AVIATION RADIO EQUIPMENT

BENDIX RADIO

DIVISION OF

BENDIX AVIATION CORPORATION

BALTIMORE, MARYLAND

U. S. A.

BENDIX AVIATION RADIO EQUIPMENT

Manufactured by

Bendix Radio Division of Bendix Aviation Corporation

Baltimore, Maryland

FOREWORD

The strictly technical nature of nearly all of the specification and descriptive data contained in these catalog pages which follow, is truly indicative of the scientific exactness with which Bendix Aviation Radio Equipment is designed and built. Its functions are far too serious—the needs which it serves are far too vital—to be discussed in general terms.

Bendix Aviation Radio Equipment is in every sense a laboratory product. Every phase of its performance is as precisely predictable as specialized science can insure. It represents the latest and most advanced progress of radio engineering, worthy of the distinguished "company" with which it travels.

The military and naval air services of many nations, including the United States and Great Britain, employ Bendix Aviation Radio Equipment in prodigious quantities and trust it thoroughly. Commercial airlines almost universally employ Bendix Radio. Pan American Airways, British Overseas Airways, and Royal Dutch Airlines rely upon its dependable service.

The functions served by Bendix Aviation Radio Equipment embrace every radio requirement of aviation. Intercommunication between airport and airplane, between airplane and airplane, among personnel within the airplane; signal transmission and reception for accurate compass-course aerial navigation; instrument landing equipment, for safe landing in low visibility.

Further information, or more detailed specifications concerning the equipment described in these catalog pages, or counsel regarding any other types of aviation radio equipment, will be gladly furnished upon request.

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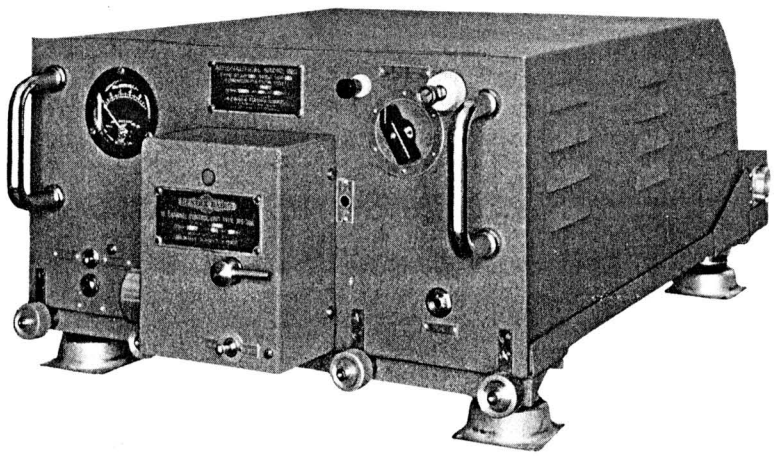
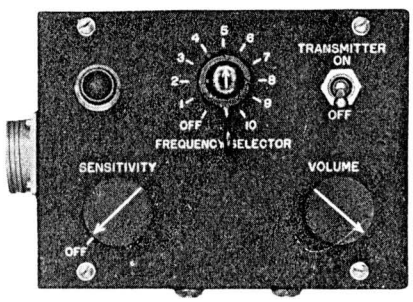


RTA-1 Transmitter-Receiver Unit



Remote Control for RTA-1

RTA-1
Transmitter-Receiver Unit

General—Basically new, the Bendix Type RTA-1 Communication Unit marks a departure from previous aircraft radio systems. Light, rugged, and compact, it combines 10 crystal-controlled receiver and transmitter channels with integral power supplies into a single unit weighing less than 75 pounds. Complete in itself, it requires only a microphone, headset, battery, and antenna to provide two-way communication. Normally designed for radio-telephone communication, the RTA-1 *can be supplied on special order to provide telegraph transmission and reception as well.*

Frequency Range—2500-13,000 kilocycles; 23-200 meters for both transmitter and receiver. On special order this range can be extended to 1500 kilocycles (200 meters).

Frequency Stability—Transmitter and receiver frequencies controlled by quartz crystals ground to within .005 per cent of specified frequency. Temperature coefficient less than 3 cycles per million per degree centigrade.

Channel Selection—Ten transmitter and ten receiver channels are available. They are selected simultaneously by a motor controlled by a ten point switch on the remote control unit.

Transmitter Specifications

Type of Emission—Radio telephone. On special order telegraph operation can be provided with remote control of received beat note.

Power Output—50 watts, 100% modulated, into a 20-ohm resistive load over the entire frequency range.

Power Requirements—Including receiver stand-by requirements while delivering a 50-watt carrier 100 per cent modulated the total power drain from either 12 or 24 volt primary power source is 462 watts.

Audio Frequency Characteristics—A 1000-cycle signal of 0.3 volts developed across the 100-ohm audio input is sufficient to produce 100% modulation of the rated carrier output.

Total harmonic distortion is less than 10% for 95% modulation. Measurements made between audio input terminals and rectified antenna current.

Receiver Specifications

Sensitivity—Two microvolts for a 4 to 1 signal-to-signal-plus-noise power ratio.

Automatic Sensitivity Control—Output remains constant within 6 decibels for inputs between 2 and 100,000 microvolts. Intelligible reception possible with inputs as high as 50 volts.

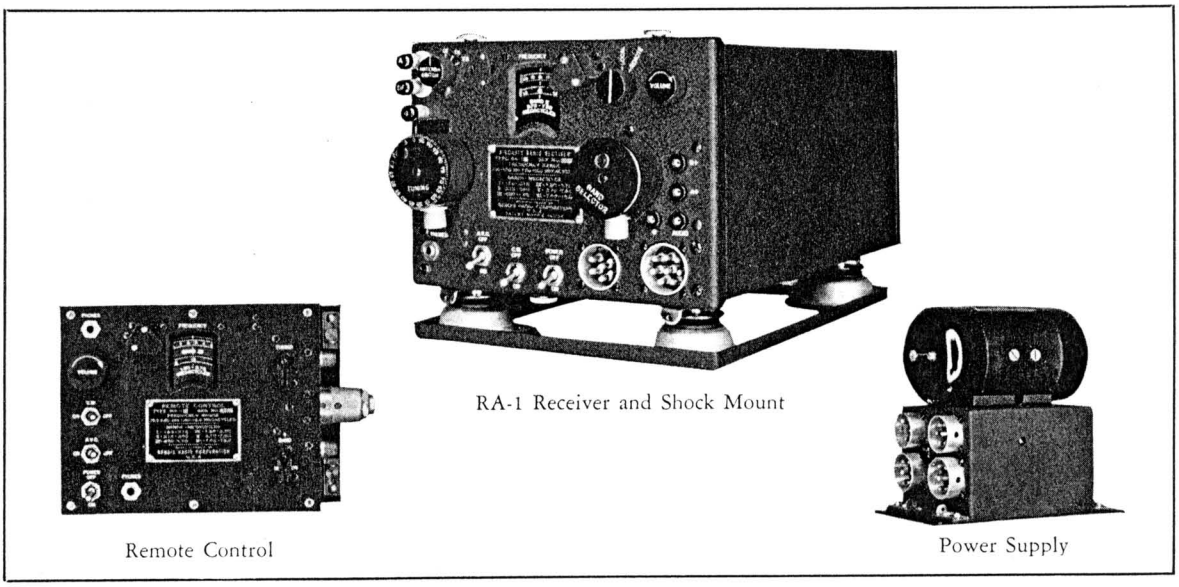
Selectivity—Less than 18 kilocycles total band width for 50 decibels attenuation. More than 4½ kilocycles total band width for 5 decibels attenuation.

Undesired Responses—More than 60 decibels below desired signal level.

Audio Frequency Characteristics—Plus-or-minus 3 decibels between 350 and 2500 cycles. Dual audio channels. Cross-talk level between channels minus 50 decibels at all audible frequencies. Output impedance 500 ohms. Output power 300 milliwatts per channel.

Power Requirements—Stand-by position, receiver only, plus 60% of transmitter heater current: 100 watts.

Remarks—Both transmitter and receiver high-frequency circuit components revolve on a single turret which may be quickly and easily removed as a unit to permit ready access to any part of the RTA-1. The number of components has been reduced to a minimum through the double utilization of those common to both the transmitter and receiver. A single antenna circuit is switched from low-voltage plate connections of the transmitter to the receiver input grid, thus resulting in lighter duty for the transfer relay. The heterodyne oscillator also serves as the transmitter oscillator and a relay merely selects the proper crystal. The transmitter and receiver crystals for each channel are combined in a single holder.



RA-1 RECEIVER

General—Recognized as the ultimate in reliability, RA-1 receivers combine precision construction with hand-picked components. Wide frequency coverage, high stability and excellent calibration accuracy have won wide acceptance of this unit as a general purpose aircraft receiver for both commercial and military operations.

Circuit—8-tube superheterodyne. Intermediate frequency 1630 kilocycles. Beat frequency oscillator included for telegraph reception. Switch provided to select fixed, trailing, or direction-finding antenna.

Frequency Range—Six calibrated bands with an overlap of approximately 2% cover either one of the two following available frequency ranges:

(A)	150- 1500 kilocycles	2000-200 meters
	1800-15000 kilocycles	166- 20 meters
(B)	150- 1500 kilocycles	2000-200 meters
	2500-20000 kilocycles	120- 15 meters

Frequency Calibration and Stability—The dial is calibrated directly in megacycles with an accuracy of 1.5% below 1500 kilocycles and 0.75% above 1500 kilocycles. This accuracy is maintained under the following conditions:

1. Any 20°C variation in temperature between minus 20°C and plus 50°C.
2. Humidity variations between zero and 100%.
3. Battery voltage variation of 15%.
4. Normal vibration as encountered in aircraft.
5. Manipulation of sensitivity control from maximum to minimum.

A mask rotates with the band-change switch and covers scales not in use. A linear scale is always visible in addition to the calibrated scale in use. This linear scale moves one main division for each revolution of the tuning crank which is calibrated from 0-100. Thus the tuning adjustment may be reset to one part in 5000. The frequency can be reset within 0.1 per cent by using a previously calibrated setting.

Control—The receiver is designed to be operated locally, using the controls mounted on its front panel, or from any remote point within the airplane through the use of the MR-1 remote control unit which includes duplicate operating controls. Calibration accuracy is not as good with remote tuning controls and local control is recommended whenever possible.

Sensitivity—The C.W. sensitivity of the receiver is 2.5 microvolts or better for a 50 milliwatt output when the volume control is adjusted to give a noise output of 5 milliwatts with no carrier input. The sensitivity of the receiver is 5 microvolts or better for the standard output of 50 milliwatts into a 300 ohm load, with a signal-to-noise power ratio of at least 4 to 1, and an input signal 30% modulated at 400 cycles.

Selectivity—The total band width in kilocycles at various reference frequencies for an attenuation of 20, 40 and 60 decibels is as follows:

	250 Kilocycles	*500 Kilocycles*	*3000 Kilocycles*
20 Decibels	10	13	20
40 Decibels	17	22	33
60 Decibels	25	30	47

Power Output—50 milliwatts with less than 10% distortion. The maximum available power is greater than 1000 milliwatts. Models are available with either 600 or 4000 ohm output impedance.

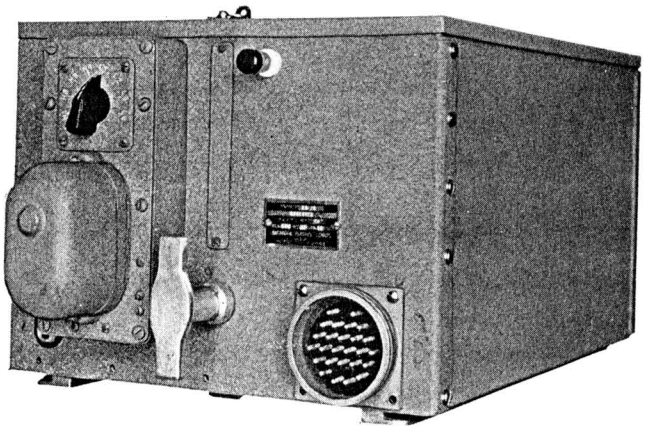
Power Requirements—Available for operation from either a 12 or 24 volt primary power source. A separate dynamotor such as the MP-5 unit is required as a high potential source. When operated with Bendix TA-2 or TA-3 transmitters the combined MP-10 transmitter-receiver power unit is often used as a source of high potential for the RA-1. The overall power consumption of the receiver is:

4.5 Amperes at 14 Volts 2.3 Amperes at 28 Volts

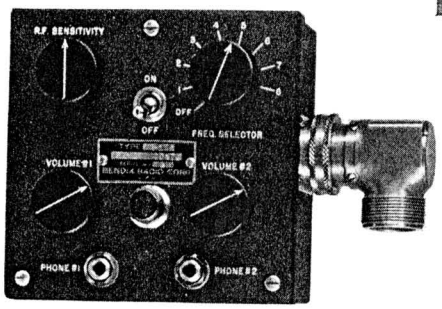
Dimensions and Weights—

RA-1 Receiver, Shockmount and Tubes	Weight—26.5 Pounds	12.0 Kilograms
Height	8⅞ Inches	22.54 Centimeters
Width	9⅞ Inches	25.08 Centimeters
Depth	16⅛ Inches	40.96 Centimeters
MR-1 Remote Control Unit	Weight— 4.4 Pounds	2.0 Kilograms
Height	7⅛ Inches	18.10 Centimeters
Width	9¾ Inches	24.76 Centimeters
Depth	3¼ Inches	8.25 Centimeters
MP-5 Power Supply Unit	Weight— 8.9 Pounds	4.0 Kilograms
Height	7½ Inches	19.05 Centimeters
Width	7⅜ Inches	18.73 Centimeters
Depth	4⅜ Inches	11.11 Centimeters

Remarks—An antenna selector switch is provided on the front panel of all RA-1 series receivers and permits the choice of operation with either a fixed or trailing antenna, or with a direction-finding shielded loop antenna. To operate with the latter, the MN-13 direction finding accessories may be employed as shown on another page of this catalog.



RA-2 Receiver



MR-14 Remote Control for RA-2 Receiver

RA-2 RECEIVER

General—The type RA-2 receiver is a highly sensitive unit designed for reception of radio telephone signals on eight pre-determined channels. It has proved its worth in service on many leading air lines.

Frequency Range—Eight crystal-controlled channels are provided; four in the range of 2600-4500 kilocycles (113-66 meters) and four between 4400 and 7000 kilocycles (68-43 meters). If desired, the receiver may be supplied with fewer than eight channels equipped. Crystals for additional channels can easily be added at a later date.

Frequency Stability—Frequency controlled by quartz crystals ground to within .005% of specified frequency. Temperature coefficient less than 3 cycles per million per degree centigrade.

Control—Complete electrical remote control facilities are provided by the type MR-14 control unit. Channels are selected by means of a remotely controlled motor-driven switch.

Sensitivity—The overall sensitivity of the receiver is one microvolt input for 50 milliwatts output on all bands, with a signal-to-noise ratio power of better than 4 to 1, when the received carrier is modulated 30%.

Image Ratio—The image ratio of the equipment is 10,000 to 1 for frequencies in the 2600-4500 kilocycle band and 5000 to 1 between 4400-7000 kilocycles.

Automatic Sensitivity Control—Amplified automatic sensitivity control maintains the output constant within 2 decibels for inputs varying between 1 and 100,000 microvolts.

Audio Characteristics—Two audio output channels are provided, each supplying 500 milliwatts at 600 ohms.

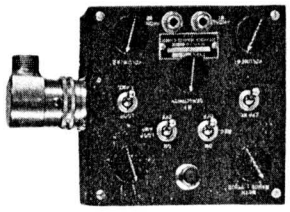
Power Requirements—The equipment is designed to operate from a 12 volt primary power source. The receiver draws 1.6 amperes at 12 volts and .065 amperes at 250 volts. The type MP-12 dynamotor power unit may be used to supply 250 volts.

Dimensions and Weights—

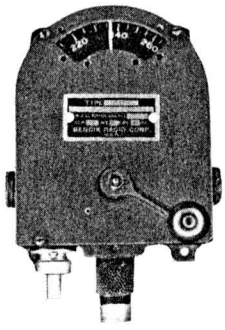
RA-2 Receiver and Projections.....23¾ pounds—10.8 kilograms
Width ..... 10½ inches—26.7 centimeters
Height ..... 8½ inches—21.6 centimeters
Depth ..... 17¾ inches—45. centimeters

Type MR-14 Remote Control Unit .....1 pound 12 ounces—.8 kilograms
Width ..... 7½ inches—19. centimeters
Height ..... 5⅛ inches—13. centimeters
Depth ..... 2½ inches— 6.4 centimeters

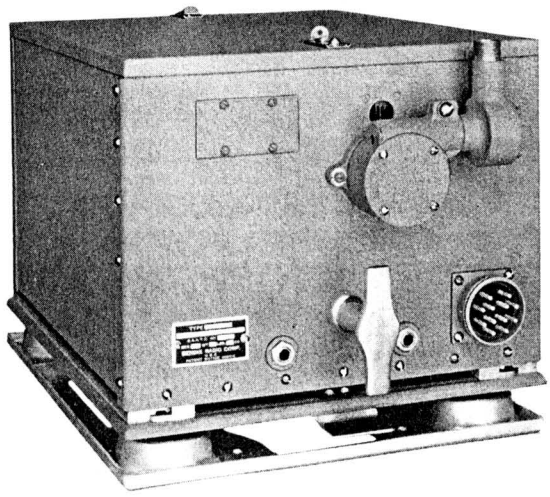
Remarks—Provision has been included to use the last audio stage as an intercommunication or transmitter sidetone amplifier by switching its input to the transmitter audio system.



MR-18 Remote Control
for RA-4 Receiver



MR-12 Remote Tuning Control



RA-4 Receiver and Shock Mount

RA-4 RECEIVER

General—The Bendix Type RA-4 aircraft receiver is designed for the reception of A-N radio range beacon, weather broadcast and airport traffic control signals.

Circuit—8 tubes are used in a conventional superheterodyne circuit.

Frequency Range—The receiver is continuously tunable from 195 to 415 kilocycles (1538 to 723 meters) and provides, in addition, a fixed frequency channel within this range, which may be selected instantaneously by the operation of a switch.

Control—The receiver is designed for remote control operation only. Manual volume control only is used for maximum distinction between the "on course" and "off course" radio range signals.

Sensitivity—The usable sensitivity of the receiver for an output of 50 milliwatts and a signal-to-noise power ratio of 4 to 1 is better than 6 microvolts for any frequency in the continuously tunable band, and 5 microvolts for the fixed channel. The image response is 90 decibels below the signal level and incoming signals at the intermediate frequency are attenuated 50 decibels.

Power Output and Requirements—The equipment is designed to operate from a 12 volt direct current source and a 200 to 250 volt D.C. supply. When the receiver is used in conjunction with other receiving equipment, it is usually possible to take the high voltage from a common dynamotor. When used independently, or if the capacity of the existing source is not sufficient, a type MP-12 power supply unit is used. The current drain is approximately 1.2 amperes at 12 volts and about 50 milliamperes at 200 to 240 volts. The fixed-channel relay, when operated, draws an additional .5 ampere approximately.

Dimensions and Weights—Type RA-4 installation requires the following equipment:

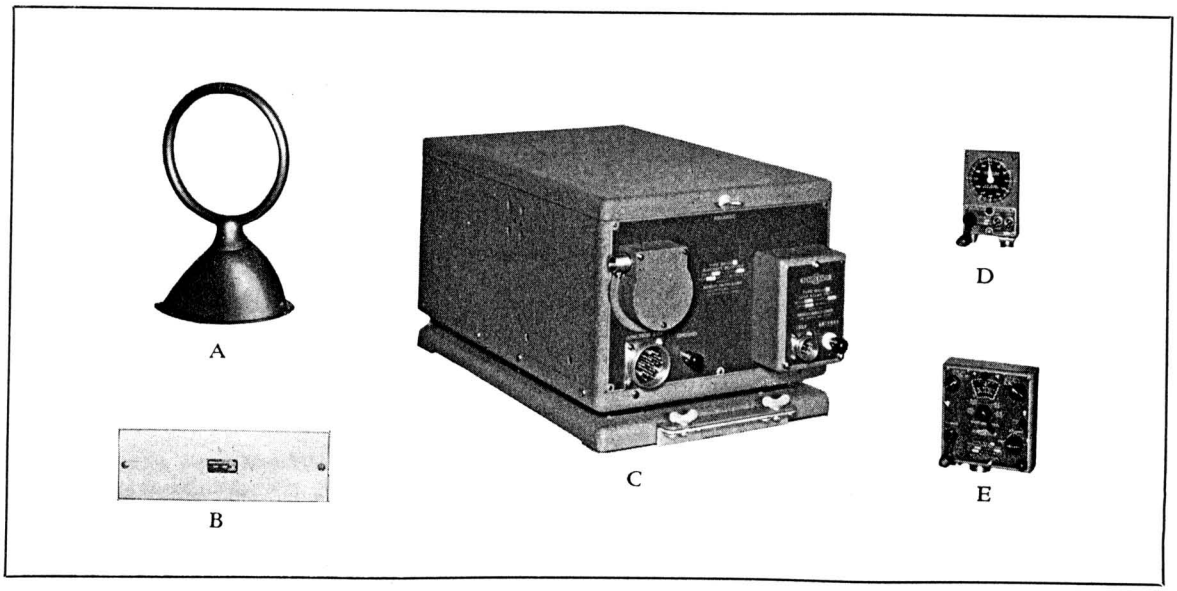
TYPE RA-4 Receiver with Shockmount and Tubes.....
.....17.4 Pounds—7.9 Kilograms
Height ..... 10 3/16 inches—26.0 centimeters
Width ..... 10 1/4 inches—25.8 centimeters
Depth ..... 14 1/4 inches—36.1 centimeters

TYPE MR-12F Remote Tuning Control.....
.....1.3 Pounds—0.6 Kilograms
Height ..... 3 inches— 7.6 centimeters
Width ..... 6 1/8 inches—15.5 centimeters
Depth ..... 4 1/8 inches—10.4 centimeters

TYPE MR-18 Remote Control Unit.....
.....2.25 Pounds—1.0 Kilograms
Height ..... 8 1/4 inches—21.0 centimeters
Width ..... 6 inches—15.2 centimeters
Depth ..... 2 1/2 inches— 6.3 centimeters

TYPE MP-12 Power Supply Unit.....
.....5.75 Pounds—2.6 Kilograms
Height ..... 3 3/16 inches—8.09 centimeters
Width ..... 5 3/16 inches—13.2 centimeters
Depth..... 3 7/8 inches— 9.8 centimeters

Remarks—Provision has also been incorporated in the design for operation in conjunction with the Bendix radio type MN-2 direction finder equipment. The receiver is equipped with dual audio channels to facilitate mixing with other receiver outputs at two different listening points, such as a pilot and navigator.



(A) MN-20 Loop
(B) MS-14 Junction Box
(C) RA-10 Radio Receiver
(D) MN-52 Azimuth Control
(E) MR-9 Remote Control

RA-10 RECEIVER

General—The Type RA-10 Aircraft Radio Receiver is a four-band remotely controlled unit with self-contained power supply. Its many outstanding features make it ideal for practically any type of application in transportation service, in private planes, and in military and naval services.

Circuit—8-tube superheterodyne with automatic sensitivity control on all bands except 150-400 kilocycles (750-2000 meters). Lock-in crystal control is provided for one channel between 2000-5000 kilocycles (60-150 meters) and another channel between 5000-10,000 kilocycles (30-60 meters). A beat-oscillator is included for reception of unmodulated signals.

Frequency Range—Four bands cover the following range:

Band No. 1	150-400	kilocycles;	750-2000 meters
Band No. 2	400-1100	kilocycles;	273-750 meters
Band No. 3	2000-5000	kilocycles;	60-150 meters
Band No. 4	5000-10,000	kilocycles;	30-60 meters

Frequency Calibration and Accuracy—The dial located on the remote control unit is directly calibrated in kilocycles on the two low frequency bands, and in megacycles on the two high-frequency bands. The calibration accuracy of this dial is better than 1%.

Control—Complete control of receiver from MR-9 remote control unit. Electric bandswitching with a positive motor-driven selector switch which eliminates one mechanical cable and permits split-second band change.

Sensitivity—The modulated continuous wave (MCW) sensitivity, when measured at a signal-to-noise power ratio of 4:1, is better than 6.5 microvolts input for 50 milliwatts output with the proper load. The continuous wave (CW) sensitivity, when measured at a signal-to-noise power ratio of 10:1, is better than 3.5 microvolts input for 50 milliwatts output with the proper load.

Selectivity—The total band-width in kilocycles at various reference frequencies for attenuations of 20, 40, and 60 decibels is as follows:

	150 Kilocycles	*2000 Kilocycles*	*10,000 Kilocycles*
20 decibels	8	17	19
40 decibels	14	29	30
60 decibels	22	42	50

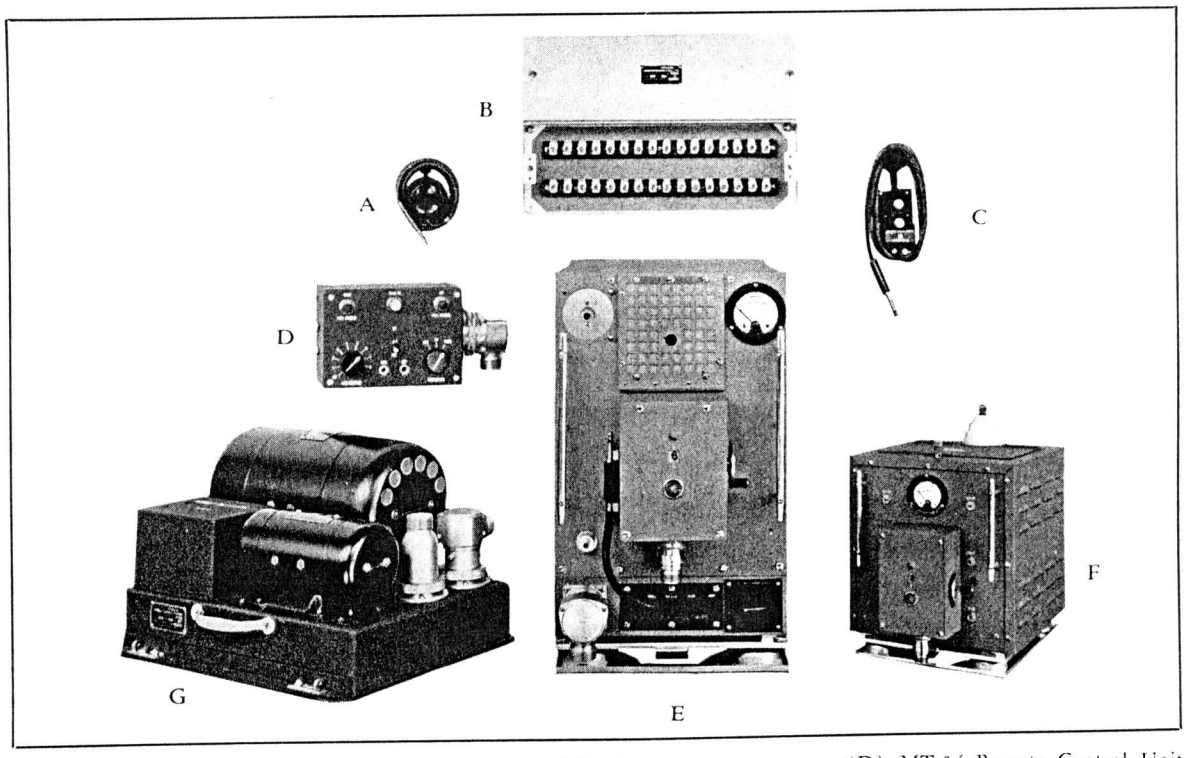
Power Output—The Type RA-10 aircraft receiver is designed for either a 500- or 4000-ohm load, and will deliver over 500-milliwatts output at not over 15 per cent distortion when properly loaded. The maximum possible output is approximately 1 watt.

Power Requirements—The RA-10 receiver is available for operation from either 12 or 24 volt primary power systems. The current drain is 6.0 amperes at 14 volts and 3 amperes at 28 volts.

Overall Dimensions and Weights—

RA-10 Receiver Including Shockmounting and Loop Relay Unit	33 Pounds 8 Ounces—15.2 Kilograms		
Width	10 3/8	inches;	26.4 centimeters
Height	8 13/16	inches;	22.4 centimeters
Depth	18 5/16	inches;	46.5 centimeters
MR-9 Remote Control Unit	2.25 Pounds—1.02 Kilograms		
Width	5 3/8	inches;	13.7 centimeters
Height	6 7/16	inches;	16.4 centimeters
Depth	3 11/16	inches;	9.4 centimeters
MN-20 Loop	4.25 Pounds—1.93 Kilograms		
Diameter	9	inches;	22.9 centimeters
Height	13 7/8	inches;	35.2 centimeters
Length	9	inches;	22.9 centimeters
MN-52 Azimuth Control Unit	82 Pounds—.37 Kilograms		
Width	3 5/16	inches;	8.4 centimeters
Height	5 11/16	inches;	14.4 centimeters
Depth	2 13/16	inches;	7.1 centimeters
MS-14 Junction Box	1.75 Pounds—.8 Kilograms		
Width	4 57/64	inches;	12.4 centimeters
Length	14 21/32	inches;	37.2 centimeters
Depth	2 1/16	inches;	5.2 centimeters

Remarks—If desired, the receiver can be supplied on special order with two permanent crystal channels in place of the two high frequency bands. In this case, the channels are selected by switching the remote control unit to the band in which the channel is located and no tuning whatever is necessary. A loop antenna relay unit which attaches to the front panel of the receiver provides instant and positive switching of receiver from regular receiving antenna to a directional loop and with the auxiliary equipment, the receiver can be used for aural null direction finding.



(A) Telegraph Key (B) Junction Box (C) Phone (D) MT-34 Remote Control Unit
(E) TA-2 Transmitter (F) MT-36 Antenna Tuning Unit (G) MP-10 Power Supply (transmitter and receiver)

TA-2 TRANSMITTER

General—Designed to fill commercial and military demands for a dependable, high power, multi-channel aircraft transmitter, the TA-2 has proved its merit in both fields. Patrol bombers and commercial airliners depend daily upon its reliable long range performance in all parts of the world. Various models are available to fill every need.

Frequency Range—2900-15000 kilocycles; 20-103 meters. With addition of MT-36 antenna tuning unit this range is increased to include: 300-600 kilocycles (1000-500 meters). Modifications can be made to accommodate other operating frequencies although the power output decreases somewhat above 17000 kilocycles (17.6 meters).

A total of 8 pre-tuned, crystal controlled channels are available. A maximum of six of these may be in the 300-600 kilocycle (500-1000 meter) range, if desired, when the MT-36 antenna tuning unit is used.

Frequency Stability—Frequency controlled by quartz crystals ground to within .005% of specified frequency. Temperature coefficient is less than 3 cycles per million per degree centigrade.

Control—Complete remote control facilities are provided by MT-34 control unit. Motor-driven remotely controlled channel selector. A maximum time of approximately four seconds required to shift from one channel to another and a minimum of one second for adjacent channels, selection may also be effected by hand crank on transmitter.

Audio Frequency Characteristics—A 1000 cycle audio input of 1 volt R.M.S. developed across the microphone input transformer (impedance approximately 125 ohms) is sufficient to produce 100% modulation of the rated carrier output.

Total harmonic distortion does not exceed 10% for 85% modulation of the rated output with 400 cycles. Measurements made between microphone input terminals and rectified antenna current.

The frequency response is flat within plus-minus 2 decibels between 400 and 3000 cycles.

Power Output—The transmitter is capable of delivering 100 watts into a 10 ohm load through 200 micromicrofarads between 2900 and 15000 kilocycles.

Type of Emission—C.W. telegraph, modulated C.W. telegraph, and telephone.

Power Requirements—100 watt C.W. operation:

100-watt unmodulated carrier: 900 watts
100-watt carrier 100% modulated: 975 watts

Equipment can be supplied for operation from either 12 or 24 volt primary power systems.

Dimensions and Weights—

TA-2 Transmitting Unit and Shock Mount with Tubes but less Channel Accessories .....40.25 Pounds; 18.28 Kilograms
Dimensions: 17.3 x 10.22 x 18.37 inches
44 x 26 x 46.6 centimeters

Channel Accessories (Crystals and Coils)
Per Channel .....1.25 Pounds; .57 Kilograms

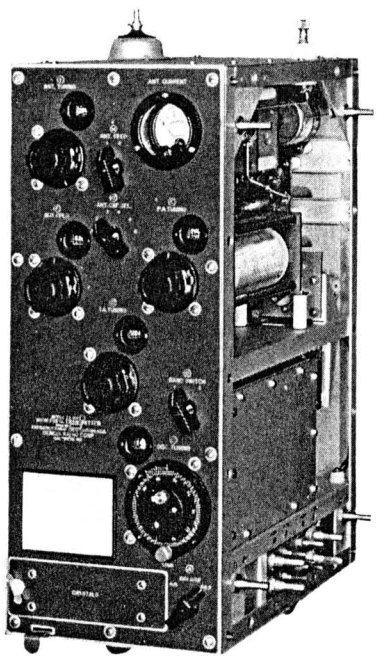
MT-34 Control Unit.....3.5 Pounds; 1.6 Kilograms
Dimensions: 4.87 x 4.56 x 9.37 inches
12.4 x 11.6 x 23.8 centimeters

MP-8 Power Unit (for Transmitter only).....
.....39.12 Pounds; 17.8 Kilograms
Dimensions: 10.06 x 7.5 x 15 inches
25.5 x 19 x 38 centimeters

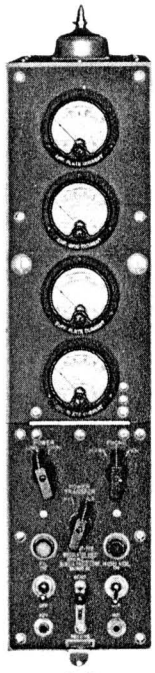
*MP-10 Power Unit (shown above).....
.....51.75 Pounds; 23.5 Kilograms
Dimensions: 9.34 x 11.59 x 14.19 inches
23.72 x 29.44 x 36.04 centimeters

MT-36 Antenna Tuning Unit and
Shock Mount .....31.25 Pounds; 14.18 Kilograms
Dimensions: 16.6875 x 11.41 x 17.37 inches
42.4 x 29 x 44.1 centimeters

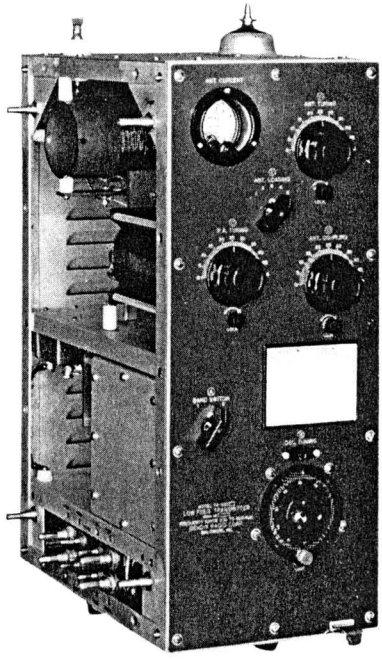
*Combination transmitter and receiver power supply.



High Frequency Section



Modulator and Control Section



Low Frequency Section

TA-3 TRANSMITTER

General—The type TA-3 aircraft transmitting equipment consists of two complete radio-frequency sections which plug in on either side of a common modulator and control section. Each radio-frequency section is independent of the other, one operating over the low-frequency range and the other covering the high-frequency spectrum. Separate sets of tubes are used in each and it is merely necessary to switch power and control circuits when changing from a low to a high frequency channel. An antenna relay unit is provided for switching to different antennae for each frequency range if desired. Transmitter is designed for local control only.

Frequency Range—

300- 600 kilocycles.....(500 to 1000 meters)
2500-15000 kilocycles.....(20 to 120 meters)

(*Note:* These ranges may be altered in the same ratio to meet specific requirements.)

Frequency Control—Stabilized self-excited oscillator over entire high and low frequency ranges, plus provision for three quartz crystals in range between 2500 and 15000 kilocycles.

Frequency Stability—When operating as a self-controlled oscillator the frequency stability within the range of the transmitter is within 0.05% under any or all of the conditions listed below:

1. Any 20° variation in temperature from minus 30° to plus 50° centigrade where the averaged rate of change is not more than one degree per minute.
2. 10% voltage variation.
3. Antenna detuned until output current drops 25%.
4. Normal keying.

For quartz-controlled operation crystals are supplied to within .005% of specified frequency at 20° centigrade. Maximum drift from minus 20° to plus 50° centigrade is less than 3 cycles per million per degree. Bendix type MX-9 crystal holders are recommended.

Frequency Calibration Accuracy—Better than 0.1%. When the dial is returned to a previous setting the frequency will be within .03% of its original value at the same setting.

Power Output—155 watts are available in the output circuit. 80 to 140 watts can be delivered into the antennae specified below. (Modulated output power is 25% of these values.)

Antenna Requirements—The transmitter will deliver 70 to 140 watts of power over the specified frequency ranges into antennae having the following characteristics:

2500-15000 kilocycles—1.5 to 1800 ohms resistance, minus 750 to plus 1000 ohms reactance.
300- 600 kilocycles—2 to 25 ohms resistance, 0 to minus 1300 ohms reactance.

Type of Emission—C.W. telegraph; modulated C.W. telegraph; radio telephone.

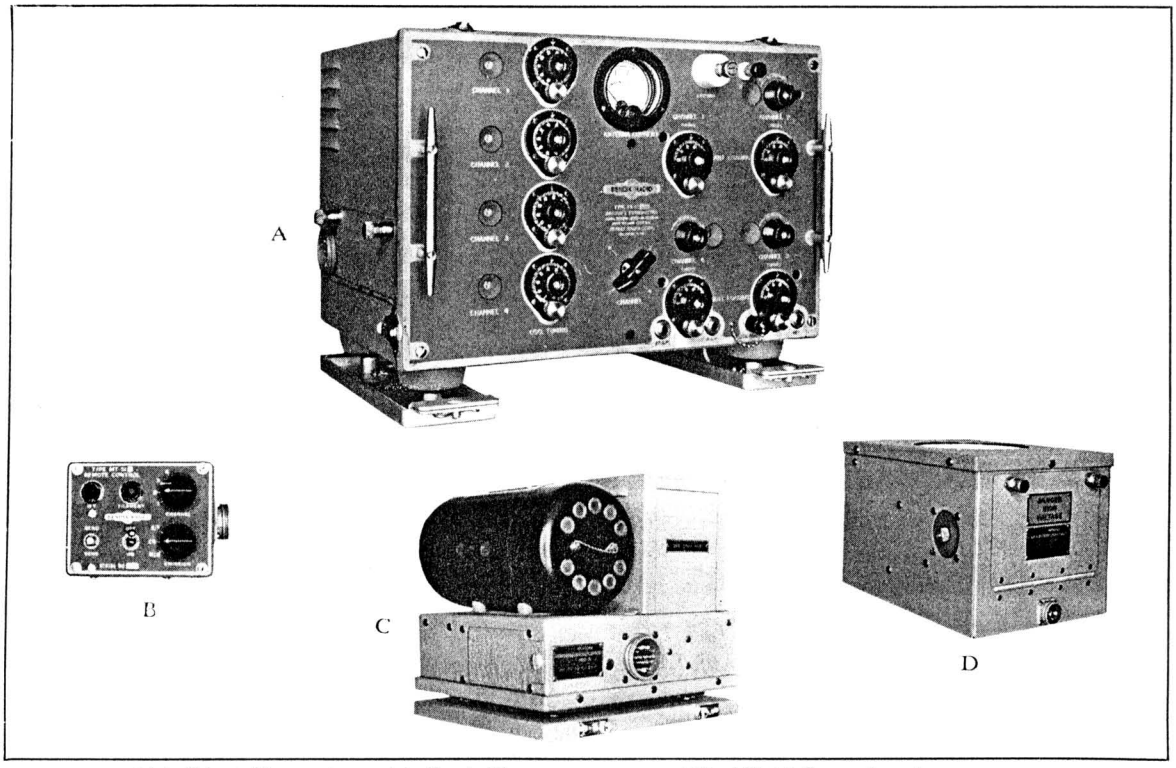
Primary Power Requirements—68 amperes at 12.5 volts, 35 amperes at 27 volts. The equipment is available for operation from either 12 or 24 volt primary power systems. Battery voltage must be specified by the customer.

Weights and Dimensions—(Over all controls and projections)—Transmitter complete with shock mountings:

Overall height .....25⅛ inches—63.8 centimeters
Overall width .....27½ inches—69.8 centimeters
Overall depth .....17⅜ inches—45.2 centimeters
Weight .....102 pounds—46.3 kilograms

Dynamotor power supply complete:

Overall height .....10¼ inches—26 centimeters
Overall width .....13¼ inches—33.6 centimeters
Overall depth .....15 inches—38.1 centimeters
Weight .....62 pounds—28.1 kilograms



(A) TA-12 Transmitter with Shock Mount
(B) MT-51 Remote Control
(C) MP-28 Power Supply
(D) MT-53 Antenna Loading Unit

TA-12 TRANSMITTER

General—Designed for exacting military service, the Type TA-12 transmitter offers the flexibility of stabilized non-crystal operation combined with compactness, wide frequency range, and ease of control. Thousands of these transmitters have proved their dependability under conditions of actual service.

Frequency Range—TA-12 transmitters are available with any one of the following frequency ranges:

1. (Requires external loading unit)—

300-600	kilocycles;	1000-500	meters
3000-4800	kilocycles;	100-62.5	meters
4000-6400	kilocycles;	75-47	meters
4370-7000	kilocycles;	68.5-42.8	meters

2. (Requires external loading unit)—

300-600	kilocycles;	500-1000	meters
3000-4800	kilocycles;	100-62.5	meters
4000-7680	kilocycles;	75.39	meters
7680-12000	kilocycles;	39.25	meters

3. (No loading unit required)—

1050-1700	kilocycles;	286-176	meters
2000-3400	kilocycles;	150-88	meters
3000-4800	kilocycles;	100-62.5	meters
4370-7000	kilocycles;	68.5-42.8	meters

Frequency Control—Master oscillator type, with facilities for switching both locally and remotely 4 predetermined frequencies within the frequency range (one low and three high frequencies). *If desired, the transmitter can be supplied with any band above 1000 kilocycles (below 300 meters) converted for quartz crystal controlled operation.*

Frequency Stability—Self-excited oscillators produce excellent stability. The maximum frequency deviations for non-crystal operation under varying electrical and mechanical conditions are indicated in the following table:

A—Change of any or all tubes	.1%
B—Change of antenna tuning to produce a 25% change in antenna current	.03%
C—10% simultaneous change of plate and filament voltages	.02%
D—Normal keying	.01%
E—With any 20° temperature change in the range of minus 30°C to plus 50°C	.05%
F—Relative humidity change from 20% to 80%	.05%
G—With ½ hour of vibration at an acceleration of 10G	.05%

Frequency Calibration—Because of limited size the frequency calibration chart will permit setting the frequency to within only 1%. However, the dial may be returned to any previous setting and the frequency will be within 0.1% of its previous value.

Control—Complete electrical remote control is provided by MT-51 control unit. A motor-driven switch selects any one of four pre-tuned channels. The transmitter may also be operated locally for test purposes.

Power Output—The transmitter delivers 40 watts of power into an antenna consisting of 10 ohms resistance in series with 250 MMF capacity.

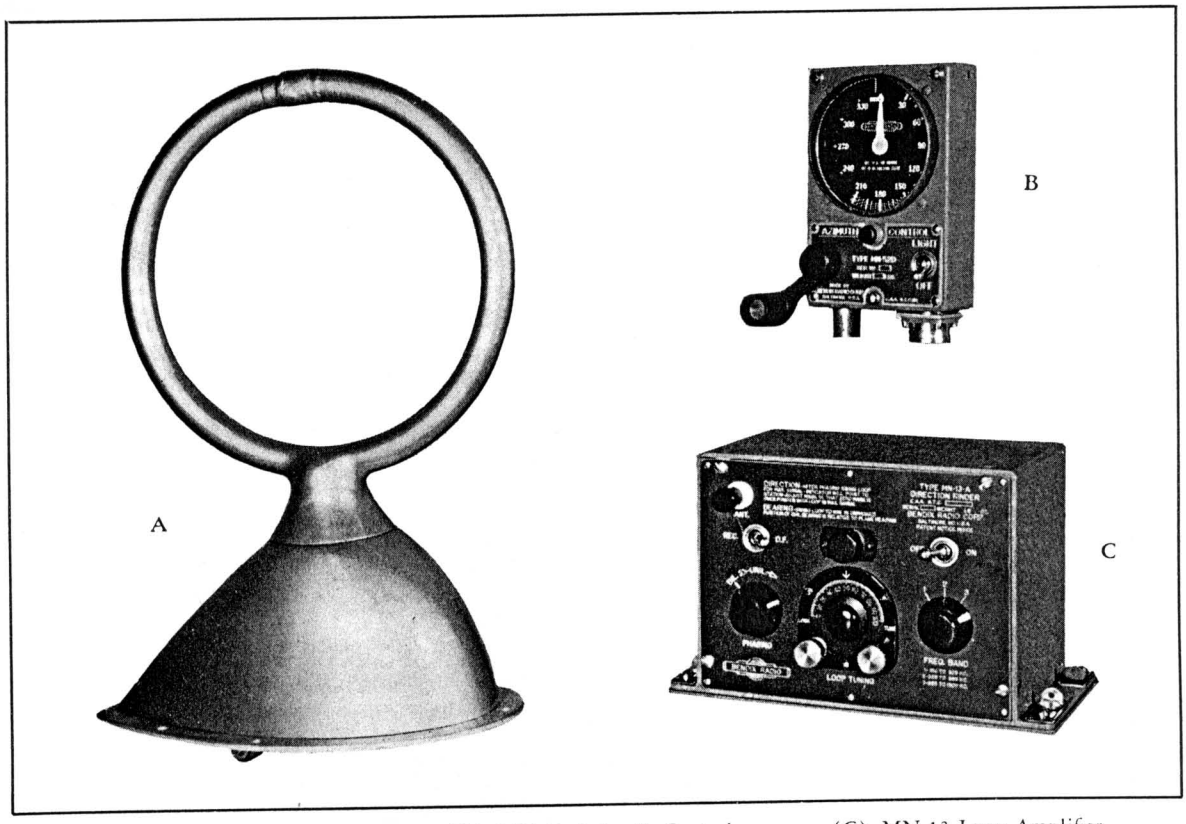
Type of Emission—C.W. telegraph; modulated C.W. telegraph; telephone.

Power Requirements—Designed for operation from either 12 or 24 volt primary power systems. Current drain: 16.5 amperes at 25 volts. 33.0 amperes at 12.5 volts.

Audio Characteristics—Models are available for operation with either low-level dynamic microphones or high level carbon microphones.

Dimensions and Weights—

TA-12 Transmitter complete with Shockproof Mounting		35.4 pounds	—16.0 kilograms
Dimensions:	Height	11⅜ inches	—29.5 centimeters
	Width	15⅛ inches	—38.4 centimeters
	Depth	12 inches	—30.5 centimeters
Dynamotor Power Supply		26.5 pounds	—12. kilograms
Dimensions:	Height	9⅜ inches	—23.3 centimeters
	Width	6⅛ inches	—15.6 centimeters
	Depth	9½ inches	—24.2 centimeters
Antenna Loading Unit		5.3 pounds	—2.4 kilograms
Dimensions:	Height	8 inches	—20.4 centimeters
	Width	6 inches	—15.3 centimeters
	Depth	6 inches	—15.3 centimeters
Remote Control Unit		1.3 pounds	—.59 kilograms
Dimensions:	Height	4 1/64 inches	—10.2 centimeters
	Width	5 1/16 inches	—12.9 centimeters
	Depth	2 13/16 inches	— 7.2 centimeters



(A) Type MN-20 Loop (B) MN-52 Azimuth Control (C) MN-13 Loop Amplifier

MN-13 DIRECTION FINDER

General—The type MN-13 direction finding equipment is designed for use with the Bendix RA-1 receivers but will work satisfactorily with any well-shielded sensitive receiver having a high-impedance input.

The MN-13 amplifier provides for the use of a sense antenna, the output of which is mixed with the signal from the loop to permit uni-directional bearings. The equipment may be used for either bi-lateral or uni-lateral direction finding, with a switch providing the choice. The azimuth control has a specially designed mask which may be used to obtain accurate uni-directional bearings without the necessity of the usual mental calculations.

Frequency Range—150-1500 kilocycles; 200-2000 meters.

Control—The loop amplifier itself must be locally operated. The direction finding equipment is normally used with a locally controlled receiver. However, the receiver may be remotely controlled and its input switched from the loop amplifier to normal antenna by means of the Bendix MR-27 rotary relay.

Sensitivity—Either the 9-inch MN-20 loop or the 18-inch MN-24 loop may be used. They are interchangeable electrically and the choice is solely dependent upon what type of service is desired. Base and mounting dimensions are identical. The larger loop is approximately four times as sensitive as the 9-inch loop and is therefore better suited for long-distance direction finding.

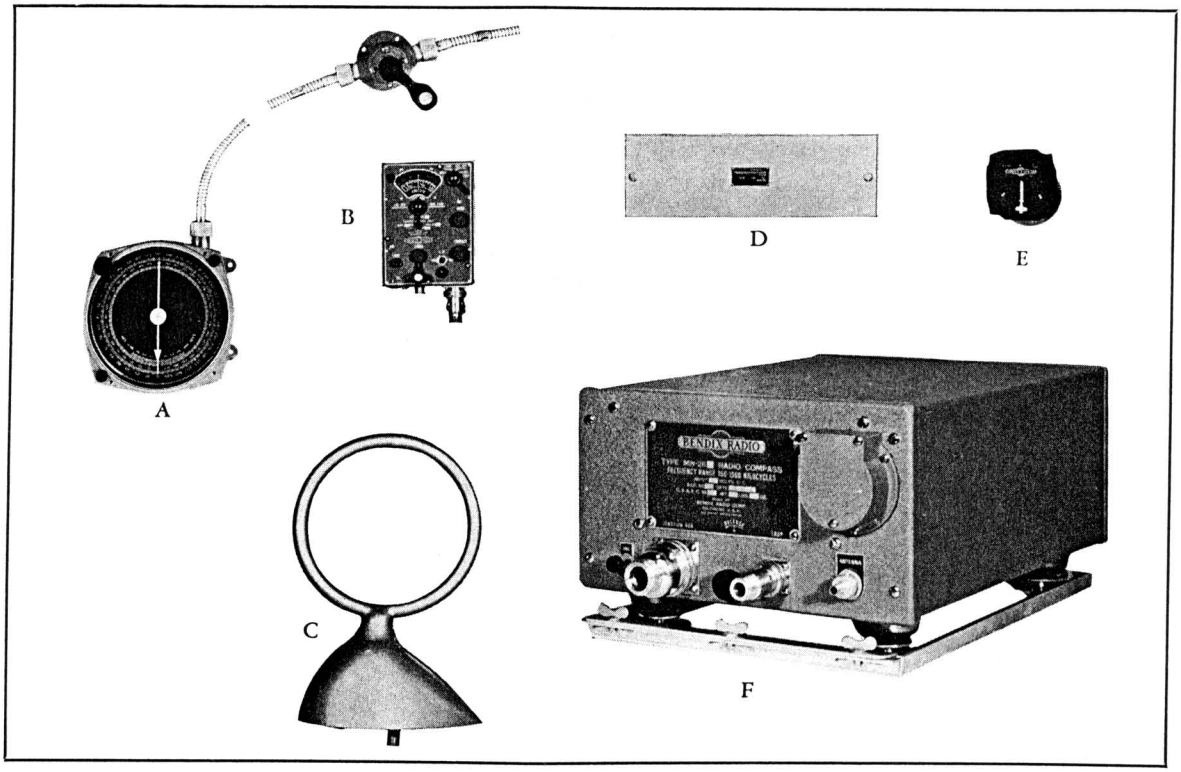
In conjunction with the RA-1 receiver and with the 18-inch loop, a field-strength of 30 microvolts per meter will produce 50 milliwatts output with a 4:1 signal-to-noise power ratio. A 120 microvolt per-meter field will produce the same output with the 9-inch loop. These measurements are made with the loop set at maximum signal.

Power Requirements—.35 amperes at 14 volts or .2 amperes at 28 volts; plus .014 amperes at approximately 250 volts.

Components and Weights—

MN-13 loop amplifier with cable, plug and tube.	4.75 pounds	2.16 kilograms
MN-52 azimuth control with cable plug.	.88 pounds	.4 kilograms
MN-20 9-inch loop antenna	4.6 pounds	2.1 kilograms
or		
MN-24 18-inch loop antenna	8.5 pounds	3.8 kilograms
AA-15410 flexible tuning shaft (15 feet).	3.9 pounds	1.77 kilograms
AC-55300 shielded cable assembly, 15 feet long, plug on both ends. Loop amplifier to power unit.	3.0 pounds	1.36 kilograms
AC-55294 RF transmission line 5 feet long, plug on one end only. Loop amplifier to receiver.	1.0 pounds	.45 kilograms
AA-15469 RF transmission line 14 feet long, plug on both ends. Loop antenna to loop amplifier.	3.5 pounds	1.6 kilograms

Remarks—Cable lengths specified are standard but will be supplied in any length to suit customer requirements. It must be pointed out that the MN-13 equipment is not a receiver but merely an accessory for a receiver. A source of power is also required.



(A) MN-22 Azimuth Indicator with MR-15 Crank (B) MN-28 Remote Control Unit (C) MN-20 Loop
(D) MS-14 Junction Box (E) IN-4 Left-Right Indicator (F) MN-26 Compass Receiver

MN-26 RADIO COMPASS

General—Several thousand MN-26 compasses are in service throughout the world as daily proof of their utility as a dependable navigational aid. The unit provides visual left-right course indication for homing. An Azimuth Indicator automatically corrected for quadrantal error permits direct-reading off-course bearings either by the aural null method or with the more sensitive visual meter method.

Circuit—12-tube superheterodyne. Intermediate frequency 112.5 kilocycles. Beat frequency oscillator included for telegraph reception.

Frequency Range—MN-26 compasses are available with any one of the three following frequency ranges, each covered by three bands:

A—Band I	150- 325 kilocycles	920-2000 meters
Band II	325- 695 kilocycles	430- 920 meters
Band III	695-1500 kilocycles	200- 430 meters
B—Band I	200- 410 kilocycles	730-1500 meters
Band II	410- 850 kilocycles	350- 730 meters
Band III	850-1750 kilocycles	170- 350 meters
C—Band I	200- 410 kilocycles	730-1500 meters
Band II	410- 850 kilocycles	350- 730 meters
Band III	3400-7000 kilocycles	42- 88 meters

Accuracy of Frequency Calibration—Within one per cent.

Control—Complete remote control facilities provided by MN-28 unit. Frequency band selected by motor-driven switch.

Receiver Sensitivity—OPERATING ON OPEN ANTENNA:
Input: 5 microvolts; modulated 30% at 400 cycles. Output: 50 milliwatts with 4:1 signal-to-noise power ratio. Artificial Antenna: 100 micromicrofarads.

OPERATING ON LOOP ANTENNA:
Input: A field strength of 120 microvolts per meter. Modulated 30% at 400 cycles. Output: 50 milliwatts with 4:1 signal-to-noise power ratio.

Compass Sensitivity—Directional changes of less than one degree can be detected with field strengths as low as 100 microvolts.

Receiver Selectivity—Average total band width for 60 decibel attenuation is less than 15 kilocycles.

Compass Selectivity—An interfering signal 1000 times stronger than the desired signal, arriving at right angles to the desired signal, and separated from it by 10 kilocycles will not produce more than a ten degree directional error. With 20 kilocycle separation, no measurable error exists.

Power Requirements—Available for operation from either 12 or 24 volt primary power systems. Total current drain: 6.2 amperes at 14 volts or 3.1 amperes at 28 volts.

Dimensions and Weights—

MN-26 Compass Receiver complete with mounting base, tubes and cable connectors	38.2 pounds	17.3 kilograms
Width	12 inches	30.5 centimeters
Height	7⅞ inches	20.0 centimeters
Depth*	17-9/16 inches	44.6 centimeters
MN-28 Remote Control Unit complete with mounting base, fuse and cable connector	2.38 pounds	1.1 kilogram
Width	3⅝ inches	9.2 centimeters
Height	5¼ inches	13.4 centimeters
Depth*	7 7/16 inches	18.9 centimeters
MN-20 Loop complete with mounting base	4.6 pounds	2.1 kilograms
Width	5½ inches	14.0 centimeters
Height*	10⅞ inches	27.7 centimeters
Depth	14-31/32 inches	38.1 centimeters
IN-4 Left-Right Indicator complete with cable connector	1.75 pounds	.8 kilograms
Width	3¼ inches	8.3 centimeters
Height	3¼ inches	8.3 centimeters
Depth*	3⅜ inches	8.6 centimeters
MN-22 Azimuth Indicator and MR-15 Hand Crank	2.185 pounds	1.0 kilograms
Width	5½ inches	14.0 centimeters
Height	2 7/16 inches	6.2 centimeters
Depth	5½ inches	14.0 centimeters

Remarks—Two left-right indicators may be operated simultaneously if desired.

* Less cable connector.

MN-31 AUTOMATIC RADIO COMPASS

General—The MN-31 automatic radio compass or direction finder provides continuous indication of the direction of arrival of a radio signal. There is no ambiguity—no computation or correction is necessary. A single arrow points at all times to the bearing of the radio station being received.

The MN-31 automatic radio compass consists of an MN-26 compass receiver, an MN-28 remote control unit, a streamlined MN-36 loop, an MN-31 loop director unit and an MN-37 bearing indicator.

For those installations which do not permit the use of the MN-28 control unit the small type MR-43 control unit is available. This unit provides tuning facilities only and measures 6 x 4⅝ x 3¾ inches (15.3 x 11.8 x 9.5 centimeters). A kit of parts is supplied with the MR-43 to provide the other elements of control such as loop function switch, volume control, et cetera. These parts are mounted and wired by the customer to fit his requirements.

An autosyn system of bearing indication is used in the MN-31 equipment. An autosyn transmitter is coupled to the loop shaft through a special type of quadrantal error corrector. Rotation of the loop drives the autosyn in such a manner that its rotor is positioned at true bearing including all correction for quadrantal error. The autosyn transmitter is connected electrically in normal manner to the bearing indicator, the pointer of which is driven by a standard autosyn indicator. Accordingly, the position of the bearing indicator pointer corresponds degree for degree with the direction of the received wave.

Power for the loop motor operation as well as for the autosyn system is obtained from a small DC to AC inverter mounted as part of the MN-31 loop director unit. A rotating inverter was chosen as the source of AC power instead of the vibrating reed type mainly because of the demonstrated reliability of small rotating machinery under general service conditions.

Circuit—The circuit used in the MN-26 automatic compass receiver consists of a 12 tube superheterodyne incorporating the necessary compass circuits. It is similar to that of the MN-26 right-left compass receiver previously described, with the addition of an automatic gain control circuit for the loop amplifier tube. This control circuit is governed by the 48 cycle compass output voltage and provides for satisfactory automatic compass operation with high signal inputs. A standard MN-26 right-left compass receiver cannot be used for automatic compass operation unless proper modifications are made.

The MN-31 loop director unit contains a dual channel audio output amplifier in addition to the thyratron motor control circuit and 400 cycle power source. The use of the dual channel amplifier is governed by the customer's requirements and does not effect operation of the automatic compass.

Frequency Range: MN-31 automatic radio compass equipment is available with any one of the three following frequency ranges each covered by three bands:

A	Band I	150- 325 kilocycles;	2000-920 meters
	Band II	325- 695 kilocycles;	920-430 meters
	Band III	695-1500 kilocycles;	430-200 meters
B	Band I	200- 410 kilocycles;	1500-730 meters
	Band II	410- 850 kilocycles;	730-350 meters
	Band III	850-1750 kilocycles;	350-170 meters
C	Band I	200- 410 kilocycles;	1500-730 meters
	Band II	550-1200 kilocycles;	545-250 meters
	Band III	2900-6000 kilocycles;	103- 50 meters

NOTE: On special order any band covering frequencies below 1500 kilocycles may be converted to provide a fixed channel pre-tuned to any frequency between the limits of the band.

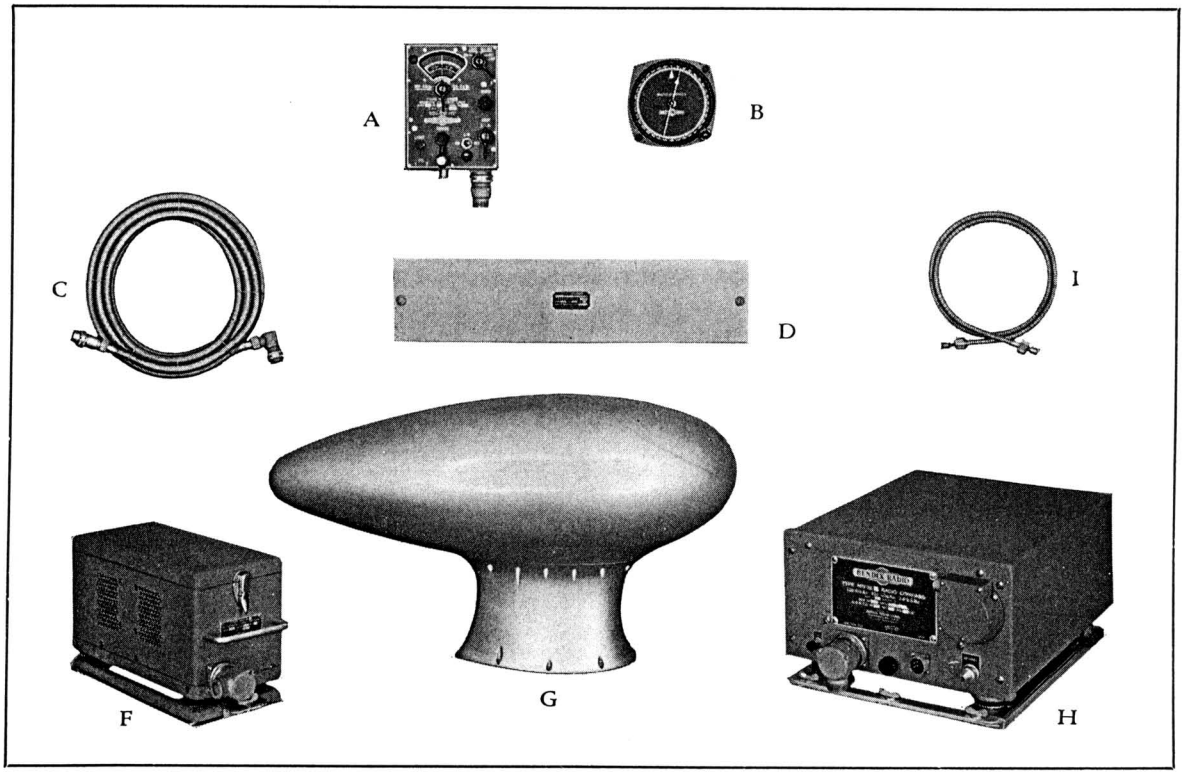
Compass operation is provided for all frequencies below 1750 kilocycles. The 2900 to 6000 kilocycles range is for communication purposes only, either telephone or telegraph.

Loop Speed—A maximum angular velocity of approximately 25 to 30 degrees per second is obtained. Incorporated in the apparatus is a means of obtaining reduction in angular velocity when the loop approaches a true bearing. This feature is desirable in that it allows bearings to be taken rapidly regardless of the position of the radio station with respect to the heading of the airplane and at the same time limits overshoot and erratic operation of the bearing indicator.

Overshoot—The maximum overshoot is less than 1 degree for any condition of use. In practice, it is usually less than 0.5 degree.

Bearing Accuracy—An overall bearing accuracy of better than plus or minus 3 degrees is guaranteed with any field strength between 100 and 100,000 microvolts per meter. This figure of merit includes the inaccuracies of the radio compass receiver and the electrical azimuth indicator. Generally the overall bearing accuracy will be better than plus or minus 2 degrees, and often better than plus or minus 1 degree.

Aural Null Operation—The complete equipment can be used as an aural null direction finder in addition to its primary function as an automatic radio compass. Provision is made for a manual left-right loop rotator switch, which permits rotating the loop electrically in either direction for taking aural null bearing.



(A) MN-28 Remote Control (B) MN-37 Bearing Indicator (C) Cables (D) MS-14 Junction Box
(E) Cables (F) MN-31 Loop Director Unit (G) MN-36 Loop (H) MN-26 Compass Receiver

MN-31 AUTOMATIC RADIO COMPASS (*Continued*)

Bearing Indicator—A single MN-37 bearing indicator is normally furnished. At the option of the customer, a second bearing indicator may be operated simultaneously if desired. For installations which will not accommodate the large size MN-37 indicator, the small instrument-size MN-44 indicator is available.

Power Requirements—10.8 amperes at 14 volts; 5.4 amperes at 28 volts.

The above values represent maximum consumption with loop motor operating at maximum speed.

Overall Dimensions and Weights—

MN-26 Automatic Compass
Receiver .....37.38 pounds—17.2 kilograms
Height .. 7⅞ inches—20.0 centimeters
Width ..12 inches—30.5 centimeters
Length ..17 9/16 inches—44.6 centimeters

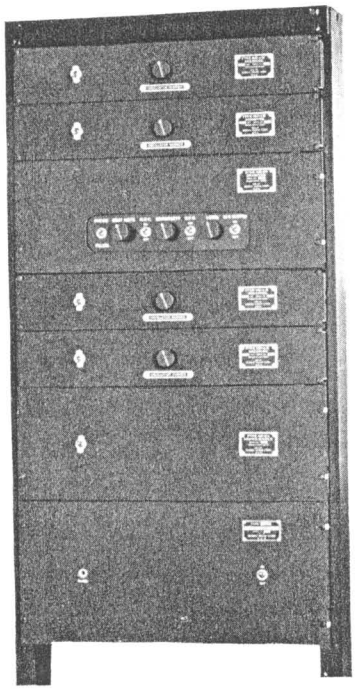
MN-28 Remote Control
Unit .....2.75 pounds—1.25 kilograms
Height .. 3⅝ inches— 9.2 centimeters
Width .. 5¼ inches—13.4 centimeters
Length .. 9 7/32 inches—23.5 centimeters

MN-31 Loop Director
Unit .....17.0 pounds—7.7 kilograms
Height .. 7 inches—17.8 centimeters
Width .. 5 1/32 inches—12.8 centimeters
Length ..14⅛ inches—35.9 centimeters

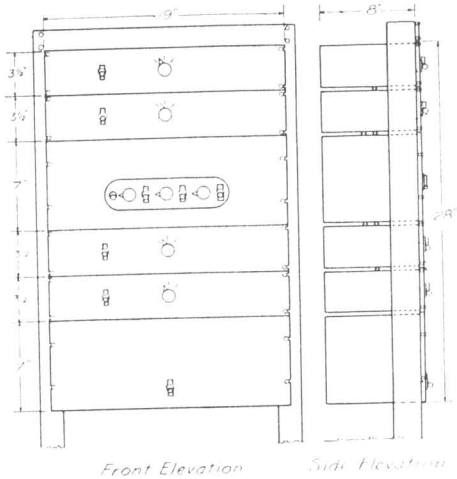
MN-37 Bearing
Indicator .....1.5 pounds—.23 kilograms
Height .. 5⅛ inches—13.0 centimeters
Width .. 5⅛ inches—13.0 centimeters
Overall
Length .. 5⅜ inches—13.7 centimeters

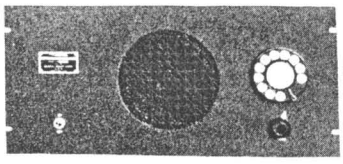
MN-36 Loop .....8.0 pounds—3.6 kilograms
Height ..14⅝ inches—37.2 centimeters
Width .. 9 inches—22.9 centimeters
Length ..25⅜ inches—64.5 centimeters

Remarks—Use of the MN-42 dual azimuth indicator operating in conjunction with two complete MN-31 automatic compass assemblies provides continuous indication of bearings from *two* stations simultaneously. This indicator has two pointers arranged on a single azimuth scale.



RG-2 Airport Receiver





MR-6 Remote Control Unit

RG-2 RECEIVER

General—The extreme sensitivity and general high performance of the RG-2 receiving equipment has found wide acceptance in the field of ground station service. It is designed for reception on fixed pretuned channels.

Flexibility of operation is an additional feature. The receiver comprises three major units: A power supply unit, an IF-AF unit including the intermediate and audio frequency amplifiers, and a preselector unit containing the radio frequency amplifiers and first detector. A maximum of four preselectors can be used with one IF-AF unit if desired. One power unit will supply a maximum of three IF-AF units and 12 preselectors. Thus any number of multi-channel arrangements is possible.

Circuit—Superheterodyne, intermediate frequency 385 kilocycles (780 meters). Amplified automatic sensitivity control. Noise suppression circuits. Heterodyne oscillator either crystal controlled or self-excited oscillator with vernier tuning range. Beat oscillator included for CW telegraph reception.

Frequency Range—2600 to 12000 kilocycles (25-115 meters) covered by five standard preselector units. Each preselector provides one fixed channel within its range.

Sensitivity—One microvolt with a signal-to-noise power ratio of 4 to 1. Noise measured with carrier on; signal measured with carrier modulated 30 per cent.

Automatic Sensitivity Control—Output remains constant to within 3 decibels when input is varied between 2 microvolts and 2 volts.

Selectivity—Total band width 13 kilocycles at 60 decibels down, from 2700 kilocycles to 7600 kilocycles (39.5-111 meters).

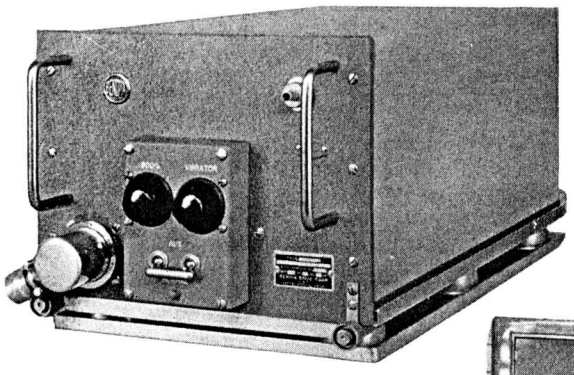
Control—Either remote or local. Complete dialing system provides full control over telephone line.

Power Requirements—150 watts at 110 volts 50-60 cycles for 4 channel combination. Can be supplied for different voltage or frequency on special order.

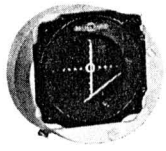
Dimensions and Weights (Designed for standard rack mounting)—

	MR4 Preselector Unit	*MR2 IF-AF Unit*	*MP2 Power Supply*	*MR6 Remote Control*
Width, inches	3½	7	7	8¾
Width, centimeters	8.9	17.8	17.8	22.22
Length, inches	19	19	19	19
Length, centimeters	48.3	48.3	48.3	48.26
Depth, inches	8	8	8	9¼
Depth, centimeters	20.4	20.4	20.4	23.5
Weight, pounds	43	11	19	39
Weight, kilograms	19.5	4.99	8.63	17.7

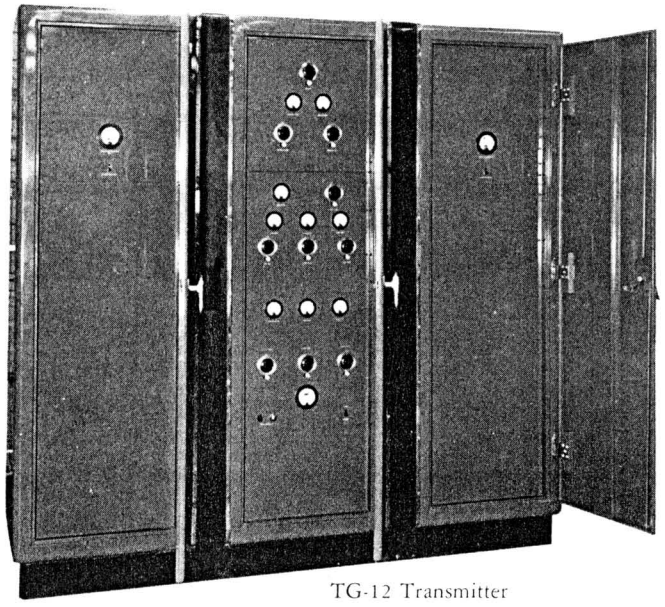
Special Features—Simultaneous monitoring of many channels or the instantaneous selection of a single desired channel, manual or automatic volume control; a noise suppression circuit to provide quiet operation when no carrier is being received; voice or telegraph (CW or MCW) reception; unusually high image suppression ratio; individual filtering of control and power leads; novel electro-static input shield; manual or automatic remote control of the receiver; provision for disconnecting the high voltage and grounding the AVC when the transmitter is on. To these features are added painstaking electrical assembly and mechanical construction.



RA-12 Instrument Landing Receiver



IN-3 Cross Point Indicator



TG-12 Transmitter

INSTRUMENT LANDING

General—Bendix instrument landing equipment is designed to eliminate flight interruption and provide safe landing in low visibility. Briefly, the system consists of one main transmitter at the ground station and one receiver in the airplane which together give indications on a cross-pointer instrument both in elevation and azimuth. Additional low power transmitters may be placed at various points along the landing trajectory to provide marker indications in conjunction with an additional receiver in the airplane. The frequency used for the azimuth and elevation indications is 93.9 (3.2 M) megacycles, whereas the frequency of the marker transmitters is 75 megacycles. Identification of the various markers is obtained by different modulation frequencies and keying characteristics.

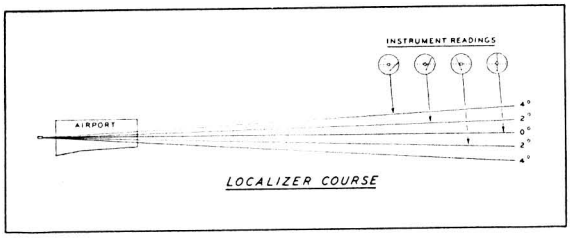
TG-12 TRANSMITTER

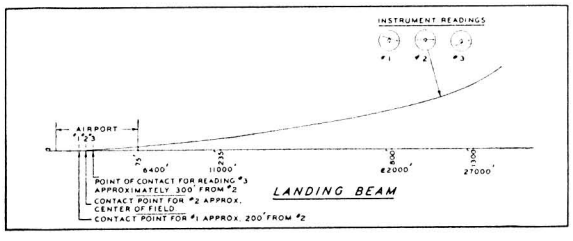
General—The type TG-12 instrument landing transmitter has the following characteristics:

1. Frequency of the carrier is stabilized at 93.9 megacycles (3.2 meters) by means of a low temperature coefficient quartz crystal.

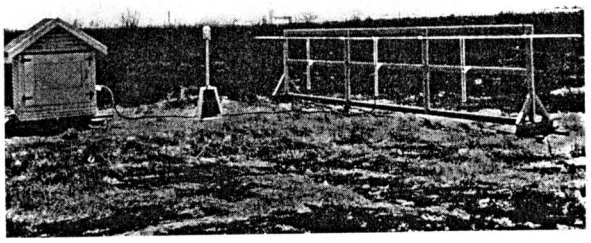
2. The 300-watt carrier output of the transmitter is unmodulated, keying of the radiated wave being accomplished in the antenna array.

3. The circuit employs the following tubes:
5 EIMAC 35T 4 EIMAC 100TH 6 RCA 866A

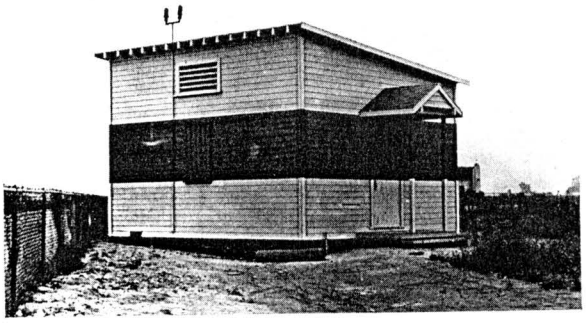




Numbers written vertically indicate height of trajectory in feet.
Numbers written horizontally indicate distance in feet from left end of airport.



Marker Beacon Installation



Beam Transmitter House Installation

4. A crystal oscillator controls, through three stages of harmonic amplifiers, the final stage consisting of 2 EIMAC 100TH tubes in push-pull arrangement.

5. The equipment is normally supplied to operate from a 220 volt AC 60 cycle single phase source, but can be supplied for other voltages or frequencies on special order.

Antenna Requirements—The antennae supplied for instrument landing use consist of two horizontally polarized yagi arrays excited in phase. The axes of the arrays are in the same horizontal plane and form an angle of 30°. A yagi array consists essentially of a series of parasitically excited elements so spaced and of such a length as to aid forward radiation. These elements are placed in a series in front of the antenna and are called directors. One reflector is placed behind the antennae to further accentuate forward radiation. Reflectors are normally longer than directors and are spaced differently in the array. The power gain for a four-director array is in the order of thirteen to one.

Keying—Keying of the space patterns is secured by making use of the reflector director action of one of the elements of each array. A motor-driven cam-operated contact is arranged to short circuit periodically a telescoping banjo in the center of the first director of the array. When the contacts are closed, the banjo is shorted and the length of the element is adjusted for a maximum forward radiation. When the contacts are open, the length of the banjo is adjusted for minimum forward radiation. The actuating cams in the keying units of each array have seven and nine sides, respectively, and are rotated at ten revolutions per second by means of synchronous motors operating through speed reducing gears.

Mechanical Description—The total weight of the transmitter, keying units, and antenna arrays is approximately 2000 pounds (908 kilograms).

The overall dimensions of the transmitter are:

Height	79¼ inches	201. centimeters
Width	82 inches	208. centimeters
Depth	22 inches	56. centimeters

The overall dimensions of the antenna arrays are:

Height (above ground)	13 feet	3.97 meters
Width	19 feet	5.79 meters
Depth	19 feet	5.79 meters

The transmitter equipment is housed in a three-section relay track type cabinet formed of $\frac{1}{16}$-inch steel. A base common to the three sections is formed of ⅛-inch steel. The entire cabinet, including the doors and base is copper plated prior to painting to provide resistance to corrosion and to give good electrical contact between sections.

RA-12 RECEIVER

General — The type RA-12 instrument landing receiver, when used in conjunction with the type TG-12 instrument landing transmitter installation, provides indications in elevation and azimuth which allow the pilot of an aircraft to make safe landings entirely by the use of instruments. The receiver operates on a single fixed frequency (93.9 megacycles) and thus requires no remote control accessories other than a power on-off switch. A Type

IN-3 Crosspointer instrument gives the indications in elevation and azimuth.

Circuit—Type RA-12 instrument landing receiver consists of a special balanced detector and a dual channel audio amplifier which operate in conjunction with the space patterns created by the TG-12 transmitter and its associated antenna arrays to give the proper indications on the crosspointer instrument.

Sensitivity—Sufficient to produce satisfactory azimuth and elevation indications 22 miles (35 kilometers) from the airport at an altitude of 3000 feet (900 meters), or 32 miles (48 kilometers) from the airport at an altitude of 7000 feet (2100 meters).

Power Requirements—Power supply for the receiver is self-contained. The total consumption from a 12-volt primary power source is 2.0 amperes.

Antenna and Transmission Line—A horizontal circular dipole of special design, about twenty inches in diameter and provided with a matching stub for concentric feedline, has been found to be the most satisfactory antenna.

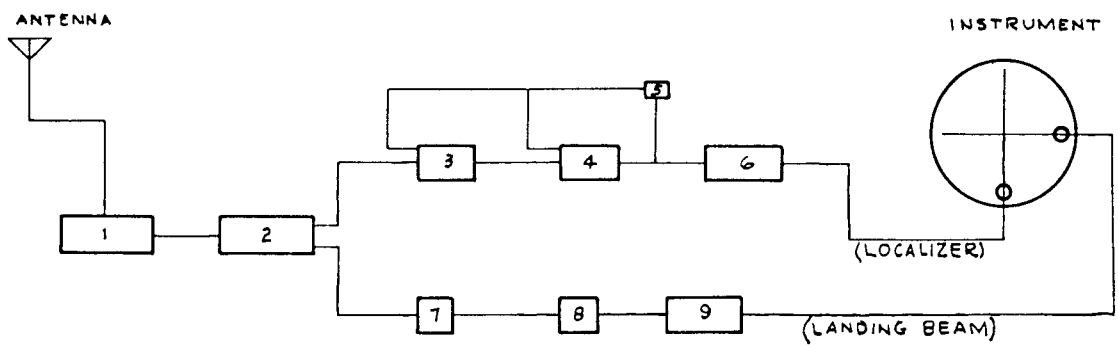
IN-3 Crosspointer Indicator Meter—Two movements in a single case are positioned so that the needles are perpendicular to one another when the correct path of the system is followed. One of the movements, which is a 300 DC microampere full-scale meter, provides the elevation indications. The other movement is of the dynamometer type which supplies the azimuth indications. The latter movement is used as a frequency discriminating network. The needle's position either to the right or the left of "on-course" is dependent upon the amplitude of the predominant frequency being received. When the two audio frequencies being received are equal in amplitude, the needle will be in the "on-course" or centered position. The 90-cycle frequencies cause the needle to move to the right and the 70-cycle frequencies cause the needle to move to the left when the ship is approaching the field.

Component Units and Weights—

1—Type RA-12 receiver; complete with vacuum tubes; power supply; shockmount base
26.5 pounds— 12 kilograms

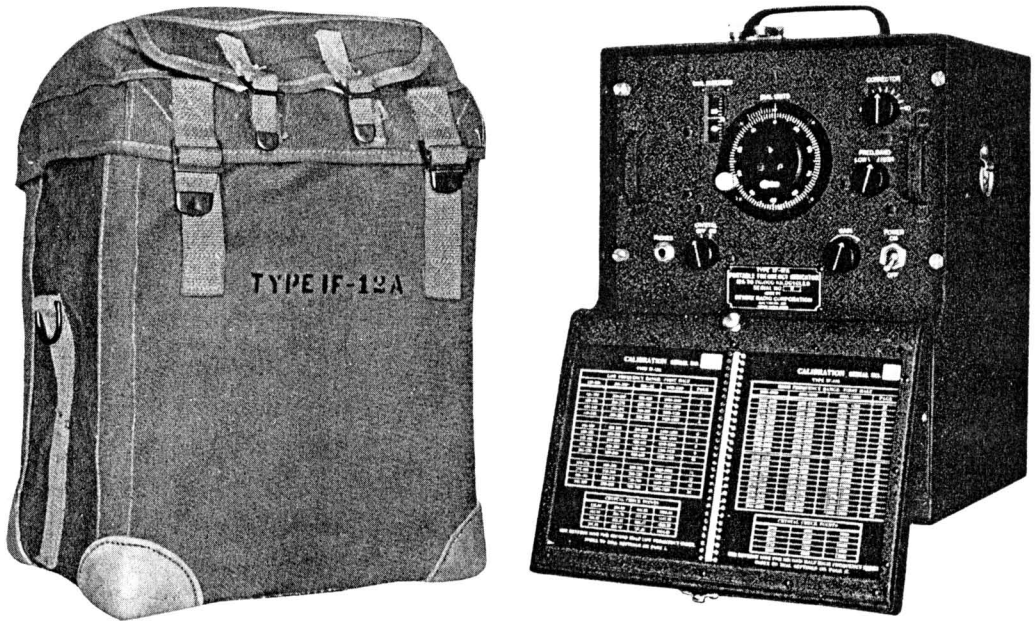
1—Type IN-3 crosspointer indicator meter
2.5 pounds—1.1 kilograms

Remarks—The system as described has been installed in several countries throughout the world and thousands of safe landings have been made under conditions of no visibility.



1. Detector
2. Band—Pass Filter
3. Audio
4. Audio
5. AVC Tube
6. Separation Filter and Rectifier
7. Amplifier
8. Amplifier
9. Rectifier and Limiter

FUNCTIONAL DIAGRAM OF THE RA-12 INSTRUMENT LANDING RECEIVER



IF-12 Portable Frequency Indicator Equipment

MODEL IF-12 PORTABLE FREQUENCY INDICATOR EQUIPMENT

General—The model IF-12 Portable Frequency Indicator Equipment provides a simple, accurate and reliable means of calibrating both transmitters and receivers. Since it is completely portable and self-contained, it is particularly useful for adjusting aircraft transmitters and receivers in the field. It is also a versatile piece of laboratory equipment.

Circuit—A crystal controlled reference oscillator is used to correct the calibration of a heterodyne oscillator, the output of which is mixed in a high gain detector with the frequency being measured. Part of the output of the heterodyne oscillator is radiated for use in calibrating radio receivers.

Frequency Range—125 to 20,000 kilocycles; 2400 to 15 meters.

Accuracy—The IF-12 will generate a standard frequency or measure an unknown frequency with an accuracy of .01 per cent or within 500 cycles—whichever is the greater.

Calibration—There are 5000 full divisions on the dial and a vernier scale which permits setting to within one tenth of one division. Each dial is individually calibrated for every kilocycle between 125 and 2000 kilocycles and every 10 kilocycles between 2000 and 20,000 kilocycles. This calibration is corrected against crystal check points before using the IF-12. The "corrector" knob is used for this purpose.

Power Output and Sensitivity—The radio frequency output of the heterodyne oscillator is in excess of 100 microvolts at any frequency within the calibrated range. An audio output of 3 milliwatts at 1000 cycles per second into a 20,000 ohm resistive load is available with an input signal of approximately 100,000 microvolts from an external source.

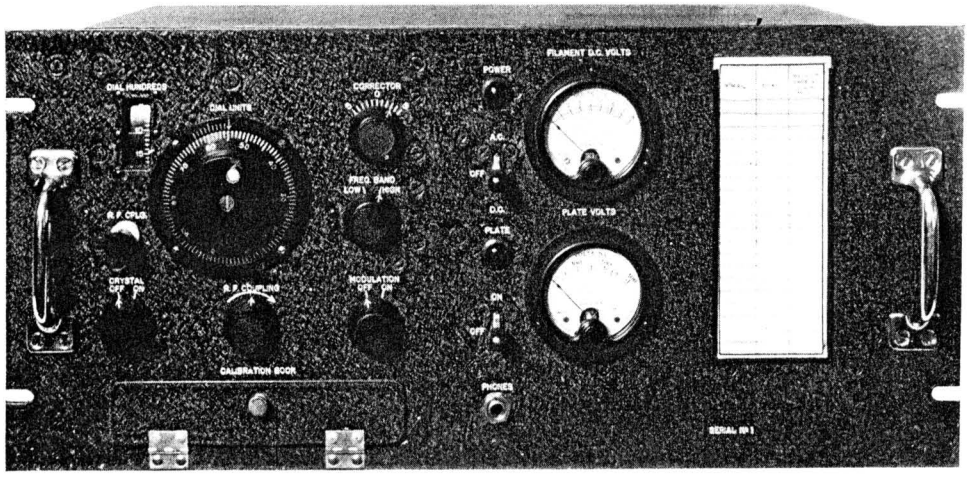
Power Consumption—Battery drain at specified voltage limits are:

5.4 to 6.0 volts, 0.86 to 0.92 amperes
121.5 to 135.0 volts, 0.0131 to 0.0173 amperes

Weights and Dimensions—

Weight	38.5	pounds—17.5 kilograms
Width	10	inches—25.4 centimeters
Height	13⅞	inches—35.2 centimeters
Depth	9⅞	inches—25.1 centimeters

Remarks—The equipment is furnished with a canvas carrying case. The unit itself contains space for all necessary batteries as well as spare tubes. Headphones are required but do not form part of the equipment.



IF-9 Frequency Indicator

MODEL IF-9 FREQUENCY INDICATOR

General—The IF-9 Frequency Indicator Equipment is a non-portable version of the IF-12 apparatus described on page 18. It is nearly identical in performance with the IF-12, differing only in frequency range dimensions and the addition of facilities for operation from 105 to 120 volt, 60-cycle, single phase power source as well as external batteries.

Frequency Range—195 to 64,000 kilocycles; 1538 to 5 meters.

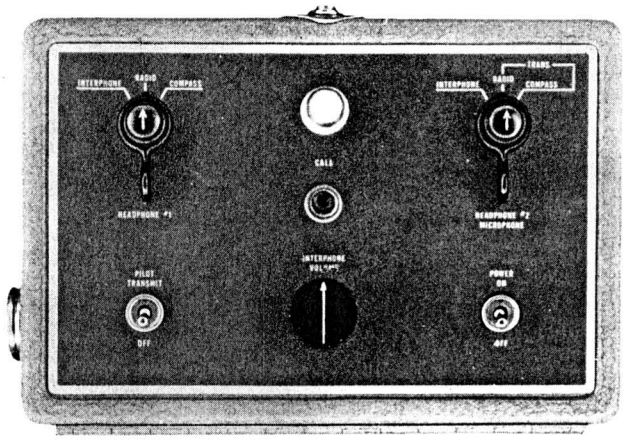
Accuracy—The IF-9 will generate a standard frequency, or measure an unknown frequency with an accuracy of .02 per cent between 195 and 3000 kilocycles (1538-150 meters) or .01 per cent between 2000 and 64,000 kilocycles (150-5 meters).

Power Consumption—31 watts at 120 volts, 60 cycles. When used with external batteries the drain is same as specified for IF-12.

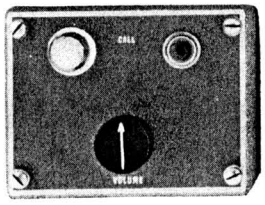
Dimensions and Weights—The IF-9 is designed for mounting in a standard 19-inch, (48.3-centimeter) relay rack, requiring 8¾ inches, (22.2 centimeters) of mounting space. The panel is finished in durable blank wrinkle enamel, and the chassis and dust cover are sandblasted and coated with clear lacquer. The dust cover is removable without disturbing the mounting of the unit.

The weight of the equipment, including cables, tubes and calibration books, is 27.03 pounds (12.27 kilograms).

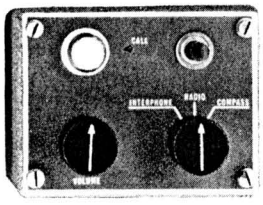
Remarks—Characteristics other than those listed above are the same as specified for the IF-12 equipment.



(A) MI-11 Operator's Unit



(B) MI-13 Station Box for Communication over Interphone System



(C) MI-12 Pilot's Station Unit

MI-11 INTERPHONE EQUIPMENT

The Bendix MI-11 Interphone equipment provides inter-communication between the radio operator and any other members of the crew of the modern transport or military aircraft. While the number of stations may vary, the primary requirements of an interphone system are usually such that the radio operator has complete control over both the interphone system and the radio communication equipment, that at least one other station also has the ability to transmit and receive over the radio equipment, and that sufficient stations be available to permit communication between all members of the crew. These requirements are met through the use of one MI-11, one MI-12 and a number of MI-13 units. Either a low-level dynamic microphone or a high-level carbon microphone can be used.

Functions—The MI-11 operator's control unit contains the amplifying circuits and all major controls. Its wiring is such as to permit the use of split headphones, either one of which may be individually switched for reception from the interphone system, radio receiver, or radio compass. The operator may transmit over either the interphone system or the radio transmitter. A separate switch permits connection of the pilot's station microphone into the radio transmitter circuits.

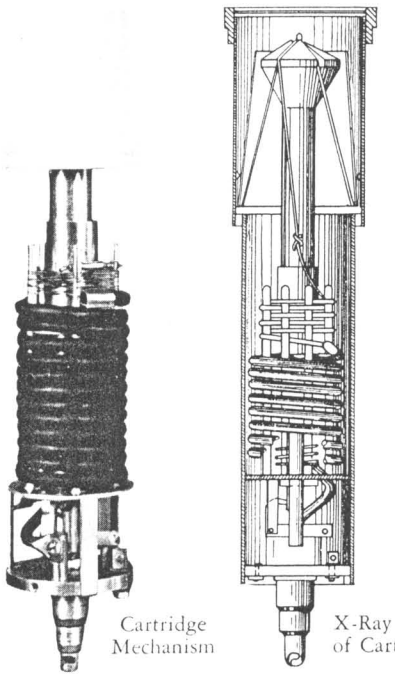
The MI-12 pilot's station may have its headset switched for reception from the interphone system, radio recevier, or radio compass. Its microphone may be switched to either the interphone system or the radio transmitter.

Characteristics—One watt of audio power available at 500 ohms. Gain sufficient to operate from low level dynamic microphone (—40 decibels).

The MI-13 station boxes are used only for communication over the interphone system.

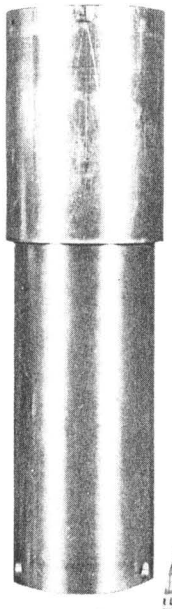
Dimensions and Weights—

MI-11 operator's control unit	9.0	pounds—4.1 kilograms
Length	9¾	inches—24.8 centimeters
Width	6½	inches—16.5 centimeters
Depth	3¾	inches— 9.5 centimeters
MI-12 pilot's station	.8	pounds— .36 kilograms
Length	4	inches—10.2 centimeters
Width	3⅛	inches— 7.9 centimeters
Depth	2 3/16	inches— 5.6 centimeters
MI-13 station box	.75	pounds— .34 kilograms
Length	4	inches—10.2 centimeters
Width	3⅛	inches— 7.9 centimeters
Depth	2 3/16	inches— 5.6 centimeters



Cartridge Mechanism

X-Ray View of Cartridge



Cartridge Receptacle

MS-26 Control Unit Provides Independent Control and Indication of Operation for *Two* Cartridges

CLEARS UP RADIO STATIC DURING RAIN OR SNOW

"Static was so severe we were unable to get message through. Released Bendix Static Cartridge. Immediately static cleared up on both long and short wave."

—from an airline pilot's log.

BENDIX STATIC SUPPRESSOR

The purpose of the Bendix anti-static cartridge equipment is to reduce precipitation static which results from the corona discharges normally present while flying through rain or snow storms. The accumulated static charge on the airplane is dissipated into the air through a 1.5 meter length of small diameter wire which is connected through a 1.5 meter flexible resistance to the tail of the aircraft. The static charge leaks off the wire rather than off the plane because of the small diameter of the wire with respect to other radii of curvature on the aircraft. The flexible resistor prevents the generation of high amplitude transients and also removes the discharge from the proximity of the receiving antenna.

The operation of the Bendix static suppressor is extremely simple. No adjustment to be made—no complicated procedure to learn. Replacement cartridges can be installed easily and quickly.

The simplified design of the ejector mechanism provides trouble-free operation even under the most adverse icing conditions. Tell-tale lights on the control panel give positive indication when the dissipator is properly extended. Once released, the operation of the static suppressor is completely automatic. There is nothing to go wrong—nothing to require the pilot's attention.

Low in initial cost, the Bendix static suppressor requires no maintenance except to replace dissipator assemblies which may become damaged in landing. Cartridges may be refilled in the field with dissipator assemblies at very low cost.

Bendix Static Suppressor can be installed on any type of plane by the addition of one or two cartridge receptacles described in the table below as MM-4. This receptacle normally is placed below the rear tail-light behind the rudder. Cartridges (MM-3) and control panel (MS-26), properly wired, complete the installation.

Dimensions and Weights—

MS-26 Control Panel (Equipped with two Switches) . . . . . 0.5 pounds—.23 kilograms
Length . . . . . 5¼ inches—13.4 centimeters
Height . . . . . 3¼ inches— 8.3 centimeters
Depth . . . . . 2 inches— 5.1 centimeters
(Behind panel)

MM-4 Cartridge Receptacle (One required for each cartridge) . . . . . 1.0 pound—.45 kilograms
Length . . . . . 9½ inches—24.2 centimeters
Diameter . . . 2½ inches— 6.4 centimeters
(The above dimensions for cartridge and receptacle assembled together).

MM-3 Cartridge only . . . . . 1.0 pound—.45 kilograms

P-16471 refill kit consists of fine wire, flexible resistor, paper cone, and associated swivel connectors.

RADIO RANGE BEACON EQUIPMENT

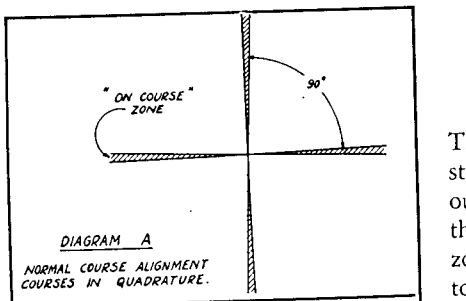


DIAGRAM A

NORMAL COURSE ALIGNMENT COURSES IN QUADRATURE.

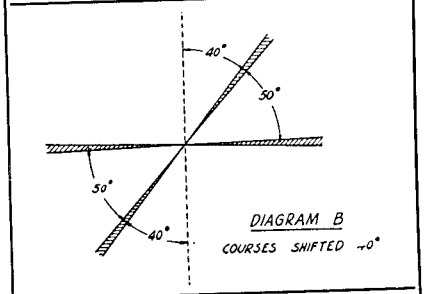


DIAGRAM B

COURSES SHIFTED ±0°

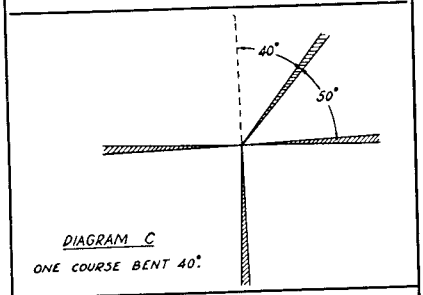


DIAGRAM C

ONE COURSE BENT 40°.

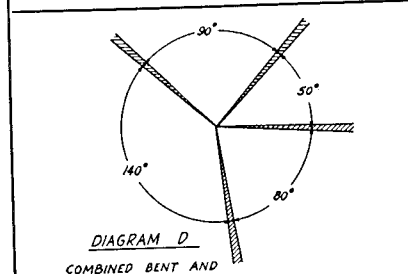


DIAGRAM D

COMBINED BENT AND SHIFTED COURSES.

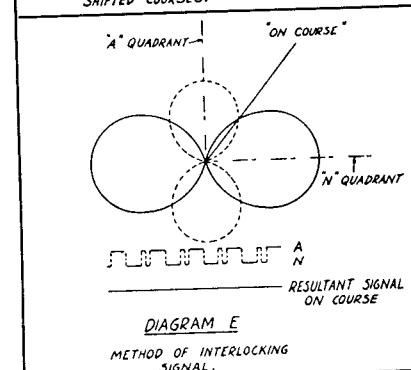


DIAGRAM E

METHOD OF INTERLOCKING SIGNAL.

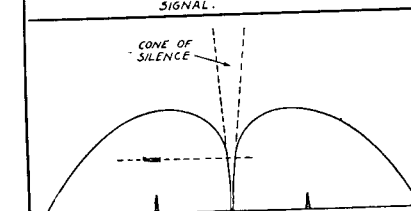


DIAGRAM F

VERTICAL FIELD PATTERN OF RADIO RANGE BEACON.

The so-called Radio Range Beacon is a transmitting device, installed on the ground, generally adjacent to an airport. It sends out energy which combines along predetermined paths to furnish the plane with an "on course" signal. These "on course" signal zones, or "beam" paths are arranged to lie along the proper route to the next airport. Each station is capable of transmitting four such courses. While considerable leeway in adjusting the relative positions of these courses is possible, there is a limit to the combinations obtainable. In general it is desirable to keep the courses straight lines passing through the station, and perpendicular to one another. Such an arrangement is illustrated in Diagram A. Under these conditions the station operates with maximum efficiency and stability. If some reduction in efficiency can be accepted, resulting in a decreased range on some courses, the courses can be shifted. Shifting courses consists of changing the pairs of courses from their perpendicular relation. This is illustrated in Diagram B. Course shifts are limited to about 40 degrees. Greater shifts than this result in unsatisfactory operation of the station.

If the station is properly installed on suitable ground so that some loss in stabilization is permissible, it is also possible to introduce course bends. Course bending consists of changing the courses from their reciprocal relation to one another. This is illustrated in Diagram C. Course bends are likewise limited to about 40 degrees. Course bending can also be combined with course shifting to secure almost any arrangement of the four courses, with one limitation. No two courses can approach each other closer than 50 degrees nor be farther apart than 130 degrees. Adjusting the courses beyond this figure results in unsatisfactory operation of the beacon. Diagram D illustrates the case where course bending has been combined with course shifting.

As stated before, the beacon course is identified by a particular signal. It operates in the following manner. Two figure-of-eight patterns are radiated alternately by the station. One of these patterns is keyed with a characteristic dot-dash signal, the other is keyed with a characteristic dash-dot signal. This keying is so arranged that the two signals interlock, that is, the character of one pattern is being transmitted during the space of the other. If both signals are received with equal intensity, they are indistinguishable, and the pilot hears a steady tone. The course, then, is along the line of equal field strength of the two signals. Diagram E illustrates the manner in which this is accomplished. If the pilot gets off course, veering to one side or the other, one of the characters becomes louder than the other. The effect is that the pilot hears a distinct dot-dash or dash-dot, depending upon the side on which he has left the course. When he returns "on course" the signals blend again into a steady tone. By determining which character is evident in his earphones, he can correct his direction of flight to return to the "on course" zone. Equipment can also be provided for visual operation. Instead of applying the signal to earphones, it is applied to a panel instrument which indicates to the left or right when the plane leaves the "on course" zone.

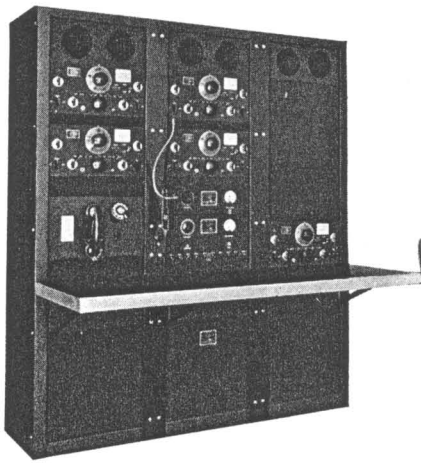
In addition to the course indication, the beacon provides a "cone of silence," marking its exact location. Due to the directional character of the beacon signal, there is no energy radiated directly above the station. When a pilot approaches a beacon station, he is first warned by a rapid increase in received signal strength, then, as he

passes directly over the station, this signal suddenly drops completely out and returns as he strikes the beam on the far side of the station. This phenomenon is illustrated in Diagram F. The "cone of silence" is utilized by pilots to determine when they have reached the station and its adjacnt airport, while flying above the overcast or in thick weather. Since the position of the station with respect to the field is known, the pilot uses the "cone of silence" to mark the beginning of his "instrument" descent.

The following equipment constitutes a complete station:

A. Remote Control Equipment

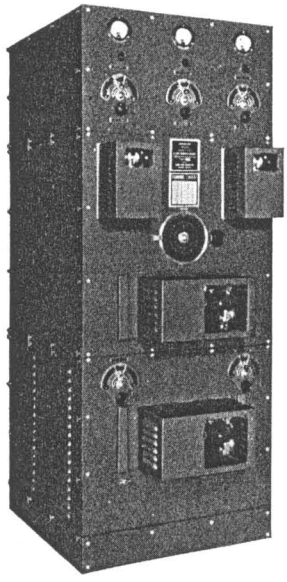
This equipment includes two cabinet type racks, one to be installed in the operations office of the local airport and one in the station house. The rack at the control point contains a microphone, speech amplifier, volume indicator and monitoring panel. It is also provided with a standard telephone-type dialing mechanism for controlling the transmitting equipment. The rack at the station house contains the telephone-type selector switch and primary relays for controlling the transmitter. It also contains a double rectifier unit which provides voltage for dialing the remote control unit and the range keying devices.



Radio Range Remote Control Equipment

B. Two Complete Radio Frequency Transmitters

These transmitters are provided complete with tubes and crystals, and everything necessary for taking power from the commercial power lines and delivering it to the antenna coupling system as radio frequency energy. One of these transmitters is utilized to radiate the beacon side band and one is utilized to radiate the carrier. The carrier is modulated in its own transmitter to carry weather broadcasts to the airplane pilot. The two signals are prevented from interfering with one another by the use of properly designed filters in the transmitting and receiving equipment.



Radio Range Antenna Coupling Unit

C. Radio Range Coupling Unit

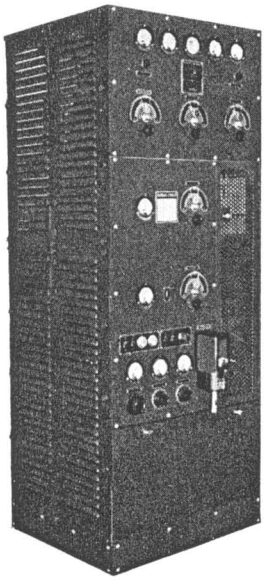
This unit includes a goniometer, the various keying devices, artifical lines, etc., necessary for setting up the required beacon courses. It is assembled as a single unit, similar in size and appearance to the transmitter units. Except for the connecting cables, no external wiring is required.

D. Five Antenna Tuning Houses

One of these houses is installed at the base of each of the vertical radiators. Each house contains the necessary tuning units for terminating the transmission lines and coupling their energy to the radiators. In addition, appropriate circuits are included for lighting the radiators in accordance with Department of Commerce specifications. This is accomplished with negligible loss of radio frequency power.

E. Power Distribution Cabinet

This unit is utilized for terminating the incoming commercial power lines and distributing the circuits properly to the various units of the technical equipment. Included with this unit are a lighting transformer and lighting contactor to be used in conjunction with the tower radiator lights.



Radio Range Transmitter

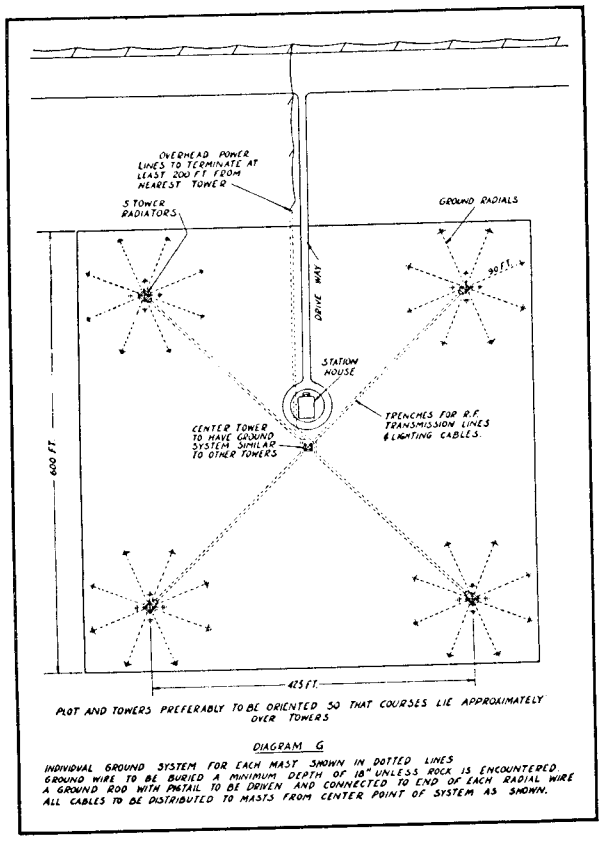


DIAGRAM G

INDIVIDUAL GROUND SYSTEM FOR EACH MAST SHOWN IN DOTTED LINES
GROUND WIRE TO BE BURIED A MINIMUM DEPTH OF 18" UNLESS ROCK IS ENCOUNTERED
A GROUND ROD WITH PIGTAIL TO BE DRIVEN AND CONNECTED TO END OF EACH RADIAL WIRE
ALL CABLES TO BE DISTRIBUTED TO MASTS FROM CENTER POINT OF SYSTEM AS SHOWN.

RANGE BEACON EQUIPMENT
(Continued)

The following *additional material is required* and is generally supplied on separate order:

F. Radio Frequency Transmission Line

Bendix equipment utilizes the latest type of gas-filled concentric tubing line with Isolantite insulation. Fifteen hundred feet are required per station.

G. Five 125-Foot Radiator Towers

Bendix equipment can be supplied with the latest type of elevated towers, equipped with counterpoises and rain shields. These towers are impervious to rain, sleet and snow. They guarantee absolutely stable courses.

H. Miscellaneous Electrical Material

This material includes power cable, lighting cable, and other wire and hardware for installation of the technical equipment and its connection to the commercial power supply. It also includes approximately 5,000 feet of #6 hard drawn copper wire for the ground system and 64 eight-foot ¾-inch copperclad steel ground rods.

It is usual for the purchasing agency to *provide the necessary ground and installation facilities. They include:*

a. Transmitter House. This building, illustrated by Diagram K, houses all the technical equipment with the exception of the tuning houses. It should be approximately 24 by 16 feet, heat insulated and adequately ventilated. No heating system is required, as the equipment is designed to operate from minus 15 degrees to plus 50 degrees Centigrade. A wooden frame or brick veneer building is satisfactory.

b. Ground Plot. This plot should be approximately 600 by 600 feet, properly drained and graded. Refer to Diagram G.

c. Protective Fence. Not essential but desirable. A fence of the hurricane type should be used.

d. Power Control Lines to within 200 feet of the station plot.

TYPICAL MODEL—OTHER TYPES AVAILABLE

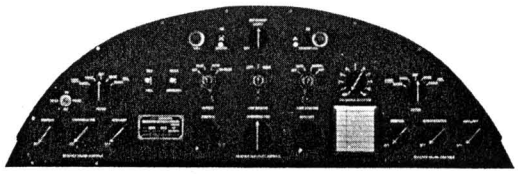
Service	Simultaneous weather broadcast and beacon operation
Range	75 to 125 miles
Ground Requirements	600 by 600 feet
Housing	16 by 24 feet. Tile and brick veneer
Antenna Type and Equipment	Five—125 foot insulated tower radiators on concrete bases
Transmitter	Two—400 watt
Range Coupling Unit	One—Type T with artificial lines
Antenna Tuning Houses	Five required
Remote Equipment	Microphone amplifier, monophone panel, and Strowger automatic switching
Lighting Equipment	750 V. A. transformer and contactor
Obstruction Lights	Four—Double Eight—Single
Lighting Cable	1500 feet #12 Duplex Armored
Power Cable	500 feet #2 Duplex Armored
Power Supply	10 kilowatt 110 or 220 volt 50/60 cycle single phase
Miscellaneous Electrical Material	

MISCELLANEOUS ACCESSORIES

The following is a partial list of the many Bendix Radio accessory items.

Control Panels

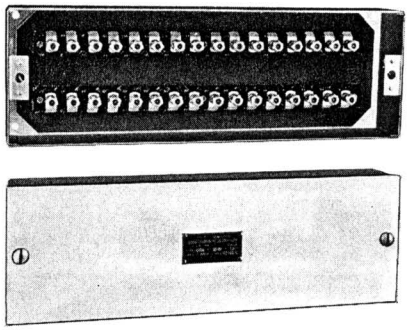
Bendix engineering extends beyond the laboratory to design coordinated control systems and equipment individually tailored for particular aircraft and particular requirements. The MS-6 radio control panel was designed for a specific Lockheed Lodestar installation.



MS-6 Control Panel

Junction Boxes

As a part of the policy of engineering *complete* aircraft radio installations, Bendix manufactures junction boxes of various sizes. The MS-14 series is available with either 14, 32, or 46 terminals. All terminals are numbered and are mounted on a light-weight moulded strip with guide posts to prevent shorts between adjacent connections.

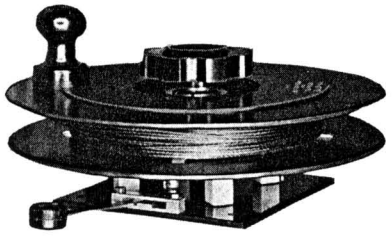


MS-14 Junction Box

Antenna Accessories

The MT-48 antenna insulator is specially designed to withstand high electrical potentials encountered with long-wave operation into fixed antennae. It is available with ice shield. The MT-5 trailing antenna reel is a dependable unit used in many installations and is furnished with a disengaging ratchet.

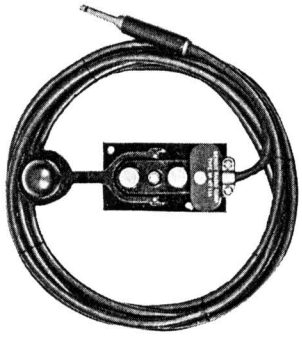
MT-48 Antenna Insulator



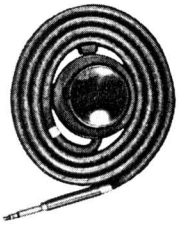
MT-5 Antenna Reel

Telegraph Keys—Microphones

The MT-11 flame-proof telegraph key is available with or without a leg strap for portable work. The MT-42 hand microphone and the MT-81 throat type microphone (not illustrated) are both high quality units which produce approximately 6 milliwatts of power from normal speech.



MT-11 Telegraph Key (without leg strap)



MT-42 Hand Microphone