

A New National

By JAMES MILLEN*

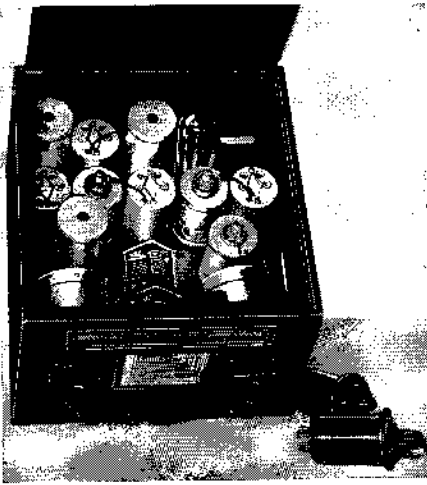


Fig. 3. Little need be said concerning this top view of the new receiver. Its compactness, symmetry of design and complete expressibility are immediately apparent.

trol and comparatively reasonable in price. There has been a great deal of discussion regarding the advisability of making a combination broadcast receiver which will also perform satisfactorily on short-wave. Several extremely satisfactory receivers of this general type have been marketed and are performing a very valuable service in familiarizing the broadcast listener with the extremely interesting programs which are now available on short-waves. Then, too, several very satisfactory short-wave receivers for amateur communication purposes have been introduced and have been giving a very satisfactory account of themselves.

The combination broadcast and short-

above, are also very expensive and the majority of amateur radio telephone and telegraph communications enthusiasts ("hams," as they are called among themselves) demand characteristics in a communications receiver which are not generally found in the combination type.

Before embarking upon a description of the particular characteristics of the new receiver to be described here, it may be well to clear up one point which has been causing a considerable amount of discussion among short-wave enthusiasts and engineers as well. The question has to do with the desirability of covering a great band of wavelength without the necessity of changing coils. Experience has led us to the conclusion that the most satisfactory type of receiver for short-wave use is one which employs changeable coils. We have made several receivers, in which the change from one frequency band to another has been accomplished by a switching arrangement with coils mounted directly in the receiver itself. I do not believe that any receiver can be made to function as well on all of the wavelength bands, unless it is provided with *changeable coils*. Other radio engineers who have argued against this policy have recently come around to this way of thinking and several companies, formerly engaged exclusively in the making and selling of high-grade combination receivers, are now introducing special receivers designed for short-wave operation exclusively.

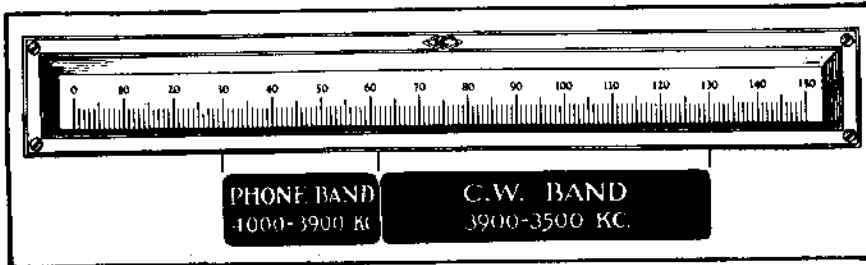


Fig. 4. One of the remarkable characteristics of the new receiver is graphically portrayed in the accompanying illustration. Here we have indicated the performance characteristics of the receiver when the "band-spread" coils for the 80 meter band are employed. It will be observed that the spread from 4,000 to 3,500 kc occupies 100 divisions on the dial, leaving an overlap of approximately 25 divisions at either end. Due to the special characteristics of the plates used on the condensers, the amateur phone band of 100 kilocycles occupies approximately half the space occupied by the 400 kilocycles in the adjacent C.W. channel.

Purpose of the New Receiver

● Nearly all of us recognize that there is an increasing demand for short-wave receivers which are highly selective and very sensitive, simple to con-

wave receivers, if they are of the high quality to which we have referred

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In consideration of all these factors and in view of the extremely satisfactory performance which the AGS receiver is delivering in all fields of com-

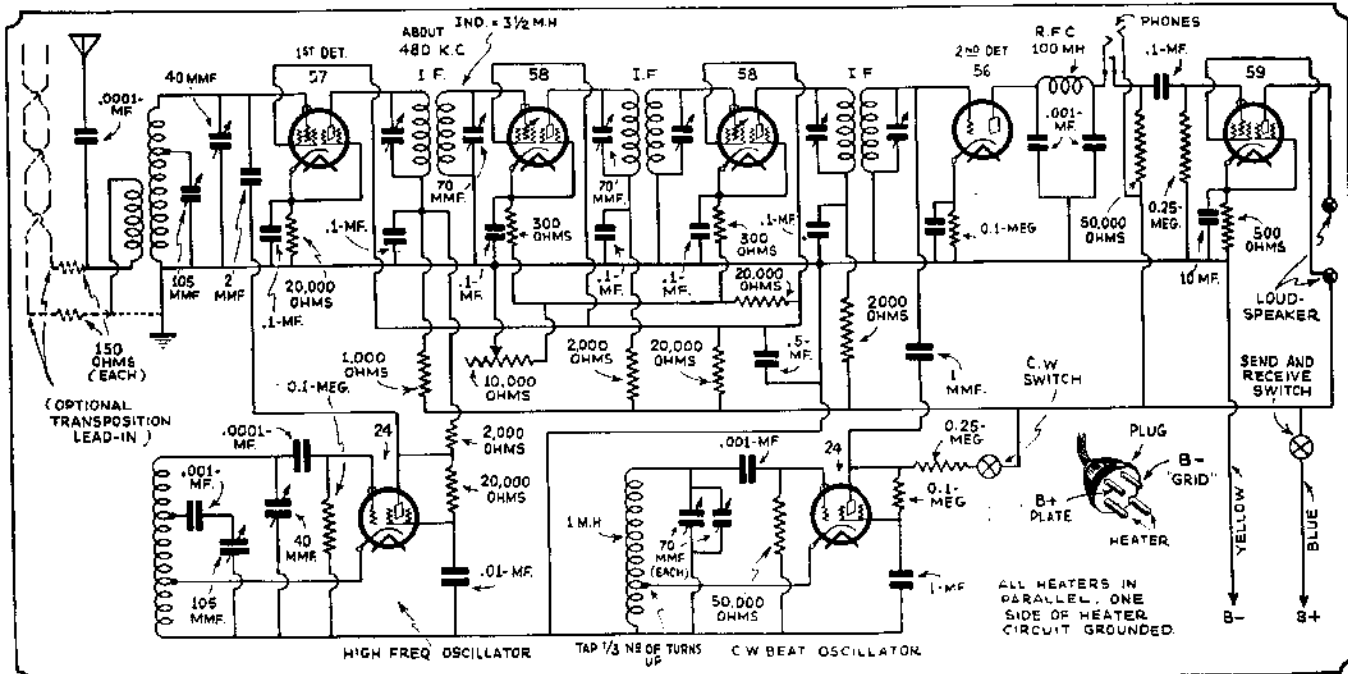


Fig. 1. The complete circuit diagram of the new National FB-7 Short-Wave Superheterodyne Receiver. Seven of the latest tubes are employed and the receiver is ideal for use in connection with many services as a study of the circuit will disclose. All of the heaters are connected in parallel. It will be noticed that one side of the heater circuit is grounded to prevent radiation from the beat oscillator. Other systems, commonly employed, were found inadequate.

Super-het, the "FB-7"

munication on short-waves, the impression grew that many of the design features incorporated in that receiver could be applied to a simpler set which would be ideal for use by the *short-wave broadcast listener*, who is particularly interested in the reception of "foreign" programs, as well as the amateur operator who, for his communication purposes, requires a far better short-wave receiver than the average and who at the same time cannot afford to avail himself of the commercial type.

General Characteristics

This new receiver carries the designation "FB-7". This designation is particularly applicable to a receiver especially suited to the needs of the amateur communication enthusiasts. FB stands for *phone band* and in the vernacular of the "ham" it also means *fine business*, which is an expression commonly employed to indicate satisfactory results.

The FB-7 is essentially a short-wave superheterodyne of the most advanced type, incorporating many of the features only to be found in the most expensive and elaborate receivers of the strictly commercial type. As may be seen from the accompanying illustration, the entire receiver is comparatively compact, while all of the component parts are completely accessible. The tuning scale is of the full vision type and is thoroughly illuminated. Tuning is accomplished by a single knob and there are no additional adjustments of any kind, other than the volume control. The tuning range of the receiver is from 15 to 200 meters or 20,000 kilocycles to 1,500 kilocycles. Five different sets of coils, with suitable overlap, are used to cover this range; they are of the regular National commercial type and plug directly into the front panel of the receiver. Provision is made for both telephone and loud speaker operation and the receiver may be operated from the regular National power supply unit or from batteries. "Hams" who desire to use this type of receiver for communication purposes sometimes find it desirable to operate from a small filament transformer and "B" batteries. This enables them to duplicate the performance of the receiver operated from the regular power supply, at slightly reduced cost.

To be more specific:

Determining upon the circuit which would most nearly meet all of the conditions required for the communication services, for which this type of receiver was designed, was the subject of a great deal of study. Another important subject was the determination of the particular types of tubes which would best function in a receiver from which so much was to be demanded. From antenna to loud speaker, we believe that the FB-7 is the satisfactory solution to a great many receiver problems. The following tubes have been selected because they seem to suit the requirements admirably. The first detector is the type 57; the high frequency oscillator and the beat oscillator are of the 24 type; the two intermediate frequency amplifier tubes are 58's; the second detector is the 56 and the output tube is the type 59 pentode. A complete diagram of the circuit employed

in this receiver appears in Fig. 1, but many of the important features of the receiver are not immediately obvious from a study of the diagram. A study of the various portions of the circuit and the reasons for their selection will give a very much more definite idea of the performance which may be expected for particular types of service.

Take the antenna, for instance. For suitable tuning over a wide band of frequencies, it is desirable to have an antenna circuit in which antenna tuning effects are reduced to a minimum. A large size primary coil is always desirable but in most cases its use has always been accompanied by high inductance and capacity which, in turn, have made a tuning free antenna system almost impossible. My experience in the design of short-wave receivers and the success obtained in connection with National standard plug-in coils for example, resulted in following a somewhat similar procedure in connection with the coils designed for the FB-7. The antenna primary is *interwound* with the secondary, in a manner which brings about a considerable loading effect which is constant and also permits utilizing the advantage of close coupling, without any noticeable antenna tuning effects.

Furthermore, the particular type of antenna circuit employed permits taking full advantage of the desirable features which a modern tuned doublet and suitable transposed transmission lines bring about. The use of the tuned doublet is becoming generally recognized as standard practice, where the best type of receiving engineering is involved. Interference, of the *man-made* variety, is reduced to a considerable degree by the elimination of the

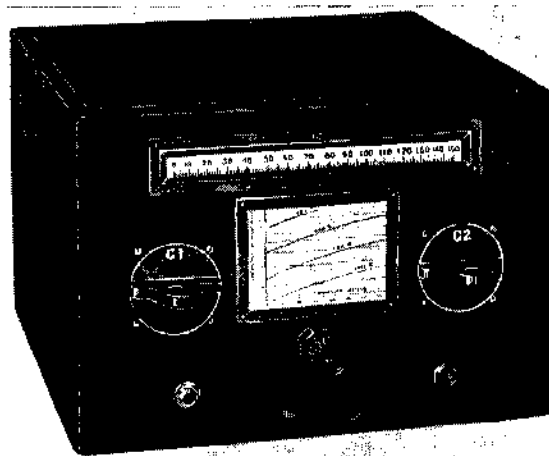


Fig. 2. Front view of the new FB-7 receiver. The full vision scale is marked off in 150 divisions. The tuning calibration curve for each one of the five sets of coils is mounted on the panel. Directly below the tuning control there is the calibrated volume control, of the type which has proven so popular in measuring signal intensity. The coils plug in from the front. Phone jack is located at the lower left-hand corner of the front panel; switch in lower right-hand corner throws the beat frequency oscillator in and out of circuit.

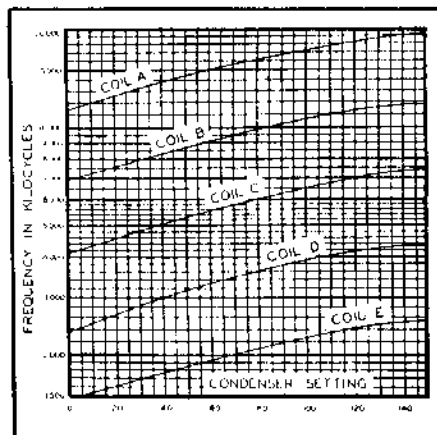


Fig. 5. Tuning Curves for FB-7, with "general coverage" coils.

ordinary ground connection in the antenna circuit. It is possible to take full
(Continued on page 761)

Short-wave "Fans," and "Ham" operators as well, have been gazing anxiously at the radio horizon, wondering no doubt when they would be able to purchase a laboratory-tested short-wave superheterodyne, at a price which the average "depression" pocketbook could stand. It has remained for James Millen and his staff of engineers to at last produce a smooth-working, 1-dial control superhet, which in the same breath provides the average SW "fan" with DX reception from European and other distant points and—secondly—it provides the licensed operator or "Ham" with a receiver on which the amateur bands can be spread out. With two sets of plug-in coils, one designed for "general coverage" and one set for "band spreading," either or both requirements are fully met. The new FB-7 employs seven of the latest style tubes and has a beat frequency oscillator, so as to pick up CW signals. A specially filtered power-pack has been designed for use with the FB-7.

A New National Super-het —The FB-7

(Continued from page 727)

advantage of the benefits which the ground connection sometimes brings as a result of grounding the chassis, without the necessity of having the ground connected to the antenna system, which is permitted to function as an almost separate entity from the remainder of the receiver.

In selecting the proper tubes for the first detector, a considerable amount of time was spent in investigating the performance of the type 58 tubes. This was abandoned in favor of the 57 because it was found that, with a 24 employed as the high frequency oscillator, having its plate coupled through the comparatively small condenser (approximately 2 mmf.) to the grid of the 57 detector tube, provided an arrangement which gave a coupling which automatically increased as the coils covering higher frequency ranges were plugged in.

Stable operation of the high-frequency oscillator, resulting in an unwavering signal response, has been obtained by using the 24 tube in what is called an *electron-coupled* circuit. The other 24 tube, employed for providing the beat frequency, when the reception of continuous waves is desired, is also of the electron-coupled type. The intermediate frequency amplifier employs two type 58 tubes and standard National commercial type intermediate frequency transformers, which are of the Litzendraht, ultra high gain variety. In other respects, the intermediate amplifier is fairly conventional.

For the second detector a 56 tube was selected because it can supply a high audio output, for the ease with which the radio frequency component may be removed from the plate circuit without sacrificing high audio frequency, and its adaptability for use with headphones.

The beat frequency oscillator is of the *electron-coupled* type. The usual difficulty of a broad zero-beat region, excessive noise in the intermediate frequency circuit as well as an apparent "pulling in" of strong signals as the volume control is advanced, has been overcome by suitable shielding of the oscillator circuit. As a result of the improved shielding, there is practically no *pick-up* in the input circuits of the intermediate amplifier and first detector.

The output tube is a type 59 pentode, which is coupled to the second detector by the resistance method.

Answers to Most Questions

It is impossible to give a complete description of a receiver of this nature within the space available in a magazine article, but a preview of this receiver has resulted in the answering of a great number of questions and the answers to these questions follow. A few points which have not been brought out by the questions have to do with the selections of the materials necessary for a particular type of service or for general purpose. As a matter of convenience to those who do not require all of the coils the receiver may be purchased with a single set of coils and additional coils may be secured as the need for them arises. Then, too, the regular power supply is optional. The receiver functions very satisfactorily with a storage battery for supplying the filament current and "B" batteries. As is general in the operation of amateur receivers, it is possible to utilize the filament transformer operated directly from the light circuit and have the plate supply come from "B" batteries.

Questions and Answers on the FB-7

For what particular purpose has this new receiver been designed?

The FB-7 has been designed primarily to enable the 80 meter amateur phone operator to secure what corresponds to commercial performance from a receiver designed especially for amateur use at a price heretofore impossible.

What is the output impedance and what type of loud speaker is recommended?

The output impedance is suitable for best operation with any standard 5,000 ohm magnetic or dynamic speaker.

What is the overall frequency range?

Standard coils are available for complete coverage from 20 mc. to 1,500 kc. (15-200 meters). Five pairs of general coverage coils cover the following ranges: 11,500-20,000 kc.; 6,900-12,000 kc.; 4,050-6,900 kc.; 2,400-4,400 kc.; and 1,300-2,600 kc.

Are band spread coils available and for what bands?

Yes. For all of the amateur bands. Each set of these coils provides a spreading of the band over a full 100 divisions of the dials. These 100 divisions come right in the center of the dial scale and there are thus 25 divisions above and 25 below the actual band covered by each pair of coils.

Is this receiver suitable for C.W. reception as well as for phone?

Yes. A switch on the front of the panel controls the special beat frequency oscillator used for C.W. reception.

Is the receiver subject to frequency drift?

No. Both the oscillators are of the electron-coupled type. This completely eliminates any tuning drift common and troublesome in other short wave superheterodynes.

Are the coils shielded?

They are not only shielded but they have been designed to fit right into the apertures in the front panel in the same convenient manner as with the AGS. They are provided with aluminum face plates and convenient grips. It is not necessary to remove the coil shields, or raise the lid of the receiver in order to change the coils.

Can intermediate stages be tuned to assure peak efficiency at all times?

Yes. The trimmer adjustments are located at the top of the intermediate frequency transformers, making it unnecessary to remove the base of the receiver or go to any other complicated trouble to assure peak performance at all times. Peaking the I.F. amplifier is a very simple matter.

Is straight frequency line tuning employed?

Yes. The latest National, illuminated, full-vision dial is used in conjunction with 270 degree straight frequency line condensers. This combination spreads the band, covered by a given set of coils over 50 per cent more dial space, than would be possible with 180° condensers.

Is the receiver thoroughly shielded?

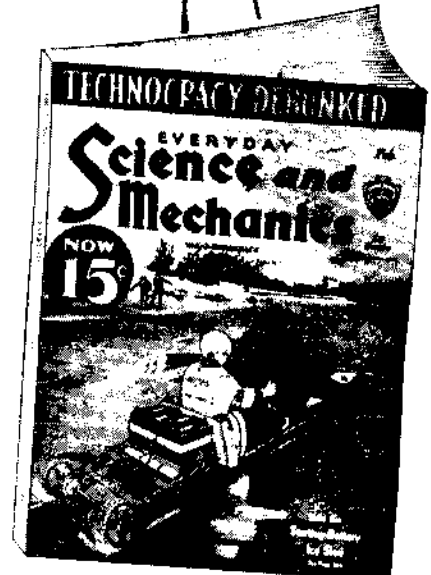
In addition to complete shielding of each of the components, in themselves, the entire receiver is contained in an all-metal cabinet. This double shielding contributes to the inherent stability of the receiver and prevent the picking up of stray interference.

Can the receiver be used with headphones?

Yes. The jack is on the front of the panel and permits ready connection of the headphones into the output of the second detector.

(Coil and other data will appear in next issue.)

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