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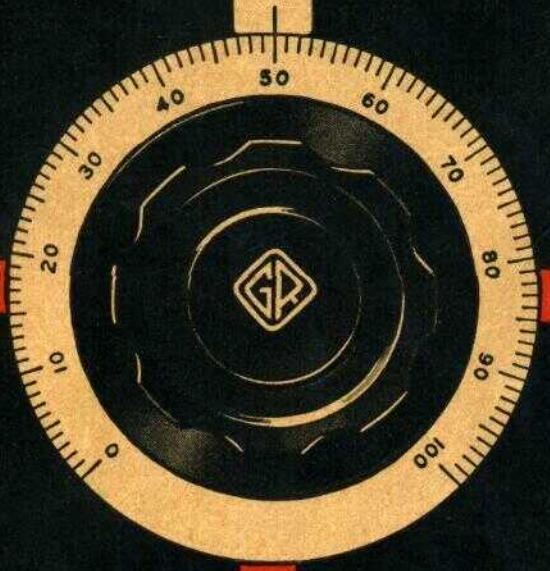
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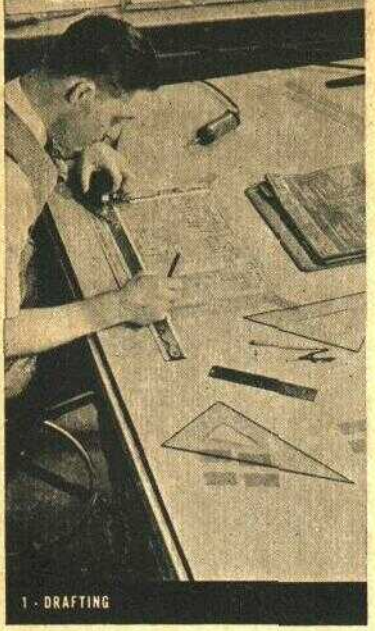
CATALOG J

GENERAL RADIO CO.
CAMBRIDGE, MASS., U. S. A.

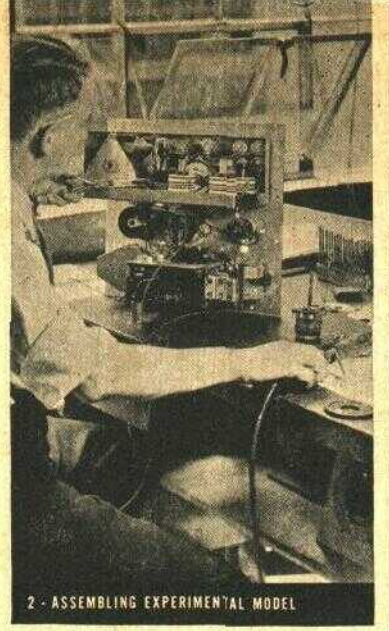


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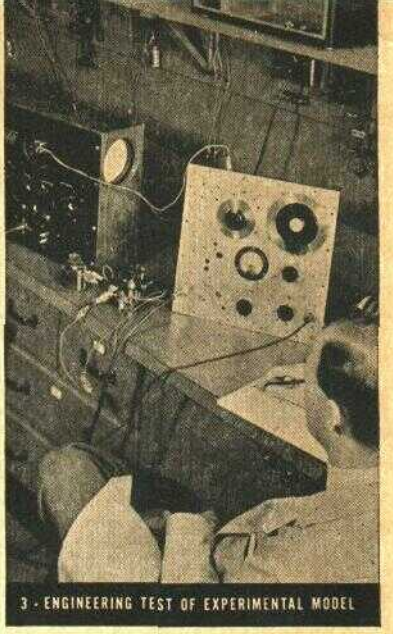
TYPICAL OPERATIONS IN MANUFACTURE OF TYPE 605-A SIGNAL GENERATOR



1 - DRAFTING



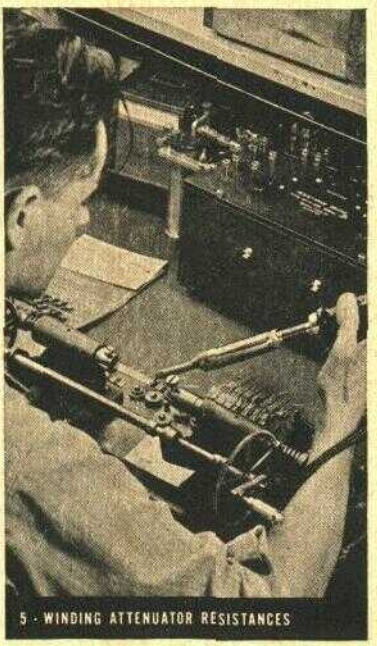
2 - ASSEMBLING EXPERIMENTAL MODEL



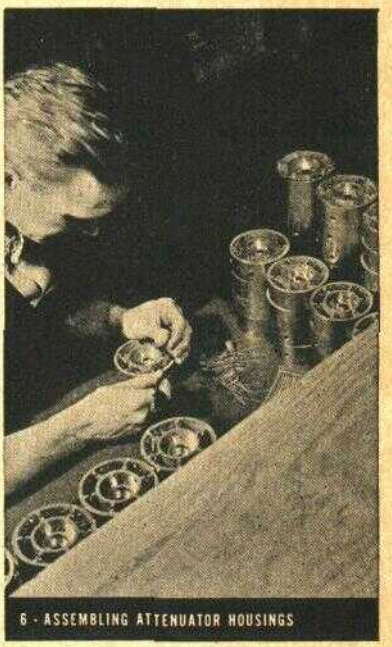
3 - ENGINEERING TEST OF EXPERIMENTAL MODEL



4 - FORMING MAIN WIRING CABLE



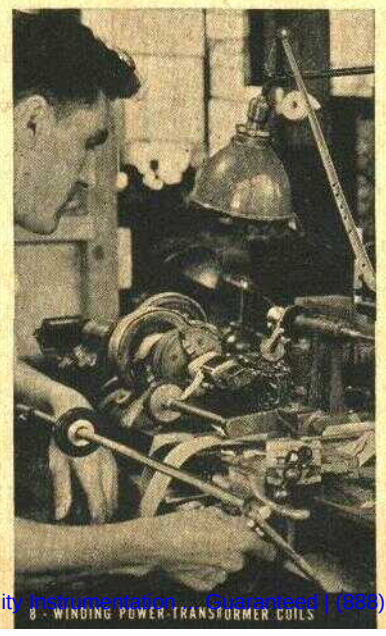
5 - WINDING ATTENUATOR RESISTANCES



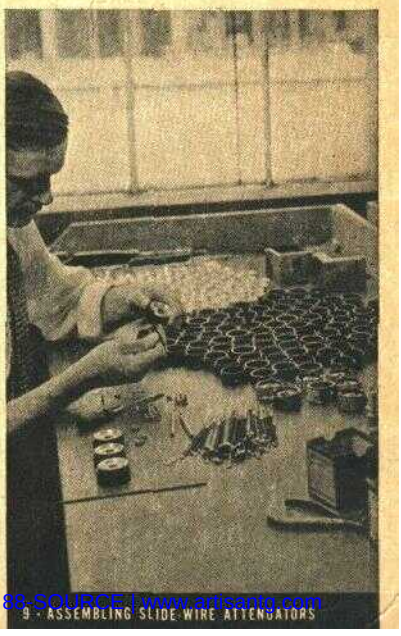
6 - ASSEMBLING ATTENUATOR HOUSINGS



7 - WINDING OSCILLATOR INDUCTANCES

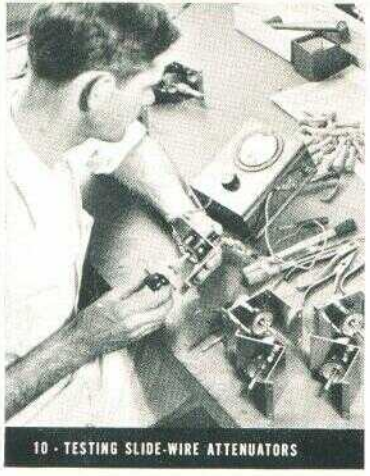


8 - WINDING POWER TRANSFORMER COILS



9 - ASSEMBLING SLIDE WIRE ATTENUATORS

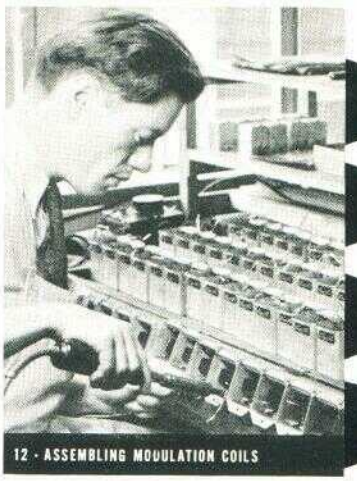
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10 - TESTING SLIDE-WIRE ATTENUATORS



11 - WIRING SLIDE-WIRE ASSEMBLIES



12 - ASSEMBLING MODULATION COILS

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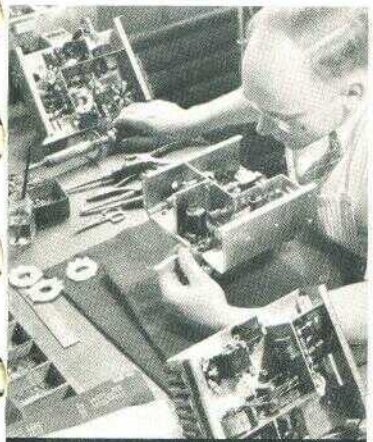
CATALOG J

SEPTEMBER, 1936

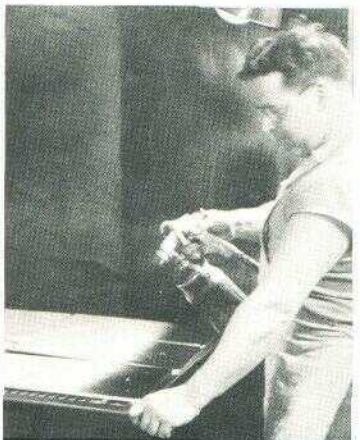
GENERAL RADIO COMPANY

CAMBRIDGE, MASSACHUSETTS, U. S. A.

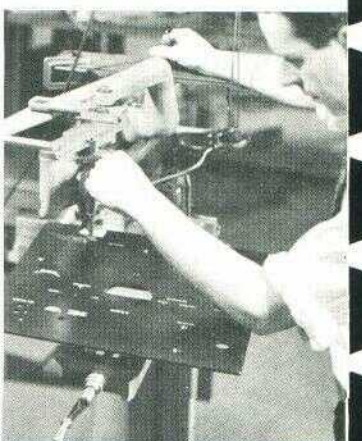
© 1936, GENERAL RADIO COMPANY



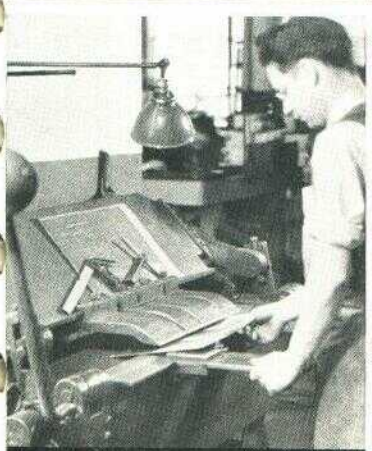
13 - WIRING AMPLIFIER SHELF ASSEMBLY



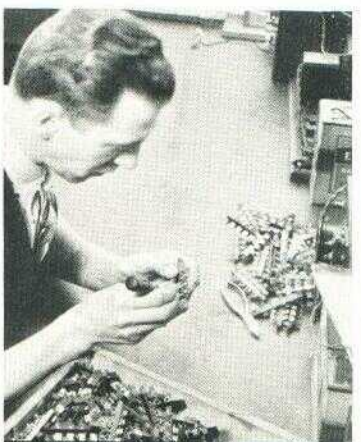
14 - FINISHING PANEL



15 - ENGRAVING MAIN PANEL



16 - FORMING OSCILLATOR SHELF ENDS



17 - INSPECTING SWITCH CONTACTS



18 - ASSEMBLING FREQUENCY-CHANGE SWITCHES

OTHER MANUFACTURING PICTURES ON INSIDE BACK COVER

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WE SELL DIRECT..

A STATEMENT OF POLICY

To develop the type of product manufactured by the General Radio Company requires a large staff of engineers, each a specialist in one or more phases of the work involved. One of the functions of this staff is to assist the customer in the selection of instruments in order that the correct equipment may be purchased with a minimum expenditure.

There has always been an intimate contact between our engineers and customers. The technical nature and the manifold uses of our product make the maintenance of this contact essential. For this reason, the General Radio Company maintains no sales agencies in the United States, but distributes its products directly to the consumer on a net, no discount, basis.

In order that customers outside the United States may receive equivalent technical service, exclusive agencies have been appointed in many foreign countries, each capable of giving technical information regarding General Radio products. In all matters regarding General Radio apparatus the customer should communicate with the agent from whom this catalog was received. Prices listed in the catalog are for domestic use only. Costs in foreign countries, where import duty and freight must be added, can be obtained from the agents in those countries.



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SUGGESTIONS FOR ORDERING

ORDER BY TYPE NUMBER

Always order by catalog type number and whenever possible mention ranges or other significant specifications as protection against misunderstanding.

Be sure to include orders for any accessories desired or for calibrations which must be made before shipment.

SHIPPING INSTRUCTIONS

Unless specific instructions accompany the order we shall use our best judgment as to the method of shipment.

All prices are F.O.B. Cambridge, Massachusetts. There is no domestic packing charge and no charge for shipping cases.

TERMS

Net 30 days. Unless credit has already been established we make all shipments C.O.D.

When cash accompanies the order, we pay transportation charges to any point in the continental United States (except Alaska).

REMITTANCES

Should be made payable at par in Boston or New York funds.

QUANTITY DISCOUNTS

When 10 or more identical items are ordered at the same time for a single shipment, the following quantity discounts are allowed:

10-19..... 5 per cent
20-99..... 10 per cent
100 or more..... Special discounts quoted on request.

The above discounts also apply to quantities of packages where the unit of sale is a package of small parts.

NO TRADE OR EDUCATIONAL DISCOUNTS

Our prices are made on a direct-to-consumer basis which permits of no discounts except cash and quantity discounts.

PRICE CHANGES

All prices are subject to change without notice. Formal quotations remain open for 30 days.

SPECIFICATIONS

We reserve the right to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

TAXES

Since the apparatus and parts furnished by us are not subject to the manufacturers' excise tax imposed on certain radio items under Section 607 of Title IV of the Revenue Act of 1932, no tax has been included in the price. If any of these component parts are used by a "manufacturer, producer, or importer" and in a taxable manner, as defined in this Revenue Act, such "manufacturer, producer, or importer" must see that the requisite tax is paid on them. Tubes on which a tax is payable have had this tax paid and the prices given include this tax. Prices are subject to such additions for state or local taxes as we are now or may be required to collect, and to revision as to any sales or excise taxes which may hereafter be imposed and which must be included in the list price.

SHIPMENTS TO GENERAL RADIO

When returning instruments for repair, recalibration, or for any other reason, please ask our Service Department for shipping instructions and our RETURNED APPARATUS tags.

REPAIR PARTS

When ordering repair parts, be sure to describe carefully the parts required and give the type number and serial number from the panel of the instrument.

TELEGRAPH AND CABLE ORDERS

We have direct telegraph printer connections with Postal and Western Union for the prompt handling of messages,

Use Bentley's code and the code words

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accompanying each catalog description. Our cable address is GENRADCO BOSTON.

SALES AGENCIES

With the exception of a stock of parts for local distribution in New York City carried by Leeds Radio Company of 45 Vesey Street, our instruments are not sold by dealers or brokers.

NEW YORK ENGINEERING OFFICE

An engineering office is maintained at 90 West Street, New York City, where technical information regarding our apparatus may be obtained by those who find it more convenient to telephone or call at that office than at Cambridge. No stock is held at the New York office.

Sales offices are maintained on the Pacific Coast at 274 Brannan Street, San Francisco, and at 555 South Flower Street, Los Angeles. Small stocks are maintained at these locations.

Although our domestic sales are made on a direct-to-the-consumer basis, we have arranged with numerous foreign agents for the distribution of our products outside of the United States.

WARRANTY

We warrant each new instrument manufactured and/or sold by us to be free from defects in material, workmanship, and design; our obligation under this warranty being limited to repairing or replacing any instrument or part thereof which shall, within one year after delivery to the original purchaser, prove by our examination to be thus defective.

OTHER GENERAL RADIO PUBLICATIONS

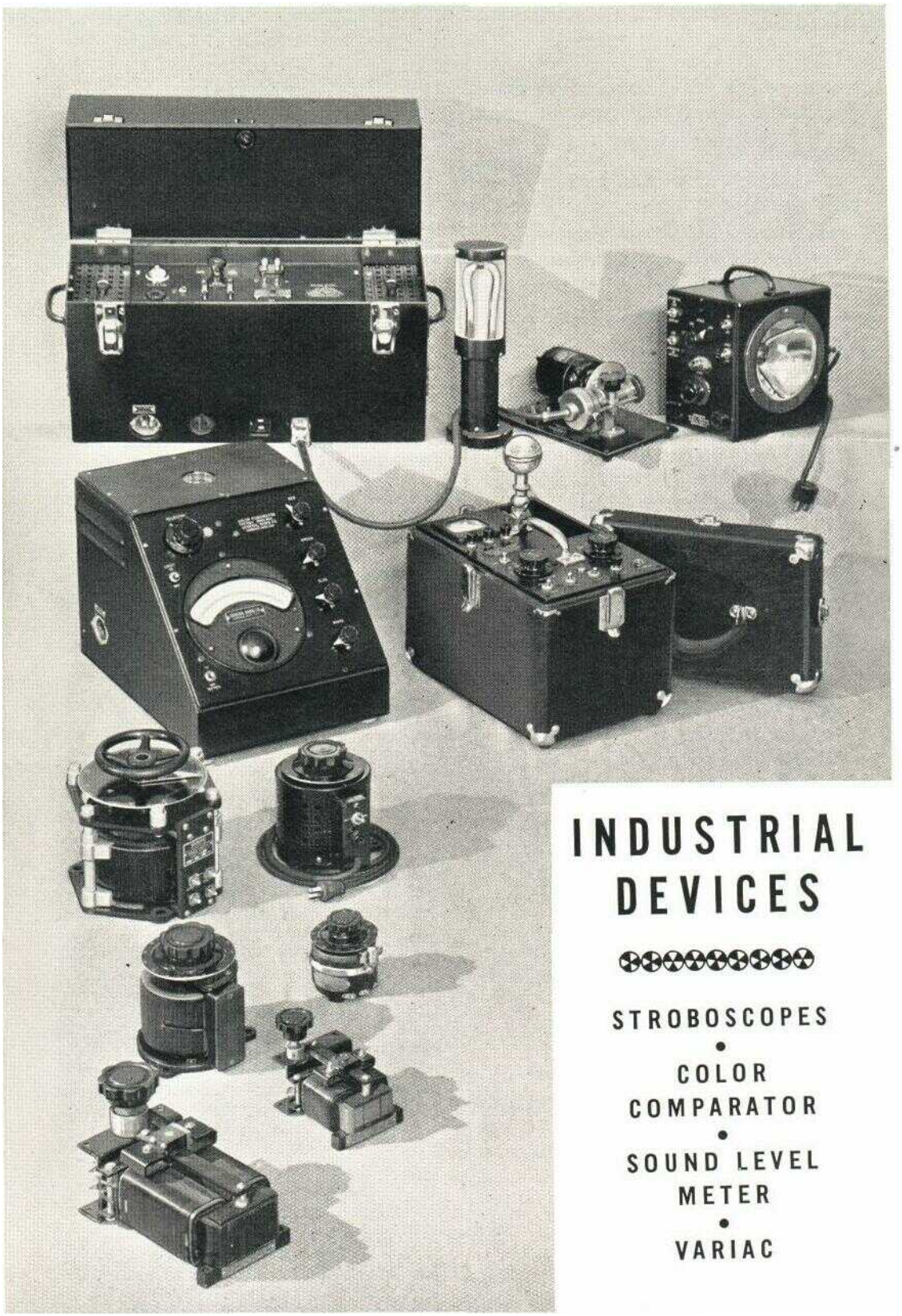
In addition to this catalog we publish a monthly magazine, the General Radio *Experimenter*, for free distribution among interested persons. It contains technical and semi-technical engineering articles which are contributed, for the most part, by our engineering staff. To be placed on the mailing list, simply address a request to us containing your name, mailing address, and business affiliation.

PATENTS

Many of our products are manufactured and sold under United States Letters Patent owned by the General Radio Company or under license grants from other companies. To simplify the listing of these patents they are given here in a single list and referred to at each instrument only by appropriate reference number.

1. Vacuum-tube amplifier devices, electrical wave filters, and vacuum-tube oscillators are licensed by Electrical Research Products, Inc., under all United States Letters Patent owned or controlled by American Telephone and Telegraph Company, or Western Electric Company, Inc., and any or all other United States patents with respect to which Electrical Research Products, Inc., has the right to grant a license, solely for utilization in research, investigation, measurement, testing, instruction, and development work in pure and applied science, including engineering and industrial fields.
2. Patent 1,871,886.
3. Patent 1,542,995.
4. Patent 1,707,594.
5. Patent 1,901,343.
6. Patent 1,901,344.
7. Patent 1,944,315.
8. Patent 1,967,185.
9. Patent applied for.
10. Patent 1,525,778.
11. Patent 2,009,013.
12. Licensed under all patents and patent applications of Dr. G. W. Pierce pertaining to piezo-electric crystals and their associated circuits.
13. Licensed under Hazeltine and Latour Designs and Patents for scientific measurement and test purposes only.
14. Patents 1,931,530; 1,943,302; 1,955,739.
15. Licensed under designs and patent applications of Dr. Harold E. Edgerton and Mr. Kenneth Germeshausen.
16. Patent 1,790,153 and other patents, covering electrical discharge devices and circuits with which said devices may be used, owned by the General Electric Company or under which it may grant licenses.
17. Patents 1,713,146 and 1,744,675.
18. Patent 1,983,447.
19. Patent 1,967,184.
20. Patent 2,012,497.
21. Patent 2,012,291.
22. Patent 1,999,869.
23. Licensed under designs and patent applications of Barss, Knobel, and Young, Inc.
24. Licensed under designs and patent applications of Dr. Frederick V. Hunt.
25. Patent No. 1,983,657.

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INDUSTRIAL DEVICES

STROBOSCOPES

•

COLOR COMPARATOR

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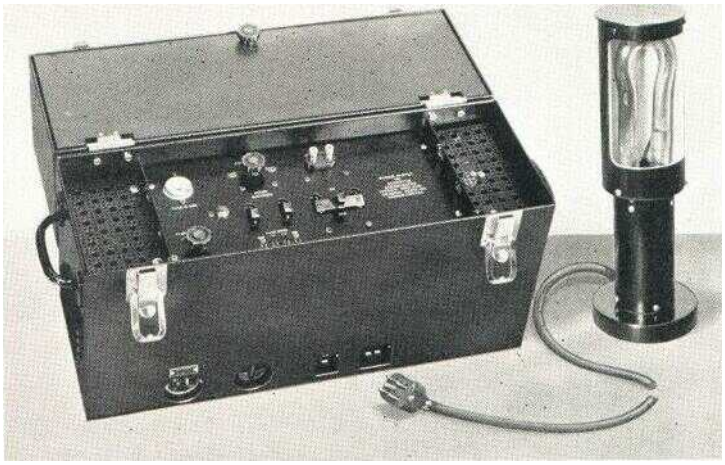
SOUND LEVEL METER

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VARIAC

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TYPE 548-B EDGERTON STROBOSCOPE



TYPE 548-B Edgerton Stroboscope (power supply and lamp)

Vision, the ability to see what is happening, is a proverbial preliminary to finding a solution for difficulties. Most modern mechanical operations have not been subject to this fundamental method of analysis because they take place at speeds too high for the eye to follow.

The stroboscope, however, depending upon the principles of intermittent viewing and retention of vision, makes this possible. If a rotating object is instantaneously viewed at only one point in its motion, the optical impression is of a stationary object. If the viewing point of successive observations progresses smoothly, the optical impression is that of an object rotating slowly at the rate of progression of the viewing point.

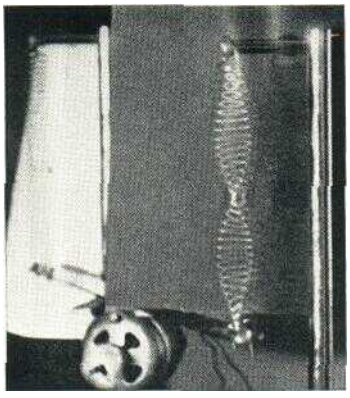
The Edgerton Stroboscope greatly simplifies the mechanics of the stroboscopic principle. Instead of using rotating discs, shutters, or other mechanical means, intermittent viewing is accomplished by flashing a light of high intensity and very brief duration. This stroboscope consists of a lamp, power source, and means for accurately timing the flash. The flash is of sufficient intensity to override moderate background illumination, and its duration is so brief that sharply defined views of objects moving at high linear velocities are obtained.

The stroboscope may be used as a light source in the photography of rapidly moving mechanisms. In this application it is used with a shutterless camera (such as the TYPE 651-A-E Assembly) in which the exposure is obtained by means of the brilliant flash instead of a shutter.

While the normal means for controlling the flash rate is the TYPE 549-B Synchronous-Motor Contactor, the rate can also be controlled (1) by closing any pair of electrical contacts, (2) by the 60-cycle supply mains (sixty flashes per second), or (3) by any external source of alternating current capable of maintaining 100 volts across 5000 ohms.

All parts of the stroboscope equipment except the lamp and tripping contacts are built into the metal cabinet which constitutes the power-supply unit. The cover stores the detachable mercury-vapor lamp and a TYPE 549-B Synchronous-Motor Variable-Speed Contactor which is optional equipment and is not included in the price of the instrument.

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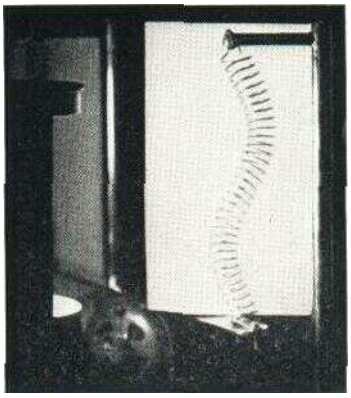
THE STROBOSCOPE STOPS MOTION

Two views of the same oscillating spring

BY ORDINARY LIGHT

BY STROBOSCOPE LIGHT

from unretouched sections of 35-mm motion-picture ***film***



SPECIFICATIONS

Flashins Range: From 0 to 15,000 flashes per minute for fundamental synchronism.

Lamp: U-shaped mercury-vapor lamp mounted in a bakelite protective housing which may be stood upright or held in the operator's hand,

Illumination: The light intensity will permit good visual observations in a semi-darkened room with the lamp several feet from the object.

Tubes: One FG-17 thyratron and two 83-type rectifier tubes are supplied with the instrument.

Power Supply: 115 volts, 50-60 cycles.

Power Consumption: 0.3 kw., maximum.

Mounting: The power supply is housed in a metal cabinet having a detachable cover in which the lamp, motor-driven contactor, and cables may be stored,

Dimensions: (Length) 23 x (width) 7 1/2 x (height) 16 1/2 inches, over-all, with cover closed. Dimensions of lamp housing, (height) 12 x (diameter) 4 inches.

Net Weight: 56 pounds, including lamp but not the TYPE 549-B Synchronous-Motor Contactor.

Type	*Code Word*	*Price*
***548-B**	MAGIC I	**$290.00**

*Includes lamp assembly. Hand contactor or synchronous-motor contactor must be ordered separately.

TUBE REPLACEMENTS

Type	*Description*	*Code Word*	*Price*
550-P1	**Lamp**	**MAJOR**	**$15.00**
FG-17	**Thyratron**		**10.00**

PATENT NOTICE. See Notes 15 and 18, page v.

TYPE 621 EDGERTON POWER STROBOSCOPES



The power stroboscope supplies much greater illumination than does the TYPE 548 instrument. It is intended for visual use where a larger field must be illuminated or where very high flashing speeds are necessary, and for taking high speed motion pictures.

In conjunction with the TYPE 651-A-M Camera Assembly, motion pictures can be taken at a maximum speed of 2000 per second, permitting the examination of the motion of mechanical systems not previously observable by any method. Specifications and prices will gladly be sent on request.

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TYPE 631-A STROBOTAC



The General Radio Strobotac is a small portable stroboscope calibrated to read directly in revolutions per minute. Although designed primarily for speed measurement, it can also be used for the stroboscopic observation of rapidly-moving mechanisms.

Illumination is furnished by a neon lamp mounted in a reflector which focuses the light at a distance of approximately eight inches from the instrument. The flashing speed is adjusted by means of an illuminated dial which is calibrated between 600 and 14,400 r.p.m. By using multiple synchronisms, speeds up to 72,000 r.p.m. can be measured. Between 900 and 14,400 r.p.m., the accuracy of the scale is 2 per cent. The Strobotac operates from a 115-volt, 60-cycle, a-c line and provision is made for standardizing the scale in terms of the a-c line frequency. If desired, the flashing speed can be controlled by an external contactor or by the a-c line frequency.

For routine plant maintenance work and speed measurement, as well as for laboratory investigation on small areas, the Strobotac will be found entirely satisfactory.

It is ideally suited for rapidly adjusting the speeds of a number of machines intended to operate at the same speed, as, for instance, textile spindles. Because of its small size and light weight, it can be used to observe the operation of mechanisms which cannot be reached by larger instruments.

All controls are grouped on the right-hand side of the instrument and are easily accessible when the Strobotac is held in the left hand. The entire assembly weighs only 12 pounds.

SPECIFICATIONS

Range: 600 to 14,400 r.p.m. Fundamental range; speeds up to 72,000 r.p.m. can be measured by using multiple synchronisms.

Accuracy: ±2% between 900 and 14,400 r.p.m.

Power Supply: 115 volts, 60 cycles.

Power Consumption: 25 watts.

Vacuum Tubes: One TYPE 631-P1 Strobotron, one 80-type and one 58-type.

Mounting: Metal case with carrying handle.

Dimensions: (Width) 6 1/2 x (length) 9 x (height) 10 inches, over-all.

Net Weight: 12 pounds.

Type		*Code Word*	*Price*
631-A			**$95.00**
631-P1	**Replacement Strobotron.**		**6.00**

PATENT NOTICE. See Note **IS,** page v.

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TYPE 549 CONTACTORS

For Use With Edgerton Stroboscope

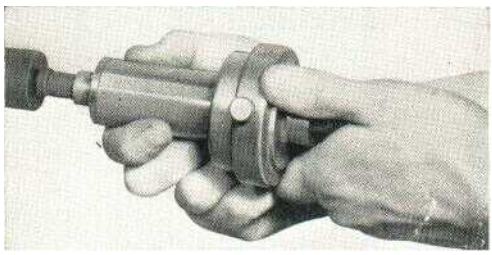
Two commutator-type contactors are available for controlling the flashing rate of an Edgerton Stroboscope. One is a motor-driven device having the flashing rate adjustable over a wide range. The other is for pressing against the end of a shaft, tachometer-fashion. It makes one flash for every revolution of the shaft.

The synchronous-motor contactor, TYPE 549-B, when driven from a 115-volt, 60-cycle line, is capable of flashing an Edgerton Stroboscope at any rate between 500 and 3000 flashes per minute. The contactor is driven by an 1800-r.p.m. self-starting synchronous motor. Flashing rate adjustment is made by turning the knurled handle which changes the ratio of the friction-drive mechanism. A calibrated scale gives the flashing rate in flashes per minute. Phase can be adjusted independently at the contactor head.

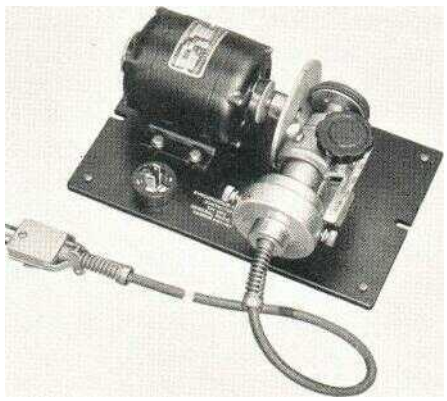
It should be remembered that the contactor can be used for speed measurements as high as 30,000 r.p.m. If one flash occurs for every second turn of the observed phenomenon, the effective range becomes 1000 to 6000 r.p.m.; if one flash occurs for every third turn, the effective range becomes 1500 to 9000 r.p.m.; etc.

By removing the contactor head and substituting a rubber driving tip which is supplied, a hand contactor equivalent to TYPE 549-P2 is obtained.

The uncalibrated head, fitted with rubber tip so that it can be driven from a rotating shaft, is available separately as the TYPE 549-P2 Hand Contactor. Phase can be varied by rotating the adjustable head.



TYPE 549-P2 Hand Contactor



TYPB 549-B Synchronous-Motor Contactor

SPECIFICATIONS (Type 549-B)

Range of Flashing Rate: 500 to 3000 flashes per minute. The contactor may be used for observing and measuring speeds up to at least 30,000 r.p.m. A calibrated scale (500 to 3000 r.p.m.) is provided.

Cords: Connecting cords are furnished.

Controls: One knob for adjusting speed and the movable contactor head for adjusting the phase. Each is provided with a locking arrangement to hold it firmly in the desired position.

Frequency Stability: Determined by stability of the 60-cycle supply mains.

Dimensions: (Length) 9 3/4 x (width) 6 3/4 x (height) 4% inches, over-all.

Net Weisht: *10%* pounds.

Type		*Code Word*	*Price*
549-B	Motor-driven Contactor.	MACAW	$70.00
549-P2	Hand Contactor.	MADAM	30.00

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TYPE 725-A COLOR COMPARATOR



The General Radio Color Comparator is an instrument for comparing, in terms of spectrophotometric reflection, the color of opaque or semi-opaque objects. It can also be used to measure the opacity and brilliance of papers and similar materials. It can be used for comparing or matching dyed, printed, or painted samples. It is an extremely useful instrument for the textile paper, paint, and similar industries. It is simple, easy, and rapid to operate, giving positive and reliable results. The response approximates that of the human eye which adds considerably to its usefulness for those who are accustomed to matching colors by eye.

Since the color comparator operates entirely on the light reflected from the sample, best results are obtained on samples of relatively high reflecting power.

Because of its small size and portability it can be used directly in the plant where it is necessary to match the colors of material in process and provides, for this type of work, laboratory accuracy which has not hitherto been available.

The Type 725-A Color Comparator consists essentially of: (1) a light source, (2) three color filters dividing the visible spectrum into three overlapping ranges, (3) a photo-electric cell, (4) a meter for indicating the degree of reflection from the sample. An infra-red filter is used to eliminate errors due to infra-red light produced in the light source. The three filters are selected by means of a knob which is turned to bring into position the filter desired. The instrument is standardized in terms of a white Carrara glass sample whenever used.

SPECIFICATIONS

Spectrophotometric Range: The entire visible spectrum is covered by means of three color filters, the spectrophotometric bands of which are spaced at approximately 100 mu intervals in the visible spectrum. The red filter is centered at approximately 650 mu, the green at 550 mu, and the blue at 450 mu.

Controls: Power supply ON-OFF switch; filter selector control; standardizing adjustments.

Meters: Micro-ammeter for indicating degree of reflection.

Power Supply: 115-volt, 60-cycle, a-c line. A voltage regulator is included tor holding the illumination to a constant value. Adequate fuse protection is provided. The total power consumption is 75 watts.

Mounting: The entire instrument is mounted in a black metal cabinet of rugged construction and durable finish. All controls and meters are mounted OH a sloping panel at the front of the instrument.

Dimensions: (Width) 12 x (length) 16 x (height) 12 inches.

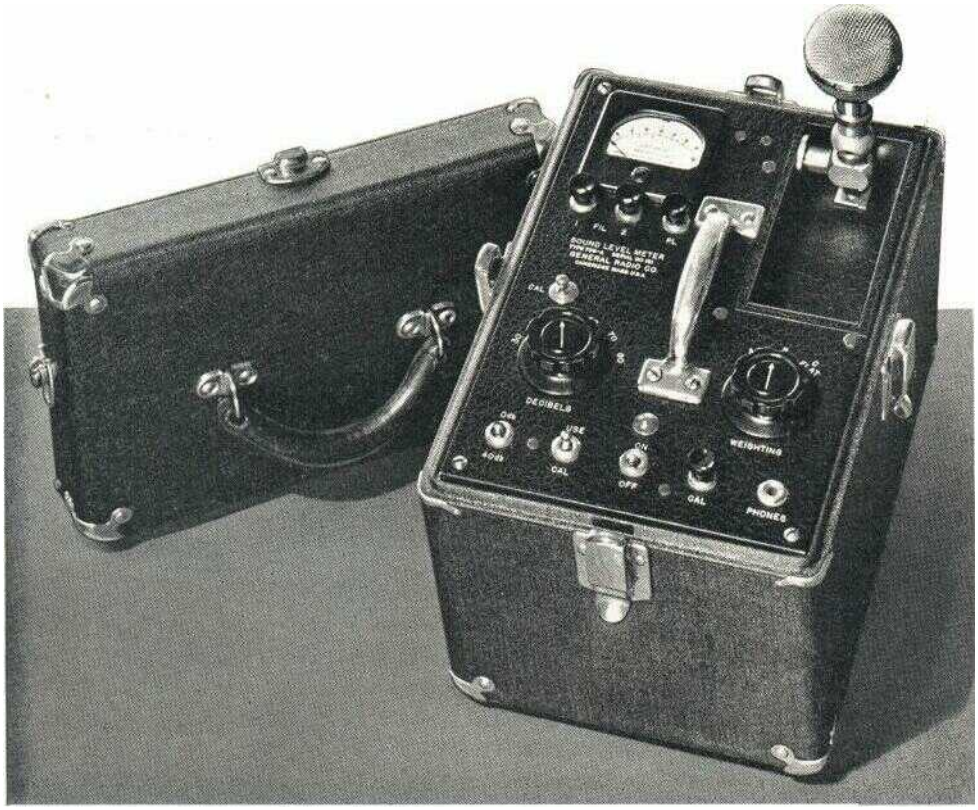
Net Weight: 40 pounds.

Type		*Code Word*	*Price*
725-A	. . . . .		**$550.00**

PATENT NOTICE. See Note 23, pagev

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TYPE 759-A SOUND LEVEL METER



This instrument was designed to meet the demand for an inexpensive sound level meter complying with the tentative standards of the American Standards Association, the American Institute of Electrical Engineers, and the Acoustical Society of America. It incorporates several features previously found only in more expensive and cumbersome instruments and is suitable for practically all types of commercial sound level measurements. Among the features of the new noise meter are the following:

1. A non-directional crystal microphone which responds satisfactorily over a wide range of frequencies, including the high frequencies which make up "hissing" and "swishing" sounds.
2. Unusual sensitivity extending to 24 decibels above a zero reference level of 10^{-16} watts per square centimeter.
3. Three separate weighting networks for adjusting the frequency response characteristics, consisting of a low level network, a high level network, and a network giving a substantially flat over-all response.
4. No rheostats or other battery adjustments.
5. Unusually light weight and small size.
6. Special tube suspension, providing a freedom from microphonic noises.
7. No inductance coils or transformers whatsoever are used in the instrument, thus eliminating error due to magnetic pickup.

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SPECIFICATIONS

Sound Level Range; Calibrated in decibels from +24 db to +130db above a reference level of 10^{-16} watts per square centimeter. (This corresponds to a range of +17 to +123 db when referred to the average threshold of hearing [0.45 millibars] as was used in some earlier model meters.)

Frequency Characteristics: The frequency characteristic of the sound level meter is adjustable to follow three different curves. The first and second of these are, respectively, the 40 and 70 db equal-loudness contours modified by the differences between random and normal free-field thresholds in accordance with the tentative standard proposed by the American Standards Association. These two response curves are used, respectively, when measuring sounds of low and high intensity. The third frequency response characteristic gives a substantially equal response to all frequencies within the range of the instrument. This characteristic is used when measuring extremely high sound levels or when using the instrument with an analyzer such as the General Radio Type 636-A Wave Analyzer,

Microphone: A non-directional piezo-electric microphone is supplied with the sound level meter. The microphone mounts directly on a folding bracket on the top of the instrument and folds down out of the way when not in use. The microphone may also be removed from the bracket and used on an extension cord. The microphone is of the sound cell type, thus eliminating the irregularities of response and the variable characteristics frequently encountered in diaphragm-type piezo-electric microphones.

Circuit: The amplifier consists of four stages of resistance-capacitance-coupled amplification using pentode tubes followed by an output stage arranged to match the especially-designed rectifier-type meter. This combination provides a high degree of stability and minimizes change in sensitivity resulting from variations in battery voltage. The tubes are all standard types and readily available. A ballast tube is provided for maintaining constant filament current.

Attenuators: A 10-db-per-step attenuator precedes the third stage of amplification and provides control of the instrument up to 90 db by means of a single knob. For measurements of higher sound levels an additional 40-db attenuator is provided. This attenuator is directly on the input of the amplifier. Since the attenuators are at low levels the possibility of errors due to amplifier non-linearity is eliminated.

Meter: The indicating meter has a scale which is approximately linear in decibels and which covers a range of 16 db, thus providing satisfactory and accurate interpolation between the steps of the attenuator. The ballistic characteristics of the meter match closely those of the human ear and agree with the tentative standards specified by the American Standards Association.

Telephones: A jack is provided on the panel for plugging in a pair of head telephones in order to listen to the sounds being measured.

Vibration Pickup: If desired, a, piezo-electric vibration pickup may be used in place of the microphone.

Tubes: Five lA4-type tubes and one IDl-type tube are required. A complete set of tubes is supplied with the instrument.

Batteries: The batteries required are two Burgess No. 4FA (little 6's), or equivalent, two Burgess No. Z30P 45-volt B batteries, or equivalent, and one Burgess No. F2BP 3-volt battery, or equivalent. A compartment is provided in the case of the sound level meter for holding all batteries and connections are automatically made to the batteries when the cover of this compartment is closed. A set of batteries is included in the price of the instrument.

Case: The meter is built into a shielded carrying case of airplane luggage construction, covered with a durable black waterproof material and equipped with chromium-plated corners, clasps, etc. This case has been designed to combine durability with light weight and good appearance. When operating the sound level meter, the cover is ordinarily removed. An additional handle is provided on the panel of the instrument for convenience in moving it about while it is in operation.

Dimensions: The over-all dimensions are approximately (height) 11 1/2 x (length) 13 1/2 x (width) 9% inches.

Net Weight: 23 1/2 pounds, with batteries; 17 1/2 pounds, without batteries.

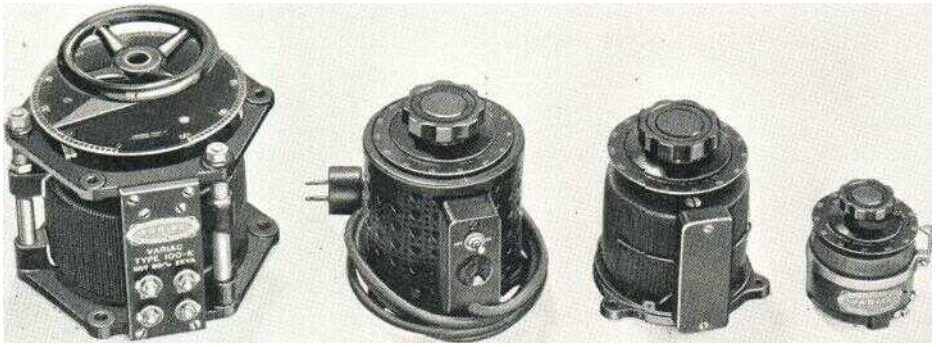
Type	*Code Word*	*Price*
759-A		**$195.00***
Set or replacement batteries for above.		**4.20**

*Price includes both tubes and batteries.

PATENT NOTICE. See Notes 1, 2, page y.

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VARIAC*



The Variac is an adjustable transformer that delivers any voltage between zero and line voltage with as smooth and uninterrupted control as that obtainable from any rheostat. (On some models any voltage between zero and 135 volts can be obtained from the 115-volt, 60-cycle line.)

The applications of the Variac to industrial control and to experimental problems in the laboratory are literally numberless. In general, it can be stated that the Variac is the ideal a-c voltage control device because of its high efficiency, low heat dissipation, and good voltage regulation. It has many advantages over the usual rheostat or potentiometer. The output voltage is essentially independent of load. Voltages in the vicinity of zero are obtainable, and it is possible to increase the voltage and thus provide a means of compensating for low line voltage.

This combination of qualities has been obtained by means of design features of considerable interest. The Variac in its simplest form consists of a laminated iron core built up of toroidal punchings. A single-layer winding traversed by a moving contact provides both the transformer effect and a convenient means of voltage adjustment. Since each turn of the winding can be reached by the contact, a continuous adjustment of voltage is obtained. The transformers are designed to have about 0.2 to 0.9 volt between turns. The carbon contact limits the current in the short-circuited turn so that no undue heating results.

Among the uses are voltage control for electrical testing, calibration and measurement work, heat control on electric furnaces, soldering irons, etc., motor speed control and illumination control in theatres, photographic studios, and dark rooms.

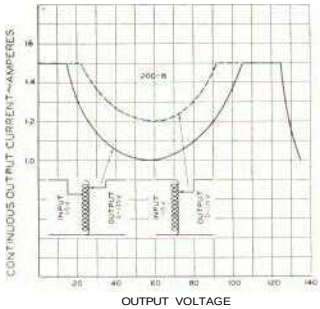
•Registered in *V. S.* Patent Office

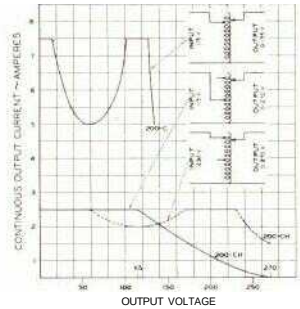
SPECIFICATIONS

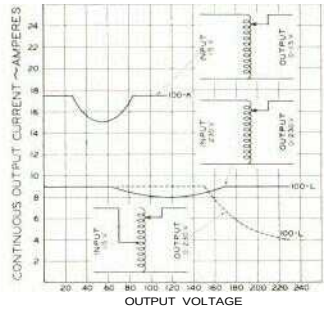
Load Rating: The value of "Load Rating" specified in the price list for *each* model is the full-voltage volt-ampere rating of a constant-impedance load. In other words, TYPE 100-K will control at any setting a load rated 2 kva at 115 volts.

Current; The "Rated Current" specified in the price list can be drawn safely at any point in the output-voltage range, but at some settings this rated value of load current may be exceeded. This increased current is the "Maximum Current" given in the price list.

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Since the Variac is an auto-transformer, maximum loss (which determines the rating) occurs at one-half line voltage. In the vicinity of full-line voltage, however, there is little transformer action, and the allowable current is limited only by heating in the brush, which permits the "Maximum Current" rating at this point.

Consequently a Variac can handle, *for any setting*, a constant-impedance load which draws at full voltage a current no greater than the specified "Maximum Current."

Calibration: Dials giving a voltage calibration accurate to ±2% when the line voltage has its rated value are furnished on TYPE 200 Variacs. TYPE 100 is supplied with a 100-division dial plate which indicates percentage of line voltage.

Knob: Type 100 has a handwheel with a fixed dial plate.

TYPE 200 models have dials permanently attached to Type 637 Knobs.

Voltage increases with clockwise rotation of the control wheel on TYPE 100. On TYPE 200 the voltage increases with counterclockwise rotation of the dial when arranged for table mounting.

Direction of rotation for increasing voltage may be reversed by a change of connections on Type 200 but not on TYPE 100.

Terminals: TYPE 200-CM and Type 200-CMH are furnished complete with attachment cord and plug for the input connection to the mains, an ON-OFF switch, and a standard plug receptacle for the output circuit.

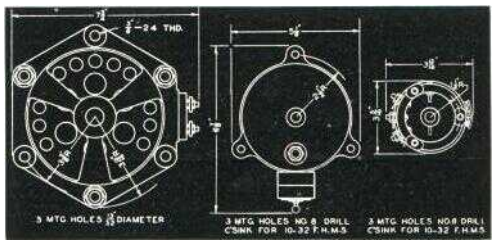
TYPES 100, 200-B, 200-CU, and 200-CUH have threaded terminal studs with nuts and soldering lugs.

Mounting: All models are readily converted from the table mounting illustrated to back-of-panel mounting. TYPE 100 models can be mounted in cascade for operation by a single shaft. See accompanying drawing for mounting dimensions.

TYPE 200-CM and TYPE 200-CMH are supplied with protecting cases. All other models are supplied without a case.

Dimensions: See sketch. Over-all height: Type 100-K, 7 3/8; TYPE 100-L, 8; TYPE 200-B, 4; and Types 200-C and 200-CH, 5 1/2 inches.

Net Weight: TYPE 100-K, 20 5/8 pounds; TYPE 100-L, 23 3/4 pounds; Type 200-B, 3 3/4 pounds; TYPES 200-CM and 200-CMH, 10 pounds; and Types 200-CU and 200-CUH, 9 pounds.



100-K, -L 200-CM,-CU 200-B

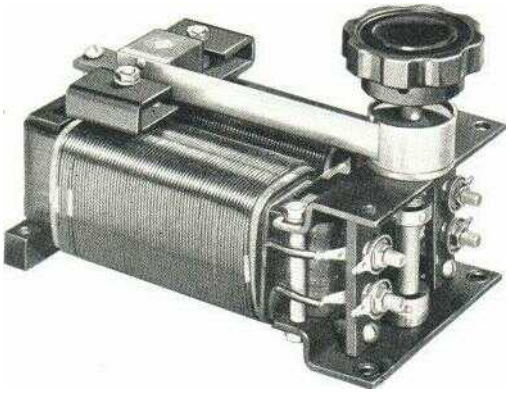
VARIAC Types

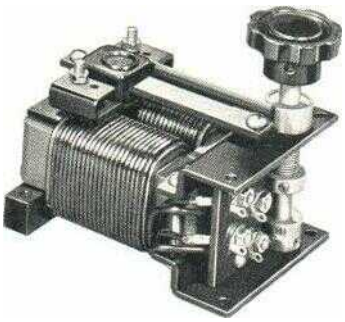
Type	Load Rating	Primary Voltage	Current Rated	Current Maximum	Output Voltage	Code Word	Price
100-K	2 kva	115 v	15 a	17.5 a	0-115 v	BEAMY	$40.00
100-L	2 kva	230 v	8 a	9 a	0-230 v	BEARD	40.00
100-L		115 v	4 a	9 a			
200-B	170 va	115 v	1a	1.5 a	0-185 v	BALSA	10.00
200-CM	850 va	115 v	5 a	7.5 a	0-135 v	BALMY	17.50
200-CU	850 va	115 v	5ft	7.5 a	0-135 v	BAKER	14.50
200-CMH	580 va	230 v	1.5 a	2.5 a	0-270 v	BAIRN	21.50
200-CMH		115 v	0.5 a	2.5 a	0-270 v		
200-CUH	580 va	230 v	1.5 a	2.5 a	0-270 v	BAGUE	18.50
200-CUH		115 v	0.5 a	2.5 a	0-270 v		

PATENT NOTICE. See Note 11, page V.

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VARIAC TRANSFORMERS





These recently developed Variac Transformers, intended for use where only small voltage variations are desired, are similar to the toroidal Variac in performance, but are radically different in design.

The new Variac Transformers are built on rectangular cores with windings in several layers on the two legs of the core. The top layers of wire are exposed to two sliding carbon contacts. These contacts are directly connected, eliminating flexible leads. By means of a steel tape, a 320-degree rotation of the control knob drives the contacts along the entire length of the windings. The windings beneath the top layer are conventional transformer coils and can be used for a number of purposes.

Four standard models are listed below. A number of different voltage-current combinations can be supplied on these cores. For good efficiency the design limitations on the special transformers are 10 amperes and a maximum voltage variation of 30 volts for the TYPE 70 core and 20 amperes and 60 volts variation for the TYPE 80 core. Within these limits special transformers can be supplied promptly and economically.

SPECIFICATIONS

Type	*Line*	*Volts*	*Output*	*Volts*	*Max. Current*
70-A	Constant	US	Adjustable	0-10	6 a
70-B	Fluctuating	100-125	Constant	115	2 a
80-A	Constant	115	Adjustable	0-10	20 a
80-B	Fluctuating	90-130	Constant	115	7.5 a

Load Rating: TYPE 70 furnishes 50 watts and TYPE 80 supplies 250 watts of variable power.

Current: See table above.

No-Load Loss; Approximately 5 watts for TYPE 70; 10 watts for TYPE 80.

Terminals: Threaded terminal studs with soldering lugs.

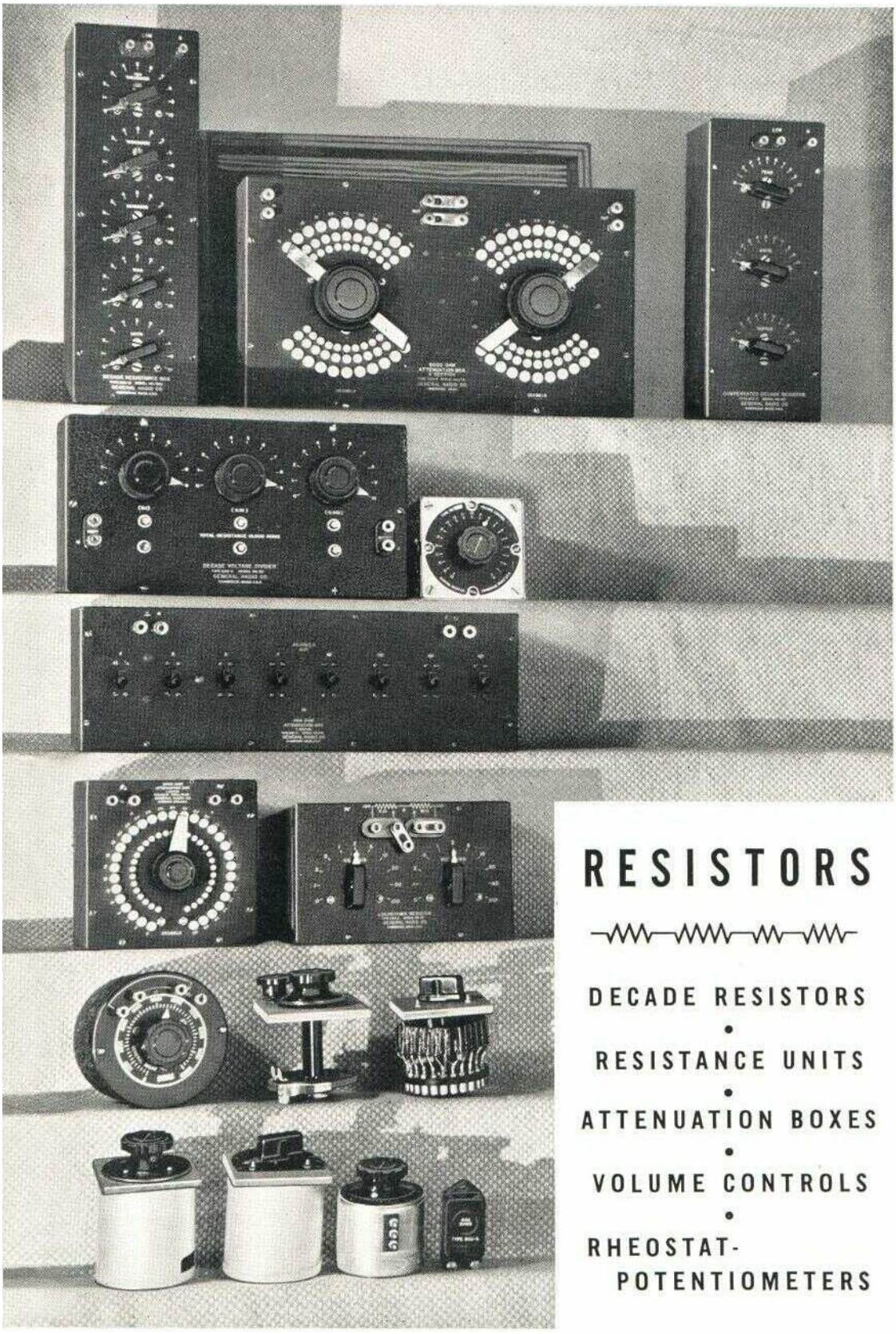
Dimensions: TYPE 70, (length) $4\frac{3}{4}$ x (width) $3\frac{3}{8}$ x (height) 4 inches; TYPE 80, (length) $8\frac{1}{2}$ x (width) $4\frac{1}{4}$ x (height) $5\frac{1}{2}$ inches, over-all.

Net Weight: TYPE 70, 4 1/4 pounds; Type 80, 13 1/4 pounds.

Type		*Cods Word*	*Price*
70-A		BASIN	$10.00
70-B			10.00
80-A			15.00
80-B			15.00

PATENT NOTICE. See Note 11, page v.

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RESISTORS

DECADE RESISTORS

•

RESISTANCE UNITS

•

ATTENUATION BOXES

•

VOLUME CONTROLS

•

RHEOSTAT-
POTENTIOMETERS

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TYPE 602 DECADE-RESISTANCE BOX



A convenient assembly of resistance cards in a single cabinet with switches is a necessary laboratory accessory wherever electrical measurements are made. Such boxes are constantly used in circuits where a wide range of resistance values is required, as laboratory standards, bridge arms, and dummy generator and load resistors.

The TYPE 602 Decade-Resistance Box is an assembly of two or more TYPE 510 Decade-Resistance Units in a single cabinet. Mechanical and electrical protection of the units is provided by the shielded walnut box and aluminum panel, which completely enclose both units and switch contacts. Two-, three-, four-, and five-dial decade assemblies are available. Each decade has eleven contact studs and ten resistance units, so that dials overlap. A detent mechanism assists in setting squarely on the contacts. This permits adjustments to be made without looking at the dials.

The resistors are adjusted to have their specified values at their own terminals and not at the terminals of the box. The resistance measured at the box terminals will, therefore, be high by the switch contact and wiring resistance, which amounts to about 0.003 ohm per dial. This method of adjustment has been adopted primarily because no method in which the switch resistance is absorbed in some one unit of a decade can give the correct value of the total resistance for all settings of the various decades. There are also many types of measurement (voltage-divider and substitution bridge measurements, for example) in which the difference in two settings of a resistance box is significant. This difference is given correctly only when the individual resistors have been adjusted independently of switch resistance. The wiring also adds a small inductance, about 0.1 microhenry per decade.

The resistance elements have no electrical connection with the shield, which is brought out to a separate terminal on the panel.

All General Radio boxes are equally useful on direct and alternating current and maintain their usefulness for many applications well into the radio-frequency range.

The frequency characteristics of the individual decades will be found under TYPE 510 Decade-Resistance Units, page 15. When several decades are assembled in a single box, the box wiring and the capacitance to shield of the individual cards will, of course, affect the frequency characteristic. These effects vary with frequency and are generally

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greater for the very low and very high resistance decades. They do not appear at audio frequencies, but have an appreciable effect on resistance values at carrier and radio frequencies.

Generally speaking, the 1-, 10-, and 100-ohm dials are most satisfactory at high frequencies.

When the boxes are used in tuned circuits, only changes in resistance due to skin effect and, in some high-resistance cards, to effective capacitance need be considered. When the boxes are used as drop wires, the reactance of wiring and cards at high frequencies will affect the apparent impedance of the box. Data on these effects will be found in the specifications under "Frequency Characteristics."

SPECIFICATIONS

Type of Winding: Sec specifications for TYPE 510 Decade-Resistance Units, page 14.

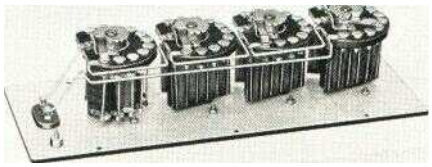
Accuracy of Adjustment: All cards are adjusted to within 0.1% of the stated value between card terminals, except the 1-ohm cards which are adjusted to within 0.25% and the 0.1-ohm cards which are adjusted to within 1%. Where necessary, add 0.003 ohm for each dial to allow for contact and wiring resistance.

Frequency Characteristics: There is no serious frequency error below 50 kc. At higher frequencies the error results from changes in resistance and the effect of the reactance in the cards, and from the inductance of the box wiring (about 0.1 uh per dial).

For characteristics of the individual decades, see specifications for TYPE 510 Decade-Resistance Units, page 14.

Maximum Current: See specifications for TYPE 510 Decade-Resistance Units, page 14.

Terminals: Jack-top binding posts set on General Radio standard 3/4-inch spacing for resistance connections. There is an extra post at the corner of the panel for connections to the shield.



Typical internal construction of a TYPE 602 Decade-Resistance Box

Mounting: A copper-lined walnut cabinet, with aluminum panel, completely encloses switches and resistance units. The panel finish is black crackle lacquer.

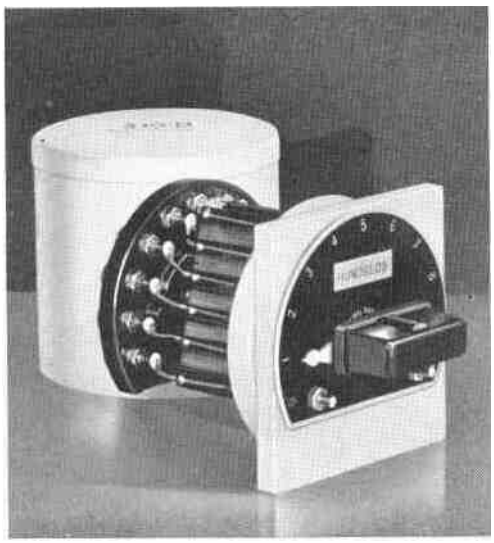
Dimensions: Panel length depends on the number of dials (see price list), being 7 3/4 for 2-dial, 10 3/8 for 3-dial, 13 for 4-dial, and 15 3/8 inches for 5-dial boxes. Panel width, 5 inches. Over-all height, 5 inches.

Net Weight: 3 1/4 for 2-dial, 4 3/4 tor 3-dial, 5 for 4-dial, and 6 1/4 pounds for 5-dial boxes.

Type	*Resistance*	*No. of Dials*	*Code Word*	*Price*
602-D	**11 ohms, total, in steps of 0.1 ohm**	**2**	DECOY	**$25.00**
602-E	**110 ohms, total, in steps of 1 ohm**	**2**	DECRY	**25.00**
602-F	**111 ohms, total, in steps of 0.1 ohm**	3	DELTA	**35.00**
602-G	**1110 ohms, total, in steps of 1 ohm**	**3**	DIGIT	**35.00**
602-K	**1111 ohms, total, in steps of 0.1 ohm**	4	DEFER	**45.00**
602-J	**11,110 ohms, total, in steps of 1 ohm**	**4**	DEBIT	**50.00**
602-N	**11,111 ohms, total, in steps of 0.1 ohm**	**5**	DEMON	**62.00**
602-M	**111,110 ohms, total, in steps of 1 ohm**	**5**	DEMIT	**70.00**
602-L	**111,100 ohms, total, in steps of 10 ohms**	**4**	DECAY	**58.00**

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TYPE 510 DECADE-RESISTANCE UNIT



These precision decade resistors are identical with those used in the TYPE 602 Decade-Resistance Box. They are intended for assembly into either experimental or permanent equipment where only a single decade is needed or where a TYPE 602 Decade-Resistance Box cannot be conveniently mounted.

Each resistor is carefully adjusted and aged, the construction being such that there is no serious error at frequencies as high as 50 kc. Operation is equally satisfactory in d-c circuits, since manganin is used for all units except 10,000-ohm cards. Quadruple-leaf switches running over large contacts insure a low and constant contact resistance.

Each decade is enclosed in an aluminum shield, and a knob and an etched-metal dial plate are supplied. The unit is also available, complete as illustrated with shield, shield cover, blank dial plate, and switch stops, but without resistors, as the TYPE 510-P3 Switch.

A discussion of the frequency characteristics of these units is given in the General Radio *Experimenter*, Vol. VI, No. 9, February, 1932.

SPECIFICATIONS

Accuracy of Adjustment: Resistors are adjusted to be accurate at, card terminals within the tolerances given in Table I below.

Maximum Current: See Table I below.

Type of Winding: See Table I below.

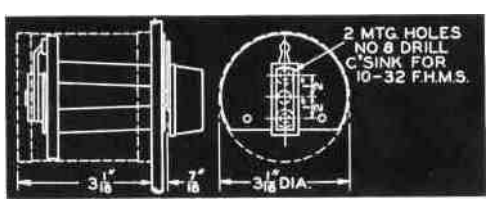
TABLE I

Type	Resistance per Step	Accuracy	Type of Winding	Maximum Current 20°C. Rise	Maximum Current 40°C. Rise
510-A	0.1Ω	±1.0%	Bifilar	1 a	1.5 a
510-B	1Ω	±0.25%	Ayrton-Perry	600 ma	1 a
510-C	10Ω	±0.1%	Ayrton-Perry	170 ma	250 ma
510-D	100 Ω	±0.1%	Ayrton-Perry	50 ma	80 ma
510-E	1000Ω	±0.1%	Unifilar on Mica	15 ma	23 ma
510-F	10,000 Ω	±0.1%	Unifilar on Mica	5 ma	7 ma

Frequency Characteristics: There is no serious error below 50 kc. At higher frequencies the error results from skin effect and reactance in the cards and leads.

Table II lists the change in resistance tor each decade at maximum setting as a function of frequency.

Table III lists the change in impedance for each decade at maximum setting as a function of frequency. These values indicate the error occurring



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TABLE II

Percentage Error in Resistance
for Maximum Setting of Each Decade as a Function of Frequency

Decade	*Frequency in kc*						
	50	100	200	500	1000	2000	5000
0.1-ohm steps	0	0.1%	0.2%	1.5%	5 %	—	—
1 -ohm steps	0	0	0.1%	0.3%	1 %	4 %	—
10 -ohm steps	0	0	0	0.1%	0.5%	2 %	11%
100 -ohm steps	0	0	0	0.1%	0.3%	0.8%	4%
1000 -ohm steps	0	-0.1%	-0.5%	-3 %	-11 %	—	—
10,000 -ohm steps	-1%	-5 %	—	—	—	—	—

TABLE III

Change in Impedance (as a percentage of nominal resistance)
for Maximum Setting of Each Decade as a Function of Frequency

Decade	*Frequency in kc*						
	50	100	200	500	1000	2000	5000
0.1-ohm steps	0.2%	0,7%	2 %	—	—	—	—
1 -ohm steps	0.1%	0.2%	1 %	5 %	—	—	—
10 -ohm steps	0	0	0.1%	0,2%	2 %	—	—
100 -ohm steps	0	0	0	0.1%	0.3%	1%	5%
1000 -ohm steps	0	-0.1%	-0.5%	-2 %	-6 %	—	—
10,000 -ohm steps	-2 %	-10%	—	—	—	—	—

when the decade is used as a series circuit element or as a voltage divider. When shunted across a tuned circuit, the reactance is tuned out and the remaining error is only that owing to skin effect.

Switches: Quadruple-leaf, phosphor-bronze switches bear on contact studs 3/8 inch in diameter. Switch brushes are bent so as not to be tangent to the arc of travel, thus avoiding cutting. A cam-type detent is provided. There are eleven contact points (0 to 10 inclusive). The switch resistance is approximately 0.002 ohms.

Temperature Coefficient: The temperature coefficient of resistance is less than ±0.002% per degree C. at room temperatures.

Resistance Wire: Manganin is used on all decades except the 10,000-ohm units, which are wound with a combination of Nichrome and Ohmax in suitable proportions to give approximately zero temperature coefficient.

Terminals: Soldering lugs are provided.

Mounting: Each decade is complete with dial plate and knob and can be mounted on any panel between 1/4 inch and 3/8 inch in thickness.

Dimensions: See sketch; shaft diameter is 3/8 inch.

Net Weight: Type 510 Units, 11 ounces; Type 510-P3, *9 1/2 ounces.*

Type	*Total*	***Per** Step*	*Code Word* ***Price***	
510-A	1 ^	0.1^	ELATE	$8.50
510-B	10 ^	1 ^	ELDER	8.50
510-C	100 ^	10 ^	ELEGY	8.50
510-D	1000^	100 ^	ELBOW	8.50
510-E	10,000 ^	1000 ^	ELECT	12.00
510-F	100,000^	10,000 ^	ELVAN	14.00
510-P3 Switch	.....		ENVOY	5.00

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TYPE 814-A AMPLIFIER



This is a general-purpose laboratory amplifier intended for use where high gain is required over the audio-frequency range. Since the instrument is operated entirely by dry batteries, the output is free from hum. The cabinet is large enough to accommodate all necessary batteries so that the unit is entirely self-contained and readily portable.

An amplifier of this type is extremely valuable for bridge measurements. The high gain increases the sensitivity of a pair of ordinary headphones by nearly 80 db at 1000 cycles. The logarithmic gain control provides a convenient means of adjusting the amplification to a satisfactory value. Provision is made for plugging in anti-resonant tuned circuits across the coupling circuit between the second and third stages of amplification. This gives a simple and effective means for restricting the amplifier response to a narrow range of frequencies, thus eliminating harmonics and noise when balancing a bridge.

In designing this amplifier, it was considered more important to have high gain over the audio-frequency range than to have an absolutely flat characteristic over an extremely wide range. The gain is practically constant between 20 and 10,000 cycles and the amplifier is still usable at frequencies up to 50 kc although the characteristic is not flat.

SPECIFICATIONS

Amplification: The gain of the amplifier throughout the greater portion of the audio-frequency range is approximately 80 db when operating into a high impedance (1 megohm or more) such as a vacuum-tube voltmeter or a cathode-ray oscillograph. When operating into a 20,000-ohni load such as, for instance, a TYPE 483-C Output Meter, the gain is approximately 77 db. About this same amount of gain is secured at 1000 cycles when operating into an average pair of telephones.

The above figures for gain in the amplifier represent merely voltage ratios and do not take into account the fact that the input impedance of the amplifier is generally considerably higher than the load impedance connected to the amplifier. Naturally, an input transformer greatly increases the

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