the GENERAL RADIO Experimenter

Since 1915 — Manufacturers of Electronic Apparatus for Science and Industry

VOLUME 30 No. 8 JANUARY, 1956

NEW MODELS OF THE "STRIPPED-DOWN" VARIAC® SPEED CONTROLS

Also IN THIS ISSUE

Enclosed models of the so-called "stripped-down" VARIAC® Speed Controls are now available in ¾, ⅓, and ⅙-hp sizes, Types 1702-BW, 1700-CW and 1703-BW, respectively, in addition to the 1 and 1½-hp ratings,[1] Types 1704-BW and 1705-BW, announced in October, 1955. Variac Speed Controls operate from the a-c power line to control shunt and compound d-c motors.

Earlier models in these ratings were supplied without cabinet or braking resistor, primarily for machine manufacturers. Even when the unit was incorporated in a machine cabinet, however, a covering was often needed to protect the equipment or the operator. The dynamic braking feature has proved so generally desirable that the necessary resistor is now included in the standard chassis. As now supplied these controls are complete except for the switching necessary for starting, stopping and reversing, and for the fuses and line cutout switch. The latter may frequently be the main switch to the machine and may control other circuits also.

The appearance of the new controls with covers in place is shown in Figure 1. A new hammertone gray finish is employed throughout. The covers have ventilating holes at the bottom and louvres at the sides, and are removable from the front. Since access to the

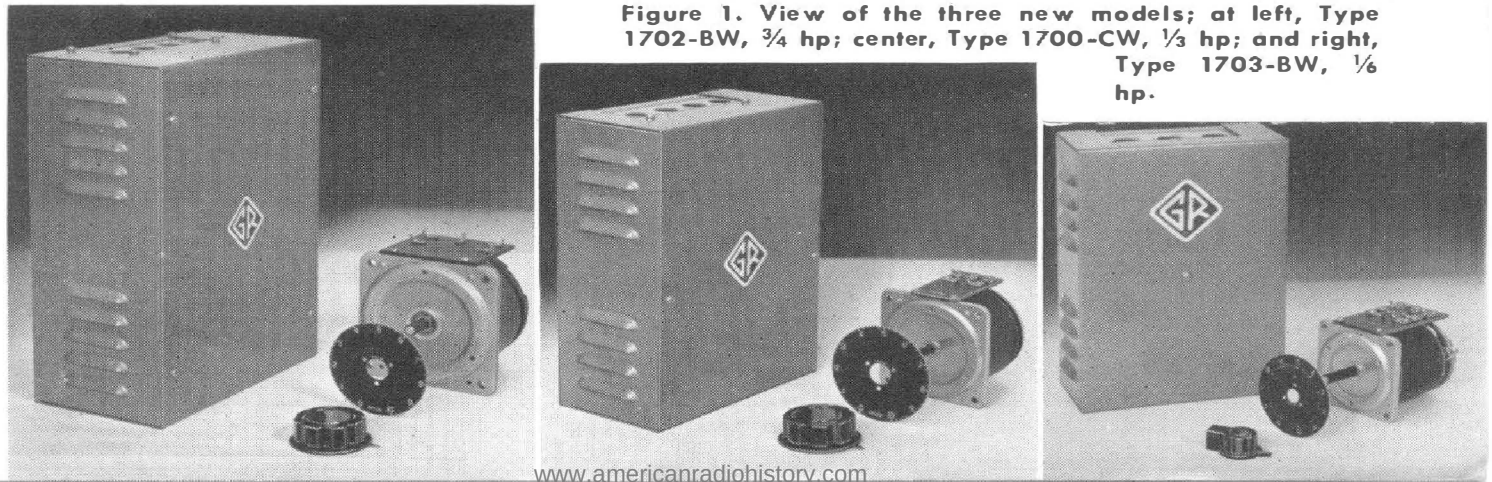

Figure 1. View of the three new models; at left, Type 1702-BW, ¾ hp; center, Type 1700-CW, ⅓ hp; and right, Type 1703-BW, ⅙ hp.

cabinets is required only for servicing, they may be placed in any location where there is adequate circulation of air. The depth has been kept as shallow as possible in all cases. The VARIAC and control switches are usually mounted by the user on a single panel.

Circuits

These controls are offered for users who want switching arrangements different from those in the standard complete controls or who do not have room for the cabinet at the operator's position and wish to separate it from the switches and VARIAC. Various circuit arrangements to meet particular requirements are described in the operating instructions for the different models of the controls. Some of these will be reviewed briefly here.

3-Position Switch

The availability of suitable switches and relays in the various ratings determines to some extent the choice of circuit. For example, the appliance-type switch supplied in the TYPE 1700-B and TYPE 1702-A controls has enough contacts to break the a-c and d-c circuits simultaneously and also to handle reversing and dynamic braking. An important safety feature is that the lever can not be thrown directly from forward to reverse but must be held momentarily in the intermediate stop position. The standard connections for this switch are shown in Figure 2.

Drum Controller

The appliance-type switch is not particularly suitable for machine-shop production work, and the higher cost of a drum controller, as used with the larger Variac Speed Controls, may be justified for heavy duty of this kind. We have several installations of drum controllers in our own plant. Connections are the same as those given in Figure 2 for the appliance switch except that extra series contacts are provided in both the a-c and d-c portions of the circuit.

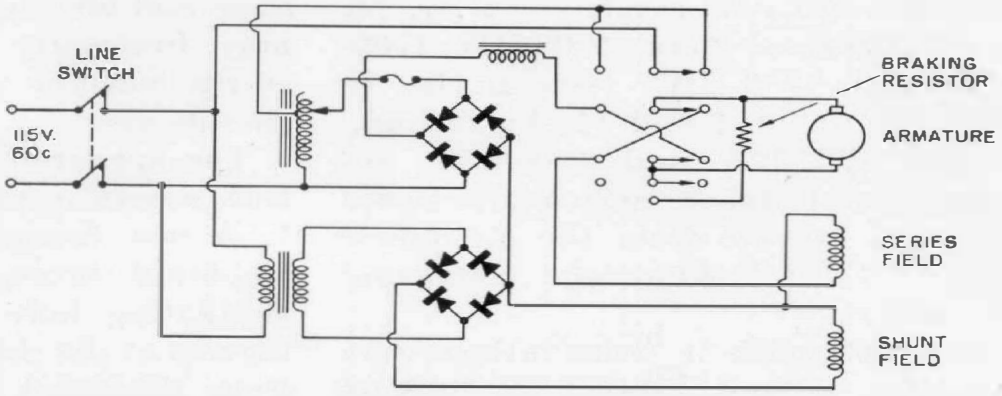

Figure 2. Connections for three-position appliance-type switch.

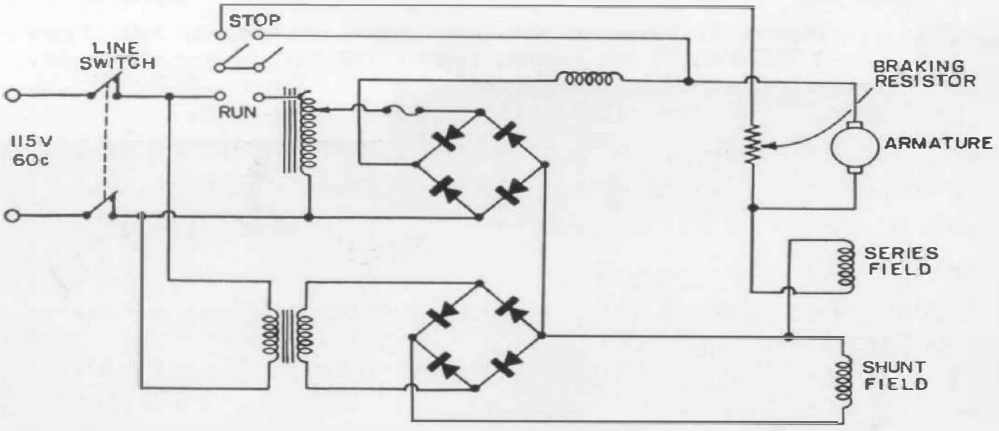

Figure 3. Connections for start-stop switch, used when reversing is not required.

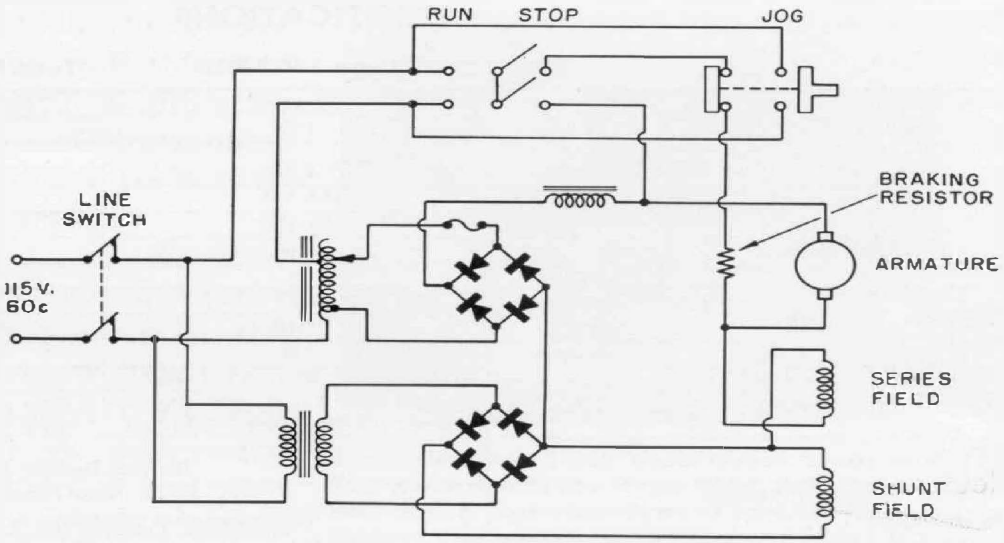

Figure 4. Connections for jogging button.

Start-Stop Switch

In some applications reversing is never required, and a DPDT toggle switch can be used for starting and stopping with dynamic braking. The diagram is shown in Figure 3. A jogging button can be added as shown in Figure 4, the braking circuits of the switch and button being in series and the power connections in parallel.

A limit switch of the manual-resetting, snap-acting type can be used with a relay in the circuit of Figure 3 to stop a machine at a predetermined point. This switch will stay in the off position while the machine is set up for the next operation, and the reset button can be used for restarting. If dynamic braking is not required, the relay can be omitted and the limit switch inserted directly in the a-c input line. An arrangement of this kind is used on the machines that wind General Radio VARIACS. Controls of ¾ hp and lower ratings are controlled directly by the limit switch, and the larger controls through a relay.

Push Buttons

The use of standard reversing contactors is straightforward where the additional cost is justified. A less-expensive circuit is available [2] for push-button operation using two 4PDT relays, but the rating is limited to controls of ⅙ hp and below.

The new "stripped-down" models should greatly increase the flexibility of application of Variac Speed Controls, making the entire line from 1/15 hp to 1½ hp available either with or without switching. All types have been in demand to meet the ever-growing list of applications. Characteristics which have proved most important in making the controls successful have been the simple, long-life construction, reduced maintenance requirements, heavy overload capacity for fast and repeated starting, low torque pulsation, and the smoothly controlled torque available for starting delicate operations.

A user of these controls commented at the recent Chicago Exposition of Power and Mechanical Engineering that the Variac Speed Control is "a masterpiece of simplicity and essentially service free."

The appliance-type switch and the drum controller mentioned in this article are available from the General Radio Company, as listed below.

— W. N. Tuttle

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[1] W. N. Tuttle, "New Variac® Speed Controls in 1 and 1½ hp Ratings," *General Radio Experimenter*, 30, 5, October 1954, pp. 1–4.

[2] Described in Operating Instructions for Type 1703-BW Variac Speed Control.

SPECIFICATIONS

			Type 1703-BW			Type 1700-CW		Type 1702-BW	
Motor Horsepower Range:			1/12 to 1/6			1/4 and 1/3		1/2 and 3/4	
Power Supply Single-Phase		Volts	115			115		115	
		Full-load Amperes	2.2			5		10	
Line-Voltage Limits		At 60 Cycles	105–125			105–125		105–125	
		At 50 Cycles	105–125			Note 2			
Input Power Watts		Full Load	325			560		1150	
		Stand-by	30			38		65	
Motor Control Output DC	Armature	Amperes	1.5			3		6.5	
		Volts	0–115			0–115		0–115	
		Amperes	0.2			0.4		0.4	
	Field	Volts	115	66	48	115	75	115	75
Speed range			0 to rated	0 to 1.25 rated	0 to 1.5 rated	0 to rated	0 to 1.15 rated	0 to rated	0 to 1.15 rated
Dynamic Braking			Braking Resistor Furnished						
Armature Overload Protection			None Furnished						
Control Station			Variac furnished; Switching to be Provided by User						
Over-all Dimensions in inches	Chassis		7½ × 10¼ × 3½			9¾ × 12⅝ × 5		11¼ × 15¼ × 5⅞	
	Variac		3¼ × 3 11/16 × 4⅜			4½ × 4 15/16 × 5½		5¾ × 6¼ × 5⅞	
Net Weight in Pounds	Chassis		4½			17		27½	
	Variac		3½			6½		11¼	
Code Word			SABOT			SALTY		SATIN	
Prices, Net F.O.B. Factory	1 to 4 units		**$72.00 ea.**			**$135.00 ea.**		**$195.00 ea.**	
	5 to 19 units		**68.50**			**122.00**		**177.50**	
	20 units and up		**65.50**			**116.00**		**170.00**	

MOTORS FOR USE WITH ABOVE SPEED CONTROLS (Note 1)

Motor ratings: open, drip-proof, reversible, 40°C rise continuous, horizontal, rigid base	Compound	Compound	Compound with interpoles
General Radio Designation	MOD-11	MOD-3	MOD-6
Horsepower	1/6	1/3	3/4
Speed (RPM)	1725	1725	1725
Leads (brought out separately)	6	6	6
Bearings	Sleeve	Sleeve	Sleeve
Frame Size	F-56	H-56	H-66
Net Weight — Pounds	25	30	60
Code Word (Note 3)	MOTOR *	MOTOR *	MOTOR *
Price	**$52.50**	**$59.00**	**$100.00**

Note 1. Any motor within control rating can be used. Compound motors for use with Type 1703-BW must have separate series-field leads.
Note 2. 50-cycle model available on special order.
Note 3. To order motor with Variac Speed Control, add motor to the code word of the corresponding speed control; thus SATIN MOTOR is the code word for the TYPE 1702-BW Variac Speed Control with MOD-6 motor. Motors are not sold separately.

Type		*Code Word*	*Price*
1702-P2	**Switch**	FLIPO	**$ 6.00**
1705-P1	**Drum Controller**	DRUMO	**22.00**

A TUNED FILTER FOR USE IN CAPACITANCE MEASUREMENTS AT ONE MEGACYCLE

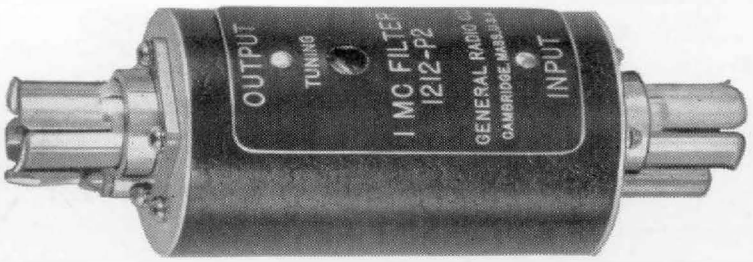


Figure 1. View of the Type 1212-P2 1-Megacycle Filter.

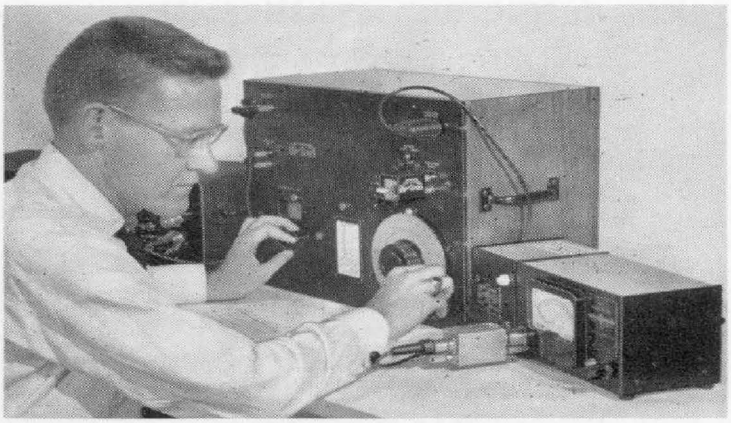
The TYPE 716-CS1 Capacitance Bridge,[1] which operates at a frequency of one megacycle per second, is well suited to the measurement of small capacitors, such as the disc-ceramic type, and low-loss dielectrics. To realize

the full precision of which the bridge is capable, however, the null detector should be provided with a filter to reduce the magnitude of harmonics and noise. An experimental filter was illustrated in a previous article.[2]

The commercial version of this filter is now available and is shown in Figure 1. This convenient plug-in unit, the TYPE 1212-P2 1-megacycle Filter, when used with the TYPE 1212-A Unit Null Detector, results in high selectivity against harmonics and noise and also provides considerably increased sensitivity. These features are particularly important for dissipation-factor measurements on low-loss capacitors. When this combination is used with the TYPE 716-CS1 Capacitance Bridge and the TYPE 1330-A Bridge Oscillator,[3] the dissipation factor balance can be set to a precision of .00002, or 1/5 of the smallest dial division.

Figure 2 is a schematic diagram of the filter. The LC ladder section provides insertion gain at 1 MC and attenuation at higher frequencies. The bridge output impedance is capacitive (in the normal oscillator-detector connection) so that there are effectively two R-C ladder sections for low frequency rejection. Gain and rejection figures for a typical filter are:

[1] Ivan G. Easton, "A 1-Megacycle Schering Bridge," *General Radio Experimenter*, XXVI, 9, February, 1952, pp. 4–8.
[2] "A Convenient Test Fixture for Small Capacitors," *General Radio Experimenter*, 30, 4, September, 1955, pp. 4–6.
[3] The TYPE 1211-A Unit Oscillator with the TYPE 1203-A Unit Power Supply is equally satisfactory.



Equipment for 1-mc capacitance measurements. The generator is the Type 1330-A Bridge Oscillator, the bridge the Type 716-CS1 Capacitance Bridge. The null detector (Type 1212-A) is shown at the right. The filter shown is the experimental model; the Type 1212-P2 plugs into the detector in the same way.

Unknown Capacitor	100 $\mu\mu$f	1000 $\mu\mu$f
Insertion Gain 1 Mc	22 db	32 db
Relative 2nd Harmonic Rejection	39 db	47 db

The resonant frequency of the filter is affected but slightly by the setting of the bridge, and a single tuning adjustment suffices for all bridge settings. If the filter is tuned for the 100 $\mu\mu$f bridge setting, the net sensitivity actually increases for higher capacitance values, because the decreasing output impedance of the bridge causes enough increase of inherent sensitivity to more than compensate for the slight detuning of the filter.

The filter plugs directly into the input terminals of the TYPE 1212-A Unit Null Detector through TYPE 874 Coaxial Connectors, which provide complete shielding. — HENRY P. HALL

SPECIFICATIONS

Net Weight: **Dimensions: 2" diameter, 5" long.**

Type		*Code Word*	*Price*
1212-P2	**One-Megacycle Filter**	**ANNUL**	**$30.00**

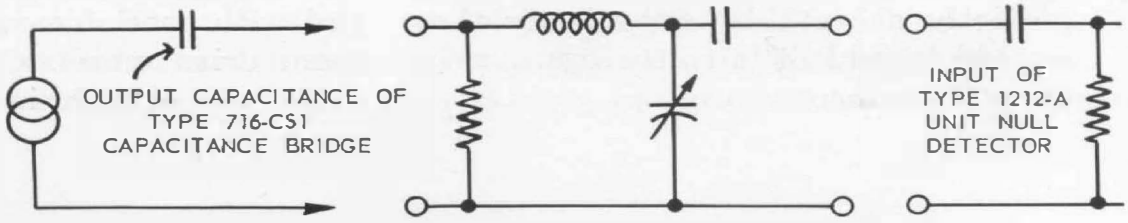


Figure 2. Schematic diagram of the filter circuit.

DIELECTRIC MEASUREMENTS

This filter is particularly useful in the measurement of dissipation factor of low-loss dielectrics at one megacycle. Complete equipment for the measurement comprises:

Type		*Code Word*	*Price*
716-CMS1	Capacitance Bridge*.....	BOGEY	$640.00
1330-A	Bridge Oscillator.....	ACORN	525.00
1212-A	Unit Null Detector.....	ALACK	145.00
1203-A	Unit Power Supply.....	ALIVE	40.00
1212-P2	One-Megacycle Filter.....	ANNUL	30.00
1690-A	Dielectric Sample Holder.....	LOYAL	435.00

* A relay-rack model is also available.

CAPACITOR MEASUREMENTS

When small capacitors with closely spaced parallel leads are to be measured, the Type 1691-A Capacitance Test Fixture should be substituted for the Dielectric Sample Holder.

Type		*Code Word*	*Price*
1691-A	Capacitance Test Fixture.....	EDICT	$22.50

AN INGREDIENT OF QUALITY

To the manufacturer of precision instruments, the search for improvement in product quality is never ended. Not only in engineering development and design, but also in manufacturing methods and material, a constant attention to detail has proved over the years to be a basic ingredient of quality.

To illustrate the point, it was back in the early part of 1947 that growing dissatisfaction at General Radio with instrument cables culminated in a specific project to develop methods for improving the appearance of this component. For many years, the trunk and subsidiary cables, which carry the major wiring of an instrument, had been hand laced with armature twine. Though functionally these cables were perfectly acceptable, esthetically they seemed to add little to the appearance of an instrument.

At this time, on multiple-strand, straight-through cables, braided coverings of various materials were quite common. But unfortunately, to braid a cable with many diverging arms of various lengths, different diameters, and of any configuration needed, and to do it uniformly, repetitively, and economically all called for quite a different application of existing braiding machinery and methods.

Nevertheless, late in 1947, for experimental purposes, a conventional braiding machine was purchased. Modifications proceeded, and during the months which followed, trial and error gradually accumulated into a practicable method. The machine, and, of course, subsequent units, were suitably mounted, equipped with Variac® Speed Controls, and modified with special movable stops on the main drive wheel. Cotton, rayon, and nylon thread were in turn tested, with

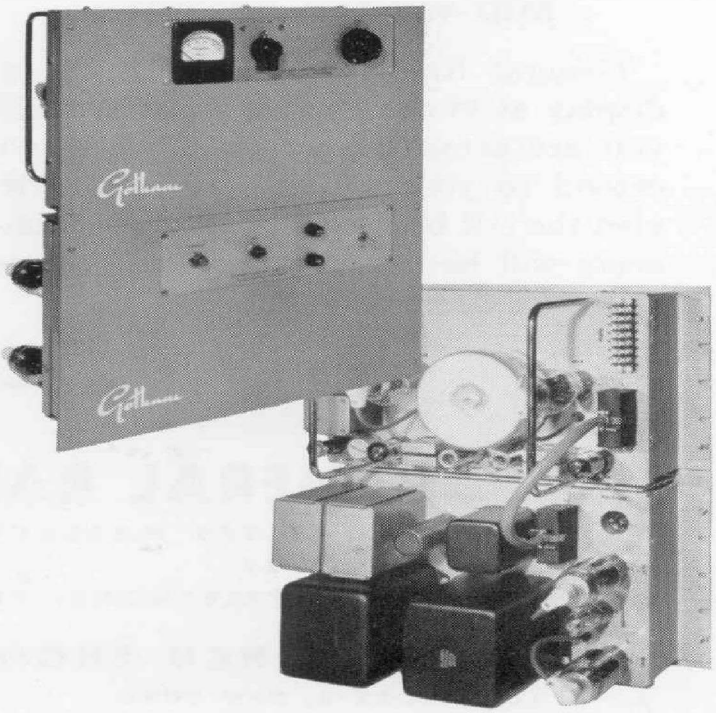
nylon in the end proving the superior material, not only for its ability to wrap tightly and uniformly around any diameter, but also for its non-hygroscopic quality, which insures against trapping moisture within the cable.

Since mid-1948 when production of nylon-braided cables was first begun for a few new instruments, nearly all GR equipment has now incorporated this improved component. And, too, with the increasing quantities and further refinements in methods and equipment, it is interesting to note that, although the initial desire was for enhanced appearance and quality, a parallel and unexpected result has been a welcome 40% reduction in labor cost in the improved braided cable.

Of course, a cable is only one component, one detail, among hundreds or even thousands in an instrument. But constant attention to these details, both in engineering and manufacturing, helps to build quality into General Radio instruments. — P. W. POWERS

HIGH POWER WITH LOW DISTORTION

The General Radio TYPE 942-A Output Transformer [1] is designed to meet the exacting requirements of high-power, low-distortion audio amplifiers. A typical application is the Model PFB-150WD Power Amplifier manufactured by Gotham Audio Development Corporation, and shown in the accompanying photographs. Manufacturers' specifications for this amplifier indicate a continuous rating of 150 watts output at less than 0.7% harmonic distortion and less than 1% intermodulation distortion. Complete specifications can be obtained from the manufacturer at 2 West 46 Street, New York 36.



Front and rear views of the Gotham PFB-150 WD. The Type 942-A Output Transformer is shown at the top center of the rear view.

[1] H. W. Lamson, "A High-Power Toroidal Output Transformer," *General Radio Experimenter*, XXVI, 6, November, 1951, pp. 5–8.

MISCELLANY

During the past few months we have welcomed visits from many friends from overseas.

Among these are:

W. M. Ferris, Director, Ferris Bros. Pty. Ltd., Sydney, Australia.

Tan Chan, Dean and Acting President, and Liau-Tsung Lin, Instructor, Taiwan College of Engineering, Taiwan, Formosa-China.

Knud Blendstrup, Instructor, Elektroteknisk Laboratory, Polyteknisk

Laeranstalt, Copenhagen, Denmark.

S. W. Gough, Manager, Physical Research Division, Dunlop Research Center, Birmingham; Dr. George L. Grisdale, Chief of Communication Research Group, and R. E. Burnett, Marconi's Wireless Telegraph Company, Ltd., London; and E. R. Ponsford, Production Manager and Engineer, Solartron Electronic Group, Ltd., Surrey, England.

L. Bignon, Regul-France, Paris.

V. Balasubramanyam, Research Engineer, All India Radio, Bombay.

Nello Meoni, President, and Ing. M. Federici, Consultant, LESA Company, Milan; and Ing. A. Beltrami, Professor, Head of Institute, Instituto Radiotecnica, Milan, Italy.

Tomizo Ariska, Midoriya Electric Company, Tokyo; Y. Nozaka, Chief of Automatic Control and Special Instruments, Yawata Iron & Steel Company, Ltd , Fukuoka, Japan.

M. Gruenberg, Business Manager, Etabilissement Mehmet Vasfi, Istanbul, distributors of General Radio products in Turkey.

MID-WINTER EXHIBITS

General Radio products will be on display at two mid-winter meetings. If you are attending either of these, we extend to you a cordial invitation to visit the GR booth. General Radio engineers will be in attendance to discuss your measurement problems.

American Institute of Physics
25th Anniversary Meeting and Exhibit
Hotel New Yorker, New York, N. Y.
January 30 to February 4
Booth 22

Eighth Annual Southwestern Regional IRE Conference and Electronics Show
Municipal Auditorium
Oklahoma City, Oklahoma
February 9 to 11
Booths 84 and 85

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