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ELECTRICAL MEASUREMENTS AND THEIR INDUSTRIAL APPLICATIONS

V-10 SERIES VARIACS—NEW, STANDARD MODELS INTERMEDIATE BETWEEN 200-C AND 100 SERIES

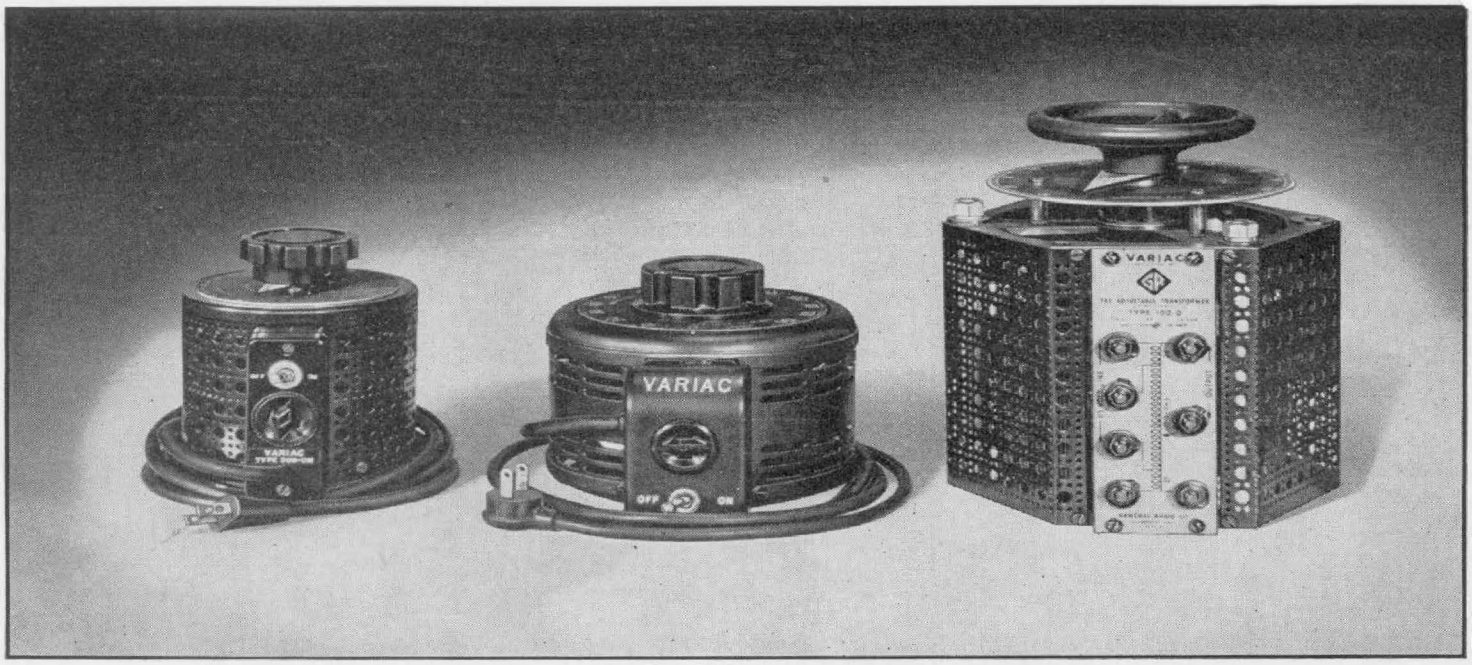

FIGURE 1. Intermediate between the old TYPE 200-CM (left) and the TYPE 100-A (right), the new TYPE V-10 Variac is rated at 10 amperes for 115-volt input.

● **THERE HAS BEEN** an awkward gap between TYPE 200-C and TYPE 100 Variacs ever since the latter's introduction. Loads but slightly exceeding 200-C capacities called for the much larger and more costly TYPE 100 size.

V-10 Series Variacs neatly plug this gap, with ratings just double those of the new V-5 or old 200-C Variacs. The 115-volt V-10's are rated at 10 amperes, with a 15-ampere maximum, coinciding with the capacity of commonly used outlets, plugs, cords, and No. 14 wire circuits.

As contrasted with older models, V-10MT (115-volt mounted model) delivers 112 per cent *more* KVA per pound than 100-Q and 59 per cent *more* than 200-CM. This startling gain in output to weight ratio stems from three sources, recently derived design formulae for the most favorable distribution of copper and iron, the use of a low-loss scroll core, and light-weight structural parts.

The article on V-5 Series Variacs[1] dealt mainly with "user" features. V-10 Series Variacs have these same improvements, unit brush, simplified shaft reversal, better and extended terminal facilities, modern appearance, and so forth.

The present article will be chiefly devoted to certain highlights of V-10 manufacture in the hope that an exposition of these unseen processes may not only be of interest but may further an appreciation of built-in Variac quality.

V-10's, like all Variacs, start with an "iron" core. Actually cold-finished silicon steel strip with a guaranteed maxi-

[1]Gilbert Smiley, "V-5 Series Variacs," *EXPERIMENTER*, XX, 12, May 1946.

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mum core loss[2] is used. The strip is wound on precision mandrels exactly as ribbon would be wound. Side guides prevent wandering; limit switches control outside diameter. Ends are cut and "tack" welded to prevent unwinding, and cores are removed from mandrels.

These cores, however, are far from finished. The strains and stresses of winding have increased losses to some ten times the guaranteed maximum. Like balls of dough in which lie incipient loaves of bread, these coils of steel have, dormant within their fibers, the excellent magnetic properties inherent in the strip material. To make bread, bake dough. To make cores, bake coils of strip for three hours at 1450° F in a protective, non-oxidizing atmosphere, followed by a slow cool. Each core is now eight pounds of top magnetic performance.

A finished core is next sandwiched between top and bottom grooved phenolic winding plates which, with inner and outer wrappers, mutually insulate core and winding. The grooves, cooperating with the winding machine, accurately position each turn, and make possible a precision double-banked winding on the inner edge.

The gaping jaws of the V-10 winding machine receive the sandwich (Fig. 2), which is firmly gripped by the rotating vise. The jaws close; the magazine ring is locked to the power-driven winding ring and filled with wire as required to wind a V-10 (Fig. 3). After the magazine ring is freed from the winding ring, the wire is threaded over the take-off guide, through the winding guide, and anchored to the rotating vise, which is positioned for the first turn and latched to the gear train that advances it one wire per rev-

[2]Core loss is guaranteed not to exceed a specified maximum.

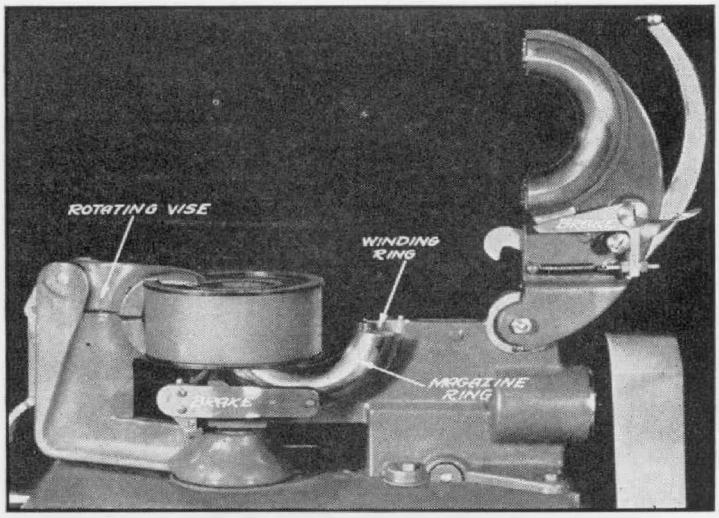
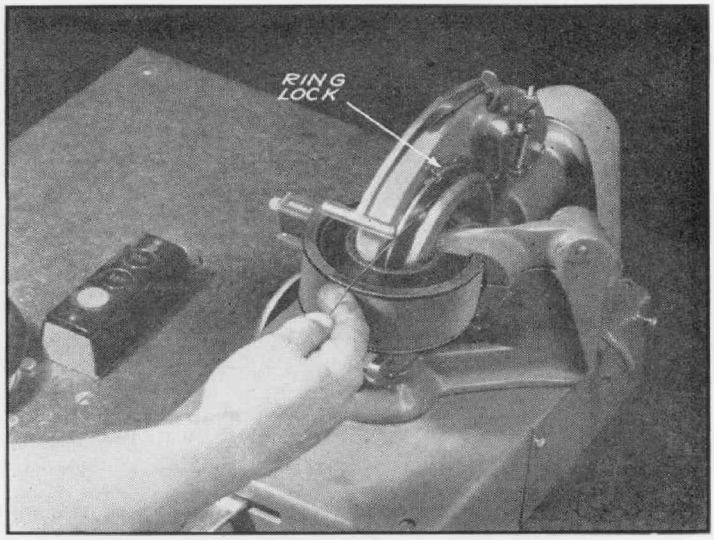
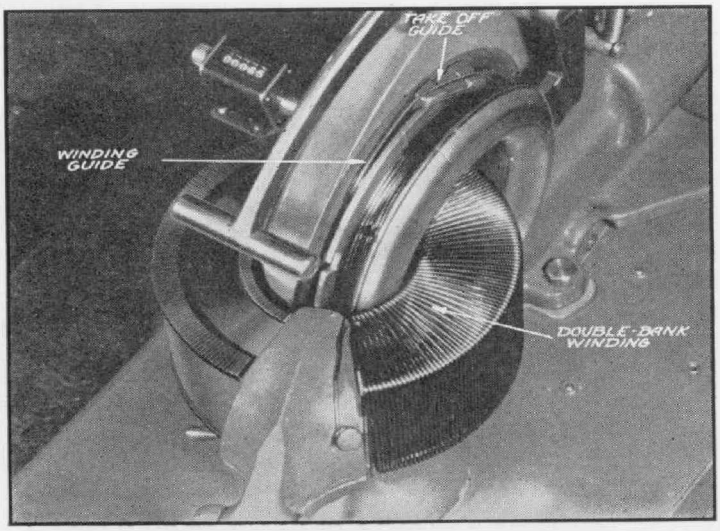


FIGURE 2. Core and winding plate assembly are inserted with winding head assembly opened. Note particularly the concentricity of the winding ring about the core section.



(*Above*) FIGURE 3. Magazine ring being loaded with wire prior to actual winding.
(*Below*) FIGURE 4. A partially wound V-10 coil.



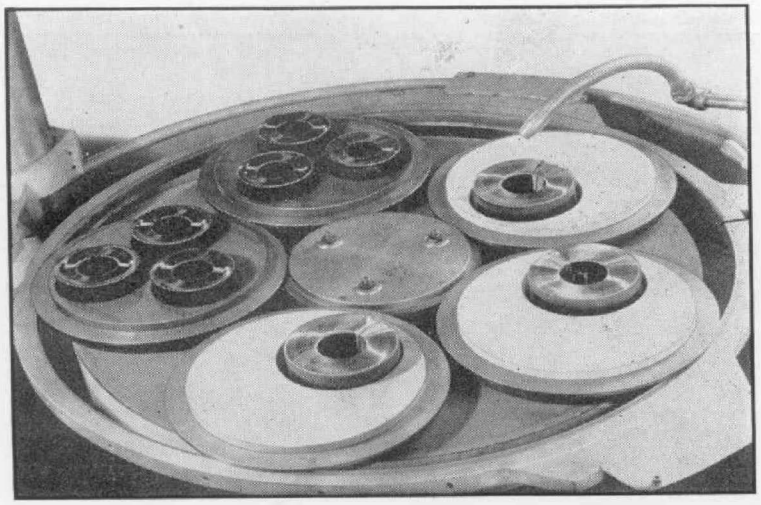
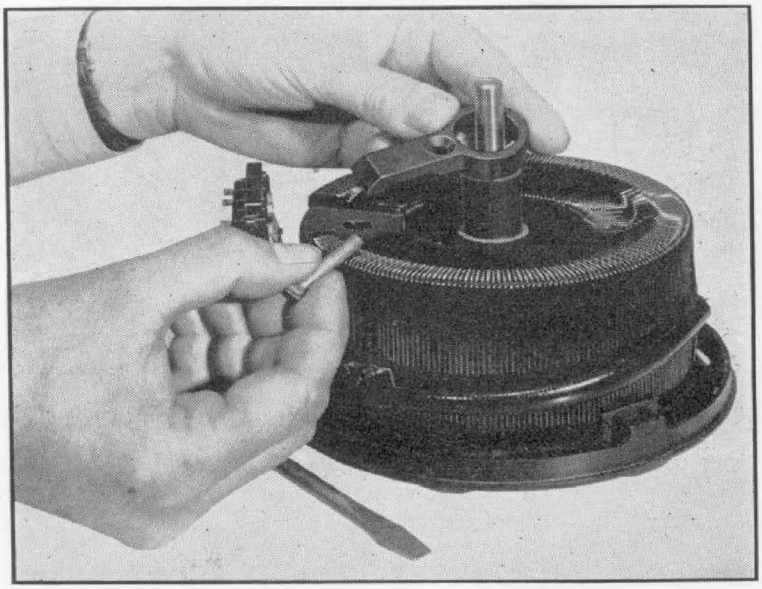
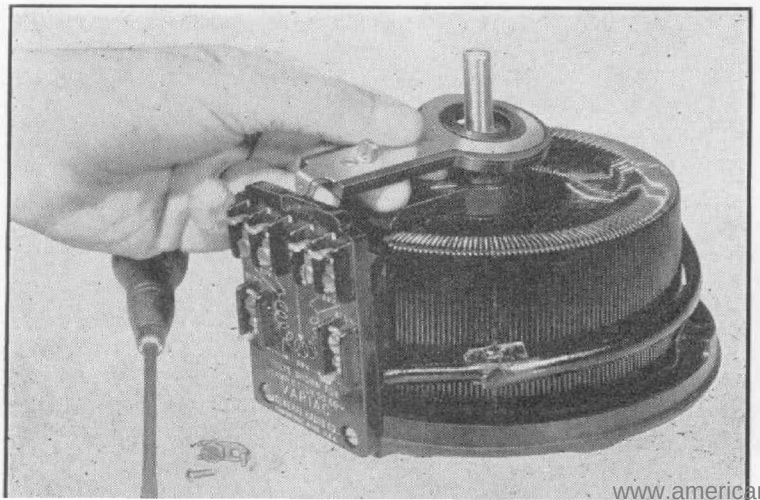


FIGURE 5. Variac coils are here shown in place in the oscillating work holders of the "Hyprolap".



(*Above*) FIGURE 6. The coil is firmly held to the base by the coil clamp here shown during installation.

(*Below*) FIGURE 7. Installing the brush take-off sub-assembly which carries brush current from radiator to terminal, supports the upper end of the terminal strip and serves as a resilient brush stop.



olution of the winding ring. The drive is reversed to winding position, brake tension is applied to the magazine ring, and winding starts, the winding ring pulling wire from the magazine ring as it wraps turn after turn around the core, which moves smoothly into position for each wire by the action of the rotating vise. Figure 4 shows a partially completed winding. Note particularly the uniform banking formed on the inside of the coil.

The V-10 winding machine represents (to the best of our knowledge) a radically new approach to the toroidal winding problem. Unlike earlier machines, the winding ring is concentric with the core center, resulting in a more uniform rate of wire removal from the magazine ring and permitting a five-fold increase in winding speed by eliminating excessive acceleration and deceleration of the magazine and its load. A further advantage is the close proximity of the winding guide to the winding, yielding more accurate wire positioning. This winding machine is a product of our own tool room, developed and designed by General Radio.

After the operations of anchoring end turns, coining to leave the brush track raised, and attachment of taps, the brush track is "Hyprolapped" to a plane, highly polished surface (Fig. 5). Coil and base then meet, insulation is installed, and the coil clamped down (Fig. 6) to avoid passing bolts through the core structure.

The sub-assembly of brush take-off lead and insulator, next to be added (Fig. 7), has three separate functions. It replaces a pigtail, serves as a brush stop, and supports the top of the terminal strip. Figure 8 shows the metal-to-metal pressure construction of V-10 terminals. No dependence is placed upon bakelite under pressure.

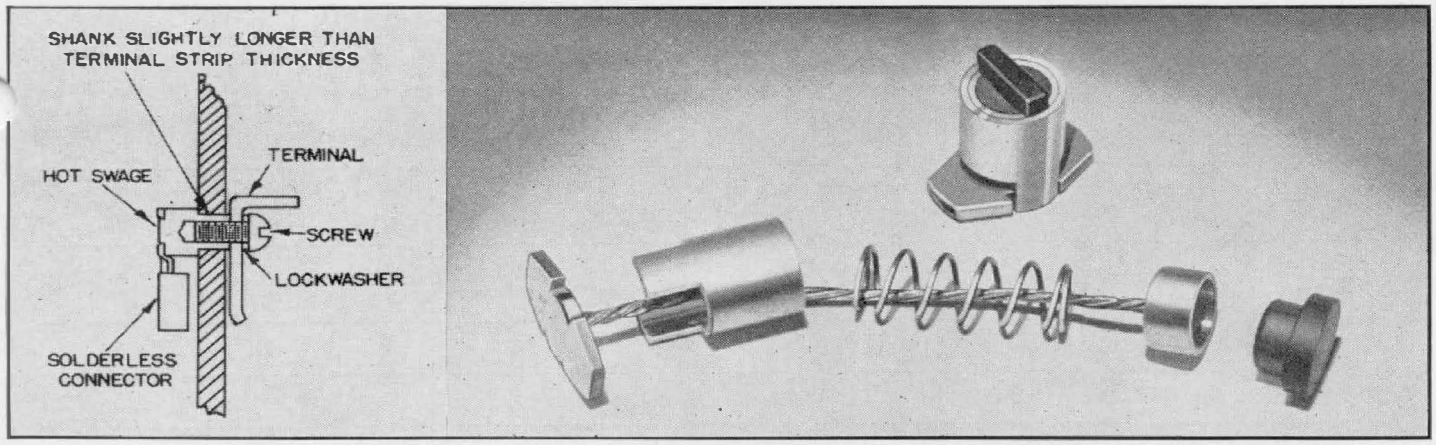


FIGURE 8. Sectional drawing of terminal assembly.
FIGURE 9. Assembled and exploded views of the V-10 Brush.

The addition of the radiator, insulation, and shaft parts completes assembly of uncased models except for brushes. Figure 9 gives assembled and exploded views of the V-10 unit brush. Extended research on carbon-to-metal contacts have convinced us that pressure, properly applied, yields the lowest resistance. Solder or electro-deposited metals do not "wet" carbon, they simply cling to a relatively few surface irregularities. Such contacts improve with pressure but never equal direct pressure contacts between carbon and brush holder. So we press the carbon into the brush holder, and the holder into the brush shell. Then we spot weld a flexible copper shunt (ever try a copper to brass spot weld?) between the movable brush parts to prevent load current from traversing the spring and spoiling its tension. The diamond-shaped retainer is snapped into place, and the unit brush is assembled.

The V-10 case parts are spot welded notched for terminal strip registration, finished, and then assembled with cover band, terminal cover, knob, and dial to the V-10 to make a V-10MT cased model.

The scope of this article is too limited for a more complete exposition of the tools and tricks, gadgets and "know-how" that go into Variac production and that make the new Variacs more useful, more reliable, more efficient than ever before. We hope we have been able to show you something of the care and precision that make today's Variacs better.

—GILBERT SMILEY

SPECIFICATIONS

Note: Models are designated by type number. The basic VARIACS, V-10 (for 115-volt input) and V-10H (for 230-volt input), are supplied with terminal strip, but without case, terminal box, switch, convenience outlet, and cord. Models V-10M and V-10HM include the case. Models V-10MT and V-10HMT are complete mounted models with case, terminal box, switch, cord, and outlet.

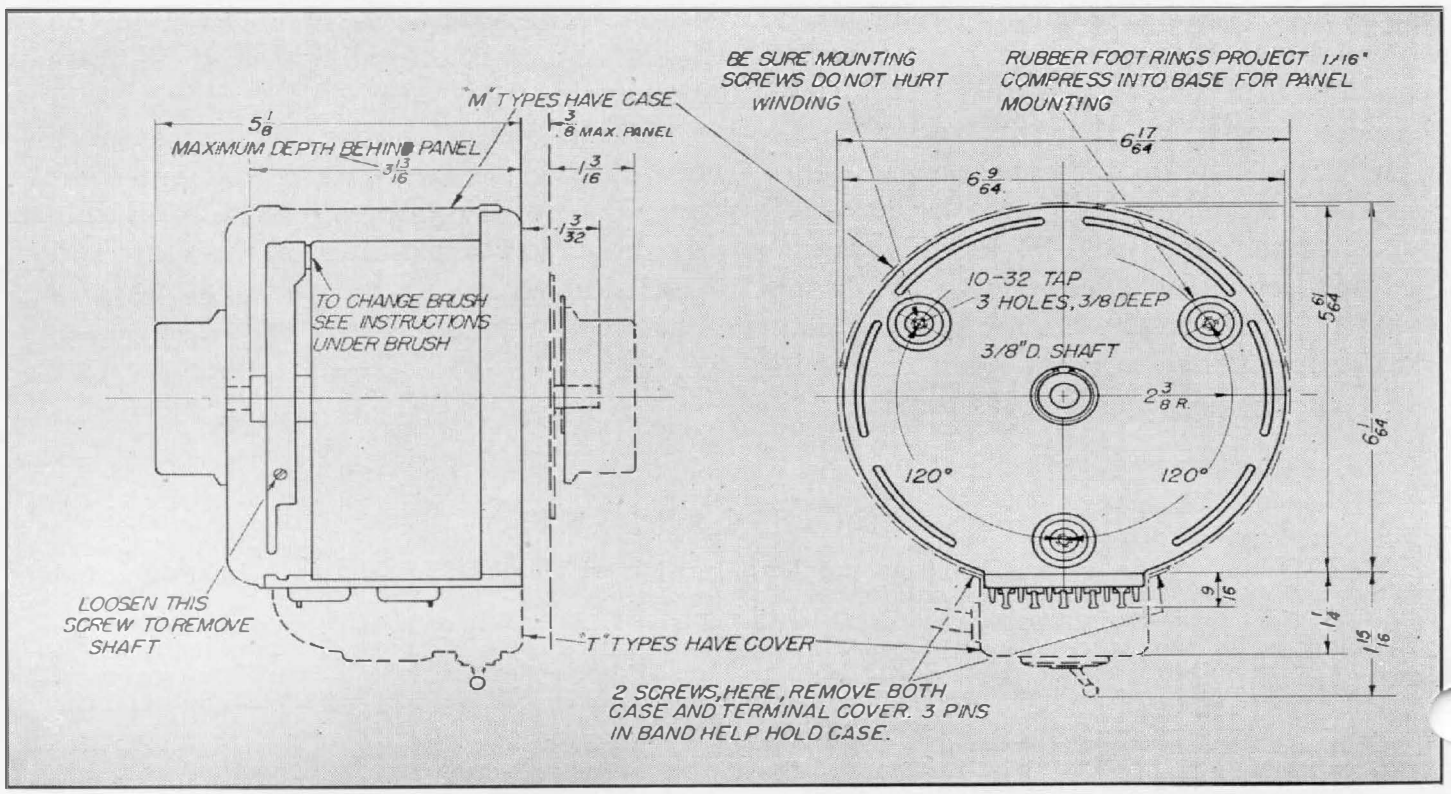
Dials: Dials are engraved for overvoltage connection (135 or 270 volts maximum). Special dials are available for 115- and 230-volt maximum output. Dial is reversible, one side for table mounting, the other for panel.

Type	*V-10*	*V-10M*	*V-10MT*	*V-10H*	*V-10HM*	*V-10HMT*
Load Rating (KVA)	1.725	1.725	1.725	1.15	1.15	1.15
Input Voltage	115	115	115	230 or 115	230 or 115	230 or 115
Output Voltage (Zero to)	135 115	135 115	135 115	270 230	270 230	270 230
Rated Current (Amperes)	10	10	10	4 2*	4 2*	4 2*
Maximum Current (Amperes)	15	15	15	5	5	5
No-Load Loss — 60 ∽ (Watts)	17	17	17	17	17	17
Overall Height for Table Mounting (Inches)	5 1/8	5 1/8	5 1/8	5 1/8	5 1/8	5 1/8
Maximum Panel Thickness (Inches)	3/8	3/8	3/8	3/8	3/8	3/8
Depth behind Panel (Inches)	3 13/16	4 5/32	4 5/32	3 13/16	4 5/32	4 5/32
Diameter of Variac Cylinder (Inches)	6 9/64	6 17/64	6 17/64	6 9/64	6 17/64	6 17/64
Add for Terminals (Inches)	3/8	5/16	1 11/16	3/8	5/16	1 11/16
Net Weight (Pounds)	11 1/4	11 5/8	12 1/8	10 5/8	11	11 1/2
Code Word	HAZEL	HEAVY	HELOT	HINNY	HOARY	HOBBY
Price	$27.50	$29.00	$31.50	$31.50	$33.00	$35.50

*With 115-Volt input applied across half the winding.
Load rating is reduced to one-half the value shown.

DELIVERIES TO START IN NOVEMBER

FIGURE 10. Universal dimension sketch for V-10 series Variacs.



AIRLINE RADIO TESTING WITH GR INSTRUMENTS

• **THE FINAL STEP** in the testing of radio direction finders used in American Airlines Flagships is checking them against General Radio Signal Generators.

American, which flies the greatest fleet of commercial aircraft in the world, has two of these signal generators in constant use in their Radio Overhaul shop at La Guardia Field, New York. In the course of a regular 90-day radio overhaul, the direction finders are put on the revolving test stand whose aerial is connected with a TYPE 605-B Standard Signal Generator. When the overhaul is finished, and immediately before the unit is sent down to the hangars for installation in one of the giant Flagships, it is sent to the "screen room" to be checked out against a TYPE 805-B Generator. American owns 200 radio direction finders, which are completely overhauled after every 90 days of service.

American Airlines has found these generators to be among the best obtainable. For American's purposes a signal generator must transmit a signal that is not only measurable but extremely accurate. The generators in use in their

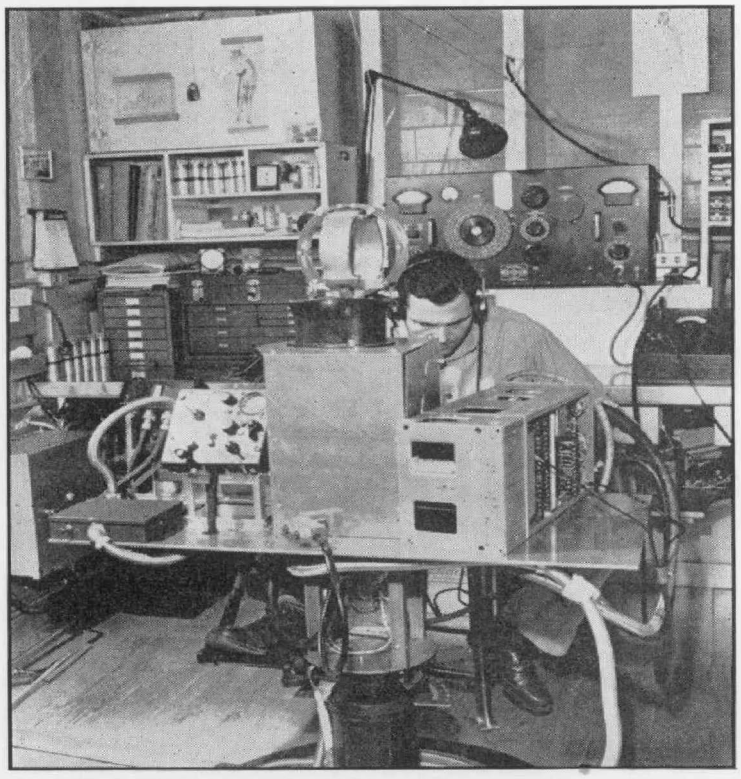
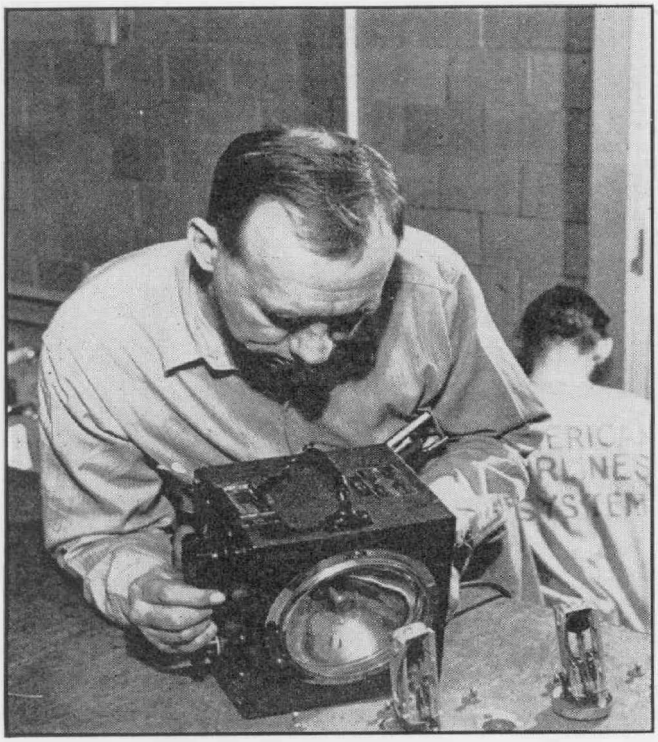


FIGURE 1. In the screen room of American Airlines radio-overhaul shop, automatic direction finders are mounted on a revolving test stand and checked against a General Radio TYPE 805-B Standard-Signal Generator. Here lead mechanic Gerard Miller tests the set with a TYPE 726-A Vacuum-Tube Voltmeter.



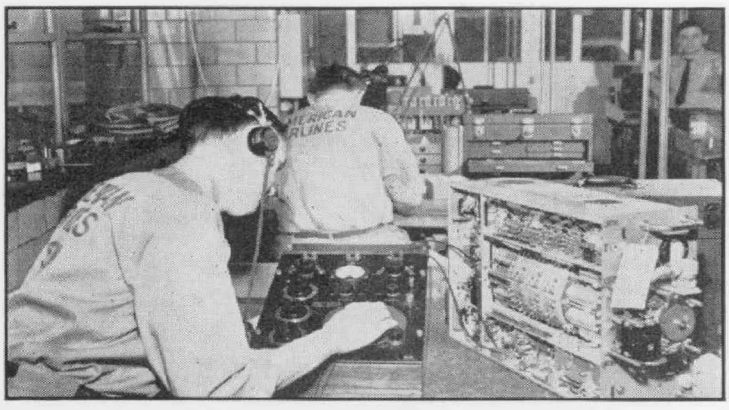


FIGURE 2. The TYPE 631-B Strobotac is used to check vibrator reeds by James Hargreaves, lead mechanic in radio-overhaul shop.

radio shops cover all frequencies in the high frequency band.

The Signal Generators are but two of the pieces of General Radio Co. equipment in use by this great airline. Also in constant use in their shops at La Guardia are the TYPE 650-A Impedance Bridge, the TYPE 631-B Strobotac, the TYPE 726-A Vacuum Tube Voltmeter, and the TYPE 813-A Audio Oscillator.

The Voltmeter and the Bridge have come to be highly important pieces of equipment in the routine operation of the shop. While the Impedance Bridge is actually a laboratory instrument, American radio engineers have found it to have an important daily use in the testing of various parts. With it the capacity of condensers, resistance of resistors, and inductance of coils can be immediately ascertained.

A stroboscope is not only a great time and trouble saver, but has come to be a true necessity in the modern radio shop. American Airlines has in its Radio Overhaul a General Radio Strobotac, TYPE 631-B. This piece of equipment is small enough and light enough to be handily moved to wherever it might be needed. It is in constant use by American radio repairmen, who bring it into play in analyzing anything that moves. With it vibrator reeds are checked for proper contact, armatures are searched for correct brush contact, and rotating gyroscopes are inspected.

The Strobotac is frequently used in the American shops to check items which do not in themselves move, but which are affected by movement. This is done on a "shaker table". The table is mounted on shock mounts, and a high speed air motor with an attached eccentric weight is connected to the table itself. An item which might be affected by vibration is put on the table. Then the table is put into motion and the item in question scanned with the Strobotac, which will show up any cracks or bad connections caused by the stress of the motion.

Possibly the best record set for American Airlines by a General Radio product is that of the TYPE 813-A Audio Oscillator. This Oscillator, which transmits a constant 1000 cycle tone, was chosen by American for use in their range stations in Mexico. There are five such stations in the company's Mexican leg. These stations were put into operation on September 5, 1942. On March 11, 1946, the first one of the Oscillators to need repair was received in the American Airlines shops in New York. This makes a total of 41 months of constant service by five General Radio Audio Oscillators before one of them needed adjustment.

Text and photographs for this article were furnished through the courtesy of American Airlines, Inc.

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