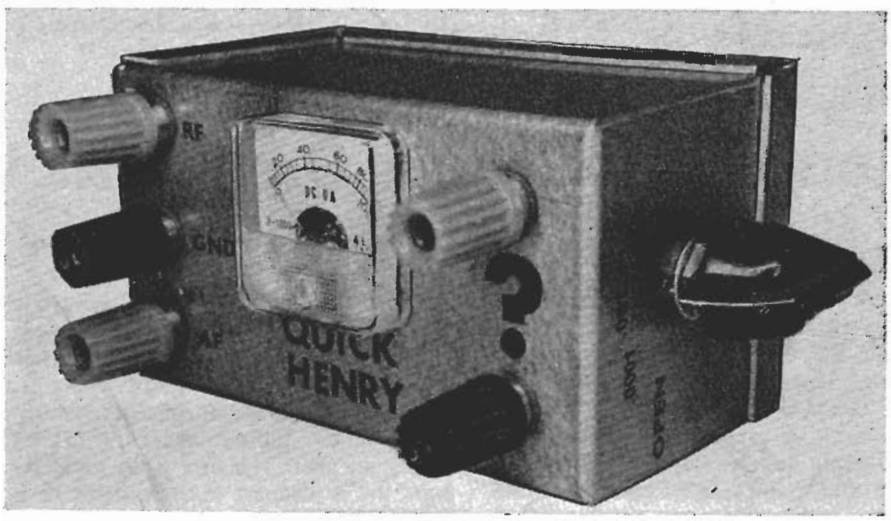
**Instrument you can build in an evening measures inductance, checks resonance with the help of an audio or rf generator**

# QUICK HENRY!

**By FRED BLECHMAN K6UGT**

**Measuring the inductance of a choke, i.f. transformer, toroid or any other coil is a clumsy process. Unless you have an inductance bridge, you usually avoid measuring inductance because of the "difficulty." With Quick Henry, anyone with an audio generator can measure inductance quickly and easily from less than 1 mh to over 5 henries. With an rf generator, measurements can be made down to a couple of microhenries. Quick Henry will allow you to determine the resonant frequency and Q of audio and rf circuits from below 100 cycles to over 30 mc with reasonable accuracy. The resonant frequency of unmarked i.f. transformers can be found easily, and you can determine the inductance of unmarked filter chokes, slug-tuned coils, and rf chokes. You can design, test and trim audio bandpass circuits to your requirements.**




*Quick Henry takes up amazingly little space for its versatility.*

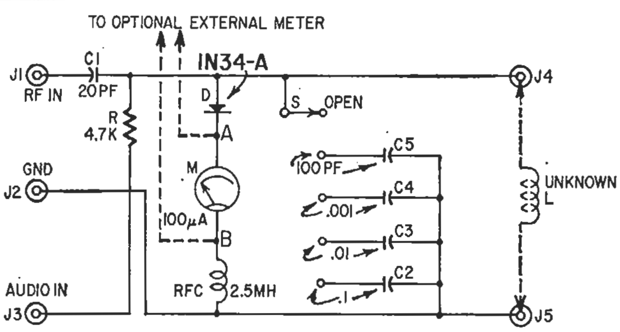



*Fig. 1—Circuit of Quick Henry.*

C1—20 pf
C2—0.1 μf
C3—.01 μf
C4—.001 μf
C5—100 pf
D—1N34-A or equivalent
J1–J5—Insulated 5-way binding posts (Lafayette 99 R 6233 or equivalent)
M—1-inch clear plastic 100-μa meter (Alco P-1000** 0–100 range), or 1⅝-inch 50-μa meter (Lafayette 99 R 5049)
R—4,700 ohms, ½ watt
RFC—2.5-mph rf choke (National R-50 or equivalent)
S—5-position switch (Lafayette* 99 R 6164 or equivalent)
4 x 2¼ x 2¼-inch aluminum box

*Lafayette Radio-Electronics Corp., 111 Jericho Turnpike Syosset, N. Y. 11791

**Alco Electronic Sales, Inc. 3 Wolcott Avenue Lawrence, Mass.

Quick Henry's built-in meter indicator is optional. If you have a 10,000-ohm/volt or better multimeter, use it instead. The total cost of parts for Quick Henry, including the meter specified in the parts list, is only $8. If you prefer to use a meter you already have, the cost drops to only $3.50!

### Circuit description

Fig. 1 is the schematic of Quick Henry. A signal fed to posts J1 or J3 and ground (J2) passes through R or C1 and then through the unknown inductance connected between J4 and J5. Switch S1 selects an appropriate capacitor (C2, C3, C4 or C5), which is placed in parallel with the unknown inductor. The input frequency is varied, and at the resonant frequency of the unknown L and the selected C in parallel, the voltage across J4-J5 increases sharply. This is because at resonance the parallel L-C circuit suddenly becomes a high impedance to the signal, shunting less of it around the meter. The further from resonance, the lower the impedance, depending on the Q, which we'll get to later.

This ac voltage across the unknown inductor is rectified by diode D and passed on to the sensitive dc microammeter M and the rf choke RFC. When you use an rf generator, the signal is coupled to the resonant circuit through C1, a 20-pf capacitor.

Capacitors C2 through C5, selected by S, allow a broad range of L-C ratios. The OPEN position of S allows you to measure external resonant circuits or to trim an inductor with exactly the value of capacitance needed for resonance.

### Building it

I built my instrument into a standard 4 x 2¼ x 2¼-inch two-piece aluminum box. Wiring is not critical, but don't make the leads longer than necessary, and place S, C2, C3, C4 and C5 near J4 and J5. Be sure that *all* binding posts are *insulated* from the box; there shouldn't be any connections to the box.

The 1-inch meter and five-position switch specified in the parts list contribute to the small size of the unit, but any equivalent switch or meter may be used if you don't mind a bigger box. The alternate meter listed will still fit in the specified box, is less expensive and more sensitive than the meter I used, but it *does* take up more space.

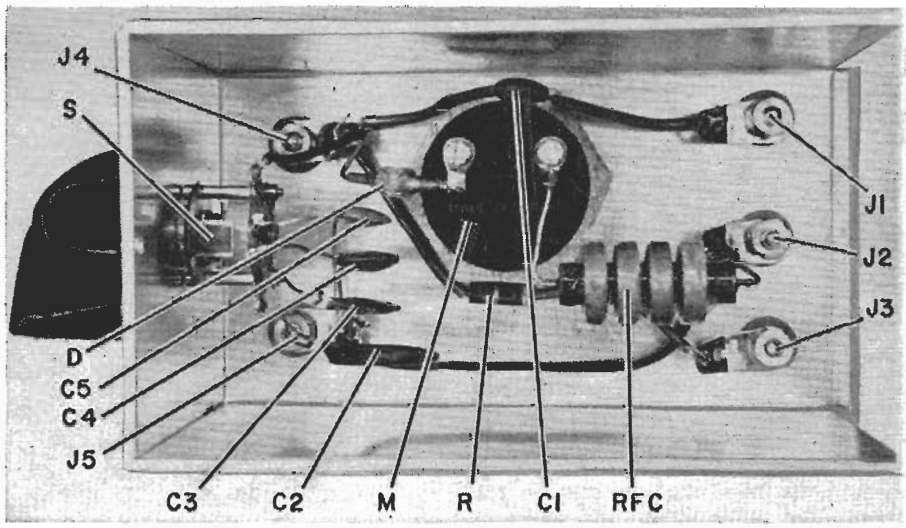
If you intend to use an external multimeter to detect resonance instead of building a meter into Quick Henry, bring two additional binding posts out on the side of the unit. These points are marked A and B on the schematic. Mark these posts with the proper polarity.

## Using it

Most inductors with many turns of wire wound on a ferrite or iron core measure over 1 mh, and can be checked by using an audio generator with Quick Henry. For air-wound coils, use an rf generator. Never connect *both* generators to Quick Henry at the same time, because all sorts of spurious signals will result. Connect the generator to J2 and either J1 (rf) or J3 (audio). To start, set S to the .001 position. Starting at the low-frequency end, vary the frequency, changing generator frequency bands when necessary, until you see a clear meter deflection. There may be minor spurious responses (especially with an rf generator and measuring in the low microhenry range), but these can be ignored.

If you don't find any response, switch S to the next higher value, and sweep the frequencies again. When you do get a response, it will be quite definite, and might "pin" the meter. Adjust the generator output for a comfortable peak reading. Most audio generators have enough output to deflect the meter well beyond full scale, and rf generators will give at least half scale under most conditions. The best accuracy comes with the highest value of C that gives a sharp peak meter reading, so readjust the position of S if necessary. A broad peak—that is, one which is not too definite as you vary frequency—is "low Q", and may be improved by using a higher value for C (setting S to a higher value).

Once you have found the best setting for S, use Fig. 2 to determine the inductance of the unknown coil if you are using an audio generator, or Fig. 3 if you are using an rf generator. Enter the horizontal axis at the resonant frequency, as read on the generator dial; move directly upward until you intersect the line that represents the value of capacitance selected by S, and then move straight to the left and read the value of the unknown inductance on the vertical scale.




*What's inside the box. Tiny rotary switch and 1-inch meter help make wiring easy.*

To determine the resonant frequency of, say, an unmarked i.f. transformer, connect one of the windings (an ohmmeter will identify the windings by continuity) to J4 and J5, and set S to OPEN. Using an rf generator, find the frequency that peaks the meter, and read this resonant frequency right off the generator dial. A particular value of capacitor can be connected across an unknown inductor, and the resonant frequency determined the same way.

You can actually plot the audio bandpass of an R-C or L-C network by taking successive meter readings near resonance and plotting them on graph paper, with frequency along the horizontal axis and meter reading along the vertical axis. In this case, it is convenient to set the generator output to read full scale on the meter at resonance.

Figs. 2 and 3 have been plotted showing only the values of capacitance I used. If you want to use other values, either internally or connected to the binding posts externally, you'll find it worth while to get a slide-rule resonance calculator, such as the Shure Reactance Slide Rule (Allied Radio, catalog No. 37 U 950E, $1 postpaid). This covers resonant L-C combinations from 5 cycles to 500 mc.

Series-resonant circuits can also be

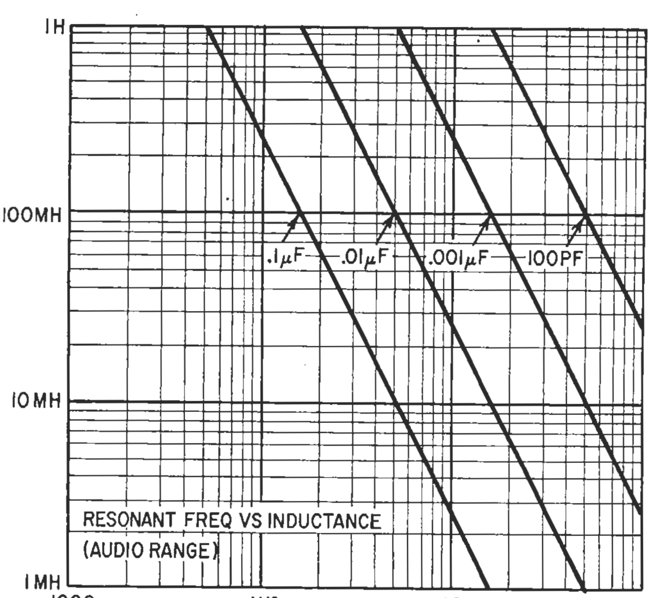



*Fig. 2—Chart of resonant frequency inductance in the range of an audio generator.*

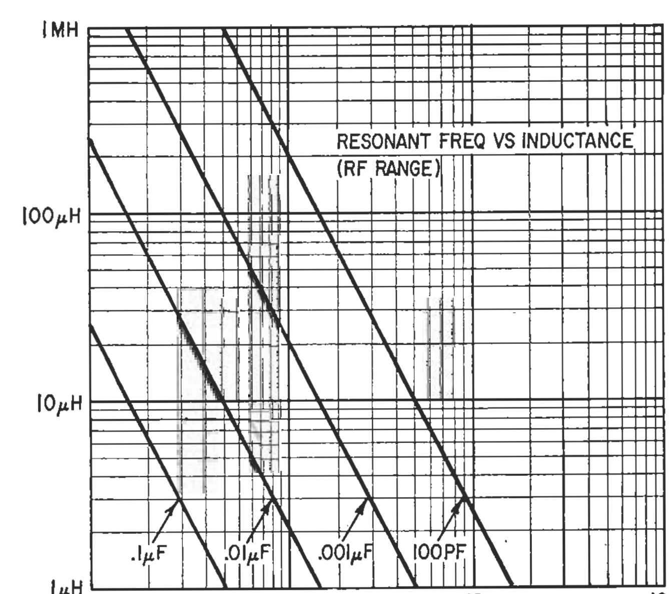



*Fig. 3—Chart of resonant frequency inductance in the range of an rf generator.*

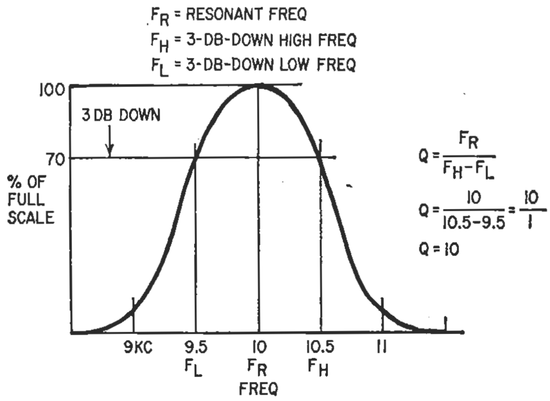


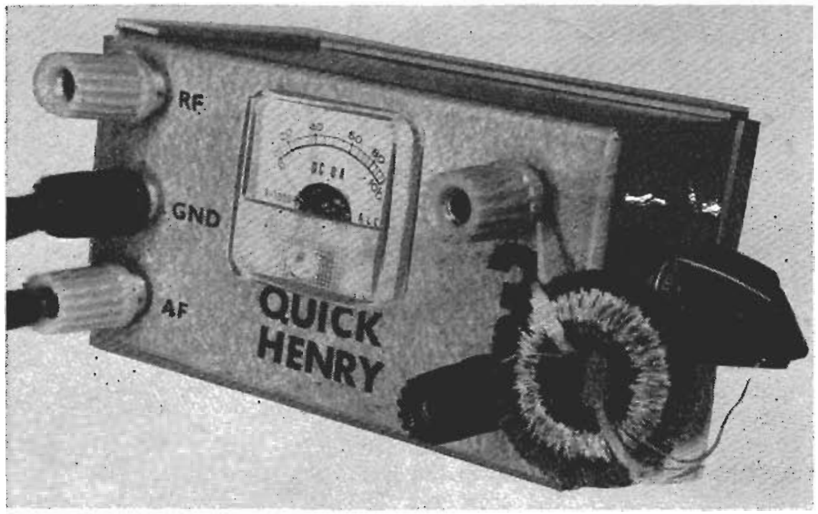

*Fig. 4—Q-measuring formula and example.*

measured across J4 and J5 by noting a *dip* in the meter reading, since at resonance the tuned circuit will effectively short out the meter circuit.

To find the Q (figure of merit) of a resonant circuit, set the peak meter reading to full scale by adjusting the generator output. Now vary the input frequency on both sides of the resonant frequency to the points where the meter reads 0.7 of full scale (3 db down). Note the frequencies where these meter readings occur, and apply the formula given in Fig. 4, which shows an example of a Q calculation.

When you use an external multimeter instead of the built-in meter arrangement to sense resonance, set the multimeter on its lowest dc *voltage* range, observing proper polarity. Do *not* use the current scales.

The accuracy of Quick Henry does not qualify it as a laboratory standard by any means. Numerous errors are cumulative, such as the accuracy of your capacitor "standards," the internal capacitance of the circuitry, the external capacitance of test leads and the calibration accuracy of the signal generators used. However, for hams and home experimenters, radio and TV service shops even for small labs, Quick Henry will satisfy a long-felt need to measure inductance and resonance quickly and cheaply. END



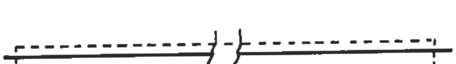

*Checking an unknown toroid is no trick with Quick Henry. Select a capacitor with the switch, then adjust the audio generator until you see the meter peak.*

# WHAT'S YOUR EQ?

**Conducted by E. D. CLARK**

## How Many Relays?

Using ordinary spst toggle switches, working from any standard



type of power, how many relays can you control on the far end of this shielded two-conductor line, each entirely independent of all others?—*Eugene Austin*

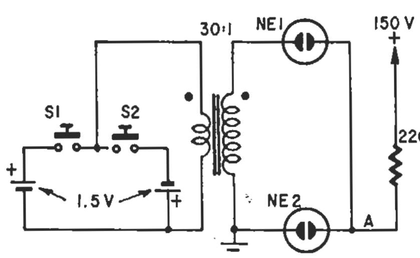
Two puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.

**Answers to this month's puzzles are on page 101.**

## Glow-Lamp Memory Circuit

This flip-flop memory circuit uses two NE-23 neon glow lamps and a 30:1 audio output transformer that functions as a voltage-peaking transformer. The output is in the form of transient peaks that exceed 45 volts and are sufficient to fire a nonconducting lamp.




When the circuit is stable, one lamp is on and the other is off. The voltage requirements of NE2 are: firing voltage 75, maintaining voltage 65, and extinguishing voltage 64. NE1 has a firing voltage of 70, maintaining voltage of 60 and extinguishing voltage of 59.

The pushbuttons (S1, S2) are normally open and each is correlated to a glow lamp. When a button is pressed, the lamps will flip. Upon release, they will flip. Can you determine which lamp will flip into steady conduction if S1 is pressed for ½ second and released? —*Kendall Collins*

### 50 Years Ago

**In Gernsback Publications**
**In January, 1916**
**Electrical Experimenter**

Microphonic Device Detects Submarines 20 Miles Away
Transmission of Photographs Telegraphically
Regenerative Audion Circuits for Wireless Receiving
Hearing Through Your Teeth
Ultra-Sensitive [Baldwin] Telephone Receiver