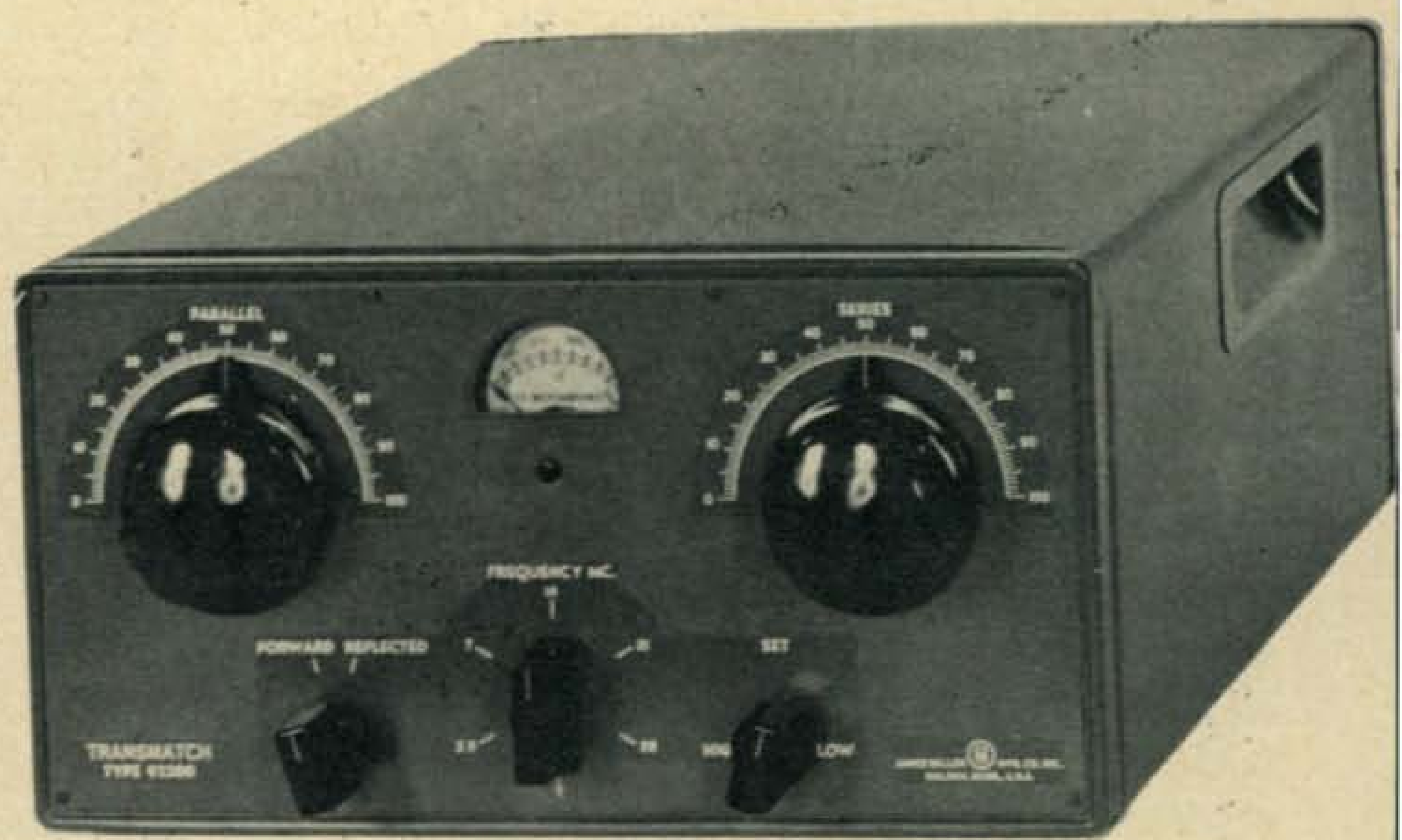

CQ Reviews: The Millen 92200 2 KW Transmatch

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MUCH of the present-day transmitting gear is designed with a fixed output impedance for matching to loads of 50 ohms or so. Others may have an adjustable output for matching over only a limited range such as for essentially non-reactive loads of 25-100 ohms. As a consequence, in such cases, maximum output from the transmitter or sufficient loading for proper operation of a linear amplifier may not be possible where the load impedance falls outside the matching range or where such loads are reactive and the s.w.r. seen by the transmitter is greater than 1.5 or 2 to 1. These situations may exist where large frequency excursions are made over a band, a multi-band antenna is in use or other cases where the transmission line cannot be properly matched or be thus maintained for presenting a low s.w.r. to the transmitter.

Under these conditions, it would therefore be desirable to employ some external means of providing the proper load for best transmitter performance. An expedient for accomplishing this is an impedance-matching antenna coupler. A number of such affairs have been described in amateur literature and have become to be known as a "Transmatch." This is a title suggested in an article on a matching device described some time ago by Lewis McCoy, W1ICP[1].

Commercial versions of W1ICP's Transmatch are produced by the James Millen Manufacturing Co., Inc. There are two models, the No. 92201 for handling up to 300 watts peak r.f. power and the No. 92200 for 2 kw peak. Both models are designed to allow a 50 ohm transmitter output on the 3.5-28 mc amateur bands to be matched to impedances ranging from 10 ohms up to 300-1300 ohms, depending on the frequency of operation.

Athough they have been available for some time and are widely used, we shall take a look at the Millen units at this time for the benefit of those who may have missed other published data on them or to whom they may not otherwise be familiar.

Circuitry

The basic circuit is shown at fig. 1. It consists of an LC network made op of an inductor (L_1) in parallel with which is a split-stator variable capacitor (C_1). A single-section variable capacitor (C_2) is in series with the output

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[1]McCoy, L. G., "The 50-Ohmer Transmatch," *QST*, July 1961, p. 30.

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line. The inductor is tapped to provide bandswitching. Examination of the circuit will reveal that it is similar to a Pi-network, except for the reversal of the ground and the hot r.f.-input connections and the addition of the series output capacitor. C_1 provides the resistive tuning or impedance conversion, while C_2 tunes out the load reactance.

The input to the network is fed through a reflectometer that provides relative forward-and reflected power readings. Its primary purpose is to show when the Transmatch is properly tuned to provide a non-reactive low-impedance input as will be indicated by a minimum or zero reflected-power reading. Forward power readings are subsequently useful for adjusting the transmitter for maximum output.

An additional feature is a small loop that allows an oscilloscope to be coupled to the network for monitoring or measurement purposes.

Construction

The Transmatch made available to us for evaluation was the No. 92200, designed for 2 kw peak power. It embodies the high-quality construction which typifies Millen gear. Except for some comments on special details, the type of components and the method of construction are best visualized from the photograph of the interior view.

Rugged variable capacitors with wide-spaced polished-aluminum plates are provided to withstand breakdown at the high voltages with the high impedances that might be encountered in the particular portion of the circuit under the various conditions within the design limitations. In the case of the parallel capacitor, the breakdown rating is 6000 volts, while that of the series capacitor is 9000 volts. The capacitors are mounted on 1″ high ceramic insulators and the capacitor control shafts are insulated from the panel and the operating knob by high-voltage type ceramic couplings.

The inductor is made up of two sections, both of which are used for 3.5 and 7 mc operation. Only the smaller inductor is used for 14, 21 and 28 mc. They are space-wound with #10 wire held by grooved glasskyd supports. The oscilloscope-coupling loop mounts alongside the smaller inductor section.

The bandswitch is one of the Millen 51000 series, designed especially to handle high r.f. currents and voltages.[2] It has large size heavy-duty solid-silver contacts and silver-plated conducting elements. A very heavy spring pressure is used to further ensure a low resistance r.f. contact and reduce heating, while a positive snap-in detent maintains correct alignment.

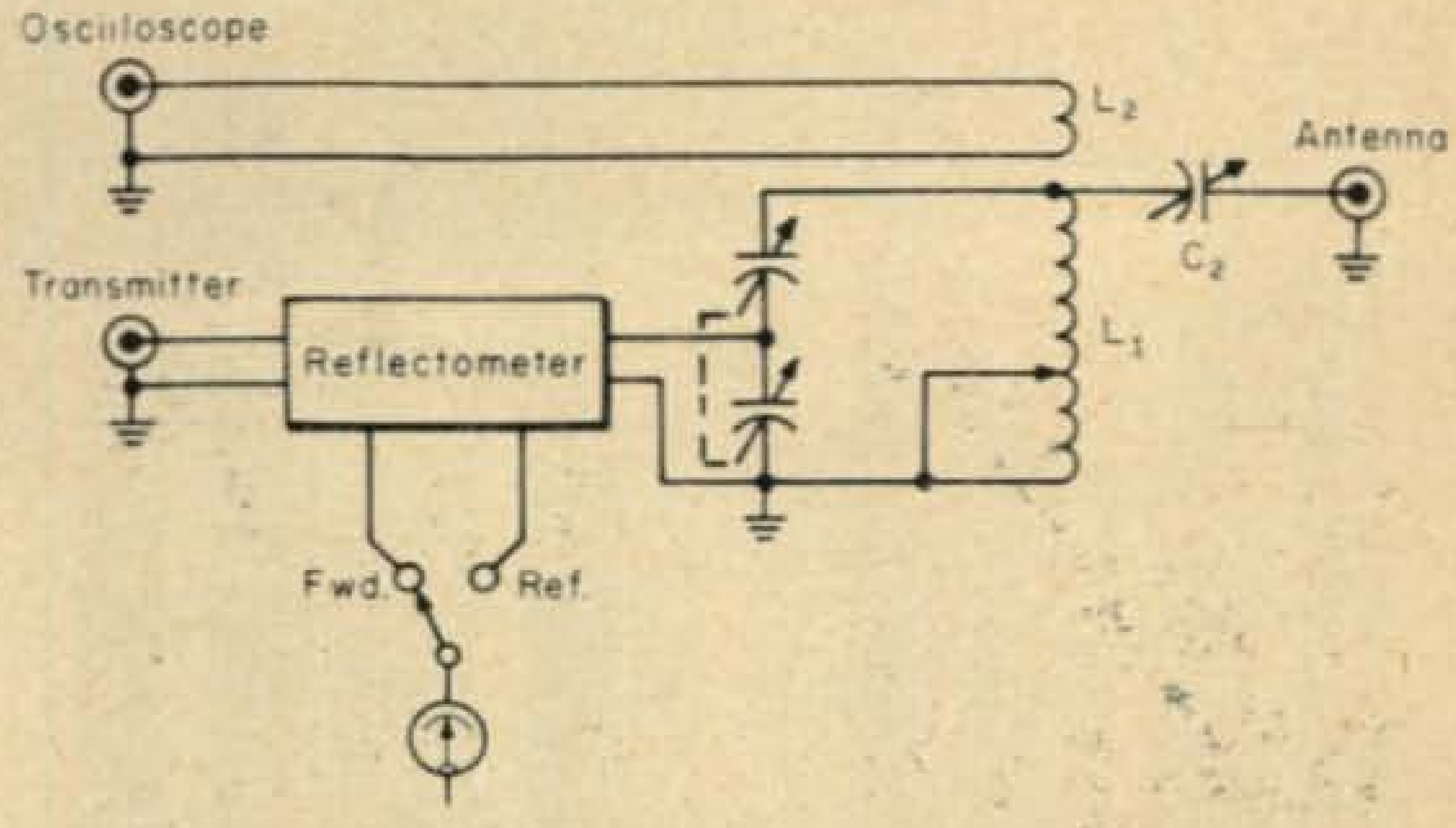

Fig. 1—Setup as used in the Millen Transmatch. Details are given in the text.

When the switch is operated, both the switch contacts and the common connection to the switch arm are opened at the same time. This provides a dual break to minimize arcing should a "hot switch" be inadvertently attempted. The insulated frame is made of glass-reinforced alkyd that has a very high voltage-breakdown characteristic and which is most resistant to arcing and arc-tracking.

Since the 3.5 mc band covers a large percentage of the basic frequency, two bandswitch positions are provided for this range to optimize operation toward both the low and high ends of the band.

The reflectometer is the trough-line type. Its associated meter is a 0-500 microamp job and it is completely shielded at the rear. Forward- or reflected-power readings are selected by a panel switch, while another control adjusts the meter sensitivity.

Dial scales, calibrated 0-100 in unit steps, are provided for both the parallel- and series-tuning capacitors. They are useful for logging the settings for operation on various bands or under different conditions. Reference to these settings thus avoids the need for any extensive retuning, or determination thereof, when changes in operation are made.

The Millen transmatch is built on a heavy-gauge chassis formed in one piece along with sturdy side brackets to which the panel is fastened. The cabinet slides into lips that are bent around the edges of the panel. This produces a very tight fit which, together with spot welding along the joints of the cabinet, results in a virtually water-proof enclosure that provides the maximum effectiveness of

[2] "New Components by Millen Mfg.," *CQ*, June 1965, p. 55.

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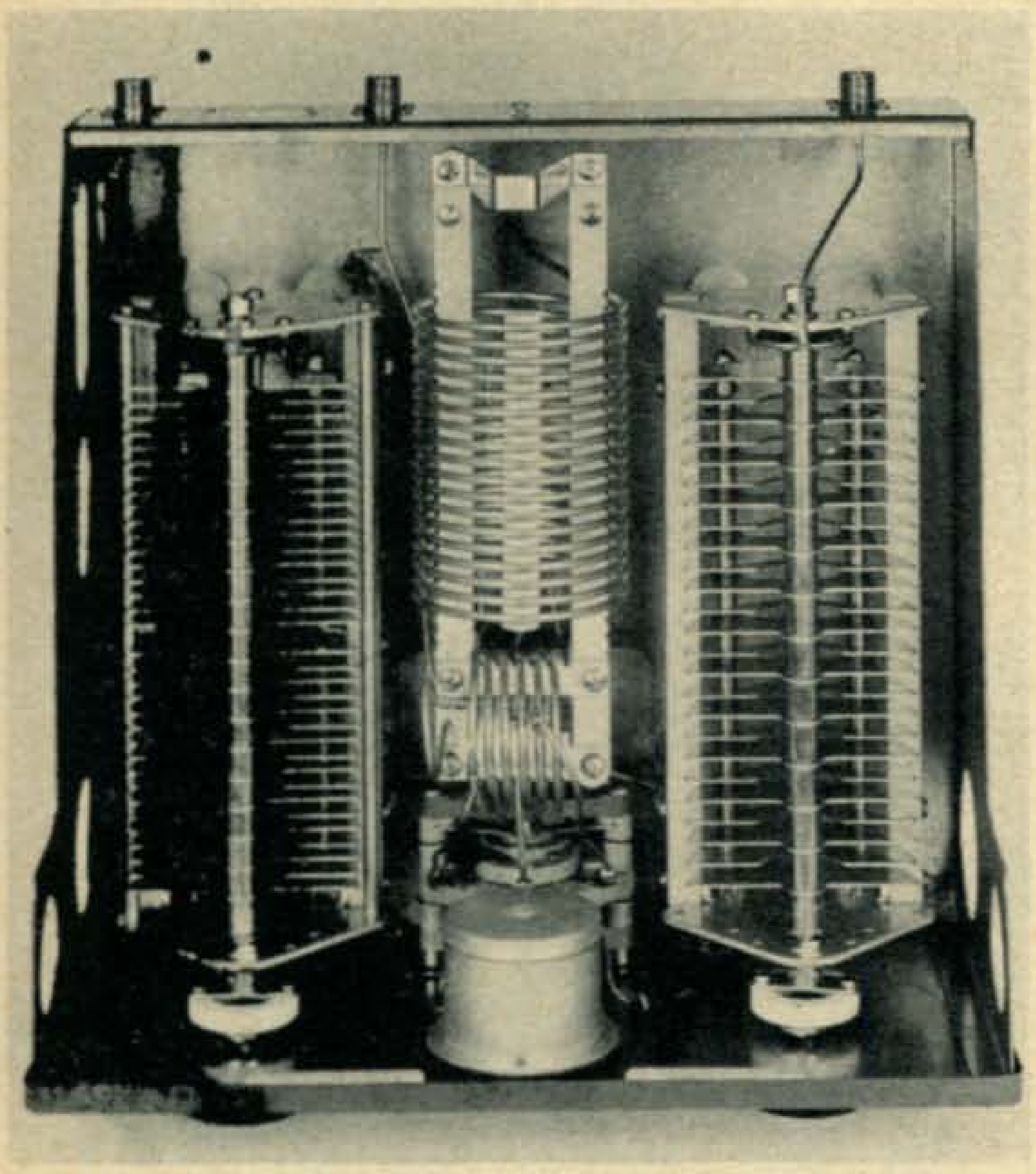

Interior view of the Millen 92200 Transmatch. The series-tuning capacitor is at the left. The parallel-tuning one is at the right. The h.f. inductor is the small one near the center. The larger inductor, toward the bottom of the photo, is added to the h.f. inductor for the lower frequency bands. The bandswitch is underneath the round meter shield on the panel at the top.

the shielding for the minimization of stray r.f. radiation or harmonics that might otherwise cause t.v.i. or other difficulties. This is further enhanced by the shielding at the rear of the meter. In addition, all the metal work in respect to the above is copper-plated. Type SO-239 u.h.f. coax receptacles are furnished for the input, output and oscilloscope connections.

The size of the No. 92200 2 kw Transmatch is 7″ × 14″ × 13⅝″ (h.w.d.) and it weighs 17 pounds. The No. 92201 300 watt model is 4¾″ × 7″ × 9″ with a weight of 6 pounds. Its small size makes this unit suitable for mobile applications. Both models are finished in medium gray and have black knobs.

Operation

The No. 92200 Transmatch is designed to work into a wide range of impedances (unbalanced loads) while providing a 50 ohm impedance at the input or transmitter end. These ranges are as follows:

3.5-4.0 mc	10-1300 ohms
7.0-7.3 mc	10-1300 ohms
14.0-14.35 mc	10-600 ohms
21.0-21.45 mc	10-500 ohms
28.0-29 mc	10-300 ohms
29.0-29.7 mc	10-700 ohms

Presumably these specifications are for resistive loads. The maximum values for reactive impedances may differ somewhat.

Operation on MARS frequencies in the 3.0-5.2 mc range also will provide matching ranging from up to 8000 ohms at 4.6 mc to 90 ohms at 3.0 and 5.2 mc.

Adjustment

Detailed information for adjusting the Transmatch is given in the instructions supplied with the unit. Basically it simply involves initially tuning up the transmitter in the normal manner, setting the Transmatch meter-sensitivity control for a convenient forward reading near full scale and then, with the meter switched to read reflected power, alternately adjusting the two Transmatch capacitors until a zero reflected-power reading is obtained.

The instruction sheet also includes charts with calibration curves indicating the capacitor settings over the operating-impedance range for the frequencies at the end of each amateur band. These are helpful as a guide for providing approximate dial settings for a starting point *before* tuneup or for estimating the actual load impedance *after* tuneup.

It should be noted that the Transmatch is designed for operation with unbalanced or coaxial line loads. Where the load is a balanced affair, a suitable balun should be used between the transmitter and the load.

Performance

The Model 92200 Transmatch was tested using a 2 kw p.e.p. input amplifier with 1300 watts output. No problems were encountered with voltage breakdown or overheating and in easily obtaining a 50 ohm match to the transmitter with a number of different type loads, including a random length end-fed antenna working against ground. One important consideration found in most cases, especially in relation to operation with an end-fed antenna, was that the Transmatch should be grounded directly rather than relying on a ground patch through the shield of the cable to the transmitter. There is no ground post on the unit, but the connection may be made to a screw at the rear.

No built-in provisions are included to bypass the network for direct feed to the

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