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A Sneak Preview Of The FPM-200

One of the big items of interest at the recent San Jose ARRL Convention was the new Hallcrafters FPM-200 transistorized transceiver. The new transceiver represents a great stride forward, not only for transistors, but for SSB. Interest in this device is at an all time high.

By distracting the local "rep" with a curvaceous blonde, I was able to inspect the "innards" and shoot some interesting photographs (none of the blonde—sorry). Most of this material is reproduced from memory, some of it is "educated guessing," and there may be a few minor technical errors.

The FPM-200 covers all amateur bands between 75 and 10 meters. Two *vfo*'s provide independent tuning, or either *vfo* can be used to control the receiver and transmitter simultaneously. Only three tubes are used in the design (12BY7 driver, parallel connected 6146's in the final), the rest of the circuits are completely taken over by transistors. The over all design of the transceiver is shown in the accompanying block diagram. You will note that identical *rf* and *if* systems are used in the receiver and exciter sections. This is not the least expensive way to do it, but it is the best way. It avoids making some transistors do "double duty" and greatly simplifies the switching problems.

Let's start at the receiver antenna connection and work back towards the speaker. The antenna feeds a two stage common base *rf* amplifier using two RCA "drift" transistors, type 2N370. The mixer, a type 2N372, combines the signal from either of two identical *vfo*'s (depending on *vfo* switch setting) which have a tuning range of 8.0-8.5 *mc*. The *vfo* frequency is not changed regardless of what amateur band is being received. Such a system necessitates a different 1st *if* for each band and has been given the name "step *if*". As an example, if the *vfo* mixes with signals between 14.0 and 14.5 *mc*, a 22.5 *mc* 1st *if* would be used. For 15 meters, a 29.5 *mc* *if* would be used, and so on. The step *if* includes a second mixer which combines the first *if* and the crystal controlled local oscillator energy. The oscillator is on the proper frequency to heterodyne the step *if* down to 2.2 *mc* for

each band. Thus on 20 meters, a 20.3 *mc* crystal would be used to convert the step *if* to the 2nd *if*. Additional "drift" transistors are used in the 2nd *if* amplifier and SSB selectivity is obtained with crystal filters. Individual filters are employed for the selection of upper or lower sideband. Again, this is more expensive than a single symmetrical filter, but it is better than switching the carrier insertion frequency. This would require that the conversion oscillator or variable oscillator frequency be changed also. This would be difficult with a crystal and if it was done in the *vfo*, the tracking problems would be terrific. A beat frequency oscillator and detector are used to demodulate the sideband signal. The detector output drives an audio amplifier which winds up in a class A stage delivering 5 watts of audio power.

The transmitter section operates like the receiver, but it works the "other way around". The *bfo* is also used as the carrier generator, and it drives the balanced modulator. This produces a double sideband suppressed carrier signal when audio is applied from the speech amplifier. The two sidebands are passed through the appropriate filter (bilateral circuitry) and the unwanted sideband is rejected. The output of the filter drives an *if* system that is identical to the receiver *if*. The amplified 2.2 *mc* SSB signal drives another step *if*. This circuit also includes a mixer to convert the first exciter *if* up to the 2nd exciter *if* (22.5 *mc* for 20 meters). This signal is mixed with the 8.0 *mc* *vfo* to produce a sideband on the operating frequency. If a common *vfo* is used, the transmitter will be on the same frequency as the receiver is tuned to. This low level signal on the operating frequency is amplified in another two stage common base *rf* amplifier to a level that will provide adequate drive for the 12BY7. The parallel connected 6146's insure that the signal will be strong enough to "cut the mustard".

The *vfo* switching circuit allows any one of four possible combinations. "A" can tune the receiver, while "B" tunes the transmitter, or they can be interchanged. In a third position *vfo* "A" can be used to control both the receiver

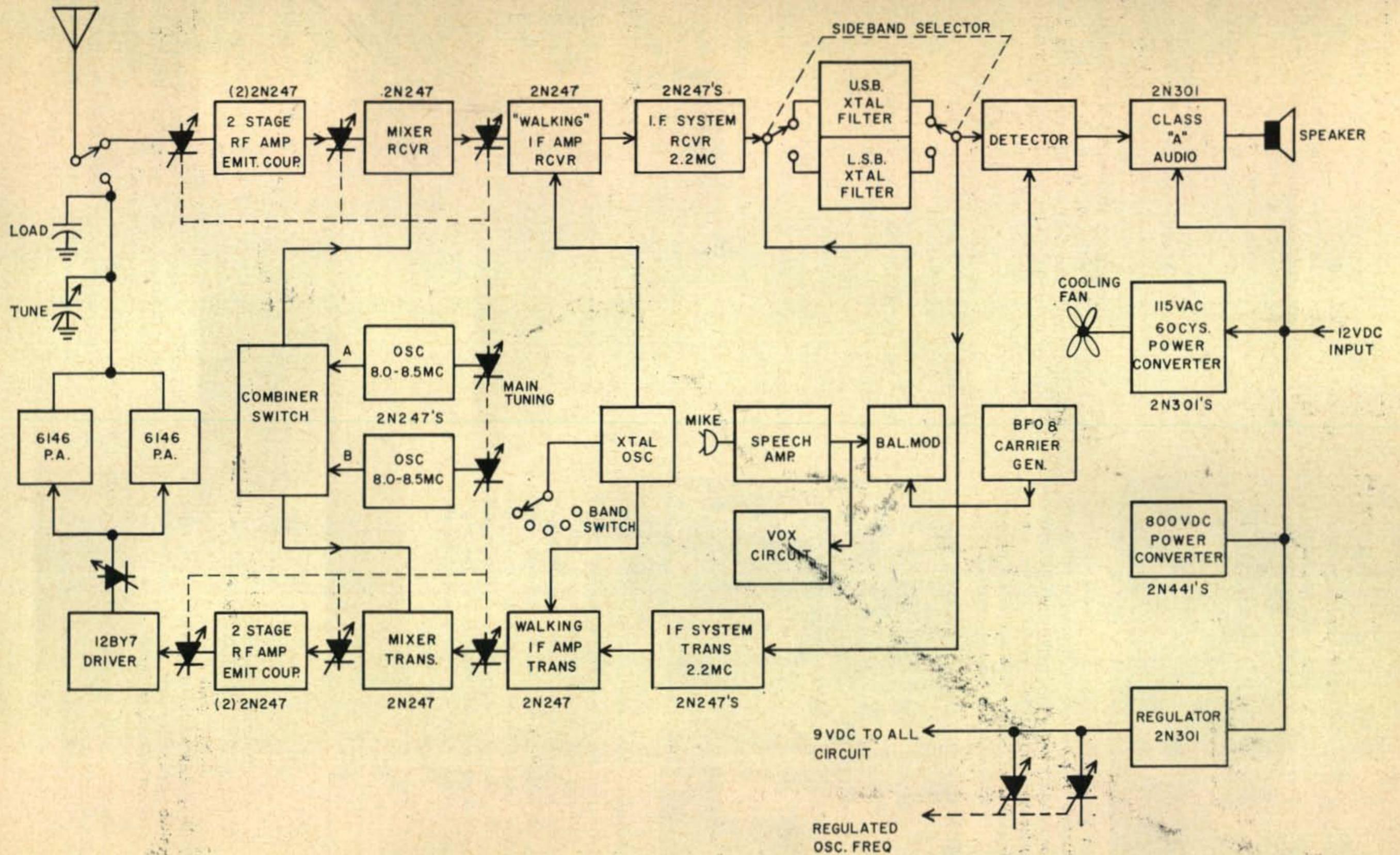
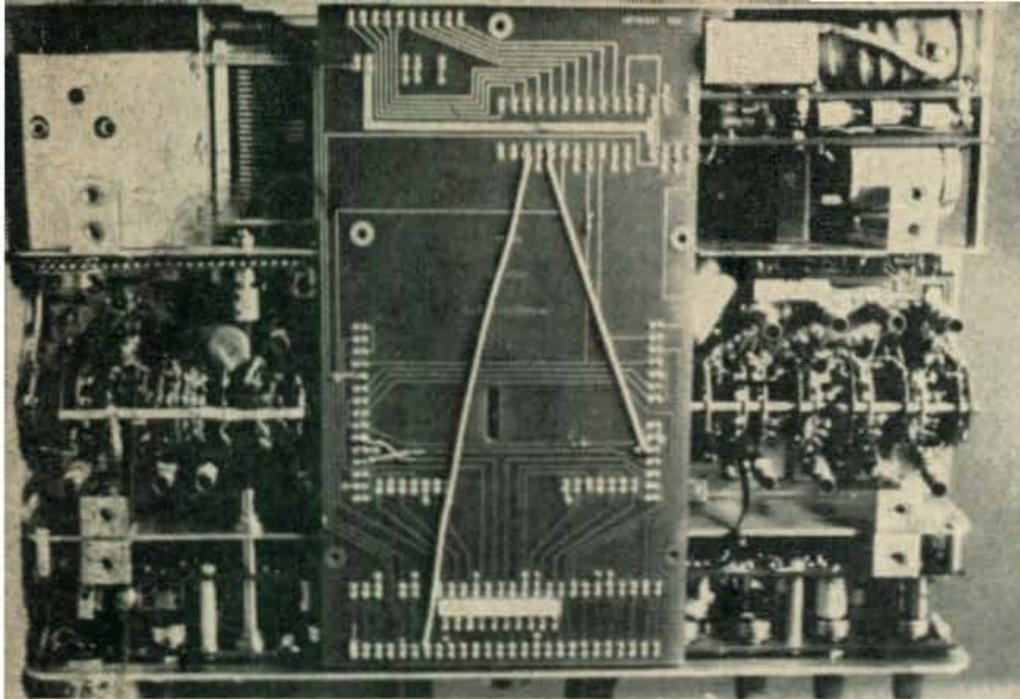
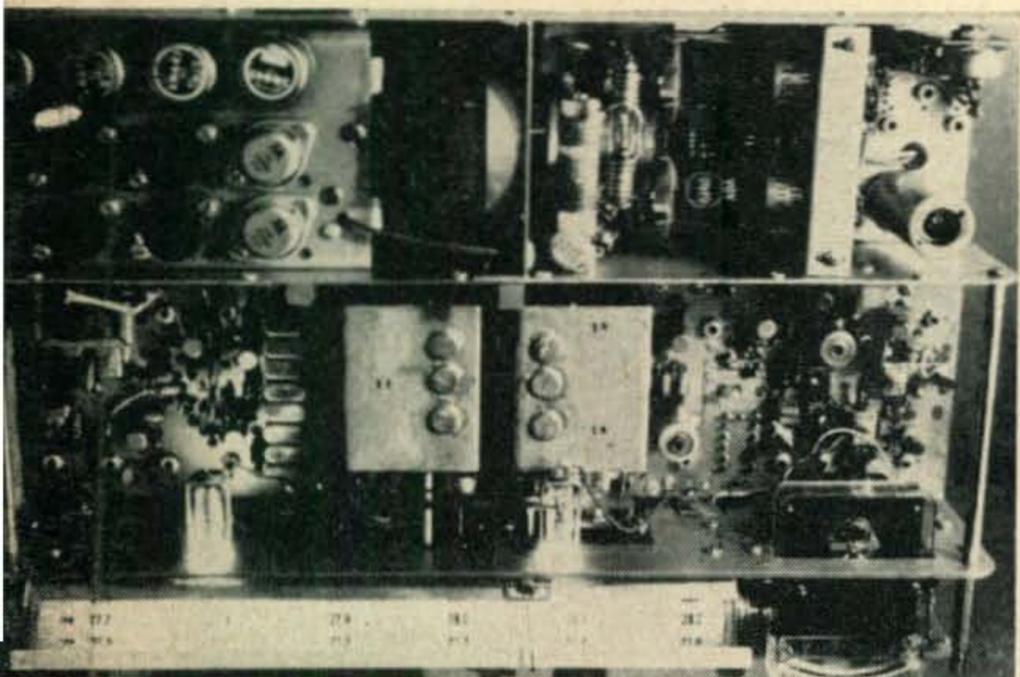


Fig. 1—Block diagram of the new Hallicrafter Transistor Transceiver, Model EPM-200.



Bottom view showing the E.C. board that the sub-assemblies plug into. At the upper left is the exciter compartment, upper right transistor power converter section. At left center is the transmitter exciter r.f. circuits. The equivalent receiver r.f. circuits are opposite right.



Transistors for the power converter, fan driver, and regulator are shown at the upper left. In the center is the fan, and to the right the 6146's which are driven by the 12BY7 at extreme right. The two varicap tuned oscillators are in the center. Transmitter and receiver r.f. circuits are at center right and left respectively. The eight crystals for the "step i.f." are mounted on the receiver EC board.

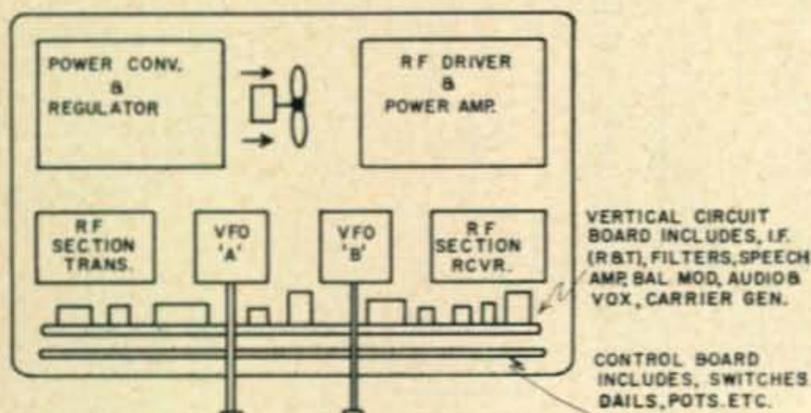


Fig. 2—Layout sketch of the FPM-200 Transistor Transceiver. Space between the plug-in sections is exaggerated to show positions.

and transmitter, and in the last position *vfo* "B" tunes the two.

Quite a few drift transistors are used in the FPM-200 because they are very dependable and quantity purchase lowers the unit cost. The RCA "shortwave series" (2N370-2) are used

in the front ends and the factory tests the transistors for best performance in this high frequency application.

It may have occurred to the reader that the step *if* system requires more tuned circuits which must be tracked to the tuning dial. The duplication of circuits in the receiver and exciter requires twice as many circuits also. You might also wonder how all these circuits are tracked. No slug tuned coils or variable capacitors are used for tuning! Rather, the resonant frequency of each circuit is tuned with a Pacific Semiconductors "Varicap" variable capacity silicon diode. The tuning dial turns a potentiometer which adjusts the voltage on each "Varicap", including the *vfo* tuning diode. In this manner all variable tuned circuits are "ganged" to the tuning potentiometer.

Stability of the *vfo* is extremely good. Not only is the famous Hallicrafters temperature compensation system used, but additional "Varicaps" are connected to the collector voltage source. Any voltage variations (which would affect the oscillator frequency) are cancelled out. The *vfo*'s will not drift more than 25 cycles with an input voltage variation between 10 to 14 volts, it is claimed.

For the most part, TR switching is electronic and gate diodes are sprinkled throughout the transceiver.

To increase the overall stability, the device uses an electronic regulator system to smooth out the fluctuations due to changing battery voltage. The nominal 12 volts is leveled off at 9 volts with a Zener diode regulated supply, and this delivers voltage to the rest of the circuits.

A transistor power converter is used to supply power to the driver and high voltage plus bias to the final amplifier.

A real design problem cropped up when it was discovered that the heat from the tubes disturbed the transistor circuits. The obvious solution was to employ a fan and get the heat out of the box. But inexpensive *dc* types created too much electrical interference and shielded motors were far too expensive. The problem was resolved by including a second power converter to supply 117 volts, 60 cycles for a synchronous fan motor. The overall cost was less, and the results far superior. The latest models have incorporated the supply switching transformer in the fan motor winding!

The accompanying photographs show the layout of the various sections in the transceiver. All the transistor circuits are mounted on high quality fiber glass etched circuit boards, which plug into printed circuit connectors. Behind the front panel is a sub-panel which holds the switches, pots, and so on. Behind this is another vertical etch circuit board upon which the *if*'s filters, speech amplifier, balanced modulator, carrier generator, audio, vox, and components are mounted.

[Continued on page 123]

His fingers loosened a bit more on his record. He then asked if I knew of any other method by which a radar could be made inaccurate due to outside influences. I cited Jamming as an example.

He shrugged his shoulders and sat down.

I then asked the court to dismiss on the grounds that the people had not produced prima facie evidence that the radar receiver had "read" the correct signal. The court dismissed on the grounds of reasonable doubt. ■

FPM-200 [from page 40]

As you can see, from this peek, the new FPM-200 uses some very new and startling innovations—particularly in the application of diodes and transistors. Judging from the interest that this unit has created, I believe it will be an extremely popular piece of equipment. ■

LETTERS [from page 22]



Hya Wayne:

Here are some photos that may be of interest to the gang. #1 is Rundy XV5A, who is not allowed on the air right now, but is still trying to get back on from Viet Nam. #2 Myself, Col. Hudson KR6QM and Maj. Mahler KR6OT on Okinawa. QM is the president of the Okinawa Amateur Radio Club and commanding officer of the Quartermaster Corps, OT is an old fishing buddy of mine. #3 Stopped off at Cocos Island just in time to meet VK9LE who was about to return to Perth. I picked up a QSL card for my SSB QSO with Lionel in December. Well Wayne, am going on a 20 day safari. Will stop at Durban, Pt. Elizabeth, Nairobi, Livingstone, etc.

73,
Dave Marks, W2APF

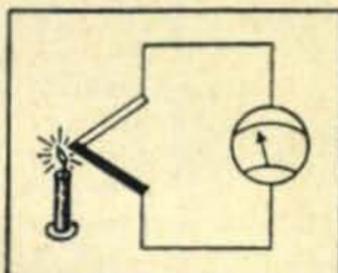
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