RESTRICTED

Ser. No. 1589

INSTRUCTION BOOK FOR
NAVY MODEL TBW-4
PORTABLE RADIO TRANSMITTING EQUIPMENT
MANUFACTURED FOR U.S. NAVY DEPARTMENT
BUREAU OF SHIPS
CONTRACT NXsa-19329
WESTINGHOUSE ELECTRIC & MFG. CO.
RADIO DIVISION BALTIMORE, MD.

CF-377

RESTRICTED

INSTRUCTION BOOK

FOR

NAVY MODEL TBW-4

Portable Radio Transmitting Equipment

FREQUENCY RANGE

I.F.	H.F.
350 to 1000 Kcs.	3000 to 18100 Kcs.

TYPES OF EMISSION

C.W. Telegraphy (A-1) - M.C.W. Telegraphy (A-2) - Telephony (A-3)

POWER OUTPUT RATING

C.W. and M.C.W. -- 350 to 1000 and 3000 to 18100 Kcs. - 100 Watts
Telephony -- 350 to 1000 and 3000 to 18100 Kcs. - 25 Watts

Manufactured for U. S. Navy Department

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By

Westinghouse Electric & Manufacturing Company
Radio Division Baltimore, Md.

CF-377

SPECIAL NOTE

In the preliminary instruction book for the Navy Model TBW-4 Portable Radio Transmitting Equipments, the following items have been omitted. They will, however, be included in the final instruction book.

1. All Photographs, Figures 1 to 24, incl.
2. Drawings, Figures 36, 49, 50, 51, 52 and 53.
3. Section IX Table III Parts List by Navy Type Numbers.

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This instruction book is furnished for the information of the commissioned, warranted, enlisted and civilian personnel of the Navy whose duties involve design, instruction, operation and installation of radio and sound equipment. The word "RESTRICTED" as applied to this instruction book signifies that this instruction book is to be used only by the above personnel, and that the contents of it should not be made known to persons not connected with the Navy.

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DICAL DEPARTMENT
ITED STATES NAVY

(DIVISION OF PREVENTIVE MEDICINE)
1942

E L E C T R I C S H O C K
FIRST-AID TREATMENT

FETY FIRST — REGARD ELECTRICAL APPARATUS GENERALLY, AND ESPECIALLY ALL CURRENT-CARRYING PARTS, AS DANGEROUS, IRRESPECTIVE OF VOLTAGE. EXERCISE GREAT CARE IN HANDLING, AND AVOID BROAD CONTACTS SUCH AS ARE MADE BY STANDING ON A METAL DECK OR IN WATER.

DANGEROUS CONTACT MAY RESULT THROUGH LESSENED RESISTANCE WHEN THE SKIN AND CLOTHING ARE WET WITH PERSPIRATION. CONTACT WITH DAMP METAL SURFACES - DECKS, BULKHEADS, GUNS, MACHINERY - MAY ALLOW THE CURRENT TO GROUND THROUGH THE MOIST SKIN AND BODY.

ELECTRIC SHOCK IS DUE TO CURRENT PASSING THROUGH THE BODY - CURRENT ACTUALLY PASSING - IRRESPECTIVE OF THE VOLTAGE. A PRESSURE AS LOW AS 110 VOLTS HAS CAUSED DEATH. CURRENT PASSING THROUGH THE BODY IN THE REGION OF THE HEART IS ESPECIALLY DANGEROUS. IN USING ELECTRIC BREAST DRILLS AVOID THE POSSIBILITY OF A GROUND.

USUALLY ELECTRIC SHOCK DOES NOT KILL INSTANTLY. LIFE CAN OFTEN BE SAVED EVEN THOUGH BREATHING HAS STOPPED.

FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY

USE A DRY NONCONDUCTOR (RUBBER GLOVES, CLOTHING, ROPE, BOARD) TO MOVE EITHER THE VICTIM OR THE WIRE. BEWARE OF USING METAL OR MOIST MATERIAL.

SHUT OFF THE CURRENT.

IF NECESSARY TO CUT A LIVE WIRE, USE AN AX OR HATCHET WITH A DRY WOODEN HANDLE; TURN YOUR FACE AWAY FROM THE ELECTRICAL FLASH.

. ATTEND INSTANTLY TO THE VICTIM'S BREATHING

BEGIN RESUSCITATION AT ONCE ON THE SPOT. DO NOT STOP TO LOOSEN CLOTHING; EVERY MOMENT COUNTS.

RESUSCITATION BY THE PRONE PRESSURE METHOD OF ARTIFICIAL RESPIRATION

GAS ASPHYXIATION — ELECTRIC SHOCK — DROWNING

WASTE NO TIME. WHEN THE PATIENT IS REMOVED FROM THE WATER, GAS, SMOKE, OR ELECTRIC CONTACT, GET WORK AT ONCE WITH YOUR OWN HANDS. SEND FOR THE MEDICAL OFFICER OR NEAREST PHYSICIAN.

NO RELIANCE SHOULD BE PLACED UPON ANY SPECIAL MECHANICAL APPARATUS, AS IT IS FREQUENTLY OUT OF DER AND OFTEN IS NOT AVAILABLE WHEN MOST NEEDED. THE PATIENT'S MOUTH SHOULD BE CLEARED OF ANY STRUCTION SUCH AS CHEWING GUM OR TOBACCO, FALSE TEETH, OR MUCUS, SO THAT THERE IS NO INTERFERENCE TH THE ENTRANCE AND ESCAPE OF AIR.

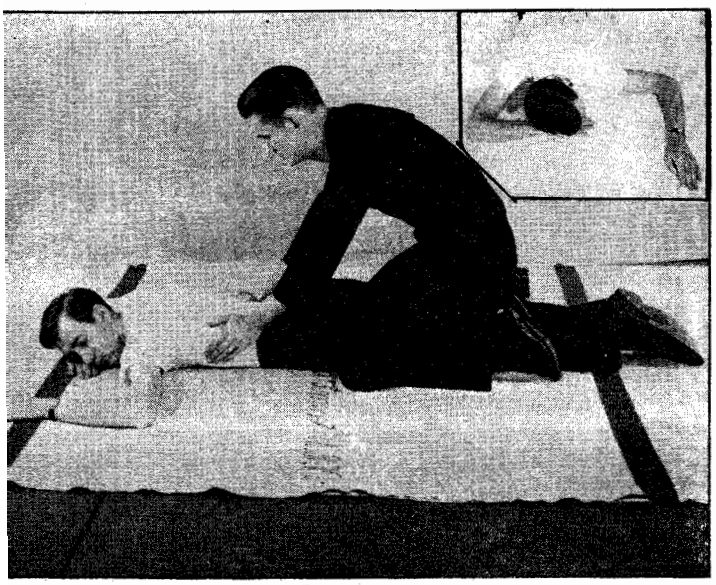

FIGURE 1

POSITION

1. LAY THE PATIENT ON HIS BELLY, ONE ARM EXTENDED DIRECTLY OVERHEAD, THE OTHER ARM BENT AT ELBOW AND WITH THE FACE TURNED OUTWARD AND RESTING ON HAND OR FOREARM, SO THAT THE NOSE AND MOUTH ARE FREE FOR BREATHING. (SEE INSET FIG. 1.)

2. KNEEL STRADDLING THE PATIENT'S THIGHS WITH YOUR KNEES PLACED AT SUCH A DISTANCE FROM THE HIP BONES AS WILL ALLOW YOU TO ASSUME THE POSITION SHOWN IN FIGURE 1.

PLACE THE PALMS OF THE HANDS ON THE SMALL OF THE BACK WITH FINGERS RESTING ON THE RIBS, THE LITTLE FINGER JUST TOUCHING THE LOWEST RIB, WITH THE THUMB AND FINGERS IN A NATURAL POSITION, AND THE TIPS OF THE FINGERS JUST OUT OF SIGHT (SEE FIG. 1.)

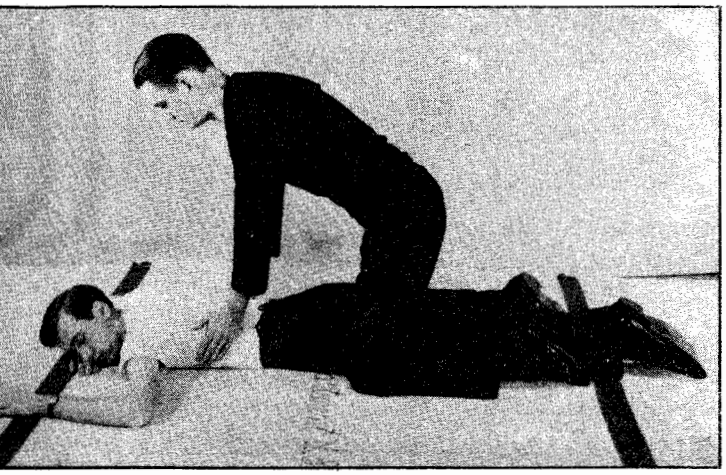

FIGURE 2

FIRST MOVEMENT

3. WITH ARMS HELD STRAIGHT, SWING FORWARD SLOWLY, SO THAT THE WEIGHT OF YOUR BODY IS GRADUALLY BROUGHT TO BEAR UPON THE PATIENT. THE SHOULDER SHOULD BE DIRECTLY OVER THE HEEL OF THE HAND AT THE END OF THE FORWARD SWING. (SEE FIG. 2.) DO NOT BEND YOUR ELBOWS. THIS OPERATION SHOULD TAKE ABOUT TWO SECONDS.

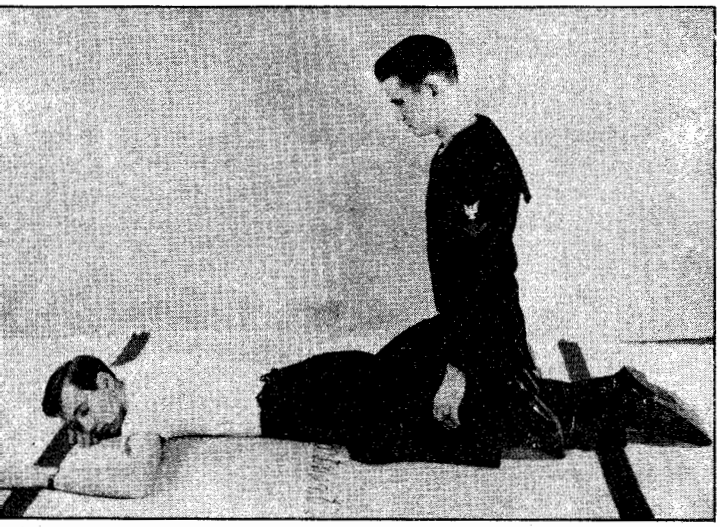

FIGURE 3

SECOND MOVEMENT

4. NOW IMMEDIATELY SWING BACKWARD, SO AS TO REMOVE THE PRESSURE COMPLETELY. (SEE FIG. 3.)

5. AFTER TWO SECONDS, SWING FORWARD AGAIN. THUS REPEAT DELIBERATELY TWELVE TO FIFTEEN TIMES A MINUTE THE DOUBLE MOVEMENT OF COMPRESSION AND RELEASE, A COMPLETE RESPIRATION IN FOUR OR FIVE SECONDS.

6. CONTINUE ARTIFICIAL RESPIRATION WITHOUT INTERRUPTION UNTIL NATURAL BREATHING IS RESTORED. NOT GET DISCOURAGED AT THE SLOW RESULTS THAT SOMETIMES HAPPEN WHEN RESUSCITATING THE APPARENTLY OWNED. EFFORTS OFTEN HAVE TO BE CONTINUED A LONG TIME BEFORE SIGNS OF LIFE ARE APPARENT. DO NOT SCONTINUE THE EFFORTS UNTIL CERTAIN THAT ALL CHANCE IS LOST. SOMETIMES, EVEN AFTER SEVERAL HOURS' RK, RECOVERY TAKES PLACE.

7. AS SOON AS THIS ARTIFICIAL RESPIRATION HAS BEEN STARTED AND WHILE IT IS BEING CONTINUED, AN SISTANT SHOULD LOOSEN ANY TIGHT CLOTHING ABOUT THE PATIENT'S NECK, CHEST, OR WAIST. TO KEEP THE TIENT WARM DURING ARTIFICIAL RESPIRATION IS MOST IMPORTANT AND IT MAY BE NECESSARY TO COVER HIM TH BLANKETS AND WORK THROUGH THEM, AS WELL AS TO APPLY HOT-WATER BOTTLES, HOT BRICKS, ETC. DO NOT VE ANY LIQUIDS WHATEVER BY MOUTH UNTIL THE PATIENT IS FULLY CONSCIOUS.

8. TO AVOID STRAIN ON THE HEART WHEN THE PATIENT REVIVES, HE SHOULD BE KEPT LYING DOWN AND NOT LOWED TO STAND OR SIT UP. IF THE DOCTOR HAS NOT ARRIVED BY THE TIME THE PATIENT HAS REVIVED, HE OULD BE GIVEN SOME STIMULANT, SUCH AS ONE TEASPOONFUL OF AROMATIC SPIRITS OF AMMONIA IN A SMALL ASS OF WATER OR A HOT DRINK OF COFFEE OR TEA, ETC. CONTINUE TO KEEP THE PATIENT WARM AND AT REST.

9. RESUSCITATION SHOULD BE CARRIED ON AT THE NEAREST POSSIBLE POINT TO WHERE THE PATIENT RE-IVED HIS INJURIES. AS A GENERAL RULE HE SHOULD NOT BE MOVED FROM THIS POINT UNTIL HE IS BREATHING RMALLY OF HIS OWN VOLITION AND THEN MOVED ONLY IN A LYING POSITION. SHOULD IT BE NECESSARY, DUE TO TREME WEATHER CONDITIONS, ETC., TO MOVE THE PATIENT BEFORE HE IS BREATHING NORMALLY, RESUSCITATION OULD BE CARRIED ON DURING THE TIME THAT HE IS BEING MOVED.

10. A BRIEF RETURN OF NATURAL RESPIRATION IS NOT A CERTAIN INDICATION FOR STOPPING THE RESUSCI-TION. NOT INFREQUENTLY THE PATIENT, AFTER A TEMPORARY RECOVERY OF RESPIRATION, STOPS BREATHING AIN. THE PATIENT MUST BE WATCHED, AND IF NATURAL BREATHING STOPS, ARTIFICIAL RESPIRATION SHOULD BE SUMED AT ONCE.

11. IN CARRYING OUT RESUSCITATION IT MAY BE NECESSARY TO CHANGE THE OPERATOR. THIS CHANGE MUST MADE WITHOUT LOSING THE RHYTHM OF RESPIRATION. THE RELIEF OPERATOR SHOULD KNEEL BEHIND THE ONE VING THE ARTIFICIAL RESPIRATION AND AT THE END OF THE MOVEMENT, THE OPERATOR CRAWLS FORWARD WHILE E RELIEF TAKES HIS PLACE. BY THIS PROCEDURE NO CONFUSION RESULTS AT THE TIME OF CHANGE OF OPERATOR, D A REGULAR RHYTHM IS KEPT UP.

PRACTICE IN THE PERFORMANCE OF ARTIFICIAL RESPIRATION ON A VOLUNTEER SUBJECT SHOULD BE OBTAINED BY EVERYONE

WARNING!

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION, BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER ASSOCIATED POWER EQUIPMENT AND OPEN MAIN SWITCH IN POWER SUPPLY CIRCUIT. UNDER CERTAIN CONDITIONS, DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES, ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

Since the use of high voltages which are dangerous to human life is necessary to the successful operation of the radio transmitting equipment covered by these instructions, certain reasonable precautionary measures must be carefully observed by the operating personnel during the adjustment and operation of the equipment.

The major portions of the equipment are within shielding enclosures, provided where necessary with access doors which are generally fitted with safety interlock switches which act to shut off dangerous voltages within the enclosures when the access doors are open.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

It should be borne in mind that interlocks are provided only on normal access doors on certain major units; and, therefore, side, back, or top screens, commutator covers, if removed, will not cause interlocks to function and will thereby allow access to circuits carrying voltages dangerous to human life.

KEEP AWAY FROM LIVE CIRCUITS. Under no circumstances should any person be permitted to reach within or in any manner gain access to the enclosure with interlocked gates or doors closed or with power supply line switches to the equipment closed; or to approach or handle any portion of the equipment which is supplied with power; or to connect any apparatus external to the enclosure to circuits within the equipment; or to apply voltages to the equipment for testing purposes while any non-interlocked portion of the shielding or enclosure is removed or open. Wherever feasible in testing circuits, check for continuity and resistance, rather than directly checking voltage at various points.

CAUTION SHOULD BE OBSERVED WHEN OPERATING THIS EQUIPMENT FOR TEST PURPOSES IN THE VICINITY OF OTHER TRANSMITTING EQUIPMENT. DUE TO THE RELATIVELY HIGH POWER OUTPUT OF THIS EQUIPMENT, OPERATION IN THE VICINITY OF OTHER TRANSMITTING EQUIPMENT MAY CAUSE FLASH-OVER OR ARCS IN THE REMOTE EQUIPMENT SHOULD THE ANTENNAS BE RESONANT. TESTING SHOULD BE DONE ON 1/4 POWER UNDER THIS CONDITION.

DON'T SERVICE OR ADJUST ALONE. Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS. Under no circumstances should any access gate, door or safety interlock switch be removed, short circuited, or tampered with in any way, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

THE ATTENTION OF ENGINEER OFFICERS, RADIO OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF ENGINEERING CIRCULAR LETTER NO. 5a OF 3 OCTOBER 1934 OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO--SAFETY PRECAUTIONS TO BE OBSERVED."

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65	176	Oil Pump Assembly, a Part of Engine Generator Set Type CDO-73004-A

RESTRICTED

NAVY MODEL TBW-4

PORTABLE RADIO TRANSMITTING EQUIPMENT

I. PREFACE

CONTRACTUAL GUARANTEE

1-1. The equipment, including all parts and spare parts, except vacuum tubes, is guaranteed for a service period of ONE YEAR with the understanding that, as a condition of this contract, all items found to be defective as to design, material, workmanship or manufacture shall be replaced without delay and at no expense to the Government; provided that such guarantee and agreement will not obligate the contractor to make replacement of defective material unless the failure, exclusive of normal shelf life deterioration, occurs within a period of TWO YEARS from the date of delivery of the equipment to and acceptance by the Government and provided further, that if any part or parts (except vacuum tubes) fail in service or are found defective in ten per cent (10%) or more of the total number of equipments furnished under the contract, such part or parts, whether supplied in the equipment or as spares shall be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent (100%) replacement of all similar units supplied on subject contract by suitable redesigned replacements.

Failure due to poor workmanship while not necessarily indicating poor design, will be considered in the same category as failure due to poor design. Redesigned replacements which will assure proper operation of the equipment will be supplied promptly, transportation paid, to the Naval activities using such equipment upon receipt of proper notice and without cost to the Government.

All such defective articles will be subject to rejection and return to the contractor.

1-2. This period of TWO YEARS and the service period of ONE YEAR shall not include any portion of the time that the equipment fails to give satisfactory performance due to defective items and the necessity for replacement thereof, and provided further, that any replacement part shall be guaranteed to give ONE YEAR of satisfactory service.

The design of this equipment will be such that the vacuum tubes will operate within their published limits and in such a manner that a tube life of 2000 hours may be expected. Vacuum tubes of the 50 watt envelope size and larger will be guaranteed for 500 hours of service life, in accordance with the provisions of specification RE-13A-600C.

REPORT OF FAILURE

1-3. Report of failure of any part of this equipment during its service life shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. Refer to latest revision of Bureau of Engineering Circular Letter No. 40 for instructions concerning Reports of Failures, etc.

1-4. The blank spaces indicated below should be filled in immediately upon completion of the initial service installation. The date of acceptance by the Navy can be determined by the stamped acceptance plate located on the transmitter. These dates are stamped in sequence of month, day and year.

1-5. Contract NXsa-19329 -

Serial Number of Equipment_____

Date of Acceptance by Navy (Month)_____(Day)_____

(Year)_____

Date of Delivery to Contract Designation (Month)_____

(Day)_____(Year)_____

Date of Completion of Initial Installation (Month)_____

(Day)_____(Year)_____

Date Placed in Service (Month)_____(Day)_____

(Year)_____

INSTRUCTION BOOK

1-6. In the compilation of this Instruction Book, every effort has been made to provide the answer to every reasonable question which may arise in connection with the installation, efficient operation, and servicing of the Navy Model TBW-4 Portable Radio Transmitting Equipment. It has further been attempted to group the large amount of material it contains in such a manner that any desired information pertaining to this equipment is most readily found. For greatest convenience in use, the sheets bound in the back of the book have been folded in a manner openly displaying their titles along the right margins. To preserve the full usefulness of this book, it is suggested that these marginal edges be reinforced by backing of paper or gummed tape should they begin to show wear from handling.

1-7. To the uniniated, the electrical circuits of the Navy Model TBW-4 Portable Radio Transmitting Equipment may appear quite complicated. Actually, the various individual operating and control circuits are for the most part rather simple, and it is only the wide choice of combinations provided which complicates the combined circuit. Considerable pains have therefore been taken in Part III to describe each component circuit in some detail. On the folded sheets in the back of the book will be found not only the complete circuit diagrams and actual wiring connections of all units, but also schematic representations of the various circuits. Where it may assist in further clarifying their function, portions of the circuit are also reproduced in simplified, elementary schematic form. Since the schematic diagrams, for the sake of clarity, frequently omit minor connections and components, the actual wiring diagrams should be consulted when tracing connections and in locating trouble.

1-8. Part IX, Lists of Electrical Parts, supplies sufficient detailed information regarding the various components, suitably classified, to be valuable not only for parts replacement purposes, but also for servicing and repair work. For example, typical resistance values or winding data are supplied for all reactors, transformers, and coils. Further, since the function and use of each component part is stated, frequent reference to this section is invited in connection with the study of the various circuit diagrams.

1-9. Attention is invited to the "Table of Typical Test Currents and Voltages " (Fig. 54) which shows representative normal meter readings and should prove of value in connection with locating troubles, as described in Part VIII.

1-10. Before commencing an installation of the Navy Model TBW-4 Portable Radio Transmitting Equipment, read carefully not only Part IV of this instruction book, but also the preceding parts which lead up to it.

ABBREVIATIONS

1-11. Throughout this book only such abbreviations as are in common usage have been employed and these sparingly. A number of these are listed below:

A.C. ------alternating current
adj. ------adjustable, adjustment
a.f. ------audio frequency
amp. ------amperes
ant. ------antenna
bat. ------battery
C ------capacitor
C.F.I.------Crystal Frequency Indicator
C.W. ------Continuous wave (telegraphy)
D.C. ------direct current or double contact
DCC -------double cotton covered (wire)
DSC -------double silk covered (wire)
DPST -------double pole, single throw (switch)
fil. ------filament
flex. ------flexible
gen. ------ganerator
gnd. ------ground (chassis of equipment)
H ------henry (unit of inductance)
H.F. ------high frequency
H.T. ------high tension
H.V. ------high voltage
I.C.S.------interior communication system (interphone)
I.F. ------intermediate frequency
J ------jack, connector
kcs. ------kilocycles
L ------symbol for coil, inductance
i.f. ------intermediate frequency
L.V. ------low voltage
ma. ------milliamperes
mcs. ------megacycles (thousands of kilocycles)

M.C.W.	------	modulated continuous wave; i.e., tone modulated telegraphy
mfd.	------	microfarads
mmfd.	------	micro-microfarads (i.e., millionths of a microfarad)
M.H.	------	milli-henry (thousandths of a henry)
mic.	------	microphone
M.O.	--------	master oscillator
mod.	------	modulator, modulation
osc.	------	oscillator, oscillation
P.	------	plug, connector
P.A.	------	power amplifier
R.	------	resistor, resistance
Rec.	------	receiver, receiving
s.c.	------	single contact
Ser.	------	serial no. or series
S.	------	switch
SPDT.	------	single pole, double throw (switch)
T.	------	transformer
tel.	------	telephone, telephony
term.	------	terminal
trans.	------	transmit, transmitter
V.	------	volts
Voice	------	speech modulated transmission; i.e., radio telephony
w.	------	watts

DEFINITIONS

1-12. The following definitions apply to certain terms as used in this instruction book:

1-13. "Ground" - The terms ground and ground connection throughout this instruction book are used to denote the electrical potential of frames and cases of all major units of the Navy Model TBW-4 Portable Radio Transmitting Equipment.

1-14. "Type of Emission" - Type of radio transmission; i.e., "C.W.", "M.C.W.", "VOICE."

1-15. "Direct Ray" or "Ground Wave" - Radio wave which travels in a direct line from the antenna transmitting the signal to that receiving it, without reflection or appreciable refraction.

1-16. "Reflected Ray" or "Sky Wave" - Radio wave which travels between the transmitting and receiving station by way of "reflection" from the Kennelly-Heaviside layer (ionosphere).

1-17. "Tank Circuit" - An inductance and a capacitance, in parallel, usually connected in the grid or plate circuit of an oscillating vacuum tube and sometimes called a "flywheel circuit."

1-18. "Side Tone" - The signal heard in his own phones by the radio operator while he is transmitting.

1-19. "Pentode" - A five element vacuum tube containing a filament or cathode, grid, screen grid, suppressor grid and plate.

1-20. "Tetrode" - A four element vacuum tube containing a filament or cathode, grid, screen grid and plate.

1-21. "Triode" - A three element vacuum tube containing a filament or cathode, grid and plate.

II. INTRODUCTION AND GENERAL DESCRIPTION

INTENT OF DESIGN

2-1. The components of Navy Model TBW-4 Portable Radio Transmitting Equipment are suitable for use in establishing a complete advance base radio transmitting station.

2-2. Satisfactory communication can be provided between similar equipments or other units of the Naval Communication System without the necessity for preliminary calling, and without causing interference to communication on other channels, when functioning with the specified antennas over the following frequency bands:

Unit	Frequency	Type of Emission
Intermediate Frequency Transmitter	350 to 1000 kcs.	C.W. and M.C.W. Telegraph and Radio Telephone
High Frequency Transmitter	3000 to 18100 kcs.	C.W. and M.C.W. Telegraph and Radio Telephone

2-3. The parts comprising the transmitting equipment consist of the following:

(1) Engine-Generator Set

(2) Intermediate Frequency Transmitter, High Frequency Transmitter and Rectifier Modulator Unit. These units are enclosed in separate water-tight transportation cases.

(3) Antenna-Counterpoise System for the receiving and transmitting equipment. This is switched to either the receivers or transmitters by the keying relays in the transmitters.

(4) Power equipment (as specified) to permit operation of the transmitter from 115 or 230 volt, 60 or 25 cycle, single phase A. C. supply line.

(5) Accessories consisting of:

(a) One complete set of interconnecting cables and plugs.

(b) Operator's telegraph key

(c) Operator's hand microphone.

(d) One complete set of vacuum tubes installed in the equipment.

(e) Tools to facilitate erection and normal maintenance of the equipment in the field.

(f) Spare parts, mobile and stock.

ACTUAL DESIGN

2-4. The transmitter-rectifier assembly consists of three units fastened together to operate as a single mechanical unit. It includes the necessary electrical circuits, tubes, and control apparatus for taking power from the 115 volt, 800 cycle, single phase A.C. power supply and delivering C.W., M.C.W. and Voice modulated radio frequency energy to the antenna.

2-5. Each unit consists of an aluminum alloy angle frame which encloses and supports the various electrical parts of the equipment. The frame of each unit is supported by means of eight "Lord" type shock-mounts, four on the bottom and four of a lighter type on the top. These mounts are arranged so that the frame may be taken from the case when necessary.

2-6. For normal operation the three units are assembled together with the Type CAY-52238 INTERMEDIATE FREQUENCY TRANSMITTER on the left, the Type CAY-20084 RECTIFIER MODULATOR UNIT in the center and the Type CAY-52239 HIGH FREQUENCY TRANSMITTER on the right. The units are left in the transportation cases, only the covers and caps over the plugs being removed. They are held together by two stainless steel rods which are passed through projections on the bottom of the cases. Three tubular metal legs with chains to provide stability are provided to elevate the assembly above the ground at a convenient operating level. Attachment brackets and two lengths of chain are provided to mount the cover of the H. F. Transmitter transportation case on the flanges of the cases to provide an operating table. The brackets are attached to the flange and to the cover by means of thumb screws. The lengths of chain are attached to the outside ends of the cover and to holes higher up on the flange.

2-7. The INTERMEDIATE FREQUENCY TRANSMITTER and the HIGH FREQUENCY TRANSMITTER are interconnected to the RECTIFIER MODULATOR UNIT by means of plugs and cables which are inserted in sockets accessible through the bottom of the transportation cases.

2-8. The antenna system consists of a two-wire intermediate frequency antenna, a high frequency antenna, and a two-wire counterpoise. The component parts are packed in suitable transportation canvas bags. It is so designed that the entire system may be erected in less than an hour by a crew of six men. Connections for the antennas and counterpoise are provided on the rear of each transmitter.

2-9. The Type CDO-73004-A ENGINE GENERATOR SET consists of a gasoline engine and a suitable generator. The gasoline engine is suitable for operating the generator under service conditions. The generator is so designed that it provides sufficient output for the operation of the equipment, and is arranged for convenient and safe transportation.

2-10. The power equipment for base use to permit operation from 60 or 25 cycle, 115 or 230 volt, single phase A.C. supply consists of suitable motor generator sets. When connected to the supply line, these units provide all power necessary for operation of the equipment.

LIST OF COMPONENTS WITH WEIGHTS AND DIMENSIONS

115 Volt 60 Cycle A. C. Station Power Equipment.

2-11. INTERMEDIATE FREQUENCY TRANSMITTER, TYPE CAY-52238

Size:	Height	33-1/4"
	Width	13-5/8"
	Depth	17-1/4"
	Weight	73.5 lbs.

HIGH FREQUENCY TRANSMITTER, TYPE CAY-52239

Size:	Height	33-1/4"
	Width	13-5/8"
	Depth	17-1/4"
	Weight	84 lbs.

RECTIFIER MODULATOR UNIT, TYPE CAY-20084 (including Microphone and Telegraph Key)

Size:	Height	33-1/4"
	Width	10-7/16"
	Depth	17-1/4"
	Weight	71 lbs.

Antenna-Counterpoise - In 2 Canvas Bags

Size: Height 60" each
Diameter 12" each
Weight 90 lbs. total

One Set of Vacuum Tubes (to be used in equipment) consisting of:

1 Navy Type 801
1 Navy Type 807
2 Navy Type 803
2 Navy Type 1616
1 Navy Type 843
2 Navy Type 837
1 Navy Type 5Z3
Weight - included in weights of individual units.

One Set Accessories in canvas bag 18" diameter x 28" high consisting of:

1 Set Antenna Accessories
1 Canvas Cover for Transmitter
1 Tool Kit
Weight 72 lbs.

One Gasoline Can

Diameter
Height
Weight

One Oil Can

Diameter
Height
Weight

ENGINE GENERATOR SET, TYPE CDO-73004-A

Size: Height 17-3/8"
Width 21-1/4"
Depth 23-1/4"
Weight 168 lbs.

*MOTOR GENERATOR SET, TYPE CDO-21648

Size: Height 14-1/2"
Width 32-1/2"
Depth 20-7/8"
Weight 296 lbs.

*STATION POWER UNIT NOT SUPPLIED WITH ALL TBW-4 EQUIPMENTS, BUT INFORMATION IS INCLUDED IN THE EVENT THAT IT IS SUPPLIED AT A SUBSEQUENT DATE.

One Set Mobile Spare Parts including Soldering Iron and Interconnection Cables

Size: Height -
Width -
Depth -
Weight -

TOTAL WEIGHT OF EQUIPMENT LESS STATION POWER UNIT, SPARE PARTS, AND INSTRUCTION BOOKS.

115 Volt 25 Cycle Station Power Equipment

2-12. INTERMEDIATE FREQUENCY TRANSMITTER, TYPE CAY-52238

Size: Height 33-1/4"
Width 13-5/8"
Depth 17-1/4"
Weight 76.5 lbs.

HIGH FREQUENCY TRANSMITTER, TYPE CAY-52239

Size: Height 33-1/4"
Width 13-5/8"
Depth 17-1/4"
Weight 84 lbs.

RECEIVER MODULATOR UNIT, TYPE CAY-20084 (including Microphone and Telegraph Key)

Size: Height 33-1/4"
Width 10-7/16"
Depth 17-1/4"
Weight 71 lbs.

Antenna-Counterpoise in 2 canvas bags

Size: Height 60" each
Diameter 12" each
Weight 90 lbs. total

One Set Vacuum Tubes (to be used in equipment) consisting of:

1 Navy Type ____ 801
1 Navy Type ____ 807
2 Navy Type ____ 803
2 Navy Type ____ 1616
1 Navy Type ____ 843
2 Navy Type ____ 837
1 Navy Type ____ 5Z3
Weight - included in weights of individual units

One Set Accessories in canvas bag 18" dia.x 28" high consisting of:

1 Set Antenna Accessories
1 Canvas Cover for Transmitters
1 Tool Kit
Weight 72 lbs.

One Gasoline Can

Diameter -
Height -
Weight -

One Oil Can

Diameter -
Height -
Weight -

ENGINE GENERATOR SET, TYPE CDO-73004-A

Size: Height 17-3/8"
Width 21-3/4"
Depth 26-1/4"
Weight 168 lbs.

*MOTOR GENERATOR SET, TYPE CDO-21652

Size: Height 14-1/2"
Width 32-1/2"
Depth 20-7/8"
Weight 296 lbs.

*STATION POWER UNIT, NOT SUPPLIED WITH ALL TEW-4 EQUIPMENTS, BUT INFORMATION IS INCLUDED IN THE EVENT THAT IT IS SUPPLIED AT A SUBSEQUENT DATE.

Set Mobile Spare Parts including Soldering Iron and Interconnection Cables

Size: Height
Width
Depth
Weight

TOTAL WEIGHT OF EQUIPMENT LESS STATION POWER UNIT, SPARE PARTS AND INSTRUCTION BOOKS.

STOCK SPARE PARTS (shipped in bulk)

2-13. The spare parts supplied as part of this equipment are listed in Part IX, Table IV. Both the Mobile Spare Parts and the Stock Spare Parts are shipped from the factory to the Naval Service designated by the Bureau of Supplies and Accounts. Mobile Spare Parts are shipped in a watertight box having the dimensions given above while the Stock Spare Parts are shipped in bulk.

III. DETAILED DESCRIPTION

MECHANICAL DETAILS

Transmitter Rectifier Assembly

3-1. The general construction of the transmitter and rectifier units employ an aluminum alloy frame which is shock-mounted in a transportation case fabricated of aluminum alloy sheet and angle. The general appearance of the assembled units is shown on Figs. 1 to 18 and Fig. 31, Dwg. W-7300364. Referring to these illustrations, the INTERMEDIATE FREQUENCY TRANSMITTER is contained in the left-hand case, the RECTIFIER MODULATOR UNIT in the center case, while the HIGH FREQUENCY TRANSMITTER is contained in the right-hand case.

Intermediate Frequency Transmitter

3-2. The frame of the INTERMEDIATE FREQUENCY TRANSMITTER is made of an aluminum alloy sheet which is bent up to form the front panel, the top and the bottom. The top and the bottom are supported by means of aluminum angles at the rear. Spot welded gussets are placed in the corners of the frame to add additional strength. This type of frame construction results in a frame having unusually high strength for its weight, and considerably simplifies the frame construction. The floors are bent aluminum alloy sheet, and are held in place in the transmitter frame by means of spot welded gussets.

3-3. The transmitter frame is shock-mounted inside the transportation case. The shock-mounting details of this equipment are designed to be especially effective and are shown on Fig. 31, Drawing W-7300364. The transmitter frame is supported by means of four "Lord" type shock-mounts at the bottom of the frame and four "Lord" shock-mounts of a lighter type at the top to restrict the movement of the equipment. The front and rear shock-mounts of each pair are tied together by means of stainless steel strips running from the front to the rear of the transportation case. These strips are in turn fastened to the top and bottom of the transportation case in such a manner that by loosening thumb screws, the transmitter may be slid from the transportation case for inspection, servicing, etc.

3-4. The electrical components of the master oscillator unit are located in the bottom section. This unit consists of a casting to which is mounted the master oscillator tube, intermediate amplifier tube, master oscillator tank capacitors, tank coil and range switches. Through the use of a

casting for supporting all the frequency determining elements, the effect of shock or vibration is reduced to a minimum and increased stability is obtained. Across the rear of the frame is located a resistor bank for the various resistors in the circuit. Above the master oscillator casting is located the intermediate amplifier band pass coil and capacitors. Also across the back of the frame is located a resistor bank for the various resistors used in this circuit. The power amplifier section containing the power amplifier tank coil, power amplifier tank capacitors, power amplifier tube, and the antenna loading coil is located in the upper section.

3-5. The antenna connections to the INTERMEDIATE FREQUENCY TRANSMITTER are made through an opening in the rear of the watertight case. This opening is capped by a gasketed cover for transportation.

3-6. The items and controls which are mounted on the front panel are shown and enumerated on Fig. 3 and Fig. 31, Dwg. W-7300364. Suitable friction type locks are provided to prevent accidental movement of the tuning controls. All tuning and control knobs are marked with a designating letter. Switch controls are provided with end stops and suitable detents.

3-7. Referring to Figure 3, the following controls are located on the front panel of the INTERMEDIATE FREQUENCY TRANSMITTER: at the bottom, from left to right are the I. F. Crystal Frequency Indicator coupling post (CFI), the M.O. CALIBRATION CORRECTION access plate, and the master oscillator tuning control (M.O. TUNING Control "B"). Above this, and slightly to the left is located the master oscillator range switch (M.O. RANGE Control "A"). Immediately above this is the panel LIGHT SWITCH. Above these items immediately below the center line of the panel is located the power amplifier grid current meter (P.A. GRID CURRENT). Above the power amplifier grid current meter are located the antenna coupling control (ANT. COUPLING Control "G") to the left, and the power amplifier tuning control (P.A. TUNING Control "D") at the right. Above these two controls and to the left is the power amplifier range switch (POWER AMP. RANGE Control "C"). To the right and above the power amplifier range switch is located the antenna step switch (ANTENNA TUNING STEP Control "E") and to the left of which is located the antenna ammeter (R.F. OUTPUT). At the top of the panel is located the antenna tuning control (ANT. TUNING Control "F").

3-8. All tubes are accessible for servicing and replacement by sliding the transmitter frame partially out of the transportation case and opening the side shields.

3-9. Ample ventilation is provided for the transmitter by means of an air space all around the transmitter when secured in the transportation case. For description of transportation case see Par. 3-25 and 3-26.

Rectifier Modulator Unit

3-10. The frame for the RECTIFIER MODULATOR UNIT is fabricated of aluminum alloy sheet in a manner similar to that described for the INTERMEDIATE FREQUENCY TRANSMITTER. The plugs for the cables which interconnect this unit to the H.F. and I.F. transmitters and engine generator project up through the bottom of the frame. A sub deck is located over the cable sockets and contains the power transformers, filter capacitors, etc. On the second deck is located the various rectifier tubes. On the third deck is located the modulator tube and its associated input and output modulating transformers.

3-11. On the front panel are located the various controls, switches, rheostats, meters, etc., which are necessary for the control of the RECTIFIER MODULATOR UNIT. These items and controls are shown and enumerated on Fig. 3 and Fig. 31, Drawing W-7300364.

3-12. The controls of the RECTIFIER MODULATOR UNIT are located on the front panel and can be seen by reference to Fig. 3.

3-13. At the extreme bottom of the panel are located four jacks, the key jack (KEY), the microphone jack (MIC.), the I.F. side tone jack (I.F. REC.) and the H.F. side tone jack, (H.F. REC.). Directly above the jacks are located the four A.C. voltage compensation switches (A.C. VOLTAGE COMPENSATION) and the D.C. power switch (D.C. POWER). Above these switches from left to right are located the MCW- CW- VOICE selector switch (EMISSION), the side tone volume control (SIDE TONE) and the filament rheostat (FILAMENT). In the center of the panel immediately above the controls just mentioned is located the power control switch (POWER CONTROL). In the center left of the panel is located the A.C. power switch (A.C. POWER), in the center of the panel is the light switch (LIGHT SWITCH) and to the right of the panel is located the H.F. - I.F. transmitter transfer switch (TRANSFER SWITCH). These latter controls are located just below the tube access door. At the top of the panel to the left is located the power amplifier plate current meter (P.A. PLATE CURRENT) and to the right adjacent to it is located the filament-line voltmeter. Between the two meters is the filament-line voltmeter switch (LINE VOLTS - FILAMENT VOLTS).

3-14. All tubes and fuses are accessible for inspection and replacement through an access door in the front panel.

3-15. The transportation case for the RECTIFIER MODULATOR UNIT is constructed in a manner similar to that described in Paragraphs 3-25 and 3-26.

High Frequency Transmitter

3-16. The frame for the HIGH FREQUENCY TRANSMITTER is made of bent up aluminum alloy sheet, as previously described. In the bottom of the transmitter frame are located the components which comprise the master oscillator and doubler circuits. These are the master oscillator coil, master oscillator tank capacitors, master oscillator tube, switches, resistors, doubler coil, tuning capacitor, etc. The master oscillator tube, tank circuit and associated tuning dial and the doubler circuit and dial are separately mounted on an aluminum alloy casting. This casting is in turn fastened to the bottom of the transmitter frame in such a manner as to eliminate any strains or warping which might be transmitted to the master oscillator circuit. This type of construction is used to assure the necessary ruggedness of the equipment to meet the severe conditions encountered in portable service.

3-17. On the first deck is located the intermediate amplifier tube and its associated tank circuit consisting of the intermediate amplifier tank coil, variable tank capacitor and tank circuit switch. Across the back of the frame is located a resistor bank containing the various resistors necessary for the operation of the circuit.

3-18. On the second deck is located the power amplifier vacuum tube, power amplifier tank coil and variable capacitor, the antenna tuning inductance, the antenna tuning capacitor and the antenna voltage-current feed switch. The various parts of the power amplifier circuit are located to provide the short leads required for efficient operation at the highest frequencies for which the equipment is designed.

3-19. Antenna connections to the HIGH FREQUENCY TRANSMITTER are made through an opening in the rear of the watertight case. This opening is capped by a gasketed cover during transportation and storage.

3-20. The items and controls which are mounted on the front panels are shown and enumerated on Fig. 3 and Fig. 31, Drawing W-7300364. Suitable friction type locks are provided to prevent accidental movement of the tuning controls. All tuning and control knobs are permanently marked with designating letters. Switch controls are provided with end stops and suitable detents.

3-21. The location of the various controls on the front panel can readily be found by reference to Fig. 3. Located at the bottom on the right hand side is the doubler circuit tuning control (DOUBLER TUNING Control "D"). In the lower center is the plate covering the M.O. CALIBRATION CORRECTION access hole. To the left and slightly lower down on the panel is located the H.F. master oscillator tuning control knob (M.O. TUNING Control "B"). On the bottom left hand side is located the H.F. Crystal Frequency Indicator connection post (CFI). The controls next in line above are, on the right the doubler circuit range switch (DOUBLER RANGE Control "C") and to the left, the master oscillator range switch (M.O. RANGE Control "A"). Above the controls just mentioned and to the right is located the intermediate amplifier grid current meter (I.A. GRID CURRENT), above which is located the power amplifier grid current meter (P.A. GRID CURRENT). To the left of these two instruments is located the intermediate amplifier tuning control (INT. AMP. TUNING Control "F"). Above this is located the intermediate amplifier range switch (INT. AMP. RANGE Control "E"). The next controls above are the antenna coupling control (ANT. COUPLING Control "K"), to the left of which is located the power amplifier tuning control (P.A. TUNING Control "G"). Above these controls and in the center of the panel is located the antenna ammeter (R. F. OUTPUT). At the top right is located the antenna tuning inductance control (ANT. INDUCTANCE Control "J"). The antenna tuning capacitor control (ANT. TUNING CAPACITOR Control "I") is located at the top left of the panel. Directly below Control "I" is located the antenna voltage-current feed switch (ANTENNA FEED Control "H").

3-22. All tubes are accessible for inspection and replacement by sliding the transmitter frame partially out of the transportation case and removing the side shields.

3-23. The transmitter frame is shock-mounted inside the transportation case as previously described for the INTERMEDIATE FREQUENCY TRANSMITTER. See Par. 3-3.

3-24. The transportation case is similar to that described in Paragraphs 3-25 and 3-26.

Transportation Cases

3-25. The transportation cases are constructed of sheet aluminum, having all seams welded to provide maximum strength with minimum weight. Around the front edge of each case is spot welded a T-section flange to provide additional stiffening. The tightening screws which attach the cover fasten into this flange. The covers are also formed of sheet aluminum fastened

to the cases by means of captive screws. The seal between the cover and the case is rendered watertight by means of a soft rubber gasket mounted in a recess around the cover.

3-26. The three transportation cases fasten together to form a stable unit, and are provided with sockets for mounting legs to support the units at an operating height. The cover of the H.F. transmitter transportation case is arranged to fasten to the three units when assembled to form an operating table. A handle is provided on the top of each case to assist in handling.

Assembly of Units

3-27. The units as assembled for operation are shown on Fig. 1 and Fig. 31, Drawing W-7300364. The units are assembled side by side and are held together by two stainless steel rods through projections on the bottom of the cases as shown on Figure 6. Three tubular metal legs are provided to elevate the assembly above the ground at convenient operating level. Chains are provided with the legs to prevent them from spreading and to add rigidity to the assembly.

3-28. Attachment brackets are supplied so that the cover of the transportation case of the H.F. transmitter may be fastened to the cases to form a convenient operating table.

3-29. The units are interconnected by means of plugs and cables which are inserted in sockets through ports in the bottom of the transportation cases. These ports are covered during transportation by means of port covers which are fitted with watertight gaskets. See Figs. 6&31, Drawing W-7300364 for details.

3-30. A slip cover is provided for the front of the units for protection of the equipment during a heavy rain. This slip cover is provided with flaps held in place by slide fasteners which can be opened to allow operation of the various tuning controls.

Antenna Construction

3-31. The construction details of the antenna system are shown on Fig. 38, Drawing W-7300391. The antenna system consists of a low frequency antenna which is made up of two wires supported between the tops of the two masts, a high frequency antenna which is a single wire supported at one end, from the top of one of the masts and is supported at the other end part way up the second mast, and a two wire counterpoise which is supported at a sufficient height above ground to prevent interference with personnel. This type of construction reduces the amount of coupling obtained between the two antennas.

3-32. Each of the masts consists of ten sections of aluminum tubing which are fastened together by means of ferrules. Three sets of guy ropes are provided, one at the top of the mast, the second set located about the fourth section from the top, and the third located two sections from the base. A metal pin is provided to be inserted in the bottom tube section for use in preventing the mast from slipping on the ground. In addition, a bottom plate is also provided to prevent the mast from sinking into sandy or soft soil. Aluminum alloy stakes are provided to secure the guy ropes for supporting the antenna masts. Halyards are provided at the top of the mast so that the antennas may be quickly installed or removed. The various guys and halyards are provided with snap fasteners so that they may be quickly installed or removed.

3-33. The antenna system has been made as light and compact as practicable. Transportation cases of strong canvas are provided for transporting the masts and guy ropes.

Transmitter Base Station Power Supply

3-34. A power supply is provided for Base Station operation of the equipment. It consists of a MOTOR GENERATOR SET to provide all the power necessary for operation of the transmitter, including relays, microphone, etc., when connected to either a 60 or a 25 cycle, 115/230 volt, plus or minus 10%, single phase supply. This equipment consists of a two-unit motor and generator set, the motor of which will operate at approximately 1750 or 1450 r.p.m. for the 60 cycle or 25 cycle supply, respectively. The generator and motor are mounted on a common sub-base and are coupled together by means of a V-belt drive system. The generator delivers 120 volts, single phase A.C. at approximately 800 cycles, 1000 voltamperes, 80% power factor, 800 watts. The generator also delivers 14 volts at 20 amperes D.C. Mounted on the generator is a filter to reduce the ripple in the D.C. supply, and a magnetic controller. The controller provides automatic control of the motor generator set so that it may be started and stopped from points up to 50 feet from the transmitters. Both the motor and the generator are of the ball bearing, drip proof type and are suitable for operation in ambient temperatures of from -15°C. to +50° C. A reverse current relay is provided in the output circuit of the D.C. generator to privide protection for both the batteries and the generator windings. A protecting steel guard is provided to cover the belts and pulleys. The A.C. motors are designed to operate on single phase supply and are of the repulsion-induction type.

3-35. See Section XII for data on the gasoline-driven ENGINE GENERATOR SET.

3-36. The mobile spare parts and interconnecting cables are contained in a waterproof metal box with removable cover. The antenna mast sections are packed in two heavy canvas bags for transportation. Antenna wires and insulators, guys and miscellaneous accessories are packed in a third heavy canvas bag for transportation. Two containers with safety screw tops are supplied for carrying the spare gasoline and oil.

ELECTRICAL CIRCUITS

Intermediate Frequency Transmitter Type CAY-52238

3-37. Referring to the schematic diagram Fig. 32, Drawing T-7608187, the following description is given of the circuits involved. The INTERMEDIATE FREQUENCY TRANSMITTER (frequency range 350 to 1000 kcs.) utilizes a Navy Type ___801 vacuum tube connected in a Colpitts oscillator circuit. The master oscillator tank circuit consists of the master oscillator tuning coil L101, master oscillator step switch S101, and tank capacitors C102, C103, and C127. Coil L101 is of the variometer type and the master oscillator is tuned to the desired frequency by varying the inductance of L101.

3-38. Capacitors C102 and C103 divide the radio frequency voltage in the proper ratio for the operation of the master oscillator tube. Capacitor C125 is the compensating capacitor for correction of the calibration dial, when the master oscillator tube is changed.

3-39. Capacitor C104 is the grid blocking capacitor, and the master oscillator grid is supplied with bias by means of resistor R102.

3-40. The intermediate amplifier uses a Navy Type ___807 vacuum tube. The intermediate amplifier tube receives its excitation from the master oscillator circuit through coupling capacitor C108. Grid bias is supplied to the intermediate amplifier tube by means of resistor R105. The intermediate amplifier operates as a band pass amplifier and requires no tuning. The band pass circuit consists of the coil L107 and capacitor C114. The tube operates class AB, and is protected against overload by cathode resistor R112, screen resistor R106, and plate resistor R111.

3-41. The power amplifier uses a Navy Type ___803 vacuum tube. Excitation for the power amplifier tube is supplied by the intermediate amplifier band pass circuit. Grid bias for the power amplifier tube is supplied by means of resistor R109. The power

amplifier tank circuit consists of the tank coil L109, P. A. RANGE switch S104, and tank capacitors C121, C122, C123 and C130. The power amplifier circuit is tuned over the frequency range by changing the tank capacity in the circuit and by a change of inductance of the coil L109. The power amplifier is inductively coupled to the antenna circuit.

3-42. The antenna tuning circuit consists of the antenna tuning coil L110 and antenna range switch S106. The total inductance of coil L110 is sufficient to allow resonating of the antenna system to the lowest frequency involved.

3-43. Power for operation of the INTERMEDIATE FREQUENCY TRANSMITTER is supplied from the RECTIFIER MODULATOR UNIT by means of plugs and cables which interconnect the two units. The correct voltage for operation of the screen circuit of the Type-807 intermediate amplifier Tube V102 is supplied by a tap on the potentiometer composed of resistors R107 and R108, located in the I.F. unit. Keying of the transmitter is accomplished by primary keying of the rectifiers in the RECTIFIER MODULATOR UNIT and by grid blocking of the master oscillator and intermediate amplifier vacuum tubes. This type of keying allows break-in operation to be used.

Rectifier Modulator Unit Type CAY-20084

3-44. The following circuits and components comprise the RECTIFIER MODULATOR UNIT. The main plate supply rectifier uses two Navy Type ___1616 vacuum tubes connected in a full wave rectifier circuit. Plate voltage is supplied from the supply line through the step-up transformer T201. The primary of T201 is tapped to allow operation on quarter, one-half and full power. The rectified output of the main rectifier is filtered by means of filter capacitor C202. The output voltage of this rectifier is approximately 2000 volts and is used to supply the power amplifier tube in the I.F. and H.F. transmitters. An auxiliary rectifier consisting of a Navy Type ___5Z3 vacuum tube, filter capacitor C204, filter choke L201, filter capacitor C205 and transformer T203 is used to supply the auxiliary voltage required for the operation of the master oscillators, intermediate amplifiers of the transmitters and the modulating system. The output of this rectifier and filter system is approximately 500 volts D.C. Transformer T202 supplies the filament power necessary for the operation of all the vacuum tubes in the I. F. transmitter, rectifier, modulator and H.F. transmitter. Capacitor C201 is a compensation capacitor and is used to correct the power factor of the circuit so as to prevent undue fluctuation of the filament voltage when the transmitter is keyed.

3-45. The modulator system uses a Navy Type ___843 vacuum tube. This vacuum tube operates as a modulator for both the I.F. and H.F. transmitters and is operated Class A. The input transformer T205 steps up the microphone voltage for operation of the grid of the amplifier tube. A modulation transformer T204 supplies the correct voltage for modulation of the suppressor of the power amplifier tube, and also supplies the voice side tone voltage. Bias for the modulator tube is supplied by cathode resistor R207. Resistor R208 is the audio limitation resistor and prevents over-modulation of the transmitter by limiting the peak voltage swing of the audio tube. Since the modulator tube is operated Class A, the addition of the series grid resistor R208 limits the peak output of this tube to a value not exceeding approximately 100% modulation of the power amplifier.

3-46. Switch S209 is the MCW-CW-VOICE control switch. In the CW position, the suppressor circuit of the power amplifier tubes in the I.F. and H.F. transmitters are connected to ground. In the MCW position, suppressor circuits are connected so as to receive 800 cycle modulation from a winding on the auxiliary power transformer T203. In the VOICE position, the suppressor grid of the power amplifier tube is connected so as to receive the voice modulation from the modulation winding of transformer T204. The fuses F201 and F202 protect the rectifier circuits, and fuse F203 protects the low voltage D. C. circuits. Switch S208 is the I.F. - H.F. TRANSFER switch. This switch transfers the operating potentials from the I.F. unit to the H.F. transmitter or vice versa.

High Frequency Transmitter Type CAY-52239

3-47. The HIGH FREQUENCY TRANSMITTER utilizes a Navy Type ___837 vacuum tube connected in an electron coupled oscillator circuit. The master oscillator tank circuit consists of the coil L301, range switch S-301 and tank capacitors C302, C303, C304 and C305. Capacitor C332, is the calibration compensation capacitor and is used to reset the calibration which may have changed due to change of the master oscillator tube.

3-48. Coils L302 and L303 are filament choke coils and are used to prevent the radio frequency that is applied to the filament circuit from returning to the filament supply transformer T202, located in the RECTIFIER MODULATOR UNIT. Plate voltage for the master oscillator tube is fed through the plate choke L304. The electron coupled circuit is used for the master oscillator in the HIGH FREQUENCY TRANSMITTER, and the frequency range of the master oscillator is from 1500 to 3050 kilocycles.

3-49. A frequency multiplying circuit comprising the coil L305, range switch S302 and variable tuning capacitor C312 is connected to the plate of the master oscillator tube through the coupling capacitor C311. This circuit operates as a frequency doubler over the frequency range of 3000 to 6100 kilocycles, and as a frequency tripler over the frequency range of 6000 to 9050 kilocycles.

3-50. The intermediate amplifier uses a Navy Type ___837 vacuum tube. Excitation for the intermediate amplifier tube is obtained from the doubling circuit through coupling capacitor C314. Grid bias for the intermediate amplifier tube is obtained by means of the resistor R307 and is fed to the grid of the tube through choke coil L306.

3-51. The tank circuit for the intermediate amplifier tube consists of the coil L307, range switch S303 and capacitor C320. Throughout the range of 3000 to 9050 kilocycles, the intermediate amplifier acts as a straight through amplifier, through the range of 9050 kilocycles to 18,100 kilocycles, the intermediate amplifier stage operates as a frequency doubler. The power amplifier of the H.F. transmitter uses a Navy Type ___803 vacuum tube. Excitation for the power amplifier is obtained from the intermediate amplifier plate circuit through capacitor C335. Grid bias for the power amplifier tube is obtained by means of grid resistor R310 fed through the choke coil L308. The tank circuit for the power amplifier consists of a rotating coil L309 and variable capacitor C328. The rotating coil and the variable capacitor are ganged together and fastened to one tuning control so that the entire frequency range is covered without the necessity of tank circuit switches. The antenna circuit consists of the rotating coil L310 and a variable capacitor C330. The circuits are arranged for either voltage feed or current feed to the antenna by means of the switch S304. Capacitor C329 is the antenna coupling capacitor and is used to vary the amount of loading of the power amplifier. It should be noted that the coupling from the power amplifier is taken from the center tap of the power amplifier tank capacitor C328. This results in a greater reduction of harmonics than if ordinary capacity coupling is used, and also allows the antenna circuit to be short-circuited, open-circuited or grounded without harmful effects to the power amplifier tube.

3-52. Voltage for operation of the power amplifier tube is supplied by means of the main rectifier in the RECTIFIER MODULATOR UNIT. Voltage for operation of the master oscillator and intermediate amplifier is supplied by means of the auxiliary rectifier in the RECTIFIER MODULATOR UNIT. Correct voltage for operation of the screen circuit is supplied by means of taps on the potentiometer composed of resistors R305 and R306, located in the high frequency unit. Keying of the transmitter is accomplished by the application or removal of plate potentials by means of primary circuit keying in the RECTIFIER MODULATOR UNIT, and also through the blocking of the grid circuit of the master oscillator and intermediate amplifier tubes.

3-53. Filament power is supplied to the H.F. transmitter by means of the filament transformer T202 located in the RECTIFIER MODULATOR UNIT. Connections between the H.F. transmitter and RECTIFIER MODULATOR UNIT are made by means of plugs and cables between the two units.

3-54. As previously described in the RECTIFIER MODULATOR UNIT, telephone transmission for the HIGH FREQUENCY TRANSMITTER is accomplished by suppressor modulation of the power amplifier tube. It is also possible to voice modulate the INTERMEDIATE FREQUENCY TRANSMITTER in the same manner.

IV. INSTALLATION

UNPACKING AND SETTING UP EQUIPMENT

4-1. The method to be used in unpacking and setting up equipment for use is described in the following paragraphs.

4-2. It is assumed that the equipment has been placed on shore and is ready for setting up. The equipment should first be separated and laid out in the approximate position as shown on Figs. 37 to 39, Dwgs. P-7707150, W-7300391, and T-7605890. A clear site for the two antenna masts should be selected. The accessory bag should be opened and one counterpoise wire removed. The counterpoise wire is used as a marker for determining the exact position of the two masts, and the supporting stakes. The counterpoise wire should be stretched out along the ground in the direction that the antenna is desired. Using the counterpoise wire as a tape line, mark two points 150 feet apart. These points are the locations of the base of the antenna masts. Using the 25 ft. mark on the counterpoise wire, and with the marks previously made for the antenna base as a center, a circle should be inscribed. At a point on the circle directly in line with the desired line of antenna, a mark should be made on the ground. Using the 25 ft. length of the counterpoise wire, five additional marks should be placed around the circumference of the circle. These marks are for the placement of the guy stakes (1114). The guy stake for the guy rope, in line with the antenna and towards the antenna side should be slightly removed to the right or left approximately three feet so that the guy rope will not come in contact with the high frequency antenna. The stakes should be removed from the mast carrying cases and should be driven in the ground with the hammer provided in the tool kit. This procedure for location of stakes should be repeated for the second mast.

4-3. The antenna mast sections should be removed from the canvas bags. Since the mast sections fit tightly in the bag, this is most easily done by sliding the sections out of the bag one at a time. Place the sections at the marked locations. The cap for fastening the guy ropes (1101) and the antenna halyard should be slipped over the top of the first mast section. The guy ropes should be uncoiled and laid out with their ends near the stakes to which they are to be attached. With a man holding each of the top guy ropes, the remaining men should make up the mast by raising it vertically, section by section inserting the male portion of one tubular section into the female portion of the previous section. The collar for the second set of guy ropes (1102) should be slipped over the fourth mast section before it is inserted in the third mast section and the lower

set of guys should be uncoiled. Similarly, the collar for fastening the counterpoise (1103 for the mast near the transmitting position and 1107 for the other mast) should be slid over the ninth mast section before it is inserted in the eighth mast section. The ground spike (1112) should be driven in the ground at the marked position so that when the plate is placed over it the spike will project above the plate about 2 inches. The mast should be slipped over this projection. Holding the mast in a vertical position, the men handling the top guy ropes should secure the guys by slipping the ropes over the stakes and pulling the guys taut. The second and third sets of guy ropes should then be secured so as to hold the mast firmly and in a vertical position.

4-4. The procedure for laying out the top guy ropes, making up of the mast and securing the guy ropes should be repeated for the second mast. The snap fasteners for the antenna should be connected to the halyards and the low frequency and high frequency antennashoisted into place after attaching lead-ins to the proper antennas with the blocks and screws provided. The counterpoise wires should be fastened to the collar above the second mast section.

4-5. The transmitter and rectifier units should be placed in the following order: in the upside down position, the INTERMEDIATE FREQUENCY TRANSMITTER on the right, the RECTIFIER MODULATOR UNIT in the middle, and the HIGH FREQUENCY TRANSMITTER on the left when facing the front of the units. The transmitter supporting legs, which were stored in one of the antenna mast transportation bags should be placed near the transmitting equipment. Remove the transmitter tie rods from the antenna mast cases.

4-6. Holding the three units in position, the rods should be slipped through the holes in the case projections, starting from the H.F. transmitter side, and the end of the rod should be secured by the cotter-pin fastened to the I.F. transmitter. The tie rods will securely hold the three units together. The equipment should be turned right side up, raised in the air sufficiently and the three legs inserted in position to support the equipment. The chains are secured to the tops of the two front legs (two to each leg). The loose ends should go to the bottom of the opposite front leg and rear leg. The covers should be removed from the equipment by unscrewing the thumb screws. The brackets for securing the H.F. cover should be removed from the accessory bag and screwed into the special screw holes in the front flanges of the I.F. and H.F. transportation cases. The thumb screws on the cover should be screwed into the top hole in the bracket to securely hold the cover and to form an operating table.

4-7. The lead-in from the low frequency antenna should be connected to the I.F. antenna post, the high frequency antenna should be connected to the H.F. antenna post and the counterpoise must be connected to the I.F. counterpoise post for normal operation. These connections are made by unscrewing the water-tight port covers over the lead-out insulators in the backs of the transmitter cases and snapping the Rajah clips onto the plugs provided. In case the I.F. transmitter is not used, the counterpoise can be connected to the post on the H.F. transmitter. The cover caps over the power plug outlets in the I.F. transmitter, RECTIFIER MODULATOR UNIT, and H.F. transmitter should be unscrewed and the power plugs exposed. The interconnecting cables, which are carried in the Mobile Spare Parts Box should be connected between the rectifier and the H.F. and I.F. units. This is accomplished by inserting plugs P204 colored yellow, into the yellow sockets labeled P204, located on the under side of the rectifier and H.F. units. Plugs P206, which are also colored yellow, should be plugged into the yellow sockets labeled P206 on the under side of the rectifier and H.F. units.

4-8. Plugs P203, which are colored light blue, should be plugged into the light blue sockets labeled P203 on the underside of the rectifier and I.F. transmitter. Plugs P205 which are colored light blue should be plugged into the light blue sockets labeled P205 which are also located on the under side of the rectifier and I.F. unit. The power cable running to the ENGINE GENERATOR SET should be unrolled and plug P201 should be plugged into socket labeled P201 on the under side of the rectifier.

4-9. The watertight cover should be removed from the ENGINE GENERATOR SET. The power cable from the transmitter should be plugged into the proper socket on the ENGINE GENERATOR SET. The H.F. and I.F. side tone cables, also carried in the accessory case, should be plugged into the proper jacks on the RECTIFIER MODULATOR UNIT and into the proper jacks on the receivers being used. The receiver antenna leads should be connected from the I. F. and H.F. receivers to the I.F. and H.F. receiver posts on the respective transmitters. The microphone and key should be removed from the compartment inside the RECTIFIER MODULATOR UNIT and plugged into their correct jacks.

4-10. IMPORTANT! Before starting gasoline engine, refer to Section XII.

PACKING THE EQUIPMENT

4-11. The interconnecting cables between ENGINE GENERATOR SET and RECTIFIER MODULATOR UNIT, and the interconnecting cables between the units are removed and placed in the Mobile Spare Parts Box.

The gasoline shut-off valve on the gasoline engine is turned to the OFF position and the vent on the top of the gasoline tank is closed. When the engine has sufficiently cooled, the transportation case is securely fastened to the base so as to make the unit as a whole, watertight.

4-12. The cover of the HIGH FREQUENCY TRANSMITTER case, used to form the operating table, is removed from the brackets and fastened to its case.

4-13. The remaining covers for the INTERMEDIATE FREQUENCY TRANSMITTER and the RECTIFIER MODULATOR UNIT are also screwed on to make the three units watertight. The caps over the opening for the power plugs and the antenna connections are screwed into position. The three legs are removed from the assembly and it is placed upside down on the ground. The rods securing the bases of the equipment are removed and the three units separated. The securing rods are replaced in the carrying case from which they were originally obtained. The transmitter support legs are then placed in the second antenna mast carrying case.

4-14. The antennas are lowered and unclipped from their supporting halyards. The counterpoise is also removed by unclipping it from its supports. The antennas and counterpoise are then wound on the wire reels and stowed in the accessory carrying case.

4-15. To lower an antenna mast, first unfasten the lower set of guy ropes from their securing stakes. The top guys are unfastened from their securing stakes and each of the top guys is held by a member of the crew. The mast is lifted sufficiently and the sections removed one at a time. The cap is removed from the top mast section and the top guy ropes and antenna halyards are coiled. The mast sections are stowed in the canvas transportation bag. The guy stakes and the ground spikes are also placed in the transportation bag. The lower guys are coiled and the two sets of guys and their fastening collars are placed in the mast transportation case.

4-16. The same procedure is to be followed for lowering the second mast. The ground plates are placed in the accessory transportation case. The cases are now securely fastened and the equipment is ready for transportation.

V. CHOICE OF FREQUENCY AND METHOD OF COMMUNICATION

SKIP AND FADING DISTANCES

5-1. The high frequencies differ from the conventional intermediate frequencies in that a much greater communication range can be attained for a given power. This is in some measure due to considerably greater radiation efficiency of antennas at high frequencies. For the main part, however, the advantage of the high frequencies is due to their more efficient reflection (or refraction) by the Kennelly-Heaviside layer. This gives rise to a sky wave which may be effective at a considerable distance as compared with the direct wave which is soon lost as a result of high ground absorption. At high frequencies the sky wave is weak or entirely absent at a short distance from the transmitting station, but becomes effective at a considerable distance from it. At the same time, increasing ground absorption reduces the effective distance of the direct wave. As the frequency is raised, therefore, the skip zone commences earlier and persists over a greater distance. In the daytime, there is danger of a skip zone when frequencies above 6000 kcs. are used, while at night, frequencies as low as 4000 kcs. may exhibit skip distance. At frequencies not sufficiently high to give actual skip zones there may nevertheless be a zone of violent fading. This is generally noticeable at distances from 50 to 150 miles as a result of interference between the direct wave and the sky wave. If the direct wave is strengthened in comparison with the sky wave, the zone of critical communication due to fading or skip may be narrowed down or completely bridged over. One or more of the following methods may be practicable to obtain improvement in communication at moderate range:

(a) In case of serious voice distortion due to high frequency fading, radio telegraphy may still give excellent communication.

(b) For the most effective communication at distances between 50 and 150 miles, frequencies above 5000 kcs. should be avoided.

COMPARISON OF COMMUNICATION BY C.W., M.C.W., AND VOICE

C.W. Telegraphy

5-2. C.W. Telegraphy provides the greatest distance range and gives the least interference, both in the immediate vicinity of the transmitter and at a distance.

M.C.W. Telegraphy

5-3. (This paragraph is a general statement and is not to be confused with regulations regarding the use of M.C.W.). M.C.W. telegraphy is most valuable as an auxiliary to radio telephony during conditions of fading. Also, during initial calls and at other times when the transmitting operator is uncertain whether the receiver standing by for him is oscillating (heterodyne) condition, transmission by M.C.W. would appear the preferable method. After establishing communication by M.C.W., a change to voice communication may be made if conditions are favorable. If communication by M.C.W. is poor, a shift to C.W. generally results in improvement. When the emitted carrier lacks frequency stability due to excessive vibration or other cause, M.C.W. may be preferable to C.W.

Voice (Radio Telephone) Communication

5-4. This method, within its restricted distance range, offers the advantages of speed and effortless communication. Proper microphone technique (See Par. 6-17) and clear enunciation will often be found materially to extend the useful range of telephony. Voice communication is susceptible to easy interference by noises and electrical disturbances, and by the various forms of fading. Serious distortion of voice quality, especially at distances between 50 and 150 miles, is often the result of audio-frequency fading, and should not be attributed to the transmitting or receiving equipment. When depending upon voice communication, the selection of a favorable frequency is most important.

DISTANCE-FREQUENCY CHART

5-5. The following table is based upon general experience with high frequencies. Communication conditions on these frequencies may show appreciable variation from day to day. For any given distance, the best order of frequency not only varies with the time of day, but is also somewhat lower in winter time than during the summer. Average frequency ranges for best results over various communication distances are estimated below:

DISTANCE	ESTIMATED BEST FREQUENCY, KCS.		
Miles	Mid-day	Dawn or Dusk	Night
0-50	3000-4525	3000-4525	3000-4525
50-150	3000-4000	3000-4000	3000-4000
150-250	4000-6000	3500-4525	3000-4000
250-400	6000-8000	4000-6000	3500-4525
400-600	6000-9050	4500-7000	4000-6000
600-1000	8000-9050	6000-8000	4500-7000

VI. OPERATION

WARNING!

6-1. OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATOR OR OTHER POWER EQUIPMENT. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

GREAT CARE SHOULD BE EXERCISED WHEN OPERATING THE EQUIPMENT WITH ANY OF THE SHIELDS REMOVED FOR PURPOSE OF OBSERVATION OR BENCH TESTING. THE MAIN POWER SWITCH SHOULD BE TURNED "OFF" AND THE HIGH VOLTAGE CIRCUITS GROUNDED BEFORE ANY INTERNAL PART IS TOUCHED WITH THE BARE HAND.

CAUTION SHOULD BE OBSERVED WHEN OPERATING THIS EQUIPMENT FOR TEST PURPOSES IN THE VICINITY OF OTHER TRANSMITTING EQUIPMENT. DUE TO THE RELATIVELY HIGH POWER OUTPUT OF THIS EQUIPMENT, OPERATION IN THE VICINITY OF OTHER TRANSMITTING EQUIPMENT MAY CAUSE FLASH-OVER OR ARCS IN THE REMOTE EQUIPMENT SHOULD THE ANTENNAS BE RESONANT. TESTING SHOULD BE DONE ON 1/4 POWER UNDER THIS CONDITION.

CONTROLS

6-2. Before proceeding with the preliminary adjustment of the equipment, the operator should thoroughly familiarize himself with the functions and locations of the various controls. These are completely described in Part III of this book.

PRELIMINARY ADJUSTMENT - GENERAL
(FOR OPERATION OF ENGINE GENERATOR UNIT, SEE SECTION XII).

6-3. Before applying any power or attempting any preliminary adjustment of the equipment, the POWER switches on the RECTIFIER MODULATOR UNIT should be checked to see that they are in the OFF position. The A.C. VOLTAGE COMPENSATION should have the 4 MFD. switch ON. THE POWER CONTROL switch should be in the TUNE position. The I.F.-H.F. TRANSFER SWITCH should be set either to I.F. or H.F., depending on which transmitter is to be operated. As the adjustment of the HIGH FREQUENCY TRANSMITTER will be discussed first, this switch should be placed in the H.F. position. The EMISSION switch should be set for C.W. operation.

Preliminary Adjustment

6-4. The radio frequency adjustment must generally be made after the power is applied. However, the master oscillator range switch, M.O. RANGE Control "A"; master oscillator tuning control, M.O. TUNING Control "B"; doubler circuit range switch, DOUBLER RANGE Control "C"; doubler circuit tuning control, DOUBLER TUNING Control "D"; intermediate amplifier range switch, INT. AMP. RANGE Control "E"; and intermediate amplifier circuit tuning control, INT. AMP. TUNING Control "F" may be set approximately by reference to the calibration chart. The power amplifier circuit tuning control, P. A. TUNING Control "G", may also be set approximately to frequency by reference to the calibrated nameplate. The ANT. COUPLING Control "K" should be set to zero. After checking as above, start the ENGINE GENERATOR SET and move the A.C. POWER switch on the RECTIFIER MODULATOR UNIT to the ON position. Turn the LINE VOLTS-FILAMENT VOLTS switch to the LINE position and see that the voltage is 120 volts. If it is not, see Section XIV. Now turn the switch to the FILAMENT position and adjust to indicate 10 volts by turning the control marked FILAMENT until the meter indicates properly.

6-5. The telegraph key with cable and plug should be inserted in the keying circuit by means of the KEY jack. After allowing 30 seconds for filament warm up, move the D.C. POWER switch to the ON position. Pressing the key should energize the keying relay. This applies 500 volts from the auxiliary rectifier to the master oscillator and intermediate amplifier circuit. If the keying relay does not operate, the tube access door on the RECTIFIER MODULATOR UNIT should be inspected to see that the interlock circuit is properly closed.

6-6. Press the telegraph key and resonate the doubler tuning circuit by means of the DOUBLER TUNING Control "D". Resonance will be indicated by maximum grid current on the intermediate amplifier grid current meter (I.A. GRID CURRENT). Next, resonate the intermediate amplifier circuit by means of the INT. AMP. TUNING Control "F". Resonance will be indicated by maximum grid current on the power amplifier grid current meter (P.A. GRID CURRENT). Set the POWER CONTROL switch on the RECTIFIER MODULATOR UNIT to the 1/4 tap. When the key is pressed, this will apply approximately 1200 volts to the plate of the power amplifier tube. Press the key and resonate the power amplifier circuit. This is best accomplished by starting from a low value of dial reading on P.A. TUNING Control "G" and rotating the control knob until the power amplifier plate current meter, P.A. PLATE CURRENT, located in the RECTIFIER MODULATOR UNIT, dips downward to a

6-6. (Cont'd.)

minimum value. When the doubler circuit, intermediate amplifier and power amplifier circuits have been properly resonated, the intermediate amplifier grid current meter, I.A. GRID CURRENT, will indicate approximately 6 milliamperes, while the power amplifier grid current meter, P.A. GRID CURRENT, will indicate approximately 40 milliamperes, and the power amplifier plate current meter, P.A. PLATE CURRENT, will indicate approximately 45 milliamperes.

6-7. Set the antenna coupling, ANT. COUPLING Control "K" to approximately 25 divisions. Set the antenna tuning capacitor, ANT. TUNING CAPACITOR Control "I", at approximately 50 divisions. Set the antenna feed switch, ANTENNA FEED Control "H", in the CURRENT or #1 position. Press the key and rotate the knob of the antenna tuning inductance, ANT. INDUCTANCE Control "J", until a rise in power amplifier plate current is noted on the P.A. PLATE CURRENT meter. If no adjustment can be found that indicates resonance, change the ANTENNA FEED Control "H", to the VOLTAGE or #2 position. When the point has been found at which resonance occurs, and both controls "I" and "J" have been adjusted for maximum indication on the power amplifier plate current meter, readjust the antenna coupling ANT. COUPLING Control "K", until the power amplifier plate current indicates approximately 90 milliamperes. The power amplifier tuning, P.A. TUNING Control "G" should be readjusted for minimum power amplifier plate current.

Final Adjustment

6-8. With the equipment operating satisfactorily on the 1/4 power tap, set the POWER CONTROL switch to FULL power. Pressing the key will apply 2000 volts to the plate of the power amplifier tube. Press the key and readjust the power amplifier tuning, P.A. TUNING Control "G", antenna tuning, ANT. TUNING CAPACITOR Control "I", ANT. INDUCTANCE Control "J", and antenna coupling, ANT. COUPLING Control "K" for optimum adjustment. The power amplifier plate current meter P.A. PLATE CURRENT should not exceed the red line or 175 milliamperes. If it does exceed 175 milliamperes reduce ANT. COUPLING Control "K" until the proper plate current is indicated. The voltage compensation switches, A.C. VOLTAGE COMPENSATION, on the RECTIFIER MODULATOR UNIT should now be set so that keying the transmitter does not cause the filament voltage, as indicated by the LINE VOLTS-FILAMENT VOLTS meter, to fluctuate more than approximately 0.2 volt. In general, it has been found that a capacitance of approximately 4 microfarads is the correct compensation for the full load operation. This is in addition to the 6 microfarads of fixed capacity that is continuously connected in the circuit.

6-9. When all adjustments are considered satisfactory they may be recorded for future reference. It is desirable, also, that the operator note all meter readings and other observations which may aid in resetting the equipment.

6-10. For tuning of the equipment into a 1/4 or 3/4 wave antenna the procedure is same as for tuning into a 1/2 wave antenna except that the voltage current feed switch, ANTENNA FEED Control "H", is set in the CURRENT or #1 position.

CAUTION: Do not operate the power amplifier plate current at a value greater than 175 milliamperes as indicated by the red line on the meter.

INTERMEDIATE FREQUENCY TRANSMITTER TYPE CAY-52238

Preliminary Adjustment

6-11. Set the I.F.-H.F. TRANSFER SWITCH on the RECTIFIER MODULATOR UNIT to the I.F. position. Set the POWER CONTROL switch to the TUNE position. The master oscillator range switch, M.O. RANGE Control "A", the master oscillator tuning, M.O. TUNING Control "B", the power amplifier range switch, POWER AMP. RANGE Control "C" may be set to the desired frequency by reference to the calibration chart. Set the antenna coupling, ANT. COUPLING Control "G", to the minimum or zero position. With the power supply in operation, closing the A.C. POWER switch on the RECTIFIER MODULATOR UNIT, allowing 30 seconds for filament warm-up, closing the D.C. POWER switch, and pressing the transmitter key will apply power to the transmitter. With the POWER CONTROL switch in the TUNE position, approximately 500 volts will be applied to the plate circuit of the master oscillator and intermediate amplifier. The power amplifier grid current meter, P.A. GRID CURRENT, should indicate approximately 40 milliamperes. Set the POWER CONTROL switch on the RECTIFIER MODULATOR UNIT to the 1/4 power position. Press the telegraph key and resonate the power amplifier circuit by means of P.A. TUNING Control "D" for minimum power amplifier plate current as indicated on the P.A. PLATE CURRENT meter in the RECTIFIER MODULATOR UNIT. Under this condition, pressing the key applies approximately 1200 volts to the plate of the power amplifier tube. In the resonance position, the power amplifier plate current meter should be indicating approximately 45 milliamperes. To adjust the antenna circuit, first set the antenna coupling, ANT. COUPLING Control "G", to approximately 10 divisions. Set the ANTENNA TUNING STEP Control "E" on tap #1 and rotate ANT. TUNING Control "F" throughout the range of the dial from 0 to 100 divisions. If no indication of a current rise is noted on the P.A. PLATE CURRENT meter, set the ANTENNA TUNING STEP Control "E" on tap #2 and repeat the rotation of the ANT. TUNING Control "F". Repeat the process on each step of Control "E" until a rise in the power amplifier plate current is noted

6-11.(Cont'd.)

When the resonance point has been found, adjust the antenna coupling, ANT. COUPLING Control "G", until the power amplifier plate current is 90 milliamperes.

Final Adjustment

6-12. With the equipment operating satisfactorily on the 1/4 power tap, set the POWER CONTROL switch to the FULL power position and press the key. This will apply 2000 volts to the plate of the power amplifier tube. Adjust the antenna coupling ANT. COUPLING Control "G", until the power amplifier plate current is 175 milliamperes as indicated on P.A. PLATE CURRENT meter (pointer at the red line). Check the adjustment of the power amplifier tuning for best overall condition.

6-13. When these adjustments are considered satisfactory, they may be recorded for future reference. It is desirable also that the operator note all meter readings and other observations which may aid in the resetting of the equipment.

FREQUENCY ADJUSTMENT FACILITIES

6-14. Binding posts marked CFI are provided on the I.F. and H.F. transmitters for connection to a cyrstal frequency indicator. These binding posts are connected to the master oscillators through a ground circuit in such a manner that sufficient energy will be provided to the crystal frequency indicator to allow easy adjustment of the master oscillators to the desired frequency. The oscillator of the INTERMEDIATE FREQUENCY TRANSMITTER is always used at the same frequency as the output of the equipment and may be set with the crystal frequency indicator to the output frequency desired. However, the HIGH FREQUENCY TRANSMITTER MASTER oscillator never operates at the output frequency. For any output frequency range, the oscillator frequency range is shown on the nameplate in the green filled blocks. The approximate oscillator frequency may be obtained from the calibration curve, Fig. 23 Curve #264479. During checking or calibration of frequency, the POWER CONTROL switch on the RECTIFIER MODULATOR UNIT should be in the TUNE position. If desired, the receiver can also be used to monitor the transmitter to the same frequency as some received signal. This is accomplished by first tuning the receiver on C.W., to zero beat with the incoming signal. Then, the transmitter master oscillator frequency is varied until it is set to zero beat with the receiver, and its frequency then equals that of the previously received signal. In order to avoid false settings due to beat notes from harmonics, it is necessary that the

6-14. (cont'd)

operator assure himself, by the approximate calibration of the transmitter, that he is near the desired frequency before obtaining the exact setting with the aid of the Crystal Frequency Indicator or the receiver. After tuning the master oscillator to the correct frequency, the POWER CONTROL switch should be turned to the 1/4 power position and the intermediate amplifier and power amplifier tuning control should be adjusted for optimum operation.

M.C.W. OPERATION

6-15. After the transmitters have been adjusted as previously described for C.W. operation, they may be operated on M.C.W. by setting the EMISSION switch to MCW. No other change in adjustment is required.

6-16. Reduced power operation may be obtained by setting POWER CONTROL switch to 1/4 or 1/2 power whichever is desired; no other changes are necessary.

VOICE OPERATION

6-17. Tune the transmitters as previously described for C.W. Then set the EMISSION switch to the VOICE position. Plug in the microphone plug in the MIC. jack on the RECTIFIER MODULATOR UNIT. Pressing the button on the microphone will operate the keying relay and energize the microphone. The microphone should be held close to the mouth and the operator should speak in a normal manner. The audio volume control R-211, located on the top floor of the RECTIFIER MODULATOR UNIT has been set to give the proper percentage of modulation under this condition. If it is desired to increase or decrease the percentage of modulation, the control may be adjusted. Turning the control counter-clockwise increases the percentage of modulation.

SIDE TONE VOLUME CONTROL

6-18. With the transmitter in operation, the amount of side tone delivered to the receiver can be varied by the SIDE TONE volume control on the RECTIFIER MODULATOR UNIT. **Turning the control clockwise increases the output of the side tone.**

ROUTINE OPERATION

6-19. When the INTERMEDIATE FREQUENCY TRANSMITTER and HIGH FREQUENCY TRANSMITTER have been tuned to the frequencies desired, the normal routine operation of this equipment is as follows:

1. Start the ENGINE GENERATOR SET, following operating instructions given in Section XIV.

2. Move the I.F.-H.F. TRANSFER SWITCH on RECTIFIER MODULATOR UNIT to the transmitter desired.

3. Place the A.C. POWER switch in the ON position and check the filament voltmeter to see that it is indicating normal voltage. After 30 seconds have elapsed, close the D.C. POWER switch.

4. No other adjustments are normally required, but it is desirable that the antenna current and plate current meters be occasionally observed to see that their indications are normal.

6-20. During normal operation, and for short stand-by periods the A.C. and D.C. POWER switches may be left in the ON position. However, at the completion of a communication, or if there is to be a long period of inactivity of the equipment, the A.C. and D.C. POWER switches should be moved to the OFF position.

CHANGING FREQUENCIES

6-21. The following is the procedure required for shifting from one frequency to another:

1. HIGH FREQUENCY TRANSMITTER TYPE CAY-52239

   (a) Unlock all tuning dials

   (b) Set M.O. RANGE Control "A"

   (c) Set M.O. TUNING Control "B"

   (d) Set DOUBLER RANGE Control "C"

   (e) Set DOUBLER TUNING Control "D"

   (f) Set INT. AMP. RANGE Control "E"

   (g) Set INT. AMP. TUNING Control "F"

6-21 (cont'd)

(h) Set P.A. TUNING Control "G"

(i) Set ANTENNA FEED Control "H"

(j) Set ANT. TUNING CAPACITOR Control "I"

(k) Set ANT. INDUCTANCE Control "J"

(l) Set ANT. COUPLING Control "K"

(m) Lock tuning dials

2. INTERMEDIATE FREQUENCY TRANSMITTER TYPE CAY-52238

(a) Unlock all tuning dials

(b) Set M.O. RANGE Control "A"

(c) Set M.O. TUNING Control "B"

(d) Set POWER AMP. RANGE Control "C"

(e) Set P.A. TUNING Control "D"

(f) Set ANTENNA TUNING STEP Control "E"

(g) Set ANT. TUNING Control "F"

(h) Set ANT. COUPLING Control "G"

(i) Lock tuning dials

PERFORMANCE

6-22. The power output rating of the Navy Model TBW-4 Portable Radio Transmitting Equipment is as follows:

	Frequency	Watts C.W. or M.C.W.	Watts Voice (Unmodulated Carrier)
INTERMEDIATE FREQUENCY TRANSMITTER	350 to 1000 Kcs.	100	25

6-22. (Cont'd)

	Frequency	Watts C.W. or M.C.W.	Watts Voice (Unmodulated Carrier)
HIGH FREQUENCY TRANSMITTER	3000 to 18100 Kcs.	100	25

6-23. The actual power output of the equipment will generally be much greater than the rated power output. For actual data regarding the power output performance, the reader is referred to the typical test data (Fig.54) in the back of this book. The power taken from the power-source is also shown in this data.

RESETABILITY

6-24. The reset accuracy of the equipment is such that after adjusting the transmitter for operation at any frequency within its range, noting settings, and then completely detuning, it is possible to reset the transmitter with an accuracy of .02% when approaching the setting in either direction. For best accuracy, however, it is good policy to make final adjustments in the direction in which the dial reading increases.

6-25. The accuracy of the typical calibration curves in this book is approximately plus or minus 2%.

VII. MAINTENANCE

ROUTINE INSPECTION

7-1. In the interest of avoiding trouble, the radio installation should be thoroughly inspected at least every 30 hours of operation. Check particularly the following points:

Check for Looseness and Wear

7-2. 1. Loosening of the mountings of the units and the screws and nuts in general.

2. Mechanical and electrical condition of all cables and plugs.

Cleaning and Adjusting

7-3. 1. Check the condition of all fuses to see that their ferrules have not become corroded and clean them with fine crocus cloth, if necessary.

2. Check all vacuum tube contacts to see that they have not become loose or corroded, and clean them with fine crocus cloth, if necessary.

3. Examine the keying relay contacts for excessive wear. Do not adjust the relay unless absolutely necessary. Refer to Fig. 25 for necessary adjustment.

4. Wipe all ceramic insulators, switches, etc. free from dirt or dust.

5. Keep rotating coils clean and free from dust. The silver coil wire and silver coated roller should require no attention. The brass rod on which the roller travels should, under normal conditions, require no attention. Should the rod become corroded, it should be polished bright and clean with a very fine grade of crocus cloth. Make certain that no abrasive remains on the rod. Do not apply any lubricant to rod.

6. Special attention should be given to the master oscillator range switches in both transmitters. The contact surface should be kept clean and free from all lubricant. Do not clean with an abrasive. Use only a soft cloth and carbon tetrachloride. Avoid bending the thin switch blades during handling.

7. Should the equipment be exposed to the effects of salt water spray, it should be wiped clean and dry, removing all traces of moisture. A very small amount of light oil on a soft cloth wiped over the etched nameplates will preserve the finish and prevent the corrosive action of salt water spray.

Engine Generator Unit

7-4. See Section XII for maintenance.

7-5. All of the aluminum used in the equipment has been treated to resist the effects of salt water spray. Should this surface treatment be scratched or broken, seal the exposed surface with clear lacquer. Care should be given to see that after any screws or nuts have been removed, the surfaces under the lockwashers are properly treated with clear lacquer. Electrical contact must be maintained, however, in the case of grounding screws.

REPLACEMENTS

7-6. The only components which may normally be expected to require occasional replacement are the vacuum tubes. In general, however, whenever the performance of the equipment is below its previous standard, the tubes should be checked by comparison with fresh tubes. For replacement parts on ENGINE GENERATOR UNIT see Section XII.

7-7. If, due to abnormal conditions, other components such as transformers, reactors, resistors, etc., fail, they should be replaced by similar units as listed under the heading of "PARTS LIST - PART IX."

LUBRICATION

7-8. The tuning dial bearings, the rotating coil bearings, variable capacitor bearings, and the switch bearings should be lubricated once every six months with a few drops of light penetrating oil, such as a good typewriter oil.

KEYING RELAY

7-9. Once a year or as required, the keying relay plunger should be removed from the relay and carefully wiped off using only a soft cloth and carbon tetrachloride. The plunger may be removed from the relay by removing the two top contact boards, the back stop nut and damper assembly (nut, screw, spring and plunger). Make certain that the plunger is thoroughly dry before reassembling the relay. No lubricant should be used. Readjust relay after reassembly per Fig. 25.

VIII. LOCATION OF TROUBLES

WARNING!

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATOR OR OTHER POWER EQUIPMENT. UNDER CERTAIN CONDITIONS, DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE "OFF" POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

GREAT CARE SHOULD BE EXERCISED WHEN OPERATING THE EQUIPMENT WITH ANY OF THE SHIELDS REMOVED FOR PURPOSES OF OBSERVATION OR BENCH TESTING. THE MAIN POWER SWITCH SHOULD BE TURNED "OFF" AND THE HIGH VOLTAGE CIRCUITS GROUNDED BEFORE ANY INTERNAL PART IS TOUCHED WITH THE BARE HAND.

THE ATTENTION OF ENGINEER OFFICERS, RADIO OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF ENGINEERING CIRCULAR LETTER NO. 5a OF 3 OCTOBER 1934, OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO--SAFETY PRECAUTIONS TO BE OBSERVED."

GENERAL

8-1. In case the equipment appears inoperative, it is suggested that the following points be determined before looking for defective circuits:

1. Is the power supply connected?

2. Are both POWER switches on the RECTIFIER MODULATOR UNIT turned ON and are all other switches in proper positions?

3. Are all fused circuits complete and are the fuses making good contact in their clips?

4. Are all connecting plugs properly inserted and making good contact?

5. Have any vacuum tubes been damaged and do all filaments light properly?

6. Will the equipment operate when a different type of transmission is chosen by the EMISSION switch?

8-2. For checking operation of the various circuits in attempting to locate any trouble, the most necessary instrument is a voltmeter having a resistance of approximately one thousand ohms per volt. An indicating circuit tester or "ohm-meter" will also prove of value for this work.

8-3. The various diagrams in the rear of this book will also be of value. For actual tracing of circuits in trouble location, the wiring diagrams should be referred to in preference to the simplified schematic diagram. On Fig. 55 are listed typical test currents and voltages for various portions of the circuit and for different types of emission. While these values will vary somewhat in different equipments and under different conditions, comparison of measured voltages and currents with the tabulated values will often prove of assistance.

INSUFFICIENT DISTANCE RANGE

8-4. This may be due to the following general causes:

1. Unsuitable frequencies. Refer to Par. 5-5.

2. Variable propagation condition. (On high frequencies, considerable variation may occur from day to day). Refer to Par. 5-5.

3. Improper antenna connections. Refer to Part IV Par. 4-7.

FADING OR POOR SIGNAL QUALITY

8-5. Fading is encountered at both slow and rapid rates, sometimes so fast that it makes itself more evident by distortion of signals than by noticeable fluctuation in volume. Fading may often be reduced by changing to a different communication frequency. Vibrations may modulate the transmitter frequency by means of vibrating tuning capacitor plates, or by loose elements, especially in the master oscillator tubes. This may be checked by replacing the master oscillator tubes.

1. An excessive "growl" or "rattle" modulation in the transmitter output, usually accompanied by a reduction in the supply voltage, may be due to a partial breakdown in the generator.

2. A vibration modulation or unsteady C.W. note may be due to the frequency control not being locked or the transmitter not free to vibrate on its rubber shock-mounts.

3. Radio frequency "lilt" or poor keying on C. W. or M.C.W. will be caused by improper setting of the A.C. VOLTAGE COMPENSATION.

SIGNALS OFF FREQUENCY

8-6. Signals steady but off frequency may be due to an error in the calibration of the master oscillator or slippage of the master oscillator capacitor or the dial on the shaft.

1. Calibration of the master oscillator should be checked occasionally, and if found to be more than ±2% off frequency as compared with curves Figs. 26 and 28 or previous claibrations, the dial readings should be brought back to previous calibration. This can be accomplished by adjusting C101 in the INTERMEDIATE FREQUENCY TRANSMITTER and C301 in the HIGH FREQUENCY TRANSMITTER. Check points 300 Kcs. and 3000 Kcs. for the INTERMEDIATE FREQUENCY and HIGH FREQUENCY TRANSMITTER, respectively.

POWER SOURCE TROUBLES

8-7. Power supply trouble may be responsible for the following:

1. Keying relay refuses to operate:
   (a) Fuse F203 open or blown.
   (b) Interlock not closed.

2. Keying relay chatters when key is closed.
   (a) Excessive resistance in battery line or connection to key.

3. Excessive voltage ripple in power supply (1600 cycles carrier modulation).
   (a) Filter capacitor open or disconnected.

4. Keying relay operates and filaments light, but high voltage D.C. not available.
   (a) High voltage rectifier tubes short or open.
   (b) Fuse F202 open or blown.

R. F. CIRCUIT TROUBLES

8-8. 1. Circuit trouble in master oscillator circuit may be due to:

   (a) Poor contact in master oscillator range switch (Control "A").
   (b) Damaged master oscillator tube. Try replacing with spare.
   (c) Open grid leak.
   (d) Fuse F201 open or blown.

2. Circuit trouble in intermediate amplifier and power amplifier circuits may be due to:
   (a) Improper tuning adjustment.
   (b) Open grid resistor.
   (c) Poor contact in range switches or rotating coils.
   (d) Insufficient excitation from master oscillator or intermediate amplifier. Try replacement tubes.

3. Trouble in antenna circuit and coupling may be due to:
   (a) Antenna current meter open.
   (b) Electrical breakdown at lead-out insulator.
   (c) Partial ground on antenna or counterpoise, such as tree branch, etc.

4. "Lilting" note, when keying may be due to:
   (a) Improper adjustment of A.C. VOLTAGE COMPENSATION.

5. Excessive ripple may be the result of:
   (a) Rectifier filter capacitors open.
   (b) Faulty range switch contacts.
   (c) Defective master oscillator or rectifier tube.
   (d) Shock-mountings not free (object wedged under or above transmitter).

SIDE TONE TROUBLES

8-9. 1. If side tone absent look for:
   (a) Faulty operation of contacts 7 and 3 of keying relay K101 or K301.
   (b) Resistor R203 or R204 open or shorted.
   (c) Broken phone cord or faulty plugs.

2. If side tone is too weak, the trouble may be:
   (a) Improper impedance or defective phones.
   (b) Poor contacts in keying relay K101 or K301.
   (c) Defective volume control.

3. If side tone is too strong, the trouble may be:
   (a) The adjustment of R204 is set too high.
   (b) R203 shorted.

VOLTAGE BREAKDOWN

8-10. 1. Voltage breakdown may be caused by:
   (a) Keying relay contacts set too close.
   (b) Moisture in plugs or jacks.
   (c) Air capacitor plates out of alignment.
   (d) Insufficient antenna coupling.

RECEIVER TROUBLES

8-11. 1. Receiver howl or feedback may be caused by poor or improper adjustment of antenna back contacts of keying relay K101, K301. See Fig. 25 for adjustment.

2. No reception through keying relay:
   (a) Receiver antenna contacts fail to close.

3. Reception weak:
   (a) Receiver antenna alignment needs retrimming.

4. Receiver noisy:
   (a) Chattering contacts in relay, need re-adjusting.
   (b) Faulty regulator or filter in generator control box.

TABLE I

LIST OF MAJOR UNITS FOR MODEL TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

	QUANTITY		NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	SYMBOL GROUP OR UNIT NUMBER	ASSEMBLY DRAWING
	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE				
	1	1	CAY-52238	I.F. TRANSMITTER UNIT	101 TO 199	DL-7502121 G11
				WATER TIGHT CASE	P-203B, P-205B	DL-7502124 G15
	1	1	CAY-20084	RECTIFIER-MODULATOR UNIT	201 TO 299	DL-7502121 G12
				WATER TIGHT CASE		DL-7502124 G16
	1	1	CAY-52239	H.F. TRANSMITTER UNIT	301 TO 399	DL-7502121 G10
				WATER TIGHT CASE	P-204C, P-206C	DL-7502124 G14
	1	1	CDO-21647	A.C./D.C. GENERATOR FOR ENGINE	701 TO 710	DL-7502407 G13
	1	1	CDO-18010	GASOLINE ENGINE	711 TO 720	DL-7502407 G13
◊	1	1	CDO-21650	A.C./D.C. GENERATOR FOR M.G. SET	801 TO 810	DL-7502407 G16,G19
◊		1	CAY-21649	REPULSION INDUCTION MOTOR	811 TO 820	DL-7502407 G16
◊		1	CAY-21651	MAGNETIC CONTROLLER	821 TO 830	DL-7502407 G16
◊	1		CAY-21653	REPULSION INDUCTION MOTOR	831 TO 840	DL-7502407 G19
◊	1		CAY-21654	MAGNETIC CONTROLLER	841 TO 850	DL-7502407 G19
	X	X		PUSH BUTTON STATION	851 TO 860	DL-7502407 G16,G19
	X	X		ANTENNA SYSTEM	1101 TO 1120	DL-7502122 G13
				ACCESSORIES		
	X	X		INTERCONNECTION CABLES	1201 TO 1220	DL-7502136 L12
	X	X		CANVAS COVER		DL-7502127 G4
	X	X		SOLDERING IRON		DL-7502136 L1
	X	X		MICROPHONE		DL-7502136 L4
	X	X		TELEGRAPH KEY		DL-7502136 L5
	X	X		TOOL KIT		DL-7502136 L13
	X	X		GASOLINE CONTAINER		DL-7502407 G14
	X	X		OIL CONTAINER		DL-7502407 G11
	1	1	CDO-73004-A	GASOLINE ENGINE GENERATOR COMPLETE WITH BASE AND WATER TIGHT CASE		
◊		1	CDO-21648	MOTOR GENERATOR COMPLETE WITH BASE		
◊	1		CDO-21652	MOTOR GENERATOR COMPLETE WITH BASE		

◊ SOME EQUIPMENTS ARE SUPPLIED LESS MOTOR GENERATOR SETS IN WHICH CASE SYMBOLS 801 TO 850, INCLUSIVE WILL NOT BE SUPPLIED.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS						
X	X	*C-101	KEYER SPARK FILTER CAPACITOR	0.5 MFD., 400 V.D.C. WORKING, PAPER	-48205-A	RE13A488C	25			T-7606408 P1
X	X	*C-102	M.O. TANK CAPACITOR	0.005 MFD. ±2%, 2000 V. EFF. TEST, #(8.5, 6.5, 4, 2) MICA, CONSTANT CAPACITY	-48702-D2	RE48AA131	24			T-7606408 P2
X	X	*C-103	M.O. TANK CAPACITOR	0.0012 MFD., ±2%, 2000 V. EFF. TEST, MICA	-481213-F2	RE48AA131	24			T-7606408 P3
X	X	*C-104	M.O. GRID BLOCKING CAPACITOR	0.002 MFD., 2500 V.D.C. TEST, 1200 V.D.C. WORKING, MICA	-48642-B10	RE48AA112N	25			T-7606408 P4
		C-105	NOT USED							
X	X	*C-106A	M.O. FILAMENT BY-PASS CAPACITOR	2 X 0.1 MFD., 400 V.D.C. WORKING, PAPER	-48313-A	RE13A488C	25			T-7606408 P33
X	X	*C-106B	M.O. FILAMENT BY-PASS CAPACITOR	PART OF C-106A						
		C-107	NOT USED							
X	X	C-108	I.A. GRID COUPLING CAPACITOR	30 MMF., MAX., 5.2 MMF. MIN., 20 PLATES, VARIABLE, AIR			14	HF-30-X		T-7606408 P8
X	X	*C-109	I.A. GRID BY-PASS CAPACITOR	0.01 MFD., 1000 V.D.C. TEST, 600 V. D.C. WORKING, MICA	-48487-10	RE48AA112N	25 30			T-7606408 P9
X	X	*C-110	I.A. SCREEN BY-PASS CAPACITOR	0.02 MFD., 1000 V.D.C. TEST., 600 V. D.C. WORKING, MICA	-48428-10	RE48AA112N	25 30			T-7606408 P10
X	X	*C-111	I.A. PLATE COUPLING CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-112	I.A. PLATE BY-PASS CAPACITOR	SAME AS C-110	-48428-10					

*SPARE PARTS FURNISHED REFER TO TABLE IV.
#CURRENT RATING AT (3000, 1000, 300, 100) KC.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
		C-113	NOT USED							
X	X	*C-114	P.A. GRID SHUNTING CAPACITOR	0.00005 MFD., 2500 V.D.C. TEST 1200 V.D.C. WORKING, MICA	-48744-10	RE48AA112N	25 30			T-7606408 P14
X	X	*C-115	P.A. GRID METER BY-PASS CAPACITOR	0.006 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	-48410-10	RE48AA112N	25 30			T-7606408 P15
X	X	*C-116	P.A. GRID BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-117	P.A. FILAMENT BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-118	P.A. FILAMENT BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-119	P.A. SCREEN BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-120	P.A. SUPPRESSOR BY-PASS CAPACITOR	SAME AS C-104	-48642-B10					
X	X	*C-121	P.A. TANK CAPACITOR	0.00025 MFD. ±2%, 5000 V. EFF. TEST, 2.5 AMPS. AT 1000 KC., 1 AMP. AT 300 KC., MICA	-48334-2	RE48AA131C	25			T-7606408 P21
X	X	*C-122	P.A. TANK CAPACITOR	0.0002 MFD. ±2%, 5000 V.EFF. TEST, #(3.5, 2, 0.7, 0.25), MICA	-481105-2	RE48AA131C	25			T-7606408 P22
X	X	*C-123	P.A. TANK CAPACITOR	0.00035 MFD. ±2%, 5000 V. EFF. TEST. #(8, 5, 2, 0.8), MICA	-48514-2	RE48AA131C	25			T-7606408 P23
X	X	*C-124	P.A. PLATE BY-PASS CAPACITOR	0.005 MFD., 3000 V. EFF. TEST, #(9,6.5,4,2), MICA	-48406-5	RE48AA131C	25			T-7606408 P24

*SPARE PARTS FURNISHED REFER TO TABLE IV.
#CURRENT RATING AT (3000, 1000, 300, 100) KC.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
X	X	C-125	M.O. CALIBRATION RESET CAPACITOR	25 MMF. MAX., 5 MMF. MIN., VARIABLE, AIR			14	MC #1872	K-7809663 P1	T-7606408 P25
X	X	C-126	COMPENSATING CAPACITOR	BI-METALLIC 5/16" SPACING AT 20°C			1		P-7706968 G1	T-7606408 P26
X	X	*C-127	M.O. TANK CAPACITOR	0.0005 MFD. ±2%, 3000 V.EFF. TEST, #(4, 2, 1, 0.55), MICA, CONSTANT CAPACITY	-48583-D2	RE48AA131C	24			T-7606408 P27
X	X	*C-128	M.O. PLATE BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-129	I.A. CATHODE BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-130	P.A. TANK CAPACITOR	SAME AS C-123	-48514-2					
X	X	*C-131	ANTENNA SERIES CAPACITOR	0.002 MFD., 6000 V. EFF. TEST, 6 AMPS. AT 1000 KC., 4 AMPS. AT 300 KC., MICA	-48279-5	RE48AA131C	25			T-7606408 P31
X	X	*C-201	A.C. VOLTAGE COMPENSATING CAPACITOR	8, 5, 4, 2, 1 MFD., 250 VOLTS, ONE COMMON TERMINAL RATED 6 AMPS., 600 TO 800 CYCLE	-48707	RE13A488C	25			T-7606408 P37
X	X	*C-202	H.V. FILTER CAPACITOR	3.0 MFD., 2000 V.D.C., PAPER	-48906	RE13A488C	1	S#1087313		T-7606408 P38
X	X	*C-203	METER BY-PASS CAPACITOR	SAME AS C-115	-48410-10					
X	X	*C-204	L.V. FILTER CAPACITOR	1.0 MFD., 600 V.D.C. WORKING, PAPER	-48498-A	RE13A488C	25			T-7606408 P40
X	X	*C-205	L.V. FILTER CAPACITOR	SAME AS C-204	-484981A					
X	X	*C-206	AUDIO BY-PASS CAPACITOR	2.0 MFD., 400 V.D.C. WORKING, PAPER	-48403-A	RE13A488C	25			T-7606408 P42
X	X	*C-207	METER BY-PASS CAPACITOR	SAME AS C-115	-48410-10					
X	X	*C-208	AUDIO GRID BY-PASS CAPAPCITOR	SAME AS C-101	-48205-A					

*SPARE PARTS FURNISHED REFER TO TABLE IV.
CURRENT RATING AT (3000, 1000, 300, 100) KC.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
X	X	*C-209	D.C. FILTER CAPACITOR	25 MFD., 25 V.D.C. WORKING, ELECTROLYTIC	-481095	RE13A549A	25			T-7606408 P45
X	X	*C-210	BIAS FILTER CAPACITOR	SAME AS C-206	-48403-A					
X	X	*C-211	METER BY-PASS CAPACITOR	SAME AS C-115	-48410-10					
X	X	*C-301	KEY SPARK FILTER CAPACITOR	SAME AS C-101	-48205-A					
X	X	*C-302	M.O. TANK CAPACITOR	0.00025 MFD. ±2%, 2500 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C. FROM -32°C. TO +65°C.	-481134-Z2	RE48AA131	2	1053-6K		T-7606408 P53
X	X	*C-303	M.O. TANK CAPACITOR	0.0006 MFD. ±2% 2500 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C. FROM -32°C. TO +65°C.	-481135-Z2	RE48AA131	2	1066-6K		T-7606408 P54
X	X	*C-304	M.O. TANK CAPACITOR	0.00075 MFD. ±2%, 2500 V. EFF.TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C. FROM -32°C. TO +65°C.	-481136-Z2	RE48AA131	2	1023-6K		T-7606408 P55
X	X	*C-305	M.O. TANK CAPACITOR	0.003 MFD. ±2%, 2000 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C. FROM -32°C. TO +65°C.	-481137-Z2	RE48AA131	2	1031-6K		T-7606408 P56
		C-306	NOT USED							
X	X	*C-307	M.O. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-308	M.O. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-309	M.O. SCREEN BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	*C-310	M.O. PLATE BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	C-311	M.O. PLATE COUPLING CAPACITOR	SAME AS C-125						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
X	X	C-312	DOUBLER CIRCUIT TUNING CAPACITOR	150 MMF., 31 PLATES WITH 0.07" SPACING, VARIABLE, AIR			14	MTC-150-B	T-7606108 P2	T-7606408 P63
X	X	*C-313	I.A. GRID BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-314	I.A. GRID COUPLING CAPACITOR	0.00004 MFD. ±2%, 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	-48667-B2	RE48AA112N	25 30			T-7606408 P65
X	X	*C-315	I.A. GRID METER BY-PASS CAPACITOR	SAME AS C-115	-48410-10					
		C-316	NOT USED							
X	X	*C-317	I.A. SCREEN BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-318	I.A. SUPPRESSOR BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-319	I.A. PLATE BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	C-320	I.A. TUNING CAPACITOR	SAME AS C-312						
X	X	*C-321	METER BY-PASS CAPACITOR	SAME AS C-115	-48410-10					
X	X	*C-322	P.A. GRID BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-323	P.A. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-324	P.A. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
X	X	*C-325	P.A. SCREEN BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-326	P.A. SUPPRESSOR BY-PASS CAPACITOR	0.004 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	-48024-10	RE48AA112N	25 30			T-7606409 P77
X	X	*C-327	P.A. PLATE BY-PASS CAPACITOR	0.006 MFD., 2000 V. EFF. TEST, #(9, 7.5, 4.5, 2.2) MICA	-481133-B5	RE48AA131	25			T-7606409 P78
X	X	C-328	P.A. TUNING CAPACITOR	215 MMF., 21 PLATES WITH 0.07" SPACING VARIABLE, AIR, SPLIT STATOR			14	TCD-210-L	T-7606108 P3	T-7606409 P79
X	X	C-329	ANTENNA COUPLING CAPACITOR	75 MMF., 11 PLATES, VARIABLE, AIR			1		T-7606020 G1	T-7606409 P80
X	X	C-330	ANTENNA TURNING CAPACITOR	115 MMF., 23 PLATES WITH 0.171" SPACING, VARIABLE, AIR			14	TC-110-H	T-7606108 P1	T-7606409 P81
X	X	*C-331	M.O. TANK BY-PASS CAPACITOR	SAME AS C-110	-48428-10					
X	X	C-332	CALIBRATION RESET CAPACITOR	SAME AS C-125						
X	X	*C-333	M.O. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-334	M.O. FILAMENT BY-PASS CAPACITOR	SAME AS C-109	-48487-10					
X	X	*C-335	P.A. GRID COUPLING CAPACITOR	SAME AS C-114	-48744-10					
X	X	*C-336	P A. PLATE BY-PASS CAPACITOR	SAME AS C-327	-481133-B5					
X	X	*C-701	FILTER CAPACITOR	2000 MFD., 25 VOLTS WORKING			22	#76812		
		C-702	NOT USED							

*SPARE PARTS FURNISHED REFER TO TABLE IV.
CURRENT RATING AT (3000, 1000, 300, 100) KC.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CAPACITORS (CONTINUED)						
X	X	*C-703	R.F. SUPPRESSOR CAPACITOR	0.01 MFD.			22	#76811		
		C-704	NOT USED							
X	X	*C-705	R.F. SUPPRESSOR CAPACITOR	SAME AS C-703						
X	X	*C-711	IGNITION CAPACITOR	0.5 MFD.			22	#19411		
X	X	*C-801	FILTER CAPACITOR	SAME AS C-701						
		C-802	NOT USED							
X	X	*C-803	R.F. SUPPRESSOR CAPACITOR	SAME AS C-703						
		C-804	NOT USED							
X	X	*C-805	R.F. SUPPRESSOR CAPACITOR	SAME AS C-703						
				MISCELLANEOUS						
X	X	E-101	PANEL LIGHT SOCKET	SINGLE CONTACT BAYONET CANDELABRA (LESS BULB)			6	STYLE G		T-7606409 P93
X	X	E-102	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	E-103	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	E-201	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	E-202	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	E-301	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	E-302	PANEL LIGHT SOCKET	SAME AS E-101						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				MISCELLANEOUS (CONTINUED)						
X	X	E-303	PANEL LIGHT SOCKET	SAME AS E-101						
X	X	*E-701	GENERATOR BRUSHES				22	#840		
◊ X	X	*E-711	SPARK PLUG				22	#19851		
◊ X	X	*E-712	SPARK PLUG	SAME AS E-711						
X	X	*E-713A	IGNITION CONTACT	MOVING			22	#12014		
X	X	*E-713B	IGNITION CONTACT	STATIONARY			22	#1028		
X	X	*E-801	GENERATOR BRUSHES	SAME AS E-701						
	X	*E-811	MOTOR BRUSHES	60 CYCLE			22	#76816		
X		*E-831	MOTOR BRUSHES	25 CYCLE			22	#76846		
				FUSES						
X	X	*F-201	FUSE	3/8 AMP., 1000 VOLTS			9	#2101		T-7606409 P107
X	X	*F-202	FUSE	1/2 AMP., 2500 VOLTS			9	#2107		T-7606409 P108
X	X	*F-203	D.C. LINE FUSE	10 AMPS., 25 VOLTS			9	#1081		T-7606409 P109
X	X	*F-701	FUSE	25 AMPS.,			22	#76813		
X	X	*F-702	FUSE	15 AMPS.			22	#76814		
X	X	*F-801	FUSE	SAME AS F-701						
X	X	*F-802	FUSE	SAME AS F-702						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

◊SPARK PLUG #19851 SUPPLIED ON TBW-3 EQUIPMENTS, FURNISH #19850 FOR REPLACEMENTS ON TBW-3

◊SPARK PLUG #19850 SUPPLIED ON TBW-4 EQUIPMENTS.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				INDICATOR LIGHTS						
X	X	*I-101	PANEL LIGHT	LAMP, 2 C.P., 12 TO 16 VOLTS SINGLE CONTACT BAYONET CANDELABRA BASE		NAF-212772 P11	1	TYPE 4-1/2 1103D		T-7606409 P112
X	X	*I-102	PANEL LIGHT	SAME AS I-101						
X	X	*I-103	PANEL LIGHT	SAME AS I-101						
X	X	*I-201	PANEL LIGHT	SAME AS I-101						
X	X	*I-202	PANEL LIGHT	SAME AS I-101						
X	X	*I-301	PANEL LIGHT	SAME AS I-101						
X	X	*I-302	PANEL LIGHT	SAME AS I-101						
X	X	*I-303	PANEL LIGHT	SAME AS I-101						
X	X	*I-851	INDICATOR LIGHT	55 VOLTS			22	#76817		
X	X	*I-851A	LIGHT RECEPTACLE	MODIFICATION FOR 230 VOLTS			22	#76845		
				JACKS						
X	X	J-201	KEY JACK	SINGLE CIRCUIT			10	TC-60	P-7706766 P1	T-7606412 P343
X	X	J-202	MICROPHONE JACK	DOUBLE CIRCUIT			10	TC-61	P-7706766 P2	T-7606412 P344
X	X	J-203	H.F. SIDE TONE JACK	SAME AS J-201						
X	X	J-204	I.F. SIDE TONE JACK	SAME AS J-201						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE 11 (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				RELAYS						
X	X	*K-101	KEYING RELAY	SIX POLES, DOUBLE THROW, TWO BREAKS PER CIRCUIT, 12 TO 15 V.D.C. COIL RESISTANCE 7.7 OHMS ±10%			1		M-7408215 G5	T-7606409 P132
X	X	*K-301	KEYING RELAY	SAME AS K-101						
X	X	*K-701	REVERSE CURRENT RELAY	S.P., NORMALLY OPEN, 20 AMPS.			22	#76560		
X	X	*K-801	REVERSE CURRENT RELAY	SAME AS K-701						
	X	*K-821	MAIN CONTACTOR				22	#76822		
	X	*K-822	OVERLOAD RELAY	THERMAL TYPE WITH MANUAL RESET			22	#76823		
	X	*K-822A	OVERLOAD RELAY HEATER	FOR 115 VOLT OPERATION			1	S#1040590		
	X	*K-822C	OVERLOAD RELAY HEATER	MODIFICATION FOR 230 VOLT OPERATION			22	#76815		
X		*K-841	MAIN CONTACTOR				22	#76824		
X		*K-842	OVERLOAD RELAY	THERMAL TYPE WITH MANUAL RESET			22	#76825		
X		*K-842A	OVERLOAD RELAY HEATER	SAME AS K-822A						
X		*K-824C	OVERLOAD RELAY HEATER	SAME AS K-822C						
				INDUCTORS AND CHOKES						
X	X	L-101	M.O. TANK COIL	ROTOR, 8-7/8 AND 7-7/8 TURNS OF (85 OF .004 EN. LITZ WIRE), STATOR, 16-3/4 AND 48 TURNS OF (85 OF .004 EN. LITZ WIRE)			1		P-7706962 G1	T-7606409 P136
		L-102	NOT USED							
X	X	*L-103	M.O. PLATE R.F. CHOKE	2.5 MILLIHENRIES, 125 MILLIAMPS. D.C. RESISTANCE 50 OHMS			1		M-7406562 G1	T-7606409 P138

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				INDUCTORS AND CHOKES (CONTINUED)						
X	X	*L-104	M.O. GRID R.F. CHOKE	SAME AS L-103						
X	X	*L-105	INTERMEDIATE AMPLIFIER GRID R.F. CHOKE	5.5 MILLIHENRIES			26	#12731		T-7606409 P140
X	X	*L-106	INTERMEDIATE AMPLIFIER PLATE R.F. CHOKE	SAME AS L-103						
X	X	L-107	INTERMEDIATE AMPLIFIER BAND PASS COIL	75 TURNS OF #24 D.C.C.E. WIRE WOUND CLOCKWISE			1		M-7407291 G1	T-7606409 P142
X	X	*L-108	POWER AMPLIFIER GRID R.F. CHOKE	SAME AS L-103						
X	X	L-109	P.A. TANK AND ANTENNA COUPLING COIL	TWO ROTORS, 16 TURNS AND 9 TURNS, (3 X 3 X 18 #38 EN. LITZ WIRE), STATOR, 15, 30 AND 19 TURNS OF (3 X 3 X 18 #38 EN. LITZ WIRE)			1		T-7605208 G5	T-7606409 P144
X	X	L-110	ANTENNA LOAD COIL	10 AND 82 TURNS, INDUCTANCE 850 MICROHENRIES			1		T-7606046 G1	T-7606410 P145
X	X	*L-201	AUXILIARY RECTIFIER FILTER CHOKE	1450 TURNS OF #30 EN. WIRE, 1 HENRY AT 0.2 AMP. D.C., D.C. RESISTANCE 45 OHMS	-30340		1	L-332724		T-7606410 P148
X	X	*L-202	MICROPHONE FILTER CHOKE	1300 TURNS OF #32 EN. WIRE, 0.65 HENRY AT 0.15 AMP. D.C., D.C. RESISTANCE 55 OHMS ±15%	-30311		1	L-317163		T-7606410 P149
X	X	*L-203	ISOLATING CHOKE	500 TURNS OF #28 D.S.C., 5.4 MILLI-HENRIES, 250 MILLIAMPS., D.C. RESISTANCE 11.8 OHMS			1	L-303471	M-7408035 G1	T-7606410 P150
X	X	L-301	M.O. TANK COIL	ROTOR, 3 AND 3 TURNS, STATOR 3-1/2 AND 10-3/4 TURNS, #14 (.064 DIA.) SILVER CLAD INVAR WIRE			1		P-7706924 G2	T-7606410 P152
X	X	*L-302	M.O. FILAMENT CHOKE	150 TURNS OF #24 D.C.C. WIRE, INDUCTANCE 0.55 MILLIHENRY, 1.7 OHMS RESISTANCE			1		M-7407296 G1	T-7606410 P153

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				INDUCTORS AND CHOKES (CONTINUED)						
X	X	*L-303	M.O. FILAMENT CHOKE	PART OF L-302						
X	X	*L-304	M.O. PLATE CHOKE	SAME AS L-103						
X	X	L-305	DOUBLER TANK COIL	27 TURNS OF #16 DIA. TINNED WIRE, TAPPED AT 2, 10, 15, 18 AND 21 TURNS FROM FINISH END			1		P-7707847 G1	T-7606410 P162
X	X	*L-306	I.A. GRID CHOKE	SAME AS L-103						
X	X	L-307	I.A. TANK COIL	28 TURNS OF #16 DIA. TINNED WIRE, TAPPED AT 1, 12, 19, 23, 25 TURNS FROM START END			1		P-7707847 G2	T-7606410 P164
X	X	*L-308	P.A. GRID CHOKE	SAME AS L-103						
X	X	L-309	P.A. TANK COIL	26 TURNS OF #12 DIA. SOLID SILVER WIRE			1		T-7606012 G2	T-7606410 P160
X	X	L-310	ANTENNA TUNING COIL	26 TURNS OF #12 DIA. SOLID SILVER WIRE			1		T-7606012 G1	T-7606410 P161
X	X	*L-701	FILTER REACTOR				22	#76810		
X	X	*L-801	FILTER REACTOR	SAME AS L-701						
				ELECTRICAL INDICATING INSTRUMENTS						
X	X	*M-101	P.A. GRID CURRENT METER	MILLIAMMETER, 0 TO 100 MILLIAMPS. D.C., WITH ANTI-GLARE GLASS	-22058A	17-I-12A	1	NX-33	T-7605997 P10	T-7606410 P166
X	X	*M-102	ANTENNA CURRENT METER	AMMETER, 0 TO 9 AMPS. R.F. EXPANDED SCALE, WITH ANTI-GLARE GLASS	-22239A	17-I-12A	1	NT-33	T-7605997 P11	T-7606410 P167
X	X	*M-201	PLATE CURRENT METER	MILLIAMMETER, 0 TO 300 MILLIAMPS. D.C., RED MARK AT 90 AND 175 MILLI-AMPS., WITH ANTI-GLARE GLASS	-22238A	17-I-12A	1	NX-33	T-7605997 P12	T-7606410 P169

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				ELECTRICAL INDICATING INSTRUMENTS (CONTINUED)						
X	X	*M-202	FILAMENT LINE VOLTMETER	0 TO 15 VOLTS, 0 TO 150 VOLTS ±2% AT 10 VOLTS, RED MARK AT 10 AND 120 VOLTS, 600 TO 800 CYCLE, DOUBLE SCALE WITH ANTI-GLARE GLASS (INCLUDES RESISTOR R-206)	-22330	17-I-12A	1	NA-33	T-7605997 P25	T-7606410 P170
X	X	*M-301	I.A. GRID CURRENT METER	MILLIAMMETER, 0 TO 15 MILLIAMPS. D.C., WITH ANTI-GLARE GLASS	-22135A	17-I-12A	1	NX-33	T-7605997 P14	T-7606410 P172
X	X	*M-302	P.A. GRID CURRENT METER	SAME AS M-101	-22058A					
X	X	*M-303	ANTENNA CURRENT METER	AMMETER, 0 TO 5 AMPS., R.F. EXPANDED SCALE, WITH ANTI-GLARE GLASS	-22026A	17-I-12A	1	NT-33	T-7605997 P24	T-7606410 P174
X	X	*M-701	AMMETER	0 TO 20 AMPS.			22	#76809		
X	X	*M-801	AMMETER	SAME AS M-701						
				MICROPHONES						
X	X	*MI-201	MICROPHONE	WITH PLUG AND STANDARD RUBBER CORD	-51004A	NAF SPEC. T-38C	10	RS-38A		DL-7502136 L4
				MECHANICAL PARTS						
X	X	*O-701	GREASE COVER GASKET				22	#19677		
X	X	*O-711A	CYLINDER HEAD GASKET				22	#19091		
X	X	*O-711B	BEARING PLATE & GENERATOR SUPPORT GASKET				22	#19022		
X	X	*O-711C	CYLINDER BASE GASKET				22	#19172		
X	X	*O-711D	VALVE BOX COVER GASKET				22	#19184		

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				MECHANICAL PARTS (CONTINUED)						
X	X	*O-711E	INTAKE AND EXHAUST OUTLET GASKET				22	#19191		
X	X	*O-711F	OIL BASE GASKET				22	#19276		
◊ X	X	*O-711G	GEAR CASE GASKET				22	#19301		
X	X	*O-711H	FILLER CAP GASKET				22	#19454		
X	X	*O-711J	FILLER CAP SHUT OFF GASKET				22	#19455		
X	X	*O-711K	FUEL PUMP ADAPTER GASKET				22	#19479		
X	X	*O-711L	CARBURETOR FLANGE GASKET				22	#583		
X	X	*O-711M	GEAR CASE OIL SEAL	CORK RING			22	#8127	TBW-3 ONLY	
X	X	*O-711N	REAR MAIN BEARING OIL SEAL				22	#19003		
⊕ X	X	*O-711P	GEAR CASE GASKET				22	#19312		
⊕ X	X	*O-711Q	OIL PUMP GASKET				22	#19359		
X	X	*O-711R	GEAR CASE OIL SEAL	CORK RING			22	#19382	TBW-4 ONLY	
				PLUGS AND SOCKETS						
X	X	*P-201	POWER INPUT PLUG	6 CONNECTIONS (PART OF W-1201)		NAF C-48E	12			T-7606451 P41
X	X	*P-201A	POWER INPUT SCOKET	6 CONNECTIONS, MALE SOCKET			12		T-7607341 G1	T-7606412 P347
X	X	*P-202	SIDE TONE AND KEY PLUG	BLACK BAKELITE SHELL (PART OF W-1210, W-1211 AND TELEGRAPH KEY)	-49006		15	#75		T-7606451 P44
X	X	*P-203	I.F. INTERCONNECTION PLUG	BLUE, 11 CONNECTIONS (PART OF W-1203)		NAF- C-48E	12			T-7606451 P42

*SPARE PARTS FURNISHED REFER TO TABLE IV.
◊SUPPLIED WITH EQUIPMENTS SERIALS 1 TO 500 INCL.
⊕ SUPPLIED WITH EQUIPMENTS SERIALS 501 TO 1100 INCL. } FOR TBW-3 EQUIPMENTS
⊕ SUPPLIED WITH TBW-4 EQUIPMENTS

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				PLUGS AND SOCKETS (CONTINUEDD)						
X	X	*P-203A	I.F. INTERCONNECTION SOCKET	BLUE, 11 CONNECTIONS, MALE SOCKET			12		T-7607341 G2	T-7606412 P348
X	X	*P-203B	INTERCONNECTION SOCKET	BLUE, SAME AS P-203A						
X	X	*P-204	H.F. INTERCONNECTION PLUG	YELLOW, SAME AS P-203 (PART OF W-1204)						
X	X	*P-204A	H.F. INTERCONNECTION SOCKET	YELLOW, SAME AS P-203A						
X	X	*P-204C	INTERCONNECTION SOCKET	YELLOW, SAME AS P-203A						
X	X	*P-205	I.F. HIGH VOLTAGE PLUG	BLUE, 4 CONNECTIONS (PART OF W-1205)		NAF C-48E	12			T-7606451 P43
X	X	*P-205A	I.F. HIGH VOLTAGE SOCKET	BLUE, 4 CONNECTIONS, MALE SOCKET			12		T-7607341 G4	T-7606412 P350
X	X	*P-205B	HIGH VOLTAGE SOCKET	BLUE, SAME AS P-205A						
X	X	*P-206	H.F. HIGH VOLTAGE PLUG	YELLOW, SAME AS P-205 (PART OF W-1206)						
X	X	*P-206A	H.F. HIGH VOLTAGE SOCKET	YELLOW, SAME AS P-205A						
X	X	*P-206C	HIGH VOLTAGE SOCKET	YELLOW, SAME AS P-205A'						
X	X	*P-701	PLUG RECEPTACLE	15 AMPS., 125 VOLTS, 2 PRONGS			22	#76807		
X	X	*P-702	PLUG RECEPTACLE	SAME AS P-701						
X	X	*P-703	PLUG RECEPTACLE	4 PRONGS			22	#76805		
X	X	*P-704	PLUG RECEPTACLE	6 PRONGS			22	#76806		
X	X	*P-801	PLUG RECEPTACLE	4 PRONGS			22	#76820		
X	X	*P-802	PLUG RECEPTACLE	6 PRONGS			22	#76819		

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				RESISTORS, RHEOSTATS AND POTENTIOMETERS						
X	X	*R-101	SPARK SUPPRESSOR RESISTOR	100 OHMS ±10%, 1 WATT, COMPOSITION	-63288	RE13A372G	3	FI	T-7605849 P25	T-7606410 P201
X	X	*R-102	M. O. GRID RESISTOR	10,000 OHMS, 20 WATTS	-63016E	RE13A372J STYLE E	4		T-7605861 P27	T-7606410 P202
X	X	*R-103	I.A. FILAMENT RESISTOR	1.33 OHMS ±5%, 10 WATTS	-63812E	RE13A372J STYLE F	4		T-7605861 P34	T-7606410 P203
		R-104	NOT USED							
X	X	*R-105	I.A. GRID RESISTOR	SAME AS R-102	-63016E					
X	X	*R-106	I.A. SCREEN RESISTOR	5000 OHMS, 20 WATTS	-63015E	RE13A372J STYLE E	4		T17605861 P26	T-7606410 P206
X	X	*R-107	POTENTIOMETER RESISTOR	12,500 OHMS, 60 WATTS, TAPPED WITH 5 EQUAL VALUES	+63546E	RE13A372J STYLE D	4		T-7605861 P25	T-7606410 P207
X	X	*R-108	POTENTIOMETER RESISTOR	SAME AS R-107	-63546E					
X	X	*R-109	P.A. GRID RESISTOR	3000 OHMS, 20 WATTS	-63013E	RE13A372J STYLE E	4		T-7605861 P30	T-7606410 P209
X	X	*R-110	P.A. SCREEN RESISTOR	3000 OHMS, 60 WATTS	-63081E	RE13A372J STYLE D	4		T-7605861 P10	T-7606410 P210
X	X	*R-111	I.A. PLATE RESISTOR	2500 OHMS, 60 WATTS	-63080E	RE13A372J STYLE F	4		T-7605861 P31	T-7606410 P211
X	X	*R-112	I.A. CATHODE RESISTOR	100 OHMS, 10 WATTS	-63676E	RE13A372J STYLE F	4		T-7605861 P28	T-7606410 P212
X	X	*R-113	FILAMENT SHUNT RESISTOR	25 OHMS ±5%, 5 WATTS	-631209	RE13A372J	28	KOOL-OHM 5-K		T-7606410 P213
X	X	*R-114	FILAMENT SHUNT RESISTOR	SAME AS R-113	-631209					

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE 11 (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				RESISTORS, RHEOSTATS AND POTENTIOMETERS (CONTINUED)						
X	X	*R-115	SUPPRESSOR RESISTOR	20 OHMS ±10%, 1/2 WATT, WIRE WOUND	-63678-10	RE13A372G	3	BW-1/2		T-7606410 P215
X	X	*R-201	FILAMENT RHEOSTAT	TWO MODEL "J", RHEOSTATS, 12 OHMS EACH #0314, MOUNTED IN TANDEM			13	#6601	K-7810191 LESS KNOB	T-7606411 P217
X	X	*R-202	DISCHARGE RESISTOR	500,000 OHMS, ±10%, 1 WATT, COMPOSITION	-63288	RE13A372G	3	BT-1	T-7605849 P23	T-7606411 P218
X	X	*R-203	CURRENT LIMITING RESISTOR	20 OHMS, 10 WATTS	-63003E	RE13A372J STYLE F	4			T-7606411 P219
X	X	*R-204	SIDE TONE VOLUME CONTROL POTENTIOMETER	100 OHMS, MODEL "H"			13	#0151	M-7407376 P1	T-7606411 P220
X	X	*R-205	BIAS POTENTIOMETER	800 OHMS, 50 WATTS, MODEL "J""			13	#0325		T-7606411 P221
X	X	*R-206	METER MULTIPLIER RESISTOR	4500 OHMS (PART OF M-202)	-63860					
X	X	*R-207	CATHODE RESISTOR	2000 OHMS, 20 WATTS	-63752E	RE13A372J STYLE E	4			T-7606411 P222
X	X	*R-208	GRID RESISTOR	SAME AS R-202	-63288					
X	X	*R-209	GRID FILTER RESISTOR	100,000 OHMS ±10%, 1 WATT, COMPOSITION	-63288	RE13A372G	3	BT-1	T-7605849 P53	T-7606411 P224
X	X	*R-210	MICROPHONE SERIES RESISTOR	30 OHMS ±10%, 3 WATTS, COMPOSITION	-63289	RE13A372G	20	E2	T-7605849 P8	T-7606411 P225
X	X	*R-211	MODULATION CONTROL	500,000 OHMS, BRADLEY METER, TYPE A, RESISTANCE CURVE A, HOP OFF RESISTANCE 5000 OHMS OR LESS, STD. SHAFT AND BUSHING			11			T-7606411 P226
X	X	*R-212	H.V. DISCHARGE RESISTOR	1 MEGOHM ±15%, 10 WATTS, FERRULE TERMINALS	-63809-15		3	MVP	T-7605849 P68	T-7606411 P227
X	X	*R-213	CATHODE RESISTOR	1000 OHMS, 20 WATTS	-63011E	RE13A372J STYLE E	4			T-7606411 P228

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				RESISTORS, RHEOSTATS AND POTENTIOMETERS (CONTINUED)						
X	X	*R-301	SPARK SUPPRESSOR RESISTOR	SAME AS R-101	-63288					
X	X	*R-302	M.O. GRID RESISTOR	SAME AS R-106	-63015E					
X	X	*R-303	FILAMENT SHUNT RESISTOR	50 OHMS ±2%, 1 WATT, WIRE WOUND	-63703-2	RE13A372G	3	BW-1	T-7605849 P70	T-7606411 P235
X	X	*R-304	SCREEN RESISTOR	20,000 OHMS, 60 WATTS	-63095E	RE13A372J STYLE D	4			T-7606411 P236
X	X	*R-305	POTENTIOMETER - RESISTOR	SAME AS R-107	-63546E					
X	X	*R-306	POTENTIOMETER - RESISTOR	SAME AS R-107	-63546E					
X	X	*R-307	I.A. GRID RESISTOR	20,000 OHMS ±5%, 2 WATTS, COMPOSITION	-63426	RE13A372G	3	F-2	T-7605849 P71	T-7606411 P239
X	X	*R-308	SCREEN RESISTOR	SAME AS R-304	-63095E					
X	X	*R-309	I.A. SCREEN RESISTOR	SAME AS R-106	-63015E					
X	X	*R-310	P.A. GRID RESISTOR	SAME AS R-109	-63013E					
X	X	*R-311	P.A. SCREEN RESISTOR	SAME AS R-110	-63081E					
X	X	*R-312	FILAMENT RESISTOR	4.5 OHMS, 20 WATTS	-63810E	RE13A372J	4		T-7605861 P36	T-7606411 P244
X	X	*R-313	FILAMENT SHUNT RESISTOR	SAME AS R-303	-63703-2					
X	X	*R-314	P.A. SUPPRESSOR RESISTOR	50 OHMS, 1 WATT, WIRE WOUND	-63703-10	RE13A372G	3	BW-1		T-7606411 P246
X	X	*R-701	CHARGING CURRENT RHEOSTAT	1 OHM			22	#76808		
X	X	*R-801	CHARGING CURRENT RHEOSTAT	SAME AS R-701						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				SWITCHES						
X	X	*S-101	M.O. RANGE SWITCH	D.P. SIX POSITIONS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARTY TYPE			1		T-7606024 G12	T-7606411 P286
		S-102	NOT USED							
		S-103	NOT USED							
X	X	*S-104	P.A. RANGE SWITCH	D.P. SIX POSITIONS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE			1		T-7606024 G1	T-7606411 P253
		S-105	NOT USED							
X	X	*S-106	ANTENNA TAP SWITCH	S.P. NINE POSITIONS, ONE BREAK PER CIRCUIT, 20 AMPS., 5,000 VOLTS, ROTARY TYPE			1		T-7606058 G1	T-7606411 P255
		S-107	NOT USED							
X	X	*S-108	LIGHT SWITCH	S.P.S.T., TWO BREAKS PER CIRCUIT, 3 AMPS., 250 V.D.C., TOGGLE TYPE			7	#8280	P-7706778 P1	T-7606411 P257
X	X	*S-201	MAIN LINE A.C. SWITCH	D.P.S.T., TWO BREAKS PER CIRCUIT, 10 AMPS., 250 VOLTS, 15 AMPS., 125 VOLTS, TOGGLE TYPE			7	#8244	P-7706778 P8	T-7606411 P262
X	X	*S-202	MAIN LINE D.C. SWITCH	SAME AS S-108						
X	X	*S-203	POWER CONTROL SWITCH	S.P., FOUR POSITIONS, TWO BREAKS PER CIRCUIT, 10 AMPS., 210 VOLTS, 800 CYCLE, ROTARY TYPE			1		P-7706464 G2	T-7606411 P264
X	X	*S-204	A.C. VOLTAGE COMPENSATION SWITCH	SAME AS S-108						
X	X	*S-205	A.C. VOLTAGE COMPENSATION SWITCH	SAME AS S-108						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				SWITCHES (CONTINUED)						
X	X	*S-206	A.C. VOLTAGE COMPENSATION SWITCH	SAME AS S-108						
X	X	*S-207	A.C. VOLTAGE COMPENSATION SWITCH	SAME AS S-108						
X	X	*S-208	H.F. & I.F. TRANSFER SWITCH	3 P.D.T., TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 VOLTS, ROTARY TYPE			1		T-7606024 G6	T-7606411 P 269
X	X	*S-209	CW-MCW PHONE SWITCH	3P. THREE POSITIONS, TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 VOLTS, ROTARY TYPE			1		T-7606024 G8	T-7606411 P270
X	X	*S-210	LIGHT SWITCH	SAME AS S-108						
X	X	*S-211	INTERLOCK SWITCH	S.P.S.T., TWO BREAKS PER CIRCUIT, 0.75 AMP., 125 VOLTS, 0.25 AMP., 250 VOLTS, PUSH BUTTON TYPE			7	#8410	M-7407301 P1	T-7606411 P272
X	X	*S-212	METER SWITCH	3 P.D.T., CENTER OFF POSITION, ONE BREAK PER CIRCUIT, 3 AMPS., 125 VOLTS, ROTARY TYPE			21	#763		T-7606411 P273
X	X	*S-301	M.O. RANGE SWITCH	DOUBLE POLE, FIVE THROWS, TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE			1		T-7606024 G3	T-7606411 P278
X	X	*S-302	DOUBLER CIRCUIT RANGE SWITCH	SINGLE POLE, FIVE THROWS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C. ROTARY TYPE			1		T-7607799 G13	T-7606411 P284
X	X	*S-303	I.A. RANGE SWITCH	SINGLE POLE, FIVE THROWS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE			1		T-7607799 G18	T-7606411 P285
X	X	*S-304	VOLTAGE CURRENT FEED SWITCH	TWO POLES, DOUBLE THROW, ONE BREAK PER CIRCUIT, 15 AMPS., 10,000 V.D.C., ROTARY TYPE			1		T-7606966 G1	T-7606411 P281

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				SWITCHES (CONTINUED)						
X	X	*S-305	LIGHT SWITCH	SAME AS S-108						
X	X	S-711	STOP BUTTON				22	#76821		
X	X	*S-851	PUSH BUTTON SWITCH	115 VOLTS SUPPLY WITH INDICATOR LIGHT			22	#76818		
				TRANSFORMERS						
X	X	*T-201	MAIN PLATE TRANSFORMER	0.400 KVA., 800 CYCLE WDG. TERM VOLTS AMPS. TURNS OHMS P1 1TO2 35 3.72 44 0.37 P1 2TO3 22 3.72 28 0.23 P2 3TO4 51.5 3.72 72 0.266 P2 4TO8 7 3.72 9 0.033 S1 5TO6 1750 0.175 1200 78 S2 5TO7 1750 0.175 1200 78 TEST 1500 VOLTS	-30631		1	L-365723		T-7606412 P289
X	X	*T-202	FILAMENT TRANSFORMER	0.201 KVA., 800 CYCLE WDG. TERM VOLTS AMPS. TURNS OHMS PR1 1TO2 103 2 99 .785 S1 3TO4 2.5 10 2-1/2 .0051 S2 5TO6 5 3 5 .0177 S3 9TO10 9.3 1.4 8 .0453 S3 10TO11 9.3 1.4 7-1/2 .0444 S4 7TO8 7.6 2.15 7-1/2 .0294 S5 12TO13 2.5 205 2-1/2 .0120 S6 14TO15 10.4 10 10-1/2 .0127 TEST 1500 VOLTS	-30629		1	L-365721		T-7606412 P290
X	X	*T-203	LOW POWER PLATE TRANSFORMER	0.133 KVA., 800 CYCLE WDG. TERM VOLTS AMPS. TURNS OHMS PR1 1TO2 115 1.23 99 1.6 S1 6TO7 525 0.2 456 21 S1 7TO8 525 0.2 457 21 S2 4TO5 50 0.005 46 1.8 S3 3TOGND 8 7 .27 TEST 2000 VOLTS	-30628		1	L-365720		T-7606412 P291

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				TRANSFORMERS (CONTINUED)						
X	X	*T-204	MODULATION TRANSFORMER	RATIO 1:1.4, 300 TO 3000 CYCLE WDG. TERM VOLTS AMPS. TURNS OHMS PR1 1TO2 147 0.02 2800 620 S1 7TO6 31 600 230 S1 6TO5 21 400 180 S1 5TO4 53 1000 400 S2 3TOGND 6 130 3.8 TEST 1700 VOLTS EXCEPT S2	-30313A		1	L-340149		T-7606412 P292
X	X	*T-205	INPUT TRANSFORMER	RATIO 1:32, 200 TO3500 CYCLE WDG. TERM VOLTS AMPS. TURNS OHMS PR1 1TO2 0.5 0.08 400 11 S1 3TO4 16 12800 7700 TEST 1200 VOLTS	-30630		1	L-365722		T-7606412 P293
				VACUUM TUBES						
X	X	*V-101	MASTER OSCILLATOR TUBE	TRIODE, OSCILLATOR	-801	RE13A600B	5	801		T-7606451 P22
X	X	*V-102	INTERMEDIATE AMPLIFIER TUBE	SCREEN GRID, AMPLIFIER	-807	RE13A600B	27	807		T-7606451 P30
X	X	*V-103	POWER AMPLIFIER TUBE	PENTODE	-803	RE13A600B	27	803		T-7606451 P29
X	X	*V-201	H.V. RECTIFIER TUBE	HIGH VACUUM RECTIFIER	-1616	RE13A600B	5	1616		T-7606451 P24
X	X	*V-202	H.V. RECTIFIER TUBE	SAME AS V-201	-1616					
X	X	*V-203	AUXILIARY RECTIFIER TUBE	HIGH VACUUM DUAL RECTIFIER	-5Z3	RE13A600B	5	5Z3		T-7606451 P26
X	X	*V-204	SPEECH AMPLIFIER MODULATOR TUBE	TRIODE INDIRECTLY HEATED SPEECH AMPLIFIER AND MODULATOR	-843	RE13A600B	5	843		T-7606451 P23
X	X	*V-301	MASTER OSCILLATOR TUBE	PENTODE, OSCILLATOR, AMPLIFIER	-837	RE13A600B	27	837		T-7606451 P31
X	X	*V-302	INTERMEDIATE AMPLIFIER TUBE	SAME AS V-301	-837					
X	X	*V-303	POWER AMPLIFIER TUBE	SAME AS V-103	-803					

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				SOCKETS						
X	X	X-101	M.O. TUBE SOCKET	4 PRONGS - ISOLANTITE	-48327		8		P-7706776 P2	T-7606412 P298
X	X	X-102	I.A. TUBE SOCKET	5 PRONGS - ISOLANTITE	-49328		8		P-7706776 P3	T-7606412 P299
X	X	X-103	P.A. TUBE SOCKET	5 JUMBO PRONGS - ISOLANTITE	-49356		1		M-7407750 P1	T-7606412 P300
X	X	X-201	RECTIFIER TUBE SOCKET	SAME AS X-101	-49327					
X	X	X-202	RECTIFIER TUBE SOCKET	SAME AS X-101	-49327					
X	X	X-203	RECTIFIER TUBE SOCKET	SAME AS X-101	-49327					
X	X	X-204	SOCKET	SAME AS X-102	-49328					
X	X	X-301	M.O. TUBE SOCKET	7 PRONGS (LARGE)	-49365		8		P-7706776 P5	T-7606412 P309
X	X	X-302	I.A. TUBE SOCKET	SAME AS X-301	-49365					
X	X	X-303	P.A. TUBE SOCKET	SAME AS X-103	-49356					
				CABLES						
X	X	*W-1201	GENERATOR RECTIFIER CABLE	4 CONDUCTOR WITH 2-6 PRONG PLUGS ATTACHED			1		T-7606033 G5	T-7606451 P2
		W-1202	NOT USED							
X	X	*W-1203	INTERCONNECTION CABLE RECTIFIER TO H.F. TRANSMITTER	11 CONDUCTOR, WITH 2-11 PRONG PLUGS ATTACHED			1		T-7606033 G8	T-7606451 P51
X	X	*W-1204	INTERCONNECTION CABLE RECTIFIER TO H.F. TRANSMITTER	SAME AS W-1203						

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				CABLES (CONTINUED)						
X	X	*W-1205	HIGH VOLTAGE CABLE RECTIFIER TO I.F. TRANSMITTER	4 CONDUCTOR, WITH 2-4 PRONG PLUGS ATTACHED			1		T-7606033 G6	T-7606451 P6
X	X	*W-1206	HIGH VOLTAGE CABLE RECTIFIER TO H.F. TRANSMITTER	SAME AS W-1205						
		W-1207 TO W-1209	NOT USED							
X	X	*W-1210	I.F. SIDE TONE CABLE	2 CONDUCTOR			1		M-7407550 G1	T-7606451 P11
X	X	*W-1211	H.F. SIDE TONE CABLE	SAME AS W-1210						
X	X	*W-1212	I.F. RECEIVER TO I.F. TRANSMITTER ANTENNA CABLE	1 CONDUCTOR			1		T-7606039 G2	T-7606451 P13
X	X	*W-1213	H.F. RECEIVER TO H.F. TRANSMITTER ANTENNA CABLE	SAME AS W-1212						
				ACESSORIES						
X	X	1101	GUY - TOP	ANTENNA TOP GUY ASSEMBLY			1			T-7605981 P2
X	X	1102	GUY - INTERMEDIATE	ANTENNA INT. GUY ASSEMBLY (4TH SECTION FROM TOP)			1			T-7605981 P3
X	X	1103	GUY - BOTTOM	FOR MAST NEAREST LEAD-IN			1			T-7605981 P4
X	X	1104	LEAD-IN	INTERMEDIATE FREQUENCY			1			T-7605981 P5
X	X	1105	LEAD-IN	HIGH FREQUENCY			1			T-7605981 P6
X	X	1106	LEAD-IN	COUNTERPOISE			1			T-7605981 P7

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				ACCESSORIES (CONTINUED)						
X	X	1107	GUY - BOTTOM	FOR MAST FARTHEST FROM LEAD-IN			1			T-7605981 P8
X	X	1108	SPREADER SUPPORT				1			T-7605981 P9
X	X	1109	WIRE				1			T-7605981 P10
X	X	1110	SUPPORT	HIGH FREQUENCY ANTENNA			1			T-7605981 P11
X	X	1111	ANTI-SWING HALYARD				1			T-7605981 P17
X	X	1112	BASE PIN	BOTTOM OF EACH MAST			1			T-7605981 P13
X	X	1113	BASE PLATE	REST FOR MAST			1			T-7605981 P14
X	X	1114	GUY STAKE				1			T-7605981 P15
X	X	1115A, 1115B	SPREADER				1			T-7605981 P16
X	X	1116	MAST SECTIONS	TEN SECTIONS PER MAST			1			T-7605981 P12
X	X		TOOL KIT	TO CONSIST OF THE FOLLOWING: (A) CANVAS COVER (B) SOLDER-KESTER ROSIN CORE, 1 LB. SPOOL (C) HAMMER - 3-1/2 LB. #H.F. 274 SIZE 4 (D) PLIERS - SIDE CUTTING, UTICA #50-6" (E) PLIERS - SLIP JOINT, UTICA #511-6" UTICA FIN. (F) PLIERS - DIAGONAL CUTTING, UTICA #41-6" (G) PLIERS - LONG NOSE, UTICA #33-6"			19			DL-7502136 L13

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE II (CONTINUED)

PARTS LIST BY SYMBOL DESIGNATIONS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

25 CYCLE & GAS ENG.	60 CYCLE & GAS ENG.	SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
				ACCESSORIES (CONTINUED)						
				(H) WRENCH-CRESCENT ADJUSTABLE 6" SINGLE END, NICKEL PLATED (I) MONKEY WRENCH-CRESCENT AUTO #019 (J) WRENCH SET - LOCK SOCKET ICA #999 (K) FILE - DELTA HALF ROUND 10" 2ND CUT (L) FILE - HANDLE - LUTZ #3 (M) FILE - IGNITION 6" - DELTA COIL FILE (N) SCREW DRIVER - MACHINE TYPE BLADE 6" LONG TIP 1/4" X 1/32" ROUND SHANK WHALE DE LUXE R146 (O) FRICTION TAPE - ROLL W.E. & M. CO. ADHERE FRICTION TAPE (P) SET ALLEN WRENCHES						
X	X		TELEGRAPH KEY		-26001B	RE26F112C	21			DL-7502136 L5
X	X		SOLDERING IRON	LARGE AND SMALL TIP			19	HEXIGON NO. 85		DL-7502136 L1
X	X		GASOLINE CAN	5 GALLONS			19			DL-7502407 G14
X	X		OIL CAN	1 GALLON			19			DL-7502407 G14

*SPARE PARTS FURNISHED REFER TO TABLE IV.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
					MISCELLANEOUS (CLASS 10)						
X		80	80		E-701	GENERATOR BRUSHES		22	#840		
	X	8	8								
◇ X		20	20		E-711, E-712	SPARK PLUGS		22	#19851		
	X	8	8								
	X	1	1		E-713A	IGNITION CONTACT ARM		22	#12014		
	X	1	1		E-713B	IGNITION CONTACT STATIONARY POINT		22	#1028		
X		80	80		E-801*	GENERATOR BRUSHES		22	#840		
	X	8	8								
X			40		E-811*	MOTOR BRUSHES FOR 60 CYCLE		22	#76816		
	X		4								
X		40			E-831*	MOTOR BRUSHES FOR 25 CYCLE		22	#76846		
	X	4									
	X	4	4		I-101, I-102, I-103, I-201 I-202, I-301, I-302, I-303	INDICATOR LAMP, 2 C.P., 12 TO 16 V. SINGLE CONTACT, BAYONET CANDELABRA BASE	NAF-212772 P11	1	TYPE 4 1/2 -1103D		T-7606409 P112
	X	1	1		I-851*	INDICATOR LAMP, 55 VOLTS		22	#76817		
	X	1	1		I-851A*	MODIFICATION RECEPTACLE FOR 230 VOLTS OPERATION		22	#76845		
X		20	20		O-701	GENERATOR GREASE COVER GASKET		22	#19677		
	X	1	1								
X		40	40		O-711A	CYLINDER HEAD GASKET		22	#19091		
	X	2	2								
X		20	20		O-711B	BEARING PLATE AND GENERATOR SUPPORT GASKET		22	#19022		
	X	1	1								

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* SEE NOTE ON SHEET 1

◇SPARK PLUG #19851 SUPPLIED ON TBW-3 EQUIPMENTS. FURNISH #19850 FOR REPLACEMENTS ON TBW-3

◇SPARK PLUG #19850 SUPPLIED ON TBW-4 EQUIPMENTS.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

	SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
	STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
							MISCELLANEOUS (CLASS 10) CONTINUED					
	X		40 2	40 2		O-711C	CYLINDER BASE GASKET		22	#19172		
		X										
	X		40 2	40 2		O-711D	VALVE BOX COVER GASKET		22	#19184		
		X										
	X		80 4	80 4		O-711E	INTAKE AND EXHAUST OUTLET GASKET		22	#19191		
		X										
	X		20 1	20 1		O-711F	OIL BASE GASKET		22	#19276		
		X										
◊	X		20 1	20 1		O-711G	GEAR CASE GASKET		22	#19301		
		X										
96	X		20 1	20 1		O-711H	FILLER CAP GASKET		22	#19454		
		X										
	X		20 1	20 1		O-711J	FILLER CAP SHUTOFF GASKET		22	#19455		
		X										
	X		40 2	40 2		O-711K	FUEL PUMP ADAPTER GASKET		22	#19479		
		X										
	X		20 1	20 1		O-711L	CARBURETOR FLANGE GASKET		22	#583		
		X										
	X		20 1	20 1		O-711M	GEAR CASE OIL SEAL CORK PLUG		22	#8127	TBW-3 ONLY	
		X										
	X		20 1	20 1		O-711N	OIL SEAL REAR MAIN BEARING		22	#19003		
		X										
@	X		20 1	20 1		O-711P	GEAR CASE GASKET		22	#19312		
		X										
@	X		20 1	20 1		O-711Q	OIL PUMP GASKET		22	#19359		
		X										
	X		20 1	20 1		O-711R	GEAR CASE OIL SEAL CORK PLUG		22	#19382	TBW-4 ONLY	
		X										
	X		10	10			THIMBLE, 5/32" GALVANIZED STEEL, INSIDE DIAMETER 0.40, INSIDE LENGTH 0.80, CADMIUM PLATED		17			T-7606451 P48

◊SUPPLIED WITH EQUIPMENTS SERIALS 1 TO 500 INCL
@SUPPLIED WITH EQUIPMENTS SERIALS 501 TO 1100 INCL
FOR TBW-3 EQUIPMENTS

@SUPPLIED WITH TBW-4 EQUIPMENTS

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
						MISCELLANEOUS (CLASS 10) CONTINUED					
X		10	10			SNAP, 5/8" DIAMETER, 2-7/8" LONG, TO BE OF MALLEABLE IRON		23			T-7606451 P49
						ELECTRICAL INDICATING INSTRUMENTS (CLASS 22)					
X		1	1	-22026A	M-303	AMMETER, 0 TO 5 AMPS., R.F., EXPANDED SCALE, WITH ANTI-GLARE GLASS	17-I-12A	1	NT-33	T-7605997 P24	T-7606410 P174
X		2	2	-22058A	M-101, M-302	MILLIAMMETER, 0 TO 100 MILLIAMPS. D.C., WITH ANTI-GLARE GLASS	17-I-12A	1	NX-33	T-7605997 P10	T-7606410 P166
X		1	1	-22135A	M-301	MILLIAMMETER, 0 TO 15 MILLIAMPS. D.C., WITH ANTI-GLARE GLASS	17-I-12A	1	NX-33	T-7605997 P14	T-7606410 P172
X		1	1	-22238A	M-201	MILLIAMMETER, 0 TO 300 MILLIAMPS. D.C., RED MARK AT 90 AND 175 MILLIAMPS., WITH ANTI-GLARE GLASS	17-I-12A	1	NX-33	T-7605997 P12	T-7606410 P169
X		1	1	-22239A	M-102	AMMETER, 0 TO 9 AMPS. R.F., EXPANDED SCALE, WITH ANTI-GLARE GLASS	17-I-12A	1	NT-33	T-7605997 P11	T-7606410 P167
X		1	1	-22330	M-202	VOLTMETER, 0 TO 15 VOLTS, 0 TO 150 VOLTS ±2% AT 10 VOLTS, RED MARK AT 10 AND 120 VOLTS, 600 TO 800 CYCLES, DOUBLE SCALE WITH ANTI-GLARE GLASS (INCLUDES RESISTOR R-206)	17-I-12A	1	NA-33	T-7605997 P25	T-7606410 P170
X		1	1	-	M-701	AMMETER, 0 TO 20 AMPS.		22	#76809		
X		1	1		M-801*	AMMETER, 0 TO 20 AMPS.		22	#76809		
						SWITCHES (CLASS 24)					
X		1	1		S-101	D.P. SIX POSITIONS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE		1		T-7606024 G12	T-7606411 P286

*SEE NOTE ON SHEET 1

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
					SWITCHES (CLASS 24) CONTINUED						
X		1	1		S-104	D.P. SIX POSITIONS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE		1		T-7606024 G1	T-7606411 P253
X		1	1		S-106	S.P. NINE POSITIONS, ONE BREAK PER CIRCUIT, 20 AMPS., 15,000 VOLTS, ROTARY TYPE		1		T-7606058 G1	T-7606411 P255
X		1	1		S-108, S-202, S-204, S-205, S-206, S-207, S-210, S-305	S.P.S.T., TWO BREAKS PER CIRCUIT, 3 AMPS., 250 V.D.C., TOGGLE TYPE		7	#8280	P-7706778 P1	T-7606411 P257
X		1	1		S-201	D.P.S.T., TWO BREAKS PER CIRCUIT, 10 AMPS., 250 VOLTS, TOGGLE TYPE		7	#8244	P-7706778 P8	T-7606411 P262
X		1	1		S-203	S.P. FOUR POSITIONS, TWO BREAKS PER CIRCUIT, 10 AMPS., 210 VOLTS, 800 CYCLE, ROTARY TYPE		1		P-7706464 G2	T-7606411 P264
X		1	1		S-208	3 P.D.T., TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 VOLTS, ROTARY TYPE		1		T-7606024 G6	T-7606411 P269
X		1	1		S-209	3 P. THREE POSITIONS, TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 VOLTS, ROTARY TYPE		1		T-7606024 G8	T-7606411 P270
X		1	1		S-211	S.P.S.T., TWO BREAKS PER CIRCUIT, 0.75 AMP. 125 VOLTS, 0.250 AMP. 250 VOLTS, PUSH BUTTON TYPE		7	#8410	M-7407301 P1	T-7606411 P272
X		1	1		S-212	3 P.D.T., CENTER OFF POSITION, ONE BREAK PER CIRCUIT, 3 AMPS., 125 VOLTS ROTARY TYPE		21	#763		T-7606411 P273
X		1	1		S-301	D.P. FIVE THROWS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE		1		T-7606024 G3	T-7606411 P278

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
						SWITCHES (CLASS 24) CONTINUED					
X		1	1		S-302	S.P. FIVE THROWS, ONE BREAK PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE		1		T-7607799 G13	T-7606411 P284
X		1	1		S-303	S.P. FIVE THROWS, TWO BREAKS PER CIRCUIT, 10 AMPS., 3000 V.D.C., ROTARY TYPE		1		T-7607799 G18	T-7606411 P285
X		1	1		S-304	TWO POLES D.T., ONE BREAK PER CIRCUIT, 15 AMPS., 10,000 V.D.C., ROTARY TYPE		1		P-7706766 G1	T-7606411 P281
X		1	1		S-851	PUSH BUTTON STATION COMPLETE		22	#76818		
						FUSES (CLASS 28)					
	X	2	2		F-201	FUSE, 3/8.AMP., 1000 VOLTS		9	#2101		T-7606409 P107
	X	2	2		F-202	FUSE, 1/2 AMP., 2500 VOLTS		9	#2107		T-7606409 P108
X	X	◊2	◊2		F-203	LINE FUSE, 10 AMPS., 25 VOLTS		9	#1081		T-7606409 P109
	X	2	2		F-701	FUSE, 25 AMPS.		22	#76813		
	X	2	2		F-702	FUSE, 15 AMPS.		22	#76814		
	X	2	2		F-801*	FUSE, 25 AMPS.		22	#76813		
	X	2	2		F-802*	FUSE, 15 AMPS.		22	#76814		
						RELAYS (CLASS 29)					
X		1	1		K-101, K-301	KEYING RELAY, SIX POLES DOUBLE THROW TWO BREAKS PER CIRCUIT, 12 TO 15 VOLTS D.C., COIL RESISTANCE 7.7 OHMS ±10%		1		M-7408215 G5	T-7606409 P132

* SEE NOTE ON SHEET 1.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
						RELAYS (CLASS 29) CONTINUED					
X		1	1		K-701, K-801*	REVERSE CURRENT RELAY, 20 AMPS.		22	#76560		
X			1		K-821*	DE ION LINE STARTER CONTACTOR ONLY		22	#76822		
X			1		K-822*	DE ION LINE STARTER OVERLOAD RELAY		22	#76823		
X	X	1 X	1 X		K-822C*, K-842C* K-822C* K-842C*	MODIFICATION HEATERS, 230 VOLTS		22	#76815		
X		1			K-841*	DE ION LINE STARTER CONTACTOR ONLY		22	#76824		
X		1			K-842*	DE ION LINE STARTER OVERLOAD RELAY		22	#76825		
						TRANSFORMERS AND REACTORS (CLASS 30)					
X		1	1	-30311	L-202	FILTER CHOKE, 1300 TURNS, 0.65 HENRY AT 0.15 AMP. D.C., D.C. RESISTANCE 55 OHMS ±15%		1	L-317163		T-7606410 P149
X		1	1	-30313A	T-204	RATIO 1:1.4, 300 TO 3000 CYCLE, TEST 1700 VOLTS		1	L-340149		T-7606412 P292
X		1	1	-30340	L-201	FILTER CHOKE, 1450 TURNS, 1 HENRY AT 0.2 AMP. D.C., D.C. RESISTANCE 45 OHMS		1	L-332724		T-7606410 P148
X		1	1	-30628	T-203	0.133 KVA., 800 CYCLE, TEST 2000 VOLTS		1	L-365720		T-7606412 P291
X		1	1	-30629	T-202	0.201 KVA., 800 CYCLE, TEST 1500 VOLTS		1	L-365721		T-7606412 P290

*SEE NOTE ON SHEET 1.

TABLE IV (CONTINUED

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
						TRANSFORMERS AND REACTORS (CLASS 30) CONTINUED					
X		1	1	-30630	T-205	RATIO 1:32, 200 TO 3500 CYCLE, TEST 1200 VOLTS		1	L-365722		T-7606412 P293
X		1	1	-30631	T-201	0.400 KVA., 800 CYCLE, TEST 1500 VOLTS		1	L-365723		T-7606412 P289
X		1	1		L-701, L-801*	REACTOR		22	#76810		
						VACUUM TUBES (CLASS 38)					
	X	1	1	-5Z3	V-203	AUXILIARY RECTIFIER TUBE	RE13A600B	5	5Z3		T-7606451 P26
	X	1	1	-801	V-101	MASTER OSCILLATOR TUBE (TRIODE)	RE13A600B	5	801		T-7606451 P22
	X	1	1	-803	V-103, V-303	POWER AMPLIFIER TUBE	RE13A600B	27	803		T-7606451 P29
	X	1	1	-807	V-102	INTERMEDIATE AMPLIFIER TUBE	RE13A600B	27	807		T-7606451 P30
	X	1	1	-837	V-301, V-302	MASTER OSCILLATOR OR AMPLIFIER (PENTODE)	RE13A600B	5	837		T-7606451 P31
	X	1	1	-843	V-204	SPEECH AMPLIFIER TUBE	RE13A600B	5	843		T-7606451 P23
	X	1	1	-1616	V-201, V-202	H.V. RECTIFIER TUBE	RE13A600B	5	1616		T-7606451 P24
						INDUCTORS AND CHOKES (CLASS 47)					
X		2	2		L-103, L-104, L-106, L-108, L-304, L-306, L-308	CHOKE, 2.5 MILLIHENRIES, 125 MILLI-AMPS., D.C. RESISTANCE 50 OHMS		1.		K-7808974 P1	T-7606412 P323
X		1	1		L-105	5.5 MILLIHENRIES		26	#12731		T-7606409 P140
X		1	1		L-203	ISOLATING CHOKE, 500 TURNS, #28 D.S. C. WIRE, 5.4 MILLIHENRIES, 250 MILLI-AMPS. D.C. RESISTANCE 11.8 OHMS		1	L-303471	M-7408035 G1	T-7606410 P150

* SEE NOTE ON SHEET 1.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
						INDUCTORS AND CHOKES (CLASS 47) CONTINUED					
X		1	1		L-302, L-303	M.O. FILAMENT CHOKE, 150 TURNS OF #24 D.C.C. WIRE, INDUCTANCE 0.55 MILLIHENRY, D.C. RESISTANCE 1.7 OHMS		1		M-7407296 G2	T-7606412 P324
						CAPACITORS (CLASS 48)					
X		1	1	-48024-10	C-326	0.004 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606409 P77
X		1	1	-48205-A	C-101, C-208, C-301	0.5 MFD., 400 V.D.C. WORKING, PAPER	RE13A488C	25			T-7606408 P1
X		1	1	-48279-5	C-131	0.002 MFD., 6000 V. EFF. TEST, 6 AMPS. AT 1000 KC., 4 AMPS. AT 300 KC., MICA	RE48AA131C	25			T-7606408 P31
X		1	1	-48313-A	C-106A, C-106B	2 X 0.1 MFD., 400 V.D.C. WORKING, PAPER	RE13A488C	25			T-7606408 P33
X		1	1	-48334-2	C-121	0.00025 MFD. ±2%, 5000 V. EFF. TEST 2.5 AMPS. AT 1000 KC., 1 AMP. AT 300 KC., MICA	RE48AA131C	25			T-7606408 P21
X		1	1	-48403-A	C-206, C-210	2.0 MFD., 400 V.D.C. WORKING, PAPER	RE13A488C	25			T-7606408 P42
X		1	1	-48406-5	C-124	0.005 MFD., 3000 V. EFF. TEST #(9, 6.5, 4, 2), MICA	RE48AA131C	25			T-7606408 P24
X		2	2	-48410-10	C-115, C-203, C-207, C-211, C-315, C-321	0.006 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606408 P13
X		3	3	-48428-10	C-110, C-111, C-112, C-117, C-118, C-119, C-129, C-309, C-331	0.02 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606408 P10

CURRENT RATINGS AT (3000, 1000, 300, 100) KC.

TABLE IV (CONTINUED,

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
					CAPACITORS (CLASS 48) CONTINUED						
X		4	4	-48487-10	C-109, C-116, C-128, C-307, C-308, C-310, C-313, C-317, C-318, C-319, C-322, C-323, C-324, C-325, C-333, C-334	0.01 MFD., 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606408 P9
X		1	1	-48498-A	C-204, C-205	1.0 MFD., 600 V.D.C. WORKING, PAPER	RE13A488C	25			T-7606408 P40
X		1	1	-48514-2	C-123, C-130	0.00035 MFD. ±2%, 5000 V. EFF. TEST #(8, 5, 2, 0.8), MICA	RE48AA131C	25			T-7606408 P23
X		1	1	-48583-D2	C-127	0.0005 MFD. ±2%, 3000 V. EFF. TEST, #(4, 2, 1, 0.55), MICA, CONSTANT CAPACITY	RE48AA131C	25			T-7606408 P27
X		1	1	-48642-B10	C-104, C-120	0.002 MFD., 2500 V.D.C. TEST, 1200 V.D.C. WORKING, MICA	RE48AA112N	25			T-7606408 P4
X		1	1	-48667-B2	C-314	0.00004 MFD. ±2%, 1000 V.D.C. TEST, 600 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606408 P65
X		1	1	-48702-D2	C-102	0.005 MFD. ±2%, 2000 V. EFF. TEST, #(8.5, 6.5, 4, 2), MICA CONSTANT CAPACITY	RE48AA131	24			T-7606408 P2
X		1	1	-48707	C-201	8, 5, 4, 2, 1 MFD., 250 VOLTS, ONE COMMON TERMINAL RATED 6 AMPS., 600 TO 800 CYCLES, PAPER	RE13A488C	25			T-7606408 P37
X		1	1	-48744-10	C-114, C-335	0.00005 MFD., 2500 V.D.C.TEST, 1200 V.D.C. WORKING, MICA	RE48AA112N	25 30			T-7606408 P14
X		1	1	-48906	C-202	3.0 MFD., 2000 V.D.C. EFF. TEST, PAPER	RE13A488C	1	S#1087313		T-7606408 P38
X		1	1	-481095	C-209	25 MFD., 25 V.D.C. WORKING, ELECTROLYTIC	RE13A549A	25			T-7606408 P45

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
						CAPACITORS (CLASS 48) CONTINUED					
X		1	1	-481105-Z2	C-122	0.0002 MFD. ±2%, 5000 V. EFF. TEST, #(3.5, 2, 0.7, 0.25), MICA	RE13AA131C	25			T-7606408 P22
X		1	1	-481133-B5	C-327, C-336	0.006 MFD., 2000 V. EFF. TEST, #(9 7.5, 4.5, 2.2), MICA	RE48AA131	25			T-7606409 P78
X		1	1	-481134-Z2	C-302	0.00025 MFD. ±2%, 2500 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C. FROM -32°C TO +65°C	RE48AA131	2	1053-6K		T-7606408 P53
X		1	1	-481135-Z2	C-303	0.0006 MFD. ±2%, 2500 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C, FROM -32°C TO +65°C	RE48AA131	2	1066-6K		T-7606408 P54
X		1	1	-481136-Z2	C-304	0.00075 MFD. ±2%, 2500 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C FROM -32°C TO +65°C	RE48AA131	2	1023-6K		T-7606408 P55
X		1	1	-481137-Z2	C-305	0.003 MFD. ±2%, 2000 V. EFF. TEST, MICA, TEMPERATURE COEFFICIENT -.002% (±.001%) PER °C FROM -32°C TO +65°C	RE48AA131	2	1031-6K		T-7606408 P56
X		1	1	-481213-F2	C-103	0.0012 MFD. ±2%, 2000 V. EFF. TEST, MICA	RE48AA131	24			T-7606408 P3
X		1	1		C-701, C-801*	2000 MFD., 25 VOLTS WORKING		22	#76812		
X		1	1		C-703, C-705, C-803*, C-805*	0.01 MFD.		22	#76811		
X	X	1	1		C-711	0.5 MFD.		22	#19411		
						PLUGS AND SOCKETS (CLASS 49)					
X		1	1	-49006	P-202	SIDE TONE AND KEY PLUG, WITH BLACK BAKELITE SHELL		15	#75		T-7606451 P44

* SEE NOTE ON SHEET 1.

CURRENT RATINGS AT (3000, 1000, 300, 100) KC.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
					PLUGS AND SOCKETS (CLASS 49) CONTINUED						
X		1	1		P-201	POWER INPUT PLUG, 6 CONNECTIONS	NAF C-48E	12		T-7607797 G30	T-7606451 P62
	X	2	2								
X		1	1		P-201A	POWER INPUT SOCKET, 6 CONNECTIONS, MALE		12		T-7607341 G17	T-7606412 P355
X		1	1		P-203, P-204	I.F. AND H.F. INTERCONNECTION PLUG, 11 CONNECTIONS	NAF C-48E	12		T-7607797 G20	T-7606451 P42
	X	2	2								
X		1	1		P-203A, P-203B, P-204A, P-204C	I.F. AND H.F. INTERCONNECTION SOCKET, 11 CONNECTIONS, MALE		12		T-7607341 G18	T-7606412 P356
X		1	1		P-205, P-206	I.F. AND H.F. HIGH VOLTAGE PLUG, 4 CONNECTIONS	NAF C-48E	12		T-7607797 G31	T-7606451 P63
	X	2	2								
X		1	1		P-205A, P-205B, P-206A, P-206C	I.F. AND H.F. HIGH VOLTAGE SOCKET, 4 CONNECTIONS, MALE		12		T-7607341 G19	T-7606412 P357
X		1	1		P-701, P-702	PLUG RECEPTACLE		22	#76807		
X		1	1		P-703	PLUG RECEPTACLE		22	#76805		
X		1	1		P-704	PLUG RECEPTACLE		22	#76806		
X		1	1		P-801*	PLUG RECEPTACLE		22	#76820		
X		1	1		P-802*	PLUG RECEPTACLE		22	#76819		
X		3	3			"RAJAH" PLUG WITH EXTENDED BAKELITE FERRULE		29	#406		T-7606451 P40
						MICROPHONE (CLASS 51)					
X		1	1	-51004A	MI-201	MICROPHONE WITH PLUG AND 47-1/2" RUBBER CORD	NAF SPEC. T-38C	10	RS-38A		T-7606451 P17

* SEE NOTE ON SHEET 1.

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
						WIRES AND CONDUCTORS (CLASS 62)					
X		20'	20'	◊	W-1201	GENERATOR RECTIFIER CABLE, 4 CONDUCTOR		16		T-7609781 P6	T-7606451 P59
X		3'	3'	◊	W-1203, W-1204	H.F. & I.F. INTERCONNECTION CABLE, 11 CONDUCTOR		16		T-7609781 P8	T-7606451 P60
X		3'	3'	◊	W-1205, W-1206	H.F. & I.F. HIGH VOLTAGE CABLE, 4 CONDUCTOR		16		T-7609781 P7	T-7606451 P61
X		12' 9"	12' 9"		W-1210, W-1211	SIDE TONE & KEY CABLE, 2 CONDUCTOR		17			T-7606451 P38
X		6'	6'		W-1212, W-1213	RECEIVER ANTENNA CABLE, 1 CONDUCTOR		16		K-7809787 P4	T-7606451 P34
X		550'	550'		W-1212, W-1213	MODEL "J" AIRCRAFT ANTENNA WIRE		1			T-7606451 P46
X		50'	50'			TIN-COPPER WIRE, #2003-2, #20 (0.032)		1			T-7606451 P47
X		50'	50'			2000 VOLTS RUBBER INSULATED, HIGH TENSION CABLE, #16 GAUGE STRANDED TINNED COPPER CORE, COVERED WITH RUBBER		1		K-7809787 P4	T-7606451 P53
						INSULATORS (CLASS 61)					
	X	2	2			INSULATOR		1		M-7407246 G1	T-7606451 P45
						RESISTORS, POTENTIOMETERS AND RHEOSTATS (CLASS 63)					
X		1	1	-63003E	R-203	20 OHMS, 10 WATTS	RE13A372J STYLE F	4			T-7606411 P219

◊ RUBBER SUBSTITUTE MATERIAL

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

SPARE PARTS STOCK	SPARE PARTS MOBILE	QUAN. 25 CYCLE & GAS ENGINE	QUAN. 60 CYCLE & GAS ENGINE	NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
						RESISTORS, POTENTIOMETERS AND RHEOSTATS (CLASS 63) CONTINUED					
X		1	1	-63011E	R-213	1000 OHMS, 20 WATTS	RE13A372J STYLE E	4			T-7606411 P228
X		1	1	-63013E	R-109, R-310	3000 OHMS, 20 WATTS	RE13A372J STYLE E	4		T-7605861 P30	T-7606410 P209
X		1	1	-63015E	R-106, R-302, R-309	5000 OHMS, 20 WATTS	RE13A372J STYLE E	4		T-7605861 P26	T-7606410 P206
X		1	1	-63016E	R-102, R-105	10,000 OHMS, 20 WATTS	RE13A372J STYLE E	4		T-7605861 P27	T-7606410 P202
X		1	1	-63080E	R-111	2500 OHMS, 60 WATTS	RE13A372J STYLE F	4		T-7605861 P31	T-7606410 P211
X		1	1	-63081E	R-110, R-311	3000 OHMS, 60 WATTS	RE13A372J STYLE D	4		T-7605861 P10	T-7606410 P210
X		1	1	-63095E	R-304, R-308	20,000 OHMS, 60 WATTS	RE13A372J STYLE D	4			T-7606411 P236
X		1	1	-63288	R-101, R-301	100 OHMS ±10%, 1 WATT, COMPOSITION	RE13A372G	3	F-1	T-7605849 P25	T-7606410 P201
X		1	1	-63288	R-209	100,000 OHMS ±10%, 1 WATT, COMPOSITION	RE13A372G	3	BT-1	T-7605849 P53	T-7606411 P224
X		1	1	-63288	R-202, R-208	500,000 OHMS ±10%, 1 WATT, COMPOSITION	RE13A372G	3	BT-1	T-7605849 P23	T-7606411 P218
X		1	1	-63289	R-210	30 OHMS ±10%, 3 WATTS, COMPOSITION	RE13A372G	20	E-2	T-7605849 P8	T-7606411 P225
X		1	1	-63426	R-307	20,000 OHMS ±5%, 2 WATTS, COMPOSITION	RE13A372G	3	F-2	T-7605849 P71	T-7606411 P239
X		1	1	-63546E	R-107, R-108, R-305, R-306	12,500 OHMS, 60 WATTS, TAPPED AT 5 EQUAL VALUES	RE13A372J STYLE D	4		T-7605861 P25	T-7606410 P207
X		1	1	-63676E	R-112	100 OHMS, 10 WATTS	RE13A372J STYLE F	4		T-7605861 P28	T-7606410 P212

TABLE IV (CONTINUED)

SPARE PARTS LIST BY NAVY TYPE NUMBERS FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

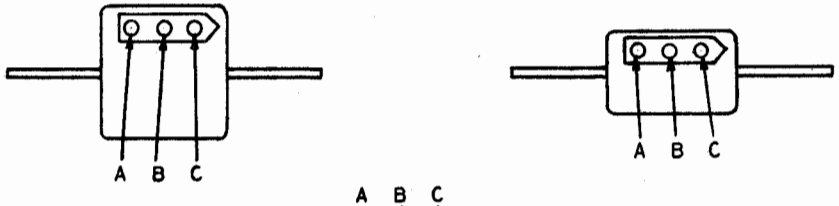
SPARE PARTS		QUAN.		NAVY TYPE NUMBER	ALL SYMBOL DESIGNATIONS INVOLVED	DESCRIPTION	NAVY SPEC. OR DRAWING NUMBER	MFR.	MFR. DESIG.	SPECIAL TOL. RATING OR MODIFICATION	CONTRACTOR'S DRAWING AND PART NUMBER
STOCK	MOBILE	25 CYCLE & GAS ENGINE	60 CYCLE & GAS ENGINE								
						RESISTORS, POTENTIOMETERS AND RHEOSTATS (CLASS 63) CONTINUED					
X		1	1	-63678-10	R-115	20 OHMS ±10%, 1/2 WATT	RE13A372G	3	BW-1/2		T-7606410 P215
X		1	1	-63703-2	R-303, R-313, R-314	50 OHMS ±2%, 1 WATT	RE13A372G	3	BW-1	T-7605849 P70	T-7606411 P235
X		1	1	-63752E	R-207	2000 OHMS, 20 WATTS	RE13A372J STYLE E	4			T-7606411 P222
X		1	1	-63809-15	R-212	1 MEGOHM ±15%, 10 WATTS, FERRULE TERMINALS		3	MVP	T-7605849 P68	T-7606411 P227
X		1	1	-63810E	R-312	4.5 OHMS, 20 WATTS	RE13A372J	4		T-7605861 P36	T-7606411 P244
X		1	1	-63812E	R-103	1.33 OHMS ±5%, 10 WATTS	RE13A372J STYLE F	4		T-7605861 P34	T-7606410 P203
X		1	1	-631209	R-113, R-114	25 OHMS ±5%, 5 WATTS	RE13A372J	28	KOOL-OHM 5-K		T-7606410 P213
X		1	1		R-201	TWO MODEL "J" RHEOSTATS, 12 OHMS EACH, MOUNTED IN TANDEM		13	#6601	K-7810191 LESS KNOB	T-7606411 P217
X		1	1		R-204	POTENTIOMETER, 100 OHMS, MODEL "H"		13	#0151	M-7407376 P1	T-7606411 P220
X		1	1		R-205	800 OHMS, 50 WATTS, MODEL "J"		13	#0325		T-7606411 P221
X		1	1		R-211	POTENTIOMETER, 500,000 OHMS, RESISTANCE CURVE A		11			T-7606411 P226
X		1	1		R-701, R-801*	RHEOSTAT, 1 OHM		22	#76808		

* SEE NOTE ON SHEET 1.

TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA
FOR MODELS TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

COLOR CODE IN MMFD. FOR CAPACITORS

COLOR	A 1ST DIGIT	B 2ND DIGIT	C CIPHERS
BLACK	-	0	.0
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0000
GREEN	5	5	00000
BLUE	6	6	000000
PURPLE	7	7	0000000
GRAY	8	8	00000000
WHITE	9	9	--



RCA COLOR CODED CAPACITORS

CAPACITY IN MMFD.

VALUES DESIGNATE TOLERANCE BY COLOR.

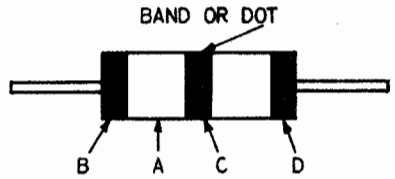
YELLOW ±20% BLUE ±10% BLACK ±5%

RMA COLOR CODE FOR RESISTORS

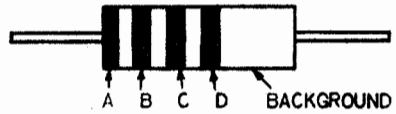
COLOR	A 1ST DIGIT	B 2ND DIGIT	C CIPHERS
BLACK	-	0	.0
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	000
YELLOW	4	4	0000
GREEN	5	5	00000
BLUE	6	6	000000
PURPLE	7	7	0000000
GRAY	8	8	00000000
WHITE	9	9	--

D - TOLERANCE CODE:

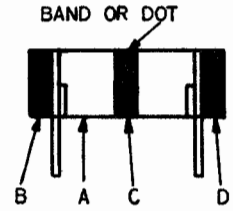
GOLD = 5% SILVER = 10% OMIT = 20%



ORIGINAL COLOR ARRANGEMENT FOR AXIAL LEADS



NEW COLOR ARRANGEMENT FOR AXIAL LEADS

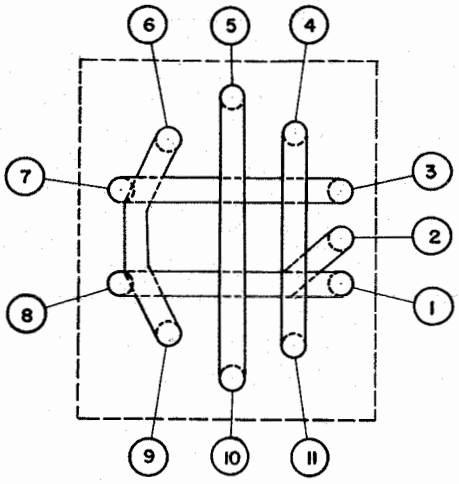


STANDARD COLOR ARRANGEMENT FOR RADIAL LEADS

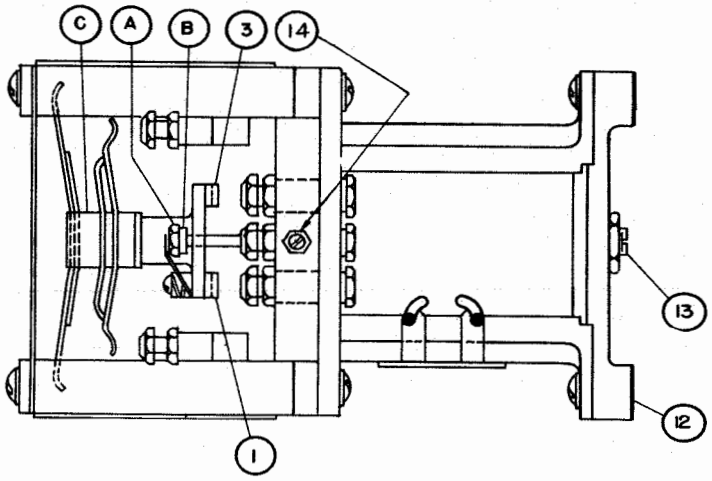
TABLE VI
LIST OF MANUFACTURERS

FOR MODEL TBW-3 AND TBW-4 PORTABLE RADIO TRANSMITTING EQUIPMENT

CODE NUMBER	MFR. PREFIX	NAME	ADDRESS
1	CAY	WESTINGHOUSE ELECTRIC & MFG.	2519 WILKENS AVENUE BALTIMORE, MD.
2	CD	CORNELL-DUBILIER COND. CORP.	SOUTH PLAINFIELD, N. J.
3	CIR	INTERNATIONAL RESISTANCE CORP.	401 N. BROAD STREET PHILADELPHIA, PA.
4	CAO	WARD LEONARD CO.	MT. VERNON, N. Y.
5	CRC	R. C. A. RADIOTRON	HARRISON, N. J.
6		CULVER-STEARNS MFG. CO.	WORCESTER, MASS.
7	CAE	CUTLER HAMMER MFG CO.	12TH E. ST. PAUL AVENUE MILWAUKEE, WIS.
8	CNA	NATIONAL RADIO PRODUCTS	61 SHERMAN STREET MALDEN, MASS.
9	CLF	LITTELFUSE LABORATORIES, INC.	4757 RAVENSWOOD AVENUE CHICAGO, ILL.
10	CTE	TELEPHONICS CORP.	350 W. 31ST STREET NEW YORK, N. Y.
11	CBZ	ALLEN-BRADLEY	1322 S. 2ND STREET MILWAUKEE, WIS.
12	CUA	A. J. ULMER CO.	90 WEST BROADWAY NEW YORK, N. Y.
13	COM	OHMITE MFG. CO.	4835 FLOURNEY STREET CHICAGO, ILL.
14	CHC	HAMMARLUND MFG. CO.	424 WEST 33RD STREET NEW YORK, N. Y.
15	CMA	P. R. MALLORY CO., INC.	INDIANAPOLIS, IND.
16		SIMPLEX WIRE & CABLE CO.	79 SIDNEY STREET CAMBRIDGE, MASS.
17		J. R. ROEBLING & SON	TRENTON, N. J.
18		ELECTRIC STORAGE BATTERY CO.	PHILADELPHIA, PA.
19		L. A. BENSON & CO., INC.	BALTIMORE, MD.
20	CCC	CONTINENTAL CARBON CO.	13900 LORIAN AVENUE CLEVELAND, OHIO
21	CJB	J. H. BUNNELL CO.	215 FULTON STREET NEW YORK, N. Y.
22	CDO	D. W. ONAN & SONS	1428 ROYALSTON AVENUE MINNEAPOLIS, MINN.
23		PHILA. HARDWARE & MALLEABLE IRON WORKS, INC.	7500 STATE ROAD PHILADELPHIA, PA.
24	CD	CORNELL-DUBILIER COND. CORP.	SOUTH PLAINFIELD, N. J.
	CAW	AEROVOX CORP.	NEW BEDFORD, MASS.
25	CD	CORNELL-DUBILIER COND. CORP.	SOUTH PLAINFIELD, N. J.
	CAW	AEROVOX CORP.	NEW BEDFORD, MASS.
	CSL	SOLAR MFG. CO.	BAYONNE, N. J.
26		F. W. SICKLES CO.	SPRINGFIELD, MASS.
27	CWL	WESTINGHOUSE LAMP CO.	BLOOMFIELD, N. J.
28		SPRAGUE SPECIALTIES CO.	NORTH ADAMS, MASS.
29		THE RAJAH COMPANY	BLOOMFIELD, N. J.
30		MICAMOLD PRODUCTS CORPORATION	1087 FLATBUSH AVENUE BROOKLYN, N. Y.
		SANGAMO ELECTRIC COMPANY	SPRINGFIELD, ILL.



TOP VIEW OF SPRING CONTACTS



LEGEND

(1) GRID END OF GRID-GROUNDING CONTACT
(2) RECEIVER END OF RECEIVER-GROUNDING CONTACT
(7) & (3) SIDE TONE CONTACTS
(11) & (4) POWER CONTACTS
(10) & (5) ANTENNA BACK CONTACTS
(9) & (6) ANTENNA TRANSMITTING CONTACTS
(8) GROUND END OF GRID AND RECEIVER GROUNDING CONTACTS
(12) RELAY BASE
(13) STUB & LOCKING NUT
(14) DAMPER ASSEMBLY *

CAUTION NOTE: REMOVE RELAY FROM SET AND MICA PLATES FROM RELAY BEFORE ATTEMPING TO MAKE ADJUSTMENTS. MAKE ALL ADJUSTMENTS BY RAISING OR LOWERING STATIONARY CONTACT STUDS. DO NOT BEND SPRING CONTACTS. IF POWER CONTACT (#11 AND #4) SPRINGS DO NOT SEAT PROPERLY WHEN CONTACT IS MADE, ADJUST BLOCKS CARRYING STUDS SO CONTACT FACES ARE PARALLEL TO SPRINGS. SLIDE A PIECE OF CROCUS CLOTH BACK AND FORTH LIGHTLY BETWEEN SPRING AND STUD TO CLEAN CONTACTS.

RELAY ADJUSTMENT PROCEDURE

1. REMOVE RELAY BASE (12) AND ADJUST STUB (13) TO BE 27/32 ± 1/64 HIGH AND REPLACE RELAY BASE (12).
2. BE CERTAIN PLUNGER IS SEATED AT BOTTOM.
3. RAISE PLUNGER .030" FROM BOTTOM.
4. ADJUST POWER CONTACTS #4 & #11 TO JUST MAKE CONTACT.
5. ADJUST GRID END #1 OF GRID-GROUNDING CONTACT TO JUST MAKE CONTACT.
6. RAISE PLUNGER AN ADDITIONAL .010" MAKING A TOTAL OF .040" FROM BOTTOM.
7. ADJUST SIDE TONE CONTACTS #3 & #7 TO JUST MAKE CONTACT.
8. ADJUST TRANSMITTING ANTENNA CONTACTS #6 & #9 TO JUST MAKE CONTACTS.
9. ADJUST GROUND END #8 AND RECEIVER END #2 OF GRID AND RECEIVER GROUNDING CONTACTS TO JUST MAKE CONTACT.
10. RAISE PLUNGER AN ADDITIONAL .135", MAKING A TOTAL OF .175" FROM BOTTOM.
11. ADJUST ANTENNA BACK CONTACTS #5 & #10 TO JUST MAKE CONTACT.
12. RAISE PLUNGER AN ADDITIONAL .040" MAKING A TOTAL OF .215" FROM BOTTOM.
13. ADJUST LOCKNUT "A" SO THAT LEATHER WASHER "B" IS JUST SEATED AGAINST THE CENTER OF CONTACT SUPPORT "C".
14. REMOVE DAMPER ASSEMBLY (14) WHICH IS USED ON SOME RELAYS. ANY SLIGHT BOUNCE REMAINING AFTER ABOVE ADJUSTMENTS HAVE BEEN MADE MAY BE REMOVED BY SLIGHT READJUSTMENT OF STUB (13). IF FURTHER BOUNCE IS NOTED, REPLACE ASSEMBLY (14) AND TIGHTEN ONLY ENOUGH TO REMOVE BOUNCE.
15. AFTER ADJUSTMENT OF CONTACTS, CHECK ALL STUD LOCKNUTS AND MAKE CERTAIN THEY ARE TIGHT BEFORE REASSEMBLING RELAY.

* MICA PLATES ARE NOT SUPPLIED ON ALL RELAYS.

Fig. 25 Keying Relay Adjustment (Drawing P-7708688)

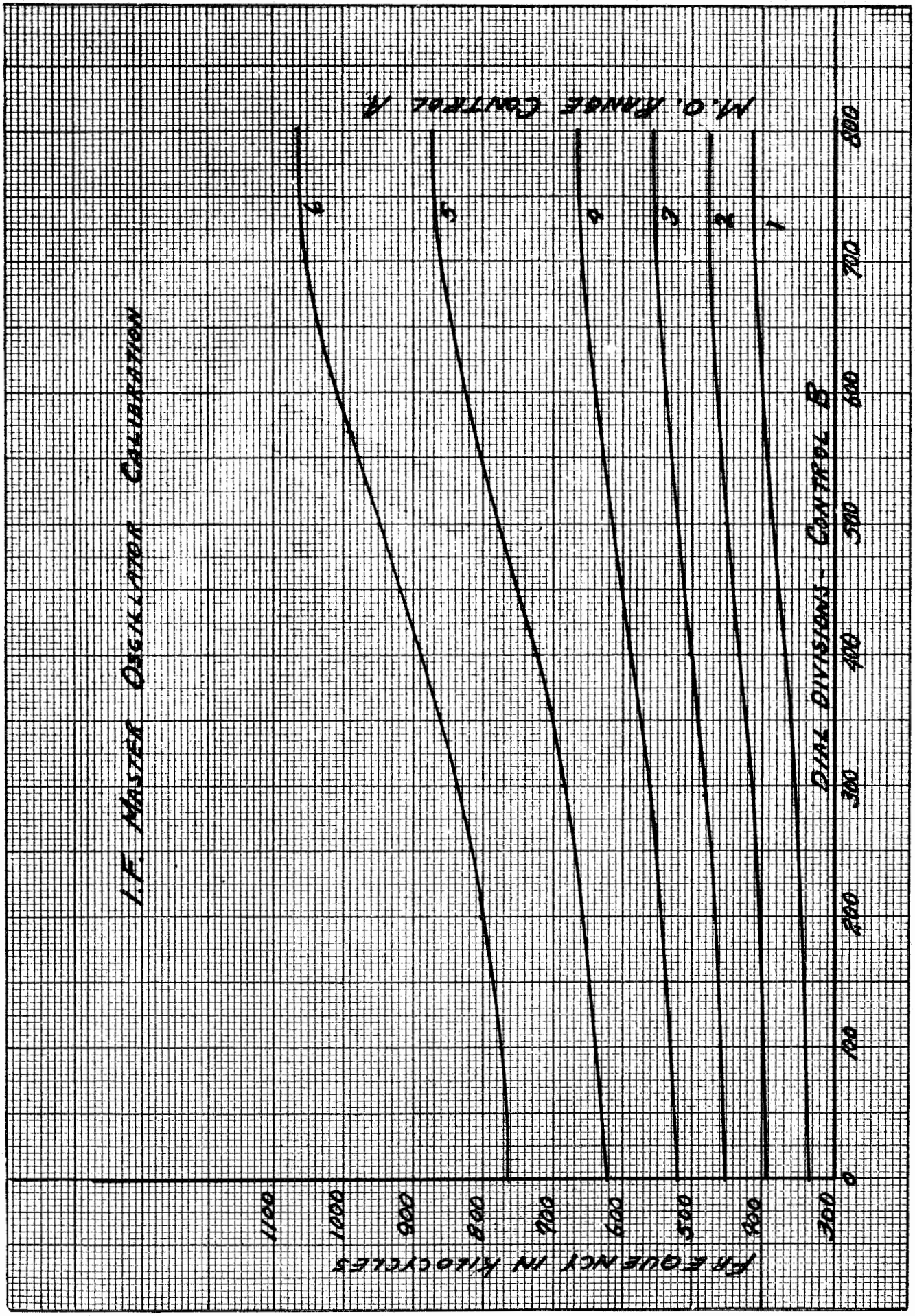


Fig. 26 Average Frequency Calibration Curve of Master Oscillator, Intermediate Frequency Transmitter Type CAY-52238, Controls A and B (Curve 236830)

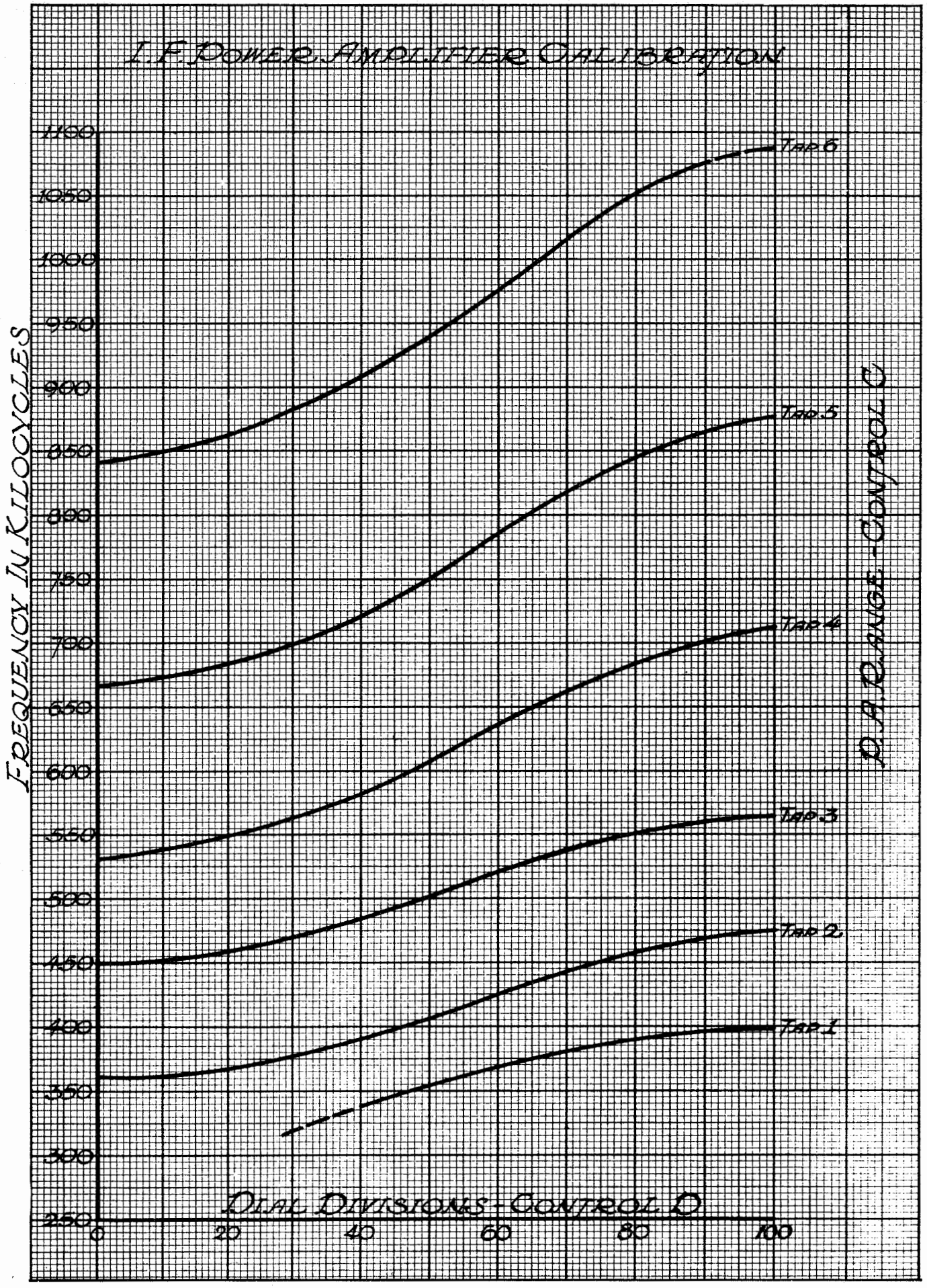


Fig. 27 Average Frequency Calibration Curve of Power Amplifier, Intermediate Frequency Transmitter Type CAY-52238, Controls C and D (Curve 264441)

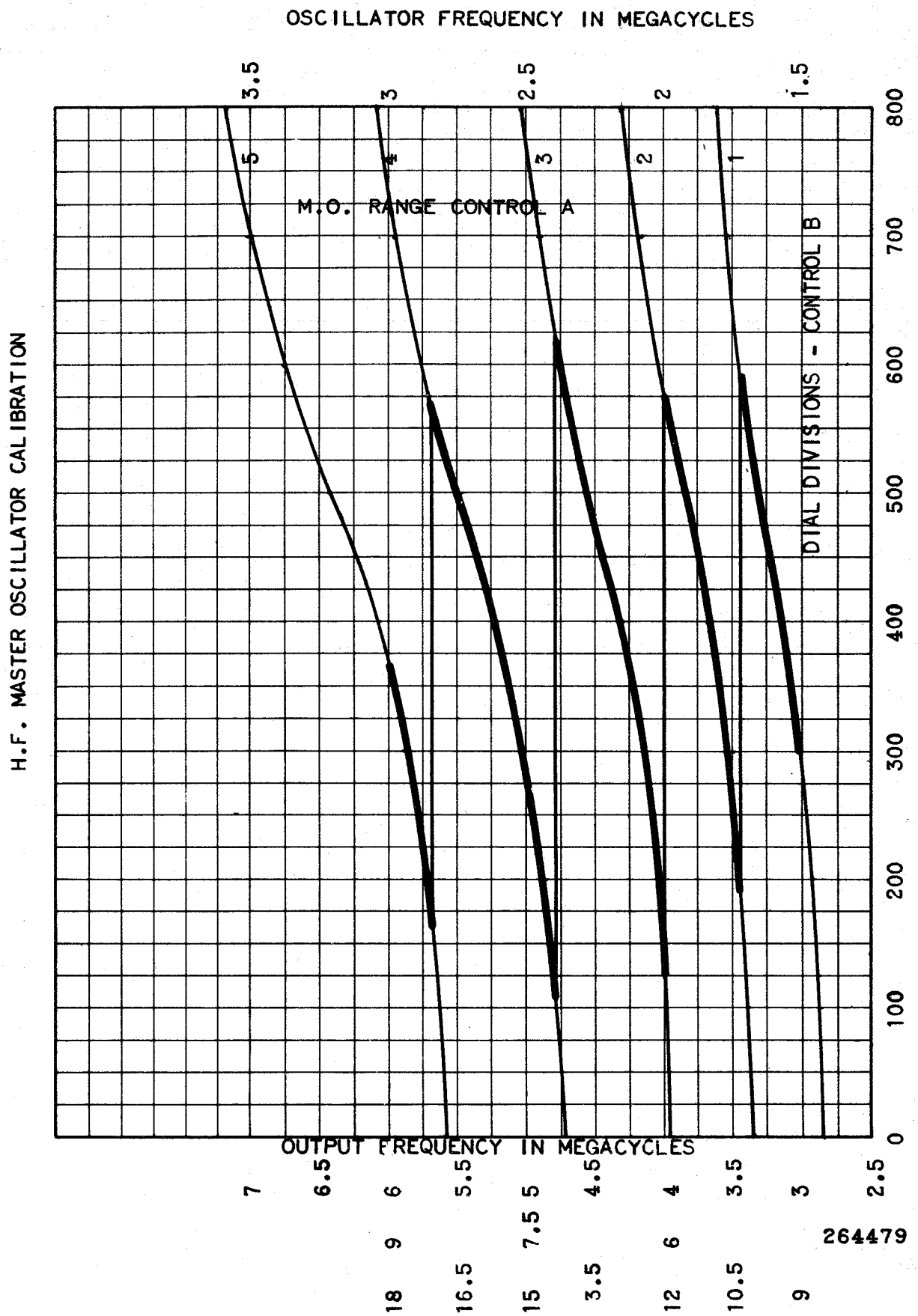


Fig. 28 Average Frequency Calibration Curve of Master Oscillator, High Frequency Transmitter Type CAY-52239, Controls A and B (Curve 264479)

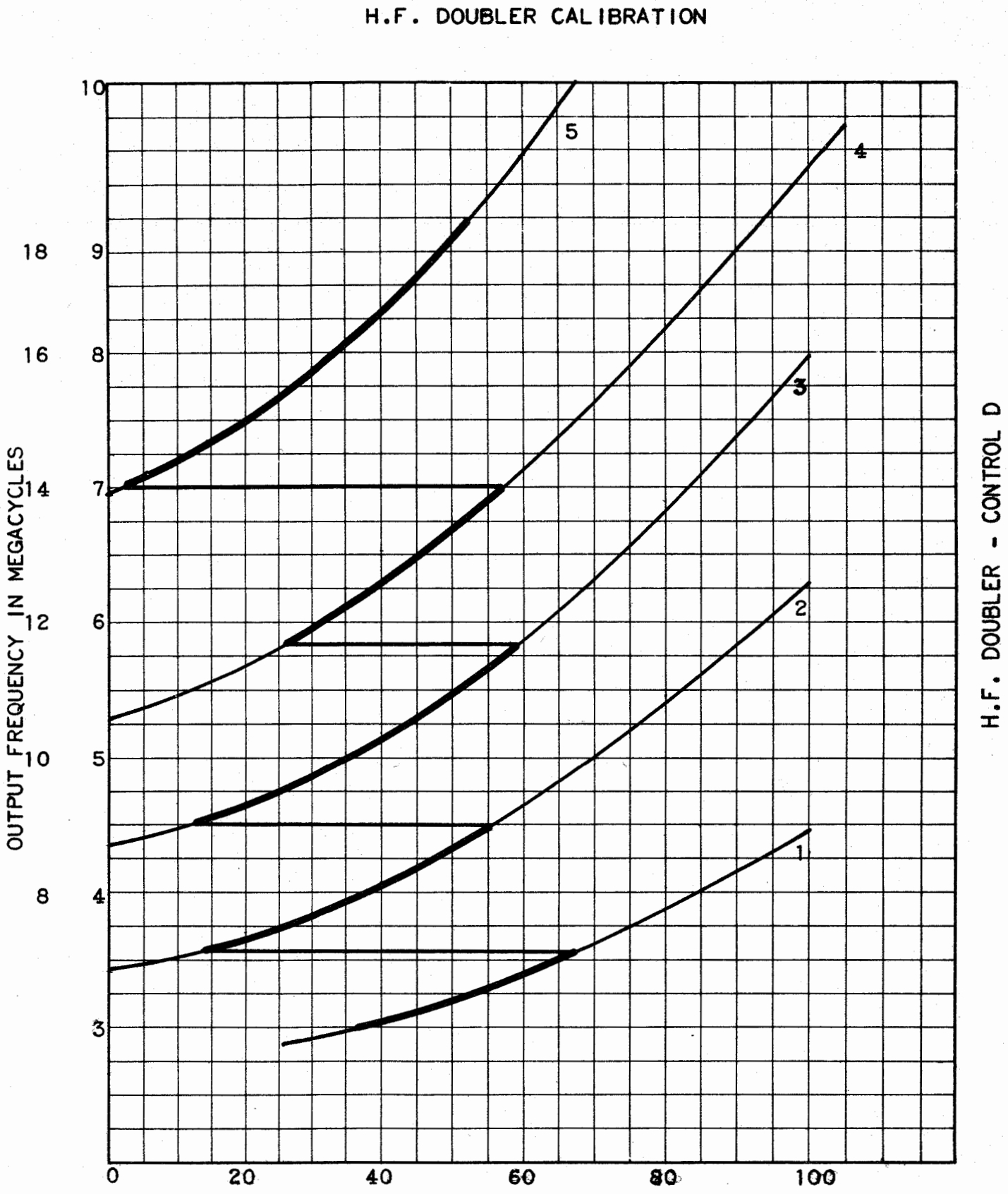


Fig. 29 Average Frequency Calibration Curve of Doubler Circuit, High Frequency Transmitter Type CAY-52239, Controls C and D (Curve 264480)

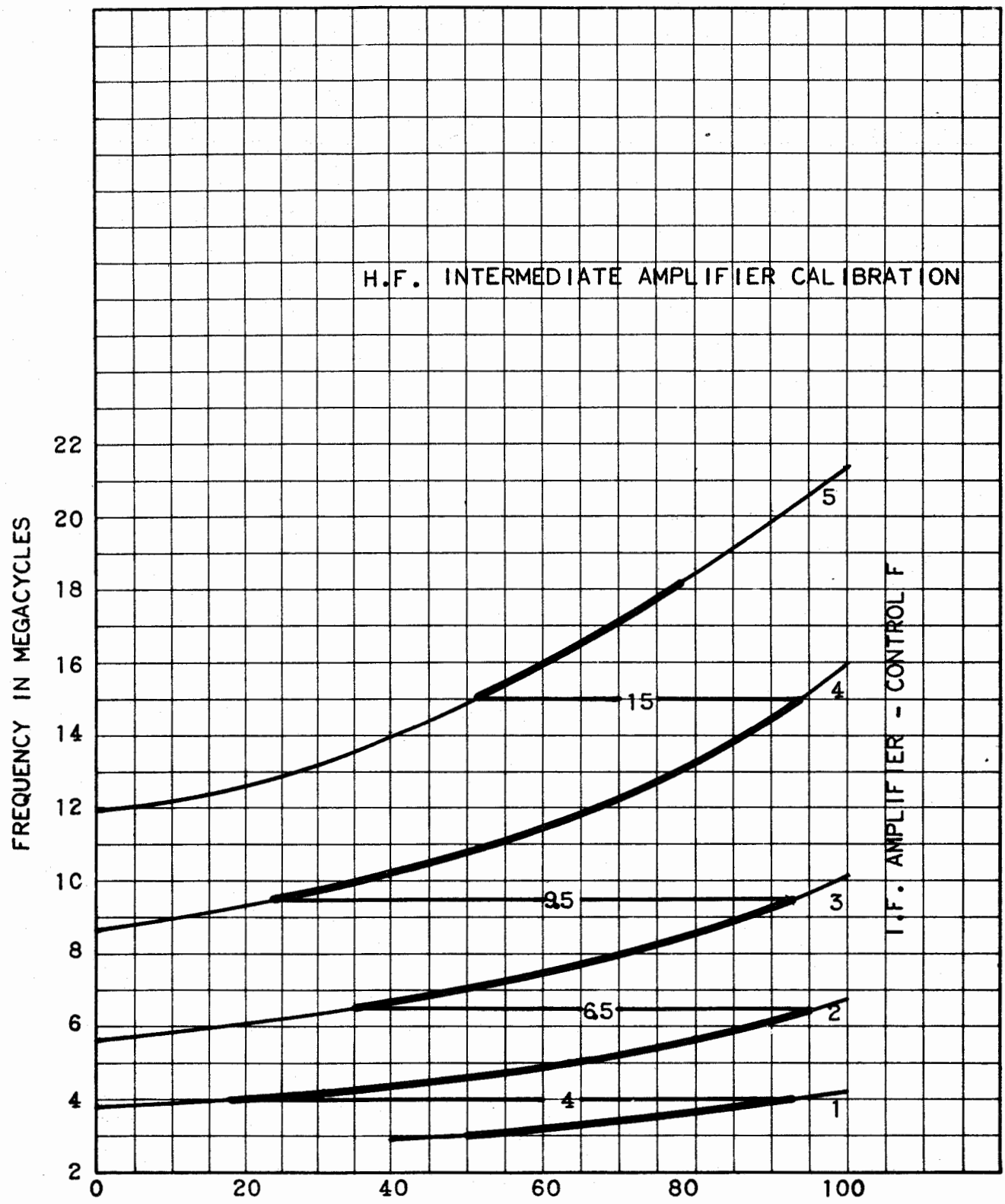


Fig. 30 Average Frequency Calibration Curve of Intermediate Amplifier, High Frequency Transmitter Type CAY-52239, Controls E and F (Curve 264481)

LEGEND

1 - I.F. MO. CONTROL KNOB
2 - I.F. M.O. DIAL
3 - CALIBRATION CAPACITOR ADJUSTMENT WINDOW
4 - M.O. DIAL LOCK
5 - I.F. RANGE SWITCH

7 - PANEL LIGHT
8 - PANEL LIGHT SWITCH

10 - P.A. GRID CURRENT METER
11 - ANT. COUPLING
12 - POWER AMP. TUNING
13 - ANT. TUNING
14 - P.A. RANGE SWITCH

16 - PANEL LIGHT
17 - ANTENNA CURRENT METER
18 - ANTENNA TUNING RANGE
19 - POWER PLUG

20 - D.C. POWER SWITCH
21 - MICROPHONE JACK
22 - KEY JACK
23 - I.F. SIDE TONE JACK
24 - H.F. SIDE TONE JACK
25 - COMPENSATION CAPACITOR SWITCHES
26 - SIDE TONE VOLUME CONTROL
27 - CW-MCW-PHONE SWITCH
28 - FILAMENT RHEOSTAT
29 - POWER CONTROL SWITCH
30 - PANEL LIGHT
31 - H.F. - I.F. SWITCH
32 - PANEL LIGHT SWITCH
33 - START-STOP SWITCH
34 - CALIBRATION CHART
35 - PANEL LIGHT
36 - FILAMENT VOLTMETER
37 - P.A. PLATE CURRENT METER
38 - POWER PLUG
39 - POWER PLUG
40 - H.F. M.O. CONTROL KNOB
41 - H.F. M.O. DIAL
42 - M.O. DIAL LOCK
43 - CALIBRATION CAPACITOR ADJUSTMENT WINDOW
44 - H.F. M.O. RANGE SWITCH

45 - DOUBLER RANGE SWITCH
46 - DOUBLER TUNING
47 - PANEL LIGHT
48 - INT. AMP. TUNING
49 - INT. AMP. GRID CURRENT METER
50 - INT. AMP. RANGE SWITCH
51 - P.A. GRID CURRENT METER
52 - P.A. TUNING
53 - ANTENNA COUPLING
54 - ANTENNA CAPACITOR TUNING
55 - ANTENNA INDUCTANCE TUNING
56 - VOLTAGE-CURRENT FEED
57 - PANEL LIGHT
58 - ANTENNA CURRENT METER
59 - POWER PLUG
60 - COVER CAP - I.F. - H.F.
61 - SUPPORT RODS
62 - H.F. CASE COVER
63 - TABLE SUPPORT BRACKET
64 - CARRYING HANDLE
65 - PANEL LIGHT SWITCH
66 - CONNECTION CABLE
67 - COVER CAP - RECT
68 - LEG
69 - METER, SWITCH

SECTION A-A
WITH COVER IN PLACE

	A	B	C
TBW, TBW-1	37 1/16	13 7/16	10 7/16
TBW-2	37 1/16	13 3/8	10 7/16

Fig. 31 Transmitter-Rectifier Assembly, Navy Model TBW-4 Portable Radio Transmitting Equipment, Outline and Mounting Dimensions (Dwg. W-7300364)

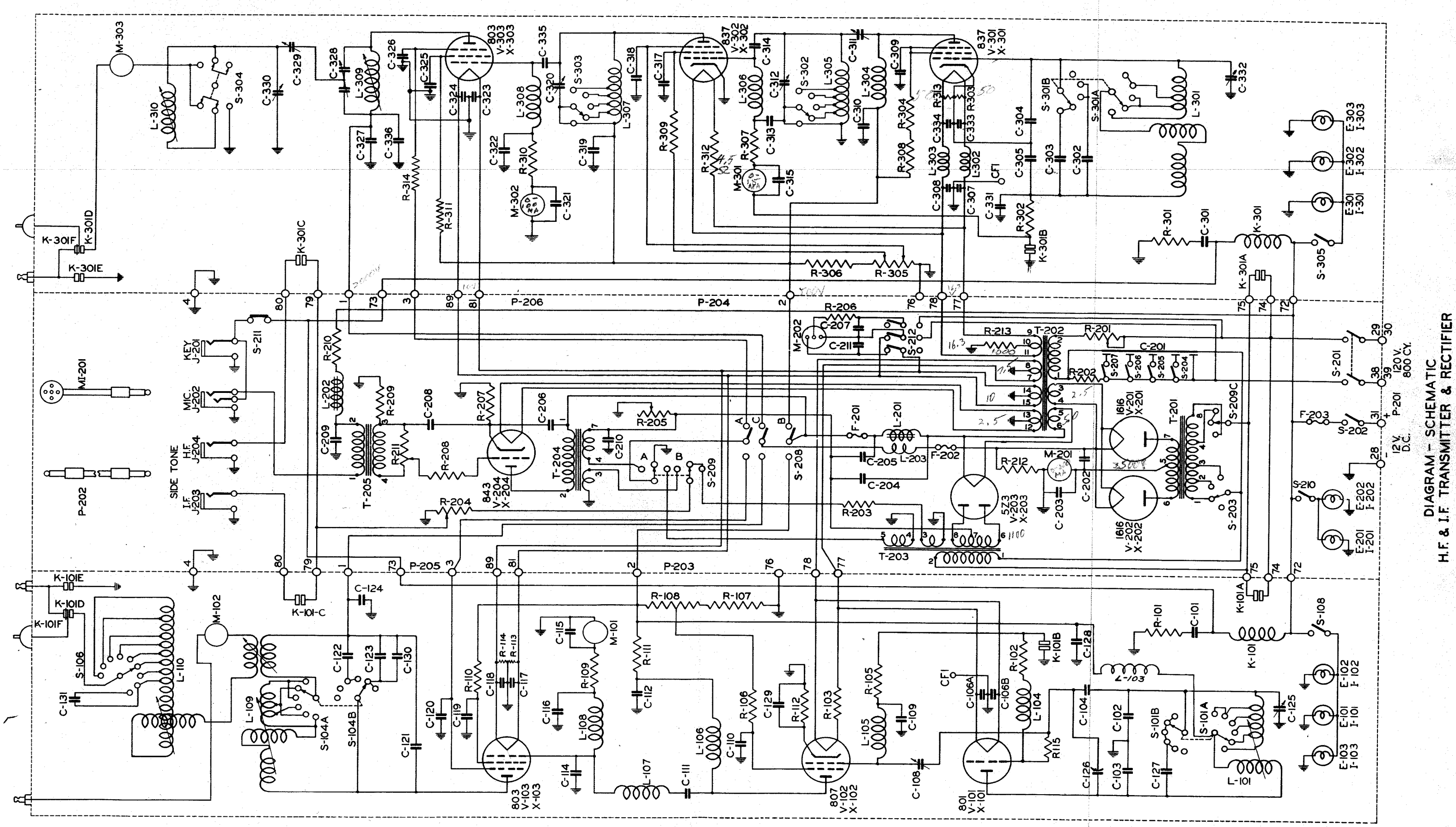


Fig. 32 Navy Model TBW-4 Portable Radio Transmitting Equipment, Schematic Diagram (Drawing T-7608187)

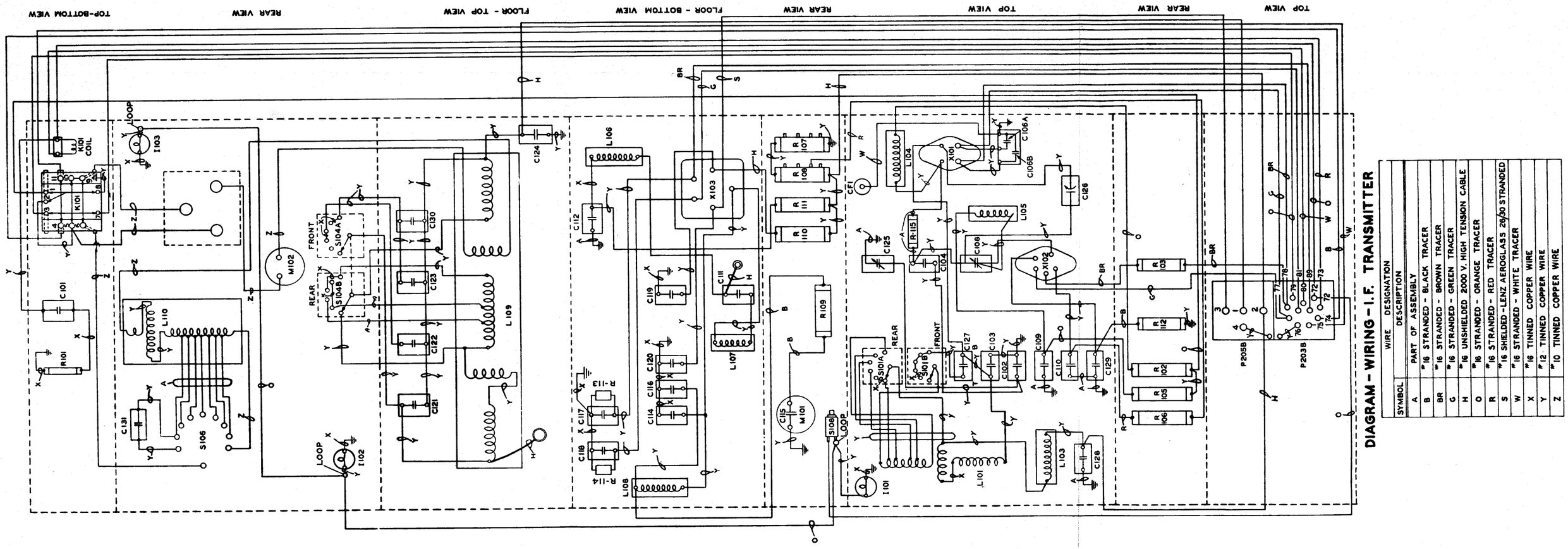


Fig. 33 Intermediate Frequency Transmitter Type CAY-52238, Wiring Diagram (Drawing W-7300471)

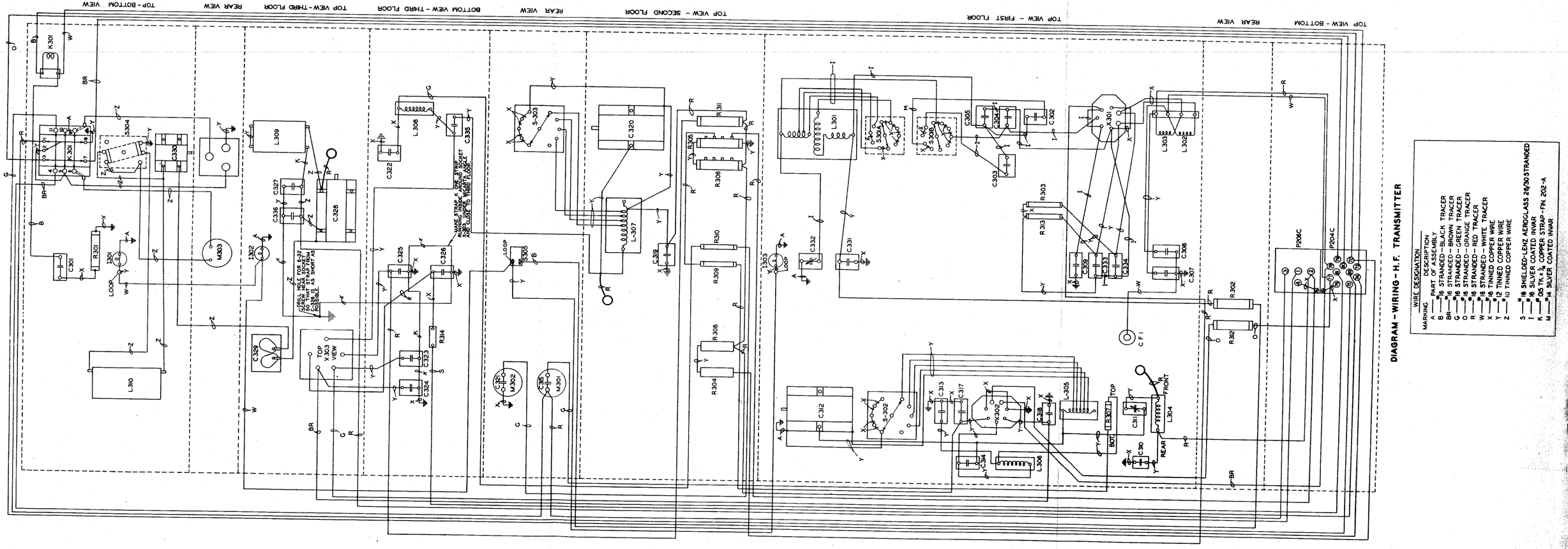


Fig. 34 High Frequency Transmitter Type CAY-52239, Wiring Diagram (Drawing W-7300470)

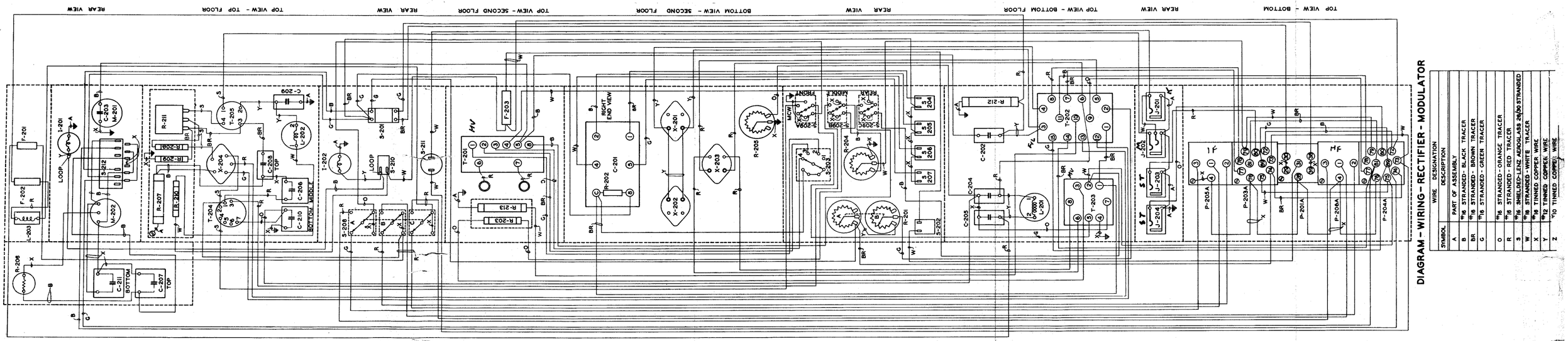


Fig. 35 Rectifier Modulator Unit Type CAY-20084, Wiring Diagram (Drawing W-7300380)

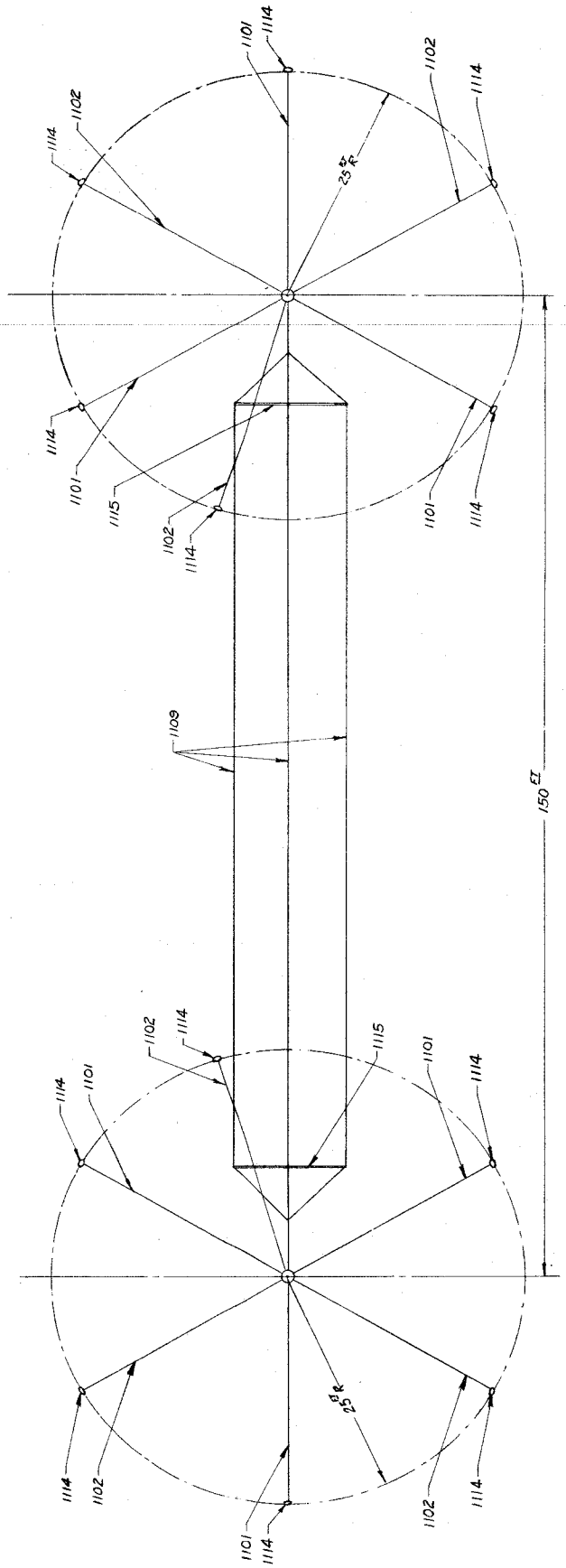


Fig. 37 Ground Layout, Antenna and Counterpoise System (Drawing P-7707150)

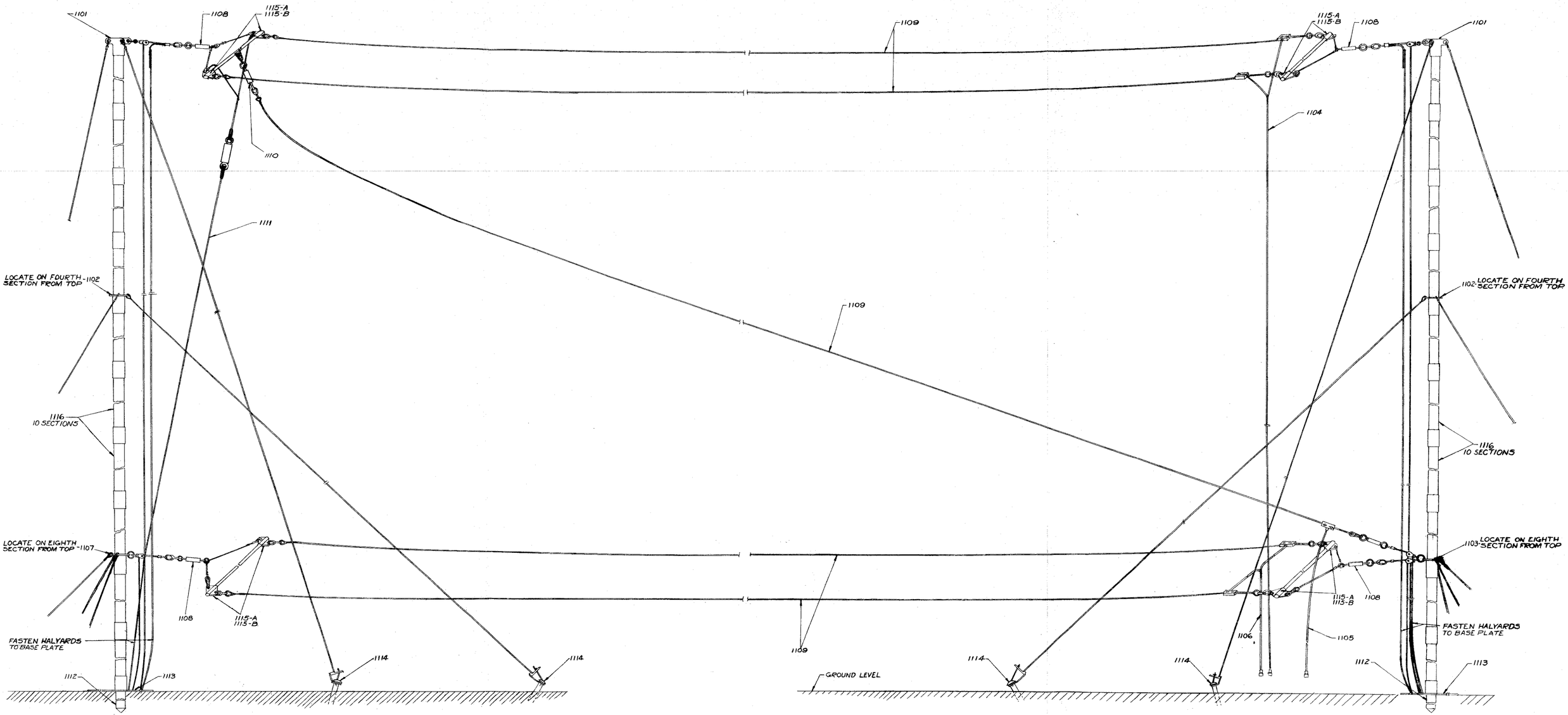


Fig. 38 Antenna and Counterpoise System, a Part of Navy Model TBW-4 Portable Radio Transmitting Equipment (Drawing W-7300391)

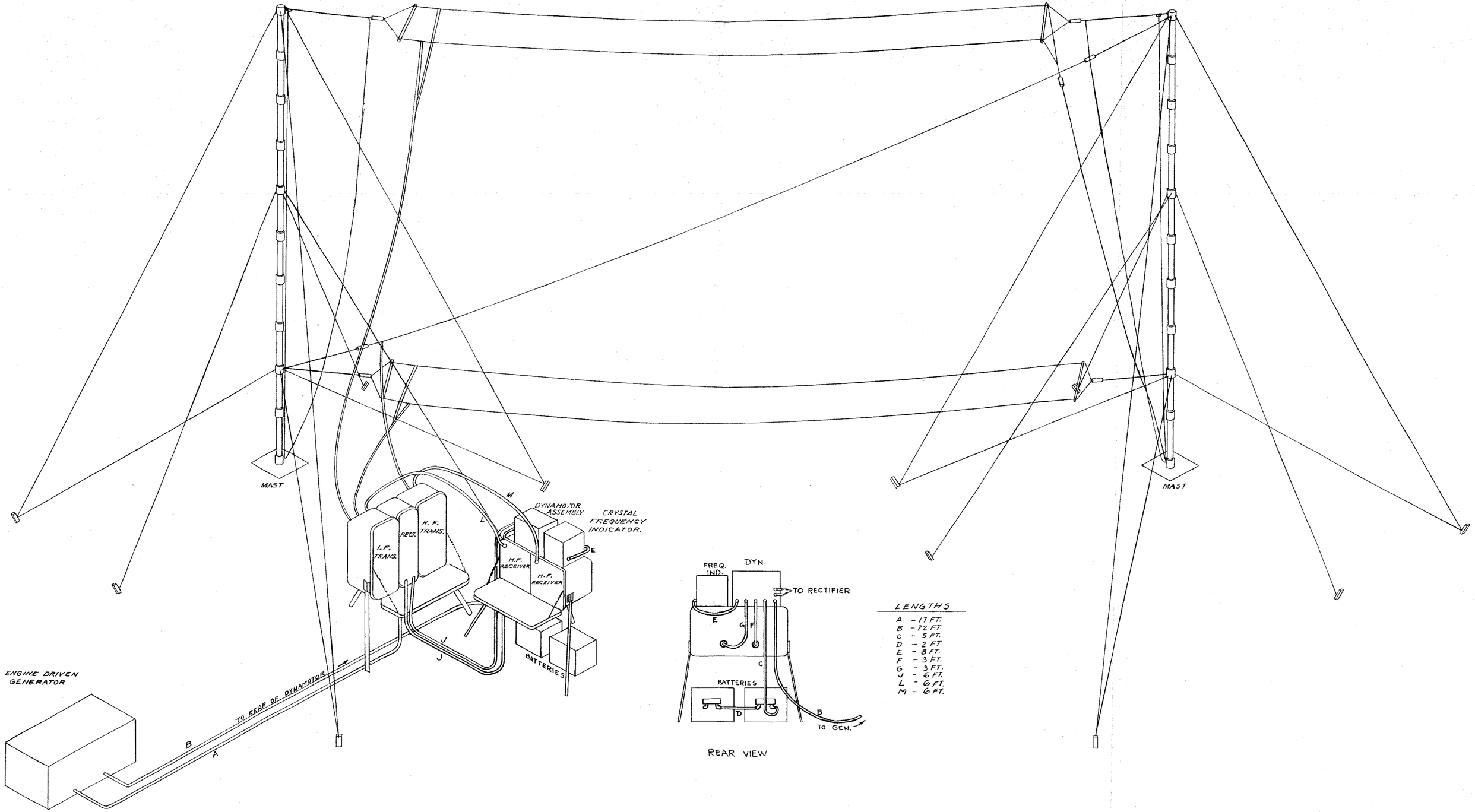


Fig. 39 Interconnection and Installation Drawing, Navy Model TBW-4 Portable Radio Transmitting Equipment (Drawing T-7605890)

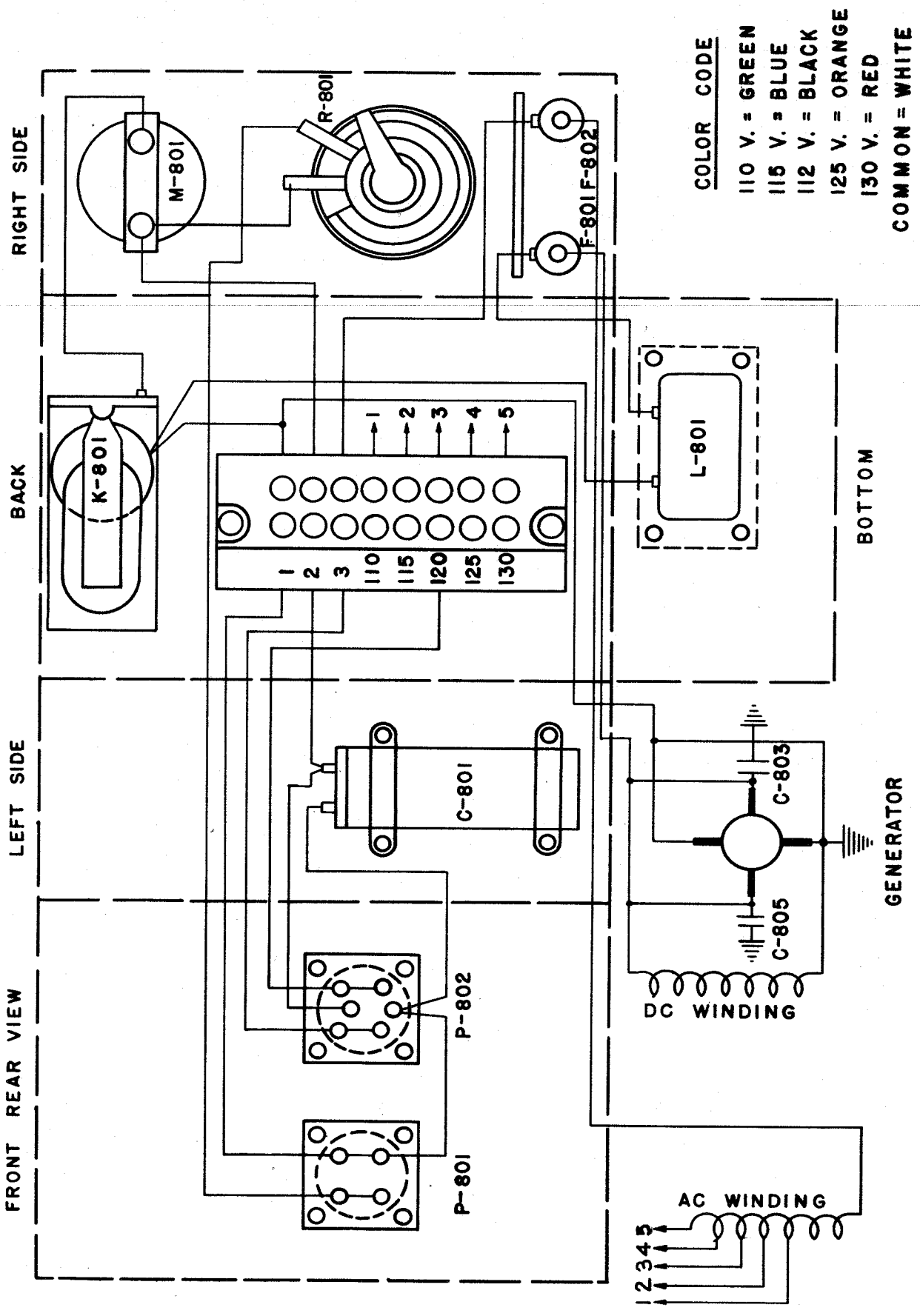


Fig. 40 Wiring Diagram for Generator Type CDO-21650, 120 Volts, 800 Cycles, Single Phase A. C. Output, a Part of Motor Generator Set Type CDO-21648 and Type CDO-21652 (Drawing M-7408411)

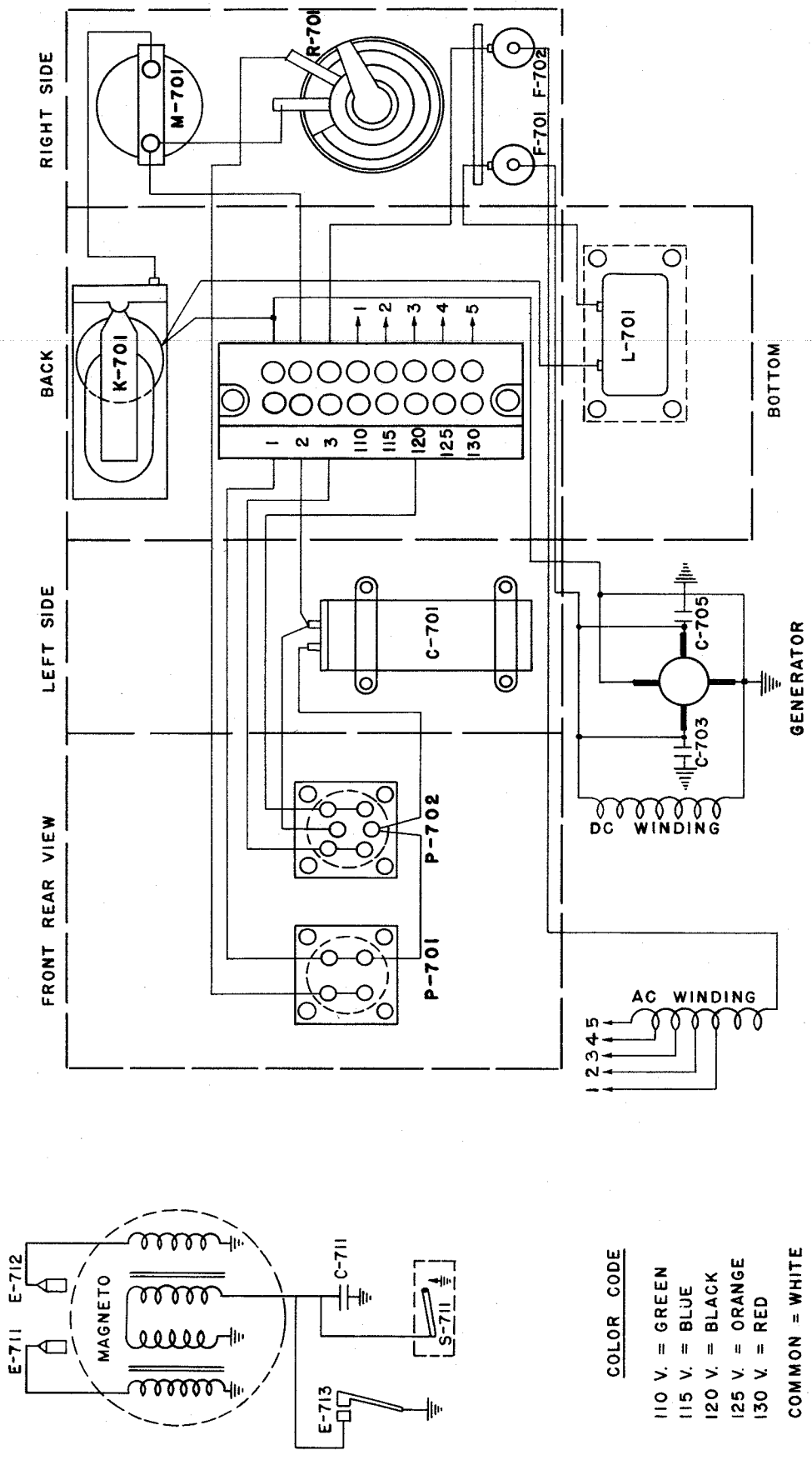


Fig. 41 Wiring Diagram for Generator Type CDO-21647, 120 Volts, 800 Cycles, Single Phase A. C. Output, a Part of Engine Generator Set Type CDO-73004-A (Drawing M-7408412)

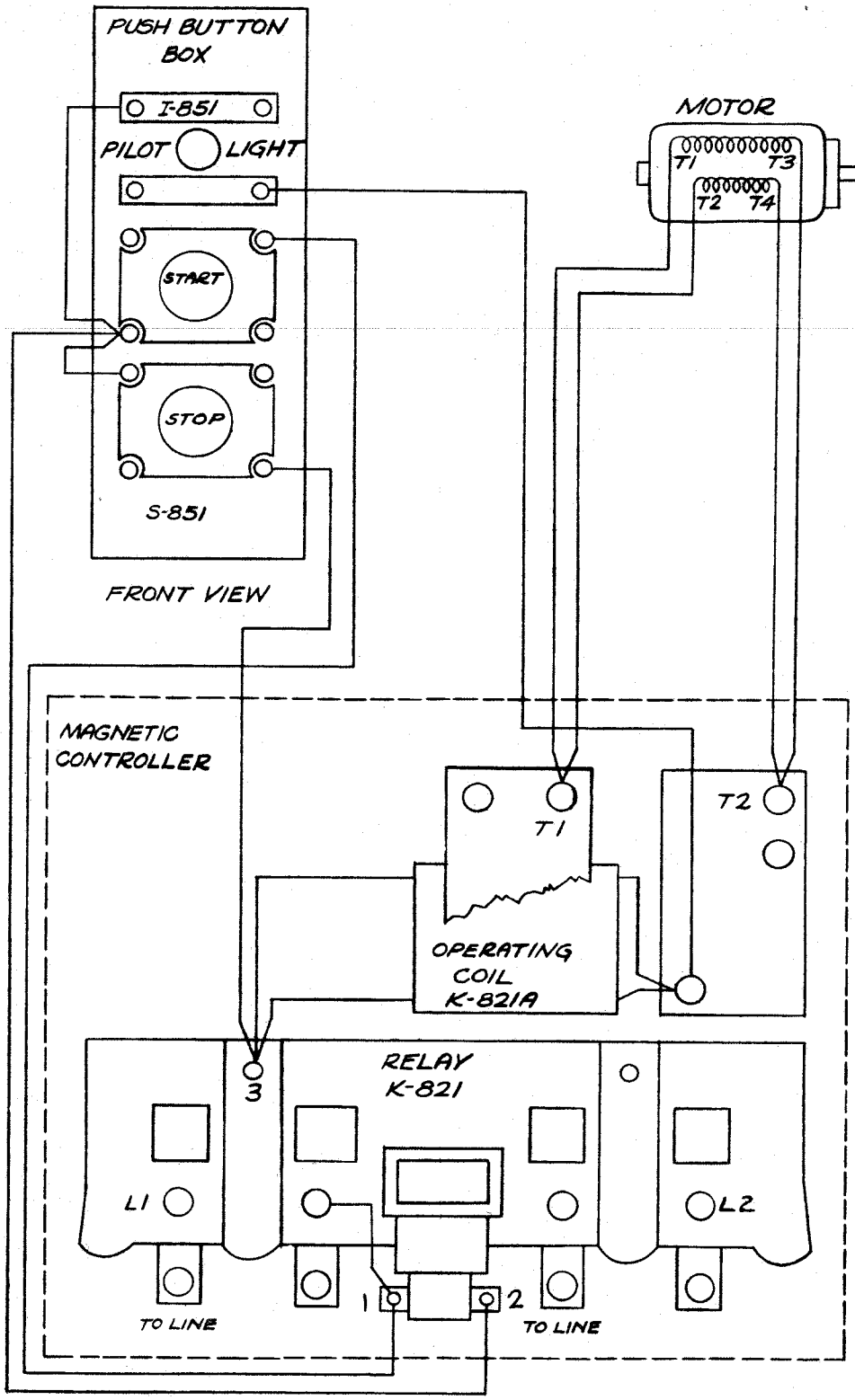


Fig. 42 Wiring Diagram for Motor Type CAY-21649 and Magnetic Controller Type CAY-21651 for 115/230 Volt, 60 Cycle, Single Phase A. C. Operation, Parts of Motor Generator Set CDO-21648 (Drawing M-7408417)

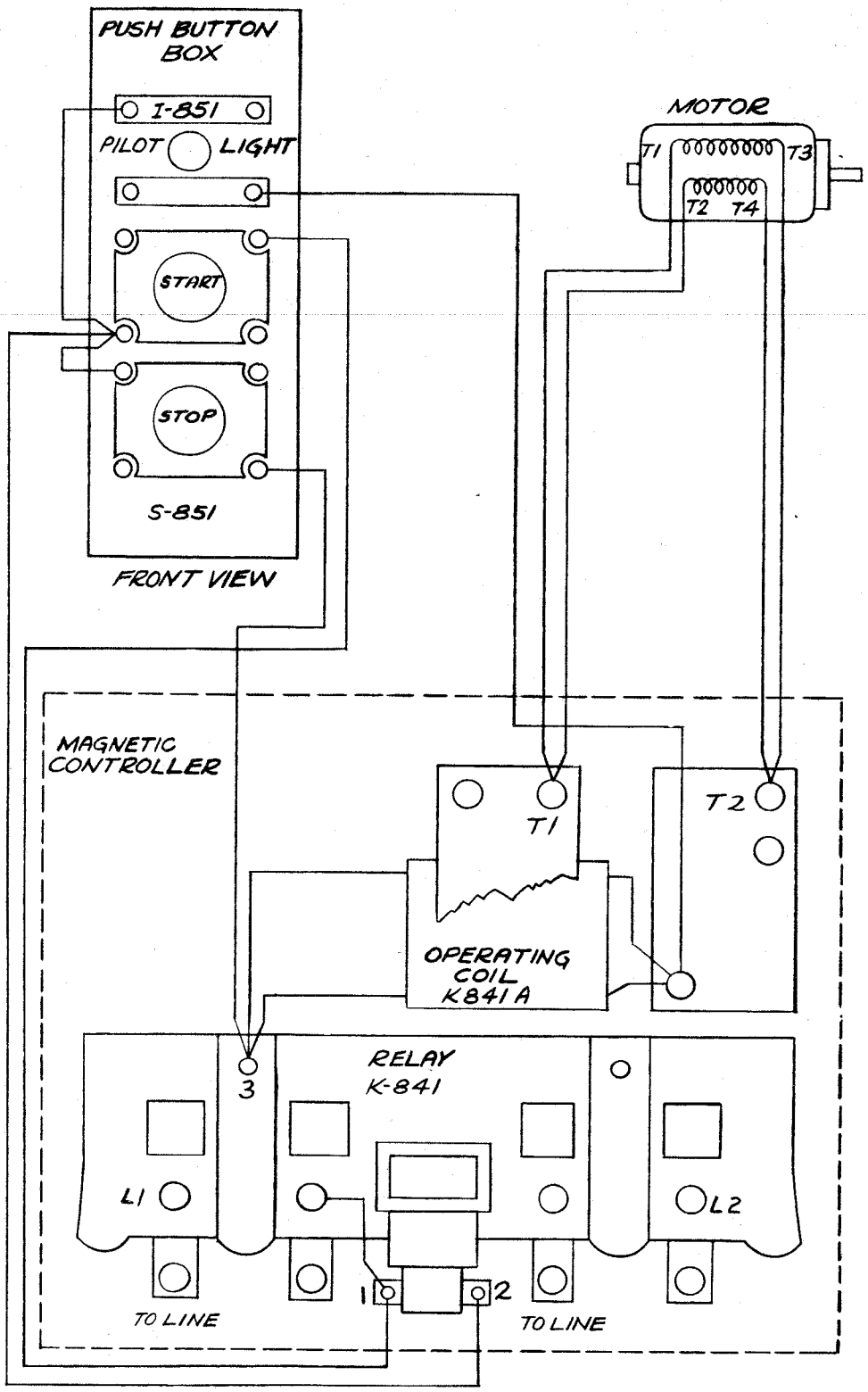


Fig. 43 Wiring Diagram for Motor Type CAY-21653 and Magnetic Controller Type CAY-21654 for 115/230 Volt, 25 Cycle, Single Phase A. C. Operation, Parts of Motor Generator Set CDO-21652 (Drawing M-7408416)

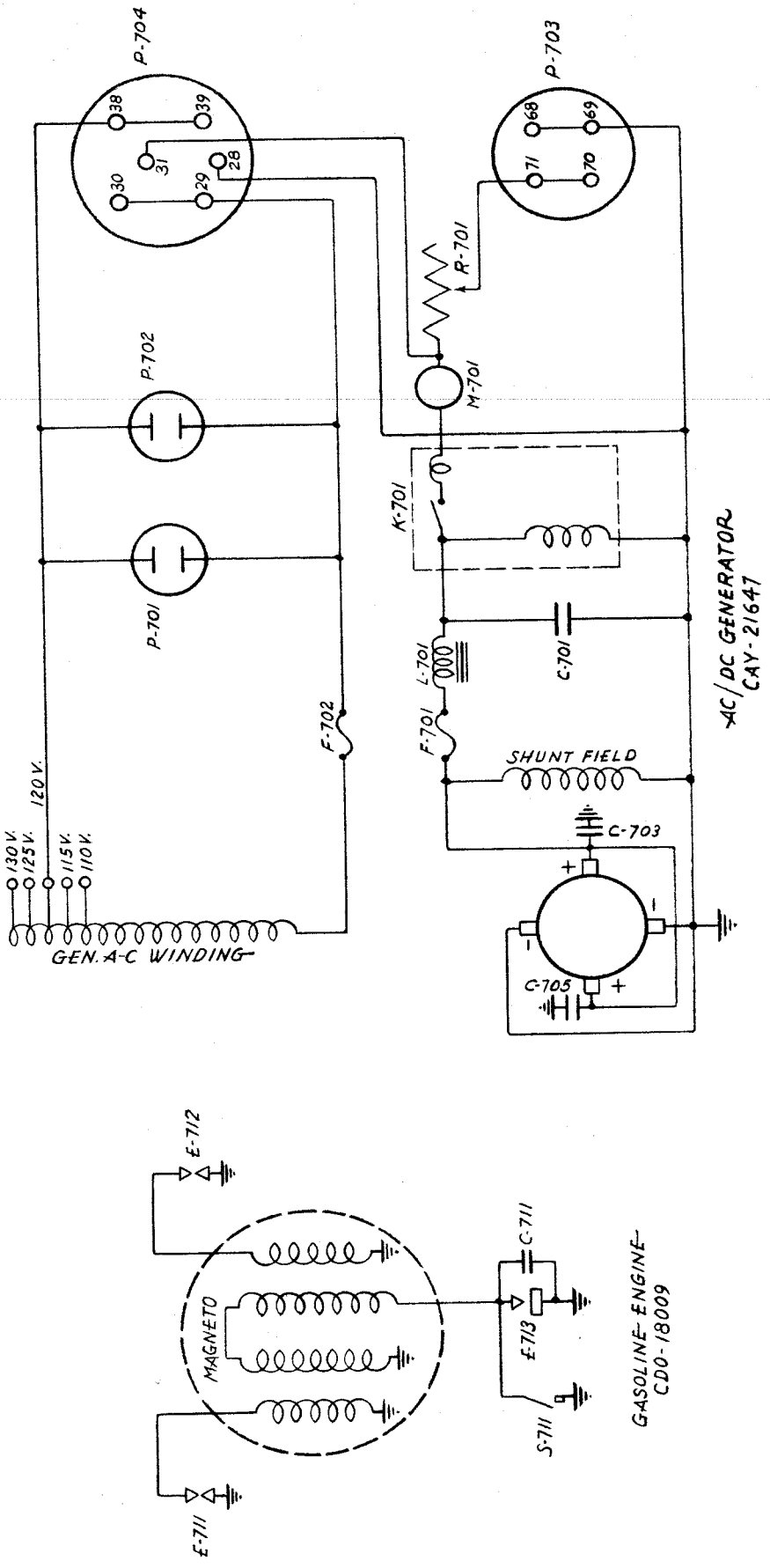


Fig. 44 Schematic Diagram for Engine Generator Set Type CDO-73004-A for Portable Field Operation (Drawing M-7408390)

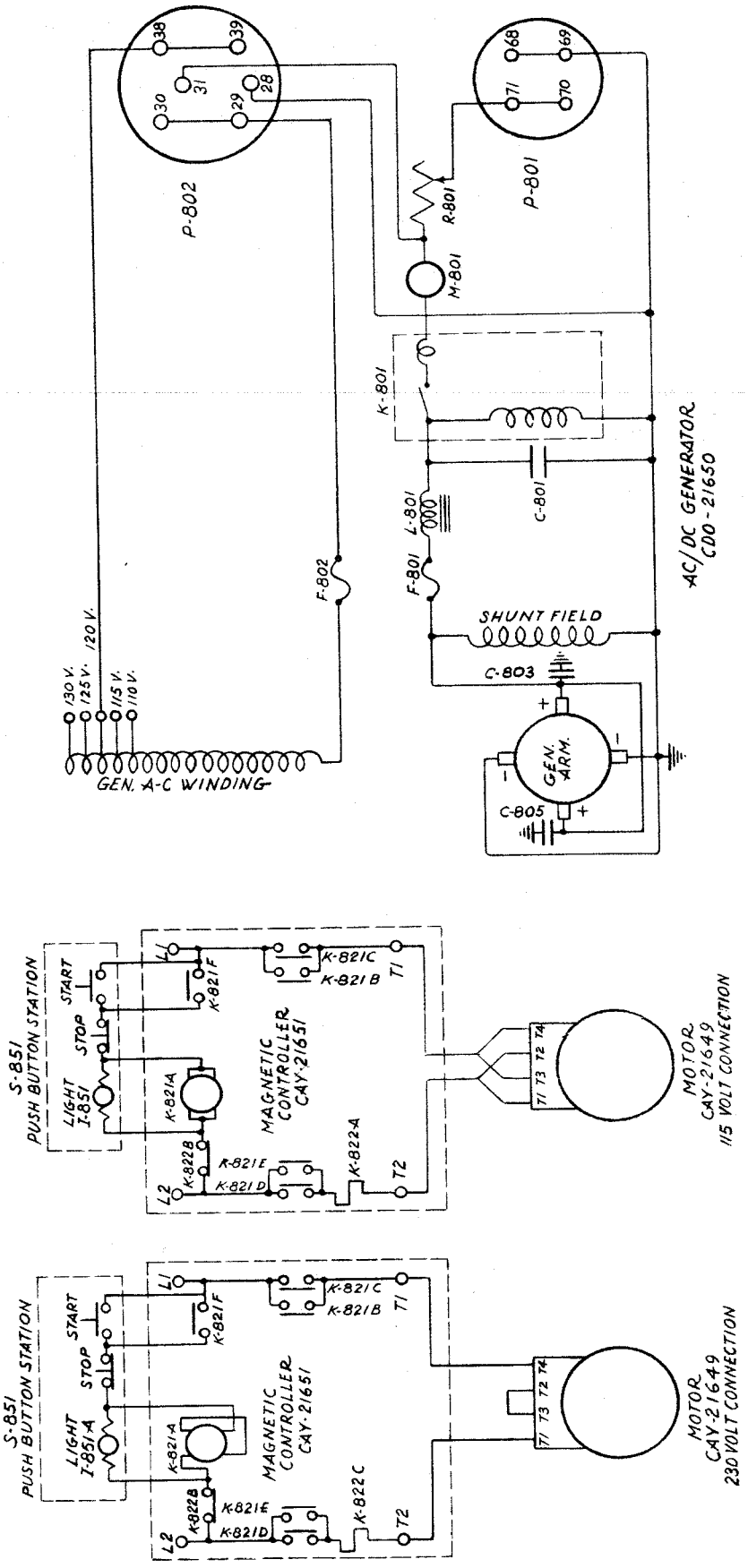


Fig. 45 Schematic Diagram for Motor Generator Set Type CDO-21648 for 115/230 Volt, 60 Cycle, Single Phase Operation, Consisting of Motor Type CAY-21649, Generator Type CDO-21650 and Magnetic Controller Type CAY-21651 (Drawing M-7408392)

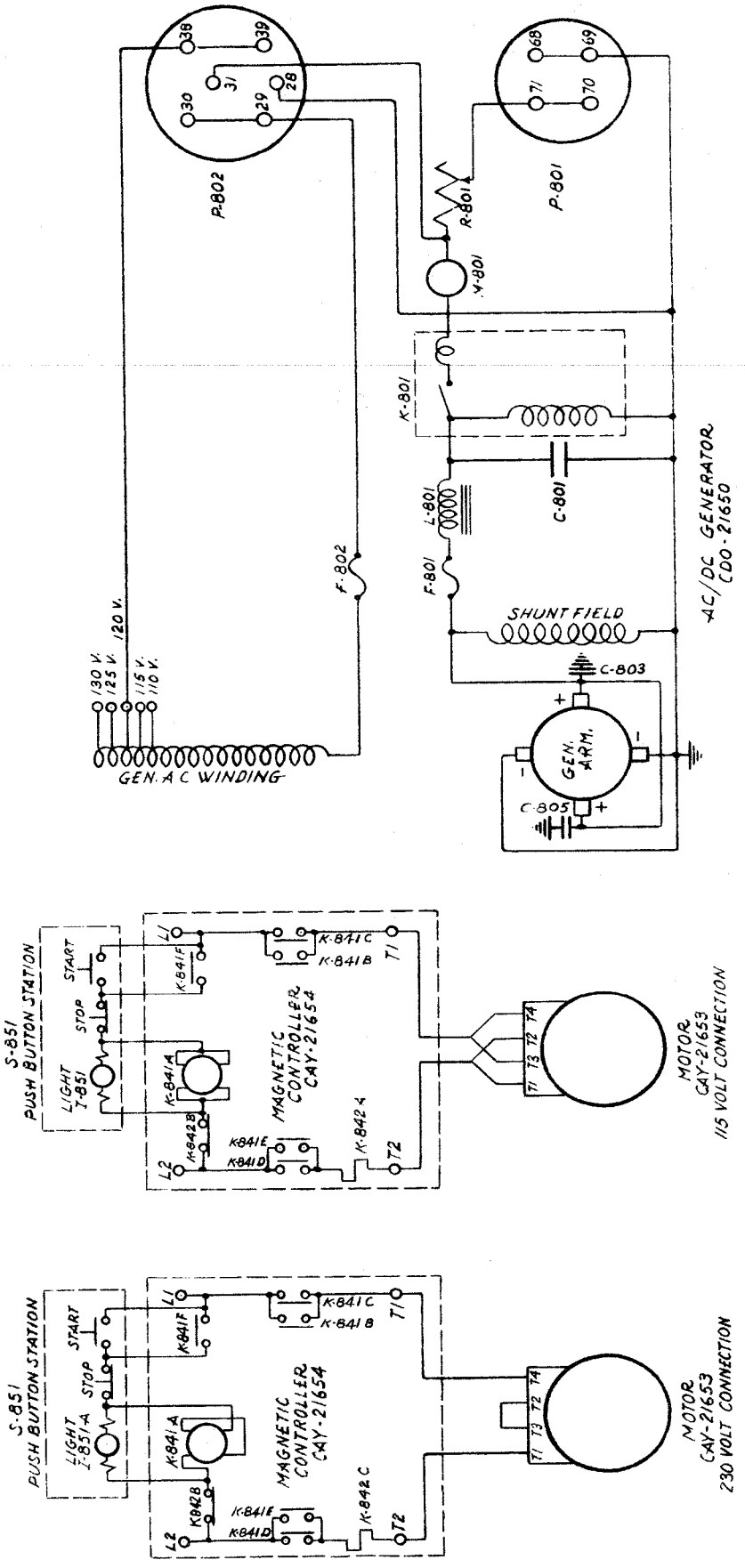
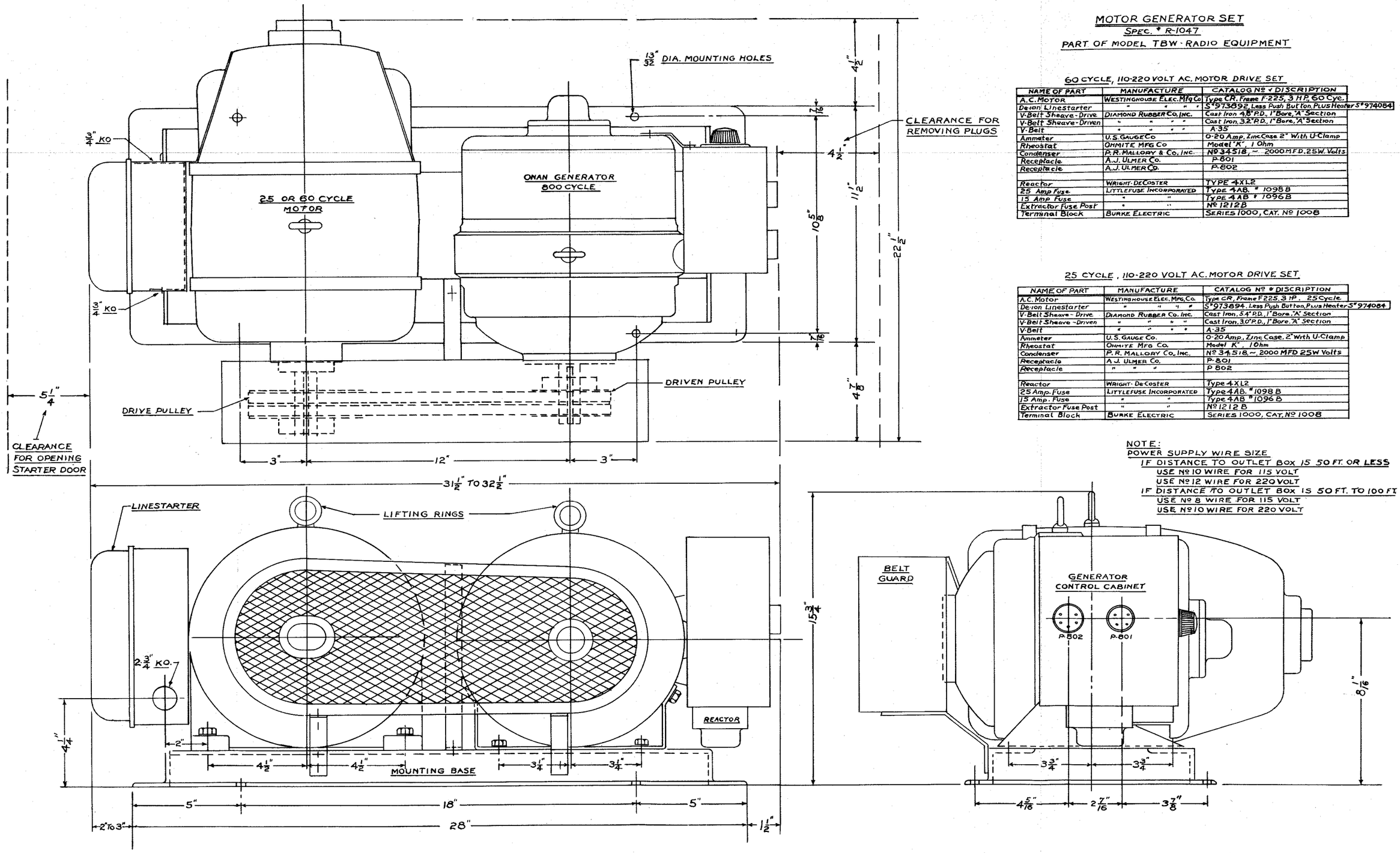


Fig. 46 Schematic Diagram for Motor Generator Set Type CDO-21652 for 115/230 Volt, 25 Cycle, Single Phase A. C. Operation, Consisting of Motor Type CAY-21653, Generator Type CDO-21650 and Magnetic Controller Type CAY-21654 (Drawing M-7408391)



MOTOR GENERATOR SET
SPEC. * R-1047
PART OF MODEL TBW · RADIO EQUIPMENT

60 CYCLE, 110-220 VOLT AC. MOTOR DRIVE SET

NAME OF PART	MANUFACTURE	CATALOG Nº & DISCRIPTION
A.C. MOTOR	WESTINGHOUSE ELEC. MFG Co	Type CR. Frame F-225, 3 H.P. 60 Cyc.
De-ion Linestarter	" " " "	S*973892 Less Push Button, Plus Heater S*974084
V-Belt Sheave - Drive	DIAMOND RUBBER CO. INC.	Cast Iron 4.8" P.D., 1" Bore, "A" Section
V-Belt Sheave - Driven	" " " "	Cast Iron, 3.2" P.D., 1" Bore, "A" Section
V-Belt	" " " "	A-35
Ammeter	U.S. GAUGE CO	0-20 Amp. Zinc Case 2" With U-Clamp
Rheostat	OHMITE MFG CO	Model "K" 1 Ohm
Condenser	P.R. MALLORY & CO., INC.	Nº 34518, ~ 2000 MFD. 25 W. Volts
Receptacle	A.J. ULMER CO.	P-801
Receptacle	A.J. ULMER CO.	P-802
Reactor	WRIGHT-DECOSTER	TYPE 4XL2
25 Amp Fuse	LITTLEFUSE INCORPORATED	Type 4AB. * 1098 B
15 Amp Fuse	" "	Type 4AB * 1096 B
Extractor Fuse Post	" "	Nº 1212 B
Terminal Block	BURKE ELECTRIC	SERIES 1000, CAT. Nº 1008

25 CYCLE, 110-220 VOLT AC. MOTOR DRIVE SET

NAME OF PART	MANUFACTURE	CATALOG Nº & DISCRIPTION
A.C. Motor	WESTINGHOUSE ELEC. MFG. CO.	Type CR, Frame F225, 3 HP 25 Cycle
De-ion Linestarter	" " " "	S*973894. Less Push Button, Plus Heater S*974084
V-Belt Sheave - Drive	DIAMOND RUBBER CO. INC.	Cast Iron, 3.4" P.D., 1" Bore, "A" Section
V-Belt Sheave - Driven	" " " "	Cast Iron, 3.0" P.D., 1" Bore, "A" Section
V-Belt	" " " "	A-35
Ammeter	U.S. GAUGE CO.	0-20 Amp., Zinc Case, 2" Wrth U-Clamp
Rheostat	OHMITE MFG CO.	Model K", 10hm
Condenser	P.R. MALLORY CO, INC.	Nº 34,518, ~, 2000 MFD 25W Volts
Receptacle	A.J. ULMER CO.	P-801
Receptacle	" " "	P 802
Reactor	WRIGHT-DE COSTER	Type 4XL2
25 Amp. Fuse	LITTLEFUSE INCORPORATED	Type 4AB. "1098 B
15 Amp. Fuse	" "	Type 4AB "1096 B
Extractor Fuse Post	" "	Nº 1212 B
Terminal Block	BURKE ELECTRIC	SERIES 1000, CAT. Nº 1008

NOTE:
POWER SUPPLY WIRE SIZE
IF DISTANCE TO OUTLET BOX IS 50 FT. OR LESS
USE Nº 10 WIRE FOR 115 VOLT
USE Nº 12 WIRE FOR 220 VOLT
IF DISTANCE TO OUTLET BOX IS 50 FT. TO 100 FT.
USE Nº 8 WIRE FOR 115 VOLT
USE Nº 10 WIRE FOR 220 VOLT

Fig. 47 Outline and Mounting Dimensions, Motor Generator Set Type CDO-21648 and Type CDO-21652 (Drawing W-7300489)

ENGINE-GENERATOR SET

SPECIFICATION R-1033

WEIGHT OF ENGINE-GENERATOR SET - 141½ LBS.

WEIGHT OF ENGINE-GENERATOR SET & BASE - 152 LBS.

WEIGHT OF ENGINE-GENERATOR SET, BASE & BOX - 170 LBS.

PART OF MODEL TBW RADIO EQUIPMENT

NAME OF PART	MANUFACTURER	CATALOG Nº & DESCRIPTION
AMMETER	U.S. GAUGE	0-20 AMP. ZINC CASE - 2" WITH U-CLAMP
RHEOSTAT	OHMITE MFG. CO.	MODEL K - 1 OHM.
CONDENSER	P.R. MALLORY CO. INC.	Nº 34518 - 2000 MFD - 25 W. VOLTS
RECEPTACLE	A.J. ULMER CO.	P-703
RECEPTACLE	A.J. ULMER CO.	P-704
RECP. COVER & FLANGE	ARROW-HART & HEGEMAN ELEC. CO.	#7792 (P-701 & P-702)
REACTOR	WRIGHT-DECOSTER	TYPE 4XL2
25 AMP. FUSE	LITTLEFUSE, INC.	TYPE 4AB #1098B
15 AMP. FUSE	LITTLEFUSE, INC.	TYPE 4AB #1096B
EXTRACTOR FUSE POST	LITTLEFUSE, INC.	Nº 1212B
CARBURETOR	ZENITH CARBURETOR CO.	MODEL R20T
SPARK PLUG	CHAMPION SPARK PLUG CO.	JA11
RUBBER ENG. MOUNT'S	LORD MFG. CO.	H-1002 - ONE END FLANGED
TERMINAL BLOCK	BURKE ELECTRIC	SERIES 1000 - CAT. Nº 1008

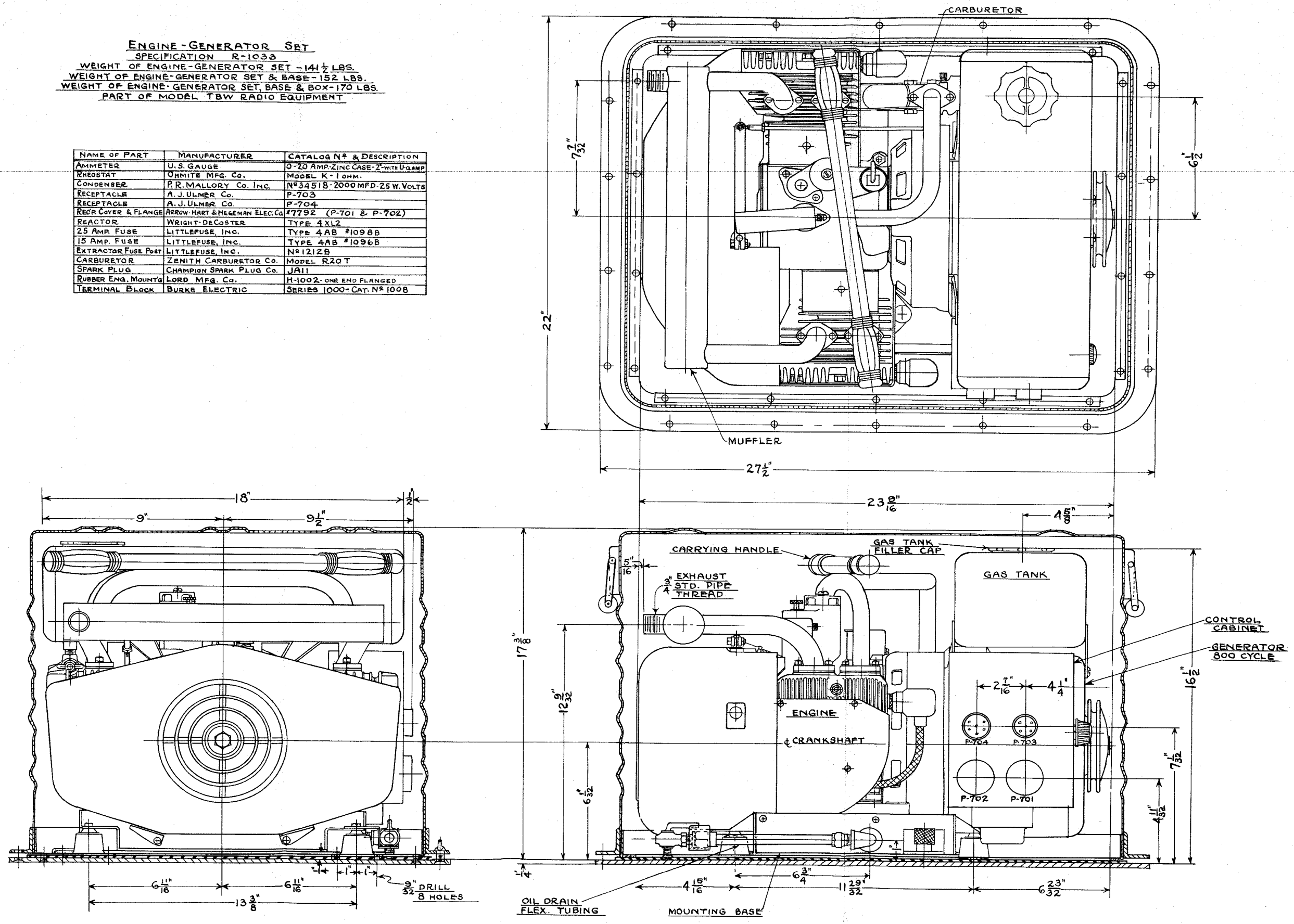


Fig. 48 Outline and Mounting Dimensions, Engine Generator Set Type CDO-73004-A (Drawing W-7300488)

Fig. 54 POWER INPUT, RF. POWER OUTPUT, TYPICAL METER READINGS AND DIAL SETTINGS, I.F. TRANS. TYPE CAY-52238

Freq. Kc.	Ant. Res. Ohms	Ant. Cap. Mmf.	Input AC W	Input DC V	DC I	PA Ig	PA Ip	Fil. V	Ant. Int. Meter	Current Ext. Meter	R.F. Act. W	Output Guar. W	A	B	C	D	E	F	G	H	I	J	K
350	12.75	300	680	12.4	5.3	35	175	10	3.4	3.3	139	100	1	163	1	41	1	37	25				
400	20	300	680	"	"	38	"	"	2.6	2.65	140	"	1	586	2	43	4	60	65				
500	12.75	400	680	"	"	39	"	"	3.3	3.2	131	"	3	386	3	44	6	29	55				
600	8.37	400	680	"	"	36	"	"	3.9	3.65	111.5	"	4	457	4	46	6	84	48				
700	"	"	690	"	"	36	"	"	4.1	3.75	117.5	"	5	355	5	29	7	56	51				
800	"	"	690	"	"	34	"	"	4.4	4.0	134	"	5	570	5	62	7	82	45				
900	"	"	690	"	"	33	"	"	4.4	4.0	137	"	6	445	6	34	8	32	49				
1000	"	"	690	"	"	29	"	"	4.15	3.9	127	"	6	607	6	61	8	52	43				

POWER INPUT, RF. POWER OUTPUT, TYPICAL METER READINGS AND DIAL SETTINGS, H.F. TRANS. TYPE CAY-52239

3000	200 Watt	800	12.4	5.3	30	175	10	1.3		175	100	1	273	1	19	1	20	480	1	73	90	38
4525	Type "O"	720	"	"	30	"	"	1.4		184	"	3	480	1	84	1	88	1234	1	50	1711	45
7000	Lamp	770	"	"	29	"	"	1.4		184	"	5	718	2	71	2	71	1723	1	100	1930	42
9050		800	"	"	29	"	"	1.3		190	"	3	472	1	84	3	41	1950	2	50	1753	42
13575		750	"	"	23	"	"	1.0		180	"	5	605	2	67	4	27	2185	2	0	2435	30
18100		780	"	"	16	"	"	1.3		135	"	5	355	3	44	4	74	2314	2	26	2560	17

All Readings taken on CW Emission

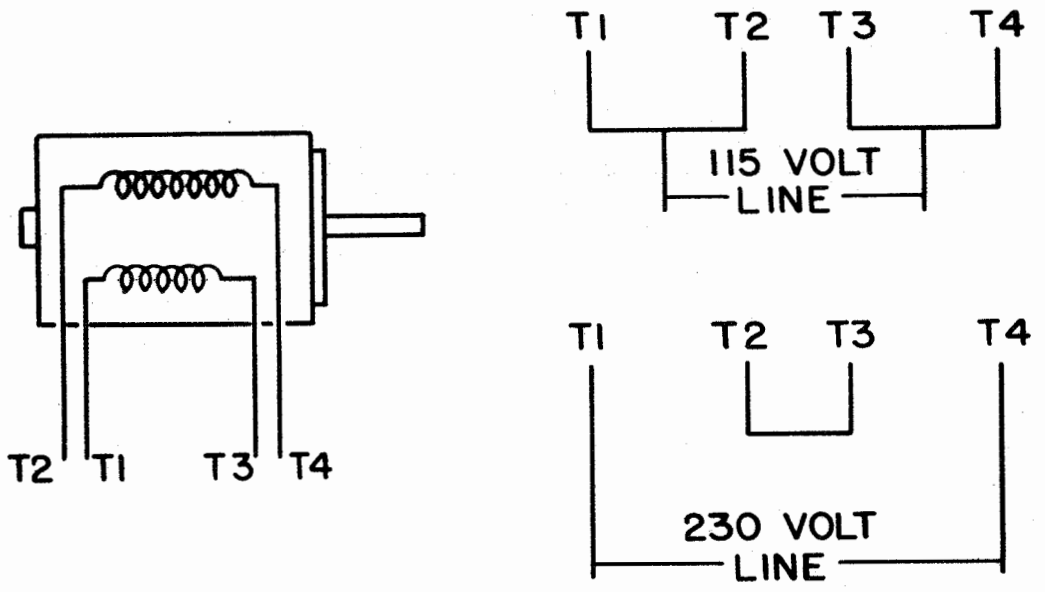


FIGURE A.
MOTOR CONNECTIONS

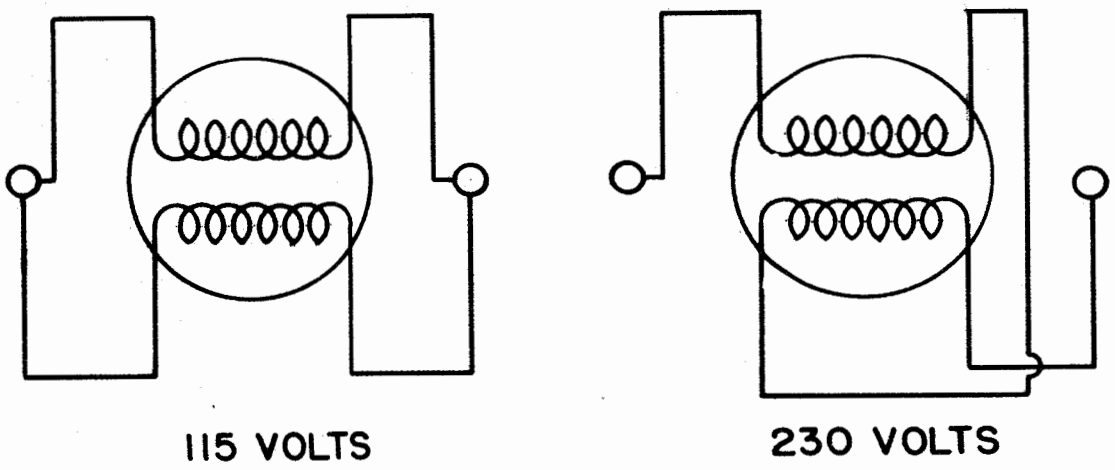


FIGURE B.
HOLDING COIL CONNECTIONS

Fig. 55 Diagram for Changing Motor and Magnetic Controller from 115 Volt to 230 Volt A. C. Operation (Dwg. M-7408033)

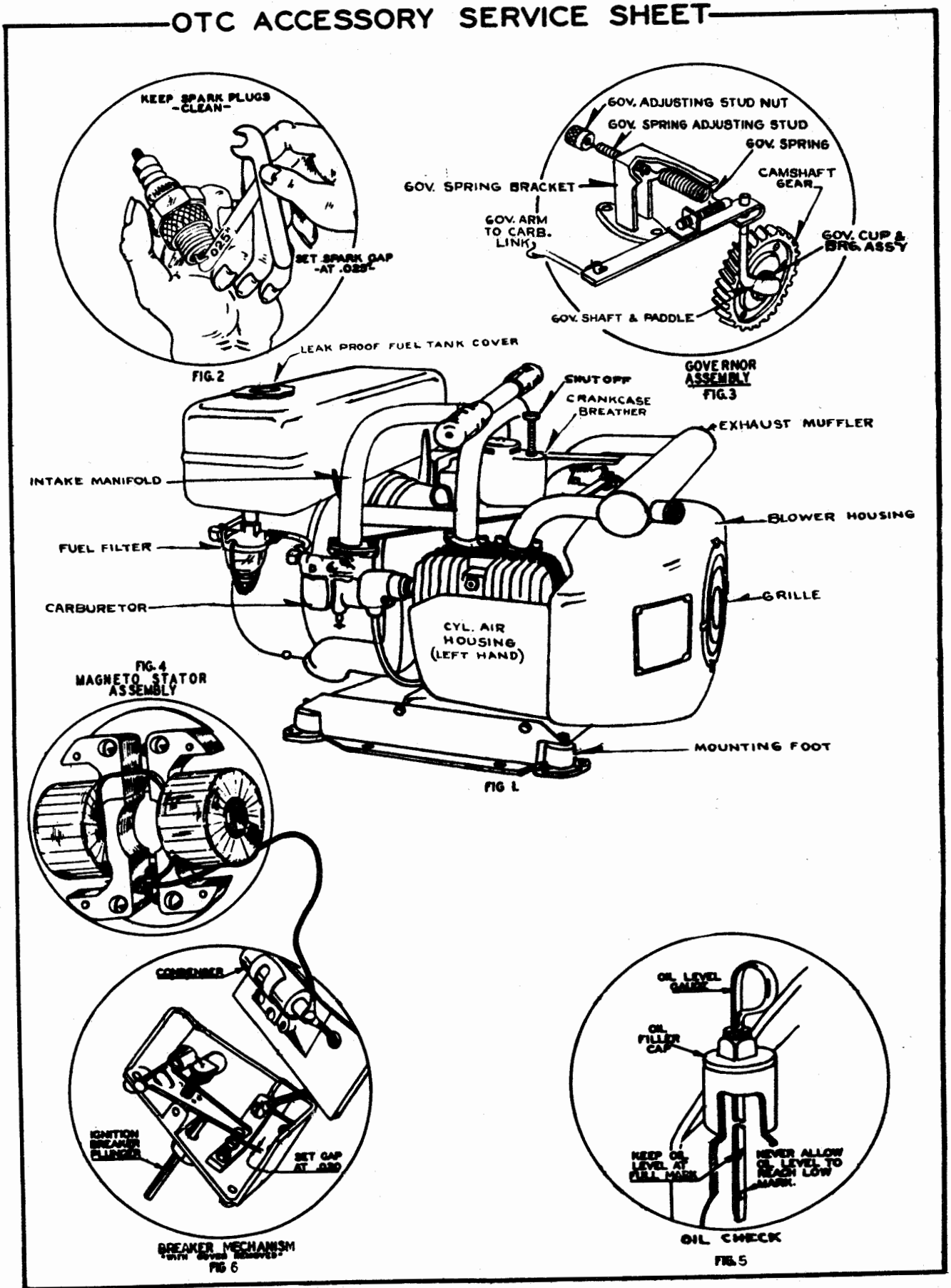


Fig. 56 Accessory Service Drawing for Engine Generator Set Type CDO-73004-A.

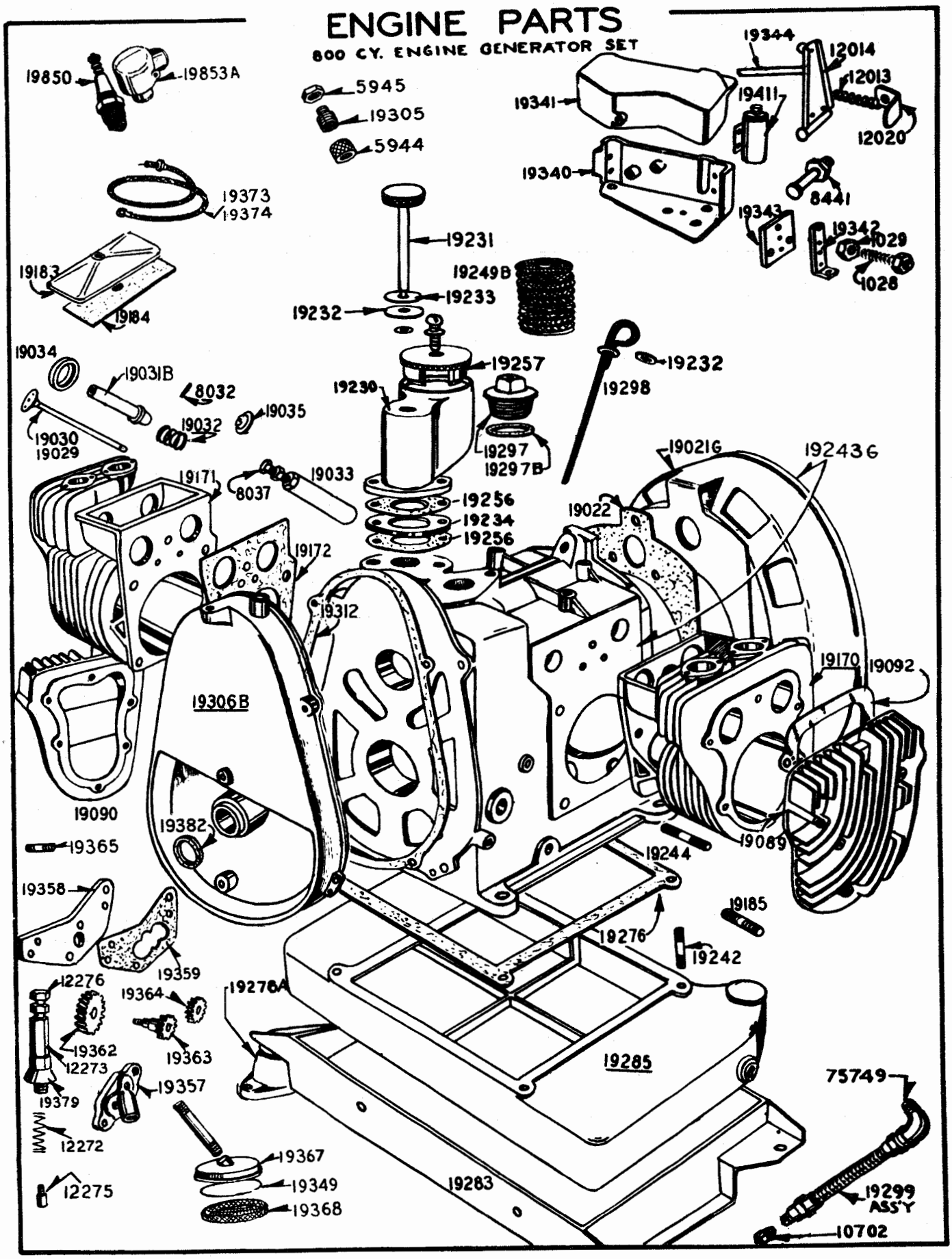


Fig. 57 Engine Parts, Main Components for Engine Generator Set Type CDO-73004-A.

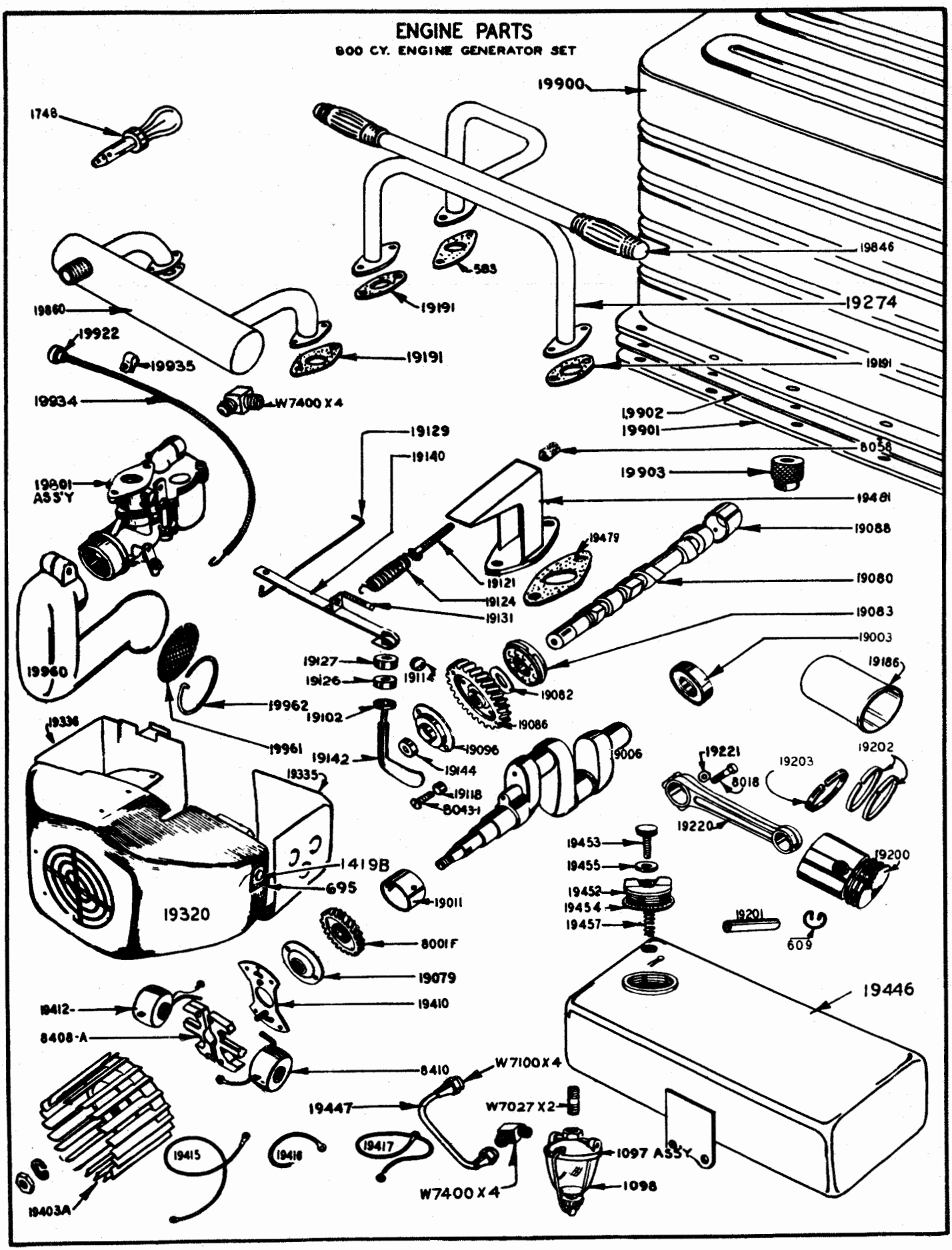


Fig. 58 Engine Parts, Detail Components for Engine Generator Set Type CDO-73004-A.

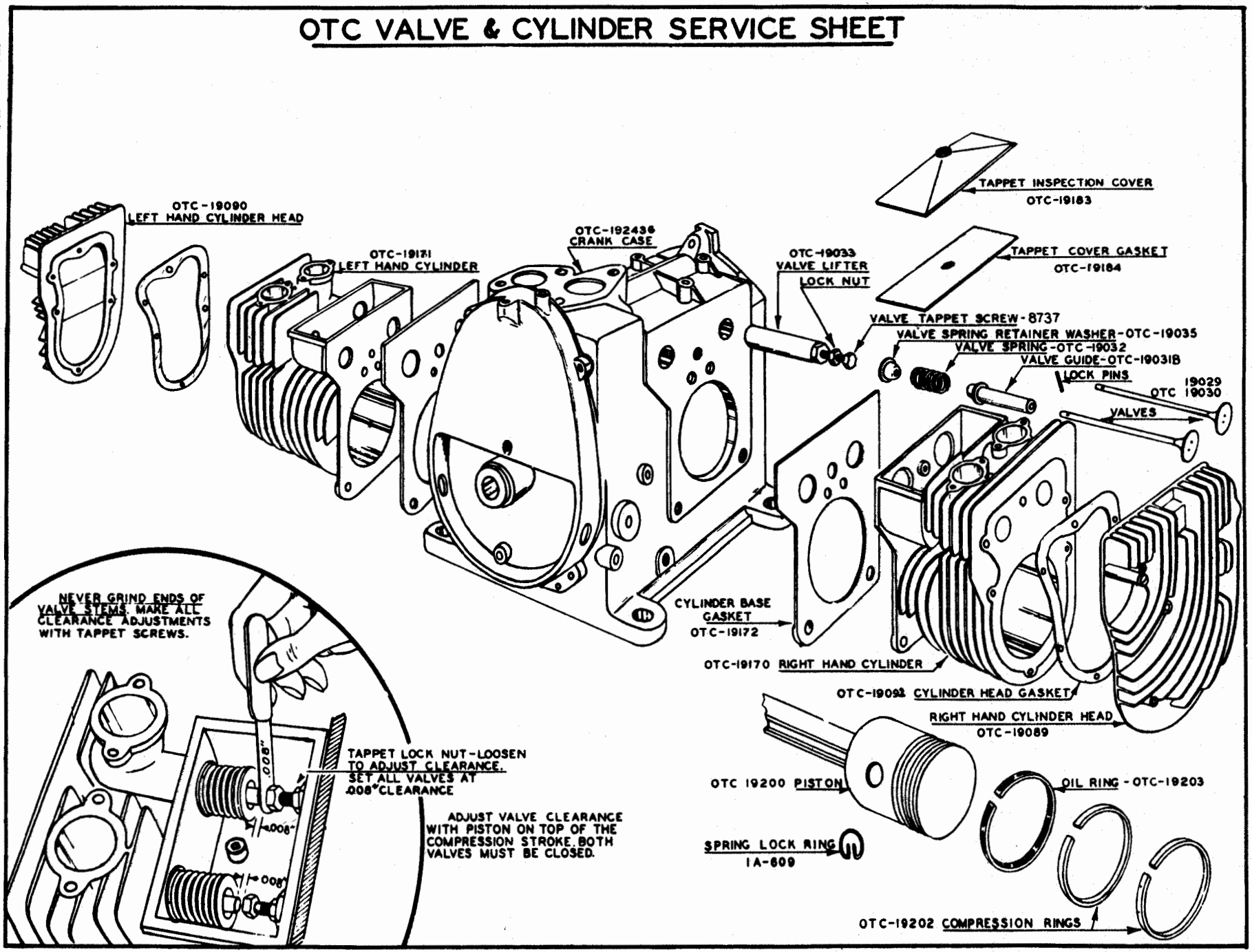
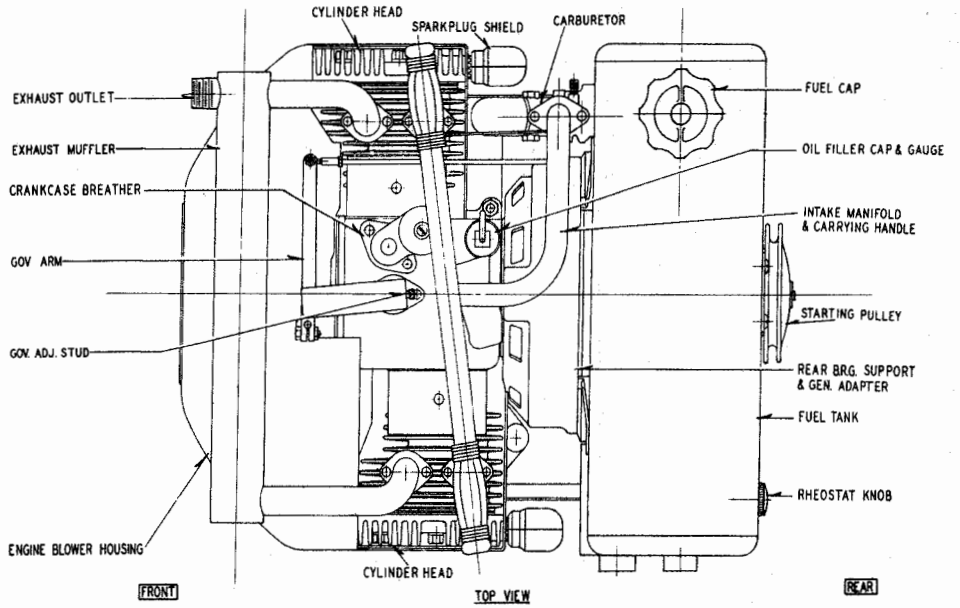
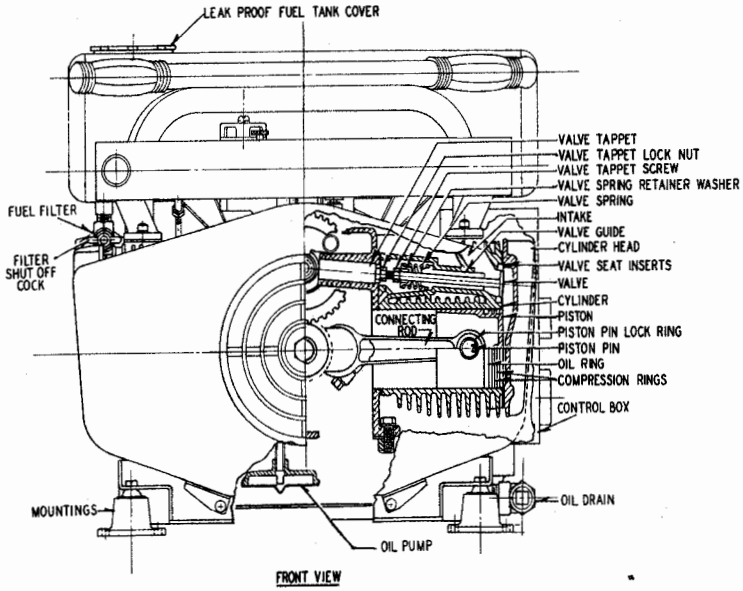


Fig. 59 Valve and Cylinder Service Drawing for Engine Generator Set Type CDO-73004-A.

CROSS SECTION
—OF—
OTC SERIES
ELECTRIC PLANT

DIMENSIONS
LENGTH...OVERALL.....31"
WIDTH.....OVERALL.....18"
HEIGHT.....OVERALL.....18"





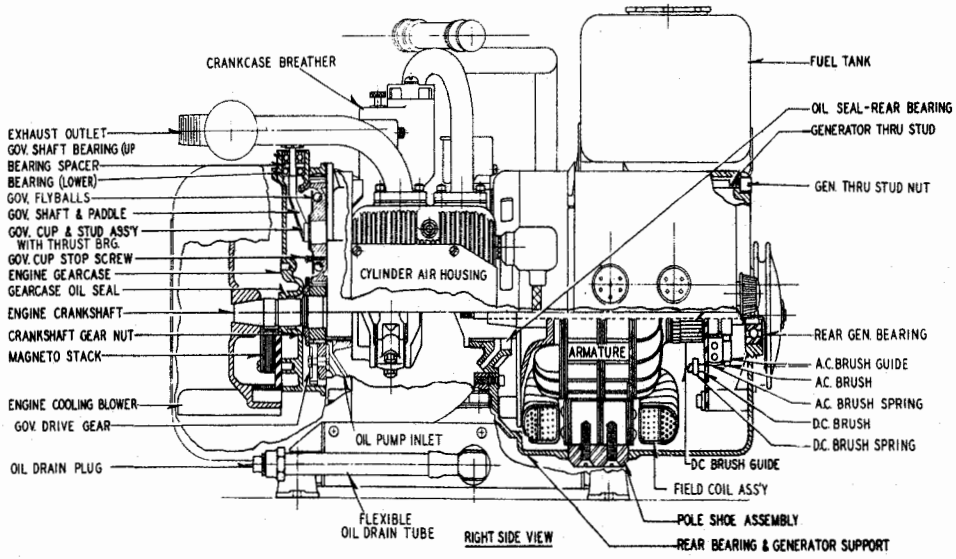


Fig. 60 Cross Section Drawing for Engine Generator Set Type CDO-73004-A.

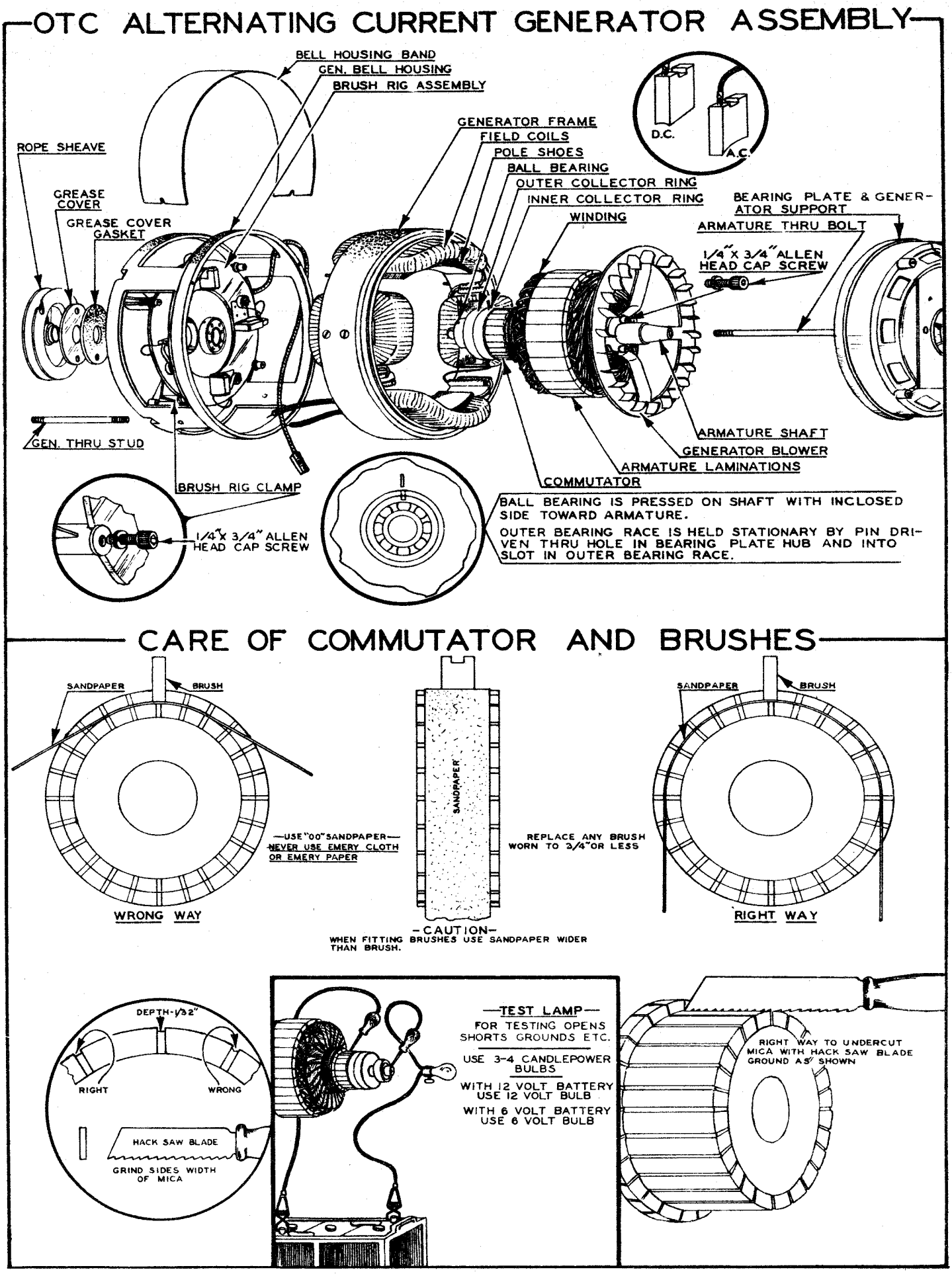


Fig. 61 Generator Assembly and Care of Commutator and Brushes, Generator Type CDO-21647, a part of Engine Generator Set Type CDO-73004-A.

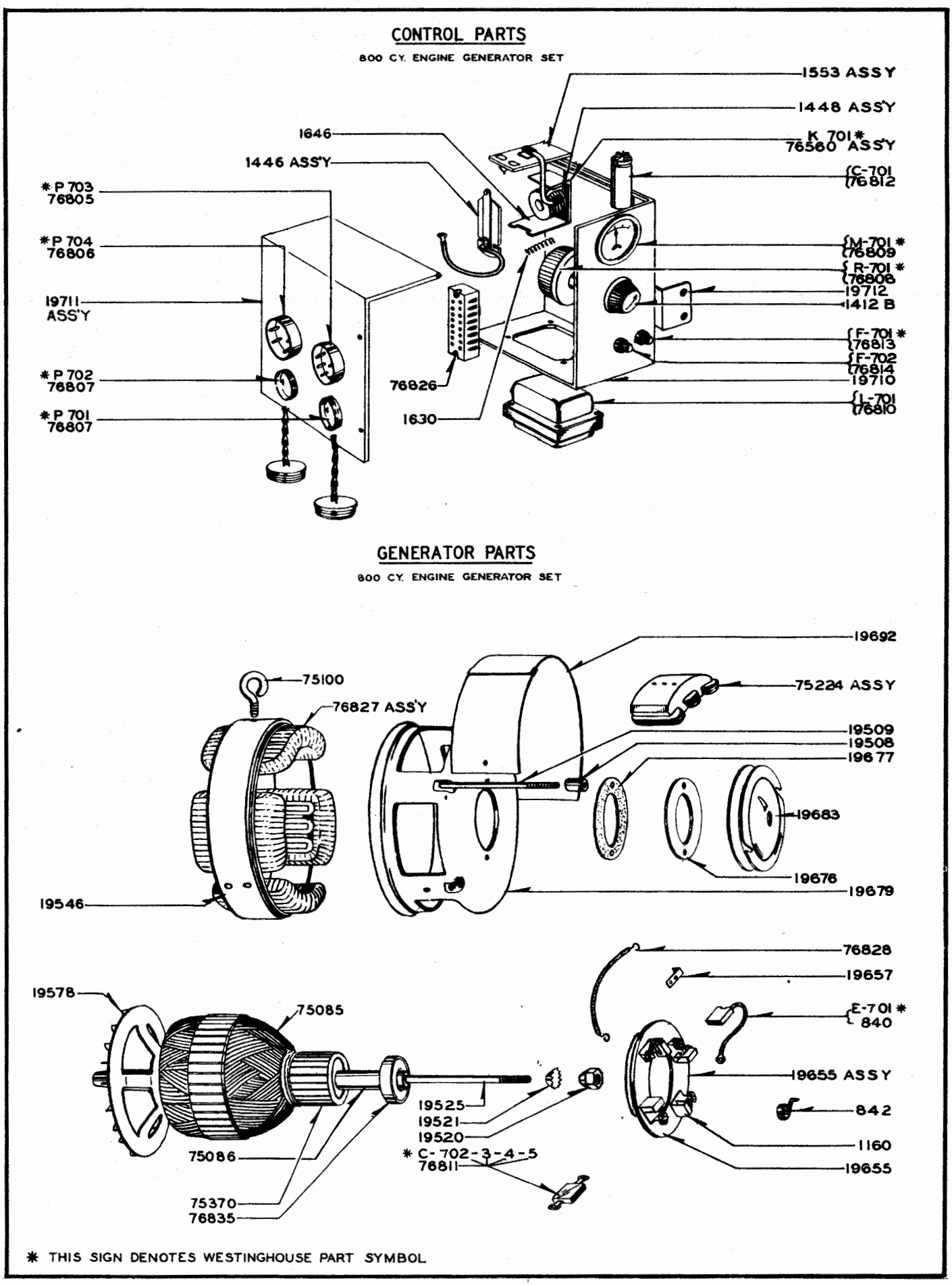
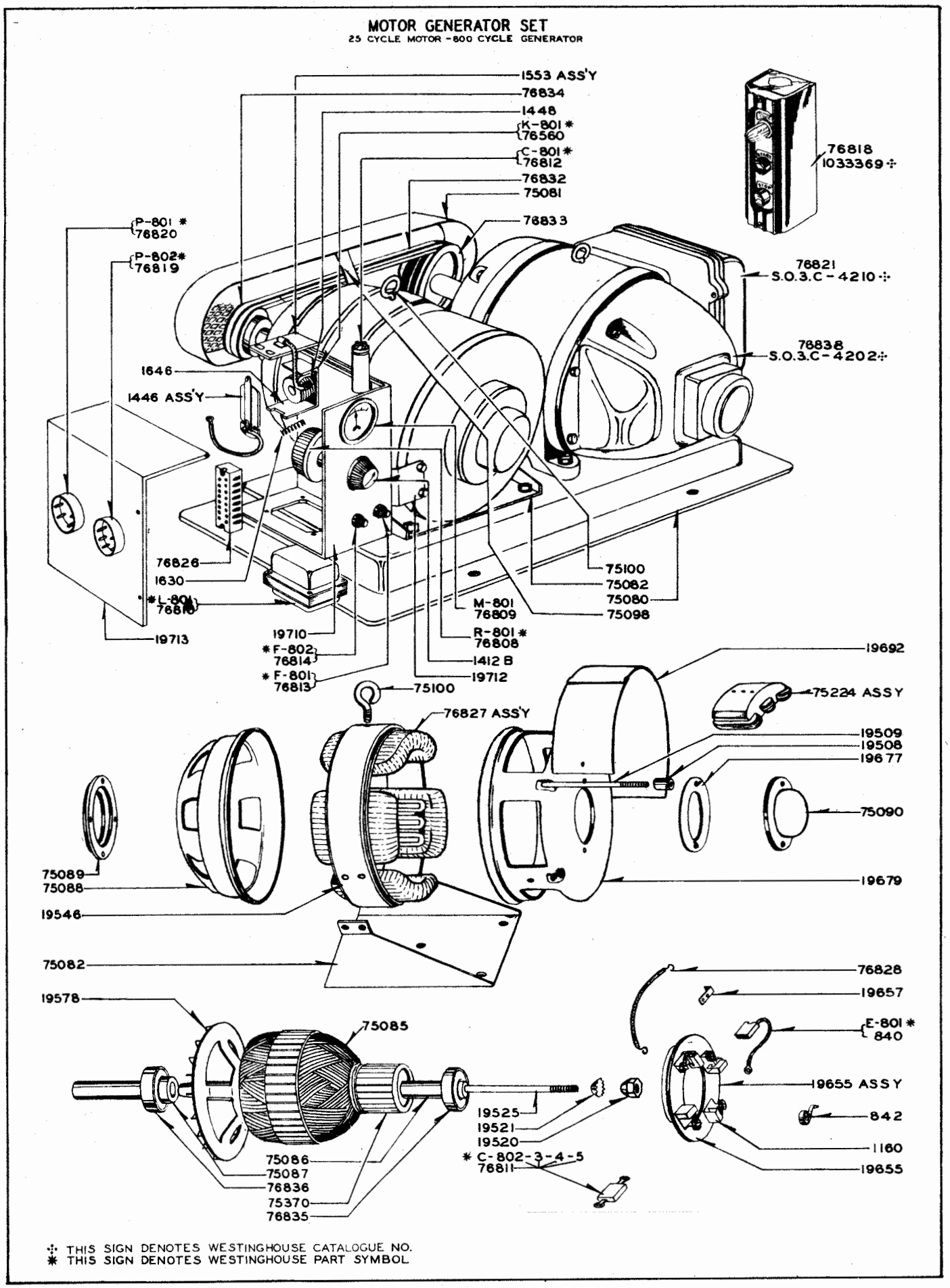


Fig. 62 Control and Generator Parts for Generator Type CDO-21647, a Part of Engine Generator Type CDO-73004-A.



÷ THIS SIGN DENOTES WESTINGHOUSE CATALOGUE NO.
* THIS SIGN DENOTES WESTINGHOUSE PART SYMBOL.

Fig. 63 Motor Generator Parts for Motor Generator Set Type CDO-21652.

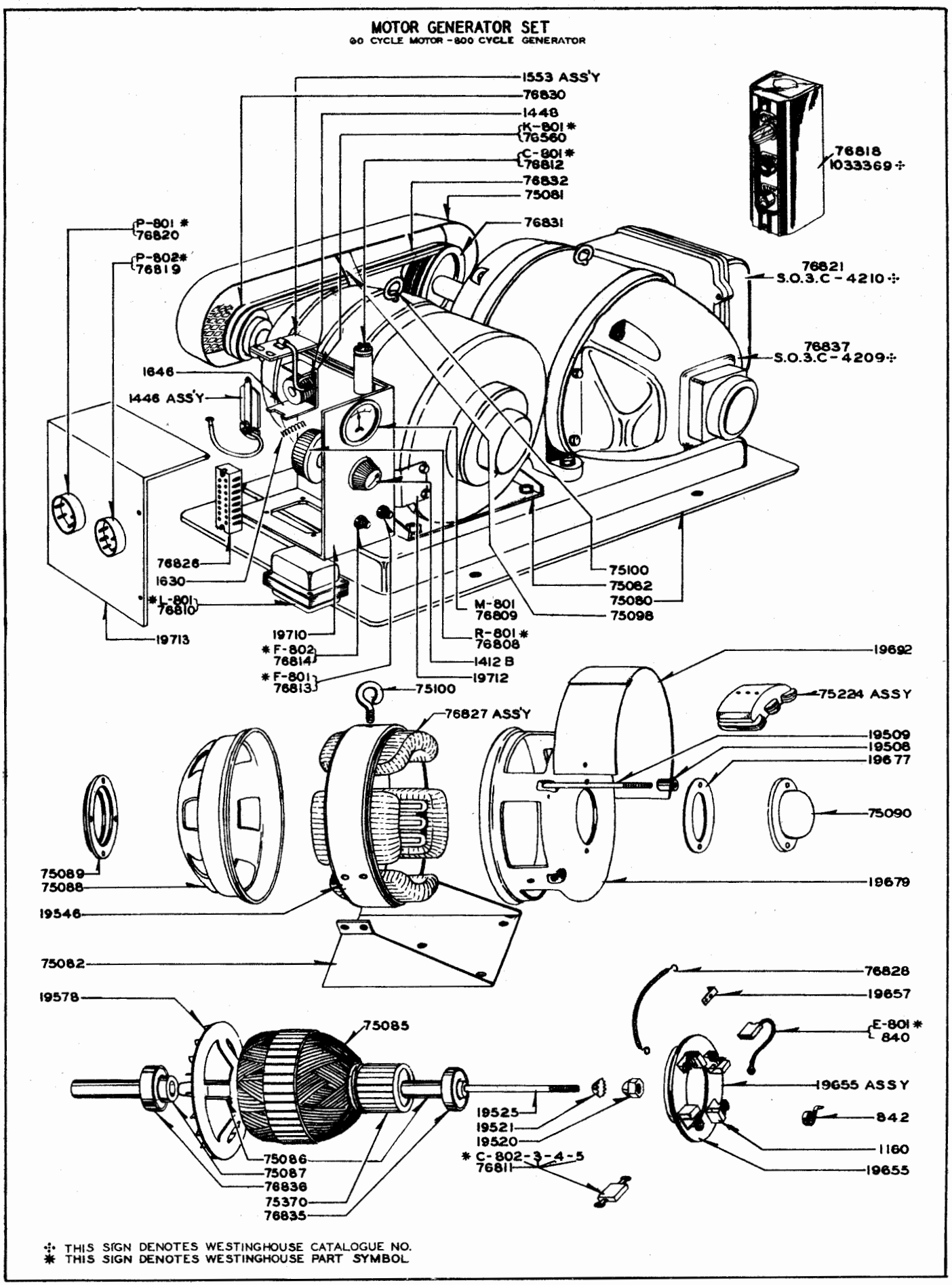
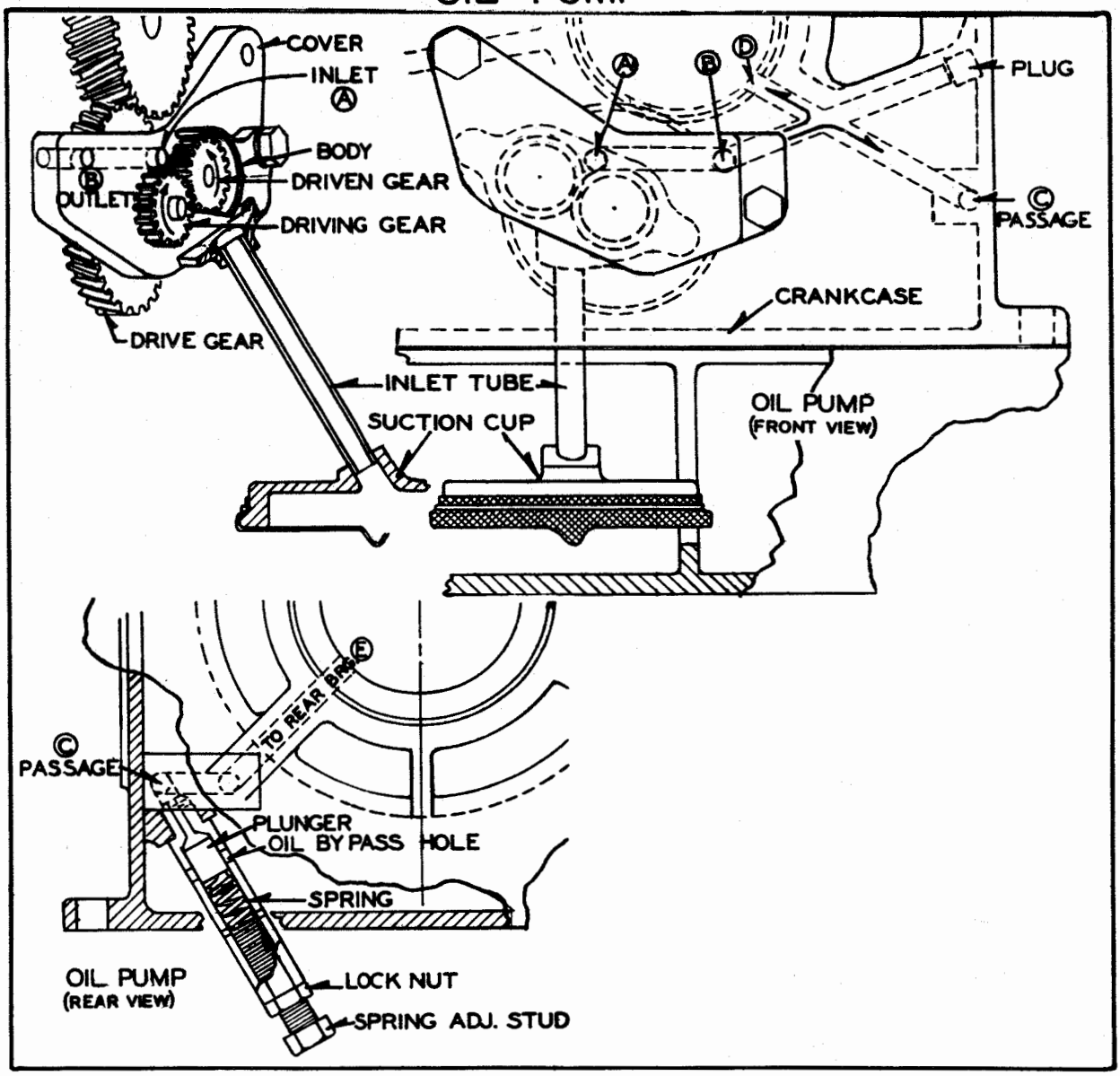


Fig. 64 Motor Generator Parts for Motor Generator Set Type CDO-21648.

OIL PUMP



OIL PUMP - The pressure oil pump is of the gear type, operated by a drive gear meshing with the main crankshaft gear. Action is positive and insures lubrication at all times providing there is a sufficient quantity of oil in the base.

OPERATION - The crankshaft gear meshes with and drives the main drive gear which is on the outside of the crankcase but within the gearcase. The driving gear which meshes with the driven or idling gear which rides freely on a shaft in the oil pump body. Both the driving and driven gears are inside the crankcase and are covered by the oil pump body. The oil is sucked from the oil base thru the intake cup and inlet tube into the oil pump body. The intake cup is screened to present foreign bodies getting into the oil pump.

OILING - Both the pump and crankcase have drilled oil passages conveying the oil under pressure to the points of required lubrication. Oil enters the oil pump passage at "A" and travels through a short passage in the body to the point "B". There it leaves the body and enters the crankcase passage to "C". A cross passage drilled to "C" permits oiling the front crankshaft bearing at "D". The oil also travels across the side of the crankcase through passage "C". At the other end of the case "C" the pressure relief valve controls the pressure of the oil in this system. Also the oil enters another passageway "C" and lubricates the rear crankshaft bearing.

At "E" and "D" the crankshaft is drilled so that the oil enters the drilled passages and is fed to the connecting rod bearings. It is also sprayed onto the other moving parts such as the cylinders, pistons, tappets, etc. It then drains down into the oil base.

Fig. 65 Oil Pump Assembly a Part of Engine Generator Set Type CDO-73004-A.

XI. VACUUM TUBES

ALL TUBES SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

CAUTION: - IN ORDER TO OBTAIN SATISFACTORY TUBE LIFE, THE FILAMENT VOLTAGE MUST BE MAINTAINED AT THE CORRECT VALUE OF 10.0 VOLTS AS INDICATED BY THE RED LINE ON THE FILAMENT VOLTMETER. OPERATION AT OVER VOLTAGE WILL REDUCE THE FILAMENT LIFE, WHILE OPERATION AT UNDER VOLTAGE WILL REDUCE THE EMISSION FROM THE TUBE AND IN TIME RESULT IN A DECREASE IN OUTPUT. OTHER RATINGS GIVEN THROUGHOUT THE TEXT OF THIS INSTRUCTION BOOK MUST BE REGARDED IF OPTIMUM TUBE LIFE IS TO BE OBTAINED.

LIST OF TUBES EMPLOYED

11-1. The tubes used in the Navy Model TBW-4 Portable Radio Transmitting Equipment are as follows:

Intermediate Frequency Transmitter

1 Navy Type _801 Master Oscillator
1 Navy Type _807 Intermediate Amplifier
1 Navy Type _803 Power Amplifier

High Frequency Transmitter

1 Navy Type _837 Master Oscillator
1 Navy Type _837 Intermediate Amplifier or Frequency Doubler
1 Navy Type _803 Power Amplifier

Rectifier Modulator Unit

1 Navy Type _5Z3 Low Voltage Rectifier
2 Navy Type _1616 High Voltage Rectifiers
1 Navy Type _843 Modulator

11-2. The vacuum tubes used in this equipment are operated within the limits specified in Navy Specification RE-13A-600C. If optimum tube life is to be obtained, the cautions given throughout this instruction book must be observed.

11-3. When the cirucits of the HIGH FREQUENCY TRANSMITTER have been properly resonated, the grid current of the Navy Type _837 tube, used in the intermediate amplifier or frequency doubler circuit, will be approximately 3 to 7 milliamperes as indicated by the I.A. GRID CURRENT meter, while the grid current of the Navy Type _803 tube used in the power amplifier circuit will be approximately 20 to 40 milliamperes as indicated by the

P.A. GRID CURRENT meter. The input to the Navy Type _803 power amplifier tube should never exceed 175 milliamperes as indicated by the P.A. PLATE CURRENT meter. Overloading of the power amplifier tube will result in decreased tube life.

11-4. The INTERMEDIATE FREQUENCY TRANSMITTER circuits when properly resonated will result in a grid current of approximately 12 to 20 milliamperes for the Navy Type _803 tube used in the power amplifier circuit. This current will be indicated by the P.A. GRID CURRENT meter. The input to the power amplifier tube should never exceed 175 milliamperes as indicated by the P.A. PLATE CURRENT meter.

11-5. Both the Navy Type _801 and Navy Type _803 tubes are of the thoriated filament type. In case of severe overload resulting in the overheating of tubes of this type, the electron emission may be very slight or may be reduced to a point where oscillations will not start. Unless the overload has liberated a large amount of gas the activity of the filament can usually be restored by operating the tube at normal filament potential for ten minutes or longer with the plate potential off. This reactivating process, if carried out in the equipment, can be accelerated by raising the filament potential, as indicated by the filament voltmeter, to 12 volts, but no higher. If the reactivating process is carried out on a test set up 12 volts should be used for the Navy Type _803 and 9 volts for the Navy Type _801 tube. The useful life of all thoriated filament tubes is usually ended long before the filament burns out. If a tube loses its emission and cannot be reactivated within a reasonable length of time by the method described above, it should be replaced by a new tube.

11-6. The following tabulation compares the operation of tubes used in the equipment with the ratings listed in Navy Specification RE-13A-600C.

Navy Type _801 Tube as a Class C Oscillator.

	Full Load Operating Data	Maximum Rating
Plate Voltage	450 Volts	600 Volts
Plate Current	60 MA	70 MA
Control Grid Current (D.C.)	12 MA	15 MA
Filament Voltage	7.5 Volts	7.5 Volts
Filament Current	1.25 Amps.	1.25 Amps.
Plate Dissipation	15 Watts	20 Watts

Navy Type ___843 Tube as Audio Amplifier Class A

	Full Load Operating Data	Maximum Rating
Plate Voltage	250 Volts	425 Volts
Plate Current	25 MA	18 - 32 MA
Control Grid Volts (D.C.)	-20 Volts	-35 Volts
Control Grid Current (D.C.)	0	-
Filament Voltage	2.5 Volts	2.5 Volts
Filament Current	2.7 Amps.	2.7 Amps.

Navy Type ___803 Tube as a Class C Amplifier (C.W. and M.C.W. Condition)

Plate Voltage	1950 Volts	2000 Volts
Plate Current	175 MA	175 MA
Plate Dissipation	125 Watts	125 Watts
Filament Voltage	10.0 Volts	10.0 Volts
Filament Current	5 Amps.	5 Amps.
Control Grid Voltage (D.C.)	-75 Volts	-500 Volts
Control Grid Current (D.C.)	40 MA	50 MA
Screen Grid Voltage	350 Volts	600 Volts
Screen Grid Watts	25 Watts	30 Watts
Suppressor Grid Voltage	45 Volts	50 Volts

Navy Type ___803 Tube as a Suppressor Modulated R.F. Amplifier Class C (VOICE Condition)

Plate Voltage	2000 Volts	2000 Volts
Plate Current	90 MA	110 MA
Plate Dissipation	40 Watts	125 Watts
Filament Voltage	10 Volts	10.0 Volts
Filament Current	5 Amps.	5 Amps.
Control Grid Voltage (D.C.)	-200 Volts	-500 Volts
Control Grid Current (D.C.)	10 MA	50 MA
Screen Grid Voltage	250 Volts	600 Volts
Screen Grid Watts	25 Watts	30 Watts
Suppressor Grid Voltage	-110 Volts	50 Volts
Suppressor Grid Current	0	-

Navy Type ___807 Tube as a Class AB R.F. Amplifier

Plate Voltage	250 Volts	* Volts
Plate Current	100 MA	* MA
Plate Dissipation	25 Watts	25 Watts
Heater Voltage	6.3 Volts	6.3 Volts
Heater Current	0.9 Amp.	0.9 Amp.
Control Grid Voltage (D.C.)	-10 Volts	* Volts
Control Grid Current (D.C.)	3 MA	* MA
Screen Grid Voltage	250 Volts	* Volts
Screen Grid Current	3.5 MA	* MA

*Class AB R.F. Amplifier Operating Data not included in Specification RE-13A-600 C

CF-377

Navy Type ___5Z3 Low Voltage Rectifier

	Full Load Operating Data	Maximum Rating
Filament Voltage	5 Volts	5 Volts
Filament Current	3.0 Amps.	3.0 Amps.
Peak Inverse Voltage	1400 Volts	1400 Volts
Average Plate Current	125 MA	125 MA

Navy Type ___1616 Tube as a Half Wave Rectifier

Filament Voltage	2.5 Volts	2.5 Volts
Filament Current	5.0 Amps.	5.0 Amps.
Peak Inverse Voltage	5000.0 Volts	5500.0 Volts
Peak Plate Current	0.8 Amp.	0.8 Amp.
*Average D.C. Plate Current	175 MA	260 MA

*From two tubes

Navy Type ___837 Tube as a Class C Oscillator

Plate Voltage	500 Volts	500 Volts
Plate Current	.075 Amps.	.080 Amps.
Plate Dissipation	10 Watts	12 Watts
Filament Voltage	12.6 Volts	12.6 Volts
Filament Current	0.7 Amps.	0.7 Amps.
Control Grid Voltage (D.C.)	-100 Volts	-200 Volts
Control Grid Current (D.C.)	.008 Amps.	.008 Amps.
Screen Grid Voltage	150 Volts	200 Volts
Suppressor Grid Voltage	35 Volts	200 Volts

XII. POWER EQUIPMENT, OPERATING AND SERVICE INSTRUCTIONS

ENGINE GENERATOR SET TYPE CDO-73004-A

12-1. When operating the Type CDO-73004-A ENGINE GENERATOR SET in field service, the location of the plant is important. When operated on the ground, a place should be selected where it will be free of sand, mud, and dust, if possible. Although the unit is protected against normal exposure, it is desirable to shelter it wherever practical. The plant will operate satisfactorily in rain, but unnecessary exposure to rain as well as other elements is undesirable. Locations of high humidity are also undesirable and should be avoided when possible. This generator set is of precision construction, and keeping the unit as clean as possible will aid greatly in reducing break-downs and trouble.

12-2. Great care should be taken when moving the unit to see that it is not damaged by bumping against other objects, or dropped, thereby damaging its transportation case, the mounting system, or the motor generator or controls themselves. If the plant is filled with oil and gasoline, it should always be kept in an upright position unless it is certain that the vent openings for the breather and gasoline tank are tightly closed. With these openings shut tightly, the unit is sealed, and may be temporarily carried in any position.

12-3. When operating the unit in a small room or shed, proper consideration must be given to ventilation. An adequate supply of fresh cool air to the engine and a means for discharging heated air and exhaust must be provided. Similarly, great care should be exercised in the selection of the location for the plant aboard any mobile vehicle or boat to insure that mechanical noises and vibration will not interfere with operation of the equipment or personnel aboard.

CAUTION: EXHAUST GASES FROM THE TYPE CDO-73004-A ENGINE GENERATOR CAN CAUSE ILLNESS OR DEATH IF PROPER PRECAUTIONS ARE NOT TAKEN.

Exhaust

12-4. When the engine generator is operated in a closed, or even a well ventilated room, the exhaust pipe must be connected to dispose of the carbon-monoxide gas. Otherwise illness or even death to personnel will result.

12-5. It is extremely important, when operating the unit in a closed vehicle, to provide some means of disposing of the exhaust gases. A flexible metal hose must be connected to the exhaust muffler outlet pipe, and run outside of the truck. This pipe must be securely connected to the plant, so there will be no danger of it becoming loose or disconnected, and it should be of a type that is reasonably gas tight.

12-5. Precautions must be taken that exhaust pipes do not pass near any inflammable material. Consideration must also be given to the high temperature of the exhaust pipe when handling gasoline or oil, as any inflammable fluid spilled on the pipe or muffler would immediately become ignited.

Ventilation

12-7. Ventilation is most important when operating the plant inside a room, or any confined area. Lack of proper ventilation will cause serious damage due to overheating.

12-8. Any gasoline engine develops considerable heat during operation and means must be provided to remove the heat from the compartment in which it is operating. Proper ventilation openings must be provided in the form of inlets and outlets from the room or enclosure to prevent hot air discharged by the plant from being recirculated and again passed through the engine cooling system. This will cause an eventual rise in temperature in the room, which may reach 40 or 50 degrees higher than normal room temperature and cause damage to the plant.

12-9. In cold weather it is possible to control the temperature of the room or compartment in which the plant operates by simply closing a portion of the discharge opening from the room. In this way, a normal temperature can be maintained in the room.

Setting up the Plant for Operation

12-10. The first step in setting up the Type CDO-73004-A ENGINE GENERATOR SET for operation will be to select a location bearing in mind the requirements expressed in Paragraphs 12-1 to 12-9.

12-11. When the plant has been properly located, the carrying case cover should be removed. This is accomplished by removing the thumb screws from the flanged base. The cover may then be lifted from the generating set. When the cover is not in use, its flange surface must be protected against damage to prevent nicks or dents that would affect the watertight seal.

12-12. Check the quantity of fuel, the oil level, and look for any general damage that may have occurred to the unit during transportation. The fuel tank on the plant has a capacity of 2 gallons, and should be filled with standard Navy Aircraft Gasoline Type AN-9530. This should be done with the aid of a suitable measure or funnel to avoid spilling gasoline over the unit. The small screw in the center of the gasoline cap must be opened to relieve any partial vacuum that might be formed as the gasoline is used up.

12-13. The oil level should be checked by means of the bayonet gauge, and if it is more than 1/4 of an inch below the full mark, Navy Oil, Grade #1065 (for summer) or Navy Grade 2110 (for cold weather operation) must be added.

Oil Changes

12-14. The crank-case must be drained and the lubricating oil changed at least each fifty hours of operation due to the highly leaded fuel used in its operation.

12-15. When the engine is operated on highly leaded fuel a number of chemical impurities form during combustion that pass by the piston and piston rings, entering the crank-case. These gases soon combine with the oil vapor and the oil in the engine forming sludge and acid compounds in the oil. In the design of the unit the selection of metals has been limited to as few types as possible in the crankcase and fuel system to further prevent these chemical reactions. The final solution, however, is frequent oil changing to limit, as far as possible, their detrimental action.

12-16. The oil level is indicated by the bayonet gauge on the oil filler cap. Oil level should be maintained between the "Full" and "Low" mark, and never allowed to drop to the "Danger" mark. The oil level should be checked daily until the operator is familiar with the natural oil consumption of the engine, and as frequently thereafter as is necessary to insure that the oil level never drops below the "Danger" mark on the bayonet gauge.

Cold Weather Operation

12-17. When temperatures are below normal, it is essential that the proper oil be selected for operation. The following commercial grades of oil may be used if Navy grades of oil, as specified, are not available:

Navy #1065 or SAE #30 above 40° F.
Navy #2110 or SAE #10 to 10° F.
Navy #2110 or SAE #10 plus 10% kerosene for all temperatures below 10° F.

12-18. If starting becomes difficult, it is satisfactory to use a winter oil or to dilute an oil with not more than 10% of good, clean kerosene or clean fuel oil. The oil must be changed more frequently than fifty (50) hours if this practice is pursued. If difficulty is encountered in starting the engine, any one or all of the suggestions below may be followed:

1. Heat the oil in a suitable container to approximately 212° F.

2. Heat the intake manifold with a blow torch, being careful to avoid, inasmuch as possible, the danger of exploding gasoline or gasoline fumes from the fuel tank, carburetor or manifold.

3. If the engine starts but runs roughly, partially close the throttle and allow the engine to run at less than normal speed until it warms up.

4. Block off the air intake in the sheet metal blower housing to prevent an intake of cold air around the cylinders until the engine has had a chance to warm up. Under no circumstances should the engine be run longer than three minutes with the air intake blocked.

5. Allow a 15-minute warm-up period after a cold start, to make sure that the engine will come up to proper speed and will develop the required amount of power when the load is applied.

12-19. When first starting the ENGINE GENERATOR SET in low ambient temperatures, the output voltage of the A.C. generator may be low. As the set is operated, however, the output voltage will rise and within a half hour, depending on the ambient, full rated voltage will be available from the generator. Full power output from the transmitter may not be available during this period. The filaments should be operated on as near rated voltage as can be obtained by the adjustment of the filament rheostat during this period. This effect of reduced voltage during the warm-up period will not occur at normal room ambient temperature.

Transportation Clamp Nuts

12-20. Locking nuts are provided to hold the plant and clamp the unit to the base during transportation. These nuts are located near the oil base on each side of the plant. The nuts should be turned clear of the clamp to allow the vibrating motion of the plant to be restricted only by rubber shockmounts while in operation.

Crankcase Ventilation

12-21. WARNING-BEFORE STARTING THIS ENGINE MAKE CERTAIN THAT THE CRANKCASE VENTILATOR IS OPEN. This must be opened before any attempt is made to start the unit.

Starting the Engine

12-22. When the foregoing details have been checked, the gasoline valve on the underside of the fuel tank should be opened, and the engine is then in readiness to start. Starting is accomplished by winding the starting rope around the grooved pulley on the generator end of the unit and then giving a quick pull.

12-23. As this is being done, it will be necessary to partially close the choke, depending on weather conditions. In cold weather the choke must be in a nearly closed position for the engine to obtain a rich enough mixture. In warm weather only light choking will be required. Care must be used to prevent flooding or too rich a mixture.

12-24. When the engine starts, it will be necessary to continue to provide a richer than normal mixture until it is warmed up. During the first few minutes of warm-up, the choke button should be pushed gradually inward until the full open position is reached without the engine "hunting" or sputtering from a lean mixture.

Connecting Load to Power Unit

12-25. When the unit has been operated for a five or ten minute warm-up period, its operation should be stable, and the transmitter and battery load may be connected. When this is done, the charging control rheostat should be immediately adjusted to the desired value before further operation is allowed.

12-26. The transmitter may be turned on which will partially load the generator. If, at this time, there is any unsteadiness of operation or "hunting" of the governor, the engine is too cold and requires a few minutes of additional warm-up.

12-27. Operation of the unit may be continued for intermittent or extended periods. Should the occasion arise for a continuous operation, it will be necessary to check the fuel level at regular intervals of approximately two hours, and the oil level at intervals of fifteen to twenty hours.

12-28. Two receptacles are provided to receive conventional parallel blade plugs. These outlets are for the purpose of supplying current to a soldering iron, and lights for illumination of the operating equipment. The maximum output taken from these receptacles should be limited to 250 watts.

12-29. At the conclusion of the operating period, the machine is stopped by pressing the ignition stopping button that is located on the blower air housing of the machine. This button cuts off the ignition and immediately stops the engine.

12-30. When the set is to be shut down for the last time at some particular locality, it is desirable to stop the engine by shutting off the fuel valve on the under side of the gasoline tank. When this is done, the engine will continue to run until nearly all of the fuel is used from the carburetor. This will prevent spilling in the event that the unit is inverted in the carrying case.

12-31. When the fuel valve is shut off in this manner, it is desirable to also disconnect the radio transmitter to prevent surges in voltage that will occur when the unit finally runs out of fuel.

Replacing Carrying Case

12-32. When the engine generator has cooled to approximately normal temperature, the following operations are necessary to prepare the unit for transportation.

1. Securely tighten the gasoline tank cap.
2. Securely close the gasoline tank vent.
3. Make certain that the gas line valve is shut off, as this controls the fuel flow to the carburetor.
4. Shut off the crankcase ventilator. This seals the crankcase to prevent loss of lubricating oil.
5. Tighten the transportation clamp nuts (2).
6. Check the oil drain plug for tightness, to be sure no oil leak will develop at this point.
7. Recheck all of the above operations to make certain that none have been forgotten.
8. The aluminum housing should now be inspected to be certain that the flange has not been dented, and that there is no sand or obstruction on the gasket on the base of the unit. These surfaces must be treated carefully and the gasket must always be in good condition otherwise the leak-proof joint will not be maintained.

9. The aluminum housing may now be carefully lowered over the unit, and all of the hold down screws replaced and securely tightened. In doing this, it is a good idea to start all of the screws, but not tightening them down until all are in place. The unit will now be in a suitable condition for transportation.

Comprehensive Operating Data

12-33. It will frequently be desirable to check the 800 cycle A.C. operating voltage to ascertain if it is the correct value. This should be done by checking the voltage at the transmitter by the meter provided for this purpose. The voltage should not be checked at the generator as a correct reading will not be obtained due to the inductive and capacitive circuit in the transmitter power supply.

12-34. Any voltmeters or ammeters used for measuring this current must be designed for use on 800 cycle equipment, and measurements must be taken at the transmitter and not at the plant receptacle. The D.C. output voltage may, however, be checked wherever it is convenient.

12-35. Inside of the generator control box five taps are provided for the purpose of obtaining the proper A.C. voltage. The plants are provided with a range of adjustment from 110 to 130 volts, in steps of 5 volts each.

12-36. Under no consideration, however, should these taps be changed except by a person authorized and experienced in service of engine generating sets and radio transmitting equipment.

12-37. The A.C. voltage is directly proportional to the operating speed of the unit. In order to produce the proper frequency, and proper voltage, the set must be operating within a few percent of 2666 R.P.M. It is desirable that the governor be adjusted so that the operating speed of the machine at no load be somewhat over 2666, and at full load somewhat under 2666 R.P.M. This practice will bring the frequency to 800 cycles at medium load on the machine, and at this speed, also providing the proper A.C. and direct current voltage for charging. For additional data on this subject, see the wiring diagram and governor adjustment instructions.

Fuse Replacement

12-38. The generator winding is protected by a 15 ampere fuse in the A.C. circuit, and a 25 ampere fuse in the D.C. circuit. A blown fuse will be indicated by a failure to obtain either one or the other of these voltages from the machine. In this event it will be necessary to replace the fuse with one from the spare parts.

Weekly Service - 50 Hours of Operation

12-39.

1. Oil Change - The oil should be changed in accordance with the foregoing oiling instructions.

2. Spark Plugs - Remove the covers from the spark plugs and the spark plug from the cylinder head. Clean and reset the spark plug point gap to .025". The spark plugs used in these plants are 14 mm. Champion #J-10. These plugs are of the proper heat range for this type unit, and when replacements are made, they should be of the same make and model number, to insure proper results. The spark plugs should be removed and cleaned after every fifty hours of operation, and the spark plug gap set at .025". A close inspection should be made of these plugs to determine whether they should be replaced. Replacement of the plugs should be made after each 50 hours of operation if required.

3. Breaker Points - The ignition breaker points used on these plants are operated by a non-metallic plunger extending from the breaker arm to the camshaft on which is cut a cam or eccentric. This moves the the plunger in and out to open the breaker points. These breaker points should be inspected occasionally, cleaned and set at .020" clearance. If the points have become badly burned and pitted, they should be replaced. An inspection should be made of the breaker arm return spring to see that it is in its proper position. Rapid deterioration of the breaker points can be caused by a defective capacitor. The breaker point capacitor is mounted directly behind the breaker arm on the breaker mechanism housing. If excessive arcing occurs at this point, a faulty capacitor is indicated and should be replaced.

Monthly Servicing - 200 Hours of Operation

12-40.

1. Ignition - Remove the cover from the ignition breaker mechanism, turn the engine over by hand until the breaker points are open. The points should be cleaned, the gap set at .020" and cover replaced.

2. Fuel System - Remove the glass bowl from the fuel filter, clean and replace.

3. Minor Lubrication - Place a drop of light lubricating oil on the following points: throttle shaft bearings of carburetor, governor ball joint, carburetor choke shaft bearing.

Six Month's Inspection

12-41. After each six months of operation, all of the foregoing points should be gone over thoroughly. In addition, remove the brush cover from the generator, inspect all brushes, replace those that are worn appreciably, remove the gasket plates from the rear of the generator shaft, after removing the cranking shieve. Clean out all hardened grease and re-fill with ball bearing grease Navy Grade "A". Use about one tablespoonful to re-fill the bearing, replace the gaskets and tighten the gasket plate carefully. Remove the air filter from the engine, clean thoroughly in gasoline, dip in used lubricating oil, allow to drain at least two hours and replace on the carburetor.

Accessories Service

12-42. The carburetor used on this plant is the Zenith R20T. Little care or attention need be given these carburetors, outside of an occasional cleaning perhaps once a year to insure that the bowl has not become filled with sediment. There are two adjustments on the carburetor. The main jet adjustment is made by turning the handle adjustment needle at the bottom of the fuel bowl cover clockwise, to reduce the fuel mixture, and counter-clockwise to increase the fuel mixture. An idling or air vent adjustment is located at the side of the carburetor air horn, projecting from it at an angle. The proper setting of this adjustment is approximately 1/2 turn open from the full closed position. The approximate proper setting of the main jet atop the carburetor bowl is four turns open from the full closed position. Minor adjustments of these carburetor jets may be made occasionally, but continuous adjustment should not be attempted.

12-43. No adjustment should be made until after the motor has been running for at least one-half hour and has reached normal operating temperature. The proper setting of the main jet should then be determined by turning the main jet clockwise, towards the closed position, until the plant begins to reduce speed. This adjustment must be made only when the generator is loaded to its full capacity. When the engine begins to lose speed, the carburetor main jet should be opened until it regains normal speed, at which point it is properly set. With no load on the generator, or the engine running idle, the idle jet may be adjusted properly by turning it toward its closed position clockwise, until the engine runs unevenly. Open it until the engine regains its normal, smooth operation at which point it is properly adjusted.

12-44. Irregular operation of the engine, hard starting or loss of power indicate that the main or idling jets of the carburetor have become clogged. It is necessary to remove the float bowl cover of the carburetor to remove and clean the main jet. Never use a wire to scrape or clean the inside of either of the jets, as the size may be changed. When the jet has been replaced in the carburetor body, be sure that the small fibre gasket is in place below the head of the jet.

Yearly Engine Servicing

12-45. Each year, if the plant is used under normal conditions, the accumulated hours of operation should total 2500 or more. After this period of 2500 or 3000 hours of operation, the engine should be given a thorough inspection, including pistons, piston rings, valves, crankcase, and other operating parts.

12-46. One of the service operations most frequently required by gasoline engines is valve grinding. This is accompanied by a thorough cleaning of carbon.

Valve Grinding and Carbon Cleaning

12-47. Have the following parts on hand before attempting to regrind valves:

2 cylinder head gaskets	#19091
2 cylinder base gaskets	#19181
2 valve inspection plate gaskets	#19184
4 inlet and exhaust manifold gaskets	#19191

1 complete set of piston rings (optional)
1 complete set of valves, valve springs, valve locks and guides (optional)

12-48. Referring to Figure 58, the motor is disassembled in the following manner. Drain the oil from the crankcase, disconnect the fuel lines from carburetor to tank and remove the carburetor and intake manifold assembly as a unit. Remove the exhaust manifold assembly as a unit. Remove the cylinder air covers from both right and left cylinders and the blower housing from the engine. Remove the spark plugs from both cylinder heads, and remove the cylinder heads from the cylinders. Remove the valve tappet inspection covers from the cylinders. Remove the three nuts holding each cylinder to the crankcase. One nut is located inside the tappet inspection chamber, and two at the lower end of the cylinder flange. By tapping the cylinder gently, it should loosen from the crankcase, and it is possible to draw both cylinders from the case. When this operation is going on, be sure

that the piston and connecting rod assembly is not allowed to drop against the edge of the crankcase, and nick or damage the piston. Do not place a screw driver between the cylinder flange and the crankcase. Place each piston on a piece of cardboard or rag while the cylinder is being cleaned. Carbon should be removed from the cylinder head and valve stems. The guides should be cleaned, the valves ground and replaced, the cylinders washed and prepared for re-installation on the crankcase.

12-49. Inspect the piston rings carefully. Be sure that any accumulated carbon is removed from the oil return slot in the oil control ring, or replace the rings if necessary.

12-50. If taper-walled compression rings are used, be certain that the large diameter of the ring is placed at the lower end of the piston. This position is indicated by the word "top" on the piston ring facing the piston head.

12-51. When re-assembling the motor, always use new gaskets from the spare parts.

12-52. The valve springs can be removed from the valve stems by pressing down on the valve washers by hand, and removing the lock. After the carbon deposit has been removed from the cylinder head, piston rings, valve seats, valve guides and valves, inspect the valve guides for wear or carbon deposit which will decrease the valve stem clearance and cause sticking of the valves. Valve stems sticking in the valve guides are one of the most frequent causes of trouble and serious damage to the motor can result from over-heating, due to sticking valves.

12-53. Check the valves carefully. If the stems are badly worn or are warped (not straight) the valves should be replaced with new ones. Valves that have badly pitted faces can be used by refacing them on a valve face grinder. If this is done, be sure to get a true 45° face. When lapping each valve to its seat, be sure that no dirt is allowed to get into the guide to force the valve off-center. Use a light coil spring under each of the valves as it is being lapped to raise the valve off its seat during the process. Use a medium grade compound, and only a light pressure. Rotate the valve with a two-pointed tool, projecting it into the the holes on the top of the valve head. Repeat the oscillating and lifting motion, replacing the compound as it wears out and loses its cutting properties, until a clean surface is produced on both valve and seat alike. There should be a bright silvery band of uniform width all around the valve face. The correct width of the valve face is 3/32".

12-54. Carefully clean all traces of the compound from the surface and check each valve for a tight seat, by making pencil marks across the face at intervals, and then rotate the valve, part of a turn against the seat with a firm pressure. Again lift out the valve and observe if the pencil marks are all rubbed out. Regrind until this test shows a gas tight mating of valve to seat by a complete erasure of the pencil marks.

12-55. After the cylinders have been re-assembled and the cylinders tightened securely to the crankcase, the tappets should be adjusted. The proper clearance between the valve stem and the valve tappet screw head, should be .006" to .008" on both intake and exhaust valves. To obtain this proper clearance, use an accurate feeler gauge, and adjust the screw as necessary, locking the valve tappet screw lock nut securely after the adjustment has been properly made. Tappet adjustment must be made on each cylinder with the piston at top dead center on the compression stroke.

12-56. After the engine has been started and run for a short time, it is advisable to go over each of the cylinder head nuts to be absolutely sure they are dead tight. Use a good box or socket wrench when tightening the nuts.

12-57. Remove the tappet cover from the cylinder after the plant has operated for several hours. Retighten the nut retaining the cylinder to the crankcase, and recheck the tappet adjustment, making any necessary changes to keep the clearance at .006" to .008".

Governor Operation

12-58. The governor on the motor is composed of a series of balls operating in ramps cast in the iron camshaft timing gear. The ramps in which the balls are carried are designed so that, as the speed of the engine increases, these balls tending to move outward from the center of the shaft, moving forward and forcing the governor cup away from the face of the timing gear. A thrust bearing located at the center of this cup bears against the governor shaft paddle and moves it forward. This, in turn, rotates the governor shaft at the top of which is located the governor arm, linked to the throttle arm of the carburetor. An adjustable spring mounted atop the engine holds the governor arm against the attempted motion of the governor cup by the governor balls, and the balance of power between the governor spring and the governor balls regulates the speed of the engine. This regulates the voltage output of the generator.

12-59. The proper operation of the governor assembly is absolutely essential, as it controls the speed of the engine and the voltage output of the generator. When the governor is operating normally, the speed of the engine will be controlled within 130 RPM. The normal speed of the plant is 2736 RPM no load and the speed will drop to 2606 RPM when the load is increased to maximum on the generator.

12-60. If the governor assembly has not been tampered with, no change in its operation should occur. However, if for any reason the governor does not properly control the speed, within the 130 RPM range, the voltage will vary greatly, as the load is increased or decreased on the generator. The only external adjustment on the governor is made by turning the governor spring nut to increase or decrease the spring tension to increase or decrease the speed of the engine and the voltage output of the generator. After the proper adjustment has been made to bring the voltage output to the proper figure, (120 on middle tap), the screw should be turned until it seats itself in its locked position.

12-61. If the governor is disassembled or if the carburetor is removed from the engine, resetting of the external parts of the governor will be necessary. This is done in the following manner.

12-62. The governor spring forces the throttle shaft to the full open or full speed position. The throttle butterfly in the carburetor is then in line with the air-horn of the carburetor. Be sure the throttle butterfly is in the proper position by loosening the clamp screw holding the throttle arm on its shaft. Turn the throttle shaft with the fingers, clockwise (looking downward), and allow the governor spring to return the governor arm to its normal (open) position. Now lock the arm securely on the throttle shaft.

12-63. If the governor arm has become loosened from the governor shaft which extends from the front gearcase, the clamp holding the arm to the shaft should be loosened, and a screw driver inserted in the slot in the top of the governor shaft. Turn the shaft clockwise (to the right, looking downward) as far as possible, and hold it in that position. While the governor spring holds the arm in this normal idle position, relock the clamp screw securely. These operations will restore the governor to its original setting, and it should function properly.

12-64. No routine servicing is required, other than placing a drop of oil occasionally on the link between the throttle arm of the carburetor and the governor arm, and on the throttle shaft in the carburetor. None of the parts of the governor should require replacement during the life of the engine.

Timing Gears

12-65. The camshaft of the engine is driven by helical cut gears from the crankshaft. A steel gear is keyed on the crankshaft and retained by a large hexagon nut and washer. This gear meshes very closely with the cast iron camshaft gear into which the governor operating mechanism is built. Under normal operating conditions, these gears will last until a major overhaul of the engine-generator assembly is necessary, a period of time varying from one to five years, depending on the service the unit is called upon to render.

12-66. Replacement of the cast iron camshaft gear should not be made under normal operating conditions, unless the crankshaft gear is also replaced. When replacement becomes necessary, indicated by extreme noisiness of the gear assemly, it is necessary to remove the gearcase from the front of the engine, after first draining the oil from the case. Remove the blower housing and cooling blower from the front of the engine, disconnecting the governor link from the carburetor and removing the forward gearcase. The timing gears will then be exposed. The hexagonal nut on the crankshaft should be removed and the timing gear can then be pulled from the crankshaft.

12-67. Before installing a new timing gear on the crankshaft, the timing mark on the camshaft and the crankshaft gear should be lined up to provide correct timing of the camshaft. After the timing gear has been pressed or tapped on to the crankshaft, the nut should be replaced and tightened securely.

12-68. When replacement is made, the mesh between the gears should be noted carefully. A piece of ordinary newspaper should pass between the teeth of the gear without creating binding. A heavy piece of wrapping paper should not pass between the gear teeth. This test will indicate a clearance or backlash of from .003" to .005" which is desirable.

Major Engine Overhaul

12-69. After long periods of operation (1 to 5 years or more) a major overhaul of the engine and generator may become necessary. This should not be considered as essential unless engine operation has become inefficient, or unless serious noises develop within the engine, indicating looseness of main or connecting rod bearing, timing gears, piston pins, wrist pins, or other working parts.

12-70. To complete a thorough inspection of the crankcase, the case should be drained of oil and the oil base removed. By placing a trouble lamp inside the crankcase, it is

12-70. (cont'd)
possible to inspect all the working parts, or by feeling the fit of the connecting rods on their bearings, and the fit of other internal working parts, it will be possible to determine whether it is necessary to consider a major overhaul.

12-71. An overhaul of this plant should not be attempted by anyone who is not entirely familiar with the operation of modern motor car, marine, truck, tractor or aviation engines. The dismantling of the engine and generator will follow a natural course, and a careful observance of the parts, as they are removed from the plant, will indicate which of them must be replaced, which can be repaired, and which must be adjusted. It is necessary to remove the oil base from the plant, to accomplish a major overhaul.

12-72. Worn or scored pistons, pins and rings must be replaced. The cylinders can be honed or bored to oversize diameter and larger pistons can be furnished by the manufacturer. The cylinders can be returned to the manufacturer, to have new cast iron liners inserted and honed to size. Other work must be done by competent personnel, in a properly equipped service shop.

12-73. The connecting rod bearings can be adjusted if necessary, by carefully filing or dressing the connecting rod cap, to reduce the clearance between the connecting rod bearing on the crankshaft.

12-74. The main bearings of the engine are not adjustable, and should seldom need replacement. However, if this becomes necessary, the bearing cap and bearings or the entire crankcase should be returned to the manufacturer for servicing. If transportation facilities make this inconvenient or out of the question, a line reamer can be furnished by the manufacturer or the crankcase can be set up in a milling machine and the bearings carefully bored to the proper size.

12-75. The rear main bearing oil seal #19003 is a leather unit and sheet metal member pressed into the rear main bearing casting. This seal must be replaced whenever a major overhaul is made, or whenever oil leakage occurs from the rear bearing, evidenced by oil being thrown from the ventilating openings between the engine crankcase and generator frame.

12-76. Care should be taken when installing this seal to be sure that the lip of the leather is not damaged by the keyway in the shaft. Grease the shaft carefully before

12-76 (cont'd)

slipping the seal over the shaft. Tap the seal into the bearing cap evenly and shellac the surface after the seal is installed.

12-77. The oil seal 19382 in the front gearcase cover, is a cork synthetic member cemented into the casting. Replace the seal during each major overhaul or whenever leakage occurs and oil is thrown from the crankshaft flywheel blower.

12-78. Whenever any major work is done on the engine, be sure that all gaskets are replaced with new ones upon reassembly. A great deal of careful work and fine workmanship can be undone by not installing new gaskets.

12-79. Table of Clearances for Bearings and Other Parts of the Engine

	MINIMUM	MAXIMUM	CHECK WITH
Valve Tappet Clearance (Intake)	.003"	.008"	Thickness Gauge
Valve Tappet Clearance (Exhaust)	.003"	.080"	" "
Valve Seat Width (All)	.032"	.087"	(1/16"to3/32")
Valve Stem Clearance in Guide(Intake)	.0025"	.004"	Thickness Gauge
Valve Stem Clearance in Guide (Exhaust)	.004"	.006"	
Crankshaft Main Bearing(Diameter)	.0015"	.002"	
Crankshaft End Play	.010"	.015"	
Connecting Rod Bearing(Diameter)	.001"	.002"	
Connecting Rod Bearing (End Play)	.005	.007"	
Timing Gear Backlash	.002"	.005"	
Piston - Cylinder Clearance	.0025"	.0035"	
Camshaft Main Bearings (Rear)	.0015"	.002"	
Piston Pin in Piston	HAND PUSH FIT		
Piston Pin in Rod	.0005"	.001"	

GENERATOR, MAINTENANCE

12-80. A systematic inspection should be made at regular intervals with special attention to the following points:

12-81. See that both the interior and the exterior of the machine are kept free from metal dust, dirt of any description, or water.

12-82. If an excessive accumulation of dirt occurs, it is desirable to clean the air ducts of the unit. Compressed air is the most effective means of cleansing the interior parts. A small bellows might be used if compressed air is not available. Before using compressed air, be sure that the air stream is free from water, oil and foreign matter. If the interior surfaces of the generator are oily, this will cause the dust and dirt to adhere firmly in place and must be cleaned out with gasoline, benzine, or carbon tetrachloride. Insulating surfaces on parts such as the brush rigs, should be carefully cleaned of metal dust and carbon dust worn from the brushes and commutators.

Brushes

12-83. See that the brushes move freely in the holders and make firm even contact with the commutator. The brushes should all have equal spring tension to prevent one from carrying more than its share of the load. An extra set of brushes should always be kept on hand.

Commutators

12-84. The commutator should maintain a polished surface. Blackening of all the bars indicates incorrect brush position. Blackening of groups of bars at regular intervals may be due to the same cause or to poor contacts. Blackening at irregular intervals indicates a rough eccentric commutator. A severely burned bar or number of bars, indicates an open circuit in the armature, which will also be noted by excessive flashing when the machine is operating with load. This type of difficulty can only be corrected by competent personnel trained and equipped for armature repair work.

12-85. Ordinarily the commutator will require only an occasional wiping with a dry cloth or non-linting material. If, however, blackening appears and grows worse, the cause must be determined and corrected. Do not use any lubricant on the commutator. The use of any lubricant will only cause sparking and increase commutation difficulties. Noise from the brushes is due to a rough commutator, caused by high and low bars. This difficulty may only be corrected by turning down the commutator in a lathe.

Generator Heating

12-86. Overheating of the entire unit may be caused by:

1. Unequal air gap.
2. A shorted out or grounded field winding.
3. A reversed field coil winding.

12-87. Heating of the armature may result from any of the following causes.

1. Overload.
2. Short circuit of a coil or number of coils in the winding.
3. Grounds in the armature windings or commutator.
4. Poor commutation.

12-88. Any of the above troubles cause a large circulating current in the armature windings to the commutator, to the brushes, and brush connections, which will cause artificial overloading of the armature. The air gap should not vary over a few percent either way from the average value. All field coils of the shunt type should have within 10% of the same resistance, and a lower value than this indicates shorted turns in the winding.

12-89 Overheating of the field coils may be caused by the following:

1. Too high an operating speed, with a resultant high output voltage.

2. A partial short-circuit of one coil.

3. If the field coils have been removed from the machine and are not reconnected properly, this may also cause excessive heating of the shunt field.

Poor Commutation

12-90. Sparking at the brushes may be due to any of the following causes:

1. Excessive overload.

2. Brushes not set correctly in respect to the neutral position.

3. Brushes not be fitted to the surface of the commutator.

4. Brushes binding in the holders.

5. Brushes not equally spaced around the commutator.

6. Brushes have reached their limit of wear, resulting in insufficient brush spring tension.

7. Brush pressure insufficient.

12-90. (cont'd)

8. Some brushes have excessive pressure, and take more than their share of the current

9. Carbon brushes of an unsuitable grade. Metal graphite brushes are generally not used on voltages higher than 30 to 40 volts. Great care must be taken to be certain that the proper grade brushes are used for replacements.

10. Commutator bars loose or some projecting above the others.

11. High mica. This prevents a proper contacting surface between the brush and the commutator.

12. Short circuit on the line.

13. A variation in the air gap of the generator will also cause severe sparking at the commutator.

Commutator Maintenance

12-91. Mica is used for insulation between the commutator bars. After the armature is turned down, the mica should be cut away to about 1/32" below the surface of the bars. The surface of the bars will eventually wear down to the level of the mica. The mica is harder than the copper, and it forms ridges which cause the brushes to jump and make poor contact. High mica should be undercut carefully, and the commutator re-turned and cleaned.

Failure of Generator Build-up

12-92. 1. Drive speed may be below normal.

2. Reversed shunt field. One or more of the coils reversed in the series field.

3. Brushes incorrectly located; not on neutral position.

4. Open circuit in the shunt field.

5. Brushes making poor contact with commutator.

Removing Generator from Engine

12-93. The generators are carried directly on a turned diameter of the rear crankcase adapter. The generator frames are held to the adapter casting by four draw-bolts passing through the generator frame, and rear bearings support castings. If for any reason it becomes necessary to remove the generator from the engine, proceed as outlined in the following paragraphs.

12-94. First, disconnect power plugs from the control unit. Second, disconnect the fuel line from the fuel tank to the carburetor. Third, remove the brush cover from the rear of the generator and lift all of the brushes in their guides, so that the brush springs will slip down the side of the brushes and hold them in place to prevent their being damaged, when the generator frame is removed. Fourth, it is recommended that the gasoline tank be removed from the generator frame so that it will not be damaged. The cranking sheave should be removed from the end of the generator shaft by removing the nut and loosening the Allen set screw thereby making it possible to pull the sheave from the shaft. Remove the four nuts at the rear of the generator bearing support casting, holding the generator frame to the engine crankcase, loosening and removing those at the bottom first. The generator frame can now be pried and pulled from the adapter casting. If the generator frame slips from the guide ring on the adapter casting, support its weight carefully, while it is pulled all the way off the armature. Allowing its weight to hang on the armature may distort or bend the generator shaft.

12-95. After the generator frame has been removed from the crank-case, the armature will be extended from the crankshaft, and care should be taken that the engine is not turned over rapidly, or that nothing is allowed to drop on the armature. The armature can be removed from the crankshaft by replacing the hexagon nut at the rear of the armature shaft so it extends just beyond the end of the armature through stud. Pull on the armature away from the engine and strike the nut a sharp blow with a heavy hammer, to loosen it from the taper holding it in the engine crankshaft. The armature can then be pulled away from the engine, and should be handled carefully, and laid so it will not roll and damage the laminations, commutator or collecting rings.

Assembling Generator to Engine

12-96. Before the armature is reinstalled on the crankshaft. grease the taper that carried the forward end of the armature in the crankshaft so it will not rust in operation.

12-97. Before installing the frame on the crankcase, remove the bearing cap from the rear of the generator, clean the bearing surface in the frame and the bearing on the armature carefully. The frame should be installed over the armature very carefully, and the four cap screws that retain it should be tightened gradually and alternately, never pulling one down tight before the others are nearly down.

Brush Rig Position

12-98. It will not be necessary to loosen the bolts retaining the brush rig assembly to the rear of the generator frame during the disassembling of the generator. However, if this has been done accidentally, or for removal of the brush rig for servicing, it should be turned to the position marked by the small indicating point on the frame of the generator and the notch or mark on the brush rig when reinstalled. This is called the neutral position, and unless the brush rig is replaced properly in this position, excessive arcing of the brushes, heating of the generator fields and armature, and low voltage production will result.

CONSTRUCTION SPECIFICATIONS, TYPE CDO-73004-A ENGINE GENERATOR SET

Engine

12-99. The engine is of the two cylinder horizontal type with cylinder blocks which can be separated from the crankcase. The engine is a four cycle, L head air-cooled unit operating on gasoline. The bore is 2-1/2", and the stroke is 2-1/4". The compression ratio is 5-3/4 to 1. The cylinder is cast aluminum with cast iron liner shrunk in place. The valve guides are of cast iron and removable from the block. Valve seats are of alloy iron, also removable and replaceable.

12-100. A valve tappet spring chamber is an integral part of the cylinder casting and is covered by a cast aluminum plate, retained by a single screw.

12-101. The crankcase is of cast aluminum and is removable from a cast aluminum oil base by removing four hexagon nuts. The cylinders are removable as are the cylinder heads.. Aluminum pistons with three piston rings (two compression and one oil control ring) are used. Aluminum connecting rods provide light reciprocating parts.

12-102. The main bearings are pressed into the crankcase and rear bearing plate generator adapter casting and are line-reamed, with the rear casting bolted to the crankcase. The main bearing material is steel-backed babbitt. They are 1-11/16" in dia meter, 1-1/8" long. The camshaft is supported on one ball bearing at its forward end, which absorbs the timing-gear load, and one babbitt-lined steel-backed bearing at its opposite end. A cast iron camshaft gear with its integral governor mechanism meshes with a steel crankshaft gear. The engine and generator speed is controlled constantly at 2666 RPM. An external governor adjustment is accessible atop the engine to vary engine speed and voltage from the generator. A screen type air cleaner is mounted on an adapter carried on the carburetor intake horn. The crankcase is ventilated by a crankcase ventilator assembly atop the carburetor to allow passage of air in and out of the crankcase, during engine operation. An oil filler opening is located on the crankcase and is equipped with a cap and rod assembly, retained by a spring lock. Oil level is indicated by the bayonet gauge incorporated in this assembly. Ignition is supplied the engine by a fly wheel type magneto generator unit, and an external magneto breaker mechanism. See sketches of magneto stator assembly and breaker mechanism shown on Figs. 56 and 58. The magneto generator unit is housed directly behind the engine cooling blower flywheel and current generated by this assembly is interrupted and the spark provided at each spark plug at the correct time by the breaker mechanism.

12-103. The external breaker mechanism is mounted on top of the crankcase directly below the intake manifold and is protected by a cast aluminum cover that can be removed by loosening one screw. An ignition breaker plunger, operated by a cam ground in the rear main bearing section of the camshaft, operates the ignition breaker arm. The breaker point gap should be maintained at .020". The ignition breaker timing is not adjustable.

12-104. Cooling of the engine is accomplished by the flywheel blower which draws air in through the center of the blower housing and distributes it outward to both cylinders where it is forced over cylinder head surfaces, cylinder fins and all other areas which must be cooled, and discharges it upward from each of the cylinders. A flexible lubricating oil drain is located on the lower right-hand corner of the oil and mounting base. The spark plugs are shielded by an aluminum case and the high tension cables are shielded. The ignition coils which are mounted behind the engine flywheel cooling blower are permanently insulated.

12-105. The engine is lubricated by a full pressure lubricating system. Oil is pumped from the bottom of the oil base by a gear type pump actuated by a drive gear which meshes with the main crankshaft gear. Oil is pumped under 25 to 50 pounds pressure, regulated by a non-adjustable bypass set at the factory, to both front and rear main bearings, where it is forced through drilled openings in the crankshaft to the connecting rod bearings. There it is distributed by spray to all other moving parts of the engine. The oil enters the pump through a filter screen which is removable for cleaning after the oil base has been removed from the crankcase.

GENERATOR

12-106. The generator is of the four pole, inductor alternator type. The magnetic circuit of the generator is identical with that of a four pole D. C. motor or generator. The direct current excitation and charging current is generated by a rotating armature, revolving inside of four D.C. poles, which are magnetized by four individual field windings. Located in the faces of these stationary poles are a series of slots, designed with a correct numerical relation to the rotating armature slot. These slots in the pole shoes contain the A.C. winding, which produces the 800 cycle, 120 volt, A.C. output by inductor alternator action.

12-107. The armature revolving in the field produces a direct current voltage in the conventional manner. The number of slots in the armature, and in the pole faces, however, are numerically arranged so that when one rotor tooth passes out of the field pole, one is entering into the pole at the other end. This construction will provide a magnetic path of uniform cross-sectional area at all positions of the rotor while the generator is operating. In one position, the slots in the pole faces are further arranged to provide a magnetic path through the A.C. coils of as low reluctance as possible. In the next position of the armature, it will have shifted out of phase with the A.C. coil to create a magnetic path of as high reluctance as possible. It will be seen that this will create a rapidly vibrating magnetic flux through the A.C. winding, thereby producing the 800 cycle generator voltage.

12-108. In the pole shoes high grade steel of thin gauge is used. The teeth in the shoes are operating at very high flux densities which will greatly increase the iron losses unless excellent material is used. In the rotor a lower grade of electrical steel and a thicker gauge is used as the frequency of flux reversal in the rotor teeth is not the same as the

12-108. (cont'd)

fundamental frequency output of generator, but is of lower value proportional to the number of magnetizing poles in the generator, and the revolutions at which it is operating.

12-109. The winding around the field pole is of conventional shunt type as used in D.C. generators. This shunt winding is designed to operate from the 14-1/2 volts output of the generator. In order to provide the proper regulation, the magnetic circuit of the generator is saturated to prevent, insofar as possible, a lowering of the A.C. and D.C. voltages when the load is applied.

12-110. The A.C. winding is also designed with a proper amount of synchronous impedance to allow the A.C. voltage to remain constant as the load is increased. The internal reactance of the generator is neutralized by the magnetizing effect of capacitors in the radio transmitter.

12-111. In order to maintain proper synchronous impedance, it is important that the air gap of the machine be between .010 and .014 of an inch. This is controlled at the factory, and no change in it must be made as it will affect the operation of the equipment.

12-112. The revolving armature of the machine is coupled directly to the crankshaft by a male and female taper. The armature arbor is holloy with a draw bolt passing through it from the crankshaft with a nut at the rear, drawn up to hold the tapered armature shaft secure in the hollow crankshaft.

12-113. The generator is cooled by forced air circulated by a blower mounted at the engine end of the generator. Air is drawn from the bottom at the rear of the generator up and around the generator field coils and armature, and discharged from openings in the adapter casting between the engine crankcase and the generator frame.

12-114. The outboard end of the armature is carried by grease-sealed ball bearings which require attention once each six months. A conventional commutator and brush rig assembly is provided to collect D.C. current from the revolving armature. Four brushes of the metal graphite type are used and replacements must be of this same material. Small capacitors are connected across each of the brushes to minimize radio interference.

12-115. The alternating current winding is provided with five taps which are connected to a terminal block in the control assembly. By means of these taps, the proper voltage can be selected.

12-116. All windings of the generator are impregnated with a phenolic insulating varnish and baked. Several successive impregnations are used to thoroughly insulate and secure the various windings in place. The generator frame is of rolled steel ring, butt-welded and machined inside to receive the pole shoes. The complete generator is designed for a temperature rise of not greater than 40 degrees Centigrade.

12-117. Mounted on the side of the generator is a control assembly, which includes the following parts: generator terminal block; transmitter and battery receptacle; soldering iron and light receptacle; and in the direct current circuit a filter choke; charging control rheostat; reverse current cutout relay; filter capacitor; suitable fuses; and D.C. ammeter.

12-118. The A.C. output from the generator is connected through a 15 ampere fuse to the transmitter, and soldering iron and light receptacle. In the direct current circuit, a filter choke and filter capacitor are provided to reduce the direct current ripple to a negligible value. A reverse current relay prevents the battery current from flowing back into the generator when the plant is not operating. A charging ammeter indicates the direct current flowing to the battery receptacle, and a rheostat makes adjustment of this current possible. All of these parts are suitably mounted and enclosed in an aluminum housing, bolted to the side of the generator.

Carrying Case

12-119. The engine and generator are mounted on a 1/4 inch thick plate of aluminum, which is designed to serve as a base and as the bottom of the carrying case. The outer edge of this base is constructed with a Neoprene gasket to create a watertight joint when the aluminum housing is lowered over the set and screwed in place.

12-120. The aluminum base plate is fitted with stainless steel threaded inserts to avoid threading the soft aluminum alloy, which would be undesirable due to the frequent assembly and disassembly of the housing.

12-121. The housing itself is contructed of aluminum thoroughly ribbed and corrugated to produce surfaces of great strength and rigidity.

PARTS FOR ENGINE GENERATOR SET TYPE CDO-73004-A

12-122. The Type CDO-73004-A ENGINE GENERATOR SET is comprised of the following:

Type CDO-18010 Gasoline Engine
Type CDO-21647 Generator
Base & Carrying Case

W.E. PART SYMBOL	PART NO.	PART NAME
		Fuel System Group
O-711-L	583	Carburetor Flange Gasket
	1097	Assembly - Filter Bowl Assembly
	1098	Fuel Filter Glass Bowl
	W7027X2	Fuel Filter Bowl to Fuel Tank Connecting Nipple
	W7400X4	Fuel Filter Outlet Male Elbow
	19446	Gas Tank - Steel
	19447	Fuel Line - Fuel Filter to Carburetor with Fittings
	19452	Gas Tank Cap
	19453	Shut-Off Screw for Gas Tank Filler Cap
O-711-H	19454	Gasket for Gas Tank Filler Cap
O-711-J	19455	Gasket for Gas Tank Filler Cap Shut-off screw
	19457	Spring for Gas Tank Filler Cap Shut-Off Screw
	19480	Fuel Filter Bowl Gasket -(not illustrated)
	19801	Carburetor (Zenith)
	19922	Choke Shaft Knob
	19934	Choke Cable Assembly
	19935	Choke Cable Clip
		Piston & Connecting Rod Group
	609	Piston Pin Lock Ring for 2-3/4" Piston (4 used)
	8018	Connecting Rod Cap Screw (Heat Treated) (4 Used)
	19200	Piston Only - 2-1/2"
	19201	Piston Pin 3/4" x 2-1/16"
	19202	Piston Rings (Comp. 3/32" x 2-1/2")(2 used)
	19203	Piston Ring (oil) 3/16"x 2-1/2"
	19221	Washer for Connecting Rod Bolt
	19222	Connecting Rod
	19223	Connecting Rod Inserts
	19225	Connecting Rod Piston Pin Bushing
		Blower Housing Group
S-711	695	Stop Switch Push Button Name Plate
	1419B	Stop Switch Assembly
	19320	Blower Housing Only
	19335	Cylinder Air Housing - R.H.
	19336	Cylinder Air Housing - L.H.

W.E. PART SYMBOL	PART NO.	PART NAME	
		Miscellaneous Group	
	1748	Battery Hydrometer	
O-711-E	19191	Intake and Muffler Flange Gasket	
	19332	Washer for Shutoff Valve & for Bayonet Oil Gauge-Neoprene	
	19242	Stud for Oil Base	
	19860	Exhaust Muffler	
		Crankshaft & Camshaft Group	
	8001F	Crankshaft Gear - Fibre	
	19006	Crankshaft	
O-711-N	19003	Crankshaft Oil Seal (#50358 - National)	
	19011	Crankshaft Bearing - Front & Rear	
	19079	Crankshaft Gear Nut - Nickel Plated	
	19080	Camshaft	
	19082	Camshaft Gear Spacer Washer	
	19083	Camshaft Bearing - Front (Marlin Rockwell - 204 SFG)	
	19086	Camshaft Gear - Steel	
	19088	Rear Camshaft Bearing	
		Valve Group	
	8032	Valve Spring Retainer Washer Lock Pin	(4 used)
	8037	Valve Tappet Screw - 1/4" x 3/4" SAE	(4 used)
	19030	Valve - Intake	(2 used)
	19029	Valve - Exhaust	(2 used)
	19031B	Valve Guide	
	19032	Valve Spring	
	19033	Valve Lifter	
	19034	Valve Seat Insert	
	19035	Valve Spring Retainer Washer	
	19183	Valve Box Cover - Cast - Aluminum	
O-711-D	19184	Valve Box Cover Gasket	
		Governor Group	
	8043-1	Governor Cup Stop Screw	
	8058	Governor Spring Adjusting Nut	
	19102	Governor Shaft Bearing Spacer	
	19142	Governor Shaft & Paddle	
	19114	Governor Flyball - 3/8" Steel Ball	
	19118	Governor Cup Stop Screw Spacer	
	19096	Governor Cup and Stud Assembly	
	19121	Governor Spring Adjusting Stud	
	19124	Governor Spring	
	19126	Bearing - ND38	
	19127	Bearing - NDWC8103	
	19129	Governor to Carburetor Connecting Link	

W.E. PART SYMBOL	PART NO.	PART NAME
Governor Group (Cont'd)		
	19131	Governor Adjusting Stud
	19140	Governor Arm
	19144	Governor Pump Bearing
O-711-K	19479	Gasket for Governor Spring Bracket & Cover
	19481	Governor Spring Bracket & Cover
		Magneto Breaker & Gearcase Group
O-711-R	19382	Gearcase Oil Seal (Graphite Cork)
	8408A	Magneto Coil Shoe (Laminated)
	8410	Magneto Coil - Right
	8441	Ignition Breaker Arm Stud
	12013	Breaker Arm Spring
E-713-A	12014	Ignition Breaker Arm with Pt. and Shunt Wire
	12020	Breaker Spring Bracket
	19306B	Gearcase - Cast Aluminum
	19305	Ignition Wire Shield Nipple
O-711-P	19312	Gearcase Gasket
	19340	Ignition Breaker Plate
	19341	Ignition Breaker Plate Cover
	19342	Breaker Plate Mounting Strip
	19343	Contact Strip Insulator
	19344	Breaker Plunger
		1/2" SAE Nut (Hex) Magneto Wheel to Crankshaft
		1/2" Lockwasher-Magneto Wheel to Crankshaft
	5944	Ignition Wire Shield Lock Nut
	5945	Ignition Wire Shield Knurled Nut
	19403A	Magneto Wheel Assembly
	19410	Duplex Magneto Back Plate
C-711	19411	Magneto Capacitor .5 MFD.
	19412	Magneto Coil - Left Side of Engine
	19373	Spark Plug Cable - L.H.
	19374	Spark Plug Cable - R.H.
	19415	Magneto to Breaker Condenser Lead
	19416	Magneto Primary Stop Wire - Man
	19417	Magneto Primary Stop Wire - S.S.
E-711	19850	Spark Plug - Champion #J-10 - Left
E-712	19850	Spark Plug - Champion #J-10 - Right
	19853A	Spark Plug Shield Assembly
		Oil System Group
	10702	Oil Drain Pipe Plug - 3/8"
	W7100X4	Oil Lines Compression Nut
	19285	Oil Base - Cast Aluminum
	19297	Oil Filler Cap - Briggs & Stratton
	19297B	Oil Filler Cap Gasket
	19298	Oil Filler Bayonet Gauge

Oil System Group (Cont'd)

W.E. PART SYMBOL	PART NO.	PART NAME
	19289A	Flexible Oil Drain Assembly
	75749	Oil Outlet Elbow - (Street Elbow 90° 1/2" P.Thd.)
	19357	Oil Pump Body
	19358	Oil Pump Cover
O-711-Q	19359	Oil Pump Gasket
	19360	Oil Pump Drive Shaft
	19361	Oil Pump Idler Shaft
	19362	Oil Pump Drive Gear
	19363	Oil Pump Gear - Driver
	19364	Oil Pump Gear - Driven
	19365	Oil Pump Stud
	19366	Gear Drive Pin
	19367	Oil Pump Intake Cup
	19368	Oil Pump Screen
	19369	Oil Pump Gear Pin
	19349	Oil Pump Screen Retaining Wire
	12273	Oil Pump By-Pass Body
	12276	Oil Pump By-Pass Bolt 3/8" x 3/4" SAE
	19379	Oil Pump By-Pass Deflector Cup
	12272	Oil Pump By-Pass Plunger Spring
	12275	Oil Pump By-Pass Spring

Cylinder Group

	19089	Cylinder Head - Right Hand - Aluminum
	19090	Cylinder Head - Left Hand - Aluminum
O-711-A	19091	Cylinder Head Gasket - Copper Asbestos
	19170	Cylinder - 2-1/2" Bore - R.H.
	19171	Cylinder - 2-1/2" Bore - L.H.
O-711	19172	Cylinder Base Gasket - 2-1/2" Bore
	19185	Stud for Cylinder Head
	19186	Cylinder Sleeve - 2-1/2" Piston
	19244	Stud for Cylinder Base
O-711-F	19276	Oil Base Gasket

Crankcase & Bearing Support Group

	19021	Bearing Plate & Generator Support
O-711-B	19022	Bearing Plate& Generator Support Gasket
	19230	Crankcase Breather Housing
	19231	Crankcase Breather Shut-Off Valve Shaft
	19233	Shut-Off Valve Washer - Steel - for Breather Housing.

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W.E. PART SYMBOL	PART NO.	PART NAME
		Crankcase & Bearing Support Group
	19234	Breather Housing Flange Seat
	19243G-2-1/2	Crankcase Assembly with Bearings Fitted
	19249B	Breather Housing Screen Assy. -Dull nickel Plated
	19256	Gasket for Crankcase Breather Housing
		Carrying Handle & Mounting Base Group
	19274	Intake Manifold and Carrying Handle
	19278A	Mounting Foot with Vibration Dampener Insert
	19283	Mounting Base - Saddle Type
	19846	Carrying Handle Grip
		Carrying Case Group
	19900	Water Tight Plant Cover
	19901	Plant Cover Base
	19902	Plant Cover & Base Gasket
	19903	Carrying Case Clamp Screw Nut
		Air Cleaner Group
	19960	Air Cleaner
	19961	Air Cleaner Screen
	19962	Air Cleaner Screen Lock Ring
12-123.		**Control Box Parts**
	1412B	Rheostat Knob
K-701	76560A	Reverse Current Relay Assembly - Complete
	1446A	Reverse Current Relay Armature Blade Assembly
	1448A	Reverse Current Relay coil & Core Assy. (PS1065)
	1553A	Reverse Current Relay Stationary Contact Panel (with CONTACTS)
	1630	Reverse Current Relay Armature Return Spring
	1646	Reverse Current Relay Frame Only
	19710	Control Box Base
	19712	Control Box Brace
	19711A	Control Box Cover - (Includes Receptacle Covers & Chains)
R-701	76808	Rheostat - Model K -1 Ohm - Ohmite
M-701	76809	Ammeter - 0-20 - U. S. Gauge Co.
L-701	76810	Reactor - 4XL2 - Wright De Coster
C-701	76812	Capacitor #F.C. 91137 - 2000 MFD -25 W-V (Mallory)
F-701	76813	Fuse-25 Amp. Type AB CAT.1098B - Littelfuse (2 used)
F-702	76814	Fuse-15 Amp. Type AB CAT.1996B - Littelfuse (2 used)

W.E. PART SYMBOL	PART NO.	PART NAME
P-703	76805	Transmitter Receptacle (W.E. T-7604797)- Group 6 (P703) A. J. Ulmer.
P-704	76806	Battery Receptacle (W.E. - T-7604797) - Group 6 (P704) A. J. Ulmer
P-701	76807	Receptacle - 1102 #7792 - Less Plate -Arrow
P-702	76807	Receptacle - 1102 #7792 - Less Plate -Arrow

12-124. Generator & Accessories

E-701	840	Gen. Brush - M30 A - Pure Carbon Co.5/8" (4 used)
C-702)	76811	Capacitor - Type 3L-Cornell Dubilier-.01MFD
C-703)		(4 used)
C-704)	842	Brush Spring (4 used)
C-705)	1160	Brush Guide Only - Right Hand 5/8" (4 used)
	19508	Gen. Thru Stud Nut
	19509	Gen. Thru Stud
	19520	Armature Thru Stud Nut
	19521	Armature Thru Stud Nut Lock Washer
	19525	Armature Thru Stud
	19546	Generator Frame - With Field Coils
	19578	Generator Blower
	19655	Brush Rig Insulator Ring Only
(19655 Assy.)		Brush Rig - Complete with Brushes
	19657	A.C. Connector Bracket (4 used)
	19679	Generator End Bell Housing
	19692	Generator End Bell Band
	19377	Generator Bearing Grease Cover Gasket
	75085	Armature Assembly - Complete
	75086	Armature Shaft
(75224 Assy.)		Pole Shoe Assembly (with winding)
	75370	Commutator Assembly - 36 Bar
(76827 Assy.)		Generator Field Coil Assembly
	76828	Brush Jumper Lead (2 used)

MOTOR GENERATOR SET TYPE CDO-21652

General

12-125. The MOTOR GENERATOR SET TYPE CDO-21652 is for operation on 115/230 volts, single phase, 25 cycle A. C. power supplies. The generator will deliver approximately 1000 watts, 120 volts, 800 cycles, single phase, A.C. and 20 amperes, 14 volts, D. C. This unit consists of a Type CAY-21653 MOTOR, Type CDO-21650 GENERATOR and Type CAY-21654 MAGNETIC CONTROLLER assembled on a bed-plate.

Location

12-126. When planning the location of the MOTOR GENERATOR SET a place should be selected that will be as clean and dry as possible. Although the unit is protected against normal exposure, it is desirable to shelter it as much as practicable. Locations of high humidity are undesirable and should be avoided as far as possible. Keep in mind that the unit can be operated by remote control so that it is not necessary to install it at the spot where the load or load panel is located.

Mounting

12-127. The motor generator set does not need to be mounted in any particular way, but it is suggested that rubber cushioning pads be placed under the welded steel mounting base to eliminate the possibility of vibration being transmitted to the floor of the building.

Setting Up the Unit for Operation

12-128. When the set has been located and mounted, the next step is to connect the motor to the power line. The connecting lines should be run through conduit or flexible cable to the starting box located on the motor. Be sure that the motor and the motor controls are connected for use at the voltage of the power line.

12-129. When changing the motor operation from 115 volts to 230 volts, four changes in the electrical circuit must be made.

1. Reconnect the motor terminals as shown on the motor nameplate and on Figure 56.

2. Reconnect the holding coil on the starting relay as is shown on the sketch inside the MAGNETIC CONTROLLER starting box and in Fig. 55.

3. Change the overload heater element to correspond to rated current.

4. Change the pilot light in remote start-stop station.

12-130. The motor is provided with two sets of windings, which are connected in parallel for 115 volt operation and in series for 230 volt operation. Be sure that the proper connections are made before starting the unit.

12-131. The holding coil in the starting relay is also provided with two sets of windings, which are connected in parallel for 115 volts and in series for 230 volts. This coil will burn out if operation is attempted at 230 volts when the connection is made for 115 volts.

12-132. The overload heater units in the controller box must be changed when the motor input voltage is changed, because rated current at 115 volts is twice that at 230 volts, necessitating two heater elements, one rated to carry twice the current of the other.

12-133. The pilot light in the remote start-stop station must be changed as the motor input voltage is changed, since the light operates across the line, indicating when the unit is in operation.

Starting the Set

12-134. When the motor has been connected to the line through the magnetic controller, and the generator has been connected to the load panel, the set may be started. Watch the starting of the unit carefully, especially the first time that it is used, to be sure that the proper connections have been made. If the unit fails to start or fails to come up to speed:

1. Push the stop button.
2. Carefully check all connections.
3. Check the voltage of the power line
4. Check the load on the generator to make sure that the unit is not overloaded.

12-135. If the unit starts, but fails to come up to speed, after making sure that the generator is not overloaded, check the line voltage while the set is running, for it is possible to have rated voltage when the set is stopped, but if the power line is too light, the load will materially reduce the voltage at the motor after the unit has been started.

12-136. The thermal element which protects the motor in case of overloads is a heater element that expands when more than rated current flows through it. This breaks the current of holding coil, thereby opening the line contacts and stopping the motor. The MOTOR GENERATOR SET may be started again after waiting about a minute for thermal overload element to cool off. After an interruption by the overload unit, the reset button on the starting box must be pressed, and then the unit may be started by pressing the start button.

Lubrication

12-137. Both the motor and the generator are ball bearing type machines and are properly lubricated at the factory. In ordinary service, the unit will run for one year as received, but it is recommended that a small quantity of Navy Grade A grease be added every six months to maintain an even lubricating condition in the motor bearings. The generator bearings will require lubrication only once each year. The bearing on the drive end of the generator is greased by removing the plug and inserting a pressure fitting. The equivalent of not more than three teaspoonfuls of grease should be added. The commutator end bearing of the generator is greased by removing the cover which is held in place by two screws. The snap wire from the outer race of the bearing is removed, which allows the grease shield to be taken out. Grease is then pressed into the bearing by hand.

12-138. When overhauling this set, the bearings and enclosures should be washed with carbon tetrachloride or a similar solvent to remove the residue of soap which is left from the grease. If it is necessary to remove a bearing, pressure should be applied against the inner ring of the bearing.

Motor Generator Set Operation

12-139. The motor will operate satisfactorily with a 10% variation in voltage, a 5% variation in frequency, or a combined voltage and frequency variation of 10%. Low voltage reduces the torque. Guard against this condition. High voltage lowers the power factor and generally increases the temperature rise.

12-140. A thin black film will form on the commutators shortly after the set has been put into service. This is a normal condition and assists in commutation. It should not be removed except as required to clean the commutator of other foreign material. The carbon brushes supplied with this set have been carefully selected for this particular service and for best results only this make and grade should be used.

12-141. The units should be inspected at regular intervals, noting particularly that the mounting bolts, bracket bolts and pulleys are tight, and that the bearings are properly lubricated. Increase in operating temperature, localized heating, or excessive noise indicates approaching failure, and should be investigated at once.

12-142. It is desirable to thoroughly clean both motor and generator at intervals of one or two years, but it is not essential unless the unit is operating in an atmosphere containing dust or lint.

12-143. The commutator and slip rings should be kept smooth and clean of all materials except the thin black film referred to previously. Ordinarily they will require only an occasional wiping with a coarse duck cloth. Fine sandpaper can be used, but never use emery cloth or emery paper.

Generator Construction

12-144. The generator is identical to the unit described in Paragraphs 12-79 to 12-91 electrically and the only mechanical difference is that an end bell is used in place of the adaptor ring used with the Type CDO-73004-A ENGINE GENERATOR SET. A shaft extension and double V belt pulley are used as a driving means.

Motor Construction

12-145. The driving motor for the MOTOR GENERATOR SET is designed for operation from a 115/230 volt, single phase, 25 cycle A.C. supply. The motor is rated at 3 H.P., 1425 RPM, continuous duty, 40°C. rise. Ball bearings are provided, and drip-proof construction is used.

12-146. This motor is of the repulsion start-induction run type. The stator is two-pole wound and arranged for series-parallel connection to provide for dual voltage operation. The armature is two-pole wound with connections brought to a commutator. A pair of brushes are short circuited and during the starting period operation as a repulsion motor is obtained.

12-147. Before the motor reaches rated speed, a short circuiting device operated by centrifugal force acts to short circuit all of the commutator bars on the armature. The motor now operates as a single phase induction motor. The motor brushes carry current only during the starting period and therefore no radio frequency disturbances are produced by the motor to cause interference in near-by radio receivers.

12-148. Four leads are brought out to the motor terminal box and connections can be made for operation from either 115 volt or 230 volt, 25 cycle, single phase A.C. supply.

12-149. The motor is coupled to the generator by means of a V belt drive system. Two V belts are required with each MOTOR GENERATOR SET. The pulley ratio is such that with the driving motor running at rated speed, the generator speed is approximately 2666 RPM, resulting in an output frequency of 800 cycles.

Parts for Motor Generator Set Type CDO-21652

12-150. The Type CDO-21652 MOTOR GENERATOR SET is comprised of the following:

Type CAY-21653	MOTOR
Type CDO-21650	GENERATOR
Type CAY-21654	MAGNETIC CONTROLLER
	Bed Plate

12-151. Control Box Parts

W.E. PART SYMBOL	PART NO.	PART NAME
	1412B	Rheostat Knob
	1446A	Reverse Current Relay Armature Blade Assy.
	1448A	Reverse Current Relay Core Assy.(PS-1065)
	1553A	Reverse Current Relay Stationary Contact Panel (with contacts)
	1630	Reverse Current Relay Armature Return Spring
	1346	Reverse Current Relay Frame Only
	19710	Control Box Base
	19712	Control Box Brace
	19713	Control Box Cover
K-801	76560	Reverse Current Relay Assy. (Complete)
R-801	76808	Rheostat - Model K - 1 Ohm - Ohmite
M-801	76809	Ammeter - 0-20 - U.S. Gauge Company
L-701	76810	Reactor - 4XL2 - Wright de Coster
C-801	76812	Capacitor - #E.P. 91137 - 2000 MFD. - 25 W-V (Mallory)
F-802	76814	Fuse - 15 Amp. - Type AB Cat.#1096B-Littelfuse
F-801	76813	Fuse - 25 Amp. - Type AB Cat.#1098B-Littelfuse
P-802	76819	Transmitter Receptacle - A. J. Ulmer
P-801	76820	Battery Receptacle - A. J. Ulmer
	76826	Terminal Block Assy.

12-152. Motor Generator and Accessories

W.E. PART SYMBOL	PART NO.	PART NAME
B-801	840	Gen. Brush - Pure Carbon Co.(M30A)5/8" (4 used)
	842	Brush Spring (4 used)
	1160	Brush Guide Only - Right Hand 5/8" (4 used)
	19508	Generator Thru Stud Nut
	19509	Generator Thru Stud
	19520	Armature Thru Stud Nut

W.E. PART SYMBOL	PART NO.	PART NAME
	19521	Armature Thru Stud Nut Lock Washer
	19525	Armature Thru Stud
	19546	Generator Frame - With Field Coils
	19578	Generator Blower
	19655	Brush Rig Insulator Ring Only
	(19655 Assy.)	Brush Rig - Complete with Brushes
	19657	Connector Bracket (4 used)
	19679	Generator End Bell Housing
	19692	Generator End Bell Band
	19677	Generator Bearing Grease Cover Gasket
	75080	Motor Generator Unit Base
	75081	Belt Guard
	75082	Generator Base
	75085	Armature Assy. - Complete
	75086	Armature Shaft
	75087	Generator Adapter Shaft
	75088	Generator Adapter End Bell
	75089	Generator Adapter End Bell Bearing Plate
	75090	Generator Shaft Guard
	75098	Belt Guard Brace
	75100	Generator Lifting Eye Bolt
	(75244 Assy.)	Pole Shoe Assy. (With Winding)
	75370	Commutator Assy. -36 Bar
C-802) C-803) C-804) C-805)	76811	Capacitor - Type 3 L, Cornell-Dubilier .01 MFD (4 used)
	(76827 Assy.)	Generator Field Coil Assy.
	76828	Brush Jumper Lead (2 used)
	76830	Motor Generator Driven Pulley - 2 Sec. A Groove 3.2" Bore 1"
	76831	Motor Generator Driven Pulley - 2 Sec. A Groove 4.8" Bore 1"
	76832	V Belt A. Sec. A-35 Static Free (2 used)
	76835	Ball Bearing (Gen. End Bell) XB-86-X - Norma Hoffman
	76836	Ball Bearing (Gen. Adapter Shaft) 43606J Norma Hoffman
		**********
	76818	Push Button Station W.E. Cat. #1033369 Surface Mounting - Type H.D. - W.E.
	76821	Magnetic Controller W.E. Cat. #S.O.3-C-4210
	76837	Motor W.E. Cat. #S.O.3-C-4202

MOTOR GENERATOR SET TYPE CDO-21648

General

12-153. The MOTOR GENERATOR SET Type CDO-21648 is for operation on 115/230 volt, 60 cycle, single phase A.C. power supplies. The generator will deliver approximately 1000 watts, 120 volts, 800 cycles, single phase, A.C. and 20 amperes, 14 volts, D. C. This unit consists of a Type CAY-21649 MOTOR, a Type CDO-21650 GENERATOR, and a Type CAY-21651 MAGNETIC CONTROLLER assembled on a bedplate.

12-154. The operating and service instructions as given in Paragraphs 12-125 to 12-149 will apply to this MOTOR GENERATOR SET except for the electrical and mechanical details of MOTOR Type CAY-21649. These differences are given below.

Motor Construction

12-155. The driving motor for operation on 115/230 volts, single phase, 60 cycle A.C. supply is similar to the motor for operation on 115/230 volts, single phase, 25 cycle A.C. supply described in paragraph 12-145 except as follows:

1. The rated speed is 1750 R.P.M.
2. The stator and armature are wound for four pole operation.
3. A different pulley ratio is used in the "V" belt drive system to provide a generator speed of 2366 R.P.M. with a motor speed of 1750 R.P.M.

PARTS FOR MOTOR GENERATOR SET, TYPE CDO-21648

12-156. The Type CDO-21648 MOTOR GENERATOR SET is comprised of the following:

Type CAY-21649 MOTOR
Type CDO-21650 GENERATOR
Type CAY-21651 MAGNETIC CONTROLLER
_____ Bed Plate

12-157. Control Box Parts

W.E. PART SYMBOL	PART NO.	PART NAME
	1412B	Rheostat Knob
	1443A	Reverse Current Relay Armature & Blade Assy.
	1448A	Reverse Current Relay Coil & Core Assy. (PS-1035)
	1553A	Reverse Current Relay Stationary Contact Panel (with Contacts)
	1630	Reverse Current Relay Armature Return Spring
	1646	Reverse Current Relay Frame Only
	19710	Control Box Base
	19712	Control Box Brace
	19713	Control Box Cover
K-801	76560	Reverse Current Relay Assy.-Complete
R-801	76808	Rheostat - Model K, 1 ohm - Ohmite
M-801	76809	Ammeter - 0-20 - U.S. Gauge Company
L-801	76810	Reactor - 4XL2 - Wright de Coster
C-801	76812	Capacitor - #E.P. 91137 - 2000 MFD - 25 W. V. (Mallory)
F-801	76813	Fuse - 25 Amp. Type AB Cat.#1098B- Littelfuse Co.
F-802	76814	Fuse - 15 Amp. Type AB Cat.#1096B- Littelfuse Co.
P-802	76819	Transmitter Receptacle - A. J. Ulmer
P-801	76820	Battery Receptacle - A. J. Ulmer
	76826	Terminal Block Assy.

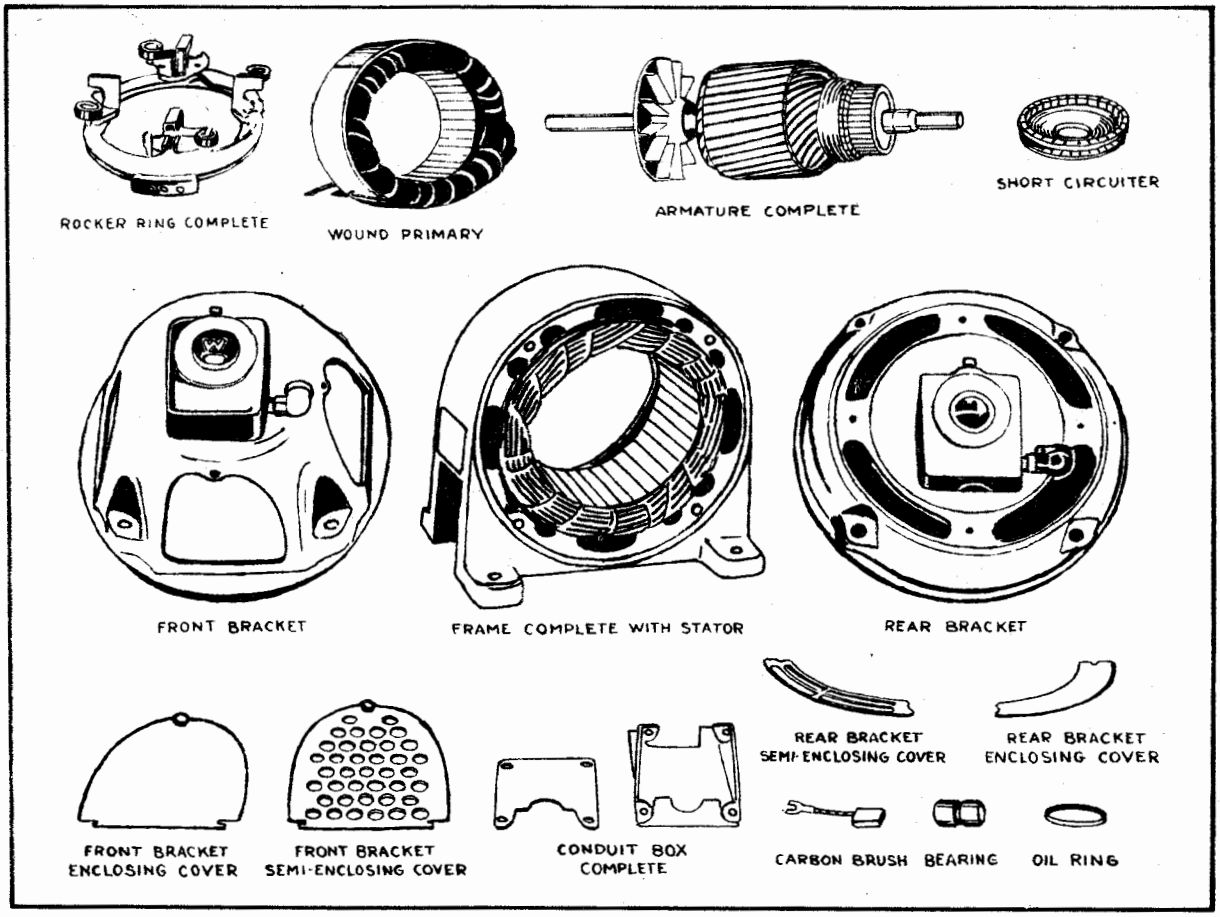
12-158. Motor Generator and Accessories

E-801	840	Gen. Brush - Pure Carbon Co.(M30A)5/8" (4 used)
	842	Brush Spring (4 used)
	1160	Brush Guide Only - Right Hand 5/8" (4 used)
	19508	Gen. Thru Stud Nut
	19509	Gen. Thru Stud
	19520	Armature Thru Stud Nut
	19521	Arm. Thru Stud Nut Lock Washer
	19525	Arm. Thru Stud
	19546	Gen. Frame - With Field Coils
	19578	Gen. Blower
	19655	Brush Rig Insulator Ring Only
(19655 Assy.)		Brush Rig - Complete with Brushes
	19657	AC Connector Bracket (4 used)
	19679	Gen. End Bell Housing
	19692	Generator End Bell Band
	19677	Gen. Bearing Grease Cover Gasket
	75080	Motor Generator Unit Base
	75081	Belt Guard

W.E. PART SYMBOL	PART NO.	PART NAME
	75082	Generator Base
	75085	Armature Assy. - Complete
	75086	Armature Shaft
	75087	Generator Adapter Shaft
	75088	Generator Adapter End Bell
	75089	Generator Adapter End Bell Bearing Plate
	75090	Generator Shaft Guard
	75098	Belt Guard Brace
	75100	Gen. Lifting Eye Bolt
	(75224 Assy.)	Pole Shoe Assy. (With Winding)
	75370	Commutator Assy. - 36 Bar
C-802) C-803)	76811	Capacitor Type 3L - Cornell-Dubilier .01 MFD (4 used)
C-804) C-805)	(76827 Assy.)	Gen. Field Coil Assy.
	76828	Brush Jumper Lead (4 used)
	76833	Driver Pulley 2 Sec. A Groove 5.4" Bore 1"
	76834	Driver Pulley 2 Sec. A Groove 3.0" Bore 1"
	76832	V Belt - Sec. A-35- Static Free (2 used)
	76835	Ball Bearing - (Gen. End Bell) XB-86-X Norma Hoffman
	76836	Ball Bearing - (Gen. Adapter Shaft) 43606J - Norma Hoffman
		**********
	76818	Push Button Station W. E. Cat. #1033369 Surface Mounting - Type H.D. - W.E.
	76821	Magnetic Controller W. E. Cat. #S.O.3-C-4210
	76838	Motor W. E. Cat. #S.O.3-C-4209

CF-377

A. RENEWAL PARTS FOR TYPE CR MOTORS



5-TYPE CR MOTORS

FRAME # F 225

2 H.P. 1750 R.P.M. 115/230 VOLTS-1 PHASE-25 CYCLES

S.O.3.C. 4202

82-TYPE CR MOTORS

FRAME # F-225

2.25/3 HP-1750 RPM 115/230 VOLTS 1 PHASE-50/60 CYCLES

S.O.3.C.-4209

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5 - TYPE CR MOTORS

Frame #F-225

2 HP - 1750 RPM - 115/230 Volts - 1 Phase - 25 Cycles

S.O.3-C-4202

The following is a list of the Renewal Parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions caused by breakdowns.

ORDER PARTS BY DESCRIPTION AND STYLE NUMBER AND GIVE COMPLETE NAME PLATE READING.

Description of Part	Style No.	No. Per Unit	Units in Use: Recommended For Stock
Armature Complete	S.O.3C4202	1	0
Commutator	755875	1	0
Short Circuiter	987467	1	0
Spring	572899	1	0
Stator Coil - Nema #ANN	L-384178	24	24
Cut Winding Insulation - Class #1 for above coil	.....	1	1
Brush	970360	2	60
Rocker Ring	755896	1	0
Rocker Ring only	755620	1	0
Brushholder	294156	2	1
Brushholder Spring	770421	2	1
Front Bracket	768833	1	0
Front Ball Bearing	664648	1	1
Front Cartridge	896271	1	0
Front Cartridge Cap	896270	1	0
Rear Bracket	S.O.3C4202	1	0
Rear Ball Bearing	664646	1	1
Rear Cartridge	896271	1	0
Rear Cartridge Cap	896270	1	0

Parts indented are included in the part under which they are indented

FORM 13848 L
PRINTED IN U.S.A.

82 - TYPE CR MOTORS

Frame #F-225

2.25/3 HP - 1750 RPM - 115/230 Volts - 1 Phase - 50/60 Cycles

S.O.3-C-4209

The following is a list of the Renewal Parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions caused by breakdowns.

ORDER PARTS BY DESCRIPTION AND STYLE NUMBER AND GIVE COMPLETE NAME PLATE READING.

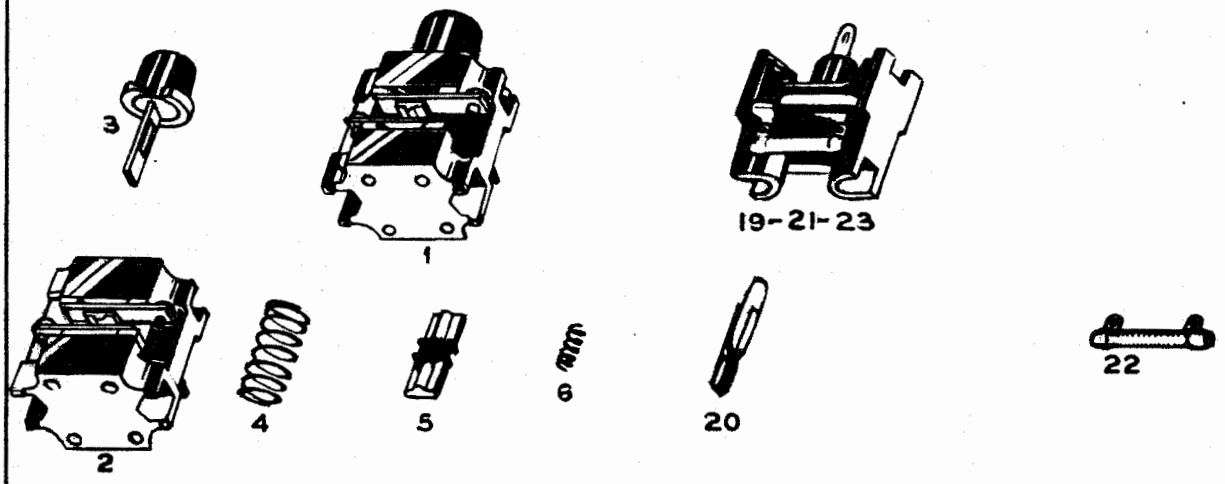
Description of Part	Style No.	No. Per Unit	Units in Use Recommended For Stock
Armature Complete	S.O.3C4209	1	4
°Commutator	1134375	1	0
Short Circuiter	987471	1	0
Spring	673180	1	0
Stator Coil - Nema #ANN	L-304083	36	144
Cut Winding Insulation - Class #1 for above coil	.....	1	4
Brush	1090819	4	1376
Rocker Ring	1134381	1	0
Rocker Ring only	1134380	1	0
Brushholder	1134379	4	4
Brushholder Spring	1124412	4	8
Front Bracket	768833	1	0
Front Ball Bearing	664648	1	6
Front Cartridge	896271	1	0
Front Cartridge Cap	896270	1	0
Rear Bracket	S.O.3C4209	1	0
Rear Ball Bearing	664646	1	6
Rear Cartridge	896271	1	0
Rear Cartridge Cap	896270	1	0

°Undercut Mica 1/16"

Parts indented are included in the part under which they are indented

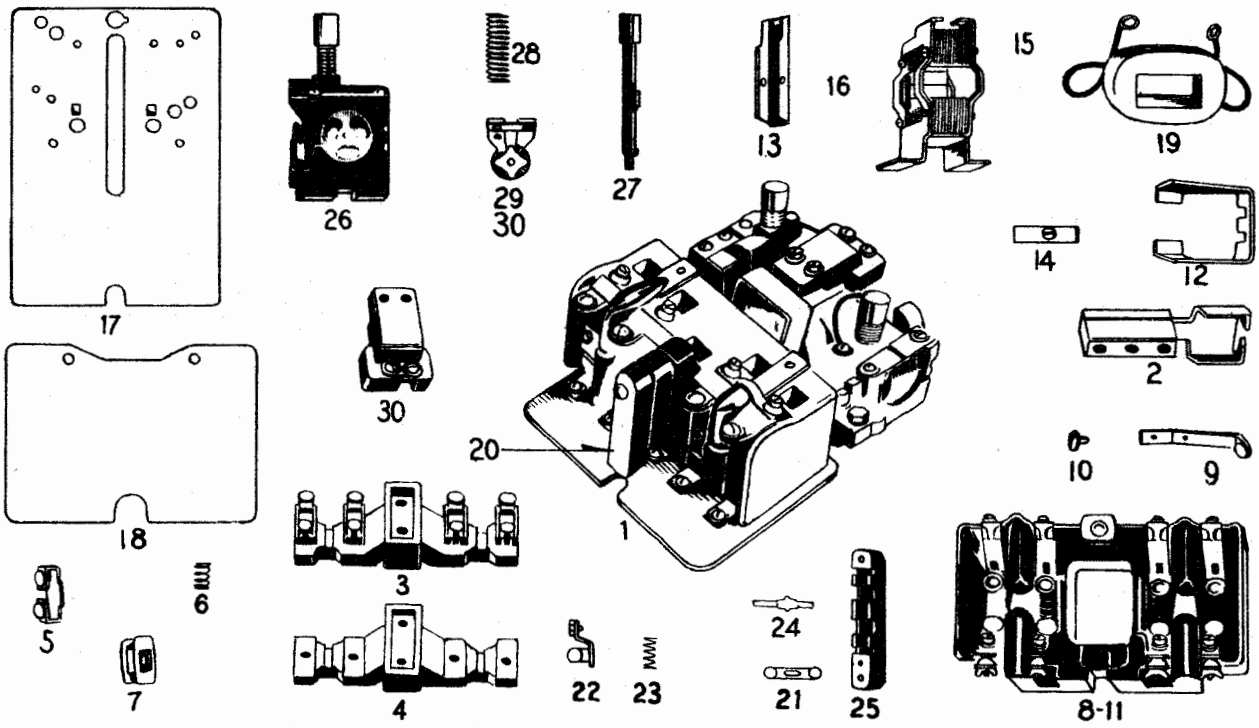
FORM 13848 L
PRINTED IN U.S.A.

B. PUSH BUTTON STATION PARTS



REF NO.	DESCRIPTION OF PART	NO. PER UNIT	STYLE NO.
1	Push Button Unit (125 Volt) (Red ..... (Black	1	1 032 881 1 032 888
2	Stationary Part with Contacts.....	1	1 092 400
3	Plunger (Red..... (Black.....	1	1 032 860 1 032 867
4	Plunger Spring.....	1	1 032 855
5	Moving Contact.....	1	1 032 853
6	Moving Contact Spring.....	1	1 032 854
19	Receptacle (125 Volt) with Lamp..... Receptacle (250 Volt) with Lamp.....	1	1 032 914 1 032 915
20	Lamp (125 Volt)..... Lamp (250 Volt).....	1	822 314 822 314
21	Receptacle Without Lamp (125 Volt)..... Receptacle Without Lamp (250 Volt).....	1	1 032 361 1 032 916
22	Resistor Tube (125 Volt)..... Resistor Tube (250 Volt).....	2	1 032 921 1 032 922
23	Receptacle without Lamp & Resistor Tubes (125 Volt). Receptacle without Lamp & Resistor Tubes (250 Volt).	1	1 072 548 1 072 548

C TYPE DN LINESTARTER, SIZE NO. 1
RENEWAL PARTS



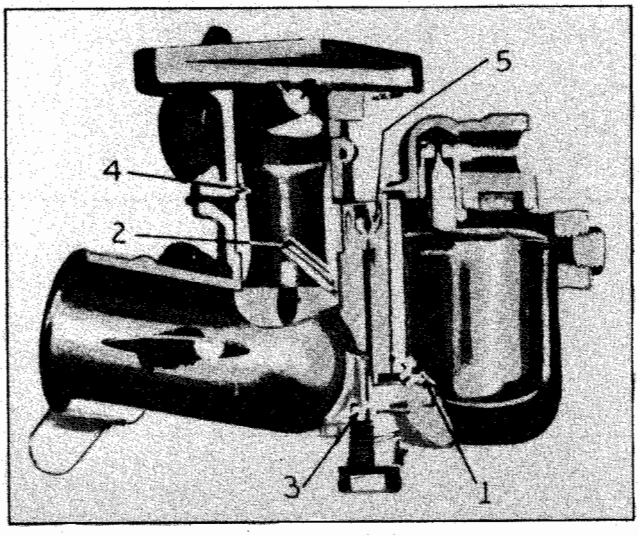
CLASS	11-200-S1	11-200-S1	
STARTER NO.	S# - 973893	S# - 973894	
MOTOR	60 CY.	25 CY	
Phase	Single	Single	Number Per Line-starter
Number of Poles	Four	Four	
Ref No. / DESCRIPTION OF PART	Style Number of Part		
1 Type Dn 140 Contactor	899 869	899 869	1
1 Type Dn 140 Contactor	968 147 ✗	968 147 ✗	1
1 Type Dn 120 Contactor	... ...	... ...	1
1 Type Dn 120 Contactor	... ...	... ...	1
2 Armature Core	899 841	899 841	1
3 Cross Bar Complete	899 838	899 838	1
4 Cross Bar	899 834	899 834	1
5 Moving Contact	899 837	899 837	4
6 Contact Spring	899 835	899 835	4
7 Moving Contact Support	899 836	899 836	4
8 Arc Box with Stationary Contact	899 833	899 833	1
9 Stationary Contacts	899 826	899 826	8
10 Washer Head Screw	665 052	665 052	8
11 Arc Box Only	1 016 994	1 016 994	1
12 Armature Stop	899 844	899 844	1
13 Armature Guide	899 842	899 842	2
14 Armature Guide Holder	899 843	899 843	1
15 Stationary Core	899 840	899 840	1
16 Shading Coil	899 839	899 839	1
17 Mounting Base	968 168	968 168	1
18 Base Insulation	899 828	899 828	1
19 Operating Coil	966 730	966 731	1
20 Type L-42 Electrical Interlock	899 851	899 851	1
21 Moving Contact	899 850	899 850	1
22 Stationary Contact	899 849	899 849	2
23 Contact Spring	899 845	899 845	1
24 Push Rod	899 848	899 848	1
25 Base	899 847	899 847	2
26 Type MW Thermal, Overload Relay.	972 879(1)	972 879(1)	2
27 Reset Push Rod	899 862(1)	899 862(1)	2
28 Push Rod Spring	899 855(1)	899 855(1)	2
29 Heater for 110V-BF 40.	1 040 590	040 590(1)	2
30 Heater for 220V-BI 21.	966 496	966 496(1)	
30 Terminal Block	899 870	899 870	1

✗ Used only in Linestarters without Cabinet.

Parts indented are included in the part under which they are indented.

( ) Figures in parenthesis indicate the Number per Linestarter.

Parts and Adjustment for
ZENITH CARBURETOR MODEL R20T



The operation of this carburetor is shown in the accompanying illustration. This shows the principal jets. The idling jet (No. 5) measures the fuel for idling speeds. The air for idling is regulated by the idling adjusting needle.

This idling system functions only when the throttle plate is almost closed, causing a very strong suction on the priming hole at the edge of the throttle plate.

The compensating jet (No. 1) is the source of fuel supply to the idling jet and as the throttle plate is opened to permit higher engine speeds, the fuel from the compensating jet flows out through the main discharge tube (No. 2). This flow remains constant, even though engine speeds increase, due to the admission of air through ventilation channel.

The main jet, (No. 3), is the high speed jet and exerts its greatest influence at higher engine speeds. It is an indirect suction jet but its flow increases with the flow of air. Its size is determined to give economical operation. Combining the characteristics of this jet with those of the compensating jet, you obtain a correctly proportioned mixture. The Venturi, No. 4, is the air metering nozzle and determines the maximum volume which may be passed through the carburetor.

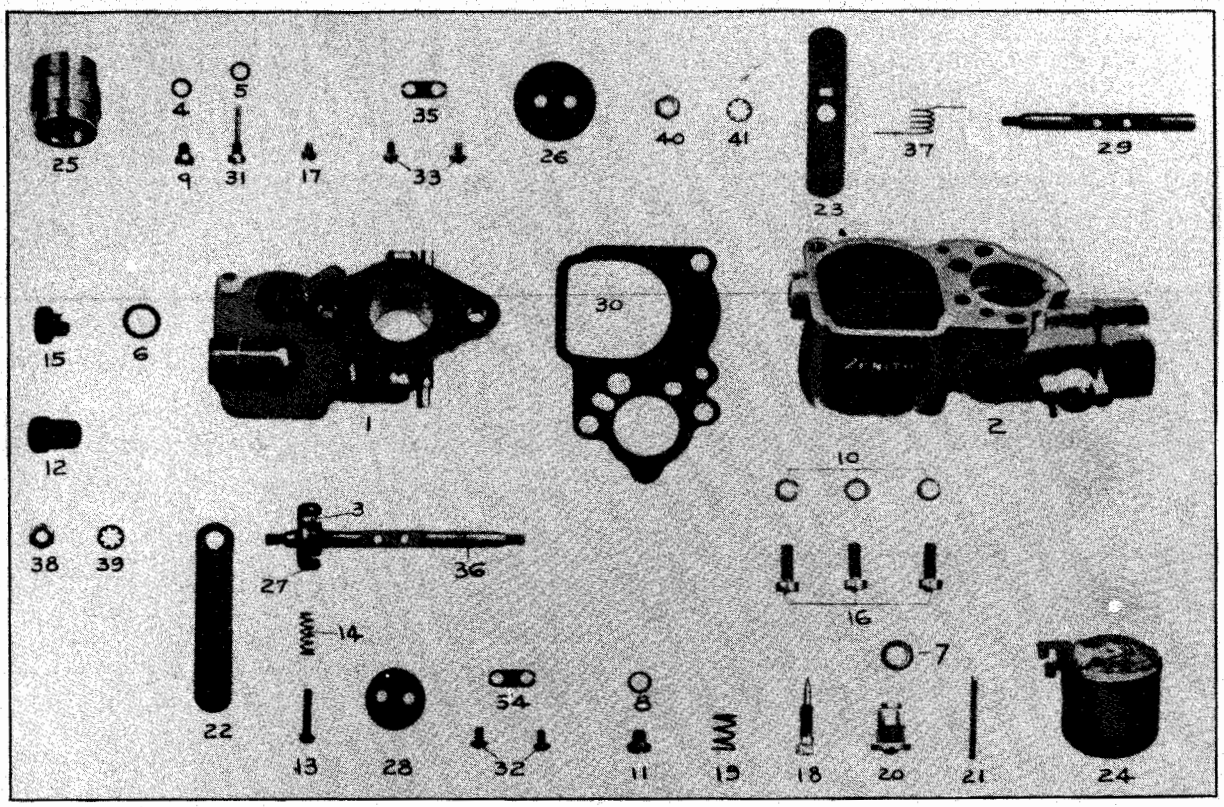
To adjust the idle set stop screw on stop lever so that engine will run sufficiently fast to keep it from stalling. Turn in or out on idling adjusting needle until engine hits evenly and without rolling or skipping. Then back off on stop screw until desired engine speed is obtained.

During the latter operation it sometimes happens that the idling needle valve can be opened a trifle, as the nearer the throttle plate is to the closed position, the greater the suction on the idle jet. The correct idling adjustment is usually found when the idling needle valve is between 1 and 3 turns. A good starting point is 1½ turns open.

The R20M carburetor is equipped with a drain pickup tube. This tube extends to the extreme bottom of the air intake and through channels has an opening just above the throttle plate. The pickup operates as soon as the motor is started, due to suction created by the motor and putting a suction on the suction jet located at the edge of the throttle plate. The pickup tube "picks up" any gasoline that has accumulated at the bottom of the air intake due to manifold condensation, over choking, etc.

Note: If carburetor is fitted with a Main Jet Adjustment the mixture is made lean by turning the adjustment clockwise and rich by turning counter clockwise.

D. Parts for Model R20T Zenith Carburetors



	R20T		R20T
1	B1866x1	Upper body assembly	$3.00
2	B1867x1	Fuel bowl assembly	3.00
3	CT63-2	Throttle stop lever taper pin	.05
4	T56-4	Compensator jet washer	.05
5	T56-4	Main jet washer	.05
6	T56-14	Lower plug washer	.05
7	T56-23	Fuel valve seat washer	.05
8	T56-24	Idle adjusting channel screw washer	.05
9	C52-1	Compensator jet (specify size)	.35
10	T41-10	Assembly screw lockwasher	.05
11	D8676	Idle adjusting channel screw (blank)	.30
12	CT91-1	Overflow plug (⅛" pipe thds.)	.10
13	T11B6-7	Throttle plate adjusting screw	.05
14	D2454	Adjusting screw spring	.10
16	T1S10-8	Assembly screw	.05
17	D8816	Idle jet (specify size)	.60
18	C46-25	Idling adjusting screw	.30
19	C111-9	Idling adjusting screw spring	.10
20	C81-2	Fuel valve and seat assembly	.60
21	C121-14	Float Axle	.10
22	D8174	Throttle lever	.15
23	D8175	Air shutter lever	.25
24	D8876	Float assembly	.65

	R20T		R20T
25	D8453	Venturi (specify size)	$ 1.10
26	D8457	Throttle plate	.50
27	D8460	Throttle stop lever	.25
28	D8810	Air shutter	.25
29	D8466	Air shutter shaft	.40
30	D8809	Bowl to body gasket	.10
31	D8469	Main jet (specify size)-	.75
32	D8472	Air shutter plate screw	.05
33	D8472	Throttle plate screw	.05
34	CR22-1	Air shutter plate screw lockwasher	.05
35	CR22-1	Throttle plate screw lockwasher	.05
36	D8462	Throttle shaft	.25
37	D8605	Air shutter lever spring	.05
38	T22S8	Throttle lever clamp nut	.05
39	T45-8	Clamp nut lockwasher	.05
40	T22S8	Air shutter lever clamp nut	.05
41	T45-8	Clamp nut lockwasher	.05
	D2888	Main jet adjustment—Not illustrated	1.25
	CR134-4	Throttle lever swivel (not illustrated)	.20
	CT52-1	Swivel washer (not illustrated)	.05
	D1134	Swivel screw (not illustrated	.05

All R20T carburetors are tagged with a round identification plate. Please specify numbers listed thereon on orders when ordering parts.

ZENITH CARBURETOR COMPANY

SUBSIDIARY OF BENDIX AVIATION CORPORATION

Manufacturers of Zenith Carburetors and Filters

696 HART AVENUE DETROIT, MICHIGAN

Prices subject to change without notice

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