

CATHODE-RAY DEMONSTRATION PANEL

• Description of a cathode-ray demonstration panel used for radio instruction at the wireless school of the Royal Canadian Air Force in Montreal

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THE "Cathode-Ray Demonstration Panel" consists of a modern 14-tube superheterodyne radio receiver, a two-stage transmitter with modulator, amplifier and power supply. All this is mounted on a panel, approximately 8'x-4' in size. The components of the receiver are spread out across the face of the panel so as to correspond as closely as possible with a schematic diagram of the receiver which is drawn on the face of the panel. Two 9" oscillographs are embodied at the top of the panel and are used for visual demonstration. An ordinary dynamic speaker, also mounted on the panel, is driven by output of the receiver and all circuit functions can thus be both aurally and visually demonstrated. Either one or both of the oscillographs can be "tapped in," at a large number of points throughout the receiver circuit. Two signal generators, type 170, provide a source of signal. The two being required for demonstrating interfering signal cross modulation, etc. The b-f-o—A-f output of one signal generated is amplified and used to modulate the r-f output of the other so that variable frequency and percentage modulation is possible.

By the use of interchangeable components, which are readily plugged into the face of the panel, and by inter-switching, practically any radio phenomenon can be demonstrated. A few of these interchangeables are shown in the photograph on Fig. 1. The entire panel is mounted on wheels so that it can be shifted from one instructional room to another.

The panel was designed by Burlec Limited and the Royal Canadian Air Force for Radio instructional use in Wireless Schools of the Empire Air Training Scheme.

The panel is in use for the training

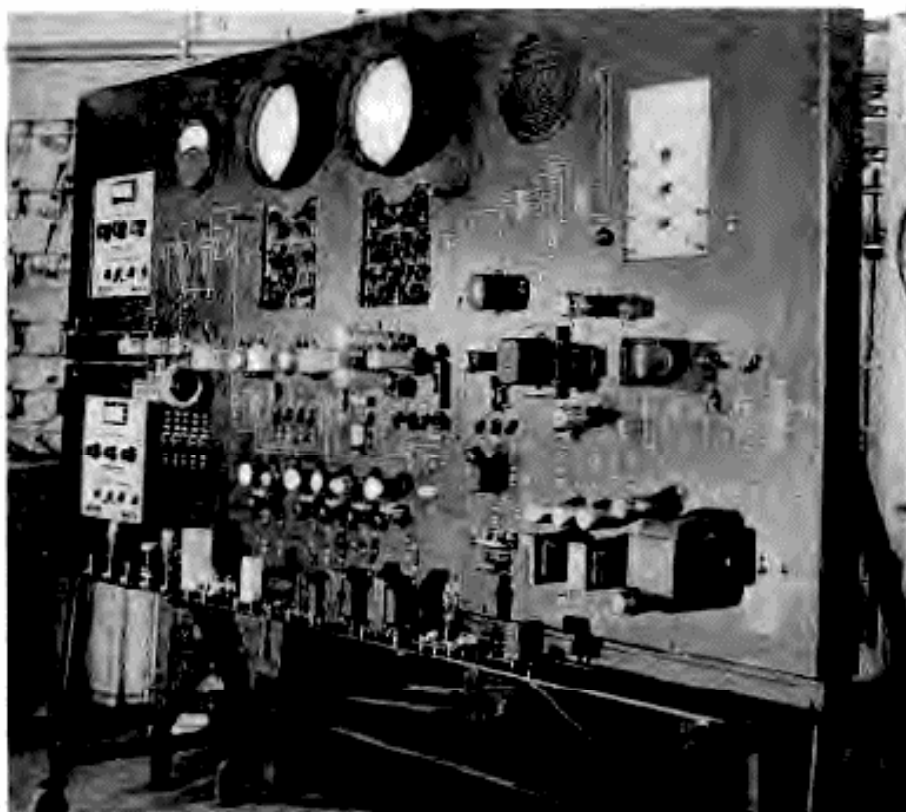
of Wireless Electrical Mechanics, Wireless Operators Ground and Wireless Air Gunners, and has its own particular uses in assisting the training of each of these tradesmen. It is estimated that with this panel, the time devoted to instruction in radio theory can be considerably reduced and the Student will obtain a clearer understanding of radio phenomena.

In the R. C. A. F. the Wireless Air Gunner ("Wag"), and the Wireless Operator Ground ("WOG") are required to know elementary radio theory, just enough to familiarize them with

the operation of radio transmitters and receivers, and in order for them to manipulate the equipment rationally. The only maintenance that they are likely to be called upon to carry out is of a routine nature. The Wireless Electrical Mechanical ("WEM") is the "radio serviceman" of the Air Force. He must understand advanced theory. The demonstration panel has its most important use in the training of the WEM as such things as alignment can be so simply demonstrated. However, elementary phenomena can, of course, be observed and demonstrated.

The receiver end of the demonstration panel can be a superheterodyne or

Fig. 1. Front view of cathode-ray demonstration panel.



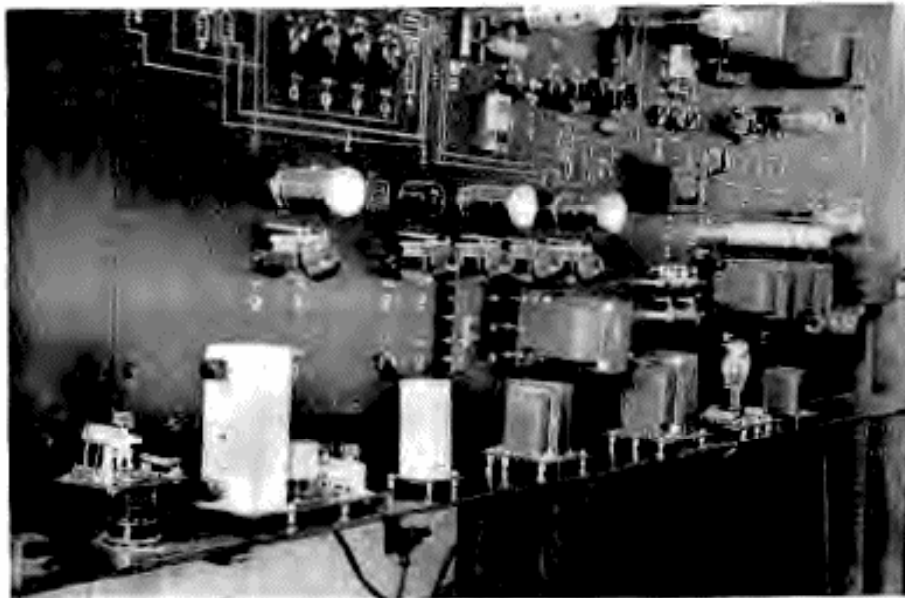


Fig. 6. [Above] Illustrating transmitter and some of interchangeable components.

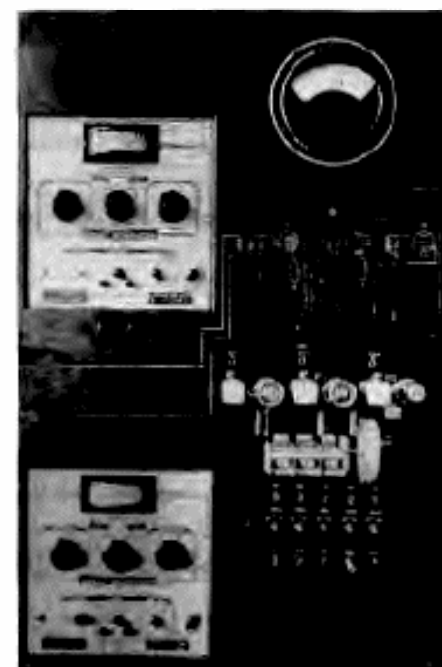


Fig. 2 [Left] The r-f section.

t-r-f receiver. It consists of a r-f amplifier tuning the broadcast band using a type 6L7G first detector and 6J5 oscillator a type 76 triode and 36 tetrode with a suitable adapter. The use of the 36 tetrode is for cross-modulation demonstrations. Fig. 2 illustrates the r-f section of the receiver.

The i-f amplifier is tuned to 100 kilocycles. This low frequency being used so that in modulated envelope demonstrations the sine wave of both the modulation and modulated frequencies may both be seen. The amplifier consists of two stages, air-tuned transformers being used. The first i-f transformer can be removed and a crystal filter unit plugged in. The second and third transformers have variable coupling so that variable band-width demonstra-

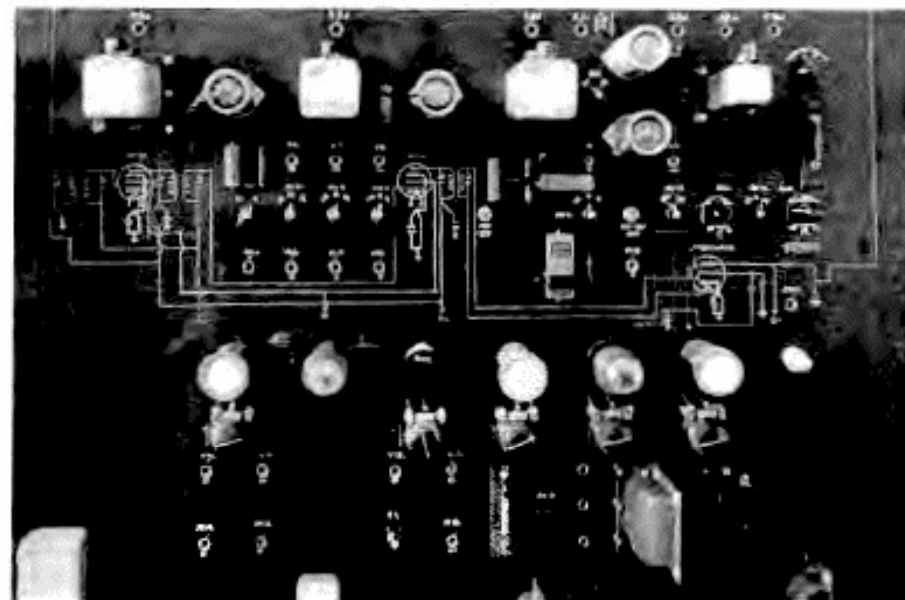


Fig. 3. [Below] The i-f and detector section.

tions are possible. The circuit possesses unusually high gain, necessary to produce overload when required. The i-f and detector section is illustrated by the photograph, Fig. 3.

In the r-f and i-f amplifier, as in the entire demonstration panel, all important resistors and condensers can be varied so that low, normal and high values of these components is obtained. This is accomplished with a three-point switch for each component. These are shown in Fig. 4, marked *Low*, *Normal*, *High*, above the switch.

The tuning condensers of the i-f amplifier are variable air type with extension shafts and a small knob provided. The tube line-up in the intermediate-frequency amplifier is a type 78 in each stage, in one of which a type 36 may be used to demonstrate overload. A type 6R7G is used as a diode or triode second detector. A switch is provided to utilize either section of this tube in the detector circuit.

The circuit is so arranged that a single switch changes operation from superheterodyne to tuned-radio-frequency receiver. Regenerative detection is similarly obtained. A 6J5G serves as a beat-frequency oscillator or quench-frequency oscillator. Superregenerative demonstration is possible by inserting the superregenerative panel in place of the second detector tube.

The demodulated output of the detector section is coupled to the first audio-frequency amplifier. The first audio-frequency amplifier may be choke-capacitance or resistance-capacitance coupled by using plug-in components. The value of the coupling condenser is varied by a three-point switch. Pro-

Fig. 7. (Below) Illustrating how cathode-ray tubes are connected into circuits.



vision is also made for feeding the output of a single-button carbon microphone into the audio channel by means of a jack marked "Mic," battery and microphone transformer being wired in the panel itself.

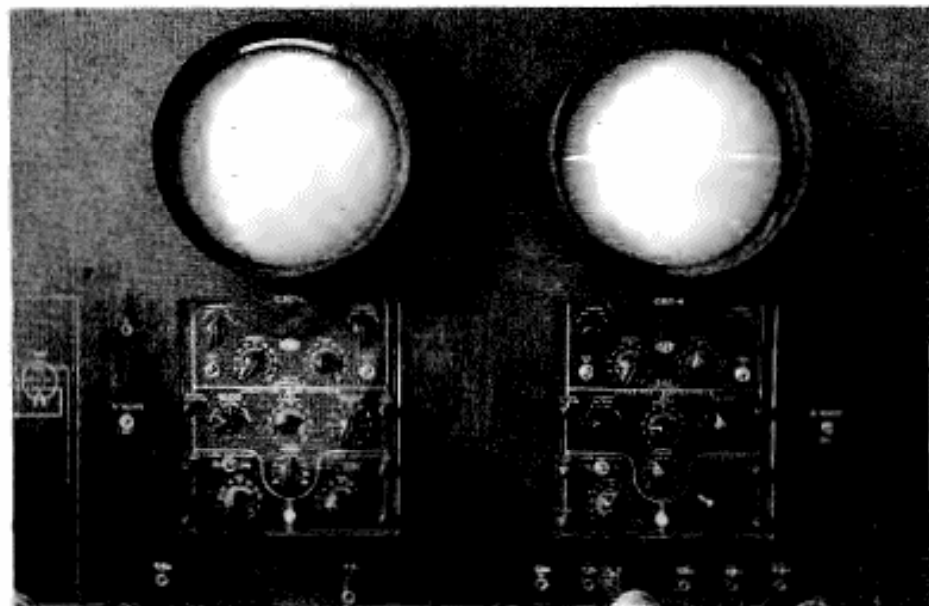
The driver audio tube is a 6F6, triode connected. This tube may be connected to either the a-f output stage or to the transmitter where it is used for grid or Heising modulation. Coupling to the push-pull stage is accomplished by either a conventional driver transformer or a phase inverter panel which may be plugged in, in place of the push-pull input transformer.

The push-pull output stage consists of 6F6 tubes which may be either triode or pentode connected by means of a toggle switch, and it is operated class "A" prime. The output transformer has secondary taps with variable output impedance which, together with a variable load resistor, provides adequate means of impedance matching. The output of the amplifier may be fed to either a resistance load or the 8" permanent-magnet dynamic speaker by means of a selector switch. This stage is also used for class "B" modulation of the transmitter, in which case, it is impedance coupled to the class "B" modulation transformer.

The power supply consists of large power transformer with two type 80 rectifiers. The anodes of each 80 tube are strapped to form a half-wave rectifier and the pair as full-wave. The anode circuit of one tube may be opened to demonstrate half-wave operation. The filter section consists of two chokes and three eight-microfarad filter condensers. Either or both chokes may be shorted, and any or all condensers cut out. (See Fig. 5.)

The demonstration transmitter consists of a master oscillator and amplifier. The master oscillator may be operated as either a "tuned-plate tuned-grid" or "Hartley" circuit, the coils for both being provided. Provision is also made for crystal operation. The oscillator tube is a 6J5G and the amplifier a 6F6G. Many demonstrations are possible in the transmitter circuit; insufficient neutralization, insufficient excitation, etc., being very easily demonstrated. The output of the transmitter is $7\frac{1}{2}$ watts, a small 7-watt lamp serves as a dummy load. Grid, Heising, and Class "B" modulation of the r-f amplifier can be easily demonstrated. To change the method of modulation the operator merely inserts the panel in the circuit, switching being done automatically by the change. (See Fig. 6.)

The preceding is an outline of the circuit of the receiver, amplifier, transmitter and power supply of the cathode-ray demonstration panel. It is impos-



Above: Front view of cathode-ray oscillographs.

Fig. 5. (Right) A-f and power supply, showing loudspeaker and electronic switch.

sible to list all demonstrations possible with this equipment. Many elementary theory demonstrations are possible, i. e., hysteresis, tube characteristics, etc, these being demonstrated simply by inserting a small plug in the jack required, all switching being automatic. It is estimated that a total of 300 radio demonstrations are possible.

The radio-frequency signal is traced from its origin, at the signal generator, to the output at the loudspeaker. To observe the signal at any of the points intervening the demonstrator has simply to insert the plug in the jack marked CRT "A" or CRT "B" at the point at which the signal is to be observed. When the plug (C-R PANEL—continued on page 33)

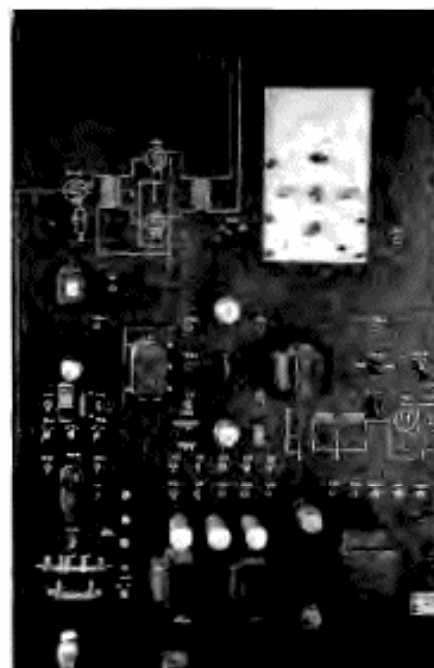


Fig. 4. (Below) Taking a current reading.

