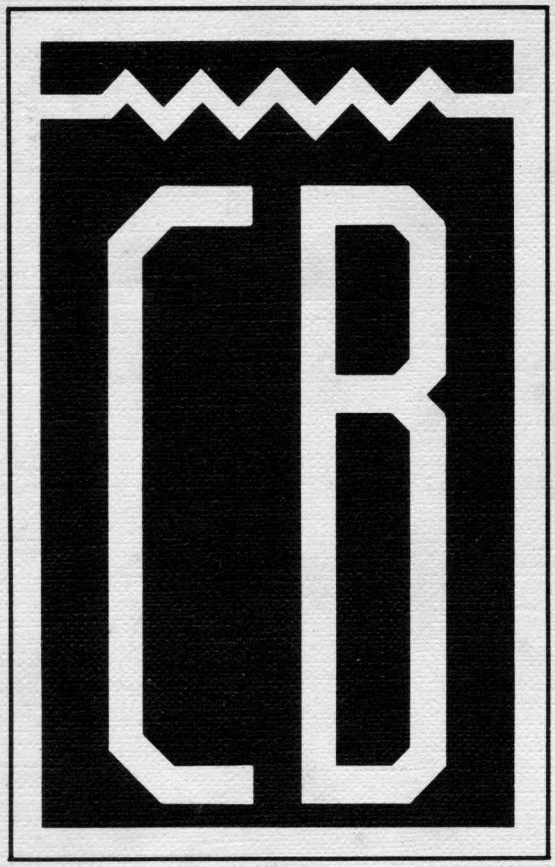


1941 CATALOG

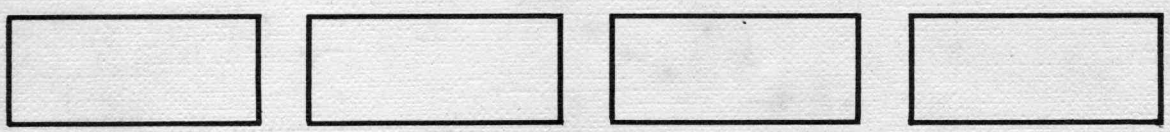
Precision

Laboratory &

Maintenance

Instruments—

For the Radio and Allied Communication Fields



The CLOUGH-BRENGLE CO.

5501 BROADWAY,

CHICAGO, U. S. A.


NINE YEARS OF FINE INSTRUMENTS

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

WAS FOUNDED IN 1932 FOR THE CONSTRUCTION OF HIGH GRADE RADIO TESTING EQUIPMENT, PRINCIPALLY FOR THE SERVICE FIELD. WHILE WE CONTINUE TO OFFER A COMPLETE SERVICE LINE, WE ARE GRATIFIED BY THE INCREASING RECOGNITION OF THE SOUNDNESS AND UTILITY OF OUR DESIGNS ACCORDED BY INDUSTRY, GOVERNMENT DEPARTMENTS AND UNIVERSITIES AND HAVE BEEN ENCOURAGED, THEREBY, TO ADD ITEMS SUITED TO THE MORE SPECIALIZED WORK IN THE LABORATORY AND DESIGN FIELDS.

OUR PRODUCTS ARE ENGINEERED AND MANUFACTURED IN A MODERN PLANT ON CHICAGO'S NORTH SIDE WITH CONVENIENT, FAST TRANSPORTATION TO THE BUSINESS DISTRICT. OUT-OF-TOWN VISITORS ARE CORDIALLY INVITED DURING THE REGULAR BUSINESS HOURS.

-0-0-0-0-0-0-0-

OUR VARIOUS INSTRUMENTS ARE PRESENTED IN DATA SHEET FORM WHERE WE SET FORTH AS CLEARLY AND SIMPLY AS POSSIBLE THEIR PERTINENT CHARACTERISTICS FOR YOUR GUIDANCE IN SELECTION OF THE PROPER ONES FOR YOUR INDUSTRIAL, SERVICE, OR EDUCATIONAL PROBLEM. IN ADDITION, ALL TECHNICAL INQUIRIES ARE HANDLED BY THE ENGINEERING DEPARTMENT SO THAT CORRESPONDENTS WILL BE ASSURED OF WELL CONSIDERED RECOMMENDATIONS.

WE ARE FREQUENTLY ABLE TO SUGGEST MEANS OR MODIFICATIONS WHEREBY OUR INSTRUMENTS MAY BE APPLIED TO PROBLEMS NOT CONTEMPLATED WHEN THEY WERE DESIGNED, OR SUPPLY CALIBRATIONS BETTER SUITED TO AN INDIVIDUAL PROBLEM AT SMALL INCREASE OVER THE REGULAR COST CORRESPONDENCE TOWARD THIS END IS INVITED.

KENDALL CLOUGH.
PRESIDENT AND CHIEF ENGINEER

SUGGESTIONS FOR ORDERING

DESCRIPTION

of the instrument desired, as well as the model number will assist in avoiding error. Customers abroad are discouraged from using code words in the present emergency without first ascertaining the rulings in force.

In the absence of instructions to the contrary we will supply units for 115 volt, 50-60 cycle lines. In ordering for other power lines, please consult the catalog page for details.

PRICES

are subject to change without notice and are net to all but authorized distributors. Formal quotations, made on request, will specify the period for which price can be guaranteed. All prices and quotations are f.o.b. our plant in Chicago unless otherwise stated.

QUANTITY DISCOUNTS

we regret, cannot be extended except on special equipment produced to order. Our standard items are produced in quantity and stocked against orders so our basic costs are not affected by the rate of withdrawal from such stocks.

TERMS

to domestic customers who have previously established credit with us are 1% for payment in 10 days from invoice date, net 30 days, except on repairs and repair parts which are net 10 days. No cash discount is allowable on packing and crating charges, prepaid transportation, or such sales taxes as may apply.

New, unrated customers are urged to supply three commercial references which we will check before shipment or, in the event shipment is urgently required, send cash with order or authorize C.O.D.

PACKING

is at no extra charge for acceptance by a common carrier for domestic delivery. Export packing is at the rate of $1.50 for each unit of 1.5 cubic feet of net contents, or fraction thereof.

TRANSPORTATION

should be specified on the order, otherwise we will use the means our experience has indicated to be least costly consistent with safe transit.

When parcel post shipment is specified we will insure and add the fee to the invoice, unless instructed to the contrary, in which case we must ask the customer to assume the risk.

DELIVERY

All instruments cataloged are regularly manufactured and stocked to the best of our ability to anticipate withdrawals. In addition, large stocks of the basic materials are kept on hand at all times to permit the promptest possible service in the event your order reaches us when we are temporarily out of stock.

Instruments for special line voltage or frequency are ordinarily converted from stock units by the tenth day after receipt of order.

ACKNOWLEDGEMENT

will not be sent, unless requested, if we anticipate making shipment on or before the third day following receipt of order. On partial shipments the invoice will indicate the probable date of shipment of back-ordered items.

PARTIAL SHIPMENTS

In the interests of best service, partial shipment will be made on domestic orders containing other items on which we are temporarily out of stock, unless specifically instructed to the contrary. Due to the complications involved, export orders are never split unless specific permission has been granted to do so.

DAMAGES IN TRANSIT

All of our products are designed and packed to stand the ordinary rigors of transport and our responsibility ceases when accepted by the carrier or his agent. All shipments should therefor be promptly inspected for both external and concealed damage and proper claim for such filed with the carrier before returning the instrument for repair.

Where equipment is urgently needed, we can frequently make replacement subject to disposition of the repair charges on the damaged instrument.

ORDERS FOR PARTS

should state both the Model number and the Serial number of the instrument for which they are intended. Power transformer orders should state the line voltage and frequency. For very old instruments, the return of the worn or damaged part will assure a perfect replacement.

We endeavor to supply parts and repairs at the lowest possible costs at all times. It will be appreciated, though, that as a design becomes older or is discontinued from the line, prices on its parts must necessarily advance to cover the fabrication and testing of the components in small or even single lots.

Due to their nature, repair parts are sold on a cash, or net 10 day basis and are not returnable for any reason.

MANUALS, INSTRUCTION CARDS, and CIRCUIT DIAGRAMS

are always produced in greater quantities than the instruments to which they apply. We cannot always predict the consumption of this extra material and it has frequently proven necessary to reprint in order to serve the needs of users of older instruments.

In order to maintain these services, a nominal charge is necessary which will vary with the amount and antiquity of the material requested. Quotations on request.

CALIBRATION AND INSPECTION DATA

is recorded at the time of production and held in file for one year from date of shipment of the instrument. During that period we are able to supply calibration and other data. After that, it will be necessary to return the instrument for recalibration and new curves or charts, in the event the originals are lost.

WARRANTY

We warrant each new instrument manufactured and/or sold by us to be and remain free from defect due to faulty material (tubes excluded) and/or workmanship, for ONE YEAR from date of shipment from our factory.

Our obligation under this warranty is expressly limited to repairing or replacing, at our plant, any part (except tubes) which is proven by our examination to be defective, provided the instrument is returned by the owner, transportation prepaid.

If the instrument is incomplete, abused or tampered with or the serial number effaced, this warranty shall be deemed null and void.

REPAIRS AND SERVICE

We have a special department conducted as a service bureau for C-B instrument users and place each instrument submitted in as nearly new condition as possible. Final tests are made with the same fixtures and equipment used in the original production.

For ordinary repairs and reconditioning to original specification, no authorization for return of the instrument is necessary. Simply wrap instrument securely in tough paper and pack in a carton with at least 3" of excelsior on all sides mark the package "ATT: SERVICE DEPT." and ship with transportation prepaid.

A letter referring to the instrument by Model and Serial number will permit us to notify you in case of non-delivery. Also, relate in as much detail as possible the nature of the difficulty encountered and the services desired. This will frequently save time in getting at the source of the trouble and effect a corresponding saving in the cost of repairs.

Unless advised to the contrary, all worn and damaged parts will be replaced and the instrument put in as nearly new shape as is possible. This complete service is suggested unless the instrument is so old that the expense is unwarranted.

We are always happy to supply an estimate of the repair costs before proceeding with the work, if requested.

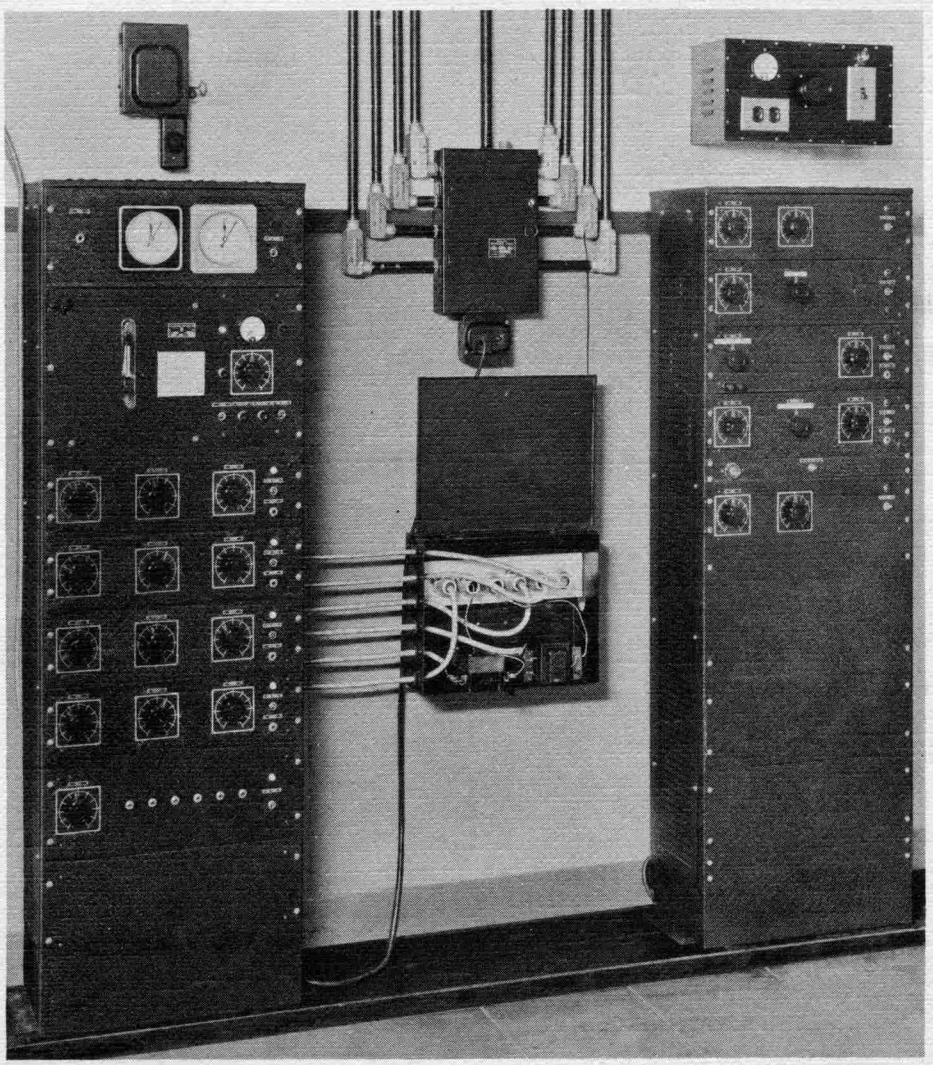
Please do not ask us to add features to or modernize old instruments to new specifications unless previous correspondence has indicated we're in a position to do so.

Like repair parts, all repair service is sold on a cash or net 10 day basis; no discount allowed.

TO ASSURE ACCURACY of all CB instruments and components, we maintain a primary standard of frequency, shown at the right.

Its output is checked daily against both standard time and the frequency transmissions of Bureau of Standards radio station WWV.

The output frequency is fed over transmission lines to all test and inspection departments of the factory so accurate frequencies can be had, not only for the calibration of r-f and a-f generators, but for many of our inductance and capacity determinations as well.

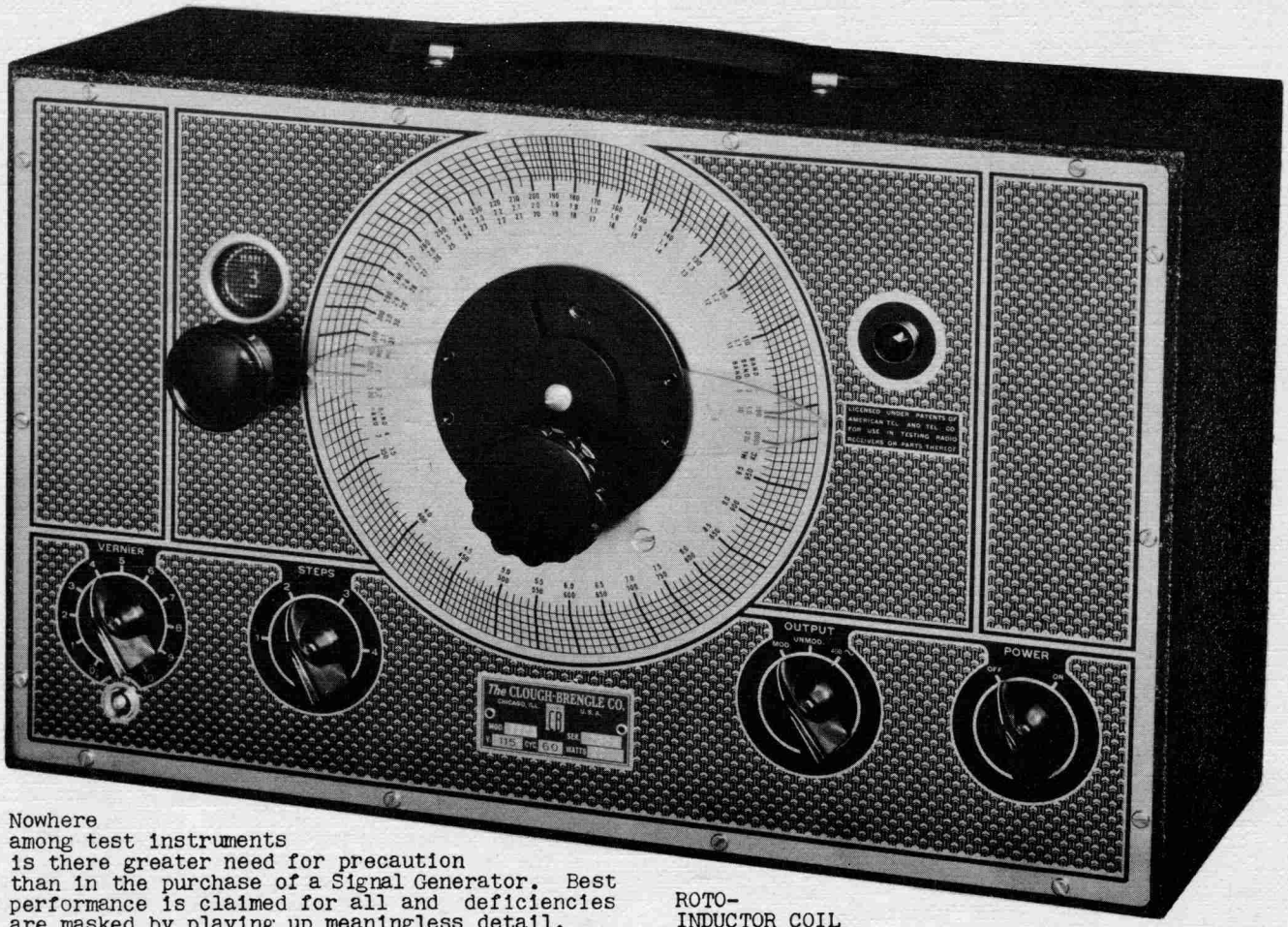


PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MOD. 110-A SIGNAL GENERATOR

RANGE 100 KC. TO 32 MC.
DIRECT READING TO HIGHEST COMMERCIAL ACCURACY



Nowhere among test instruments is there greater need for precaution than in the purchase of a Signal Generator. Best performance is claimed for all and deficiencies are masked by playing up meaningless detail.

How, then, can the prospective purchaser weigh the facts that really count and guage the true excellence? -- A certain and no-cost proceedure is to check these points in our specifications against others:-

1. Is a direct statement made of the percentage accuracy of the frequency on all bands?

2. Is the frequency unaffected by changes in line voltage and attenuator settings and is the construction so rugged that the calibration will remain after mechanical shock?

3. Is copper and copper-clad shielding provided properly arranged in sufficient quantity so ultra-sensitive receivers can be aligned below the operating level of their AVC's?

4. Is the Generator isolated from the power line by really effective filters so that the attenuator is effective when testing sensitive AC operated receivers?

5. Is the modulation clean and sinusoidal so the Generator may be used for distortion and overload testing with the cathode-ray oscillograph?

6. Is the general design so good as to be accepted by industrial and educational institutions, numerous departments of the Government and 60% of the service engineering fraternity?

All of the above questions can be answered in the affirmative for the C-B Model 110-A Signal Generator Please note the following detailed specifications and compare with others.

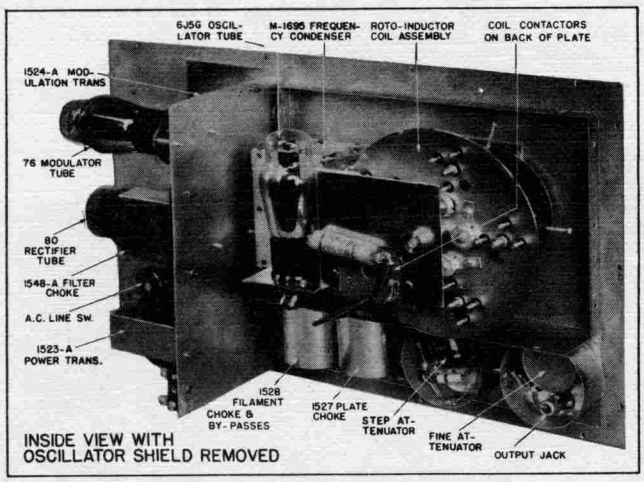
ROTO-INDUCTOR COIL SYSTEM, EXCLUSIVE WITH C-B PRODUCTS was originated by us. The turntable carries all the band coils, the one selected being rotated into a position adjacent to the tuning condenser and contacted by silver plated springs. Long lead wires in the L/C circuit are thus avoided, contributing to the oscillator efficiency at high frequencies and reducing stray fields set up by longer connecting leads.

An adjustable RF-iron slug in each coil, permits precise inductance adjustment at the factory, and individual air trimmers on each coil in the 110A adjust the coil capacity to accurately match the panel calibration.

These results cannot be duplicated by radio-type switches connecting the coils with numerous long leads, with capacity and coupling between them.

SHIELDING, THE RESULT OF LONG STUDY.
When aligning very sensitive receivers, one finds a mere metal box does not constitute shielding, particularly at the high radio-frequencies. In C-B Generators, the shielding property of the welded outer case is reenforced by a separate inner shield providing a copper path around the oscillating circuit in all directions.

RADIO-FREQUENCY FILTERING MUST BE COMPLETE
All leads carrying power to the oscillating circuit are completely filtered with small chokes wound on RF-iron by-passed to the copper shield. In addition, the line cord is carefully shielded from stray fields and is filtered to the copper shield with specially constructed RF condensers. These features account in part for the extremely low stray fields from C-B Generators.



INSIDE VIEW WITH OSCILLATOR SHIELD REMOVED

MODULATION
is by the constant current method in the plate of the oscillator tube, 30% deep in accordance with the I.R.E. recommendations for receiver testing. Modulating power is from a 400 cycle oscillator, self contained and controlled with switch for modulated, unmodulated or 400 cycle AF output.

Signal Generators are widely used for receiver examination with the cathode-ray oscillograph, so particular attention is paid to purity of modulation. In this way, the distortion viewed can definitely be attributed to the receiver, and not to the oscillator used as a source.

Facilities for an external source of modulation are not provided. Inertia effects and frequency modulation always attend direct modulation of an oscillator, particularly at high levels and high modulating frequencies and the inclusion of such facilities is apt to be misleading to the user, unable to detect such effects.

STABILITY,
a characteristic for which C-B Generators have long been noted, is a proven fact attested by the large number which have maintained their calibration accurately over long years of hard usage. This is the result of sturdy construction coupled with minute attention to details of manufacture, found important in our years of experience.

AN ACCURATE AND EASILY READ CALIBRATION
is processed directly on the front panel. Since all bands are proportioned in ratios of either 10 or $\sqrt{10}$ to one another, only two scale arcs are employed rather than the usual confusing five or six. Due to the precise adjustment of inductance and capacity permitted by the Roto-Inductor coil system, no accuracy is lost by this construction and a clean dial results which is easily read like a dual scale multi-range meter.

THE VERNI-VIDER DIAL (see illustration and illustrative example at right)
permits precise readings of frequency extending, in effect, the radius of the dial to five times its actual physical radius. The polished panel surface and transparent indicator, eliminate parallax when making precise readings.

The dial pointer is driven through a positive 10:1 ratio reduction knob, arranged with split gears and spring take up so that no backlash is experienced even after years of wear. This is a great convenience when setting the generator frequency closely to previously resonated circuits.

Pressure of Defense work has forced us to simplify our line by omission of items overlapping others, functionally. The chart calibrated Model OCX, previously cataloged here, was one of these and we feel the more modern direct calibrated 110-A to be worthy of consideration by those who had the OCX in mind.

SPECIFICATION: MODEL 110-A SIGNAL GENERATOR.

FREQUENCY RANGE: 100 KILOCYCLES TO 32 MEGACYCLES ON FUNDAMENTAL FREQUENCIES IN FIVE BANDS SELECTED BY KNOB ON PANEL.

ACCURACY OF CALIBRATION: 1/2% ON BANDS 1 TO 4 INCLUSIVE (100 KC. TO 10 MC.) AND 1% ON BAND 5 (10 MC. TO 32 MC.) DIRECT READING VERNI-VIDER DIAL 6" IN DIAMETER WITH BANDS 1-3-5 AND 2-4 CALIBRATED IN DECIMAL RELATIONSHIP ON TWO SCALES. EASILY READ TO AS CLOSE AS 1/10%.

MODULATION: 30% FROM INTERNAL 400 CYCLE OSCILLATOR, OR CW UNMODULATED OUTPUT, SELECTABLE BY PANEL CONTROL. ALSO, 400 CYCLE A-F OUTPUT 0-1.2 VOLTS THROUGH ATTENUATOR, AVAILABLE. AUDIO FREQUENCY ACCURATE TO 5% AND HARMONIC CONTENT DOES NOT EXCEED 5%.

RADIO FREQUENCY OUTPUT: FROM ZERO TO 100,000 MICROVOLT THROUGH ATTENUATOR. OUTPUT IMPEDANCE DOES NOT EXCEED 100 OHMS AT ANY SETTING.

STABILITY: STARTING FROM NORMAL ROOM TEMPERATURE, THE TOTAL CHANGE OF FREQUENCY AFTER 1 HOUR OPERATION IS LESS THAN 2/10%, AFTER WHICH THE CHANGE IN FREQUENCY DUE TO A 10% CHANGE IN LINE VOLTAGE IS LESS THAN 1/100%. FINAL CALIBRATION AT FACTORY IS AFTER THE WARM-UP PERIOD. THERE IS NO APPRECIABLE CHANGE IN FREQUENCY WITH ATTENUATOR SETTING.

CASE AND FINISH: WELDED STEEL CASE FINISHED IN BLACK WRINKLE. PANEL, BLACK ON NICKEL. SIZE IS 10"X15½"X6¾". NET WEIGHT 16 POUNDS.

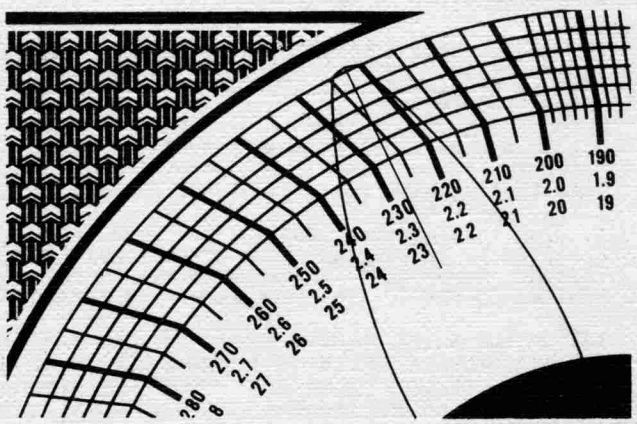
ACCESSORIES: SUPPLIED WITH 6J5G R-F OSCILLATOR TUBE, 76 A-F OSCILLATOR TUBE AND 80 RECTIFIER. 3 FOOT COAXIAL CABLE AND FITTING INCLUDED.

MODEL NO.		CODE	PRICE
110-A SIGNAL GENERATOR,	115V. 50-60~	ANKLE	$49.50
" " "	230V. 50-60~	CETIC	$53.00
" " "	115V. 25-40~	CERYL	$54.50
SHIPPING WEIGHT, 22 LB-PACKED FOR EXPORT, 27 LB-12.3 KG			
EXTRA COAXIAL CABLE		COXAL	$1.25

THE VERNI-VIDER DIAL.
A portion of the Model 110-A dial is shown full size, below with an illustrative setting of the hairline pointer. First, note that the graduations on the inner circle can be read in quite the ordinary way and the setting shown is seen to be somewhat higher than 225 and less than 230 possibly 227 or 228.

Now note that the diagonal line from 225 to a point directly above the 230 mark is intersected five times by the annular lines dividing the increment in effect into five parts of 1 each. The hairline lies coincident with the second of the annular intersections indicating that the precise reading is 225 plus 2, or 227.

The illustration also makes apparent the clarity of the decimally related dial calibration. For the setting shown the frequency would be 227 kc. with Band 1 in use, 2.27 mc. for Band 3 and 22.7 mc. with Band 5. Likewise Bands 2 and 4 read on the same calibration on the other side of the dial. Since all calibrations are on the same diameter, all bands have the same readability.



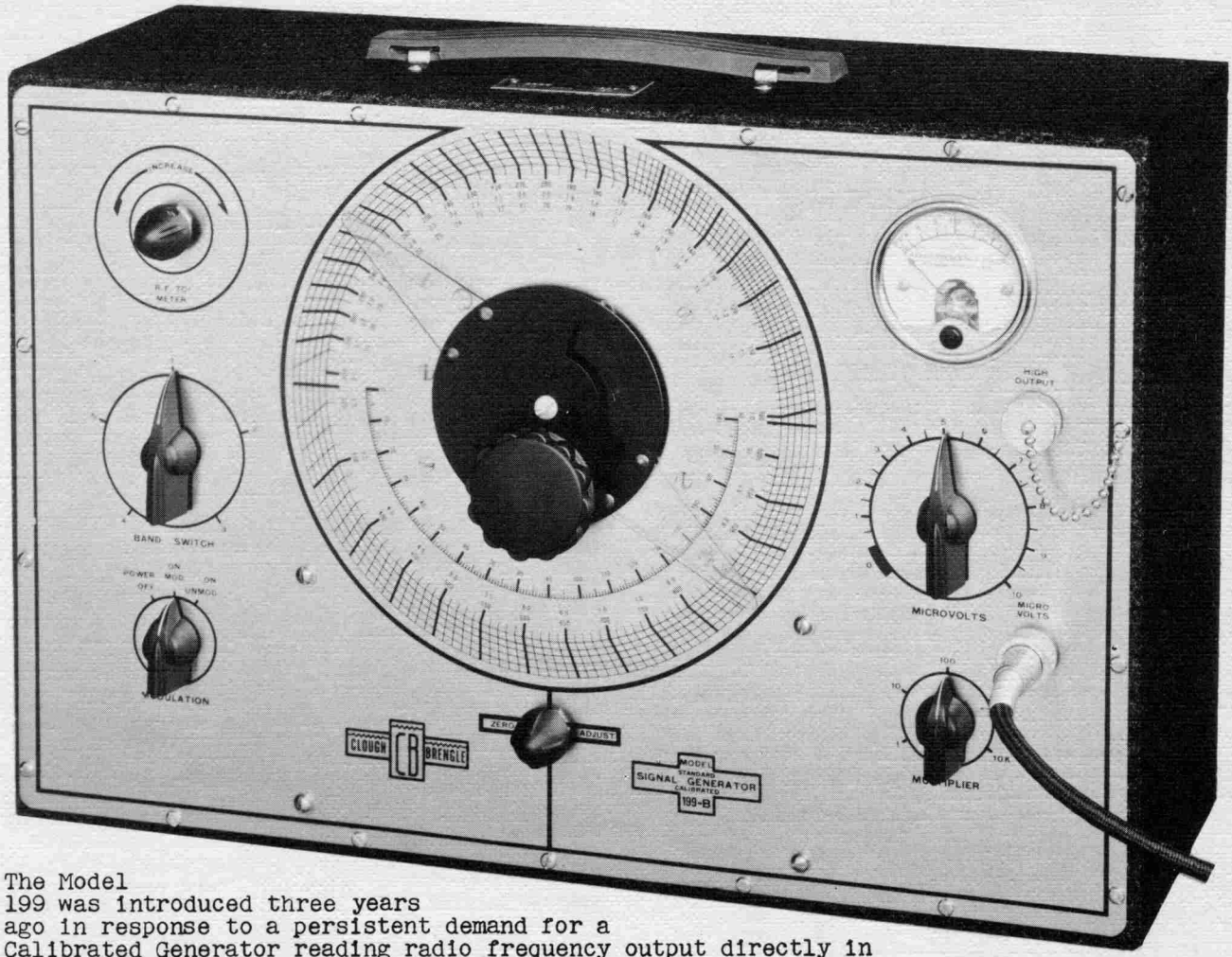
PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 199-B STANDARD SIGNAL GENERATOR

DIRECT READING IN MEASURED MICROVOLTS



The Model 199 was introduced three years ago in response to a persistent demand for a Calibrated Generator reading radio frequency output directly in measured MICROVOLTS, produced to the highest standards of accuracy by factory methods which permit a modest selling price, accuracy and utility considered.

The response has been very gratifying, for not only have many service-engineers recognized the advantage of being able to guarantee receiver sensitivity to their customers, but numerous industrial accounts have purchased the 199 for both design and production testing, as well. In such applications the Model 199-A has been compared with the highest priced products and has attested the high quality designed into it. In addition, several branches of the Government have acquired Model 199's for the most exacting service.

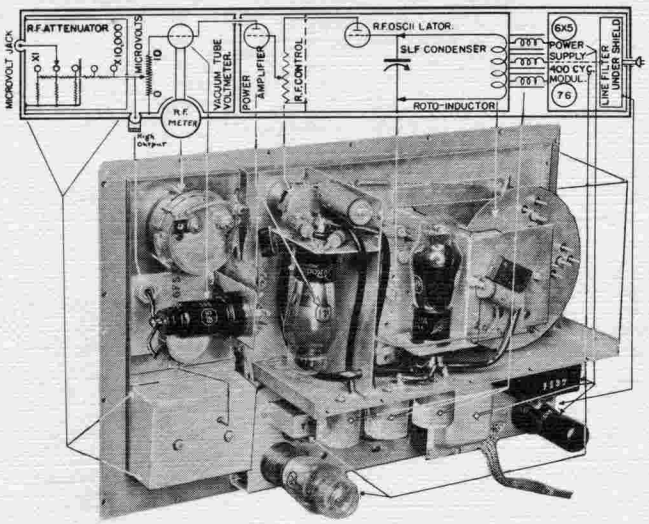
The Model 199-A incorporates the best mechanical and electrical features of our popularly priced service-type Generators and, in addition, has complete facilities for measuring the radio frequency output and subdividing it with a carefully designed and constructed attenuator, so that accurately determined signals of ½ to 100,000 Microvolts are available at all frequencies from 100 Kilocycles to 32 Megacycles.

Such features include the large full-vision dial with coincidental hands; and Verni-Vider, the latter for easy and precise subdivision of the frequency range; Roto-Inductor Coil system, which eliminates long connecting leads in the L/C circuit by swinging each coil into operating position where it connects to the SLF tuning condenser contactors; plus the generally rugged constructional features which have made C-B Generators preferred products.

Users have reported the practicability of using second harmonics from the Model 199 for standardization of receiver performance up to 64 megacycles with good repeatability, though no attempt has been made to carry the fundamental output beyond 32 MC. Our experience indicating that the entire attenuator design problem changes at or about this frequency and, in general, higher frequency problems should be deferred to a second generator.

Particular attention is directed to the use of lattice-wound resistors in the attenuator together with repetitive copper shields used in the construction of both the attenuator and the oscillator compartments. Both are representative of the best construction.

Complete description and specification will be found on the next page.



CONSTRUCTION (referring to illustration above) The power supply and modulator are on the lower chassis, the latter shielding the line filter underneath from stray fields within the case. The oscillating circuit and RF amplifier are in the upper copper compartment, separated by a shield partition. At the left are the vacuum-tube voltmeter and attenuator, built on a heavy copper foundation unit.

THE OSCILLATING CIRCUIT is the C-B Roto-Inductor Coil System, tuned by a condenser, essentially SLF. The Roto-Inductor turntable carries five coils, each with an air trimmer for adjusting the self capacitance and threaded radio frequency iron core for standardizing the inductance. When the frequency band is selected by the panel knob, the whole turntable revolves so that coil in use is connected to the variable condenser by contactor springs. The elimination of long connecting leads is important in the operation of a commercial tube at higher frequencies. We take pride that this feature was originated by C-B and has been imitated in the highest priced instruments.

Five frequency-band coils are provided:-

Band 1	100	KC	to	320	KC
Band 2	320	KC	to	1000	KC
Band 3	1.0	MC	to	3.2	MC
Band 4	3.2	MC	to	10.	MC
Band 5	10.	MC	to	32.	MC

Since all the above bands lie in the ratio of 10 or $\sqrt{10}$ to one another, only two calibrated panel dials are necessary, although all cardinal points are marked with the frequency applying for each band. Either calibration is 10-1 4"(26 cm) long. This together with the SLF condenser, Verni-Vider dial(see front panel illustration)and clarity of panel imprinting permit reading of the dial up to 2 parts in 1000, and estimation to 1 part.

The panel also has a linear scale for special purpose chart calibrations when desired.

A POWER AMPLIFIER isolates the oscillating circuit from the attenuator, so change of settings of the latter has no effect on the frequency.

MODULATION is effected in the screen of the RF amplifier, so frequency modulation effects are avoided as are the inertia effects encountered when directly modulating an oscillating tube.

A sine wave of very low distortion is generated in the audio oscillator and the modulation characteristic of the amplifier tube has been kept very linear, so the instrument is useful for making over-all distortion checks.

A VACUUM-TUBE VOLTMETER monitors the output of the modulated amplifier to the attenuator and constant level is maintained by a panel control. Special attention to coil design and adjustment makes the meter indication unusually flat over each band, so that a minimum of adjustment of RF. level to the attenuator is required in operation

THE ATTENUATOR has five steps, x1, x10, x100, x1000 and x10,000, together with an interpolating control, 0-10 microvolts. All series resistors are lattice wound of Manganin wire on two thin cards while the shunt resistors are of hair-pin construction of extremely fine Manganin, connected without leads between the switch contacts and an adjacent copper shield. The necessity of this precision technique will be appreciated when one considers that the reactance of 1 inch of #14 copper wire is more than three ohms at 30 Mc.

Double deck construction is employed together with complete copper shielding to eliminate mutual inductance effects between the various elements of the network.

The 0-10 microvolt interpolating control used in the standard instrument is of the composition type, with special low-inductance connections. It is extremely serviceable for design and general testing service but where the generator is to be subjected to day-in and day-out use for production purposes we recommend our special heavy duty lattice wire-wound unit.

THE ATTENUATOR RESISTANCE tapers so that a constant resistance of 5 ohms is presented to the receiver under test when using outputs of 0-1000 microvolts, and increases from this output to a maximum of 150 ohms at the highest output from the attenuator.

HIGH OUTPUT for initial alignments, overload and image ratio testing, are available from the upper jack. From 0-1.6 volts are available at all but the highest frequency, read on the meter and controlled by the panel adjustment.
See specification which follows.

SPECIFICATION: MODEL 199-B STANDARD SIGNAL GENERATOR

FREQUENCY RANGE: 100 KILOCYCLES TO 32 MEGACYCLES IN 5 BANDS. ACCURACY 1/2% BANDS 1 TO 4(100 KC. TO 10 MC.) AND 1% ON BAND 5. (10-32 MC.)

OUTPUT MICROVOLTS: 1/2 TO 100,000 MICROVOLTS (.1 VOLT) THROUGH ATTENUATOR. ACCURATE TO 10% PLUS 1 MICROVOLT AT ALL FREQUENCIES. HIGH OUTPUT JACK CALIBRATED 0-1.6 VOLTS.

OUTPUT RESISTANCE: 5 OHMS UP TO 1000 MICROVOLT SETTING OF ATTENUATOR, THEN TAPERING TO 150 OHMS AT HIGHEST OUTPUT SETTING. HIGH OUTPUT JACK 0-150 OHMS.

VTVM ADJUSTMENT: ON PANEL-COMPENSATES ELECTRICAL ZERO FOR LINE AND TUBE VARIATIONS. RF INPUT TO ATTENUATOR HELD TO 1 VOLT FOR ATTENUATOR OPERATION

MODULATION: INTERNAL, 400 CYCLE, FREQUENCY SET WITHIN 5% DEPTH, 30%. SWITCH SELECTS MODULATED OR CW.

TUBES: (SUPPLIED) 6J5G RF OSCILLATOR, 41 RF AMPLIFIER 6F5 VT VOLTMETER, 76 AF OSCILLATOR, 6X5 POWER RECTIFIER. OSCILLATOR TUBES PREAGED AT FACTORY TO PREVENT LATER SHIFT.

ACCESSORIES: 30 INCH COAXIAL SHIELDED OUTPUT CORD WITH LOCKING CAP FITTING. CHAINED SHIELD CAP SUPPLIED FOR HIGH OUTPUT JACK WHEN NOT IN USE.

CASE AND FINISH: WELDED STEEL CASE, 16"X10"X6", FINISHED IN BLACK WRINKLE. PANEL, NICKEL AND BLACK. NET WEIGHT 21 POUNDS.

MODEL NO.	CODE	PRICE
199-B STANDARD SIGNAL GENERATOR		
115 V.50-60~	CABIB	$95.00
230 V.50-60~	CALIB	$98.50
115 V.25-40~	CHAIB	$100.00
199-B WITH SPECIAL WIRE-WOUND POTENTIOMETER FOR PRODUCTION USE.(ADD TO ABOVE)	CAPOT	$15.00
RACK MOUNTING, ALUMINUM PANEL 1/8"X10½"X19" FINISHED IN BLACK WRINKLE. ADD		$8.50

SHIPPING WEIGHT, 27 LB-PACKED FOR EXPORT-32 LB, 14.5 KG

CATALOG NOTE.
The Model 199-B, described above, has the same electrical and mechanical specification as the Model 199-A shown in last year's catalog. The suffix has been changed to cover the modification of panel design to give conformity with our other instruments of laboratory grade as well as minor mechanical changes to improve the ruggedness of the design.

PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH [CB] BRENGLE CO.
5501 BROADWAY CHICAGO, U. S. A.

When you buy a Model 225, you have

THE BEST GUARANTEE AGAINST OBSOLESCENCE

a reputable manufacturer can offer.

No test equipment manufacturer has the "inside" to new tube developments!

To meet the new and varied needs of the rapidly expanding radio and electronic fields, tube engineers will continue to develop new types and they will do this without consulting ourselves or any other equipment manufacturer as to the adaptability of the new types to his equipment. This being the case, the test equipment manufacturer must design in anticipation of the future.

With this thought foremost, C-B engineers have taken the circuit of the justly famous Model 125 Tube Tester, of which several thousand are in use and combined it with forward looking features to become the Model 225 Tube Tester. The following considerations are your best guarantee against loss of your investment through obsolescence:-

SOCKETS.

All existing American sockets, including two midgets are built in, of course. In addition, two extra spares are provided. Combination seven-pin socket provides for testing all standard pilot lamps.

CIRCUIT SELECTOR.

Did you know that there are 20,160 ways that an eight lead tube could be connected on an eight pin base!!?

All of the available combinations have not been and never will be used by the tube engineers but combinations which are adopted, increasingly with every new tube issue, are the real threat to the usefulness of your tube tester unless it is equipped with the C-B FREE ROVING SWITCH!

This new and exclusive development makes it possible to connect any pin or combination of pins to any voltage or test impedance of the Dynatest circuit.

With the FREE ROVING SWITCH, any basing arrangement which the tube designers may introduce in the future will be accomodated without any wiring changes of any kind.

As a further safeguard, a spare roving contactor has been included in the switch in the event a nine-pin base should make an appearance.

FILAMENT VOLTAGES

All filament voltages issued to date are accomodated on the 23 point filament selector switch. This allows five open points on the switch for future voltages.

Also, the filament winding of the power transformer is on the outside and unimpregnated to per-

(See other side for further details)

*See any mathematical handbook:-
"If M denote the number of permutations of n things taken p at a time --
$M=n(n-1)(n-2)\ldots\ldots\ldots\ldots(n-p+1)$
Reversal of heater pins has not been regarded as a permutation in computing the above.

OUTSTANDING FEATURES IN THIS NEW AND DIFFERENT TUBE TESTER

FREE ROVING SWITCH of special design (not a stock radio switch or combination of radio switches) permits connection of any element of any tube, present or future, to any test point of the. ---

C-B DYNATEST CIRCUIT. Field tested in more than 2000 high grade testers this circuit combines the best features of Mutual Conductance and Emission testing. Catches opens as well as shorts.

BRIDGE TYPE INDEXING CIRCUIT makes meter calibration and Good-Bad scale independent of vagaries of tapered potentiometers. Each tester individually adjusted to precision standards of rejection.

NEW "RECARD" DATA SYSTEM permits easiest finding of more than 500 types. All data keyed to the controls through panel design. No cranking through yards of chart to test a set of tubes. New data easily added without taking instrument apart.

DEFINITE SHORT TEST eliminates "exceptions" and the resulting confusion in the customer's mind.

BATTERY TEST under load conditions, permits new profits from battery replacements in portable radios brought into your shop.

COUNTER AND PORTABLE usage in single instrument.

BEAUTIFUL DESIGN AND FINISH of a scientific instrument which will impress your customers.

mit stripping back and bringing out additional taps at the lowest possible cost, if additional voltages should be introduced in the future.

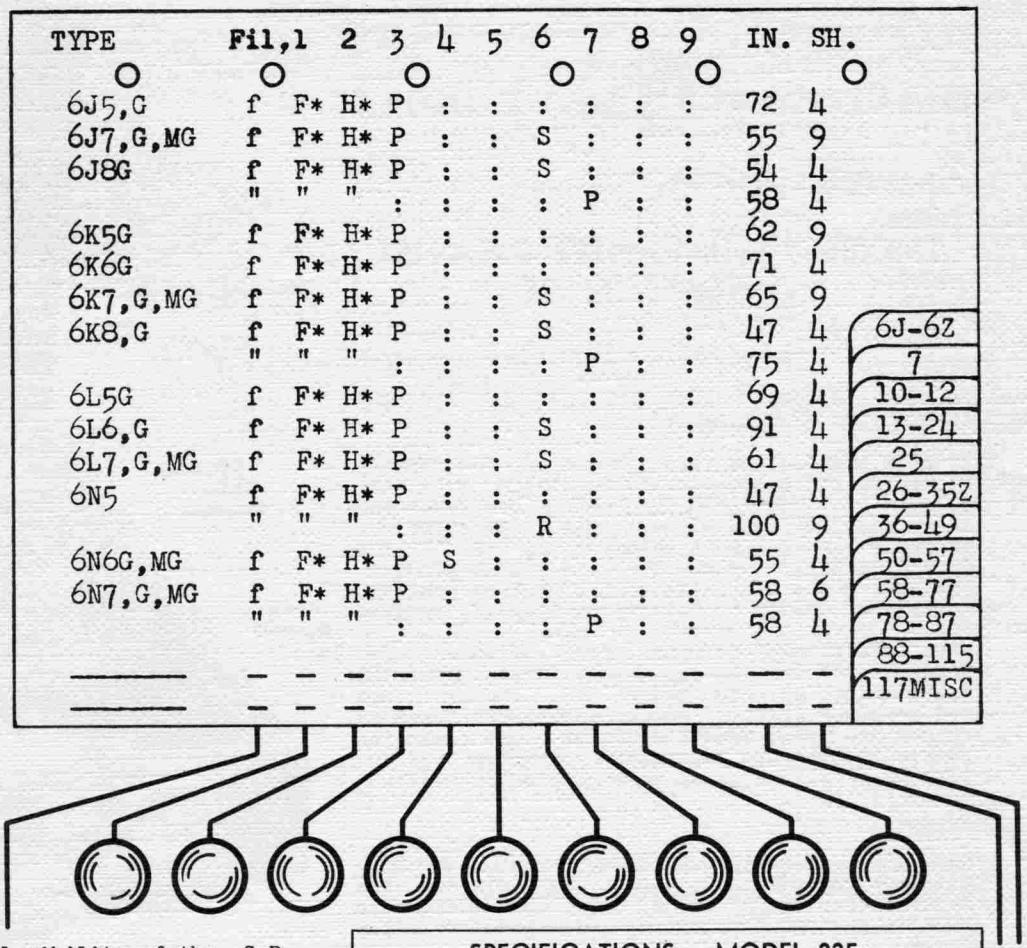
THE RECARD SYSTEM

All tube settings and data are indexed on the exclusive RECARD system. This loose-leaf card system is arranged conveniently on the panel and all data is keyed to the panel controls in such a way that mistakes and confusion are avoided.

No need to thumb off yards of roll chart if a customer brings in a complete set of tubes for test!

New data can be added as needed without disassembling the tester!

Whenever sufficient new types have appeared to make a re-codification seem desirable, we will issue complete new cards for our Model 225's in the field and you can install them in a minute.



SHORT TESTING

Because of the marvelous flexibility of the C-B Roving Switch, the tube data cards have no such notations and specials as "shows short on 20" or its equivalent, to be explained to a skeptical or confused customer.

Such exceptions on a tube chart indicate that the designer simply did not have the necessary switching facilities to clear all circuits properly. The Roving Switch eliminates this.

ADDITIONAL REVENUE FOR YOUR SHOP FROM BATTERIES.

With the Model 225 you can profitably make tests under load of the batteries in your customer's portable set at the same time you test his tubes.

You will not only add to your store or shop profits, but make a satisfied customer as well by preventing his disappointment far from a source of new batteries.

The battery test reads on a Good-Replace scale in plain English for all standard types of batteries used in portable radios.

COMBINATION MODELS

Believing it unsound for the service-engineer to tie up his investment in a tube tester and a meter tester, we offer no combination Model.

The saving in cost gained by combining the meter and cases of two instruments is small and is easily lost should mishap befall either the meter or tube tester, necessitating return to the factory.

-0-0-0-0-0-

SPECIAL NOTE
THE RECARD SYSTEM HAS BEEN REVISED AND REPRINTED TO INCLUDE ALL TUBES COMMERCIALLY ISSUED TO DATE.(1-41) THIS AND LATER EDITIONS FREE TO OWNERS LESS THAN 1 YR.50¢OVER 1 YR

SPECIFICATIONS — MODEL 225

LINE POWER:STANDARD MODEL FOR 100-130 V. 50-60~

LINE POWER:STANDARD MODEL FOR 100-130 V. 50-60~ 200-260 V. AND 25~ MODELS AVAILABLE ON ORDER. LINE ADJUSTMENT IS BY 11 POINT SWITCH ON TAPPED TRANSFORMER.

TUBE BASES:ALL STANDARD AMERICAN 4,5,6,7,(LARGE & SMALL COMBINATION)OCTAL AND LOCTAL,6&7 PRONG MIDGET. TWO SPARE SOCKET POSITIONS AND RECEPTACLE FOR DIAL LAMPS.

FILAMENT VOLTAGES:23 POINT FILAMENT SWITCH PROVIDES 1.5--2.0--2.5--3.3--5.0 6.3--7.5--12--14--25--30--35--45--50--60--70--85& 117. ANY NEW FILAMENT VOLTAGE RELEASES SUBSEQUENT TO THIS CATALOG PRINTING WILL BE ADDED PRIOR TO SHIPMENT FROM FACTORY.

SHORT TEST:STANDARD RMA WITH REJECTION AT .25 MEG OHM. EACH ELEMENT INDIVIDUALLY TESTED WITH CATHODE HOT.

METER AND SCALE:3" SQUARE CASE METER WITH THREE COLOR SCALE,500 MICROAMPERE SENSITIVITY WITH BRIDGE TYPE SHUNT GIVING ESSENTIALLY LOGARITHMIC DISTRIBUTION OF THE INDEX CONTROL AND EQUAL FACILITY OF SETTING AT ALL POINTS.

BATTERY TEST:TEST SWITCH POSITIONS FOR ALL STANDARD 1.5--6.0--45--90 VOLT BATTERIES UNDER LOADED CONDITIONS. ACCEPTS OR REJECTS ON ENGLISH READING (GOOD/REPLACE) SCALE ON METER.

CASE AND PANEL:OVERALL SIZE WITH LID CLOSED 11"X 12½"X5½".LID REMOVABLE WITH SEPARABLE HINGES WHEN COUNTER OPERATION IS DESIRED. PANEL, BLACK AND NICKEL. CASE, BLACK WRINKLE.NET WEIGHT 16 POUNDS.

ACCESSORIES:(SUPPLIED)71-A RECTIFIER TUBE AND C-B UNBREAKABLE TEST PRODS FOR BATTERIES.

MODEL	CODE	PRICE
225 TUBE TESTER, 115 V.50-60~	BANKO	$47.50
" " " 230 V.50-60~	BENDA	$52.50
" " " 115 V.25-40~	BEARD	$52.50

SHIPPING WEIGHT,22LB-PACKED FOR EXPORT,27LB-12¾KG

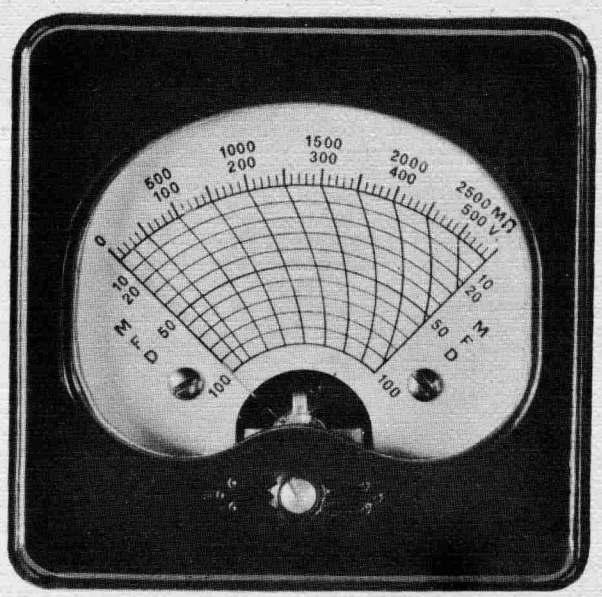
PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE CO.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 230 CAPACITY-RESISTANCE BRIDGE

HAS SELF COMPUTING LEAKAGE PER MICROFARAD SCALE



THE MODEL 230 CAPACITY-RESISTANCE BRIDGE supercedes the Model 130 and can be responsible for the quality and accuracy of three-fourths of the components used in electronic work, as well as for motor starting capacitors, wiring and winding insulation etc., in the industrial field.

Capacity Range Extended.---2 MMF. to 200 MF. The Model 230 range has been extended to 200 MF. by doubling the size of standards while retaining the essential accuracy of the slide-wire ratio arm construction of the older model. At the same time stray admittances have been reduced so the No.230 will be found useful down to 2 micro microfarads, permitting determinations on small trimmers, wiring and switch capacitance.

Electrolytic Condensers Polarized During "C" Test. A full-wave rectifier circuit supplies d-c continuously adjustable up to 550 V. read directly on the panel meter. This may be applied to the condenser while measuring its capacity and power factor, saving testing time, as well as maintaining the conditions of actual use.

Likewise this voltage may be applied while measuring capacity of mica, paper or air condensers and shorted units will be indicated by the meter without making special connections or switching.

New Circuit Measures Leakage Current with Complete Meter Safety. It is the consensus of opinion of manufacturers and large users that electrolytic condensers be accepted or rejected on the basis of measured leakage-current per microfarad of capacity. For example, Specification RE 13A 549A of the U.S. Navy stipulates the following maximum values for their use:-

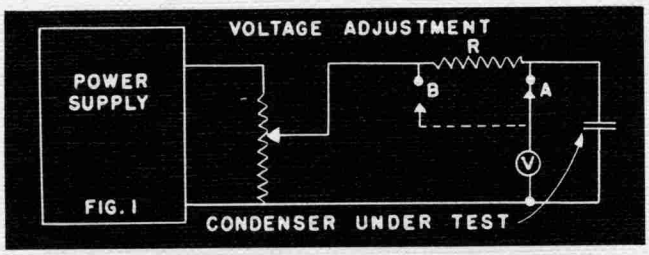
Rated D-C Voltage	Maximum Leakage per Microfarad.
25	10 microamperes.
50	15 "
100	25 "
150	30 "
200	40 "
250	50 "
300	60 "
350	70 "
400	80 "
450	90 "
500	100 "

Ordinarily, this test requires the insertion of a sensitive current meter in the high-voltage circuit, practical in production test-sets where relays for the protection of the meter can be employed, but hazardous in a portable tester, even though several milliammeter ranges are provided because of the possibility of a condenser shorting during test and burning out the meter. This possibility has been completely eliminated, while a true current test has been retained by use of a simple principle shown in the diagram:-

With the voltmeter at "A" the applied voltage is increased with the potentiometer until the meter indicates the rated voltage of the condenser under test. After the condenser is formed, the meter is switched to "B" and the meter reading will, of course, increase by the IR drop through resistor "R" caused by the leakage current.

Obviously, no danger can befall the meter in such a circuit even though the tested condenser is completely shorted for the meter indication will then simply fall to a low value and the power-pack and resistor are designed, of course, to carry the excessive current.

New Meter Scale Eliminates Leakage Computations. In the circuit, as described, the leakage current could be arrived at, of course, from the rise in voltmeter reading when the switch is thrown and the value of the resistance "R". This leakage current divided by the capacity of the unit would then be the basis for acceptance. A unique meter



scale(see illustration)is used to eliminate both of these computations.

The annular arcs concentric with the movement of the pointer are designated 0-100 mfd. These arcs are intersected by curved lines which are extensions of the voltmeter scale,shaped with consideration for the circuit characteristics and the stated Navy tolerances on leakage. Thus there is such an intersection for every value of capacity and voltage rating from 0-100 mfd.and 0-550 volts.

In application,one simply adjusts the voltage as read on the upper scale of the meter to the rating of the condenser then turns the switch and notes if the meter deflects beyond the intersection corresponding to the rated voltage and capacity. If not,the condenser is suitable for use.

Obviously,the diagram shows the circuit in its simplest principles and does not include compensation for meter loading and other features that assure perfect practical use.

Direct Reading Insulation Resistance,0-2500 Meg. Due to the high range,this may be used for testing insulation of switches,bushings and wiring as well as that of paper and mica condensers. Like the leakage current test,this test may be made with the same setting of the bridge used to determine capacity and power factor.

The voltmeter-ammeter method is used rendered portable by substitution of an electron-eye tube for the usual galvanometer arranged so the pattern just opens on 1/5 microampere. The voltage applied to the sample is indicated by the meter, and additional markings along its scale correspond to the quotients of the above values,making it direct reading in megohms.

In operation,the method is both simple and direct as compared to the widely used one in which the flashes of a neon lamp are to be timed and the resistance found by reference to a chart.

Turns Ratio Test,Useful Addition. Connections to the ratio arms as well as switching facilities are provided to permit determination of the ratio of unmarked transformers. This is very useful in selecting a transformer or tap thereon for precise matching work. Also step-down or step-up and the direction of winding of the secondary with respect to the primary is made immediately apparent.

Simple Dial Eliminates Confusion. Direct reading colinear scales are provided for capacity,and resistance,while the main scale is to be divided by two for turns ratio values. All values increase with clockwise pointer movement,requiring reversal of the ratio-arm connections from C to R measurements which is automatic. Pointer is transparent plastic with hand inscribed hair line. Sturdy pointer stops on the panel.

SPECIFICATION:MODEL 230 CAPACITY-RESISTANCE BRIDGE.

CAPACITY RANGE:2 MMF.TO 200 MF.IN THREE RANGES:2-2000 MMF.;.002-.2 MF.;.2-200 MF.ACCURACY 1% PLUS INCREMENT CORRESPONDING TO 2 DEG. ON DIAL. SEE FACSIMILE ON THIS PAGE.

POWER FACTOR:NO ADJUSTMENT ON FIRST CAPACITY RANGE,0-.5% ON SECOND CAPACITY RANGE AND 0-50% ON THIRD CAPACITY RANGE. ACCURACY 5% OF ABOVE VALUES.

RESISTANCE:2 OHMS TO 20 MEGOHMS IN TWO RANGES: 2.0-5000 OHMS AND 5000 OHMS TO 20 MEGOHMS. ACCURACY 1% PLUS INCREMENT CORRESPONDING TO 2 DEG. ON DIAL.

TRANSFORMER TURNS RATIO:.01 TO 100. ACCURACY CORRESPONDING TO 2 DEGREES ON DIAL. RATIO INDICATIONS CLEARLY CODED TO BINDING POSTS SO STEP-UP OR STEP-DOWN CAN BE DETERMINED.

INSULATION RESISTANCE:0-2500 MEGOHMS. ACCURACY 10% PLUS 50 MEGOHMS. VOLTMETER-AMMETER METHOD INDICATING ON METER AND ELECTRON-EYE.

ELECTROLYTIC LEAKAGE TEST:ON "LEAKAGE-PER-MFD." SCALE DIRECT READING, REJECTION BASED ON U.S. NAVY TOLERANCES.

ACCESSORIES SUPPLIED:TYPE 80 POWER RECTIFIER AND 6E5 ELECTRON-EYE INDICATOR TUBE.COMPLETE OPERATING INSTRUCTIONS AND CIRCUIT DIAGRAM IN LID.

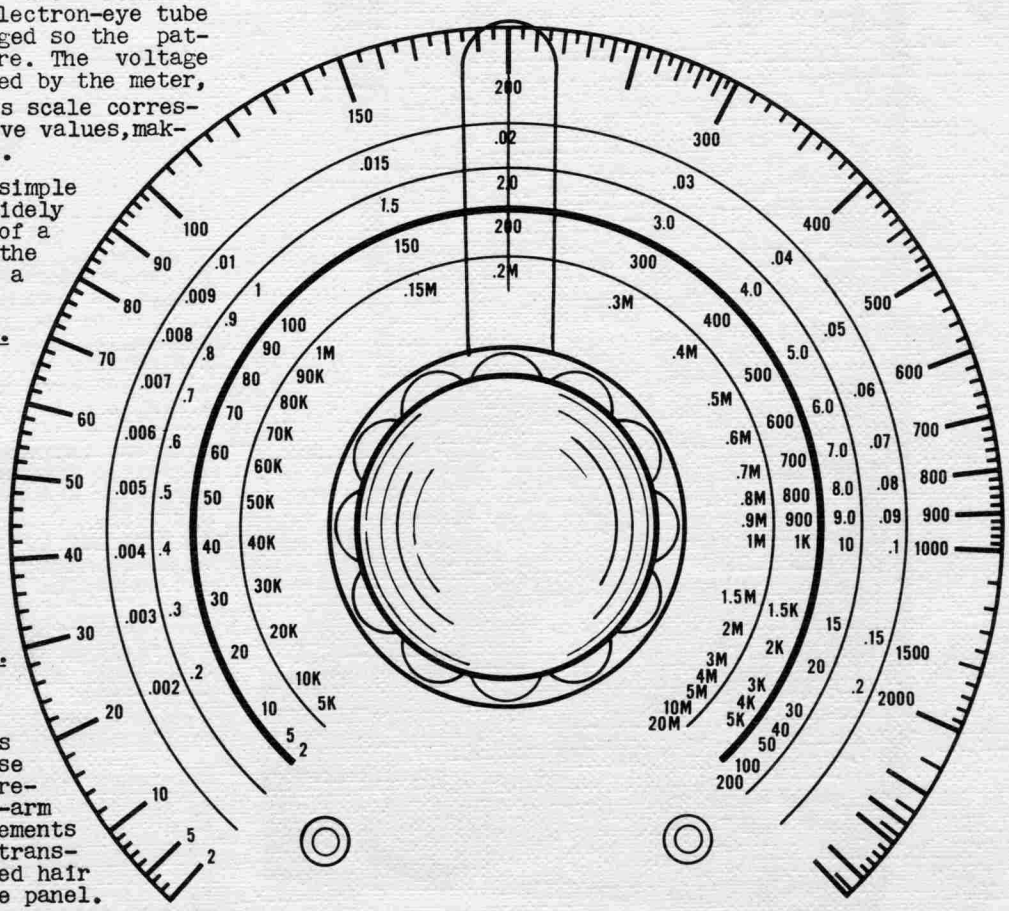
CASE AND FINISH:WELDED STEEL CASE AND LID WITH SLIP HINGES,BOTH FINISHED IN BLACK WRINKLE PANEL IN NICKEL AND BLACK. SIZE WITH LID CLOSED 10"X 8½"X7".NET WEIGHT 12 LB.

MODEL NO.		CODE	PRICE
230 A-C BRIDGE,	115 VOLT 50-60~	CATSO	$42.50
	230 VOLT 50-60~	CAUKY	$46.00
	115 VOLT 25-40~	CANDE	$47.50

SHIPPING WEIGHT,18 LB-PACKED FOR EXPORT,22LB-10.9 KG

MADE BY AN INSTRUMENT MANUFACTURER

Facsimile of Dial Calibration



PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

METERS & LABORATORY ACCESSORIES

MODEL 185-B & 220 UNIMETERS

MODEL 220 UNIMETER

is a well designed multi-range meter covering not only the more common industrial uses, but the higher voltages employed in cathode-ray tube applications such as television, as well. The latter extend to 10,000 volts. SAFETY is therefor paramount in design of both meter and accessories.

FOOL-PROOF HIGH VOLTAGE CONNECTIONS.
Special jumbo test prod with finger guard and HV serrations fits only special terminals on meter. Prevents attachment of ordinary low-voltage test prods. Extra long grooved Polystyrene post supports protect meter and eliminate leakage error.

20,000 OHMS-PER-VOLT ON D-C RANGES:
High sensitivity for testing AVC and resistance coupled circuits. Especially important for testing c-r bleeder circuits where total drain is commonly less than 1 ma.

7000 OHMS-PER-VOLT ON A-C RANGES.
C-R and television transformers are wound with small wire and high meter resistance is necessary for accurate testing and to avoid damage.

A-C RANGES TEMPERATURE COMPENSATED.
The most common shortcoming of copper-oxide rectifiers is the effect of temperature on calibration, usually exaggerated when attempting high a-c sensitivity. Thorough studies of this made possible a remarkably low temperature coefficient --1%/deg.C.or 1% for 18 degree F.total change.

SPECIAL CIRCUIT PERMITS CO-LINEAR A-C SCALES.
It is well known that the impedance external to a copper-oxide rectifier affects the calibration curve of the finished instrument. This accounts for the greater "cramping" of the low than of the high voltage scales near the zero end. This is ordinarily dealt with by providing two or more scales for the a-c ranges, or employing a single scale which is "mid-range" for the several a-c ranges but not the actual calibration of any one of them.

The 220 embodies L-type multipliers which present a constant impedance to the rectifier. All a-c ranges are thus accommodated on a single scale are, without any sacrifice of accuracy.

CONTACT RESISTANCE ERROR ELIMINATED.
The shunting circuit for the d-c current and resistance ranges is of the Ayrton-Mather ring type,eliminating all effects of contact resistance in the switches. The 5 & 20 ampere current connections are brought to separate bindingposts on the panel.

UNIQUE SWITCHING ARRANGEMENT PROTECTS METER.
With the exception of the high voltage and currents mentioned,all circuits are controlled by two switches (see illustration on next page) one of which selects the functions (volts,ma.,resistance etc.) while the other selects the range. This eliminates the usual complication of toggle switches and pin jacks and clarifies the ranges so that possibility of meter damage due to missetting of switches is reduced to a minimum.

By always setting the range switch at the highest value,at the extreme right, and progressing to the lower range values an unknown current or voltage may be swiftly brought well up-scale with complete safety to the moving coil meter.

A third control provides a single zero-setting for all the resistance ranges and the accuracy of these ranges is unaffected by the condition of the batteries.

RANGES:
DC VOLTS:0-5-20-100-500-1000-5000-10000 @20000 OHMS/V
AC VOLTS:0-3½-7-35-140-700-3500-7000 @7000 OHMS/VOLT
OUTPUT:SAME AS AC RANGES, WITH INSULATING CONDENSER.
DECIBELS:-16 TO +52 IN 7 RANGES.6MW.500 OHM REFERENCE
DIRECT CURRENT:0-50-500 MICROAMP.0-5-50-500 MILLIAMP.
0-5-20 AMP.
RESISTANCE:0-3000-30,000-OHMS.0-3- 30 MEGOHMS.
27- 270-OHMS. .027-.27 CENTER SCALE.

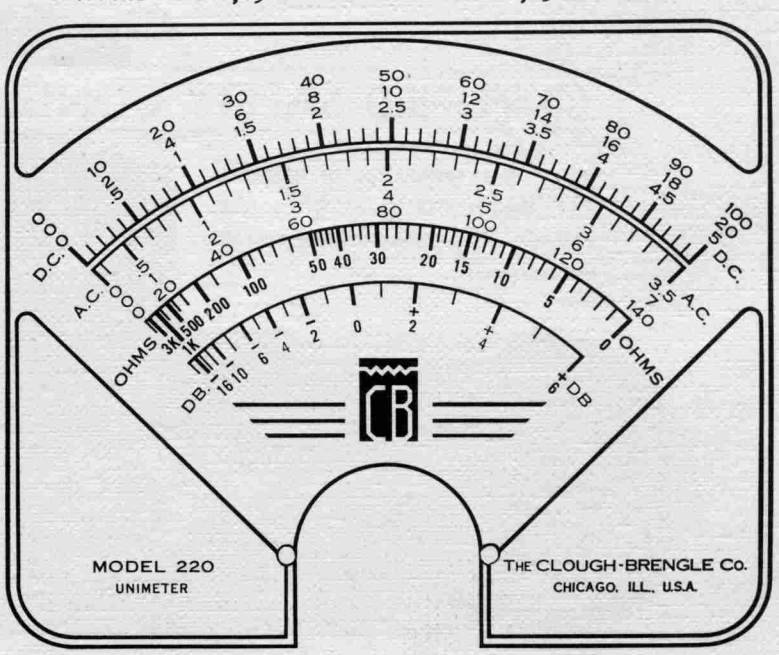
ACCURACY:ON DC RANGES-2% OF FULL SCALE VALUE.4% ON AC

ACCESSORIES:H-V TEST PROD, LINK AND C-B UNBREAKABLE TEST PRODS SUPPLIED.COMPLETE INSTRUCTIONS AND CIRCUIT IN COVER. REQUIRES TWO 7½V.C-BATTERIES.

CASE AND FINISH:WELDED STEEL CASE WITH COVER AND SNAP CATCHES. FINISH, BLACK WRINKLE. SIZE WITH COVER, 9½"X10"X5". NET WEIGHT 10 POUNDS.

MODEL NO.	CODE	PRICE
220 UNIMETER,COMPLETE LESS BATTERIES.	CATEX	$59.50

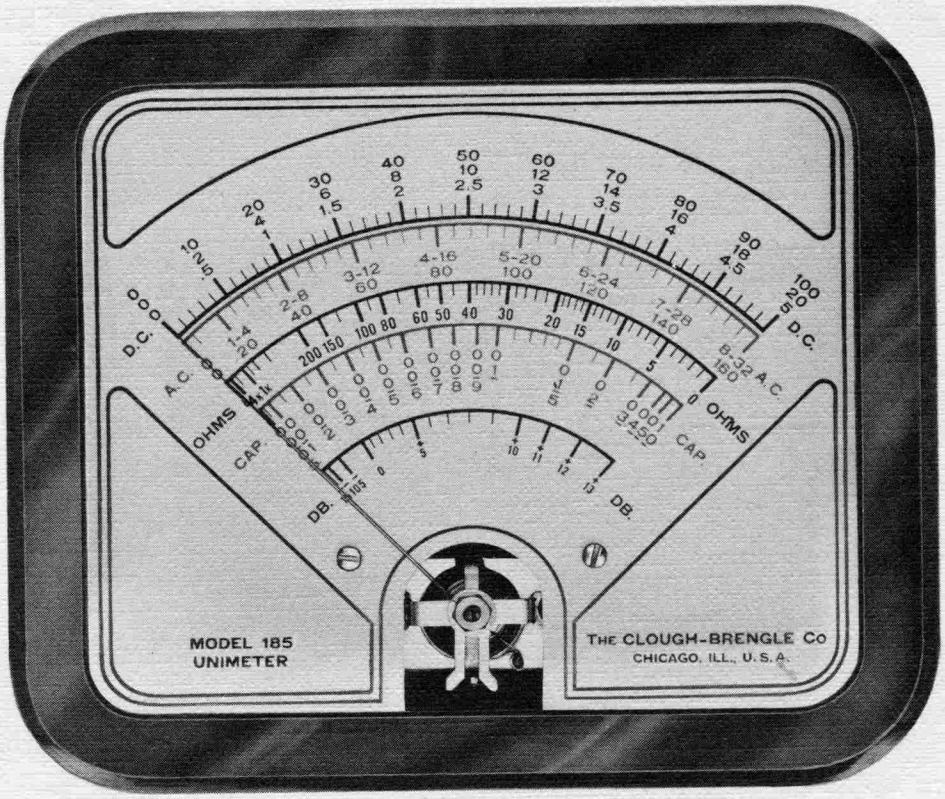
SHIPPING WEIGHT,15 LB-PACKED FOR EXPORT,19 LB--8.6 KG



MODEL 185-B UNIMETER

is an all-around utility instrument of the best quality and accuracy for those not requiring the extreme sensitivity and high voltage ranges of the Model 220. Inclusion of capacity ranges will cause the Model 185-B to be preferred by many.

Case and meter size, pocket for accessories and tools, finish and all are the same as for the Model 220 illustrated on the other side. The scale, actually printed in black and green is shown at the right.



SPECIFICATION: MODEL 185-B UNIMETER.

RANGES:
DC VOLTS: 0-5-20-100-500-1000
ALL AT 2000 OHMS/VOLT.
AC VOLTS: 0-8-32-160-800-1600
ALL AT 1250 OHMS/VOLT.
OUTPUT: SAME AS A-C RANGES ABOVE WITH INSULATING CONDENSER.
DECIBELS: -15 TO +59 DB. 6 MILLIWATT 500 OHM REFERENCE LEVEL.
DIRECT CURRENT: 0-5-10-100 MILLIAMPERE 0-5-20 AMPERES.
RESISTANCE: 0-4,000-40,000 OHMS AND 4 MEGOHMS. CENTER-SCALE VALUES 40-400 AND 40,000 OHMS RESPECTIVELY, WITH SELF-CONTAINED BATTERY. 0-20 MEGOHMS WITH EXTERNAL BATTERY. BINDING POSTS PROVIDED.
CAPACITY: .0005 TO .1 MFD. AND .05 TO 10 MFD. A-C LINE CORD SUPPLIED, ALSO CHART FOR INDUCTANCE READINGS ON CAPACITY SCALE.

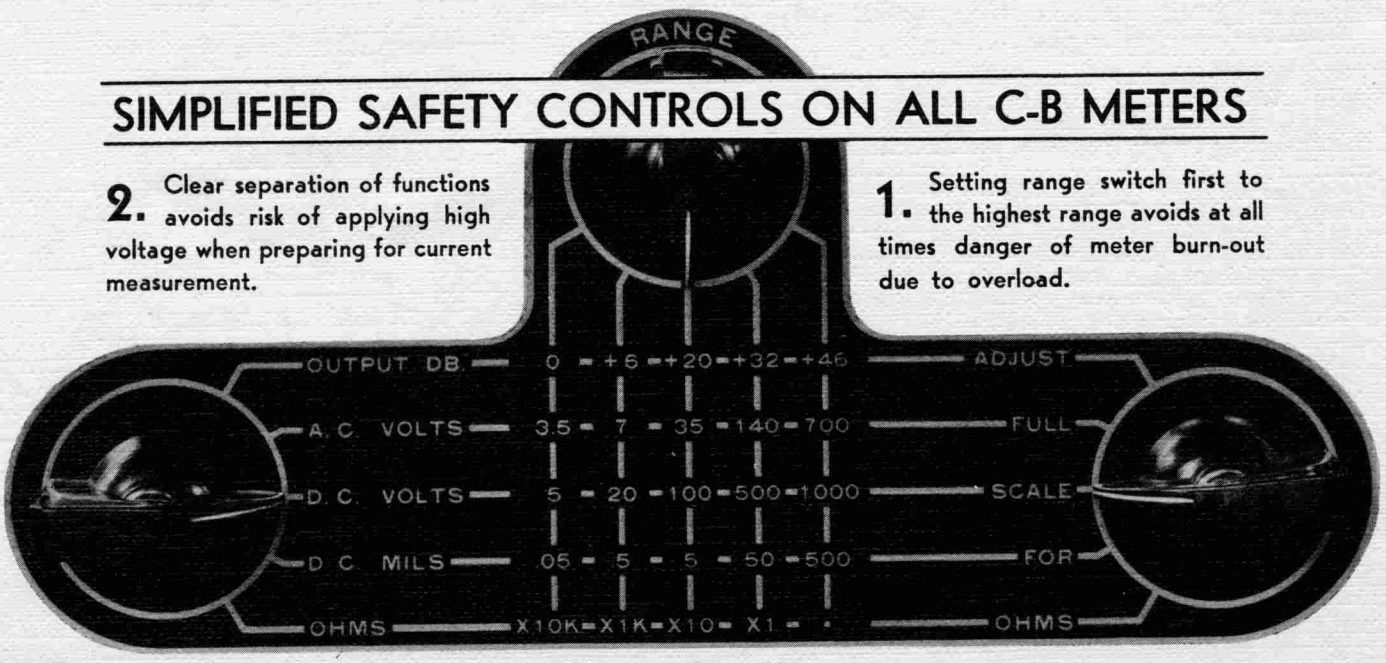
ACCURACY: ON D-C RANGES-2% OF FULL SCALE VALUE. 5% ON A-C RANGES

ACCESSORIES: FURNISHED WITH COVER AND C-B UNBREAKABLE TEST PRODS, ALLIGATOR CLIP AND LINE CORD. COMPLETE INSTRUCTIONS AND CIRCUIT POSTED IN COVER. REQUIRES 22½V. C-BATTERY, NOT SUPPLIED.

CASE AND FINISH: WELDED STEEL CASE WITH COVER AND SNAP CATCHES. FINISH, BLACK WRINKLE. SIZE WITH COVER, 9¼"X10"X5". NET WEIGHT 10 POUNDS.

MODEL NO.	CODE	PRICE
185-B UNIMETER. 115V. 50-60~, LESS BATTERY	CANAB	$29.50
" " 230V. 50-60~, " "	CARAB	$33.00
" " 115V. 25-40~, " "	CARUB	$34.50

SHIPPING WEIGHT, 13 LB-PACKED FOR EXPORT, 17 LB.-7.7 KG



SIMPLIFIED SAFETY CONTROLS ON ALL C-B METERS

2. Clear separation of functions avoids risk of applying high voltage when preparing for current measurement.

1. Setting range switch first to the highest range avoids at all times danger of meter burn-out due to overload.

PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 126-A CATHODE-RAY OSCILLOGRAPH & ACCESSORIES

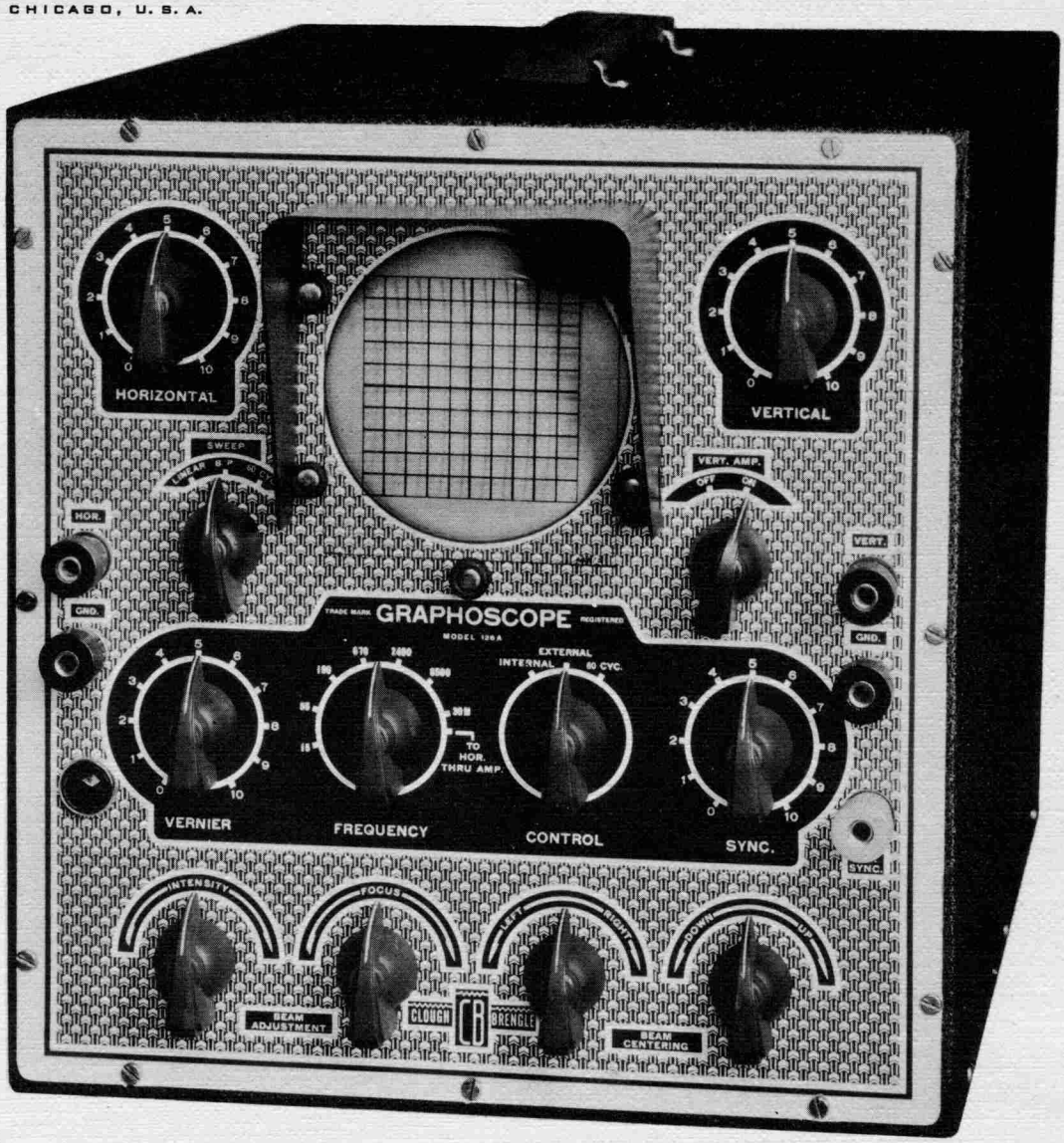
THE MODEL 126-A CATHODE - RAY OSCILLOGRAPH

is the latest refinement of our justly popular 126 Graphoscope, hundreds of which are in daily use in service shops as well as for a variety of industrial uses and problems.

In our six year's experience in the manufacture of cathode-ray equipment we have naturally had the opportunity to perfect designs and aid our customers in applying this versatile tool to a wide variety of problems in the field. The fruits of this experience are embodied in the Model 126-A and in the numerous brochures & pamphlets we have prepared around cathode-ray equipment.

The 126-A is unique in being the most portable and compact unit of its kind on the market, yet through painstaking design, all evidence of AC ripple from the field of the AC power transformer, necessarily in close proximity to the cathode-ray tube, has been eliminated.

All controls are on the front panel, making it unnecessary to reach to the side or the rear of the case for any of the many circuit and condition adjustments made possible by this flexible design.



The general electrical design is characterized by high deflection sensitivity and impedence, return trace eliminator, unusually wide sweep-range and excellent linearity of sweep.

SPECIAL MODIFICATIONS

Screens: The Model 126-A is regularly fitted with the 906-P1 tube, having a greenish, medium persistence screen suitable for daylight viewing and photography of moderately high-speed traces.

A whitish trace suitable for television studies is produced by the screen material of the No.906 P4 tube, which can be supplied on order.

Photography of high speed traces is better accomplished with the No.908 tube, having a bluish trace of short persistence. Daylight viewing of this trace is, in general, poorer with this tube than with the No.906-P1, however.

Simultaneous viewing of several traces, is possible with the No.910 tube. The long persistence screen will hold a pattern for several seconds in a darkened room making it possible to change connections between the vertical amplifier of the 126-A and various points of the circuit under test with a small rotary switch, manually, with sufficient rapidaty, so the various traces can be viewed and compared with one another.

For extremely low frequency studies, such as arise in the welding field, the Model 126-L is available on special order. The low sweep speed is three per second and both vertical and horizontal amplifiers are accordingly designed to handle these low frequencies.

The speed of small motors at no load is readily determined with the Model 126-A in conjunction with a Model 79-D Beat-Frequency Oscillator. The method is particularly valuable for tiny motors of the series type, where even the slight load imposed by a mechanical tachometer would cause misleading results. A brochure covering the method is available on request.

-0-0-0-0-0-0-

Our Engineering Department will be glad to send brochures on applications of the Model 126-A to specific problems or assist in its application to new problems.

SPECIFICATION: MODEL 126-A GRAPHOSCOPE.

SENSITIVITY: TO VERTICAL PLATES THROUGH AMPLIFIER, .30 RMS VOLTS PER INCH. TO HORIZONTAL PLATES THROUGH AMPLIFIER, 6.2 RMS VOLTS PER INCH. TO VERTICAL PLATES WITHOUT AMPLIFIER, 22 RMS VOLTS PER INCH. TO HORIZONTAL WITHOUT AMPLIFIER, 18 VOLTS PER INCH.

INPUT IMPEDANCE: TO VERTICAL AMPLIFIER - 1 MEGOHM IN PARALLEL WITH 34 MMF. HORIZONTAL, 10 MEGOHMS IN PARALLEL WITH 37 MMF.-DIRECT TO PLATES, 5 MEGOHMS AND 34 MMF TO VERTICAL, 2½ MEGOHMS AND 59 MMF. TO HORIZONTAL.

SWEEP CIRCUIT: EQUIPPED WITH LINEARIZING AMPLIFIER AND RETURN TRACE ELIMINATOR. FACILITIES PROVIDED FOR SYNCHRONIZATION FROM EITHER EXTERNAL SOURCE OR FROM THE VERTICAL CIRCUIT, INTERNALLY. SWEEP RATES FROM 15 TO 30,000 PER SECOND ADJUSTABLE BY 7 POINT SWITCH AND INTERPOLATING VERNIER.

AMPLIFIERS: FLAT AS TO FREQUENCY CHARACTERISTIC UP TO 10 KC. AND DROPPING 1 DB. PER 10 KC. THEREAFTER UP TO 100 KC.

CONTROLS: ALL ON FRONT PANEL. INTENSITY AND FOCUS-BEAM CENTERING, LEFT-RIGHT AND UP-DOWN, -VERTICAL AMPLIFIER ON-OFF SWITCH, -HORIZONTAL PLATES TO LINEAR SWEEP, INTERNAL 60~SWEEP, OR TO BINDING POSTS FOR CONNECTION TO EXTERNAL SOURCE, WITH OR WITHOUT AMPLIFICATION-HORIZONTAL AND VERTICAL GAIN CONTROLS.

ACCESSORIES: REMOVABLE LIGHT SHIELD AND UNIFORM-RULED SCREEN SUPPLIED.

TUBES (SUPPLIED): 906/P1 CATHODE-RAY TUBE, 884 LINEAR SWEEP OSCILLATOR, 42 HORIZONTAL AMPLIFIER, 6C6 VERTICAL AMPLIFIER AND TWO 80 RECTIFIERS.

CASE AND FINISH: WELDED STEEL FINISHED IN BLACK WRINKLE, 9½"X9"X14". PANEL IN NICKEL AND BLACK. NET WEIGHT 19 POUNDS.

MODEL NO.	CODE	PRICE
126-A GRAPHOSCOPE, 115V.50-60~	CADET	$69.50
" " 230V.50-60~	CAUSE	$73.00
" " 115V.25-40~	CABAL	$76.50
126-L GRAPHOSCOPE, 115V.50-60~	LATED	$95.00
FOR 906/P4 TUBE, ON EITHER MODEL ADD		$3.75
FOR 908 TUBE, " " " "		$8.50
FOR 910 TUBE, " " " "		$11.75

SHIPPING WEIGHT, 23 LB-PACKED FOR EXPORT, 28 LB-12.7 KG

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH [CB] BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 79-D BEAT FREQUENCY AUDIO OSCILLATOR

AN INEXPENSIVE A-F SOURCE OF UNUSUALLY WIDE APPLICATION

The many uses for a widely and continuously variable source of audio frequency power are well known, but have not had wide usage until the introduction of the Model 79-D Beat Frequency Audio Oscillator which permits the acquasition of a truly fine source at a cost within the average budget. A few of such sources are:

Loud Speaker and Headphone testing
Sound amplifier and sound system testing
Design and testing of hearing aids
Fidelity testing on radio receiver
Frequency and pitch determinations
Psychological determinations and experiments
Theater amplifier testing without standard film
Electrolytic conductivity determinations
Finding speed of small motors without load.

Over a period of years, our Models 79-A,B, and C have been superceded in turn, each representing constant improvement over its predecessor. The present Model 79-D has been on the market for sometime and represents the culmination of years of development and field service.

The Model 79-D differs from our more costly A.F. generator only in frequency stability, power output, distortion and convenience features. Though modestly priced, it is not to be confused in any way with the many low priced products on the market which, when analysed, are simply beat-frequency "howlers".

Many of the 79-D design features have been taken from our higher priced generators. Its excellence is indicated by the large number used by universities, colleges and the Government.

DESCRIPTION.
The Model 79-D produces a sine-wave output, continuously variable from 25 to 15,000 cycles-per-second. This is produced by beating a fixed 250 KC oscillator with another, variable in frequency from 250 KC to 235 KC, in a modulator to produce an audio frequency beat. This is filtered and amplified to assure a suitable output for all usual applications of an audio generator.

CALIBRATION
The frequency of the variable oscillator dial is controlled by the main panel dial, calibrated directly in audio frequency, 25 to 15,000 cycles-per second. This dial has a length of 8.6"(22 cm) and is equipped with our Verni-Vider which permits close reading of frequency throughout the range.

For the convenience of users in certain fields the octaves of physical pitch are also shown.

ZERO ADJUSTMENT
So the calibration of any beat-frequency oscillator will hold, a preadjustment of the two radio frequency oscillators to zero beat is necessary.

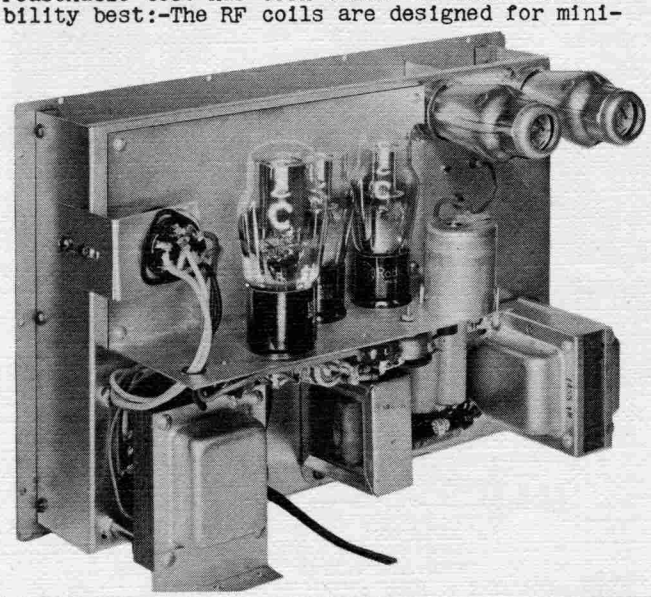
A panel control is provided to permit a slight adjustment of the frequency of the variable oscillator to bring it to zero beat with the fixed oscillator, and the beating is observed, while making the adjustment, in an electron-ray tube (6E5) The 6E5 is connected into the output of the modulator tube so the lowest possible pulsing can be observed, while adjusting to zero beat.

DE-COUPLING OF THE RADIO FREQUENCY OSCILLATORS
In order to have a sharp zero beat as well as eliminate distortion at the low frequencies, all coupling between the FR oscillators must be eliminated so there will be no tendency for them to "suck" into step as zero beat is approached. This is accomplished by complete shielding of the two plus electrical isolation and finally feeding to the modulator tube through a balanced bridge circuit. This circuit is individually balanced in each 79-D so stable beats can be maintained down to a very few beats-per-second.

OUTPUT CONTROL
appears on the panel and regulates the AF voltage applied to the grid of the amplifier tube from the modulator. Output can be controlled from zero to 120 milliwatts, although output pads are suggested for problems calling for small amounts of voltage or power, for convenient adjustment and elimination of interference. Full details are given in the instructions.

WAVE-FORM AND DISTORTION
In order to provide good wave form, three other principles, beside decoupling the RF oscillators, must be, and are, observed in the 79-D design. The modulator is operated on a section of its curve which is essentially square-law, all tubes operate below their maximum ratings and one of the RF oscillators is thoroughly filtered to eliminate harmonics.

STABILITY
Every permissable precaution, in an instrument of reasonable cost has been taken to make the stability best:-The RF coils are designed for minimum change with temperature and are constructed alike so that any temperature variation will affect both circuits equally. Tank condensers are silvered mica having low temperature coefficient The chassis construction is unconventional, being mounted in a vertical plane to form an enclosure for the oscillating circuits and barrier against heat from the power transformer and tubes. These are mounted on a shelf with a Celotex barrier between shelf and barrier and all heat is vented through openings in the rear portion of the case. No specific guarantee can be placed on the stability, as on our higher priced audio generator, but we can assure purchasers that after a thirty minute warming in an evenly heated room, it will not be sufficient to be disturbing for any but the most precise work.



SPECIFICATION: MODEL 79-D BEAT FREQUENCY OSCILLATOR.

FREQUENCY RANGE: 25 CYCLES TO 15,000 CYCLES PER SECOND. LOWER FREQUENCIES CAN BE SET AND MAINTAINED WHEN DISTORTION CAN BE TOLERATED.

FREQUENCY CALIBRATION: DIRECT ON PANEL WITH VERNI-VIDER DIAL. OCTAVES OF PHYSICAL PITCH SCALE ALSO SHOWN ON LOWER HALF OF DIAL. READABILITY OF DIAL IS -

FROM-TO	DIVISIONS SPACED	VERNI-VIDER READS TO
25-100 C.	25 CYCLES	5 CYCLES
100-1000	50 "	10 "
1000-2000	100 "	20 "
2000-15000	250 "	50 "

ACCURACY IS MAINTAINED TO THE SMALLEST READABLE VERNI VIDER DIVISION BELOW 1000 CYCLES-PER-SECOND AND TO 2% OF FREQUENCY ABOVE 1000 CPS.

MAIN DIAL IS DRIVEN BY 10:1 GEAR TRAIN FOR EASE OF ADJUSTMENT.

POWER OUTPUT: 120 MILLIWATTS AT THE HIGHEST SETTING OF THE OUTPUT CONTROL, CORRESPONDING TO 7.7 AND 24.5 VOLTS, ACROSS THE 500 AND 5000 OHMS OUTPUT TAPS RESPECTIVELY.

WAVE-FORM AND HUM: DISTORTION IS LESS THAN 3% AT 60 MILLIWATT OUTPUT ABOVE 50 CPS. AND LESS THAN 5% AT FULL OUTPUT OF 120 MILLIWATTS ABOVE 100 CPS. HUM IS 50 DB. BELOW THE MAXIMUM OUTPUT.

TUBES (SUPPLIED): TWO 6J5G R-F OSCILLATORS, 6J5G MODULATOR, 6J5G OUTPUT AMPLIFIER, 6E5 ZERO-BEAT INDICATOR, AND 80 RECTIFIER.

OUTPUT CURVE: ON 5000 OHM TAP OUTPUT IS FLAT TO 1/2 DB 100 TO 15,000 CPS., AND TO 1 DB. OVER ENTIRE RANGE. ON 500 OHM TAP TO 3/4 DB. 100-15,000 CPS. AND 1 DB. OVER ENTIRE RANGE.

CASE AND FINISH: PANEL IN NICKEL AND BLACK. CASE IS OF WELDED STEEL WITH VENTILATED BACK & FINISHED IN BLACK WRINKLE, SIZE 9¼"X13"X6½". NET WEIGHT 17 POUNDS.

MODEL NO.	CODE	PRICE
79-D BEAT FREQUENCY OSCILLATOR		
115V.50-60~	ALIGN	$64.50
230V.50-60~	CHECK	$68.50
115V.25-40~	CHIRP	$69.50

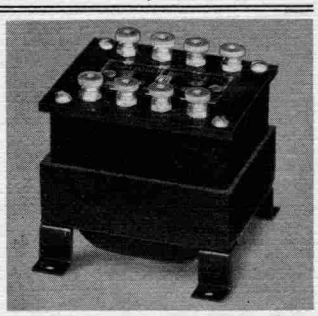
SHIPPING WEIGHT, 22 LB-PACKED FOR EXPORT, 26 LB-11.8 KG

MATCHING TRANSFORMERS FOR USE WITH THE 79-D.

When the required power is small and the input circuit of the device under test is single ended (one end grounded) impedance matching pads constructed from small radio resistors are the most convenient way of adapting either the 500 or 5000 ohm output taps of the Model 79-D to odd-valued impedances, though some loss of power is entailed by their use.

When all the power output of the Model 79-D is required or when the input of the device to be tested is push-pull (balanced to ground) one of the following transformers will be useful in bringing about the proper circuit arrangement.

All are carefully constructed with high primary inductance and low leakage reactance so their connection to the 79-D will impair the over-all output curve to the minimum possible extent.



#1184-Operates from 500 ohm tap on 79-D to single-ended leads of 1, 2, 3, 6, 8, 10 and 15 ohms. Especially useful for speaker testing.

#1201-Operates from 500 ohm tap on 79-D to single-ended loads of 1000, 2000, 3000, 6000, 8000 10000 and 15000 ohms. Recommended for driving voltage amplifiers.

#1346-Operates from 5000 ohm tap on 79-D to push pull or balanced load of 500 or 125 ohms.

#1347-Operates from 5000 ohm tap on Model 79-D to single ended loads of 500 or 200 ohms.

DESCRIPTION	CODE	PRICE
#1184 MATCHING TRANSFORMER	APEAK	$6.50
#1201 " "	APORT	$6.50
#1346 " "	APRON	$6.50
#1347 " "	APART	$6.50

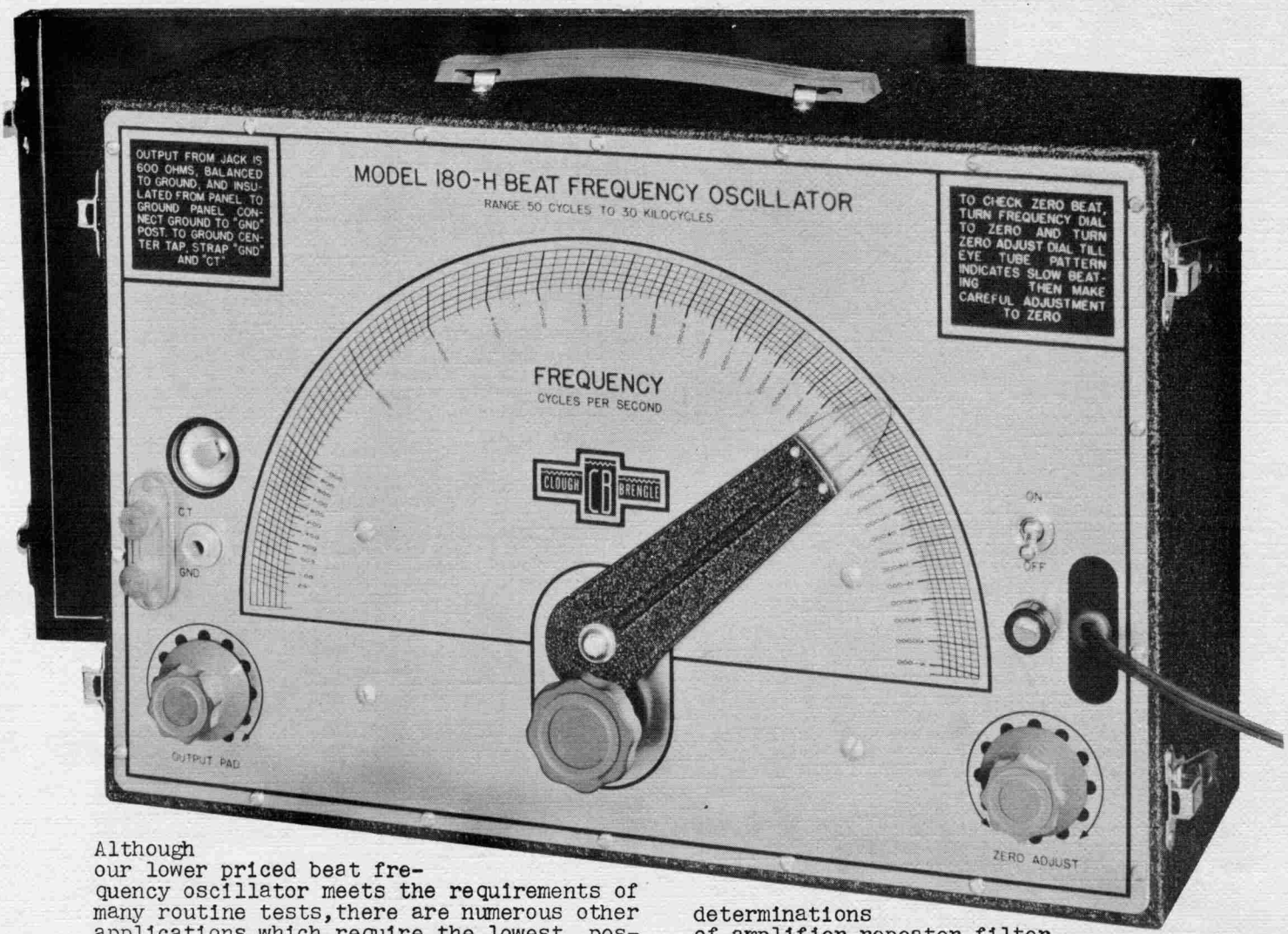
NET WEIGHT 2½ POUNDS. SHIPPING WEIGHT 3¼ POUNDS.

PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 180-H&T BEAT FREQUENCY AUDIO OSCILLATORS CHARACTERIZED BY LOW DISTORTION AND LOW NOISE LEVEL



Although our lower priced beat frequency oscillator meets the requirements of many routine tests, there are numerous other applications which require the lowest possible distortion and noise output in order to obviate confusion and secure the most reliable results. It is for these that the Models 180-H and 180-T are designed.

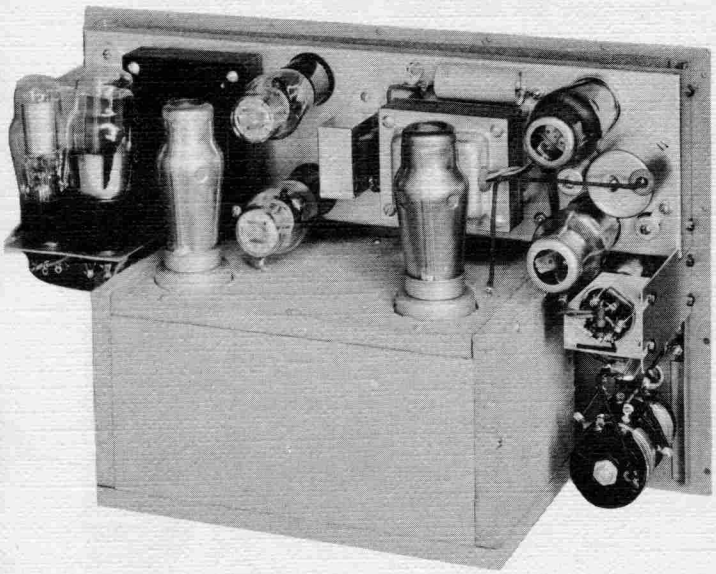
Their purity of wave-form is superior to most others and the equal of the best, with the additional advantage that the beat-note principle is retained and the entire frequency range is covered with a single sweep of the dial without hiatus or range switching! The manner of controlling the tube and circuit characteristics to accomplish this result without the use of circuit 'tricks' or degeneration is described in detail later in this bulletin.

Noise output is reduced to a minimum by the very careful filtering of the power supply and complete control of the output between the output tubes and the output terminals. Only in this way can the remaining noise components be kept at a consistently low relationship to the beat-note when testing at very low levels.

The purity of output secured through the many refinements in the Series 180 Generators permits its use in the most exacting determinations of amplifier, repeater, filter, and speaker performance without resorting to supplementary filters or tuned circuits for purification of the testing currents.

By careful mechanical design the over-all size has been kept within the limitations of portability, while room has been found for the same extensive thermal protection of the radio-frequency circuits used in our Model 133, noted for its unusual all-day stability. In addition, a voltage regulator is incorporated in the "B" supply circuit and this renders the Model 180 output practically independent of fluctuations in line voltage.

The frequency controlling condenser has a plate shape which gives excellent spread of the low frequencies, and a convenient spread through the higher frequencies, important in determinations of the cut-off frequency of reproducing systems and the performance of high frequency filters. It is mounted low on the panel permitting an unusually long and open scale on a small size panel. The main calibration is of the conventional type and the Verni-vider above it permits extremely close reading of odd-valued frequencies, if required.



DESCRIPTION

Above is a rear view of the Model 180 with the case removed. General circuit principles, the beating together of two r-f oscillators to produce the audio note and the use of the electron-eye tube for indicating zero beat, are fully described in connection with our Model 79-D and are not repeated here to permit space for outlining the features which make the Model 180 outstanding in the entire field of audio generators.

R-F Components in Thermal Compartment.
All inductors and capacities associated with the r-f oscillators are located in the lower compartment of metal, encircled by a celotex barrier for thermal isolation and removed as far as possible from heat producing parts such as the power supply and amplifier tubes which are disposed along the upper chassis where the heat is most readily dissipated.

As far as possible, the respective inductors and capacities of the fixed and variable oscillators are symetrically placed with respect to the compartment walls so that such small heat transfer as occurs will be equally felt by both oscillators. In this way, the slight drifts in each are made equal and remarkable thermal stability of the beat note results.

Careful Circuit Balance Renders Distortion Low.
While numerous circuit artifices are available for control of the wave-form of an a-f generator it was deemed best to employ tried and tested circuits throughout in the interests of uniformity of production and reliability in the field.

In the output amplifier, this calls for strictly Class A operation of triodes, in push-pull together with the best possible coupling coefficient between the two primary windings of the output transformer.

In connection with the modulator, it has been pointed out in the Model 79-D description that if the modulator is strictly square-law, that is if higher derivatives than the second vanish, the beat note will be strictly pure, or sinusoidal. In compliance, the type 37 was selected as having the best square-law characteristic for the purpose but two 37 tubes are operated back-to-back and the theory of such operation has been completely investigated for criteria by which practically perfect square-law operation can be assured in production.

Space does not permit going into the above matter in detail, but suffice it to say that the waveform of the Model 180 is the best presented to the market and that the slight trace of distortion present is practically all attributable to the output transformer, rather than to tube operation.

Other Design Features.
While most economical, control of the generator output by adjustment of the input to its amplifier tubes is not permissable in the highest type instrument. The method is satisfactory when operating the instrument at or near its maximum output but when the output is greatly reduced by this method it is found that the hum and other noise output is relatively high compared to the desired output.

For this reason, the output of the Model 180 is completely controlled by a constant impedance attenuator following the output transformer so that all undesirable components are attenuated in the same degree that the signal note is reduced, and purity is assured under all conditions.

A further operating convenience is the reduction drive on the zero-beat adjustment condenser. This together with complete decoupling of the r-f oscillators permits easy adjustment to the original calibration to within a fraction of a cycle.

SPECIFICATION: MODEL 180-H BEAT FREQUENCY OSCILLATOR.

FREQUENCY RANGE: 50 CYCLES TO 31 KILOCYCLES. (25 CYCLES CAN BE READ.)

FREQUENCY DIAL: DIRECT CALIBRATION ON PANEL WITH VERNIER DIAL. POINTER DRIVEN BY 10:1 ANTI BACKLASH GEARED DRIVE. READABILITY OF DIAL IS:-

FROM-TO	DIVISIONS EVERY	VERNI-VIDER READS TO
25-100	25 CYCLES	5 CYCLES
100-1000	50 "	10 "
1000-3000	100 "	20 "
3000-31000	250 "	50 "

ACCURACY IS MAINTAINED TO SMALLEST READABLE VERNIVIDER GRADUATION THROUGHOUT THE FREQUENCY RANGE.

POWER OUTPUT: 100 MILLIWATTS INTO 600 OHMS, CORRESPONDING TO +20 DB. WITH RESPECT TO 1 MILLI WATT.

WAVEFORM: HARMONIC OUTPUT IS LESS THAN .25% ABOVE 100 CYCLES AND AT ANY OUTPUT POWER. NOISE OUTPUT IS MORE THAN 60 DB. BELOW OUTPUT POWER AT ANY SETTING OF THE OUTPUT CONTROL.

OUTPUT CURVE: FLAT TO ± ½ DB. OVER ENTIRE RANGE OF 50-31,000 CYCLES.

OUTPUT CIRCUIT: THE #180-H OUTPUT CIRCUIT IS BALANCED WITH RESPECT TO GROUND. JACK IS PROVIDED FOR CONNECTION WITH PATCH CORD. CENTER TAP OF OUTPUT ATTENUATOR IS BROUGHT OUT TO SEPARATE BINDING-POST FOR GROUNDING, IF DESIRED.

TUBES(SUPPLIED): 2-6J5G RADIO FREQUENCY OSCILLATORS, 2-37 MODULATORS, 2-6J5G OUTPUT AMPLIFIER 1-6E5 ZERO BEAT INDICATOR, 1-80 POWER RECTIFIER AND 1 VR-150 VOLTAGE REGULATOR.

CASE AND PANEL: PANEL IN NICKEL AND BLACK. CASE, WELDED STEEL FINISHED IN BLACK WRINKLE. REMOVABLE SNAP-LOCK COVER SUPPLIED. SIZE, WITH COVER, 10"X16" X7½". WEIGHT 28 POUNDS.

SPECIFICATION: MODEL 180-A BEAT FREQUENCY OSCILLATOR. (THIS MODEL HAS THE SAME GENERAL SPECIFICATION AS THE MODEL 180-H, EXCEPT IN THE FOLLOWING PARTICULARS:-)

FREQUENCY RANGE: 25 CYCLES TO 16 KILOCYCLES.

WAVEFORM: HARMONIC CONTENT IS LESS THAN .25% OVER THE ENTIRE FREQUENCY RANGE.

OUTPUT CIRCUIT: SINGLE ENDED WITH ONE SIDE GROUNDED TO CHASSIS.

MODEL	CODE	PRICE
180-H BEAT FREQUENCY OSCILLATOR		
115 V.50-60~ POWER	AGENE	$165.00
230 V.50-60~ "	CHEGE	$167.50
115 V.25-40~ "	CHIEG	$172.00
180-A BEAT FREQUENCY OSCILLATOR		
115 V.50-60~ POWER	AGANA	$150.00
230 V.50-60~ "	CHAGA	$152.50
115 V.25-40~ "	CHANE	$156.50
MOUNTED ON 10½"X19" RELAY RACK PANEL ADD		$7.50

SHIPPING WEIGHT-34LBS. PACKED FOR EXPORT-39LBS, 17.7KG

PRINTED IN U. S. A.

PHONE LONG BEACH 5616 CABLE ADDRESS: CEBECO

THE CLOUGH BRENGLE Co.
5501 BROADWAY CHICAGO, U. S. A.

MODEL 207 TRANSMISSION MEASURING SET

FOR ALL SPECIAL AND ROUTINE MEASUREMENTS AT VOICE & CARRIER FREQUENCIES.

The Model 207 Transmission Measuring Set is designed for both field and laboratory use and all needed components for transmission testing are brought together into one simplified "package." Its circuit and physical construction have been worked out to cut testing time to the bone; at the same time laboratory accuracy has been retained in this rugged and compact assembly.

The Model 207 eliminates the usual aggregation of pads, meters (s) and other accessories usually necessary to the solution of design and maintainence problems. All necessary elements are embodied in the Model 207 with convenient switching facilities to permit all desired transmitting and receiving levels to be established and accommodated simply and easily.

Knowing that most audio and carrier measurements become 'routine' with repetition, we have employed every expedient to simplify the general operation and coordinate the meter scale with the pad values so that this work may be assigned to the less skilled with a minimum of instruction and possibility of error.

The detailed specification following shows the Model 207 to possess these salient features:-

*1. Wide Frequency Range, 50 cycles to 30 kilocycles, with negligible departure from calibration accuracy. (See curve).

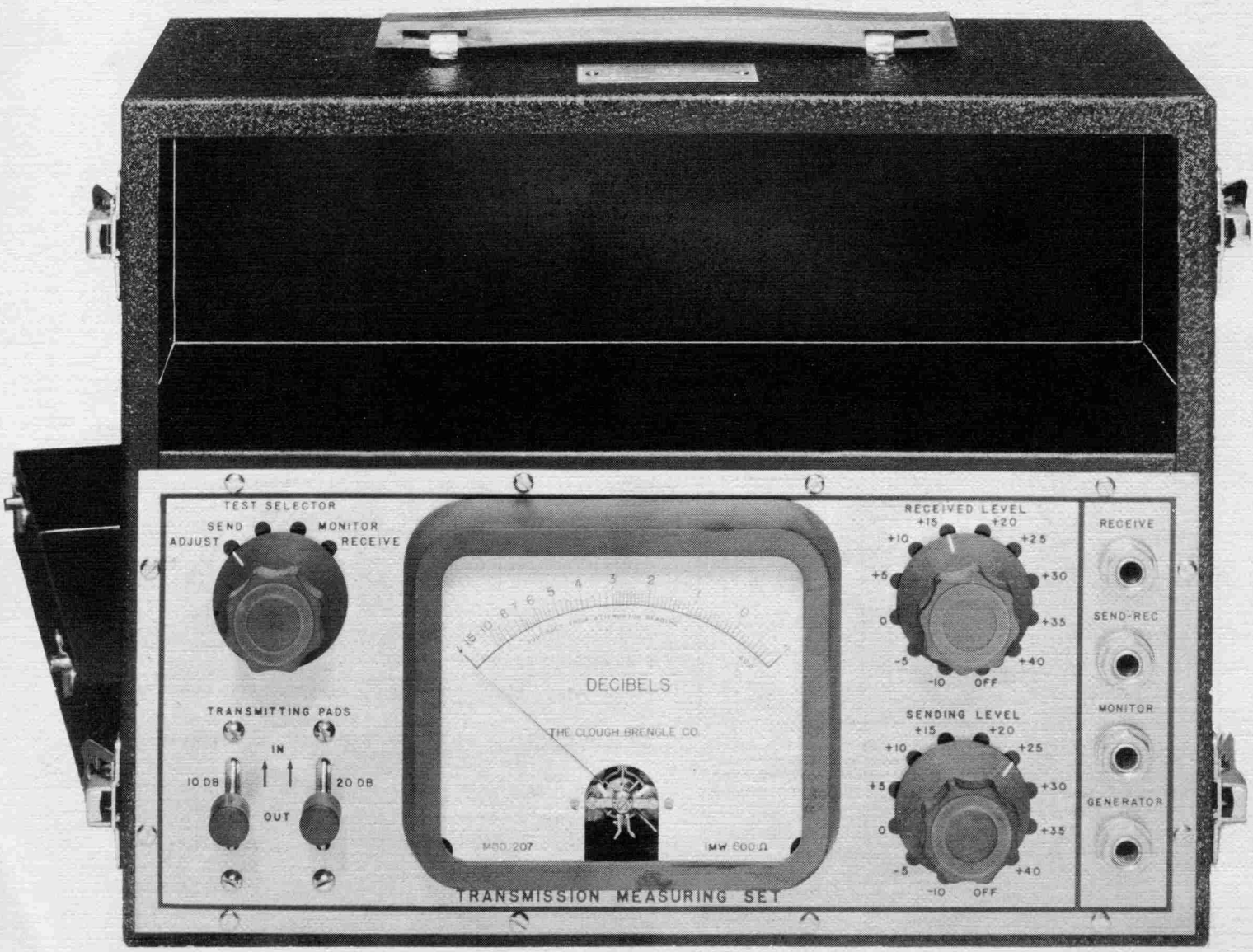
*2. Wide Range of Level, -30 to -40 db. (sending to -55 db.) permitting determinations without cross talk or overloading amplifiers or repeaters. 1 milliwatt, 600 ohm reference level is standard. Others available.

*3. All Testing Conveniences Self-Contained in one case--pads, db meter, and switching facilities including monitor jack and switch and cord compartment. (Relay rack mounted instrument also available.)

*4. Simplified Scale and Controls, with control steps of 5 db. or multiples thereof through out, permit accurate determinations with simple instructions, even by the unskilled.

*5. Maximum Meter Protection is provided at all times and under all testing conditions by the dual pad control and other keyed-in switching facilities.

*6. May be used with your present generator of 600 ohm output impedance.

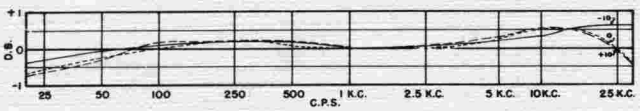


DESCRIPTION OF CONSTRUCTION.

Meter Indicating Circuit and Frequency Characteristic.
To preserve accuracy to 30 kilocycles requires the use of rectifier disks of very small area, compared to those in ordinary commercial copper-oxide meters, to avoid the capacity effect of the larger disks. The efficiency of the smaller disks is naturally less so, in addition to employing a very sensitive d-c indicating meter, other expedients are necessary.

Most important of these is a transformer to adapt the inherently high impedance of the rectifier to the instrument impedance of 600 ohms, thereby saving power for meter deflection which would otherwise be lost in the mismatch.

This transformer, like the rectifier, must have the best possible frequency characteristic and is made with very carefully arranged windings on a high permeability core combined with the rectifier and a small equalizer, the excellent frequency characterisitc of the curve is had.

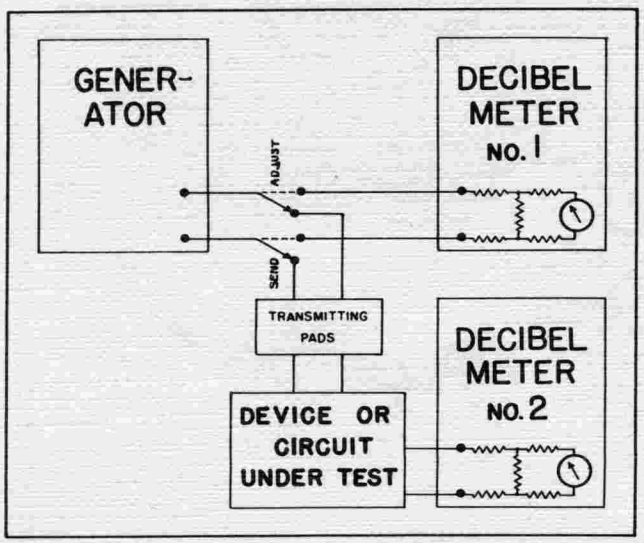


Indicating Meter Protected from Direct Currents.
Since the transformer has low resistance to d-c, the rectifier and meter are effectively protected from any direct currents unintentionally present.

Meter Calibration.
The basic sensitivity of the meter-transformer combination is -9 db. full scale, and readily readable deflections are produced at -25 db. All #207 meter-transformer assemblies are adjusted to the above and the scales are hand calibrated as shown in the photograph. The scale is designated 10 db. higher than the basic sensitivity, corresponding to two steps of the associated pad.

The Variable Meter Pad.
Preceding the meter-transformer circuit is a ten step ladder-type pad, 5 db. per step, which extends the range of the instrument to +40 db. This is constructed of precision resistors to an error of less than .1 db. in any one step. In addition, special measures assure that the cumulative error over any number of or all of the steps will not exceed .5 db.

Convenient Switching Permits Rapid Tests.
The incorporated operating conveniences of the No.207 are best appreciated by considering the diagram, showing schematically the types of work for which it is adapted together with the panel photograph, with the designation of the controls:-



With the 'Test selector' switch in the 'Adjust' position, the generator is connected to the decibel meter for adjustment of its output to "sending-level". This is read on the meter, together with the pad-control marked 'Sending Level'.

In some tests the sending level will be entirely arbitrary, while in others it will be stipulated by circuit conditions or convention. For example, in testing open or cabled lines, the sending level must be kept reasonably low to prevent the testing current from cross-talking into adjacent pairs or circuits. Under these conditions, the high sensitivity of the 207 permits measurement of a 25 db. loss while sending only 1 milliwatt, and this without employing variable and uncertain amplifiers.

Low-level Sending Pads Incorporated.
If, on the other hand, an amplifier or repeater is being tested or a circuit with a repeater near the sending end, it may be necessary to send a still lower level to avoid overloading the repeater or amplifier. This is provided for by inclusion in the Model 207 of 'Transmitting Pads' of 10 and 20 db. which are inserted in the sending circuit either individually or in tandem by convenient switches. Thus the sending level indicated by the meter may be lowered 10, 20 or 30 db. as required, permitting a level as low as -55 db. with respect to 1 milliwatt to be sent.

With sending level established, the 'Test Selector' switch is thrown to 'Send' connecting the generator to the circuit, the output of which is read on a second meter, (as indicated in the diagram). The received level is noted and subtracted from the sent level to get the gain or loss of the circuit or device under test.

If both the input and output terminals of the test circuit are available locally, as when testing an amplifier or repeater or two circuits looped at the distant end, the two decibel meters indicated in the diagram can be one and the same one, especially since then small discrepancies in calibration will be washed out in subtracting the sent and received levels.

This type of measurement is particularly convenient using the Model 207 for, while the same meter pad is used for both sending and receiving, separate sending and receiving level switches are multipled from it, hence the 'Test Selector' switch may be referred to the 'Adjust' position at will without previously resetting the meter pad. This arrangement is a time saver and also protects the meter from inadvertent reference back to the sending condition without having made the proper pad setting to accommodate the larger power. This happens so easily when only a single pad switch is used.

Added Conveniences for Two-Way Testing.
These dual switches are also a convenience for two-way testing, for constant level setting may be maintained on the 'Sending Level' switch throughout a series of tests the the level received from the far end independently accommodated on the 'Received Level' switch with a minimum risk of damage to the meter.

As a further convenience in two-way testing, a Jack is included for connection of a monitor hand-set and the 'Test Selector' switch has a position for its connection when communication is desired.

Balanced Circuit Operation and Model 207-T.
All components of the Model 207-H are of balanced construction so conditions in balanced or push-pull circuits are not upset by its connection. In addition, the case is electrically free from the circuit and can be grounded when desired to prevent interference by stray fields.

While admittances between the circuit and the case are so small that an error of less than .1 db. is caused when operating at 30 kilocycles from a grounded circuit, we also offer the Model 207-T, built on a "T" basis through out for this less usual application.

SPECIFICATION: MODEL 207 TRANSMISSION MEASURING SET

POWER RANGE: RECEIVING, -25 DB. TO +40 DB.
SENDING, DOWN TO -55 DB.

FREQUENCY RANGE: 50 CYCLES TO 30 KILOCYCLES WITH ACCURACY AS INDICATED BY THE CURVE ON THIS PAGE.

ACCURACY: METER, ±0.2 DB. OR SMALLEST READABLE SCALE DIVISION AT ROOM TEMPERATURE WITH SINUSOIDAL CURRENTS. "TURNOVER" ERROR IS NEGLIGIBLE.
PADS, 0.1 DB. ON ANY ONE STEP AND CUMULATIVE ERROR WILL NOT EXCEED 0.5 DB. ACROSS ANY NUMBER OF STEPS.

REFERENCE LEVEL: 1 MILLIWATT, 600 OHMS IS STANDARD. OTHERS AVAILABLE ON SPECIAL ORDER.

CASE AND PANEL: WELDED STEEL CASE WITH CORD COMPARTMENT AND REMOVABLE LID. FINISHED IN BLACK WRINKLE. SIZE, WITH LID, 9¼"X12"X5". PANEL, NICKEL AND BLACK. WEIGHT 12 POUNDS.

MODEL	CODE	PRICE
207-H TRANSMISSION MEASURING SET	DAHAH	$95.00
207-T " " "	DATAT	$95.00

EITHER MODEL ON 5¼"X19" RACK PANEL WITHOUT LID OR COMPARTMENT

SHIPPING WEIGHT 17 LBS. PACKED FOR EXPORT 21 LBS, 9.5KG

PRINTED IN U. S. A.

The Clough-Brengle Co., 5501 Broadway, Chicago, Illinois September 10, 1941

For the first time in its history The Clough-Brengle Co. is forced to alter prices prior to the issuance of a new catalog. The upward trend in labor and material costs, as well as the acute situation brought about by the Defense effort and Priority system, are so fully discussed in the daily papers that it is probably unnecessary to dwell on the justifications for the increases represented by the following.

In addition, a large portion of our production facilities are engaged in Defense production directly to the extent that we are unable to produce our catalog items in the usual quantities, which increases our costs and makes necessary acceptance of orders on the following basis:

1. All prices below are net, f.o.b. our factory.

2. We reserve the right to request priority or contract number before acceptance and/or delivery of order.

3. Delivery dates extended by ourselves are to be regarded as subject to previous withdrawal from our stocks on orders bearing higher priority rating than your own.

4. Cataloged performance specifications will be maintained but the right is reserved to substitute materials as demanded by the present situation.

Model	Description	Line or Mains Power 115 volt 50-60 cy	230 volt 50-60 cy	115 volt 25-40 cy
79-D	Beat Frequency Audio Oscillator	$70.00	$74.50	$75.50
	Matching Transformers for 79-D (#1184-1201-1346-1347)	$7.50 each		
110-B	Signal Generator (Verni-Vider Dial)	$55.00	$58.90	$60.50
	Extra Coaxial Cable for 110-B	$1.25	No voltage or freq. involved.	
126-A	Graphoscope (906-P1 Tube)	$75.00	$78.50	$82,00
126-L	Graphoscope (906-P1 Tube)	$105.00		
	906-P4 Tube for 126-A or 126-L	$3.75	extra on any Model	
	908 Tube " " " "	$8.50	" " " "	
	910 Tube " " " "	$11.75	" " " "	
180-A	Beat Frequency Oscillator	$160.00	$162.50	$166.50
	Mounted on 10½" x 19" Relay Rack Panel-add:	$9.00	No voltage or freq. involved.	
180-H	Beat Frequency Oscillator	$175.00	$177.50	$182.00
185-B	Unimeter	$32.50	$36.00	$37.50
199-B	Standard Signal Generator	$107.50	$111.50	$113.50
	Special Wire-wound potentiometer for production use - add to above	$17.00	No voltage or freq. involved.	
	Rack Mounting, Panel (supplied in Steel), 1/8" x 10½" x 19" - Finished in Black Wrinkle. Add -	$8.50		
207-H	Transmission Measuring Set	$100.00	Not line powered.	
207-T	Transmission Measuring Set	$100.00	Not line powered.	
	Either model on 5¼" x 19" Rack Panel without lid or compartment. Add -	DAKAR $7.50		
220	Unimeter (20,000 ohms per volt)	$65.00	Not line powered.	
	Test Prods for Models 185-B & 220	$1.25	No voltage or freq. involved.	
225	Tube Tester	$50.00	$54.50	$54.50
230	Capacity Resistance Bridge	$47.50	$50.50	$52.50


NINE YEARS OF FINE INSTRUMENTS