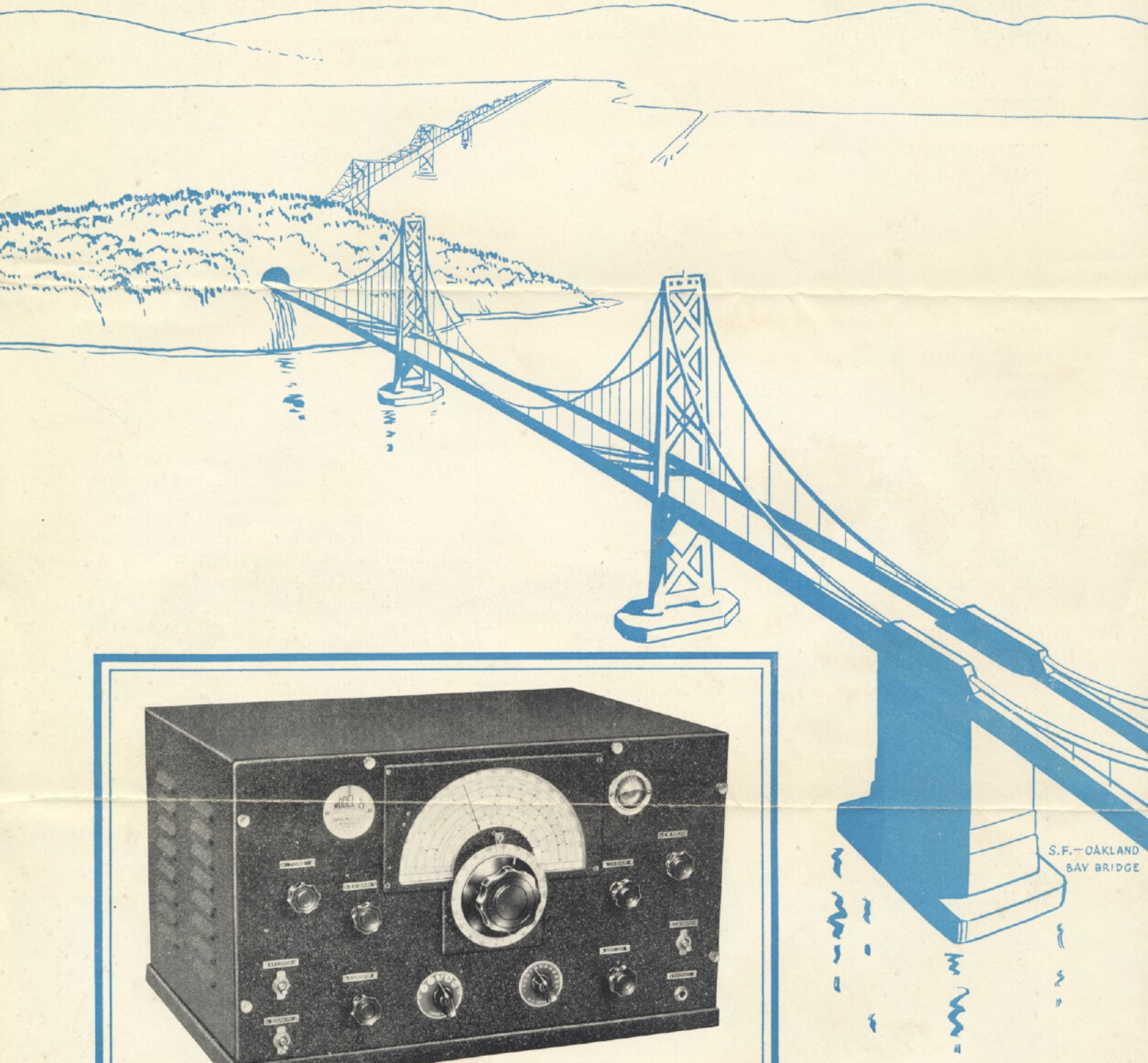
# An Engineering Achievement






SARGENT MODEL 21 COMMUNICATION RECEIVER

MODEL 21 is a radio engineering achievement of the first order. Both mechanically and electrically, this receiver has been constructed to the very finest standards. Prime consideration throughout has been given to the electrical efficiency and the layout has been arranged accordingly. Efficient reception at high frequencies requires short, direct leads, with individual parts so arranged as to make this possible. Coils, condensers, etc., associated with input circuits must be removed, and shielded from the output part of the receiver, otherwise feedbacks occur. With proper arrangement of parts and wiring, high efficiency and stability are obtained, and these two factors have been the objectives in designing and laying out Model 21.

## THE CIRCUIT

Model 21 is a super-heterodyne, and uses 12 tubes including the rectifier. The input circuit consists of a single stage of sharply tuned radio frequency amplification in combination with a regenerative circuit. This gives an extremely sensitive, non-critical regenerative input over the entire tuning range. The amplification and selectivity of this regenerative input stage are greater than that obtainable with 2 stages of non-regenerative amplification.

A 6L7 tube is used as a mixer, or 1st detector, with separate high frequency oscillator. The intermediate amplifier consists of 2 stages of Litz-wound, iron core type transformers. Second detector is a triode with separate A. V. C. and Beat Oscillator tubes. The output stage is a 6F6 pentode. A 6E5 shadow tube is used as a tuning indicator.

## THE TUBE LINE-UP

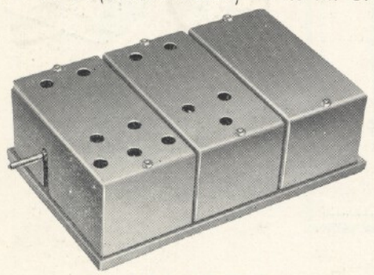
Tube line-up is as follows: 6K7 R. F. stage, 6J7 regenerator, 6L7 mixer, 6J7 H. F. Oscillator, two 6K7 I. F. stages, 6C5 2nd Detector, 6J7 Beat Frequency Oscillator, 6J7 Amplified A. V. C., 6F6 Audio, 6E5 Tuning Indicator, 5Z3 Rectifier.

## AMATEUR AND COMMERCIAL MODELS

Model 21 is supplied for both Amateur and Commercial (Marine) tuning ranges. Amateur model tunes from 9.5 to 550 meters, Commercial model from 9.5 to 3750 meters. With the exception of tuning ranges these 2 receivers are identical in every respect. The Commercial tuning range is continuous, there being no skips or dead spots. The dial is marked with shaded areas for both the short wave ship bands and amateur bands. Calibration is in M.C. from 9.5 to 200 meters, and in K. C. from 200 to 3750 meters. Efficiency is very high on 600 meters and on the beacon and time signal wavelengths.

## TUNING BANDS

The Amateur model has 5 tuning bands, as follows: 32-18 M. C., (9.5-16.7 meters)—18-9 M. C. (16.7-33.3 meters)—9-4 M. C. (33.3-75 meters)—4-1.5 M. C. (75-200 meters)—1500-550 K. C. (200-545 meters).



Model 21 Coil Unit

The Commercial model has the 5 tuning bands above, plus two more, as follows:

550-200 K. C.

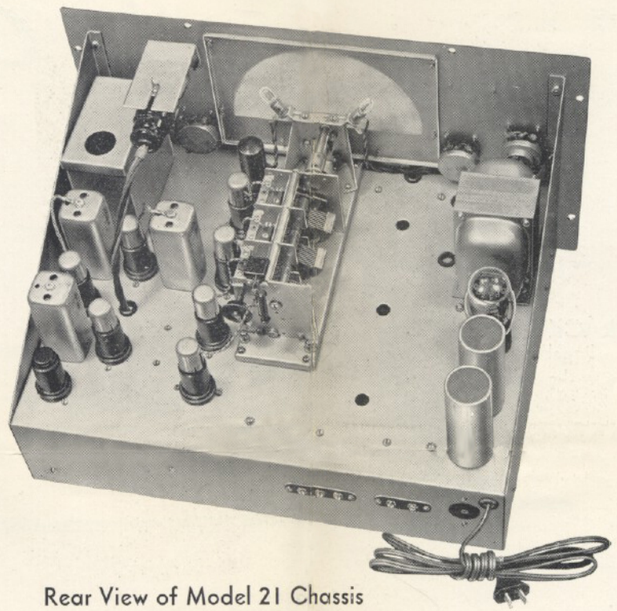
545-1500 Meters

200-80 K. C

1500-3750 Meters

## REGENERATIVE INPUT

The most important circuits in any radio receiver are those associated with the input. These circuits must deal with extremely weak signal currents, before amplification. The input circuits have the responsibility of conducting the weak signal currents, with a minimum of loss, from the antenna to the grid of the first tube, at which point amplification commences. The stronger the signal that is applied at this point, the less the amount of amplification needed in the rest of the receiver to produce a given output, and consequently the less the tube hiss and other receiver noises. Thus the signal-to-noise ratio of the entire receiver depends entirely upon input sensitivity. Distance range also is dependent upon this. Signals, weak to start with, and suffering too much power loss in the input circuits reach the first tube with too low a voltage to rise above the hiss level. Under such conditions, no amount of amplification later on in the receiver will bring them back; they are permanently lost.

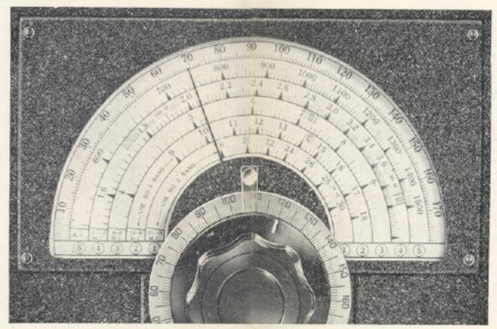


Rear View of Model 21 Chassis

The importance and desirability of regeneration at the receiver input have always been recognized. However, it has been seldom used because, in the past, complication of the receiver tuning has always resulted. By the use of a new type of regenerative circuit, with a separate tube to provide the regenerative function, this difficulty has been completely eliminated. The Model 21 input consists of 2 tubes, with grids connected in parallel. One is the R. F. stage tube, 6K7, which is operated at all times at full voltage, and hence at peak efficiency. The other, the regenerative tube, has its bias controllable from the panel, and this, in turn, controls the regeneration. Even with regeneration all the way off the R. F. tube is still acting as an efficient amplifier, and on strong signals where sensitivity is unimportant, the receiver is usually operated that way. However, when it is desired to tune in weak signals, the regeneration is brought up to a peak, greatly increasing the sensitivity and selectivity of the input. The I. F. amplification is correspondingly reduced, keeping the noise at a minimum, and the signal is brought through the receiver with the best possible signal-to-noise ratio.

## NOISE CONTROL

The action outlined above gives the operator a considerable amount of control over the noise level. By holding down the I. F. amplification the peaks of voltages due to static, automobile interference, etc., can be restricted to a fairly low level. At the same time the extremely sensitive input is building the signals up to this level with the result that signal and noise enter the 2nd detector on fairly even terms. Because of the fact that it works equally well to restrict all forms of noise interference, this system will give better all-around results than noise suppressors which operate only on certain kinds of noise.



Dial and Band Spreader

## R. F. GAIN CONTROL

A panel control is provided to control the bias on the R. F. amplifier tube separately from other adjustments. This makes it possible to apply an increased bias to this tube when receiving on a frequency adjacent to a very strong signal. While some sensitivity is lost by doing this, the extra bias prevents the grid from going positive and ruining the selectivity of this stage. Consequently this bias control makes it possible to work very close to the frequency of a strong station without "blanketing." This is one of the most important controls on the receiver.

## R. F. STAGE TRIMMER

Receivers employing one or more of the usual broad tuning type of R. F. stages can use fixed R. F. trimmers inside the coil unit, and with careful design the tracking will be close enough for all practical purposes. Not so with a regenerative stage. Regeneration sharpens the input to a point where it has more selectivity than an I. F. stage, and a panel adjustment is necessary. This adjustment is not critical, and for a small band, i.e., an amateur or short wave ship band, need not be made more than once. Many experienced operators prefer a panel trimmer on any receiver. Adjustment of this trimmer has no effect whatsoever on frequency.

## POSITIVE RE-SET DIAL

Illustration shows the main tuning dial, with clear cut, easily read calibration. The chrome plated dial, on the large tuning knob, is geared to the main dial indicator and furnishes a micrometer scale by which the main indicator may be re-set exactly to the frequency of any desired station, once its setting has been determined. Many times, an operator will desire to return to the setting of a weak station heard at some previous time, and unless an exact dialing indicator is available this will be very difficult. The arrangement used on Model 21 solves this problem.

## THE BAND SPREADER

The chrome plated dial serves also as a band spreader on the wide amateur bands. This dial makes 4 complete revolutions while the main indicator is travelling from 0 to 180 degrees. From this information, the amount of spread can be calculated for any given band. For the narrow bands, the indicator on the skirt of the tuning knob is used, and its travel measured along the markings on the chrome dial. The knob makes 5 complete revolutions for each one of the chrome dial, and gives about half a dial spread on the narrow amateur bands.

## "RED HOT" ON 10 METERS

Although the efficiency of Model 21 is very high over the entire tuning range, we feel that special comment as to results on the 10 meter band is in order. It has been customary in the past to describe receivers as "getting down to 10 meters," as if this were an accomplishment additional to the basic objectives of the design. In the last year, 10 meters has become a most important band, and we prefer to describe Model 21 by saying that it starts at 10 meters. Model 21 has been laid out as a 10 meter receiver, coils for this band being given preferred positions, separate bypasses, etc., being used. It is really a receiver within a receiver, and could be said to consist of a 10 meter tuning system and another system covering the other waves. With this arrangement plus the regeneration, absolute peak efficiency is reached on 10, and Model 21 has a world wide range on this band.

## A. V. C.—MANUAL VOLUME SYSTEM

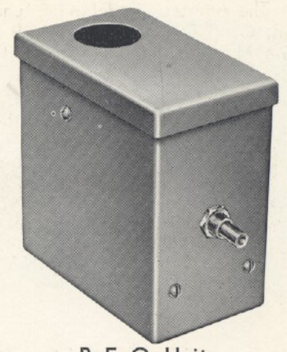
Two types of volume control, with cut-over switch are provided. A separate 6K7 A. V. C. tube is provided, for amplified A. V. C. This permits the use of a triode 2nd detector, necessary for C. W., and desirable for reception of all kinds. A. V. C. action in the regulation of short wave fading is almost perfect. Manual control is effected by varying bias on the R. F. and I. F. tubes. This, in addition to the separate R. F. Gain control gives a very fine degree of possible variation in signal length.

## BEAT FREQUENCY OSCILLATOR

Panel adjustment of the beat note pitch is provided. The B. F. O. itself consists of an entirely self-contained shielded unit, containing tube, coils, resistors and bypasses. (See illustration.) This unit, air spaced from the chassis, completely isolates this oscillator except at point of coupling. Coupling consists of an extremely small capacity from B. F. O. cathode to 2nd detector grid.

## THE COIL UNIT

The coil unit is the heart of any receiver. Model 21 uses the same style of coil arrangement that has proven so satisfactory in the Sargent Model 11 tuned radio frequency receivers. This unit consists of separate coils for each band, with a special switching connection for short-circuiting those to the low frequency side of the coils in use. This completely eliminates "dead-end" loss. Each stage is shielded

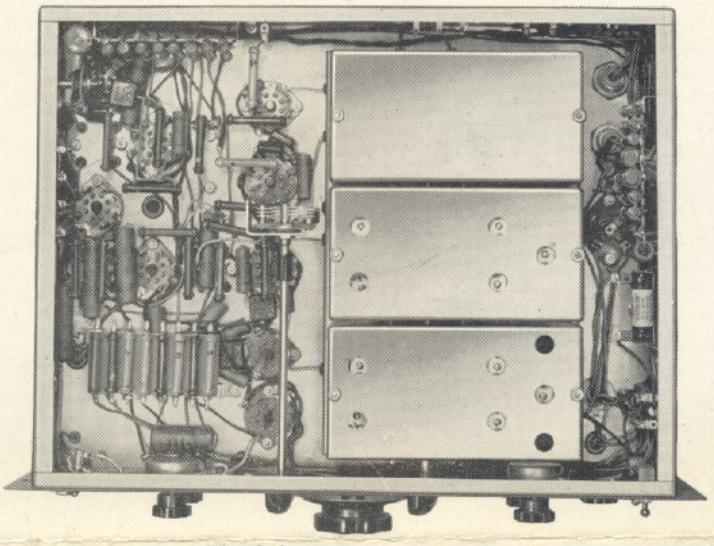


B. F. O. Unit

completely from the others, and the entire coil unit is air spaced from the chassis so as to confine coil currents to the unit itself and prevent them from going through the whole chassis.

## SELECTIVITY

Due to the use of 2 sharply tuned iron core I.F. stages, plus the regeneration when needed, Model 21 is very selective. Selectivity can be made considerably better than 10 K.C. on all bands, and approaches that obtainable in the best crystal filter type receivers. Inasmuch as this degree of selectivity is obtainable in Model 21 without the losses that ordinarily accompany other types of filters, Model 21 is not furnished with a crystal.



Model 21 Bottom View

## HEADPHONES, AUDIO AND SPEAKER

The audio system consists of a single 6F6, with tone control. The output of this tube is connected to a 10" Jensen dynamic speaker. On battery models, a permanent magnet type dynamic speaker is used. An attractive speaker cabinet, with finish to match the receiver, is furnished as part of the regular equipment. This cabinet is of metal, but is completely lined with wood baffling. Resulting tone is very pleasing.

Model 21 has a headphone jack connected in the detector plate circuit. This connection keeps noise level sufficiently low so as not to tire an operator on a long watch, and enables the receiver to be operated at full sensitivity.

## SHADOW TUNING

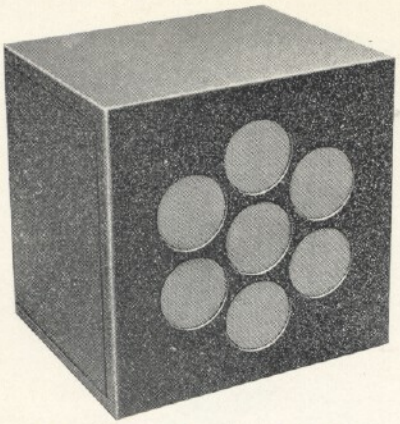
A 6E5 shadow tube is used as a tuning indicator. This is adjusted to be sensitive to extremely weak carriers, and the indicator will respond to practically any audible signal.

## B BREAK

A B break switch is provided on the panel of the receiver. Two insulated terminals for connection to a B break relay are brought out the rear of the chassis. These are in parallel with the switch connections.

## POWER SUPPLY

Model 21 has a built-in power supply. This is thoroughly filtered, and operation is entirely humless.



Model 21 Speaker Cabinet

## CABINET

Model 21 cabinet is ruggedly built along commercial lines. It is made entirely of 18 gauge steel. All joints are spot welded. The cabinet is well ventilated, and extremely strong, serving as a protector of the receiver during shipment and a complete shield when the set is in operation.

## RACK SIZE PANEL

Panel and chassis draw out the front of the receiver by removing the thumb nuts. This allows easy inspection of chassis and tubes without disturbing the power connections. It also eliminates need for hinging the top of the cabinet. Model 21 panel fits standard mounting racks, the chassis being sufficiently narrow to slip between the uprights. Cabinet and panel are finished in a handsome black crackle.

### BATTERY MODEL

Exactly the same as the A. C. set except that there is no power supply and rectifier. Designed for 6 volt operation with 135-180 volt B supply, available in both tuning ranges. Complete shielding of this model makes it excellent for use with loop for direction finding.

### R. C. A. TUBES

A receiver can operate no better than its tubes. We have selected the best ones available—R.C.A. R.C.A. tubes are accepted by amatuers and commercial operators as being the finest, regardless of price, and we regard them as typical of the materials that we have chosen from which to build Model 21.

### DIMENSIONS AND SHIPPING WEIGHT

Length, over all, 19½". Height, including rubber feet, 11¾". Panel size, 10½"x19". Front-to-back, 13¾"—add 1½" for knobs.

Speaker cabinet: Height, 11½", width, 11¼", front-to-back, 10¾".

Shipping weight of Receiver, 67 lbs.; of Speaker and Cabinet, 20 lbs. Total shipping weight, 87 lbs.

### PACKING

Model 21 Receiver is packed in strong wooden shipping box, well padded inside. Speaker in separate, heavy carton. Both are designed to stand shipment to any part of the world.

### REGARDING PRICES

All prices are net, and not subject to further discount. Prices of A. C. models include tubes, power supply, Jensen dynamic speaker, and speaker cabinet. Battery model prices include tubes, speaker, and speaker cabinet, but not batteries. All prices are f.o.b. Oakland, California, and subject to change without notice.

## Net Prices—Model 21

| Operating Voltage | Amateur Tuning Range 9.5–550 Meters | | | Commercial Tuning Range 9.5–3750 Meters | | |
|---|---|---|---|---|---|---|
| | Cat. No. | Price | Code Word | Cat. No. | Price | Code Word |
| 110 Volts 50/60 cycles A. C. | 21-AA | $125.00 | WNAAA | 21-MA | $135.00 | WNMMA |
| 110 Volts 25 cycles A. C. | 21-AB | $128.00 | WNAAB | 21-MB | $138.00 | WNMMB |
| 220 Volts 50/60 cycles A. C. | 21-AC | $128.00 | WNAAC | 21-MC | $138.00 | WNMMC |
| 6 Volt Storage Battery 135-180 Volt B. | 21-AF | $128.00 | WNAAF | 21-MF | $138.00 | WNMMF |


# E. M. SARGENT CO.

212 Ninth Street, Oakland, California, U. S. A.

CABLE ADDRESS, "EMSCO"

MANUFACTURERS OF INTERNATIONALLY-KNOWN AMATEUR AND SHORT WAVE EQUIPMENT