self-supporting coils

A set of inductance and *Q* graphs for airwound coils using screws and other threaded forms as mandrels

Self-supporting coils without forms are the cheapest, most convenient, high-*Q* inductors for inductance values under 0.4 microhenries. Unfortunately, the wire is difficult to wind on a smooth form and you have to account for wire diameter plus form diameter for accurate calculation. Presented here is a method for using conventional screw threads as forms along with measured inductance values.

Form and wire size; coded by the letters of **fig. 1**, are given below:

curve	wire size	winding form
A	26 enameled or Soldereze	4-40 screw
B	22 enameled or Soldereze	6-32 screw
C	22 enameled or Soldereze	8-32 screw
D	22 enameled or Soldereze	10-32 screw
E	18 tinned or enameled	1/4-20 screw
F	18 tinned or enameled	5/16-18 bolt
G	18 tinned or enameled	3/8-16 lag bolt
H	14 bare copper	7-watt Christmas bulb base (3/8" ID, 10 TPI)
J	12 bare copper	Paint roller ferrule (5/8" ID, 1 turn per 3/16")
K	12 bare copper	Standard 117 Vac lamp base

The method is very simple: Take any convenient screw or bolt and wind the wire firmly on the threads. When finished, allow the wire to release its tension, then carefully remove the form. **Fig. 1** shows inductance vs the number of turns for ten different screw threads on easily obtained sizes.

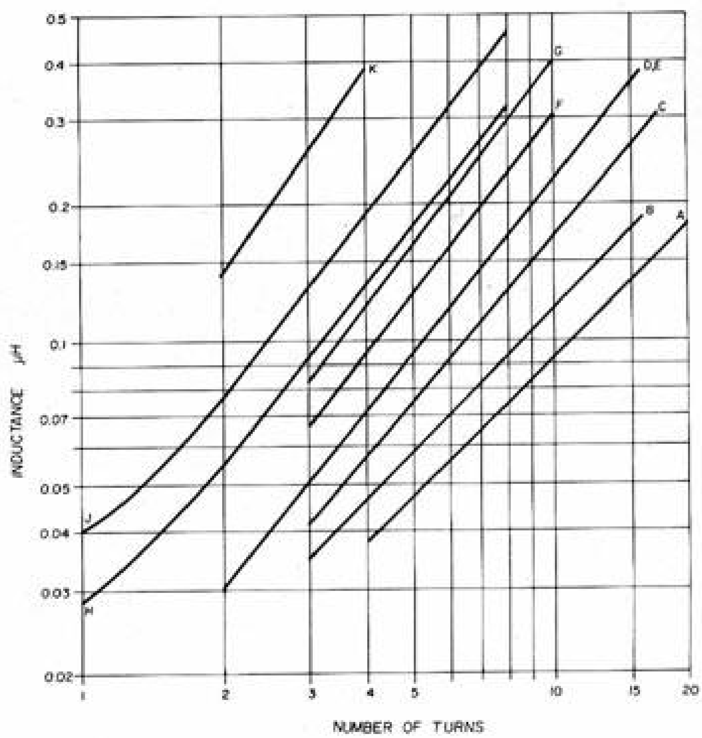


fig. 1. Inductance of airwound coils using threaded forms as mandrels. Extensive use of this chart has shown the inductance values to be reproducible to within about 5%. Inductor Q for each of the 10 forms is shown in figs. 2 through 11.

This data was originally collected by the author in 1969. It has been used since then in many commercial applications, and the values checked with other Q-meters. In all cases the inductance values were within 5% of the predicted value; *Q* was up to 20% greater, depending on the measuring instrument. **Editor.**

By Leonard H. Anderson, 10048 Lanark Street, Sun Valley, California 91352

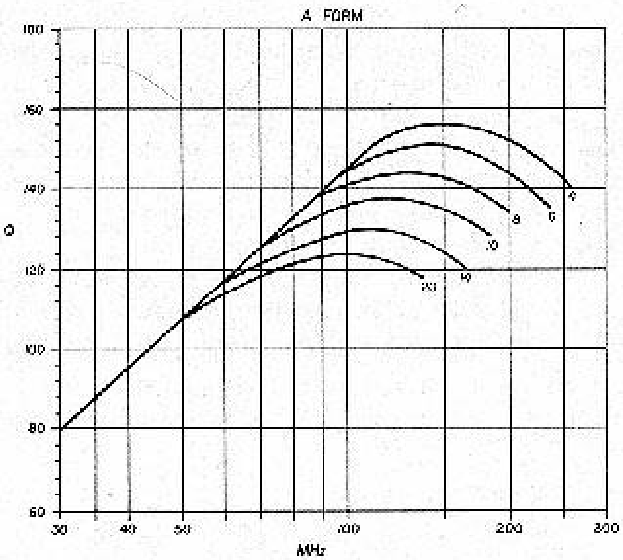


fig. 2. Q of inductors of no. 26 enameled wire wound on 4-40 screw form (curve A in fig. 1).

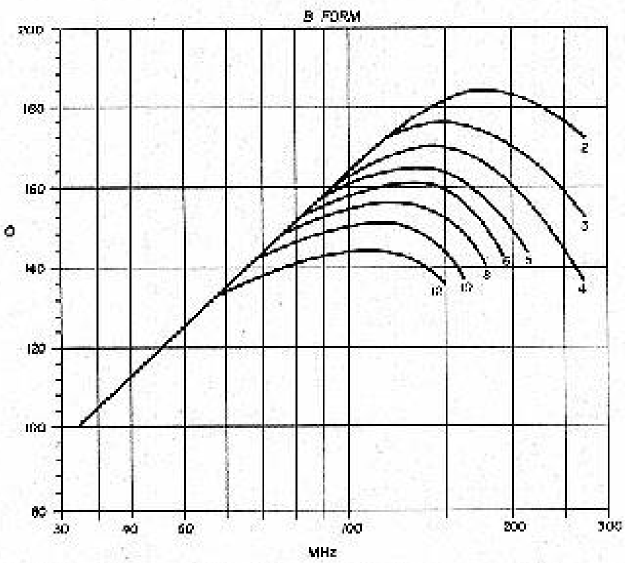


fig. 3. Q of inductors of no. 22 enameled wire wound on 8-32 screw form (curve B in fig. 1).

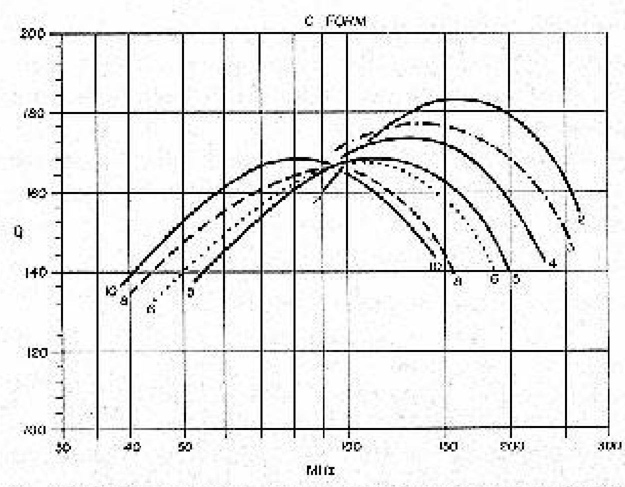


fig. 4. Q of inductors of no. 22 enameled wire wound on 8-32 screw form (curve C in fig. 1).

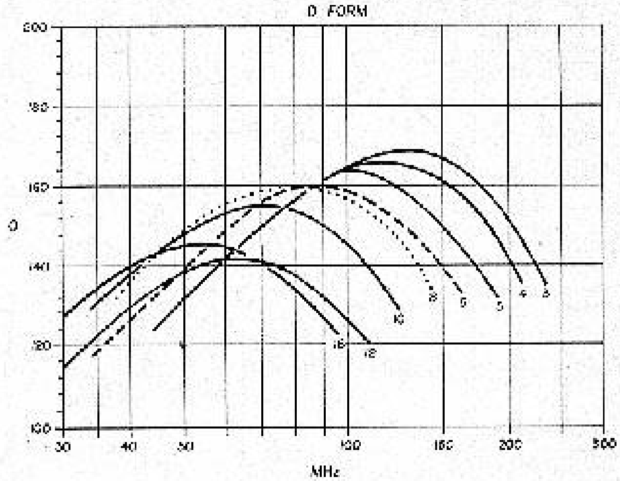


fig. 5. Q of inductors of no. 22 enameled wire wound on 10-32 screw form (curve D in fig. 1).

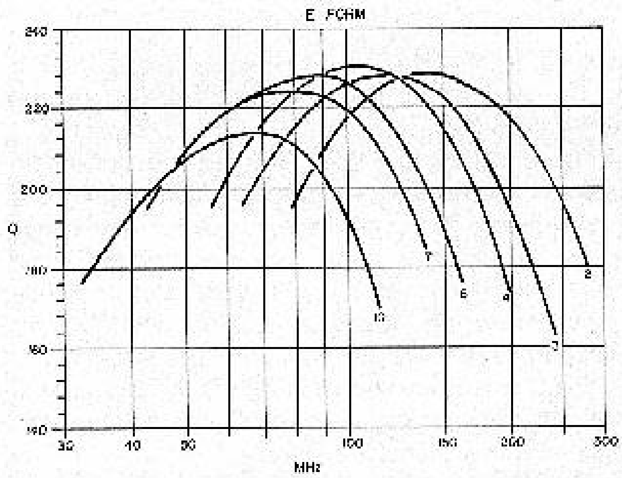


fig. 6. Q of inductors of no. 18 tinned or enameled wire wound on 1/4-20 screw form (curve E in fig. 1).

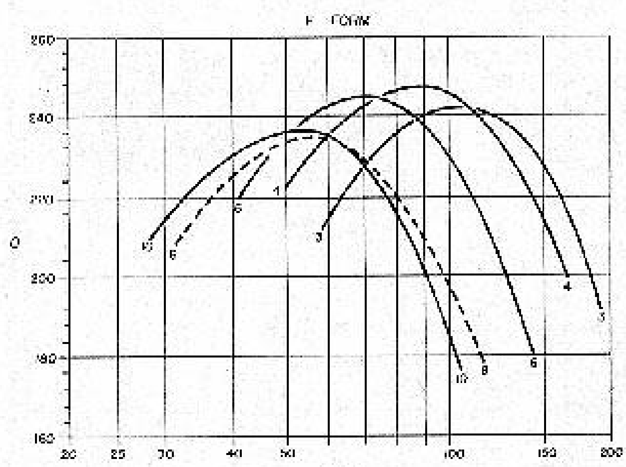


fig. 7. Q of inductors of no. 18 tinned or enameled wire wound on 5/16-18 bolt (curve F in fig. 1).

Wire size is fixed by the number of turns per inch on the screw form. This has been selected to allow a slight space between turns so that adjustment for higher inductance by squeezing may be done if

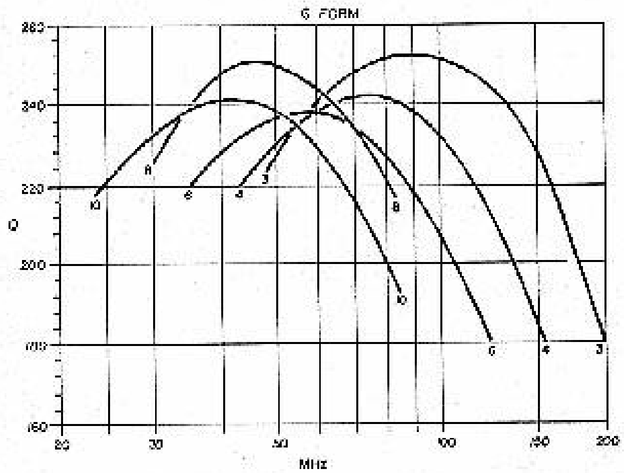


fig. 8. Q of inductors of no. 18 tinned or enameled wire wound on 3/8-16 lag bolt (curve G in fig. 1).

desired. It was also found that wire diameter had to to be restricted to just under full winding by the screw threads.

The no. 12 and 14 AWG wires are household power wires (*Romex*) with the insulation stripped off. If this material is not available, check for wire scraps at industrial plants or at new construction sites; quite a bit is thrown away. The paint-roller ferrule can most often be found on extender poles sold for that purpose and are quite uniform in dimension.

The *Q* curves are shown in **figs. 2 to 11.** Values in between the indicated number of turns may be interpolated with reasonable accuracy.

All data was obtained by construction and

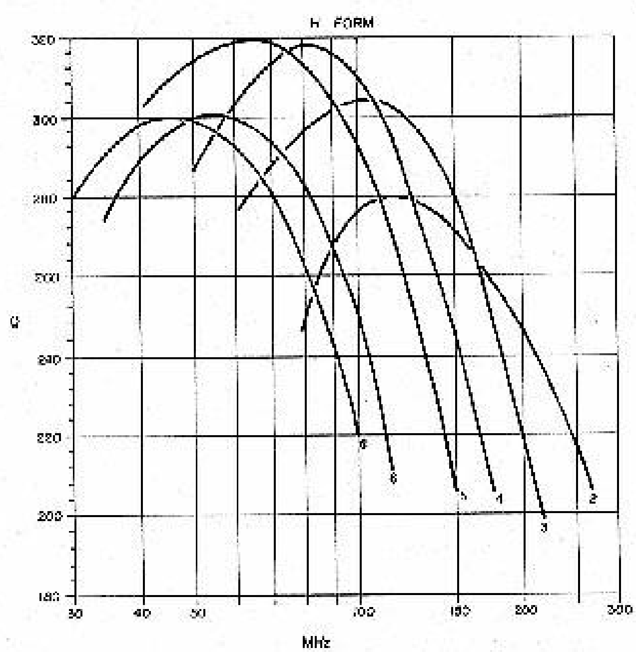


fig. 9. Q of inductors of no. 14 bare copper wire wound on 7-watt Christmas bulb base (curve H in fig. 1).

measurement with a Boonton 190A Q-meter. This limited the measurements to the 20 to 240 MHz instrument range. No compensation for lead length has been made and all coils have an assumed 3/4-inch connection spacing. Each coil was kept at least one diameter away from the top surface of the Q-Meter, consistent with shortest lead length.

Reproducibility of inductance should be within 5% and Q within 20%. This assumes standard coil wire tolerances and lead lengths given. Tolerance may

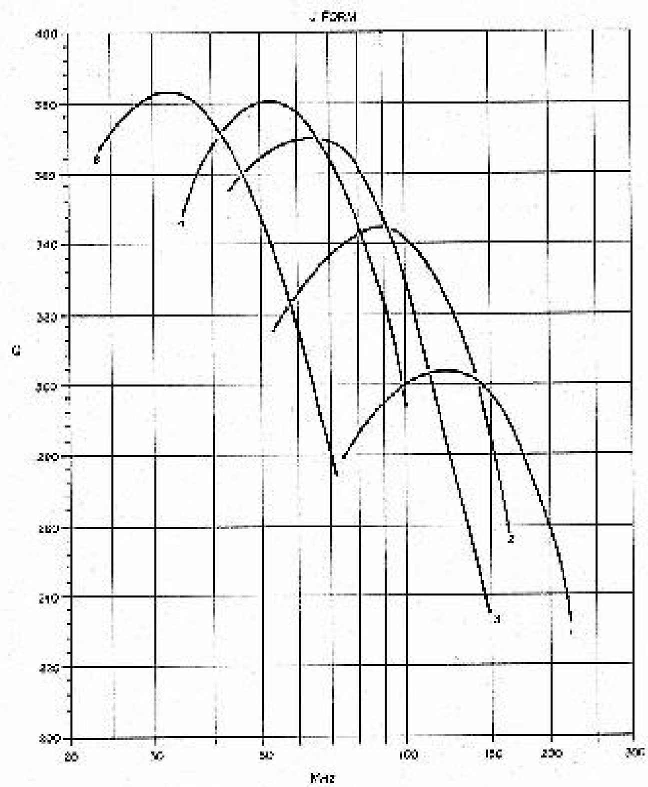


fig. 10. Q of inductors of no. 12 bare copper wire wound on paint roller ferrule (curve J in fig. 1).

drop to 10% for inductors using stripped power wires, depending on the brand; sampling wire from different manufacturers showed 5% tolerances were possible.

Where long leads are necessary, inductance can be adjusted by the following formula for straight wires:

$$L = l[11.7 \log_{10}(0.12 \cdot l \cdot g^2)]\ nH$$

Where: l = *length of wire (inches)*

g = *wire gauge (AWG)*

The formula is an approximation but accurate to 5% for AWG wire sizes from 12 through 26.

All constructions are quite stable and will hold up under most conditions encountered in amateur use. Like all self-supporting inductors made of soft wire, they are flexible and should not be used in vfo tank circuits or other critical applications.

Bare copper may be coated with varnish to retard oxidation. A light application of spar varnish or polyurethane varnish will lower *Q* by only 5 to 8 per cent. **Note:** Do note use *Q Dope* since, like all lacquers and acrylics, it will transmit moisture and lift from the non-porous surfaces.

Bare copper holds up surprisingly well. To prove a point, I wound an 8-turn coil on a paint roller ferrule (form J) and buried it in an outdoor planter along with two new plants. The coil was compressed to

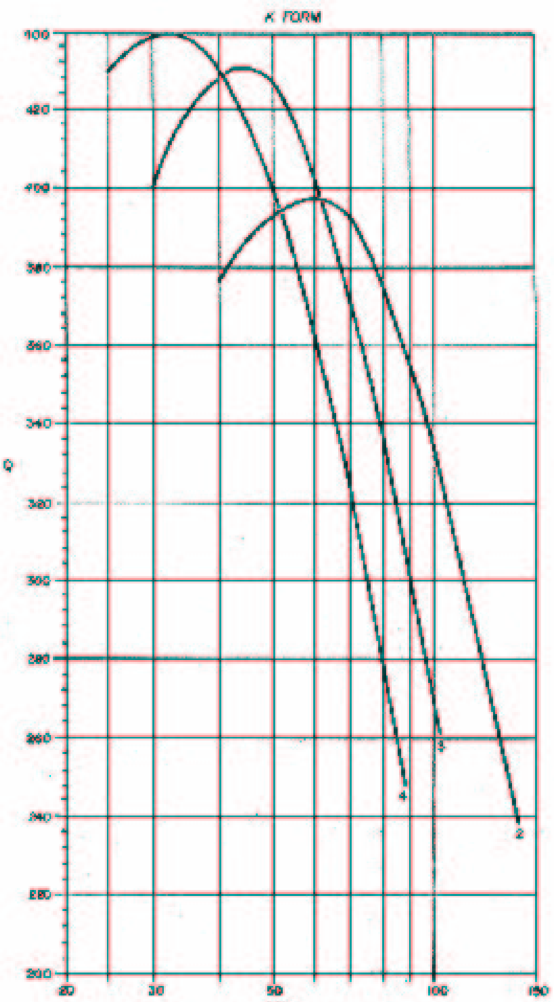
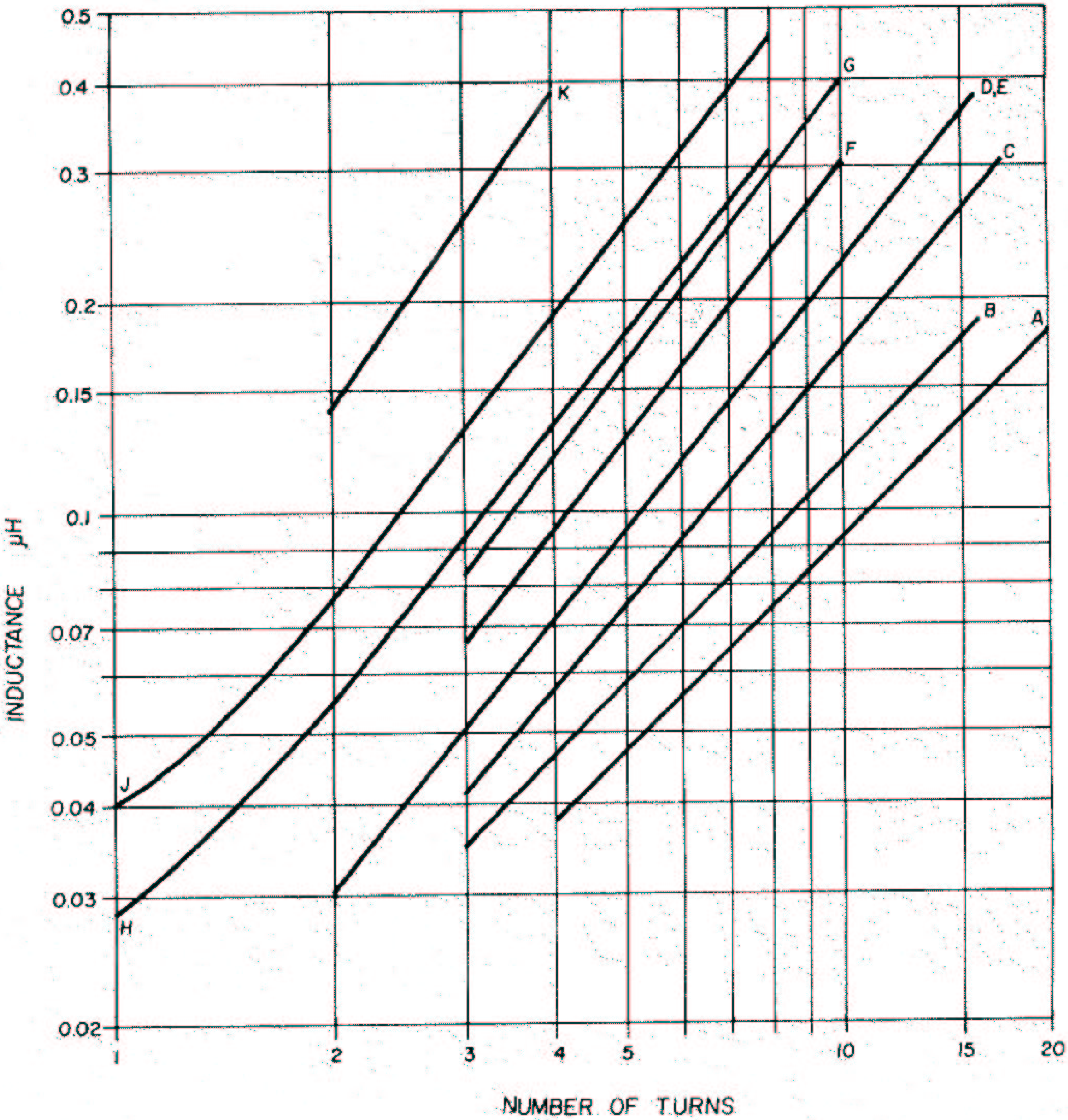


fig. 11. Q of inductors of no. 12 bare copper wire wound on 117 Vac household lamp base (curve K in fig. 1).

about 60% of finish length and readings were taken at 50 MHz prior to planting and four months later. Despite watering every other day, the untreated coil had only a 2.3% reduction in inductance and 16% drop in *Q*.

ham radio



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