MOBILE-MARINE RECEIVER

Specialized 80 Meter Superhet

Fig. 1. Front view of the Mobile-Marine Receiver.
This receiver departs from the usual amateur gear in that it is designed to cover frequencies used by other services as well as the 3.5 - 4.0 megacycle band. This was prompted by the second thought of the designer, namely boating, and, therefore, the desire to have on hand a receiver which would not only cover the 80-meter band but also monitor the various Marine stations operating between 2.5 and 3.0 megacycles.

Since the keynote of this receiver is compactness with maximum performance and simplicity, no other bands were included. Other bands could have been included, however, as in all hand-switching receivers, the design would have been a compromise and maximum performance could not have been achieved. Also the addition of hand-switching would defeat the keynote of compactness and certainly aid in making the circuit complex instead of simple.

The receiver about to be described is relatively simple and not difficult to build. The average amateur should have no trouble in constructing it and making it work properly.

**DESIGN CONSIDERATIONS**

During the design of this receiver it was realized that probably only a small percentage of amateurs are able hearing enthusiasts. Therefore, provisions were made to allow the builder to select any portion of the 80-meter band, i.e., 3.5, 3.7, and 4.0 megacycles. In other words, for 80-meter operation the receiver can be adjusted to cover only the phone band, 3.8 megacycles to 4.0 megacycles, or as a home station receiver the range can be adjusted to cover the entire 80-meter band.

This is accomplished by merely adjusting the value of the series-pitching capacitor to be discussed later. The total current drain is approximately 80 ma. No external power supplies are utilized, the 6G6 and 6V6 rectifiers being self-contained. Since both of these tubes are sensitive to various forms of noise, the receiver is utilized with the usual 300-volt, 100-milliampere vibrator power supply. Poor preselector with this type of power supply has provided some unhappy moments of seeing B plus voltage when switching from a transmitter driving the full 100 ma to a receiver driving only 40 or 50 ma because of the poor regulation. Voltages produced at this low drain are in the order of 350 to 375 volts which means the tubes are not operating within their proper characteristic conditions. Hence, maximum performance is not achieved.

Eight miniature tubes, including a voltage regulator, are employed in a full wave rectifier circuit. All of the popular superhet functions are incorporated: Antenna trimmer, R-F Gain control, AVC, BFO, Phase Limiter and Volume control. Provisions are also included for phone or loudspeaker operation.

No unusual or tricky circuits have been included in this receiver for the simple reason that any piece of mobile equipment should be both reliable and easily repaired away from home. Trick circuits do not always lend themselves to this requirement.

**ELECTRICAL CIRCUIT**

Refer to the circuit diagram, Fig. 3. A 6G6 serves as an R-F amplifier. This type does not have the gain necessary, however, in the output, it does not produce a sharp cutoff. Therefore, smoothing AVC action is afforded. C1 is the remote pad filter and C3 is the main tuning condenser and C4 is the antenna trimmer condenser.

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**Fig. 3. Circuit diagram of the Mobile-Marine Receiver.**
CIRCUIT CONSTANTS

(R. 42, R. 49. 6.35 ohm. 1/2 watt,
R. 50. R. 51. 562 ohm. 1/2 watt.
R. 52. R. 53. 6.35 ohm. 1/2 watt.
R. 54. R. 55. 6.35 ohm. 1/2 watt.
R. 56: 1000 megohms, 1/2 watt.
R. 57. 1000 megohms, 1/2 watt.
R. 58. 1000 megohms, 1/2 watt.
R. 59: 1000 megohms, 1/2 watt.
R. 60. 1000 megohms, 1/2 watt.
R. 61. 100 megohms, 1/2 watt.
C. C. 1.0045 mfd, 600 volts, 150 watts (Motorola MCR12). C. C. 1.0045 mfd, 600 volts, 150 watts (Motorola MCR12). C. C. 1.0045 mfd, 600 volts, 150 watts (Motorola MCR12).}

(All resistors and capacitors should be specified otherwise.)
As mentioned previously the 15 transformers should be of the make specified. Other manufacturer's could possibly be used and connected in reverse with the same results but it will require some experimenting.

The coil form specified are CTC type LS-4, 1 1/2 inch diameter with a powdered iron slug. Ceramic coil forms can be substituted if desired, however, they should have a powdered iron slug and not a brass slug, if experimenting for the correct number of turns to be wound.

The output transformer, T5, may be of any type which will not overload the channel head or a speaker voice coil. This item is not critical in any respect.

**CONSTRUCTION DETAILS**

It is recommended that the mechanical layout shown in the photographs and sketches be followed faithfully. Considerable thought was given to the mechanical design and layout since compactness is the keynote in any mobile equipment. Note that the various stages are placed in an orderly straight-line manner to allow the wiring to be short and direct as possible. The cabinet was fabricated from 1/8 inch thick aluminum sheet and arranged so that it may be completely disassembled. All components are mounted on the chassis and panel. When the sides, top and bottom are removed, the components and wiring are all easily accessible without poking into corners or small compartments.

The only shield partitions and brackets required are those around the coils and the panel conductors. An inspection of Fig. 3 and Fig. 4 will disclose the details. Dimensions are not given for these parts, however, no difficulty should be encountered as the actual sizes are not critical.

The first step in constructing the receiver is to make the complete cabinet. It is recommended that the parts be made in the following order:

1. - chassis
2. - sides
3. - top
4. - bottom plate
5. - shield partitions and brackets

All parts are made of 1/16 inch thick soft aluminum except the top, shield partitions, and brackets which are made of 1/32 inch thick aluminum. By using this material it is practical to make the bends in a vice by using two pieces of wood between the jaws, and both sides of the work and just long enough to equal the length of the bend. The easiest procedure is to make the bends by using a third piece of wood held in both hands in back of the aluminum and carefully pulling the wood forward and down at the same time. This will result in a smooth even bend. Of course, if a sheet metal brake is available the job will be easier. Threading a piece of soft aluminum is not essential for working small pieces of soft aluminum.

In order to make the chassis, make the lip bends first by clamping the lip portion in the vise and using the larger gap for leverage. The rear of the chassis should be bent down first. Figure 3 gives the dimensions of the chassis excluding the bend and the lip. Figure 6 gives the dimensions of the rear bend and the lip.

Using the chassis as a guide for dimensions, the sides and panel can then be made. It is advisable to make these partly from actual measurements from the bending parts in the order stated above rather than from the drawings as it is difficult to hold exact dimensions when making the bends. A good workman-like job will result if the parts of the cabinet are hand fitted to each other. The cabinet is held together by means of No. 6 x 1/2 inch binding head, self tapping sheet metal screws.

In order to make the padding condenser bracket and shield partitions move rigid, small gussets are formed at the various bends. These gussets are made by placing the bent part over a piece of soft wood and then placing a 1/8 inch diameter steel rod at an angle of 45 degrees on the outside of the bend and striking it with a hammer. This will shape the aluminum under the rod into the soft wood and result in a surprising increase in strength.

The trimmers, B5, B6, and B7, can be mounted by using a dial cord-bracket and the leads cut long enough to allow for extension. Therefore, a dial cord-bracket was desired and a home made transatlantic dial was installed to
to change the frequency range. The dial plate is bolted to the drum with small machine screws and washers.

The beat frequency oscillator condenser, C1, is fastened to the chassis with an angle bracket so that it lines up with the panel hole. A bushing is used in the panel to provide a smooth bearing sur-
face. No commercial beat frequency oscillator trans-
former of small enough size was available but it was necessary to fabricate one. A National Type 53002, 1 H r.f. choke was used in the coil. This choke has three coils. The calibrofe is made at the end of the first coil above the ground end of the coil. A 1/2 inch thick piece of balsa wood forms a support for the old TV transformer and the choke was mounted on it. It is necessary to start the top most end off of the choke coil with a soldering iron and unsaw a few turns so that connections can be made at the bottom of the can. The threaded stud of the r.f. choke is bolted through the original bottom support of the L.T. transformer and the whole assembly is mounted on the chassis in the normal manner. The beat frequency oscillator output is coupled to the second detector by means of capacitor C2 which is a three-inch piece of wire twisted around the lead indicated in the circuit diagram. The coupling is not critical but should be adjusted for good c.w. reception.

The location of the r.f. coils can be determined by an inspection of Fig. 3. They should be centered midway between the chassis and the bottom plate.

The only subassembly required is the terminal board containing the second detector and noise limiter components. This is shown in Fig. 9. This unit can be made from a 1/16 inch thick piece of bakelite or similar material. The terminals can either be No. 2 machine screws or some of the commercially available tippoints. This subassembly should be wired up outside the receiver. Parity long leads should be left so that connection to the points in-
dicated can be made later.

The power and output transformer terminals are located on the rear of the chassis. They are visible in Fig. 7. The output transformer itself is not part of the receiver but rather a part of the loudspeaker.

In wiring the receiver it was found advisable to make up the power cord and the front panel from aluminum and fasten it to the chassis with brackets. This allows the leads to be wired to the proper position. After the wiring is complete and the re-
ceiver and the leads to the panel can be discarded and the complete cabinet assembled.

The filament circuit should be wired first. Next, the stages should be wired starting with the audio output and beat frequency oscillator and working toward the front end of the receiver. The second detector sub assembly is mounted last against the back side of the chassis and wired in.

Tests were made on the receiver and it was complete to see whether load drop would affect stability. No noticeable wires could be found so it is safe to assume that ordinary good wiring practice is all that is necessary to assure satisfactory results.

ALIGNMENT

After the wiring has been completed and rechecked it is necessary to adjust for final results. The r.f. stages should be aligned first in the following order:

With the cover closed and applied, the recovery should be allowed to warm up for a few minutes against a meter. When the meter indicates a reading, the receiver should be connected through a small fixed condenser to the test oscillator and the T3 adjusted for maximum output as indicated by headphones.
Fig. 7. Front panel layout of Mobile-Marine Receiver. A loudspeaker or an output meter. Next, the signal generator is connected to pin 3 of the first LC tube and the slug of T1 adjusted for maximum output. The signal generator should then be connected to pin 4 of the mixer tube and the slug of T2 adjusted for maximum output. This procedure should be repeated several times to be sure that each stage is peaked to the exact frequency. After this has been completed the R.F. section would be aligned on the high end of the tuning range. The main tuning condenser, C9, is set at minimum capacity and condensers C1 and C4 are at maximum capacity and C6 at mid-position. With the signal generator set at 4.3 megacycles and connected to pin 1 of the

(Continued on page 8)

MOUNTING SCREWS

6AV6 - PIN 2

Fig. 9. Sub-assembly diagram.
In the last issue, it was reported the G-B Ham News was starting its seventh year of publication. However, it was also George H. Floyd (W3YTW) last in the annual survey of the publication and he has left us to accept another position within the Company. I believe I can speak for all of you readers to wish George the best of luck with his new adventure and congratulate him for the hang-up job he has done with G-B Ham News. If you follow how W3YTW on the band at anytime give him a call as he will be glad to have a QSO with you.

While we are saying our farewells to George we cannot help but reminisce somewhat of the beginning of this publication. It started back in the early part of 1949 when W2DC, Manager of Sales, Industrial & Transmitting Tube Department, was pondering over the problem of how to reach more of the engineers, technicians, and reparators in regard to G-B electronic tubes. It occurred to W2DC, that most of these fellows were also amateurs, therefore, why not put out a publication for them. So with this in mind, George was given the assignment of originating and producing such a publications. Needless to say, he worked many hours in calculating and planning what to put out that would be different from other Amateur publications. The results were G-B Ham News and yours truly. Dickinmay, Lighthouse Barry, Lighthouse Larry, and Lighthouse Tommy. His true name is Lighthouse Larry but he prefers it as he says he got his name from other names, such as Lamps Post Larry, Lightbournler Harry, Lightbournler Barry, Harrybournler Harry, and Larrybournler Larry, which can not be printed. However in his address, he is always happy to hear from you fellows, Editor's note.

Perhaps some of you would like to know our policy on equipment described in G-B Ham News and who are on the unofficial staff. First of all the policy is very simple as you can see from our Editorial, here.

1.—The equipment described must be of the type which the reader can buy and he reasonably assured of duplicating our results.

2.—The equipment must not require a complete machine shop to construct it, but tools the average fellow can build it. This is the principal reason for employing an expert on each subject, for whom the question is asked if the man with whom no experience in the subject is asked if the subject is a subject that can be done by amateurs.

3.—No complicated or tricky circuits requiring laboratory equipment for proper alignment or test will be used.

4.—Only standard equipments available from local parts distributor will be specified, unless the designer feels it is absolutely necessary to use non-standard components for maximum results.

5.—The technical theory and design must be accurate and practical.

6.—All equipment must be tried and proven and undergo considerable test before it can appear in G-B Ham News.

Believe it or not fellows, as simple as this policy is it is sometimes difficult to meet. We have designed equipment which has not appeared in G-B Ham News because it was either too difficult to build or required laboratory equipment to test.

The unofficial staff, as we like to call it, consists of amateurs who contribute part of their time and efforts. As you probably suspect, they are research associates and engineers of General Electric. Here are their call letters and names:

W3ZCF K. A. Beaudin
W1YW S. G. (Ty) Regele
W3GOV L. F. Jeffrey
W1NJX D. E. Norgaard
W3NO C. W. Blackmon
W3KEL R. L. Watters
W3SMA A. R. Koch
W3RYT G. H. Floyd
W7XKL A. H. Shorbergh
WP5W V. L. Vosler
W3ZHI W. N. Colley
W1PFO A. P. Haase

RH

While we are on the subject of G-B Ham News this seems like the proper time to answer those many requests as to how it may be obtained. This publication is available, free, from your nearest General Electric Tube Distributor. For those of you who find it difficult to obtain in this manner, a subscription plan is in effect. For $1.00, G-B Ham News will be sent to you for one year. (This offer open only in continental USA, Alaska and Hawaii.) Address all inquiries and subscriptions to me, Bldg. 267, Tube Department, General Electric Co., Schenectady N. Y.

Lighthouse Barry
ALIGNMENT (Continued from page 6)

mixture, the slug in L1 should be adjusted until a signal is heard. The signal generator is then con-
ected to the antenna terminals and the slugs in L2, L3 and L4, L5 adjusted for maximum output.
This procedure should be repeated several times to overcome any interaction between stages. After
this has been completed, the low end of the band
should be aligned. The main tuning condenser, C0
is set at maximum capacity. With the signal gen-
erator set at the low frequency desired (in the original receiver this was 2 megacycles) and connected to
pin 1 of the mixer tube, adjust C0 until the signal
is heard. The signal generator is then connected to
the antenna terminals and the series padder con-
denser C7 and C8 adjusted for maximum output.
The complete high and low frequency alignment
procedure should be repeated several times to make
sure that each successive adjustment has not de-
tuned the preceding one.

When the above procedure has been completed,
tracking over the entire range should be checked. It
may be necessary to adjust the parallel padders C3
and C4 for proper tracking; however, in the original
receiver these were set at maximum capacity and
left alone. Fine tracking can be obtained by bending
the plates of the tuning condenser, but again this
was not found necessary.

If the tuning range is going to be restricted to the
80-meter band only, capacitors C7 and C8 should
be changed to 2-50 ufd (ICA type 611 padders)
and capacitor C0 changed to 22-120 ufd (ICA
type 413 padders). This will bring the maximum
capacity of the tuning combination down to a low
enough value to spread the 80 meter band over the
whole dial.

OPERATING INFORMATION

The operation of this receiver is all that could be
desired. On-the-air listening tests have brought in
all but the sixth and seventh districts using a six
foot clip lead antenna on the cellar work bench at
WDDY. Even though the 80-meter band is crowded
at the high end of the band, no difficulty was found
in separating stations. The I.F. response was found
to be approximately 5 ky. wide at the half-power
points and the curve has rather steep slopes indicating
good adjacent channel selectivity.

The stability of the equipment is good enough to
allow continuous monitoring of the Marine tele-
phone stations for hours without retuning. Market-
ically, it is sturdy enough to survive a sharp blow
of the hand without shifting the tuning.

To those of you who build this receiver, be sure
to use good quality parts and careful workmanship
so that you can enjoy many happy hours of mobile
operation.

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[By George, Carvel of Electric Company, Ltd., Sydney, N.S.]