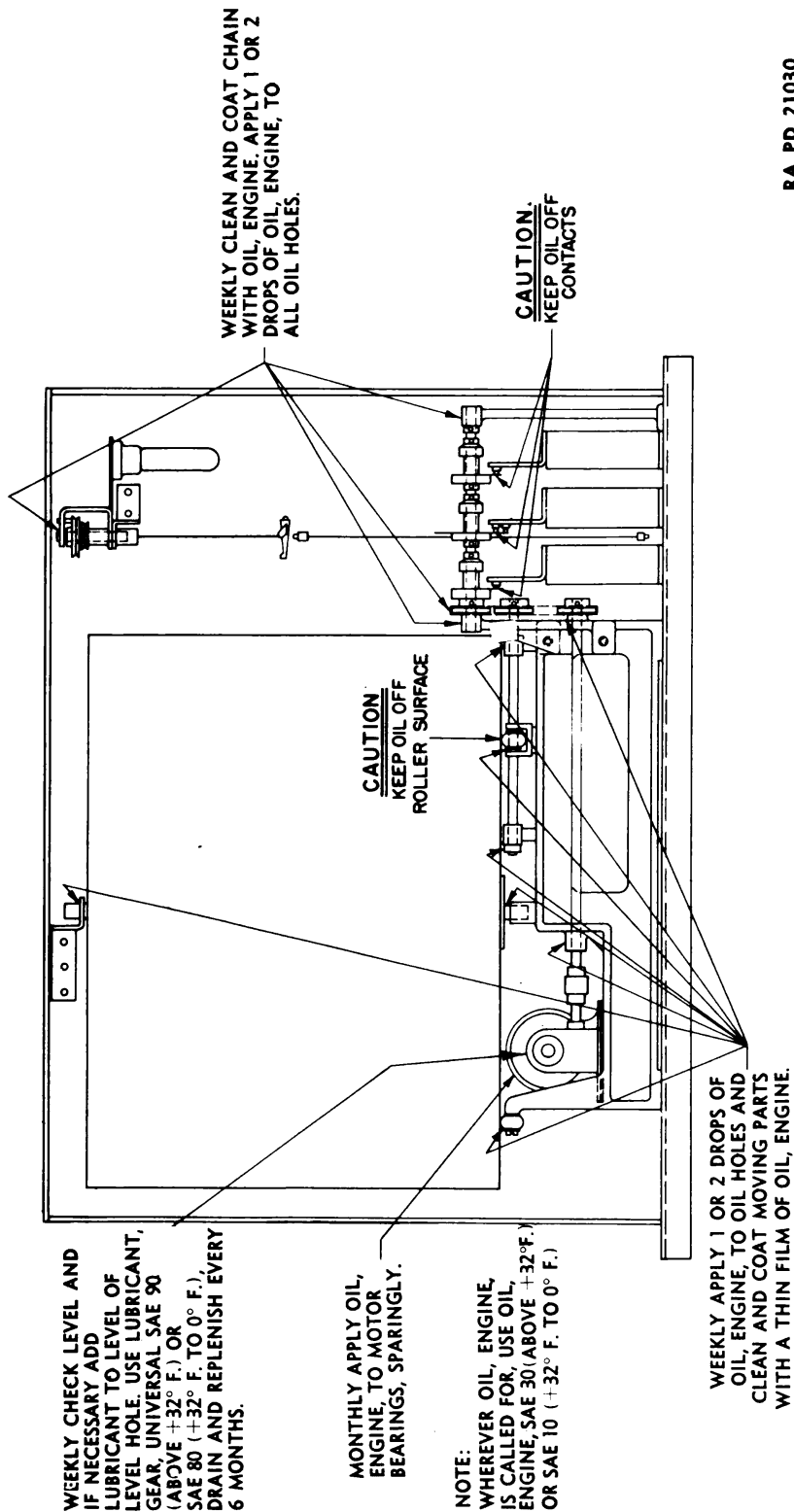


Figure 43 — Target Lubrication Guide — Side View

DIRECTOR TRAINER M8

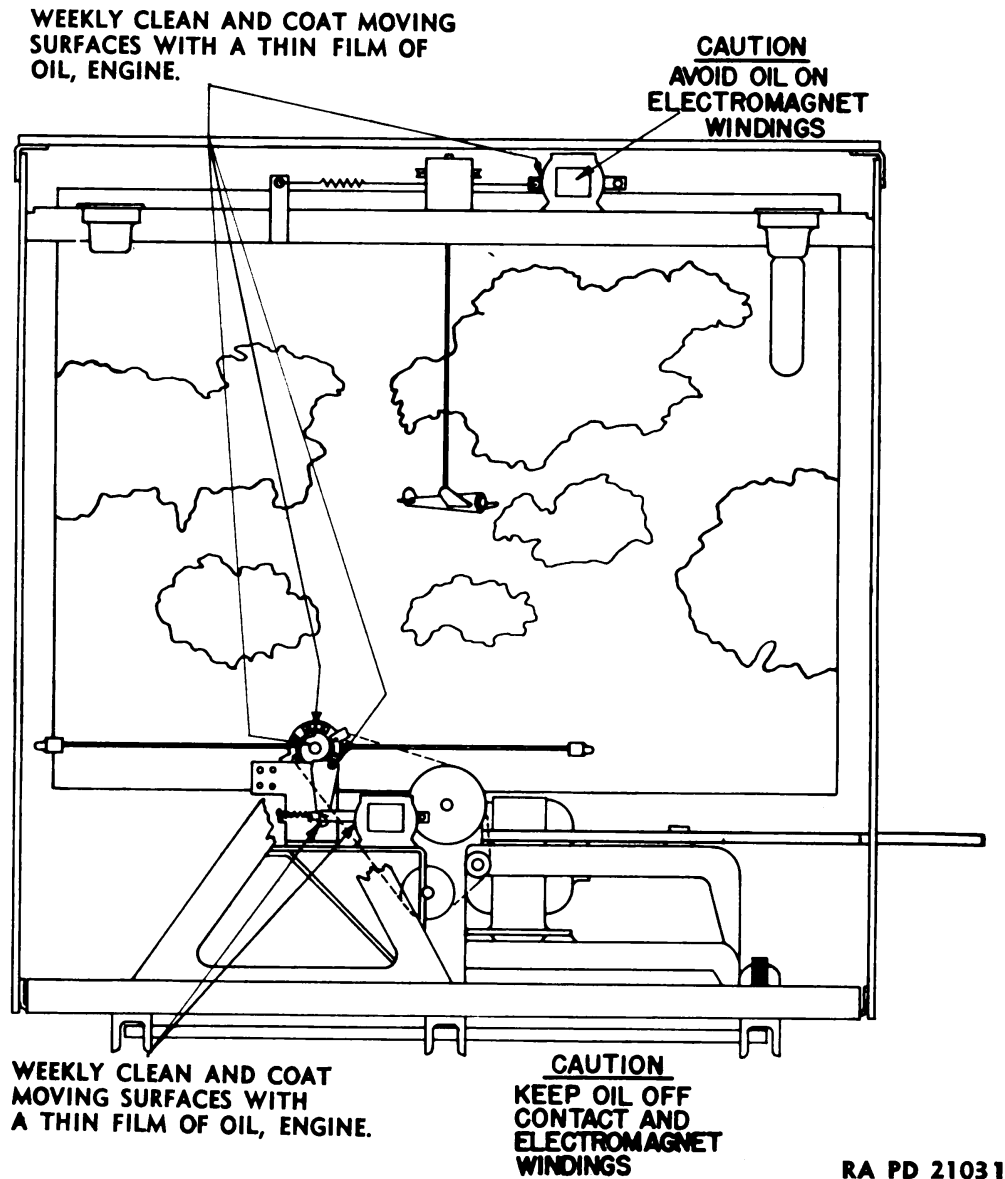


Figure 44 – Target Lubrication Guide – Front View

with a minimum of wear. The points to be oiled are shown in figures 41, 42, 43, and 44. Use OIL, engine, SAE 30, for all temperatures above +32 F and OIL, engine, SAE 10, for temperatures between +32 F and 0 F.

d. Oil must be kept off the sliding contact surfaces on the director and the director charts. The sliding contacts and slip rings of the tracer mechanism in the target must also be kept free of oil. Failure to do this may cause failure in the tracer indications.

CARE AND PRESERVATION

- e. The oil in the gear reducer box should be changed every 6 months. Use LUBRICANT, gear, universal.
- f. Oil the end bearings on the gear reducer in the director daily, using engine oil. Do this through the side door. Oil the driving motor bearings about twice a year with engine oil. Excessive oil will ruin the insulation.

19. CLEANING.

a. Weekly cleaning will preserve the life of the equipment. Any reduction in this interval will depend to some extent, upon the location of the units. Dust should be removed from the battle sound record by means of a soft wiping cloth. In doing this, move the cloth in a light circular motion. Even a fine film of dust may cause very rapid wear of the recorded sound.

b. Excessive dust and grit must be removed from the interior of the sound cabinet as well as the interior of the director and target.

c. To clean the interior of the director thoroughly, disconnect the lead to the control unit and remove the covering cabinet.

(1) To do this, release the director and target light switches by removing the ringlike nuts that support them in the metal plate, and remove escutcheon plates; then release the switch supporting plate by removing four screws that support it in the cabinet (fig. 3). Allow the switches to drop into the director.

(2) Remove the hexagonal nut from the firing switch and then the two screws holding the escutcheon in place (fig. 5). With these removed, take out the four supporting screws and allow the firing switch to fall inside the cabinet.

(3) Remove both handwheels.

(4) Remove the chart. Push the chart carriage into the cabinet while holding the pinion release lever to the left. With the carriage in the cabinet, drop the carriage chain into the cabinet through the slot. Unscrew the pinion release lever handle.

(5) Remove the four screws, which hold the cabinet to the director base. Lift the covering cabinet off the director mechanism from either side. Be careful not to injure the range setting dial. By watching the dial and back end of the director, it will be possible to guide the movement of the covering cabinet as it is removed so as to avoid damage to any of the director parts.

d. With the cover removed, clean off all excessive oil and dust with a clean wiping cloth. Particular attention should be given to the electrical parts to be sure that they are free of oil. The timing disk should have only a light film of engine oil on it so as to permit

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free movement for the movable lobes. The accumulation of excessive oil and dust may cause the lobes to be sluggish in their movement.

e. While the cover is removed for cleaning, it is desirable to check tightness of the various screws and nuts to be sure that they are tight, and to lubricate all the points requiring lubrication (figs. 41 and 42).

f. To reassemble the director, the cabinet, and the accessory parts, reverse the steps taken to remove the parts. In setting the director cover in position, work from one side and watch that the range dial is not injured during this operation.

20. PRECAUTIONS.

a. Be sure that the power source to which the Director Trainer M8 is connected is for 110-v, 60-cycle operation, unless the equipment has been provided with mechanism especially designed for some other frequency or voltage.

b. The lead wire which emerges from the rear of the tone arm of the record changer and goes down through the metal base plate, must be so placed in the panel, that it will not restrict the free movement of the tone arm across the record. It is important that the wire be free and loose at all times. Do not attempt to push the excess wire through the panel.

c. Do not run the director if the movable lobes of the timing disk are not centrally located in the slots as they enter the firing zone. The movable lobes are mechanically centered in the slots, as the disk passes a point directly behind the movable contact worm. Unless the lobes are disturbed by hand or in shipping, they will be in proper position when they complete the half turn to the firing zone, which is immediately in front of the range disk. In order to be sure that the lobes are in the correct position, drop the door on the right side of the director and inspect them before initial operation of the director. The movable lobes on the left side of the firing disk, as viewed from the range setter's position, or on the half of the timing disk farthest away from the inspector, as he stands in front of the opened side at the right of the director, must be centrally located in the slots.

d. Use care in inserting the director chart. The metal channel binding must be at the bottom. The time channel must face toward the back of the director, and engage the time-delay roller (figs. 19 and 27). Failure to engage the roller properly will cause the carriage to jam. Hold the bottom edge of the chart as nearly horizontal as possible while placing it in position.

e. Keep all nuts and screws on the mechanism tight.

f. Always have the switch control knob of the record changer in the "MANUAL" position when the tone arm is moved manually. Failure to do this will injure the tone arm mechanism.

Section VII

EASILY RECOGNIZED SYMPTOMS OF TROUBLE

	Paragraph
Sound equipment.....	21
Director	22
Target	23

NOTE: Any repairs requiring disassembly of major parts should be performed only under the supervision of competent personnel.

21. SOUND EQUIPMENT.

a. Failure of the battle sound to be reproduced when the proper connections have been made and the switches turned on may be due to improper location of the amplifier tubes. Figure 13 designates the correct position of each tube.

b. Noisy reproduction in the battle reproducing unit may indicate that record is badly worn. A poor tone may be evidence of a worn needle.

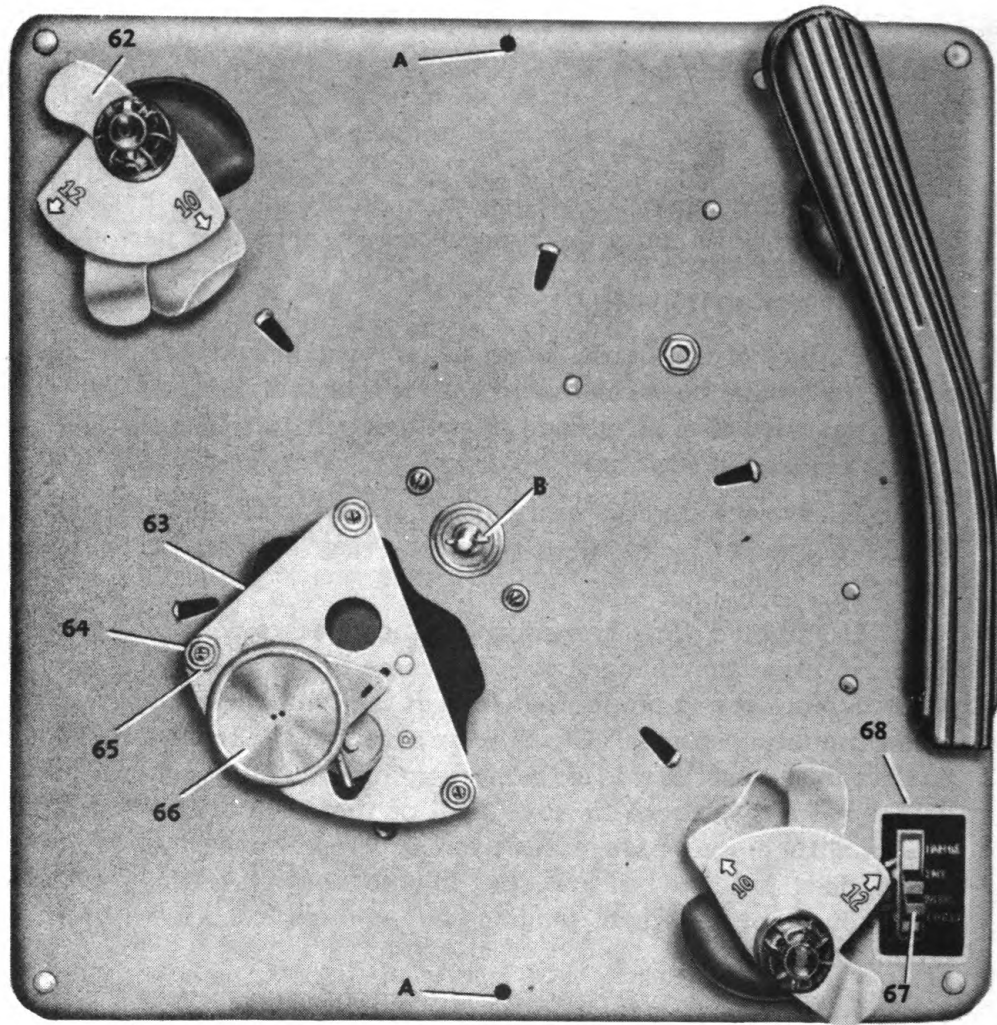
c. If troubled with howl, inspect the under side of the panel to make sure that the changer does not come into contact with any part of the cabinet at any point other than at the four corners where it rests on the mounting springs. Check to be sure that the studs, (14, fig. 47), do not rub against the side of the holes in the cabinet panel. Inspect all four mounting springs. If any or all of them are drawn too tightly, loosening them may reduce this trouble. Any phonograph equipment which does not howl below the volume control settings at which distortion appears when playing an average record will operate satisfactorily.

d. If rumble occurs, remove the turntable and inspect the rubber rimmed motor idler pulley (66, fig. 45) for flat or worn spots which would tend to jar the turntable. With the turntable removed, rotate the turntable spindle to be sure that it turns smoothly.

e. If "wow" or "speed-variation" occurs, remove the turntable and rotate the turntable spindle (40, fig. 40) with the fingers to determine whether it tends to bind. High friction at this point may be sufficient to cause the motor to slow down instantaneously. Apply only a drop or two of OIL, engine, SAE 10, to the two spindle bearings. If the turntable shaft is bent to such an extent that replacement is necessary, the entire spindle and pinion gear assembly (39, fig. 40, and fig. 46) should be replaced, instead of replacing only the spindle. This spindle and pinion gear assembly (fig. 46) is fitted with precision machines at the factory, thus insuring proper clearances and smooth operation.

f. If repeated tripping occurs, turn off the changer during a change cycle so that the clutch engagement lever (41, fig. 40) may be

DIRECTOR TRAINER M8



ITEM NO.	DESCRIPTION
62	12" SELECTOR BLADE
63	MOTOR ASSEMBLY
64	MOTOR MOUNTING BUSHINGS
65	MOTOR GROMMET
66	MOTOR IDLER PULLEY
67	SWITCH CONTROL KNOB
68	CONTROL ESCUTCHEON

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Figure 45 — Record Changer Disassembled — Top View and Parts List

EASILY RECOGNIZED SYMPTOMS OF TROUBLE

moved up and down with the finger. This clutch engagement lever should lock in the "UP" position due to its engagement with the trip lever (44, fig. 40) at the point "M." If this engagement is not positive, inspect the bearing point of the trip lever (44, fig. 40) for evidences of dirt or binding. A more positive engagement may be obtained by strengthening the spring (50, fig. 40). This spring tension must be *just sufficient* to lock the clutch engagement lever in the "UP" position. Excessive tension of the spring will result in failure to trip.

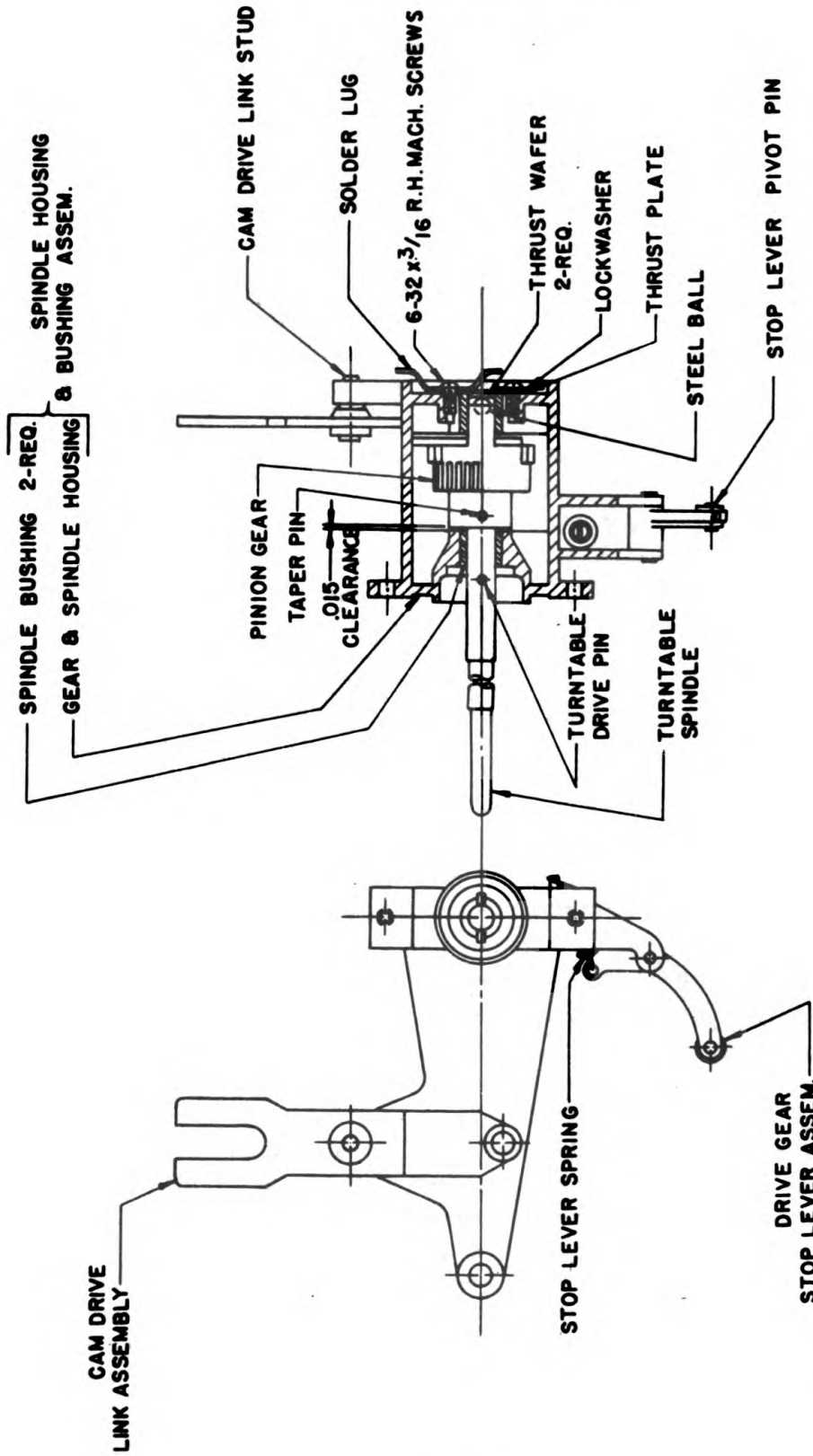
g. Repeated tripping may also be due to the fact that the switch knob does not return to the "AUTOMATIC" position when released. This condition can result from binding of the roller lever on its bearing (6, fig. 47), insufficient tension in the spring (9, fig. 47), or excessive friction or binding in the motion of the control lever (36, fig. 40).

h. If the record changer fails to trip, turn off the changer during a change cycle so that the clutch engagement lever (41, fig. 40) may be actuated with the finger. Hold the trip lever away so that the engagement lever does not lock in the "UP" position. The clutch engagement lever must not stick in the "UP" position due to binding at any point. **CAUTION:** It is not advisable to use any lubricant at the bearing point of the clutch engagement lever (51, fig. 40); this bearing is intended to be a close fit, run dry, and operate by gravity. Excessive pressure on the spring would tend to make the needle jump out of the cut-off groove of the record (subparagraph f, above) and prevent tripping. The shielded pick-up lead wire (22, fig. 40) must have sufficient slack between the tone arm and the point where the tone arm lead enters the subpanel to permit free sidewise movement of the tone arm. The shielded lead should be so positioned that it loosely rests near the tone arm post immediately below the point at which it leaves the tone arm bracket. Under no circumstances should the shielded wire be fastened in place, or pulled taut, restricting free tone arm movement.

i. If there is insufficient power to complete a change cycle, inspect the bearing of the main drive gear (1, fig. 47) for excessive friction or binding. Inspect the selector arm bearings for excessive friction or binding.

j. If the mechanism should jam at any time during a change cycle for some reason other than jamming of the selector arms with the records being changed, remove the records and attempt to free the machine by rotating the turntable in a reverse direction through one-quarter turn. If the jam is apparently cleared by such action, the machine should be checked by operating it automatically several times, without records. If the jam does not clear, inspect the under side of the changer panel for damaged or missing parts. Inspect the meshing of the drive gear (1, fig. 47) with the pinion gear (11, fig. 47). If the two gears do not mesh (that is, if they are not so timed as to fit together

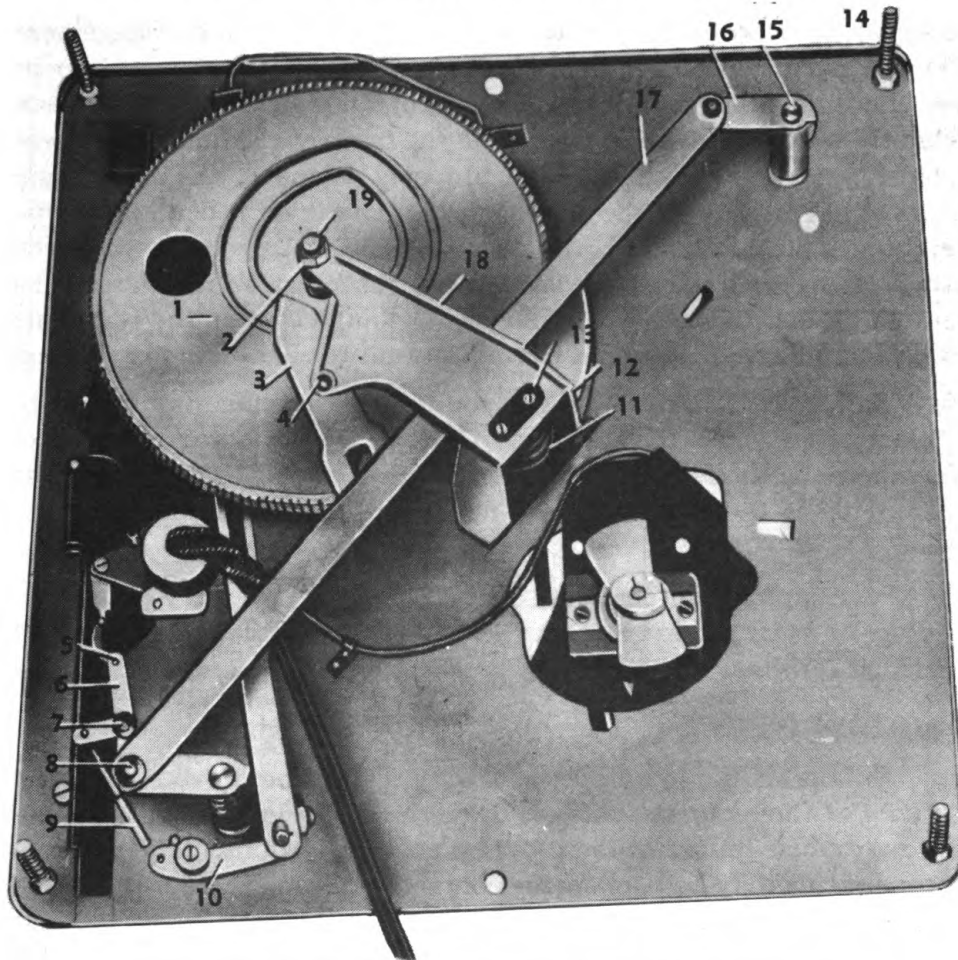
DIRECTOR TRAINER M8



RA PD 80312

Figure 46 — Spindle and Housing Assembly

EASILY RECOGNIZED SYMPTOMS OF TROUBLE



ITEM NO.	DESCRIPTION
1	DRIVE GEAR ASSEMBLY
2	FIBER THRUST WASHER
3	CAM DRIVE LINK ASSEMBLY *
4	CAM DRIVE LINK STUD *
5	ROLLER
6	ROLLER LEVER ASSEMBLY
7	1/8" SNAP WASHER
8	3/16" SNAP WASHER
9	ROLLER LEVER & 12" SET ARM SPR.
10	12" RESET ARM ASSEMBLY
11	PINION GEAR *
12	STOP LEVER SPRING *
13	THRUST PLATE *
14	PANEL MOUNTING STUD
15	SELECTOR SHAFT ASSEMBLY
16	DRIVE CRANK ASSEMBLY
17	DRIVE LINK ASSEMBLY
18	SPINDLE HOUSING & BUSHING ASSEM. *
19	DRIVE GEAR SHAFT

(*) SEE FIG. 54 FOR DETAIL ASSEM.

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Figure 47 – Changer Mechanism – Under Side View and Parts List

DIRECTOR TRAINER M8

properly), it is probably due to the fact that the clutch engagement lever (41, fig. 40) has been damaged or bent. This clutch engagement lever should contact one of the *lower projections* on the pinion gear, so that the teeth of this pinion gear and the teeth of the main drive gear (1, fig. 47) are timed to fit together properly whenever the mechanism starts a change cycle. If the clutch engagement lever is bent, it may be straightened until, by trial, the two gears mesh properly when the changer is tripped. It is advisable that the changer mechanism be operated by hand so that this timing or meshing between the two gears can be more closely observed during any adjustments or inspections.

k. Failure of the simulated gun sound to be audible may be due to a broken voice coil in the speaker. Extreme distortion or poor reproduction may be the result of a broken speaker cone. In the event that either of these difficulties occurs, notify ordnance maintenance personnel.

l. Poor impulse switch spring contact with the periphery of the timing disk, as outlined in paragraph 23 a, may cause poor simulated gun sound.

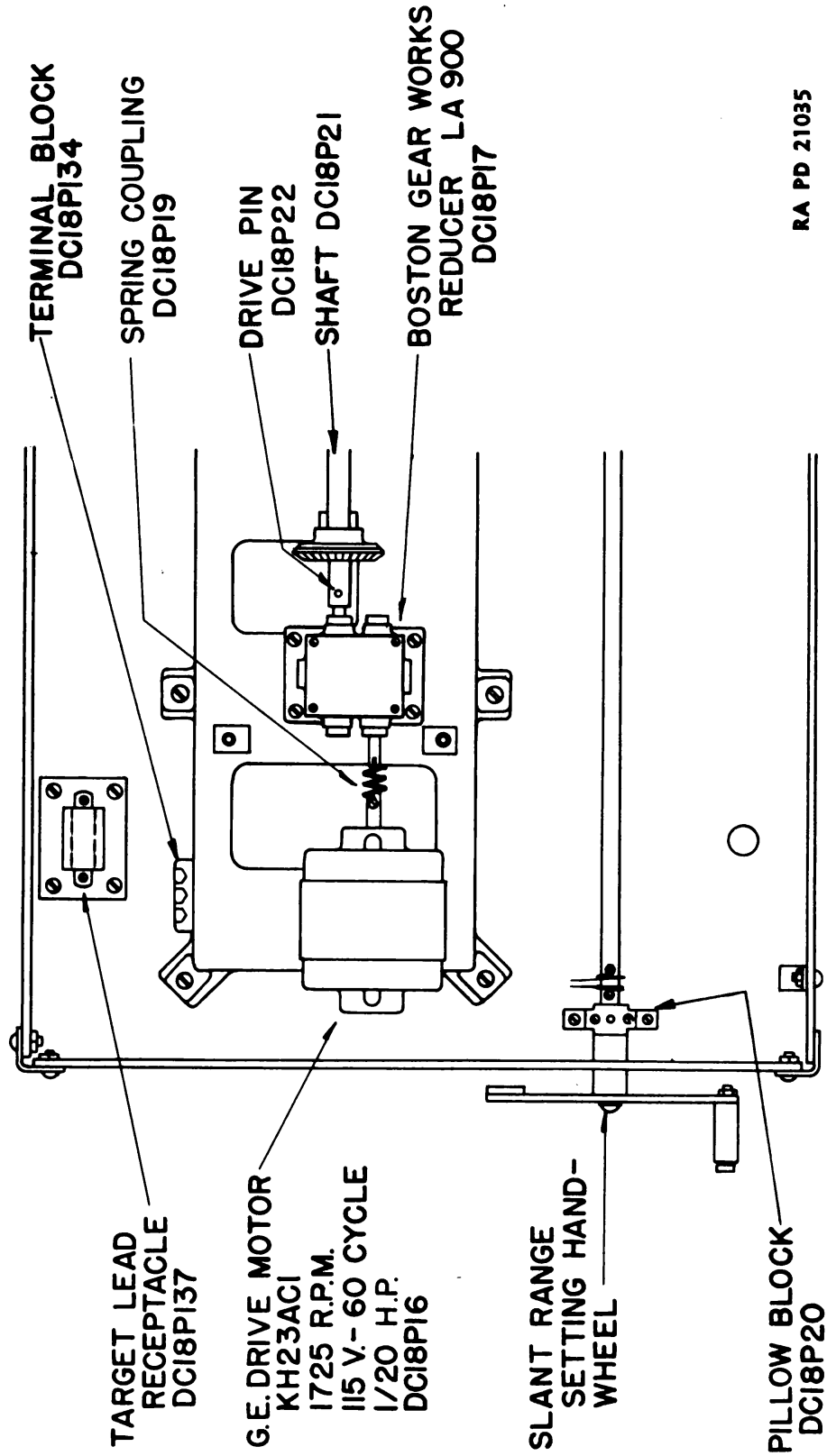
22. DIRECTOR.

a. Failure of the lobes on the timing disk to be moved to the extremities of the slots as shots are fired and the electromagnets energized may cause failure of the proper tracer indications. The cause of improper firing may be poor spring contact between the impulse switch spring and the periphery of the timing disk (fig. 17).

b. If the mechanism fails to operate when the firing switch is turned on, the difficulty may be due to the sharing of a pin in the gear reducer, or gear reducer spring coupling. To check this, open the side door and see if the driving motor is running while the other parts are not operating. This is definite proof that a pin has been sheared, or the coupling between the motor and the gear reducer has been broken. If the coupling is broken, it is a simple matter to remove it and slip a new coupling in its place. If a pin has been sheared, it will most likely be in the coupling between the gear reducer and the time-delay mechanism. In such a case, simply replace the broken drive pin. In case a pin has been sheared inside the gear reducer, notify ordnance maintenance personnel.

c. Shearing of a pin in the gear box was probably caused by the careless insertion of a chart in the chart carriage. Care must be taken to be sure the chart time-delay channel roller does not get caught outside the channel (fig. 27). Another possible source of trouble may be the jamming of one of the electromagnet levers against one of the movable lobes. This might be due to a movable lobe reaching the firing position in some location other than centered in the slot.

EASILY RECOGNIZED SYMPTOMS OF TROUBLE



RA PD 21035

Figure 48 — Motor and Gear Reducer Mounted Below Timing Disk

DIRECTOR TRAINER M8

The timing disk should be inspected to be sure that all movable lobes, on the left as viewed from the range setter's position behind the director, are centered in the timing disk slots, and that they remain in position against the normal vibration of the machine in action. Ordinarily, the chart time-delay channel roller, and the movable timing disk lobes, will not get out of position so as to cause jamming unless disturbed either by hand when oiling or through vibration in shipping.

d. Poor lighting of the range setter's dial may be due to one of the dial lights having burned out. Replace it through the door on the right side of the director, with a 7-watt bulb. Lack of light for viewing the chart through the instructor's window may be due to the light in the front of the director cabinet having burned out. It may also be replaced with a 7-watt bulb, through the door.

23. TARGET.

a. When the target light switch is snapped to the "ON" position on the director, the main target flood lights should be lighted. In the event that any of these are not lighted, it is probably due to their having burned out. If this has happened, replace them. The flood light bulb can be any standard bulb desired. A 25-watt tubular, flame colored bulb is furnished. Oil and dirt accumulated on the slip rings may prove sufficient insulation to prevent a pair of the tracer lamps from lighting. If a pair of lamps is out, clean the slip ring and contact with a piece of PAPER, flint, class B, No. 00, to make sure that the electrical contact is adequate before deciding that the lamps are burned out. The middle pair or hit-shot tracers are an exception to this condition. The bulb at the left on this group is normally "OFF."

b. Any burned out lights in the tracer stream mechanism should be replaced with a 2.2-v pencil-type, flashlight bulb. In order to remove one of the tracer stream lights, disconnect the wire from under the screw on the slip ring, and slip the lamp from its supporting clip. The new lamp assembly is replaced by reversing this action.

c. If during the operation of the director the short-shot or over-shot electromagnets in the target fail to operate, it may be that the switches on the time-delay mechanism are not operating correctly or that one of the electromagnets that releases the dogs on the tracer stream mechanism has burned out. First, inspect the switch mechanism on the director to be sure that it is not the cause of the difficulty. With the director in operation, note if the movable lobes produce sufficient interference with the leaf springs on the micro-switches to cause the micro-switches to click to the "ON" position. If this does not take place, make suitable adjustment in the defective switch spring, or correct the position of the movable lobes so that they produce the proper engagement. If the movable lobe is not being set

STORAGE AND SHIPMENT

in the proper position to engage the leaf spring of the particular micro-switch concerned, check the adjustment of the electromagnet (fig. 22). Be sure it is properly adjusted, either forward or backward, to provide the proper movement. Poor adjustment of the electromagnet may locate the movable lobe in such a position that it will pass between two of the three micro-switch springs rather than under them. Check the condition of the electromagnet lever; also replace if it is badly worn (fig. 21).

d. If the explosion light in the airplane fails to light on hit-shots, it may be due either to poor operation of the contact on the center slip ring, or because the light in the airplane has burned out. If after inspection and correction of any distortion and the removal of any accumulated dirt and corrosion, the difficulty is not cured, replace the bulb. It will be necessary to disconnect the single wire leading from the airplane up to the electromagnet support, at the joint, near the electromagnet support to make the replacement. Loosen the set screw in the collar which clamps the airplane lamp and bottom together on the support wire and lift the collar and the airplane up the support wire. The explosion lamp may then be readily removed from the bottom of the airplane. If a bulb with a lead wire attached is not available, it will be necessary to disconnect the lead wire from the base of the old bulb and solder it to a new bulb. In soldering to the light bulb base, use a minimum of heat in order to produce as little disturbance as possible in the lamp assembly. Replace the mechanism by reversing the order of operations. After relocating the target airplane, the mechanism should be checked to be sure that the airplane is set at the proper angle. To do this, insert chart No. 1 in the director, and pull it out to the initial stop while releasing the pinion gear with the pinion release lever. Release pinion release handle. Snap the firing switch to the "ON" position and watch the chart as it passes into the director cabinet. At the time the moveable contact is on the midpoint of the target path, which is indicated by the low point in the slant range chart, check the target airplane to be sure that the wings are parallel to the line of vision of the range setter, as viewed from his position behind the director. Make any necessary angular correction in the initial position of the airplane.

Section VIII

STORAGE AND SHIPMENT

Handling and storage Paragraph 24

24. HANDLING AND STORAGE.

a. If it should be necessary to move the equipment after it has been set up for use, it should be separated into units similar to the

DIRECTOR TRAINER M8

manner in which it was broken down when received. If the distance in which it is moved is slight, that is, within the same building, this may not be necessary. If the distance is great, it should, of course, be crated. In preparing for a distant move, or for crating, the sound equipment should be separated into the control unit, the speaker unit, and the supporting members, as outlined under uncrating. The supports under the control unit must be released at the back ends, and rotated until they are parallel with the side walls of the cabinet. In this position, the speaker may be set on end so that the rear end is resting on the control unit supports. The bolts taken from the back of the control unit base are to be used to bolt the speaker unit through holes, which were provided for the original packing. The uprights that were mounted on the back of the control cabinet should be used to tie the top of the control cabinet and speaker unit together, utilizing the bolts that were used for the assembly of the units. A dowel pin in either side of the top end of the speaker is provided to cooperate with suitable holes in the uprights and will act as a guide for locating and fastening the uprights across the top by means of the holes utilized in the original shipment of the parts.

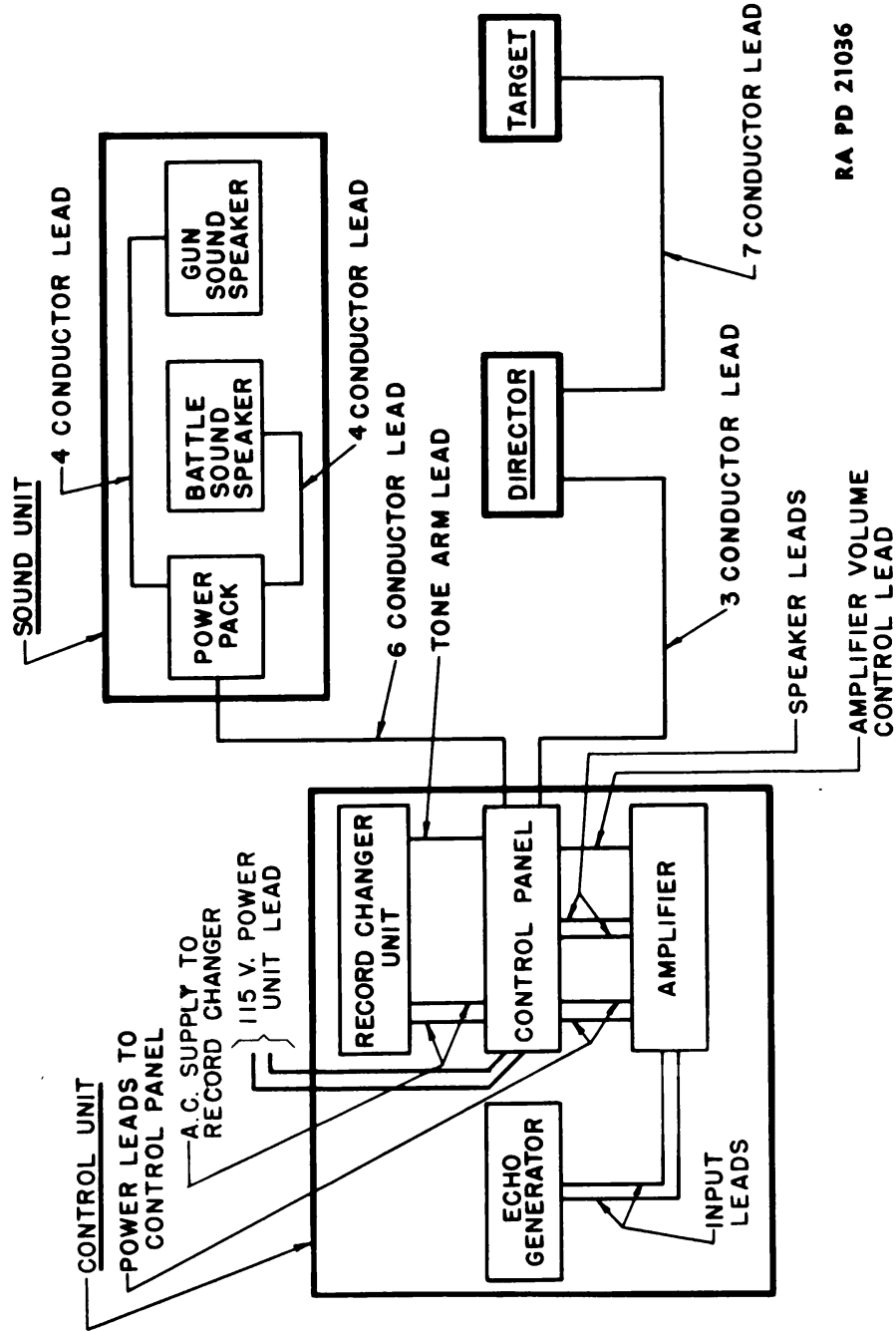
b. The director should be removed from the tripod and crated with the handwheels removed. The target should be lifted from its base and the target airplane removed by loosening the set screw in the supporting sleeve. The director base and target base can be dismantled into individual pieces by removing the bolts. The charts should be packed in the storage crate and protected against damage in moving.

c. In the event that the equipment is to be stored, the unfinished metal parts should be cleaned with SOLVENT, dry-cleaning, and coated with COMPOUND, rust-preventive, light, and the equipment stored in a dry place. It is particularly important that the moving parts in the interior of the director and in the target tracer mechanism be protected against rust. The various elements should be covered with a tarpaulin, or wrapped and crated to prevent dust and grit from accumulating on the mechanism. Weekly inspection should be made if possible and the rust preventive renewed if necessary.

d. Before the equipment is again returned to service, completely remove the COMPOUND, rust preventive, light, with SOLVENT, dry-cleaning, and then lubricate the various units.

e. Gear cases should be drained and refilled, and all bearings oiled, both before and after being stored.

WIRING DIAGRAMS



RA PD 21036

Figure 49 — Director Trainer M8 — Schematic Wiring Diagram

DIRECTOR TRAINER M8

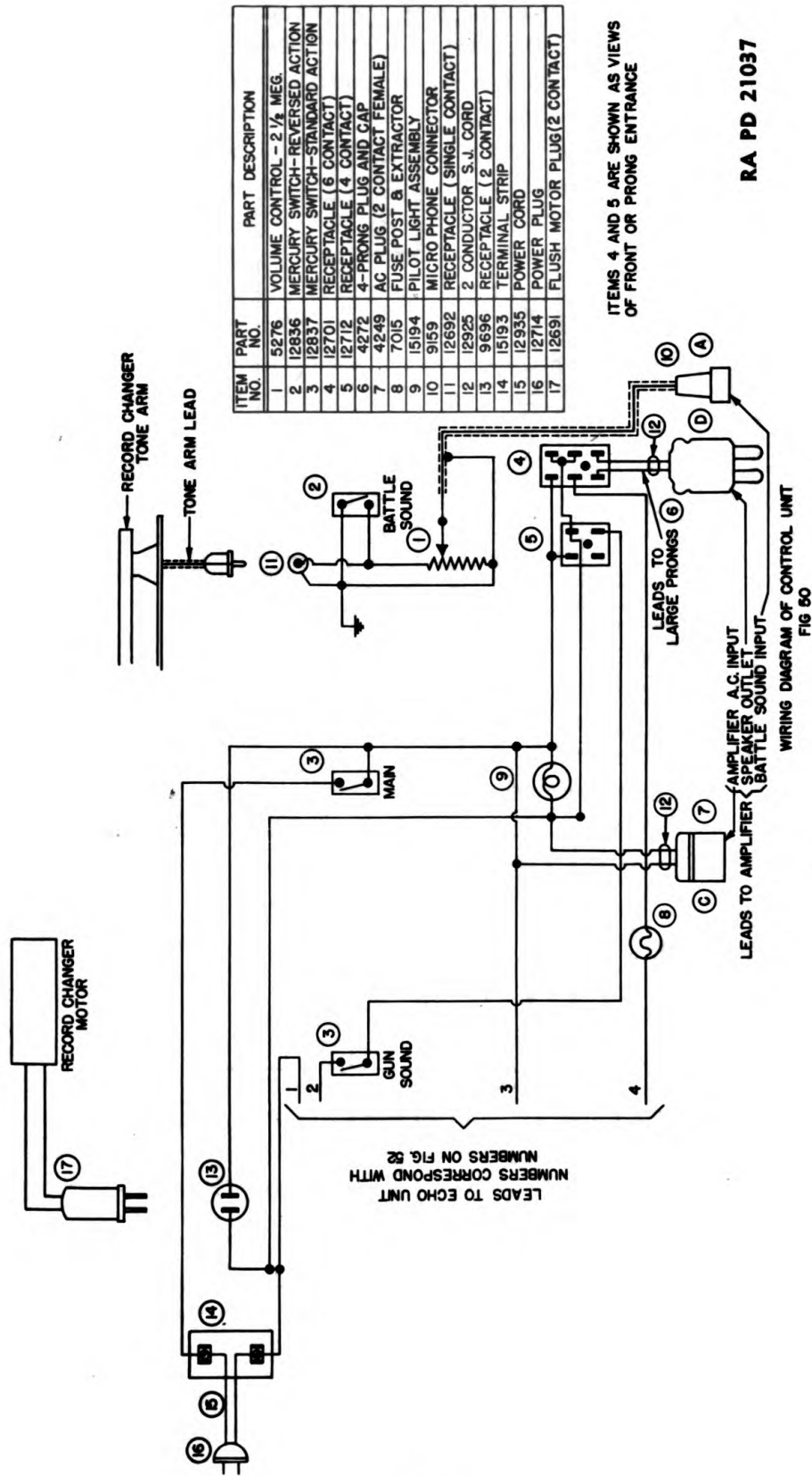


Figure 50 - Control Unit - Wiring Diagram

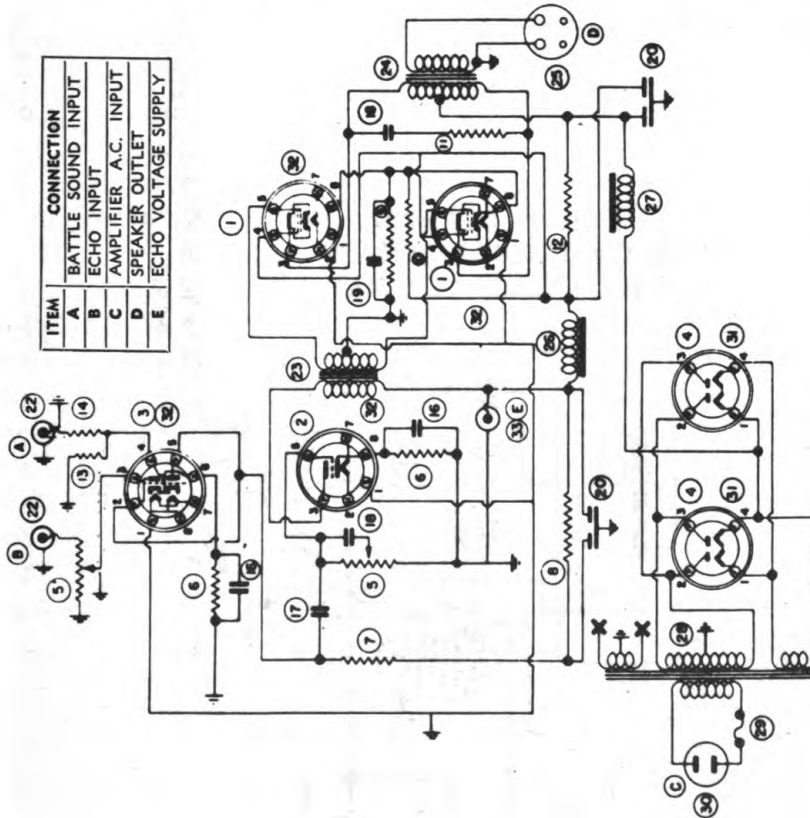
WIRING DIAGRAMS

TUBES	
ITEM NO.	PART NO.
1	6LG-G
2	6J5-GT
3	6SC7
4	5Z3

RESISTORS		
ITEM NO.	SIZE IN OHMS	DESCRIPTION
5	POTENTIOMETER 100,000	1/2 WATT INSULATED
6	1,000	1 WATT INSULATED
7	150,000	1 WATT NON-INSULATED
8	10,000	20 WATT
9	125	40 WATT
10	5,000	10 WATT
11	10,000	20 WATT
12	1,600	1/2 WATT INSULATED
13	150,000	1/2 WATT INSULATED
14	1 MEG	1/2 WATT INSULATED

CONDENSERS	
ITEM NO.	DESCRIPTION
16	20 MFD. — 25V
17	.01 MFD. — 400V
18	.005 MFD. — 600V
19	20 MFD. — 150V
20	20-20 MFD. — 450V

MISC. PARTS	
ITEM NO.	DESCRIPTION
22	INPUT RECEPTACLE
23	DRIVER TRANSFORMER
24	OUTPUT TRANSFORMER
25	SPEAKER RECEPTACLE
26	CHOKE
27	CHOKE
28	POWER TRANSFORMER
29	3-AMPERE FUSE
30	A.C. RECEPTACLE
31	4 CONTACT TUBE SOCKET (PLAIN)
32	6 CONTACT OCTAL SOCKET (PLAIN)
33	RECEPTACLE



RA PD 80316

Figure 51 — Amplifier Unit — Wiring Diagram

DIRECTOR TRAINER M8

ITEM NO.	PART DESCRIPTION
1	CONDENSER - 12 MFD. 600 VOLTS
2	RELAY (D.P.S.T.) 110 V.-A.C. COIL
3	TRANSFORMER
4	"ECHO" MOTOR UNIT
5	MICROPHONE CONNECTOR
6	SINGLE CONTACT PLUG
7	RESISTOR 50,000 OHMS 1W INSULATED
8	RESISTOR 150,000 OHMS 1W
9	RESISTOR 250,000 OHMS 1W
10	CONDENSER .5MFD. 600 VOLTS

NOTE:
VALUES SHOWN ARE THE
COLD RESISTANCES IN
OHMS EXCEPT AS OTHERWISE
SPECIFIED. THESE ARE
MEAN VALUES, HENCE WILL
VARY SLIGHTLY.

RA PD 21039

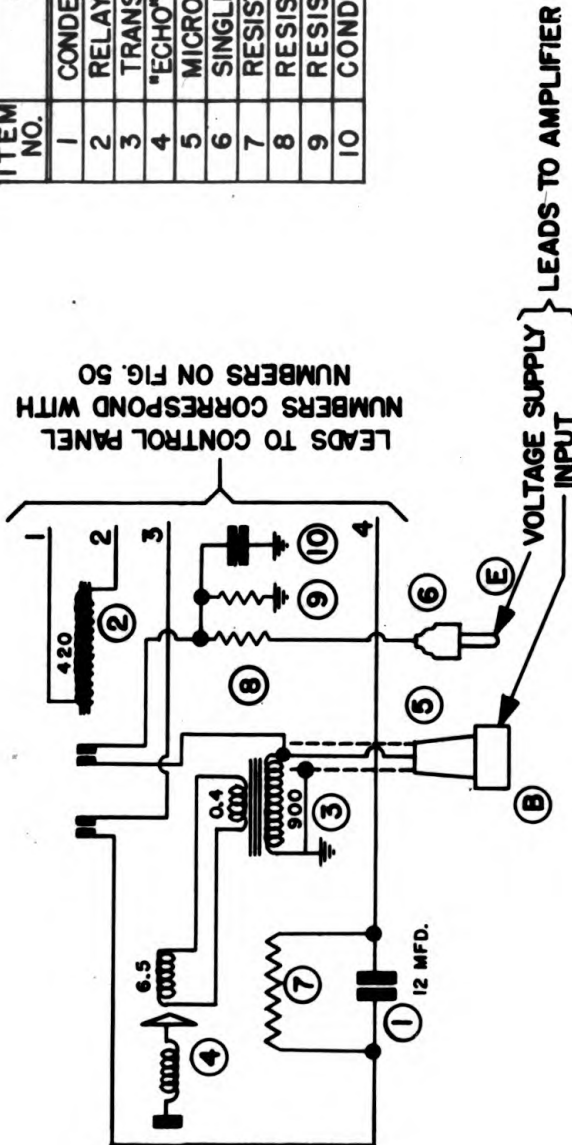
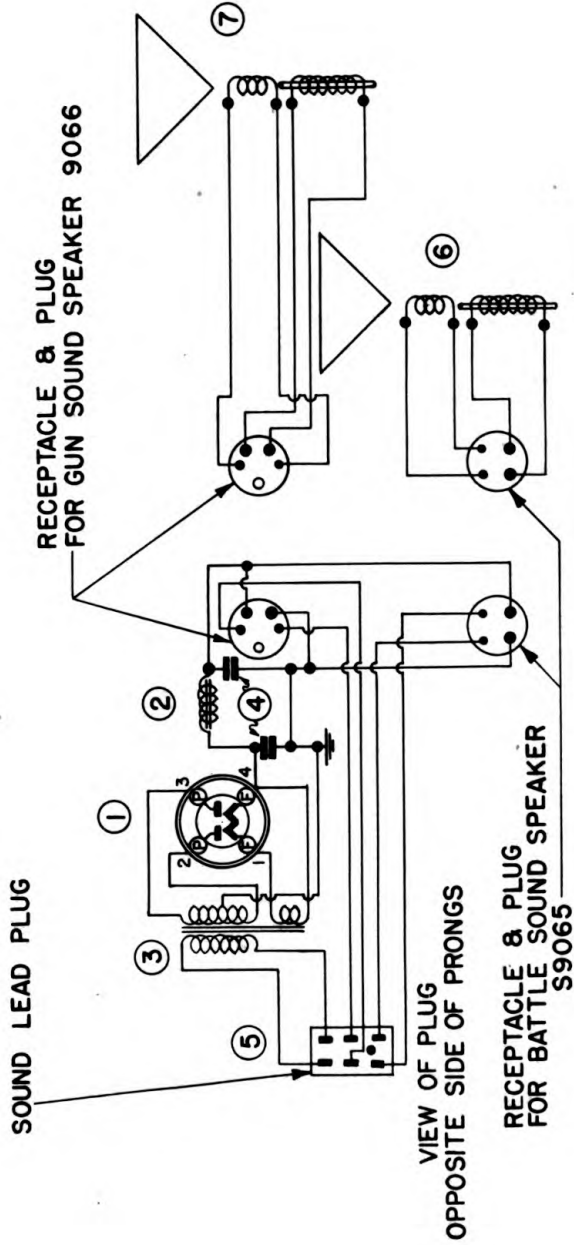


Figure 52 — Explosion Sound or Echo Unit — Wiring Diagram

WIRING DIAGRAMS



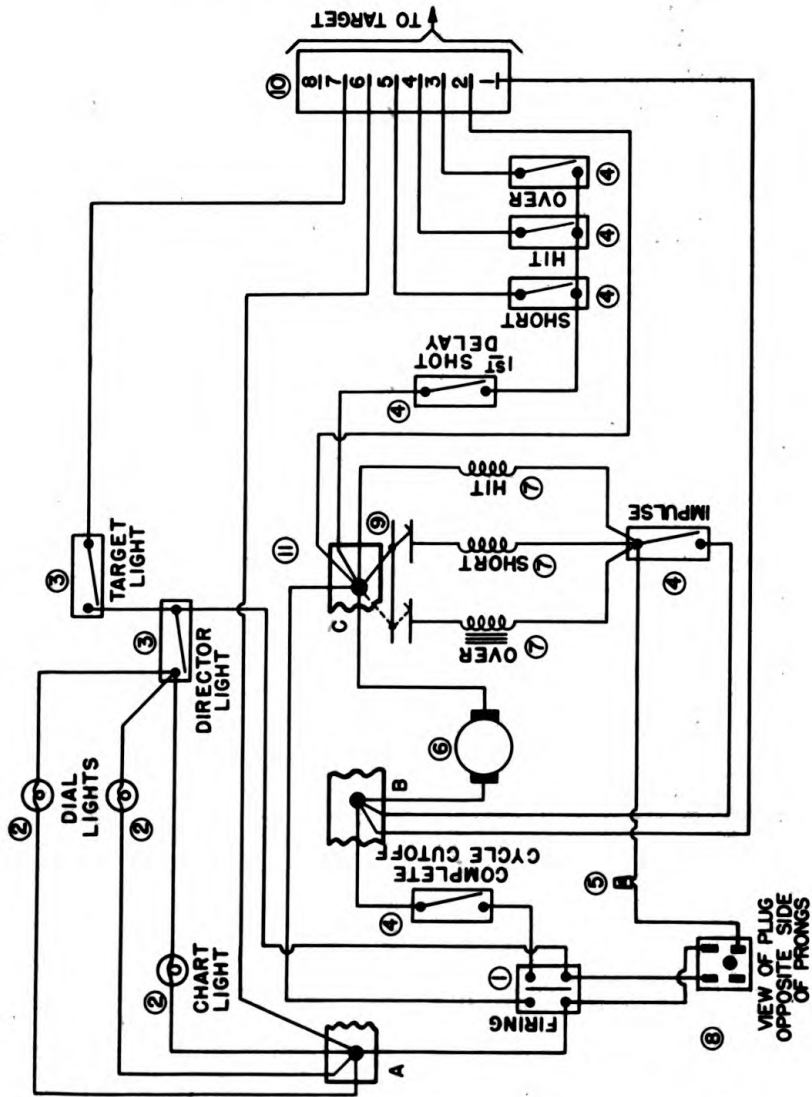
ITEM NO.	PART NO.	PART DESCRIPTION
1	5Z3	RECTIFIER TUBE
2	3799-A	CHOKE
3	6713	POWER TRANSFORMER
4	10734	CONDENSER 20 MFD. 500 V.
5	12702	6 PRONG PLUG
6	11517	CONE HOUSING ASSEMBLY
7	11515	CONE HOUSING ASSEMBLY

RA PD 21040

Figure 53 — Sound Cabinet Including Power Supply Unit — Wiring Diagram

DIRECTOR TRAINER M8

ITEM NO.	PART NO.	PART DESCRIPTION
1	IOSWI9	TOGGLE SWITCH
2	RBI4P88	CANDELABRA SCREW BASE
3	DCIBPI40	TOGGLE SWITCH
4	DCIBP55	MICROSWITCH
5	Y79P29	CONNECTOR
6	DCIBPI6	MOTOR
7	DCIBP382	ELECTROMAGNET
8	DCI6PI24	PLUG
9	DCIBPI46	PIG TAIL
10	DCIBPI37	HEAVY DUTY SOCKET
11	DCIBPI34	TERMINAL BLOCK ASSEMBLY



RA PD 21041

Figure 54 — Director — Wiring Diagram

WIRING DIAGRAMS

RA PD 21042

ITEM NO.	PART NO.	PART DESCRIPTION
1	DC18P395	HEAVY DUTY PLUG
2	DC18P401	TERMINAL BLOCKS
3	N52PI63	LAMP SOCKET
4	DC18PI06	ELECTROMAGNET
5	DC18P350	MOTOR AND SPEED REDUCER
6	DC18P382	ELECTROMAGNET
7	DC18P394	TRANSFORMER
8	DC18P392	LAMP I.I.V.
9	Y79P29	CONNECTOR
10	DC18P325	INSULATOR AND CONTACT ASSEMBLY
11	DC18P321	INSULATOR AND CONTACT ASSEMBLY

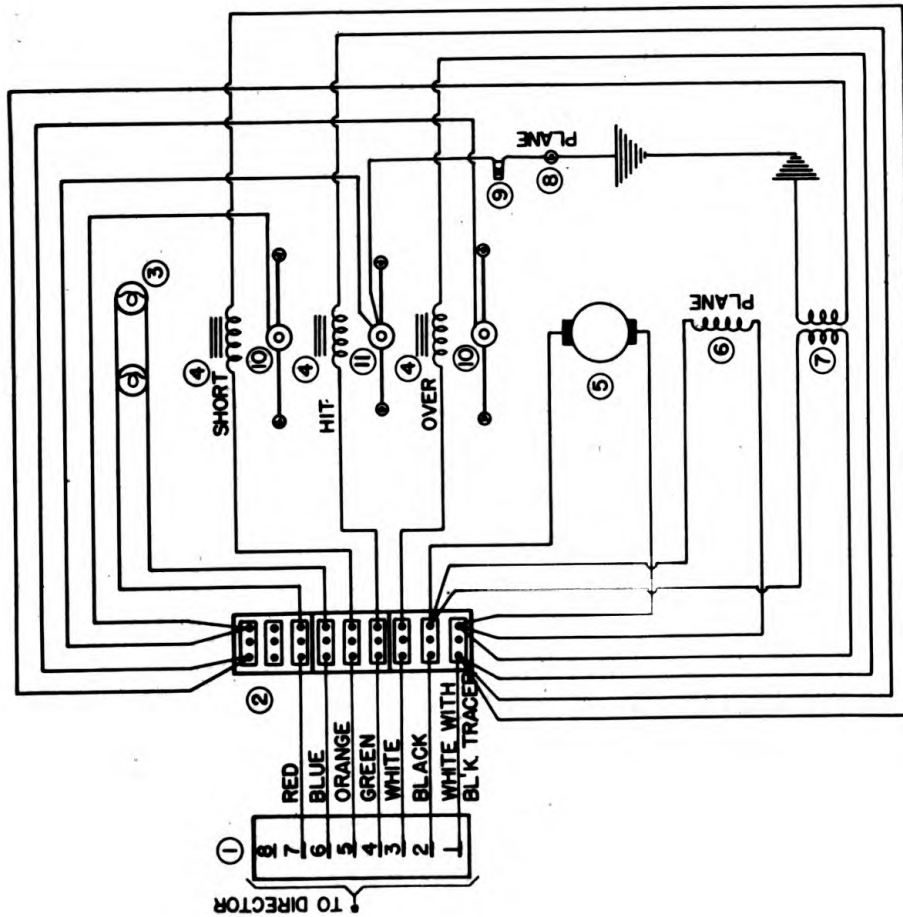


Figure 55 — Target — Wiring Diagram

DIRECTOR TRAINER M8

Section IX

REFERENCES

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25. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this section and for new publications relating to materiel covered in this manual:

- a. Introduction to Ordnance Catalog (explaining SNL system) ASF Cat.
ORD 1 IOC
- b. Ordnance Publications for Supply Index (index to SNL's) ASF Cat.
ORD 2 OPSI
- c. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, OPSR, MWO's, BSD, S of SR's, OSSC's, and OFSB's, and includes Alphabetical Listing of Major Items with Publications Pertaining Thereto) OFSB 1-1
- d. List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's concerning training) FM 21-6
- e. List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject) FM 21-7
- f. Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays) FM 21-8

26. STANDARD NOMENCLATURE LISTS.

- a. Director, A.A., M5 (for 37-mm and 40-mm A.A. gun carriages) SNL F-209
- b. Director, A.A., M5A1 (for 37-mm and 40-mm A.A. gun carriages) SNL F-209
- c. Director, A.A., M6 (British) SNL F-209
- d. Trainer, director, M8 (for directors M5 and M5A1) SNL F-250

27. EXPLANATORY PUBLICATIONS.

- a. Directors M5A1, M5, and M6 TM 9-659

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