73 Magazine *Staff*

Test Gear Bargain from Heath

— a multi-purpose RCL bridge

The new Heath 5280 series of test instruments appeared, at first glance, as probably not offering very much because of the low prices. One of the first pieces of the series that we noticed was the IB-5281 RCL Bridge. It claimed the following measurement ranges: Resistance—10 Ohms to 10 megohms; Inductance—10 uH to 10 henrys; and Capacitance—10 pF to 10 μF.

This is a fairly good range of measurement. Much more expensive test equipment, such as even the Heath IB-3128, hardly offers much more, and in some cases less, of a measurement range. The measurement ranges for the IB-3128, for example, are: Resistance—0.1 to 10 megohms; Inductance—0.1 mH to 100 henrys; and Capacitance—100 pF to 100 uF.

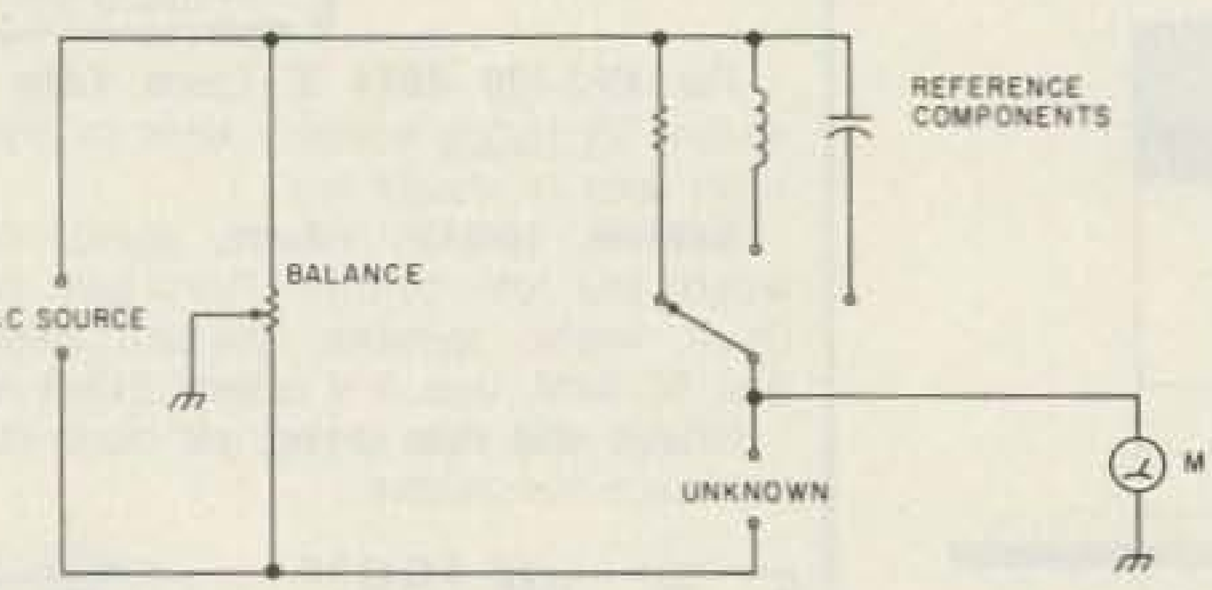

Fig. 1. Basic Wheatstone bridge type of circuit used with reference R, L, and C components compared to an unknown component to determine its value.

Of course, there are many other factors to be considered than just the measurement ranges—the accuracy of measurement being an obvious one.

As it turns out, however, the IB-5281 is much more of a sophisticated little piece of test equipment than meets the eye. Perhaps the first thing one notices when looking at the kit is that there are a fair number of parts involved for the 10-transistor circuitry used. In fact, the average amateur would probably find it difficult to buy the electronic parts for the cost of the whole kit.

The circuitry used in the kit is not new in basic principles, but it has been very neatly implemented. The bridge operates on the basic Wheatstone bridge applied to RCL components as shown in Fig. 1. A reference R, C, or L component is used which is compared with an unknown component by balancing a bridge circuit. When the bridge circuit is balanced, the meter reads zero. The balancing potentiometer's rotation can be calibrated in terms of how far in value the unknown component's value is above or below the value of the reference component. Theoretically, any value component can be measured, but in practice there are many limitations, particularly when either very small value or very large value components are involved.

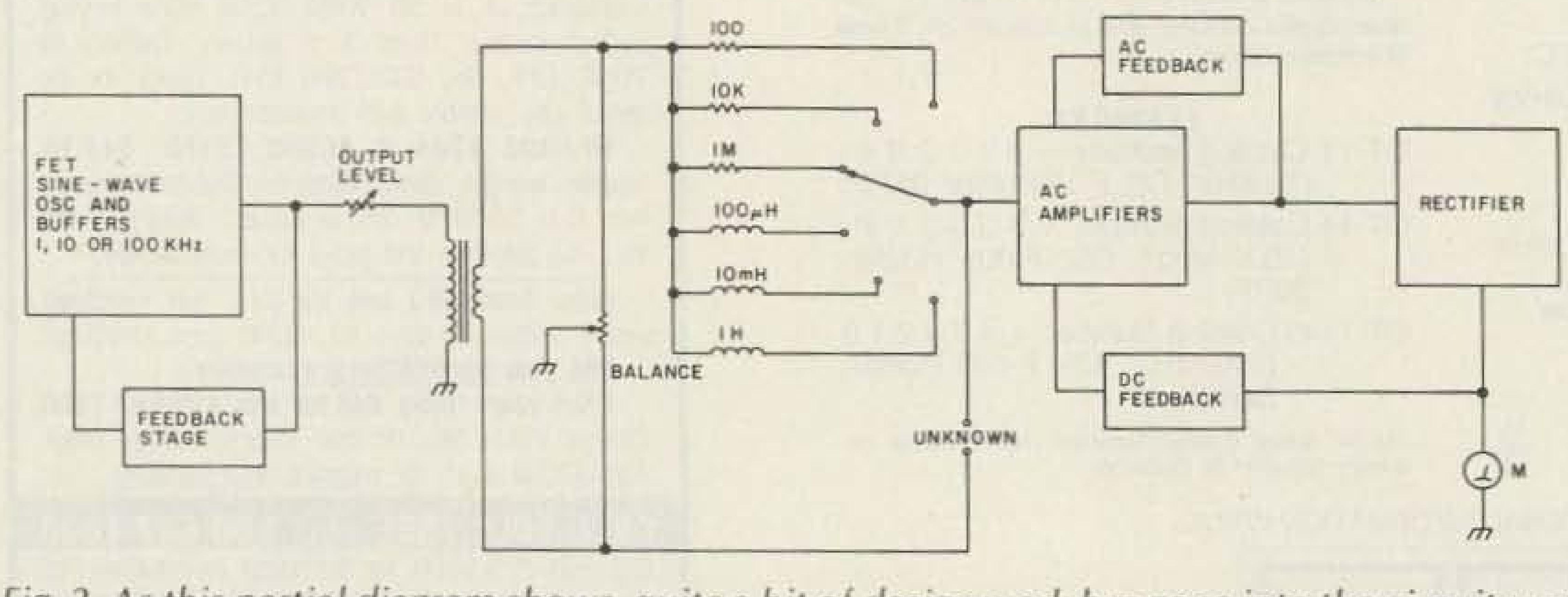

Fig. 2. As this partial diagram shows, quite a bit of design work has gone into the circuitry of the IB-5281. Only the R and L reference components are shown; there are also three reference capacitors in the actual circuit. In addition, provision is made for the use of an external reference R, L, or C component, if desired.

A partial diagram of the Heath bridge is shown in Fig. 2 and illustrates some of the very interesting features found in the unit. The ac source, or oscillator, is a rather elaborate five-transistor FET type. Part of the output is rectified, and a feedback arrangement is employed to control the gain of the oscillator. This provides better control than the usual lamp arrangement found in simpler oscillators. The oscillator also operates at three different frequencies: 1, 10, or 100 kHz, depending on the range selected for each R, L, or C component. This is a great improvement over simpler bridges which have just a 1-kHz oscillator. It becomes very difficult with such oscillators to measure small values of inductance or capacitance since one is basically trying to measure component values used at rf frequencies in a low-frequency audio-type test arrangement.

The oscillator output is coupled through the transformer, T1. The secondary of this transformer forms a balanced ac source arrangement for the actual bridge circuit. The transformer has a very low impedance, and this plays a major role in the good performance of the bridge. The actual bridge circuit is formed by the rest of the components shown. There are three ranges for each type of component. Although to simplify the diagram only three reference components are shown for resistance and inductance measurements, there are also three reference capacitors in the actual circuit.

The output of the bridge goes to a five-stage ac amplifier and rectifier which drive a meter for a null indication. The amplifier stages are relatively sophisticated in design, with both ac and dc feedback incorporated to enhance circuit stability.

The construction of the bridge is relatively straightforward. Most of the components mount on a single PC board. Perhaps the only area where a newcomer should take time and be especially careful in construction is in wiring up the range switch. A number of components mount on the switch itself and if one doesn't get this four-wafer switch wired correctly, it could cost a lot of troubleshooting time to correct it.

Photo A. The Heath IB-5281.

If it were not for the switch, one could rate the construction as simple. However, the assembly manual is very detailed, and anyone who has a basic proficiency in soldering should be able to assemble the kit. An experienced builder can assemble the kit in two evenings, while others might take up to double that time.

Performance, considering the price of the bridge, can be termed as excellent. It is not a super-accurate bridge, where one can read the difference between 100 Ohms and 102 Ohms, for instance, but one certainly can find quickly the approximate value of any components. The bridge was tried with a variety of unmarked capacitors and coils, and the values obtained compared with those obtained on a laboratory bridge. In all cases, the values checked out closely enough for most experimental uses, and there is absolutely no doubt about separating standard-size component values (.005-, .01-, .02-, .05-, and .1-uF capacitors, for example). The bridge was particularly good when measuring a variety of inductors. Air-wound coils, ferrite-core coils, slug-tuned coils, rf chokes, etc., all produced clear null indications quickly. In fact, some of the inductors tried could not be measured on the laboratory bridge (unless one wanted to spend hours at it) because of trying to compensate for their different Qs.

A look at the rear of the unit reveals that there is a lot of unused volume in the enclosure. Heath undoubtedly took the route of using a standard-size enclosure for all the IB-5280 series test instruments, for economy reasons. There is room in the enclosure to store two extra of the 9-volt transistor radio batteries which are needed to power the bridge. However, one could also easily build a dual 9-volt ac supply in the enclosure and have room to spare.

The bridge as it stands is a fine little test instrument and nicely fills the gap for those who like to do a bit of circuit experimenting where component values need to be measured, but do not have the need for a laboratory-grade bridge. In trying to think of ancillary uses for the bridge, the use of the audio oscillator and ac amplifier came to mind.

The audio oscillator probably could be made variable by the use of a dual potentiometer to augment the fixed value resistors which are switched in for 1-, 10-, or 100-kHz output. As it stands, the fixed frequencies could provide very stable sine-wave test signals with very low distortion. The ac amplifier/rectifier was measured to be able to detect rf signals all the way up to 17 MHz! So, it could be used as it stands as a tuning indicator for low-frequency rf signals and probably could be turned into a very sensitive field-strength meter by augmenting the bypassing for rf frequencies. The input to the amplifier/rectifier can be accessed from the front panel, without modification, via the "Z's" terminals. ■