CONELRAD

Crystal-controlled broadcast receiver gives alarm when key station to which it is tuned goes off air in response to FCC technique denying navigation aid to enemy aircraft. Malfunction in receiver itself sounds alarm

In complying with the request of the Federal Communications Commission to participate in the air-raid warning project CONELRAD (control of electromagnetic radiation)[1] many broadcast station engineers are confronted with the problem of constructing monitoring equipment that will give an indication of carrier failure of a key station.

The simplest solution to the problem is to utilize the failure of the avc voltage of an existing receiver to trigger some warning device. This approach has several disadvantages. Most broadcast receivers are not designed for rack mounting, and therefore present a mounting problem if a neat and compact installation is to be maintained. Such receivers are often not constructed according to broadcast equipment standards, and they may leave something to be desired in the way of dependability when operated continuously.

Single-Frequency Receiver

It is possible to purchase a communications receiver that overcomes all these objections. However, this solution raises the objection of high cost plus the rather ridiculous situation of having provided equipment capable of tuning a large portion of the spectrum to monitor one frequency. The problem is simplified by starting from scratch and building a receiver solely for an alerting device.

Since the receiver is to monitor only one frequency, crystal control can be used and all front-panel tuning controls dispensed with. In addition, this design goes a long way toward achieving dependability by virtually eliminating oscillator drift problems. With such stability in the local oscillator, and since high-fidelity audio is not required, use of a rather low intermediate frequency is justified. This low i-f will permit great gain and selectivity in a minimum number of stages.

Low intermediate frequencies are usually accompanied by image interference, but for single-frequency reception it is easy to select the intermediate frequency and local oscillator frequency so that no strong images will be present. Design is further simplified in that the range of signal intensities encountered will be much less than that an ordi-

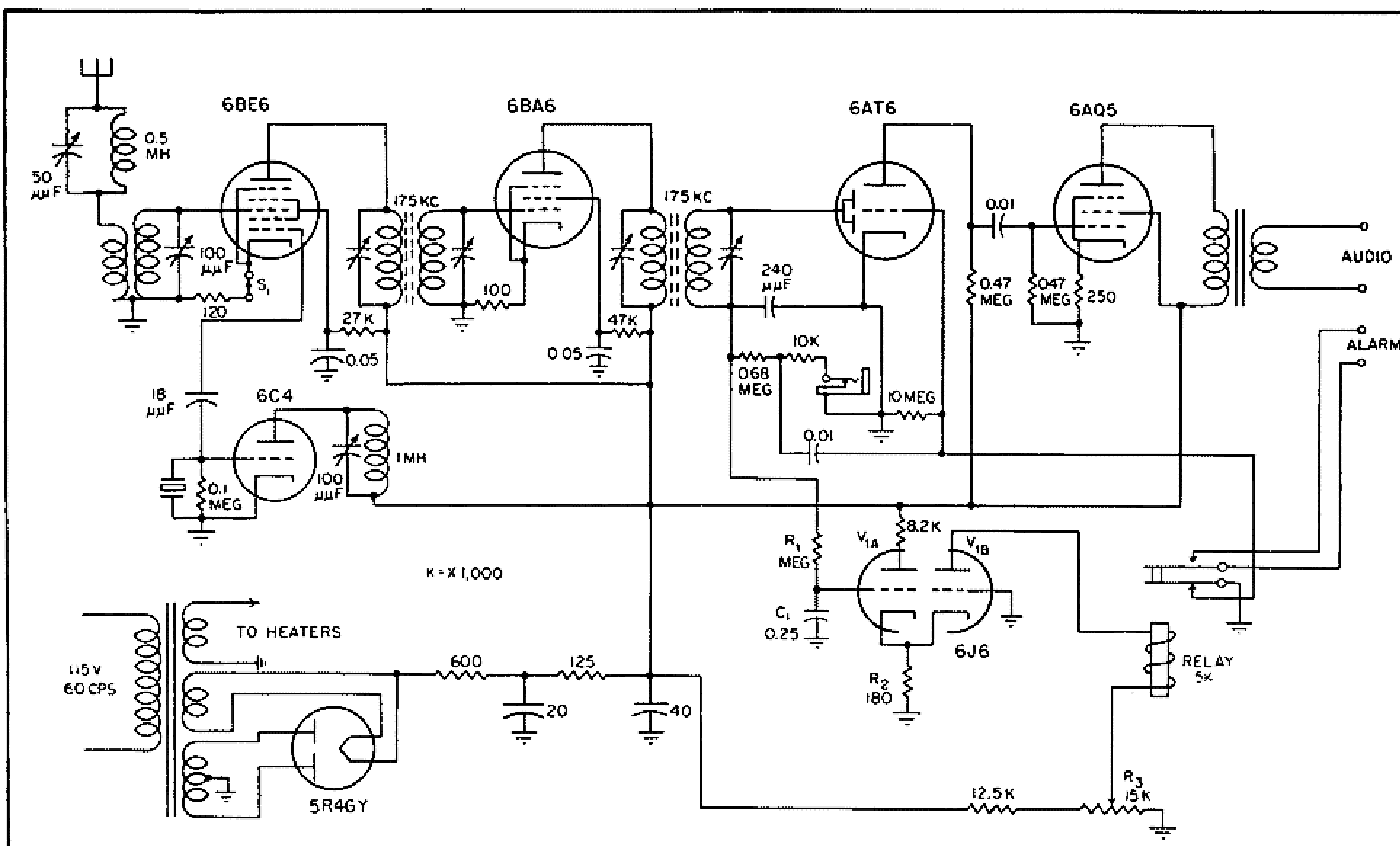

FIG. 1—Circuit diagram of the fixed-tune alert receiver

Alert Receiver

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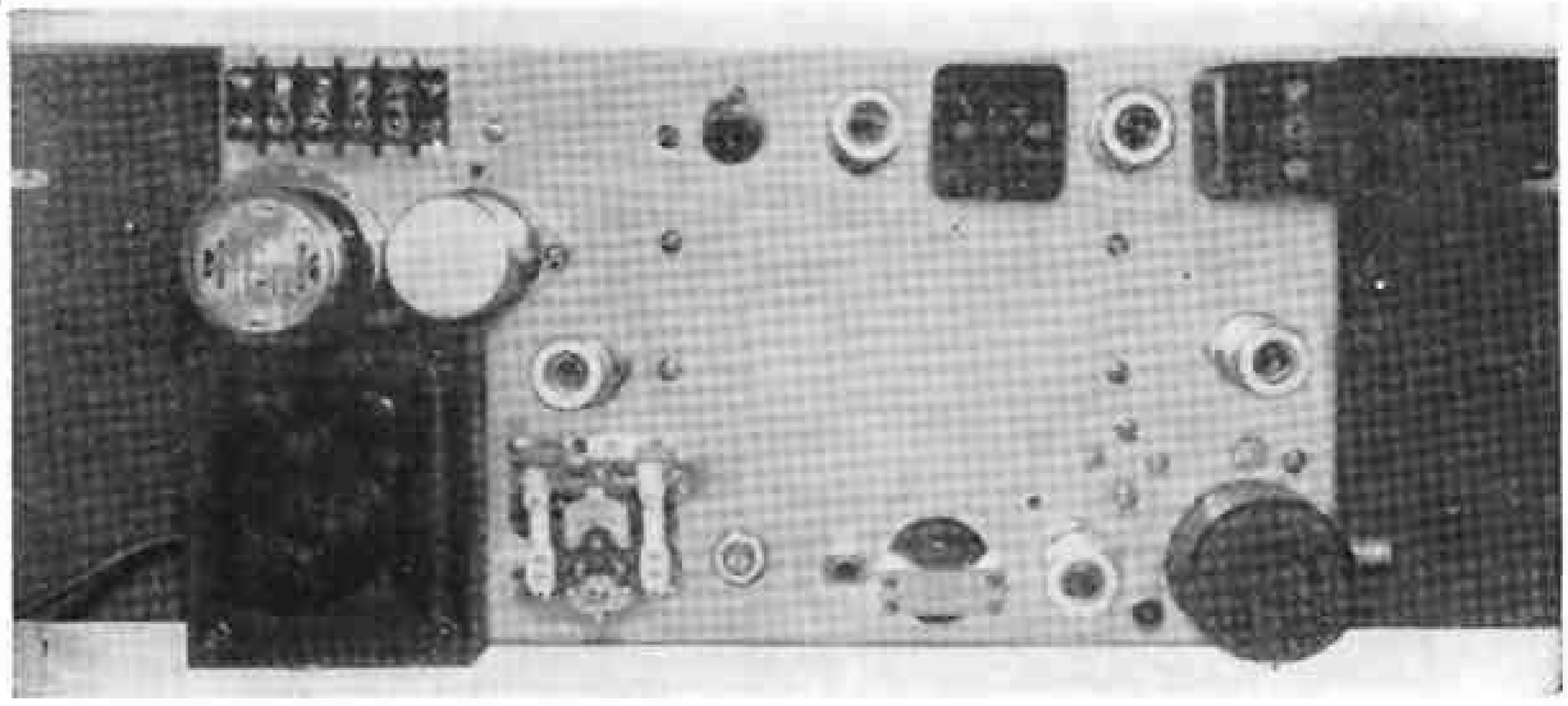

Rack mounted receiver requires no front-panel controls

nary receiver is designed to accommodate.

The system to be described was constructed for use at radio station KTTR in Rolla, Missouri to provide day and night monitoring of KMOX in St. Louis, Missouri, which operates on 1,120 kc with 50-kw. During the day, a signal of the order of 0.5 millivolt per meter can be expected from KMOX. At night the signal will vary considerably above and below this value.

Image Signals

With this much signal, it was decided that a converter and one stage of intermediate-frequency amplification would be sufficient. Since image interference was no problem, it was decided to dispense with any stages of radio-frequency amplification preceeding the converter.

An intermediate frequency of 175 kc was decided upon and the local oscillator operates at a frequency 175 kc lower than the carrier frequency of KMOX or 945 kc. There is virtually no signal present in this area on the image frequency of 770 kc.

Reference to Fig. 1 will disclose few departures, other than those already mentioned, from normal receiver design. It was decided, in the interest of simplicity, to use no avc in this receiver. Since the signal strength is not great enough to overdrive the i-f stage, and since carrier fading is taken care of in the alerting device, avc would serve no useful purpose here.

A meter jack is placed in series with the second-detector load resistor to permit the use of a microammeter as an indicating device when it is desired to make tuning adjustments or to observe carrier fading.

The simplest and therefore most obvious method of obtaining an alert alarm would be to use the voltage produced by carrier rectification to bias a tube to cutoff. The condition could be indicated by inserting a relay in the plate circuit of the tube. A moment's reflection, however, shows that with this system many receiver failures (for example, heater failure of the control tube) could occur that would make the system inoperative and yet would give no indication that things were not as they should be.

Receiver Failure

It is desirable, therefore, to design an alerting device that will indicate receiver failure as well as carrier failure of the key station. The rectified carrier voltage is therefore used to bias a triode but the relay is inserted in the plate circuit of a second triode and the two triodes share a common cathode resistor.

Under normal operation, V_{1A} is biased by the rectified carrier voltage and R_3 is adjusted so that V_{1B} is conducting enough to hold the relay closed. If a carrier failure occurs, V_{1A} will conduct, producing an increased voltage across R_2. This increased voltage biases V_{1B} enough to cause the relay to drop out. Any receiver failure that causes V_{1B} to stop conducting (such as a failure of the rectifier tube) will give an alert.

An added set of contacts on the relay provides for closing a circuit to ring a bell in case the failure is of such a nature as to provide no audio voltage to operate the speaker. The components R_1 and C_1 have a time constant that prevents relay operation until two seconds after a carrier failure. This is to prevent operation of the alerting system by momentary fading of the night-time signal of KMOX. The relay is so adjusted that it does not reclose when the carrier of the key station is restored. Resetting is done manually. Snap-action switch S_1 provides simulated carrier failure for testing.

When the receiver was installed at the KTTR transmitter, some cross modulation was encountered. This was eliminated by inserting a wave trap tuned to the KTTR frequency in the antenna lead to the receiver.

Installation

The receiver was constructed for rack mounting and occupies 7 in. of panel space. The chassis mounts vertically and all wiring is exposed by removing the front panel but without removing the receiver from the rack cabinet.

No particular claim is made for the virtues of the components used in this receiver. Some of them were selected because they were on hand or readily available. In the case of tubes, selection was made, in part, on the basis of tubes already stocked by the station for replacement in other equipment.

REFERENCE

(1) A. A. McKenzie, War-Emergency Operation of Broadcast Stations, ELECTRONICS, p 94, Aug. 1951.