CATALOG B2

Gaertner

CHRONOGRAPHS

AND

Time STANDARDS

TAPE CHRONOGRAPHS
DRUM CHRONOGRAPHS
TUNING FORKS
REGULATOR CLOCKS

THE
GAERTNER SCIENTIFIC CORPORATION
1201 Wrightwood Avenue CHICAGO, U. S. A.

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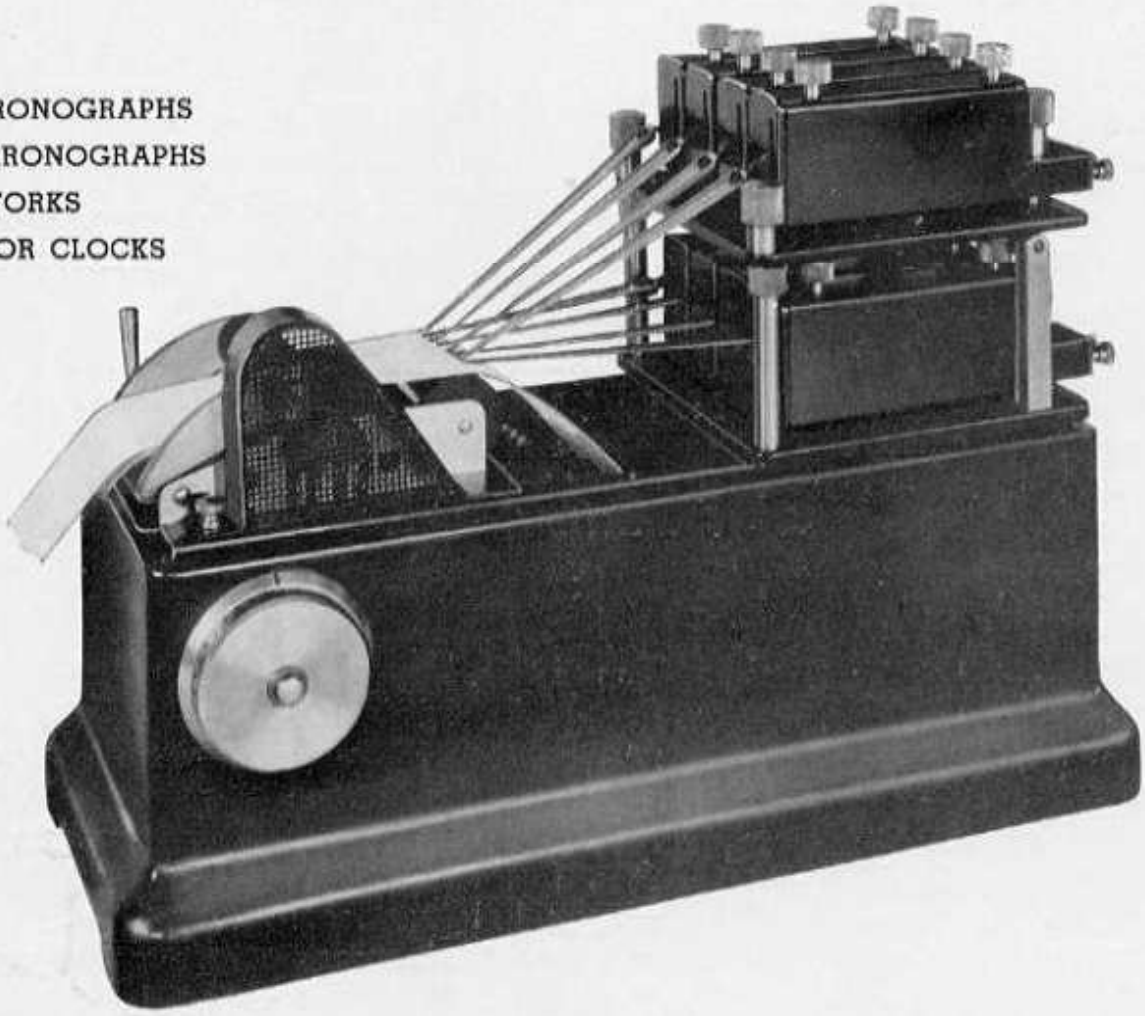


The GAERTNER SCIENTIFIC CORPORATION

1201 WRIGHTWOOD AVENUE • CHICAGO • U. S. A.

SALES CONDITIONS

ORDERING. Orders should be made in writing, with the number of the catalogue and of the item specified. To avoid errors, verbal orders should be confirmed in writing. Orders are accepted with the understanding that mutual consent is necessary for cancellation.

SPECIFICATIONS AND ILLUSTRATIONS. The illustrations and specifications given in this catalogue are not final, as continual improvements in design are being made. Notice of such changes is given only when the operation and usefulness of the instrument and accessories are affected.

PRICES. The prices listed are net at our factory at time of publication. We reserve the right to make changes without notice. Current prices will be quoted by letter or telegraph on request. The cost of packing is not included in the list price.

TERMS. Domestic accounts are due 30 days from date of invoice. Customers not having an account with us and not commercially rated, are expected to provide satisfactory references or to send remittance with order.

SHIPMENT. Shipment is made in accordance with the instructions of the customer. In the absence of such instructions we use our judgment in choosing the most expeditious and economical methods. Unless other arrangements are specified, insurance and postage are charged for at cost and express and freight shipments are sent collect.

DELIVERY. Instruments and accessories for which there is a regular demand are kept in stock for immediate shipment. More elaborate instruments, those which are frequently modified to suit the needs of the customers, and those for which the demand is small and irregular, are stocked in various stages of completion. Delivery dates will be estimated at the time quotation is made or order accepted.

GUARANTEE. All instruments are carefully inspected by qualified personnel for material, workmanship, and performance. Any defects will be promptly corrected within a reasonable period. Please describe defect in detail before making returns, and complete instructions for shipping or repair will be furnished.

SERVICE AND REPAIRS. Each instrument is shipped with instructions for unpacking, assembling and adjusting. The customer is assured of any further assistance he may require. In case of damage to the instrument our repair department is provided with facilities to give prompt and economical service.

INQUIRIES. Our technical staff is at the service of the customer who wishes recommendations on equipment. Inquiries should contain a complete description of the problem under consideration. In this way the delays associated with extended correspondence can be avoided, and our recommendations can be made more exact.

INTRODUCTION

The design and manufacture of Chronographs has been one of our outstanding specialties since the inception of this company. Described herein is a line of Chronographs and Accessories we have developed and constructed to meet the numerous needs in many fields for a precise and dependable means of recording time intervals.

For calibrating time intervals we have developed a complete line of time standards to meet all requirements. The measuring of intervals of one second and more is obtained with regulator clocks. For smaller intervals the time standards take the form of high accurate tuning forks. In many cases where less accurate timing is required, the motor contactor, regulated by controlled A. C. cycles, is satisfactory.

Our means for rating these instruments include a Regulator Clock of great precision, facilities for radio reception of time signals, and a precision Tuning Fork kindly calibrated for us by Dr. D. C. Miller, one of the leading authorities on acoustics, of the Case School of Applied Science.

We wish to thank our many friends and customers for their gratifying support and valued advice, and look forward to the continued pleasure of consulting with the research worker in the application of our instruments to the solution of their many problems.

THE GAERTNER SCIENTIFIC CORPORATION

Medal awarded by
the Franklin Institute.

OTHER LINES OF MANUFACTURE

Astronomical and Astrophysical Instruments

Precision Linear Measuring Instruments

Linear and Circular Dividing Machines

Optical Instruments and Optical Parts

Spectroscopes, Spectrometers, Monochromators

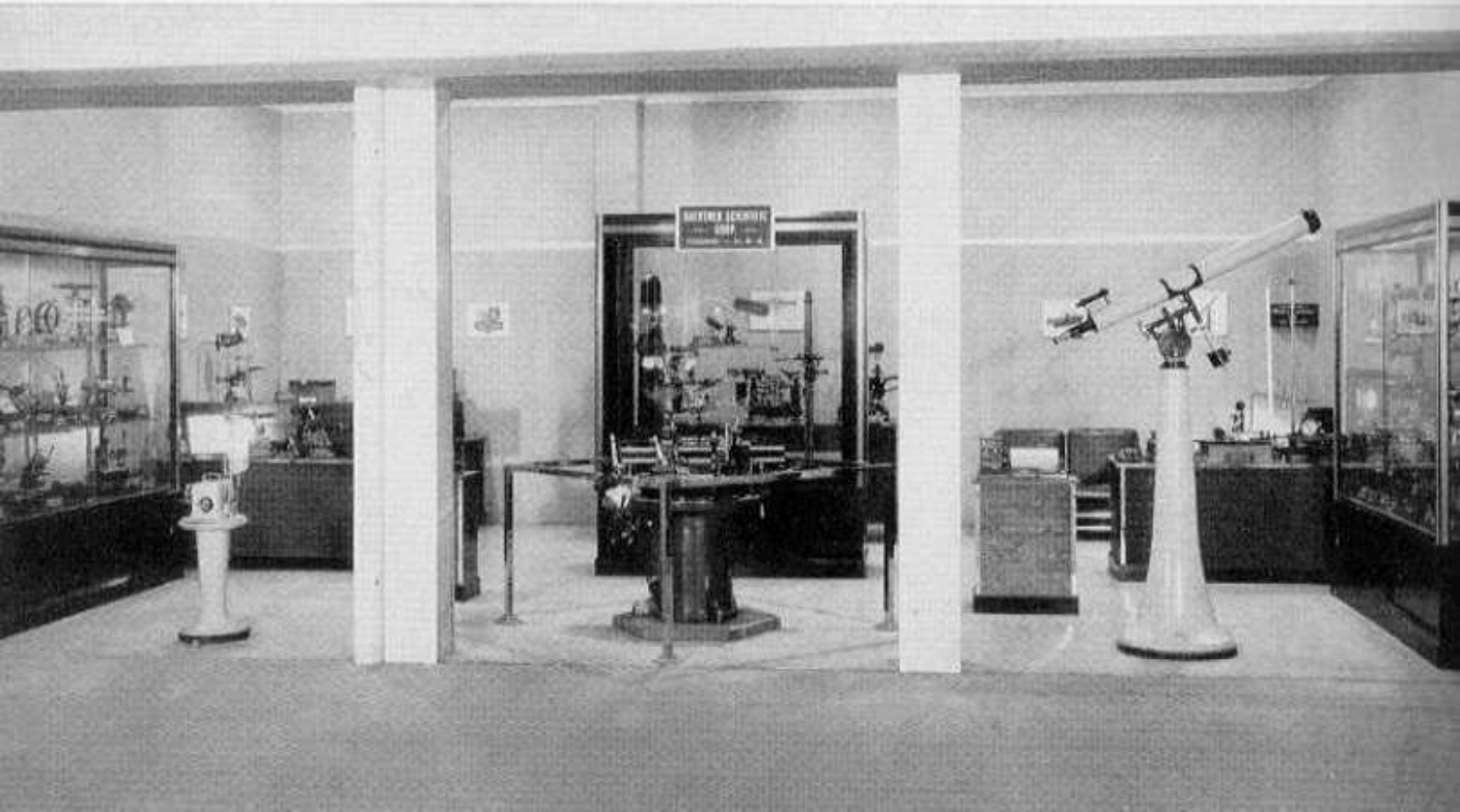
Photometers and Spectrophotometers

Calorimeters, "Studentia"

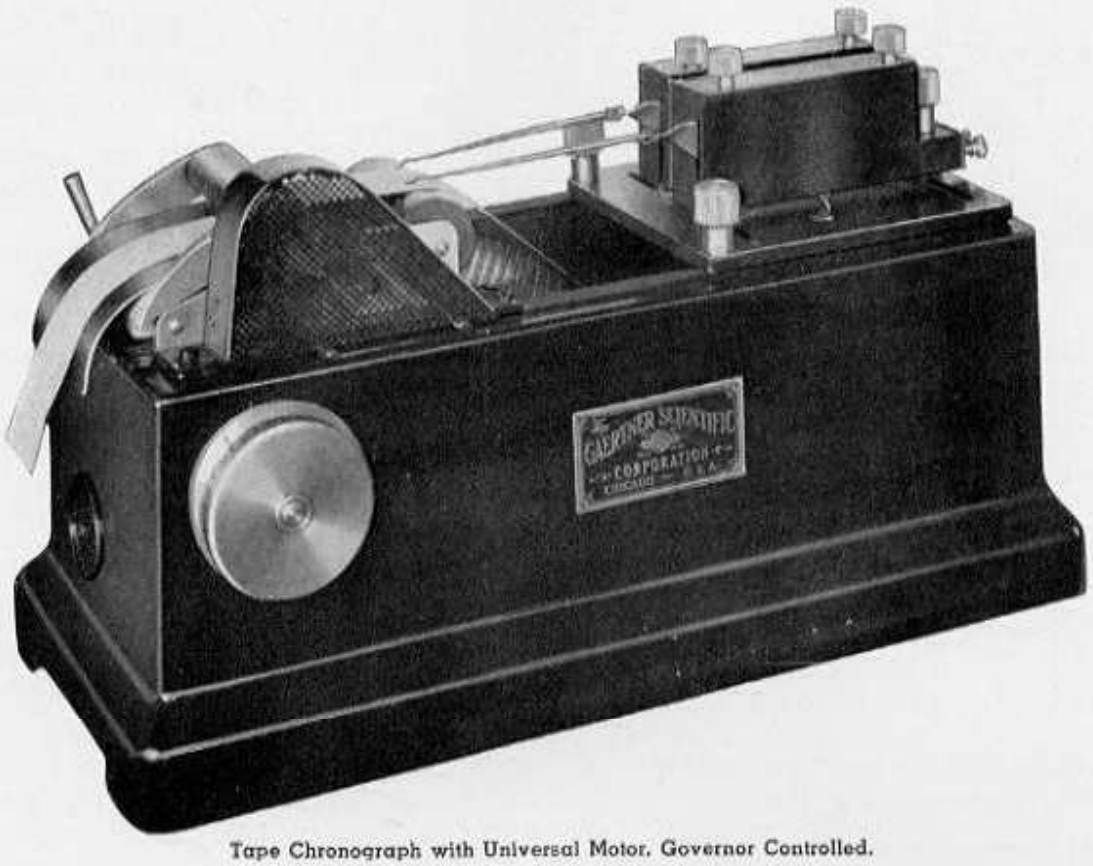
Universal Laboratory Supports

Catalogues on any of these subjects will be sent on request.

Part of the Gaertner showroom was transplanted to the Chicago World Fair, 1933.



TAPE CHRONOGRAPHS



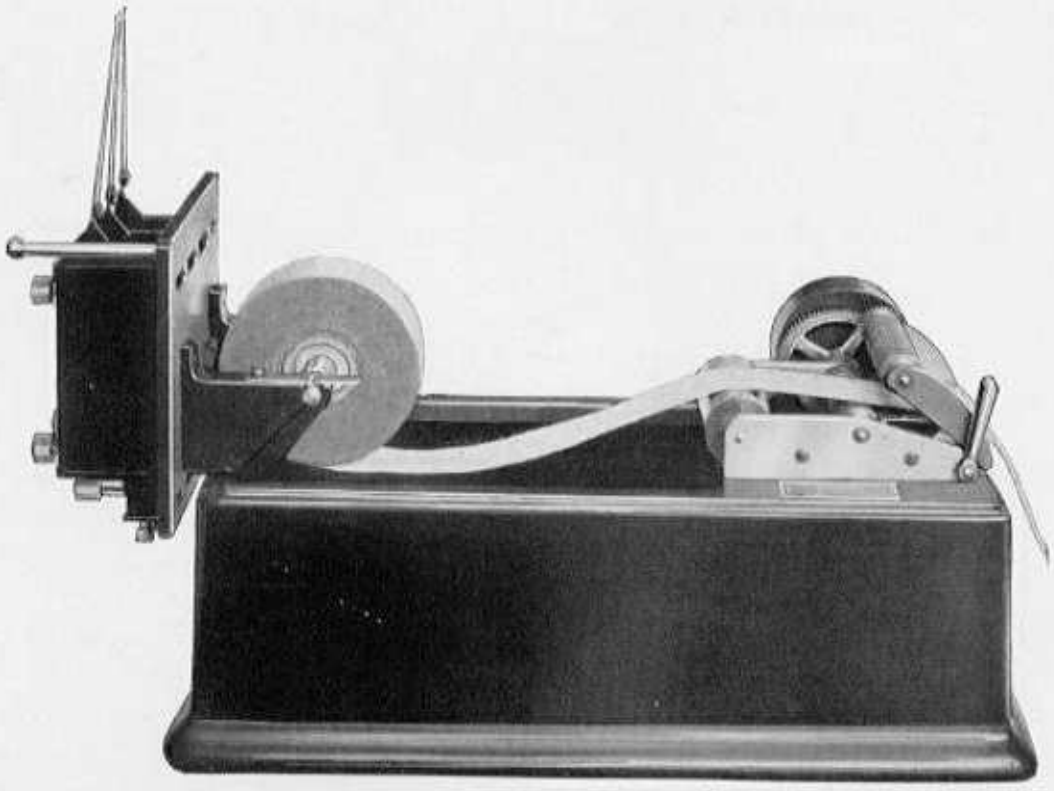
Tape Chronograph with Universal Motor, Governor Controlled.

Gaertner chronographs are precision instruments of extreme accuracy for recording time intervals. They are usually used in connection with an external time standard furnishing impulses at known intervals to one of the recording elements. Particular care has been taken in the design and construction to combine simplicity of operation with high sensitivity. They are sturdy and compact, yet light in weight and portable. The spring motor type chronograph or the 12 volt chronograph with a battery are often ordered for field use.

The housing and the base of the instrument are made of strong aluminum alloy casting and enclose the motor and the recording paper supply with the tape guide. A brass plate attached to one end of the casting supports on top the recording elements. It holds underneath the tape roll and is hinged to disengage the pens and to give access to the paper supply. To the other end of the housing is mounted the tape feeding mechanism.

The recording elements designed to keep the electrical and mechanical time constants small consist of a strong electro-magnet, a reed type armature and the pen. They are ideal for recording rapidly recurring phenomena of very short intervals as well as longer ones. A reed of high magnetic permeability and small mass permits a complete cycle of operation in less than 0.008 seconds during which time the pen may move back and forth across the paper.

Both the reed and the pen are ribbed to diminish undesirable flexures. Convenient knurled heads are provided for adjustment of spring tension, amplitude, and pen pressure to suit various conditions. An



Tape Chronograph with Recording Magnets Turned Up Showing Paper Roll.

amplitude of motion of the pen up to 2mm is obtainable except when operating on very short intervals.

Any voltage between 1½ volts (for time intervals not shorter than approximately 0.05 seconds) and 6 volts may be used for operating the recording elements.

The most desirable voltage will depend upon the rapidity of response required and upon the current carrying capacity of the contacts.

For the standard A.C. voltages a 6 or 8 volt transformer is suitable. In cases where a higher voltage is necessary—as when using a vacuum tube circuit for time records—the recording element can be furnished with high resistance coils of up to 6500 ohms.

On our standard chronographs the magnet coils have a resistance of about 2 ohms and draw 2 amperes at 4 volts for continuous use. To obtain greater speed a voltage of 6 volts can be safely applied.

Recording tape. Two kinds can be furnished: specially coated recording paper, or white bond paper.

Coated recording paper, which is free from the danger of ink smudges and pens running dry, is now most universally used with the chronographs. Very little pressure is necessary to produce a distinct record. The base is a colored paper, covered with a white, waxlike coating. A very light contact of the pen removes this coating, revealing the paper beneath, and plainly marking the path. The coating is not easily removed by rubbing or handling. This paper is satisfactory for all tape speeds.

When a more permanent record is desired, the white bond paper tape is desirable and satisfactory for all tape speeds. Records on this paper are made by the use of the chronograph ink pen.

Feeding mechanism. The tape is guided from the supply spool over a roller, on which the recording stylus or ink pen bears. An adjustable guide permits the use and interchange of tapes of 13mm or 28mm width. All our tape chronographs can be adapted to accommodate a 52mm tape. The feeding of the tape is accomplished by a set of friction rollers—one of which is finely corrugated while the other is rubber faced, normally kept in proper contact by a spring. A lever brings together or separates the two rollers, thereby starting or stopping the tape feed while the motor continues to run. Tape speeds from 1mm to 1,000mm a second are available.

Driving motors of various types are offered, including the following:

1. **Governor Controlled Electric Motor**—Universal Type, for 110 volts A.C. or D.C. and for 12 volt D.C. (other voltages on request).

The governed motor offers the advantage of speed adjustment while running and of constant speed of very close uniformity from A.C. and D.C. supply lines.

A centrifugal governor opening and closing an electric contact introduces a resistance in series with the field coils to control the speed. A condenser is placed in the circuit to prevent sparking. The contacts move so rapidly (up to 840 oscillations per second have been observed) that no perceptible irregularity of speed is thereby caused. A large knurled head and divided disc permit exact settings to the desired speed within the specified limits.

Motors of different speeds are furnished to allow tape speeds adjustable between 3 and 15mm per second, 12 and 60mm per second, 50 and 250mm per second, and 200 and 1,000mm per second.

2. **Synchronous Motor**—Telechron Type, 110 volt, 60 cycle A.C. (other frequencies or voltages on request).

These self starting motors, selected for their smooth uniform running qualities produce a constant known tape speed, and the time intervals may be conveniently evaluated from the tape with an ordinary scale.

The accuracy of the reading depends, of course, on the regulation of the frequency of the supply line.

This type has a built-in gear reduction running in oil which will run for the life of the motor without attention. Made for any one tape speed between 1 and 100mm per second.

3. **Spring Motor** used in Chronographs especially suited for field use. The spring motor, which runs very smoothly and practically noiseless, is fitted with maintaining gear, permitting winding the spring without interrupting or affecting the speed of the motor. The motor runs about fifteen minutes on one winding. A centrifugal friction governor assures a uniform speed and a dial permits accurate setting to any speed within the specified limits.

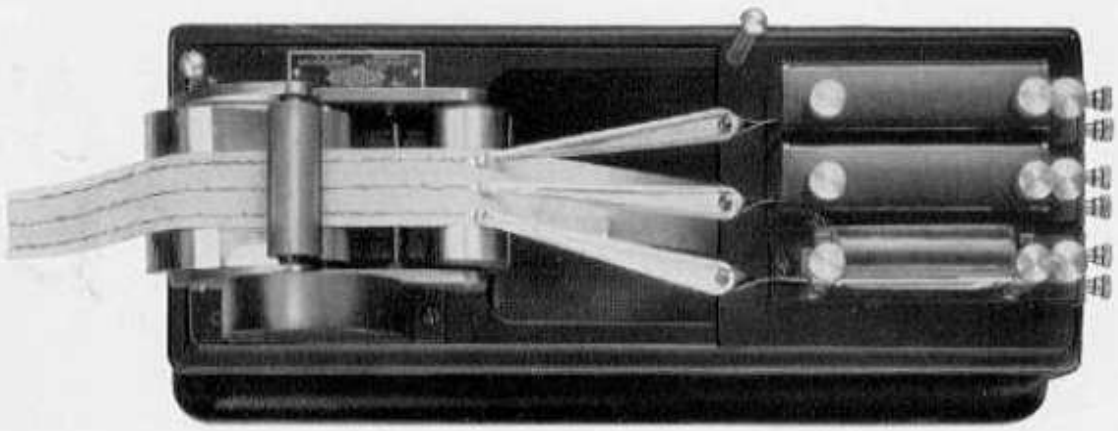
SPECIAL CHRONOGRAPHS

With the general need for higher speeds and greater accuracy, the problem of time recording instruments has become increasingly complicated. Our staff and experience are available for consultation on special requirements or applications. Your inquiries are solicited.

The standard Chronographs are furnished with one to four recording elements.

Up to eight recording elements may be accommodated on special constructed support plates.

Prices for Chronographs with more than four recording elements will be furnished on request.



Top View.

CHRONOGRAPHS, Governor Controlled Motor, 110 Volts AC or DC

Catalog Number	Number of Recording Magnets	Tape Speed Per Second Adjustable Between	Price
B371-1	1	3-15mm	$250.00
B370	2	3-15mm	275.00
B371	3	3-15mm	300.00
B372	4	3-15mm	325.00
B370-1a	1	12-60mm	250.00
B370-a	2	12-60mm	275.00
B371-a	3	12-60mm	300.00
B372	4	12-60mm	325.00
B373-1	1	50-250mm	250.00
B373	2	50-250mm	275.00
B374	3	50-250mm	300.00
B375	4	50-250mm	325.00
B373-1a	1	200-1000mm	250.00
B373a	2	200-1000mm	275.00
B374a	3	200-1000mm	300.00
B375a	4	200-1000mm	325.00

CHRONOGRAPHS, Governor Controlled Motor, 12 Volts DC

Catalog Number	Number of Recording Magnets	Tape Speed Per Second Adjustable Between	Price
B376-1	1	3-15mm	$250.00
B376	2	3-15mm	275.00
B377	3	3-15mm	300.00
B378	4	3-15mm	325.00
B376-1a	1	12-60mm	250.00
B376a	2	12-60mm	275.00
B377a	3	12-60mm	300.00
B378a	4	12-60mm	325.00
B379-1a	1	50-250mm	250.00
B379	2	50-250mm	275.00
B381	3	50-250mm	300.00
B382	4	50-250mm	325.00
B379-1	1	200-1000mm	250.00
B379a	2	200-1000mm	275.00
B381a	3	200-1000mm	300.00
B382a	4	200-1000mm	325.00

NOTE: Five 120 meter rolls of coated paper tape 13mm wide are included with the one and two recording magnet chronographs, and five 120 meter rolls of coated paper tape 28mm wide are included with the three and four recording magnet chronographs. One roll will last for thirty-three hours at a speed of 1mm per second, or for two minutes at a speed of 1 meter per second.

A waterproof cover and operating instructions are included with each chronograph.

Tape Chronograph with Synchr. Motor.

CHRONOGRAPHS, Synchronous Motor, Telechron Type, 110 Volts AC, 60 Cycle

TAPE SPEED: Different speeds between 1 and 100mm per sec. are available.

Catalog Number	Number of Recording Magnets	Tape Width	Price
B390	1	13mm tape	$255.00
B392	2	13mm tape	280.00
B393	3	28mm tape	305.00
B394	4	28mm tape	330.00

NOTE: According to various speeds applied to this type, chronographs are stocked assembled, without the speed device. Therefore, delivery in compliance with specification will take a few days.

Five 120 meter rolls of coated paper tape 13mm wide are included with the one and two recording magnet chronographs, and five 120 meter rolls of coated paper tape 28 mm wide are included with the three and four recording magnet chronographs. A waterproof cover and operating instructions are included with each chronograph.

CHRONOGRAPHS, Spring Motor

Catalog Number	Number of Recording Magnets	Tape Speed Per Second Adjustable Between	Price
B396	1	20-30mm	$250.00
B396a	2	20-30mm	275.00
B396b	3	20-30mm	300.00
B396c	4	20-30mm	325.00
B397	1	40-60mm	250.00
B397a	2	40-60mm	275.00
B397b	3	40-60mm	300.00
B397c	4	40-60mm	325.00
B398	1	80-120mm	250.00
B398a	2	80-120mm	275.00
B398b	3	80-120mm	300.00
B398c	4	80-120mm	325.00

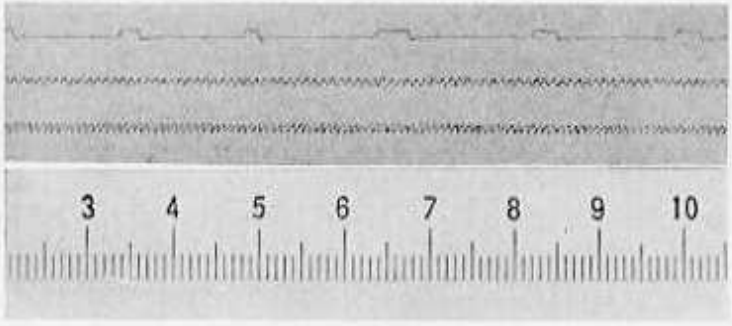
NOTE: The chronographs are mounted in a strong oak box with canvas cover, with space for accommodating a reserve supply of paper rolls. Five rolls of coated recording tape are supplied.

Tape Chronograph, Spring Motor, with Two Recording Magnets.

SAMPLE RECORD TAPE

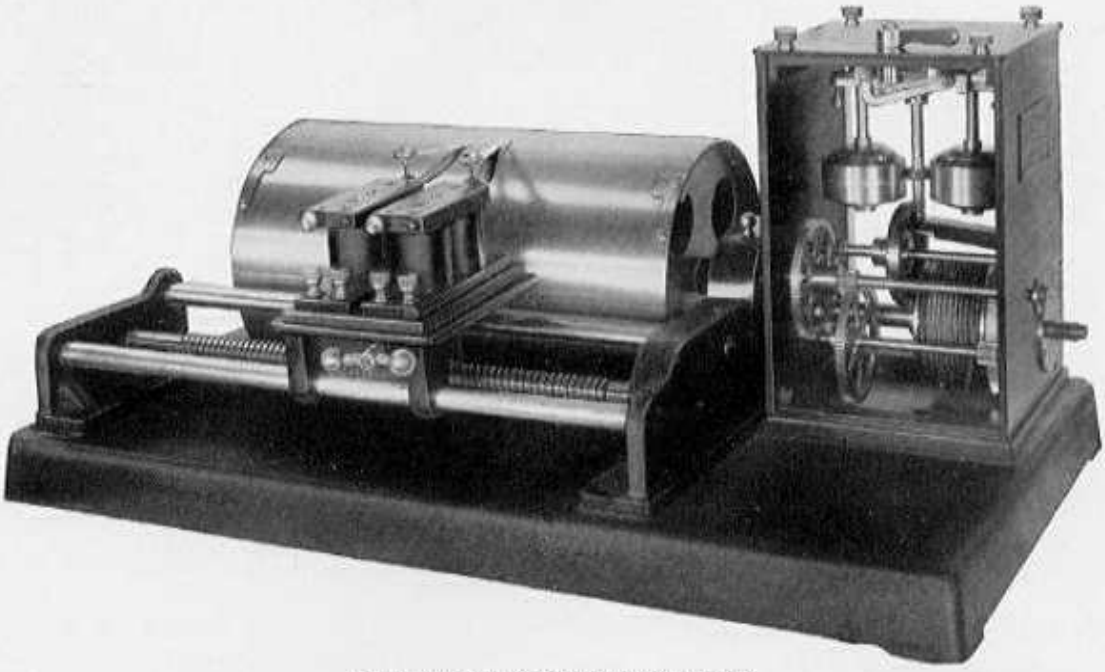
Sample Record made with B-374 Tape Chronograph and Coated Paper tape. The three recording elements were connected to give:

1. Events. Contact by hand key.
2. 100 cycle L3003 Tuning Fork (5 v.).
3. 60 cycle A.C. through B-1025 Transformer, 8 v. Each half-cycle of the current produces a complete deflection, or 120 v.p.s. A millimeter scale is shown for comparison.



Record Made with B-375 Tape Chronographs on Coated Tape.

DRUM CHRONOGRAPHS



B-352 Drum Chronograph, Clock Driven.

Drum Chronographs and their compact sheet records are customarily used by the astronomer, and in cases where it is desirable to have records conveniently stored for quick reference. On sheet form all the events are readily visible and the recurring events at multiples or even fractions of the drum revolution time are conveniently compared as they appear side by side.

These chronographs are mounted on a substantial cast-iron base and are operated by either a Weight Driven Clock or by a Synchronous Motor.

The clock driven Chronograph is fitted with a powerful clock with improved friction governor, having the arms made of invar. The governor will permit extremely close regulation and the compact construction and method of adjustment guarantees permanency of regulation. The gears are accurately cut and the shaft of the driving drum runs in ball bearings.

The clock is entirely enclosed by transparent celluloid sides, and a starting and stopping lever is conveniently placed on top of the clock. A clutch also is provided for engaging or disengaging the clock. The gears are protected from dust and injury by a suitable guard.

The motor driven drum Chronographs use a Telechron Motor, which requires 12 watts at 110 volts, 60 cycle A.C., and drives the chronograph at a rate synchronous with the frequency of the current. Where the frequency is accurately controlled, no other time standard is necessary. The reducing gears of the Telechron motor are sealed in a case filled with oil, and require no lubrication or attention during the life of the motor. The Drum chronographs with Telechron motors for any standard frequency can be furnished with gears to run at slower or faster speeds. Practically any speed from 1mm per second to 48mm per second is obtainable.

The drum is 6" (152.4mm) in diameter and 11" (275mm) long, and by means of a set of change gears can be made to rotate at a speed of 60 seconds or 30 seconds per revolution. At the slow speed the second intervals are exactly 8mm long.

The carriage carrying the recording pen (or pens) travels on two parallel stainless steel bars. The motion of the carriage is transmitted by a lead screw of 4mm pitch. One revolution of the drum shifts the carriage 4mm. The nut can easily be disengaged from the lead screw to shift the carriage back to its original position. For removing and attaching the

recording paper to the drum, the carriage is swung out of the way to give access.

The recording element which carries the pen allows a recording speed up to 125 events per second. It is designed with small electrical and mechanical time constants. A powerful reed of high magnetic permeability and small mass permits a complete cycle of operation in less than .008 seconds. Low resistance magnets operating on 3 to 6 volts are regularly supplied.

High resistance magnets up to 6500 ohms for use on higher voltages, as vacuum tube circuits, are furnished, if desired.

As record paper for the chronograph, a coated paper may be used; or if more permanent records are desired, a white bond paper for use with ink.

On the coated paper a stylus attached to the recording magnet is used, which traces a fine record line. The stylus can be easily removed and a light ink pen attached in its place.

DRUM CHRONOGRAPHS, Clock Driven

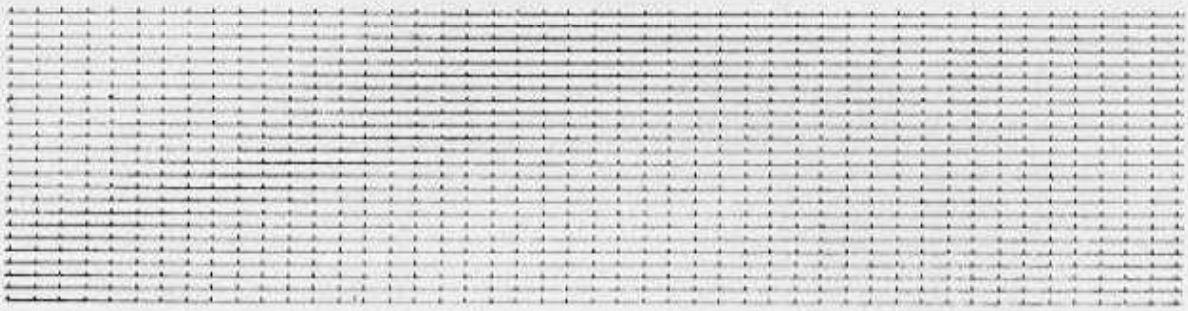
Catalog Number	Number of Recording Magnets	Price
B350	1	$525.00
B352	2	550.00
B354	3	575.00

NOTE: Each chronograph is supplied with 100 sheets of coated paper (10 x 20"), also 100 sheets of white bond paper, and a stylus and ink pen for each magnet.

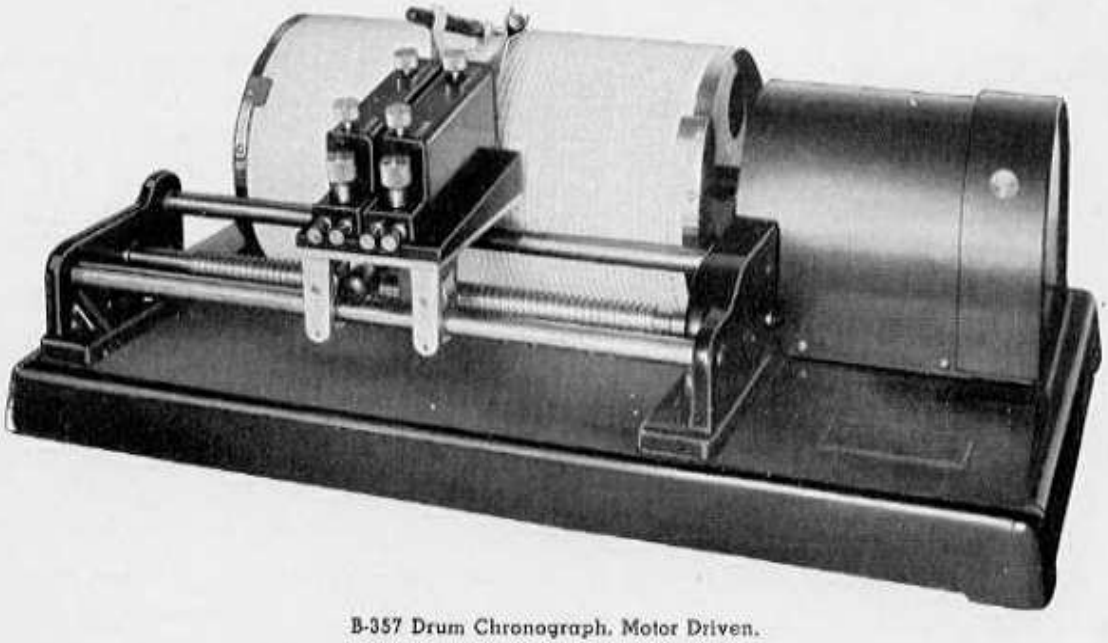
DRUM CHRONOGRAPH, Synchronous Motor Driven 110 Volts, 60 Cycles

Catalog Number	Number of Recording Magnets	Price
B356	1	$350.00
B357	2	375.00
B358	3	400.00

NOTE: Each chronograph is supplied with 100 sheets of coated paper (10 x 20"), also 100 sheets of white bond paper, and a stylus and ink pen for each magnet.



Unretouched Section of Reduced Record Made on Drum Chronograph.



B-357 Drum Chronograph, Motor Driven.

ACCESSORIES FOR CHRONOGRAPHS

B-1025 Transformer. May be used as a time standard in connection with the standard 2 ohm Chronograph recording element.

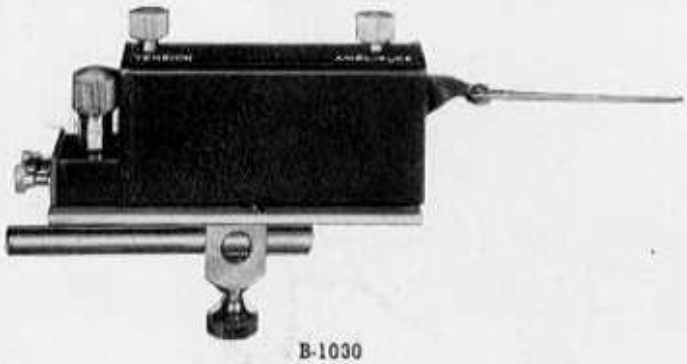
A deflection is obtained for each half cycle, therefore the controlled frequency of a 110 volt, 60 cycles power line produces 120 time marks per second **$2.75**

B-1026 Chronograph Recording Element, including pen, as described under chronographs. These elements may be added to any of our tape or drum chronographs. With all adjustments and binding posts and all parts necessary for mounting.

Five different coil resistances are available, covering most of the operating currents and voltages.

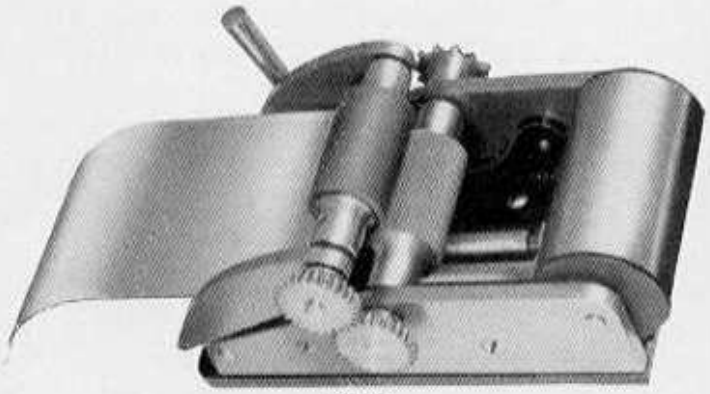
Standard values are: 2, 400, 1000, 4500 and 6500 ohms. Price..... **$25.00**

B-1030 Magnetic Time Marker, with stylus. Convenient for use in marking time intervals or for recording events to be studied when used in connection with recording drums and similar instruments. This recording element is identical to those used on our chronographs, but is fitted to a 10mm rod, 20cm long, to which it can be attached either parallel or at right angles to the stylus. Suited to carry B-1032 Chronograph Ink Pen. Price..... **$27.50**



B-1030

B-1027 Tape driving mechanism. The feeding of the tape is accomplished by a set of friction rollers. One of these rollers is finely corrugated, the other is rubber faced and normally kept in proper position by a spring. A lever separates or brings together the two rollers. Price..... **$50.00**



B-1027

B-1032 Chronograph Ink Pen. To attach to the recording magnet in place of the regular stylus.

The pen holder is ribbed to diminish flexures. To the end is attached the ink container with a capillary stainless steel tube. The writing point of this tube is made of iridium.

B-1032

This special construction allows a free flow of the ink only when the paper is moving. The pen produces a fine line on the white bond paper.

The ink supply can be replenished during records.

Complete with stylus and bottle of recording ink **$5.00**

NOTE: To avoid the rubber roller touching the wet ink record, the roller is relieved in the middle.

To secure correct guiding of the tape we recommend to use not more than 1 pen for 13mm tape, 2 pens on 28mm and 3 or 4 pens on 52mm tape.

B-360 Reading Scale for Drum Chronograph Records. The scale is divided on a beveled strip of nickel-silver, and is convenient for the rapid and accurate interpolation of the records. The total length of graduation (480mm) corresponds exactly to one revolution of the drum, and is divided in 600 parts. Each division is equal to 1/10th of a second when using the slow speeds. Every other second is numbered **$10.00**

RECORDING PAPER

Coated recording paper. which is free from the danger of ink smudges and pens running dry, is now most universally used with the Chronographs. It is also desirable because very little stylus pressure is necessary to produce a distinct record and therefore little friction is encountered.

The base is a colored paper covered with a white wax-like coating. A very light contact of the stylus removes this coating, revealing the paper beneath, and plainly marking the path. The coating is not easily removed by rubbing or handling.

B-1002 Coated Recording Tape. In rolls 13mm wide, 120 meters long. Per roll..... **$0.35**

B-1003 Coated Recording Tape. In rolls 28mm wide, 120 meters long. Per roll..... **$0.80**

B-1003a Coated Recording Tape. In rolls 52mm wide, 120 meters long. Per roll..... **$1.10**

B-362 Coated Recording Paper. In sheets 10" x 20", for drum chronographs. Per 100 sheets..... **$3.50**

White Bond recording paper. Where a more permanent record with greater economy is requested, this white bond paper tape is more desirable and satisfactory for all speeds.

B-1007 White Bond Recording Tape. In rolls 28mm wide, 100 meters long. Per roll..... **$0.40**

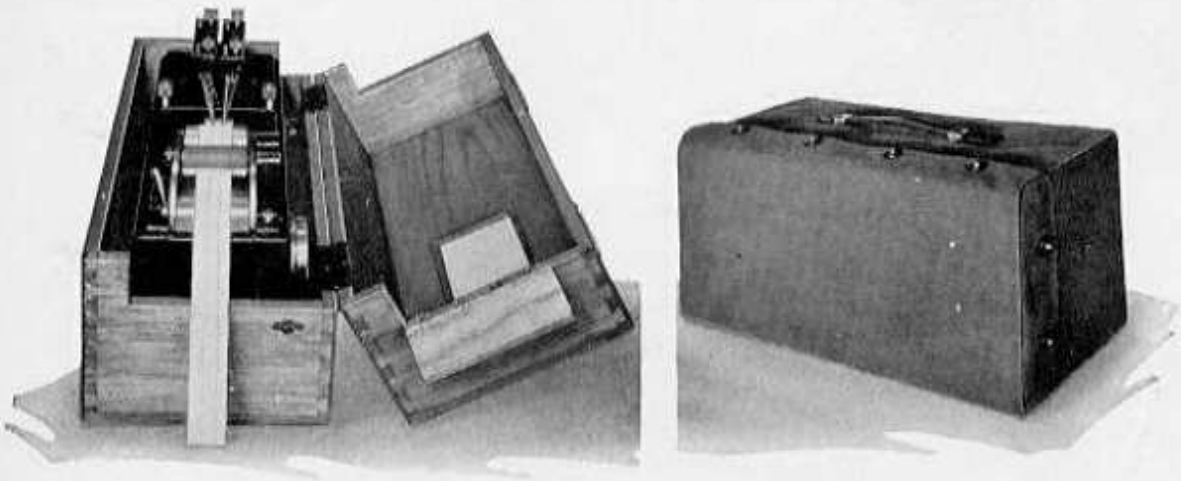
B-1007a White Bond Recording Tape. In rolls 52mm wide, 100 meters long. Per roll..... **$0.45**

B-364 White Bond Recording Paper. In sheets 10" x 20", for drum chronographs. Per 100 sheets **$1.50**

Sample of Coated Recording Tape.

CARRYING CASE FOR CHRONOGRAPHS

B-1020 Oak Case and Canvas Cover, for Tape Chronographs. Any of the chronographs listed above can be furnished mounted in a strong well seasoned oak box with canvas cover. In this form the chronograph is easy to carry and is well suited for field use. The chronograph can be operated in the case with the cover closed. A celluloid observation window and openings for wires and paper tape are provided. The outer cover is made of heavy water-proof canvas, and fits snugly around the case, closing with zippers. A strong durable carrying handle is attached to the cover..... **$20.00**



B-1020 Oak Case and Canvas Cover for Tape Chronograph.

ELECTRICALLY CONTROLLED TUNING FORKS

Important features of our tuning forks are the accuracy, independent of the temperature and the absence of extraneous frequencies.

Therefore these forks are very well suited to serve as accurate frequency standards to operate chronographs, electric clocks, stroboscopic lamps, spark recorders, oscillographs, synchronous motors and other electrically driven instruments where exact time control is essential.

The forks are made of a special steel selected to provide durability, constant accuracy and high magnetic permeability. The frequency temperature coefficient is of about 0.01% per degree Centigrade and an accuracy of 0.05% at a temperature of 20 deg. C. is guaranteed.

B-3003 TUNING FORK

These forks, made from special steel, are large and powerful enough to do mechanical work.

High speed chronograph pens can be operated directly by the output of these forks at a frequency up to 100 cycles per second.

The cast-iron bracket on which the fork is mounted, is cast integral with the base. The electromagnet operates on 6 volts D.C. and will draw an average current of about 200 milliamperes. The contacts are of generous size and made of platinum. Three marked binding posts on the base are provided. A wiring diagram and complete instructions accompany each fork.

Each fork, while operating on 6 volts, at the proper amplitude, and a load of one watt, is individually rated with a precision laboratory clock. The rated frequency can be duplicated with the necessary temperature correction for 20 deg. C. by repeating the standard operating conditions.

The maintenance of the proper amplitude is an important prerequisite for the highest accuracy. Therefore a "V" and cross line is etched on the tine of the fork to permit instant determination of the amplitude. The amplitude is correct when the apparent intersection of the vibrating "V" falls on the engraved cross line.

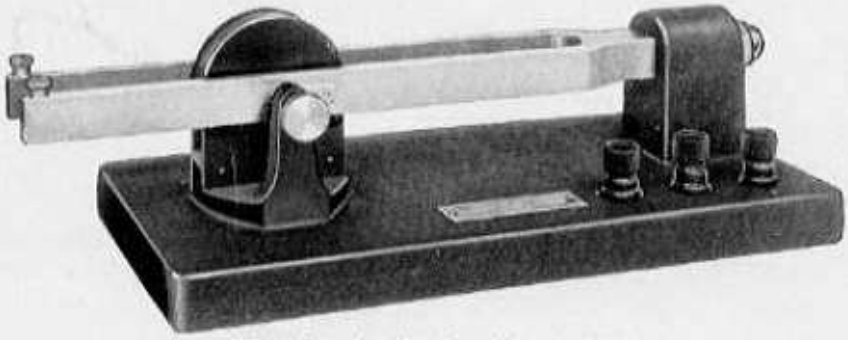
The tuning forks listed below are furnished with smooth, undrilled tines, with no attachments except the contact spring. If attachments are to be used they must be ordered with the fork or the fork returned for fitting. Attachments ordered with the tuning fork will be rated in place.

Cat. No.	Fork Material	Frequency	Price
B-3003-50	Spec. Steel	50 vps	**$75.00**
B-3003-60	Spec. Steel	60	**70.00**
B-3003-100	Spec. Steel	100	**50.00**
B-3003-200	Spec. Steel	200	**50.00**

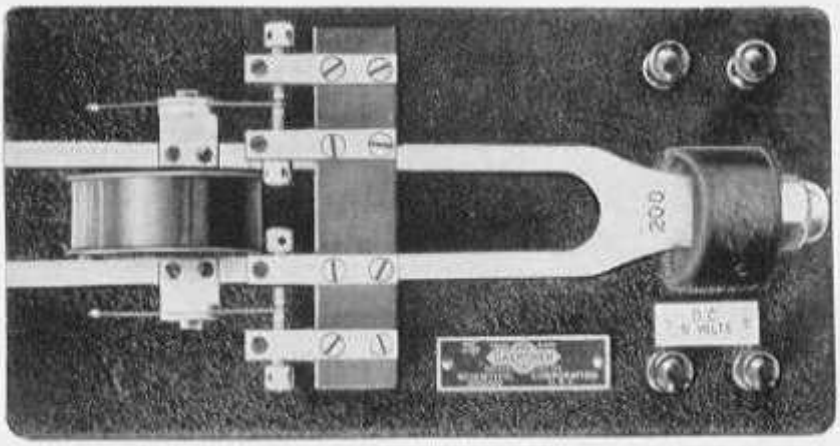
B-3004 TUNING FORKS WITH FOUR CONTACTS

Designed to give an independent output current of the same or different voltage than that of the driving circuit. By using two batteries or a center-tapped battery it is possible to obtain alternating current. The fork can also be used for the same applications listed for the L-3003 series Tuning forks. Variations due to adjustment of contacts are well within 0.5% of the rated frequency.

The electromagnets operate on 6 volts D.C. and will draw an average current of about 0.2 amperes. The stationary contacts are generous in size and of tungsten. They are adjustably mounted on a bakelite support firmly attached to the base. The vibrating contacts are mounted on flat springs which can be rotated to interchange readily one set with another.



B-3003 Electrically Driven Tuning Fork.



B-3004-200 Electrically Driven Tuning Fork.

The binding posts are conveniently located on the base and a wiring diagram and complete instructions are included with each instrument. All of the wiring is encased in the base. The cast-iron brackets on which the fork is mounted are cast integral with the base.

Our regular amplitude indicating device is provided, and the method of calibration is the same as used for our other Tuning Forks.

Cat. No.	Fork Material	Frequency	Price
B-3004-50	Spec. Steel	60 vps	$150.00
B-3004-100	Spec. Steel	100	145.00
B-3004-200	Spec. Steel	200	145.00

B-3012 VACUUM TUBE TUNING FORKS

Temperature Controlled

These Forks are designed for use as precision time and frequency standards. Vibration is maintained by a vacuum tube amplifier without electric contacts, microphone or other physical attachments to the moving tines. The constancy of these forks is within .002%. These Forks are used in connection with amplifiers for driving synchronous motors at constant speeds. They may also be used as time standards on Chronographs, Oscillographs, Stroboscopes, Synchroscopes, etc.

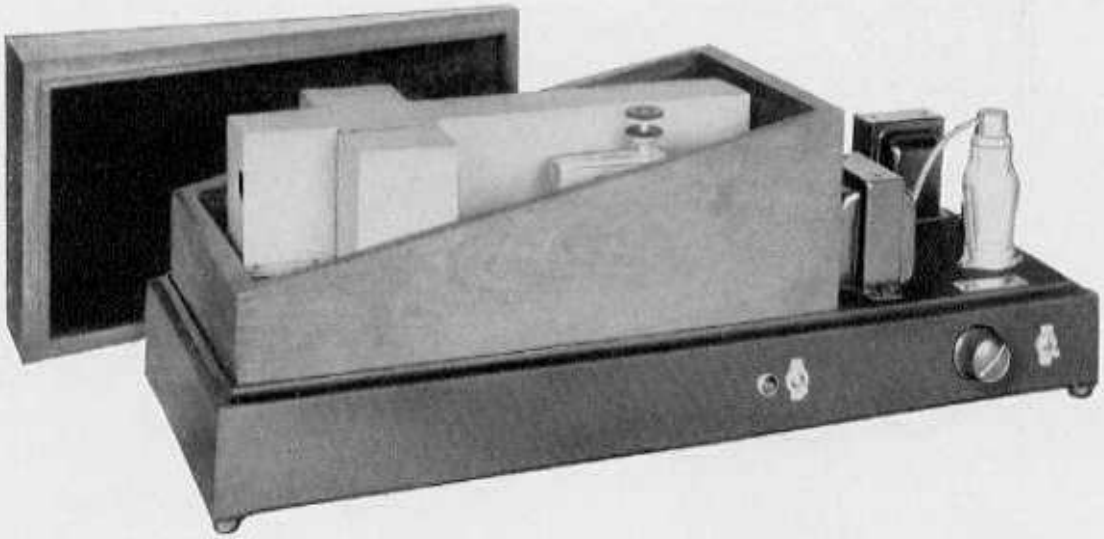
The Fork itself and the driving magnets are firmly mounted on a heavy, nonmagnetic upper base, which in turn is flexibly mounted through cork insulation upon the main base of cast aluminum fitted with rubber feet. The ends of the Fork tines are accessible for experimentation if the cover is removed.

The Forks are made of isorate alloy in frequencies from 50 v.p.s. up. The temperature coefficient of this alloy is about .00001 per degree Centigrade.

The amplifier and the tube are placed at a distance from the fork. A layer of cork ½" thick between the fork and main base provides heat insulation. For even heat distribution the fork is surrounded by a copper shield. A thermostat and heater provide temperature control. The fork, thermostat and heater are enclosed in an insulating box. On our standard instruments the heater operates from the "A" battery. If it is preferred, the heater operated directly from the power line can be supplied.

The maintaining amplifier is a compact, shielded unit mounted directly on the main base. A regenerative circuit is used in which the electromotive forces set up in one of the coils of the electromagnet are imposed upon the grid of the vacuum tube. The vibrations produced in the plate circuit are applied in the other coil to maintain the vibration. The vibrating fork itself is the coupling element in the oscillating circuit and, therefore, alone determines the frequency. Tuning condensors in the electrical circuit are definitely avoided to insure independence of the frequency from circuit elements. Spontaneous oscillation of the amplifier is prevented by a special feed-back feature incorporated in the circuit. A delayed type automatic amplitude control is also provided, which prevents unlimited increase in the amplitude of vibration of the fork, and enables a smooth manual control of amplitude to a value consistent with useful output and highest accuracy. All of these functions are performed in a single tube of type 6B8G.

The Fork is designed to be driven by batteries to insure independence from impressed line frequencies. Special consideration is given to economy of battery current. The tube draws only about 2 milliamperes from a 90 volt "B" battery. An "A" battery is required supplying .3 amperes at 6 volts and in



B-3012 Vacuum Tube Tuning Fork.

addition about 1.5 amperes average to the temperature control unless the latter is operated from the power line. The fork is suitable for continuous, economical operation over long periods of time. A detachable, shielded cable with 4 conductors is supplied to connect the "A" and "B" batteries.

This economy of battery current results in small power output. Amplifiers operating from commercial power lines or batteries may be used to obtain greater power at the standard fork frequency. The fork output is from a 100,000 ohm impedance transformer, suitable for connecting to the grid of an external amplifier. Two output binding posts and a ground post are provided.

The Forks are furnished complete with tube, instructions, and a certificate of calibration, but no "A" or "B" battery or external amplifier is included in the prices given.

The maximum overall dimensions of the instrument are 10" x 24" and height 9½".

Cat. No.	Fork Material	Freq.	Price
B3012-50	Isorate Alloy	50 vps	**$625.00**
B3012-60	Isorate Alloy	60	**615.00**
B3012-100	Isorate Alloy	100	**600.00**
B3012-500	Isorate Alloy	200	**600.00**

REGULATOR CLOCKS

B-1012 Regulator Clock with Mercury Contact. The clock is equipped with a precision weight driven 8-day movement.

This substantially constructed movement has heavy brass plates with steel cut pinions and polished sapphire pallet stones. It is fitted with maintaining gears and can be wound without stopping.

The white enameled dial is 13" in diameter.

The pendulum beats full seconds. The pendulum rod is made of well seasoned wood and is fitted on the lower end with a platinum point, which sweeps over a mercury contact.

The mercury contact assures short and accurate impulses. It is provided with adjustments for equalizing the two successive time intervals, raising or lowering of the mercury cup, and for the mercury meniscus.

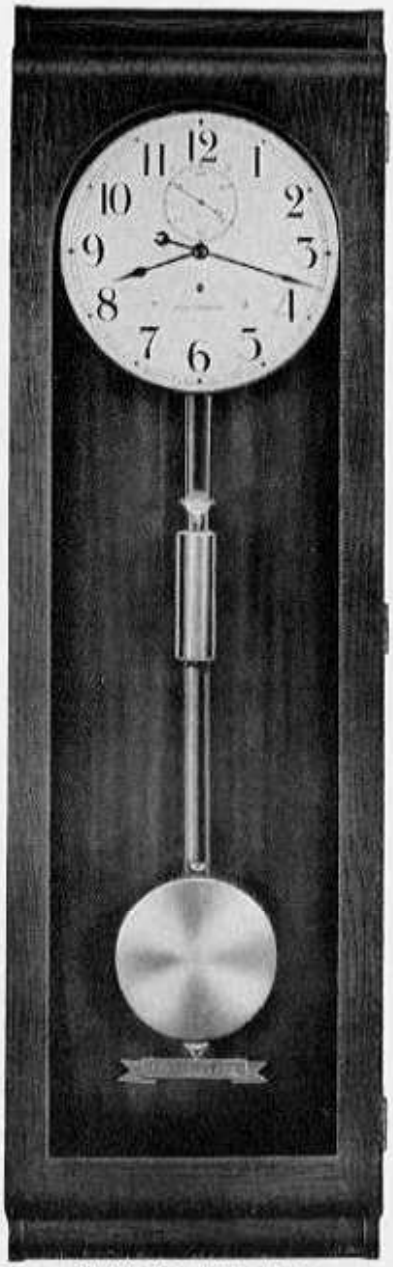
A condenser and a resistance coil is provided to overcome an excessive sparking at the mercury contact under normal load.

The case is 55½" high and 22" wide.

The clock can be regulated to keep accurate time to within plus or minus 10 seconds per month **$180.00**

B-1012a Regulator Clock with Magnetic Contact. The clock L-1012 can be equipped with a magnetic contact instead of the standard mercury contact.

The magnetic force of a small permanent magnet is used to operate the platinum contacts.



B-1012 Regulator Clock.

The device is at the lower end of the pendulum and provided with the necessary adjustment for regulating the length of contact and for equalizing the two successive time intervals. It can be furnished either as a "make" or "break" contact.

B-1012a Regulator clock with magnetic contact $210.00

B-1012c Regulator Clock with Photoelectric Contact. The photoelectric contact device has been designed to meet the requirements of highest accuracy.

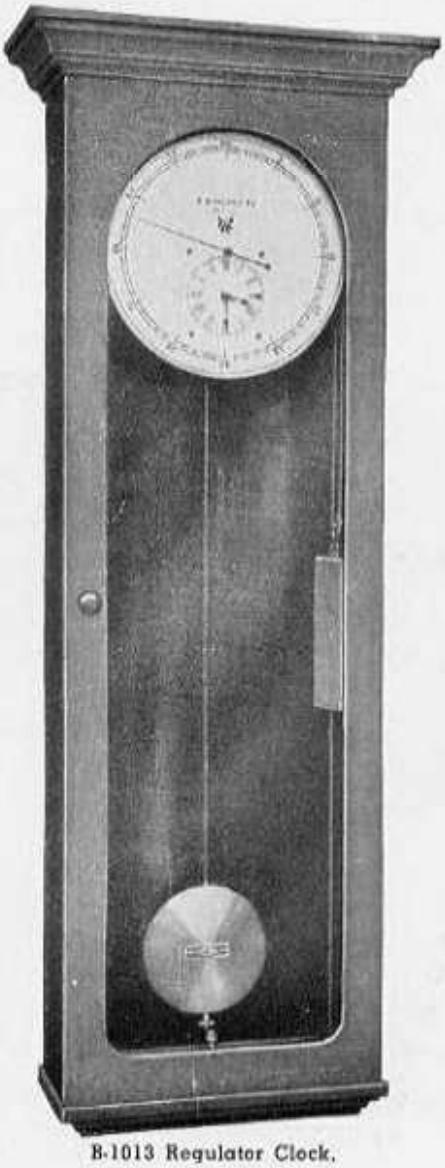
The important feature is that the interception of a light beam requires no effort of the intercepting object. Therefore the regulated movement of the clock is not affected by any exterior mechanical force, which may change its period.

The assembled device, including photo tube, and light source is enclosed in a housing and mounted separately underneath the clock case. An adjustable slit regulates the length of the contact time. A relay in the photo-electric circuit controls the external circuit.

The photoelectric contact is for operation on either 110 volts, 60 cycles AC or 115 volts DC.

B-1012c Regulator Clock L-1012 with photoelectric contact $260.00

B-1013 Regulator Clock with Mercury Contact. This precision clock is intended for accurate service in Physical Laboratories, Astronomical Observatories, etc.



B-1013 Regulator Clock.

The high grade, weight driven 8 day movement is mounted and reinforced on a heavy steel plate. The gears are cut to highest accuracy from hard rolled clock brass. The pinions and arbors are cut from solid steel rods, tempered and highly polished. The movement plates are specially heavy, affording good bearings for all pivots.

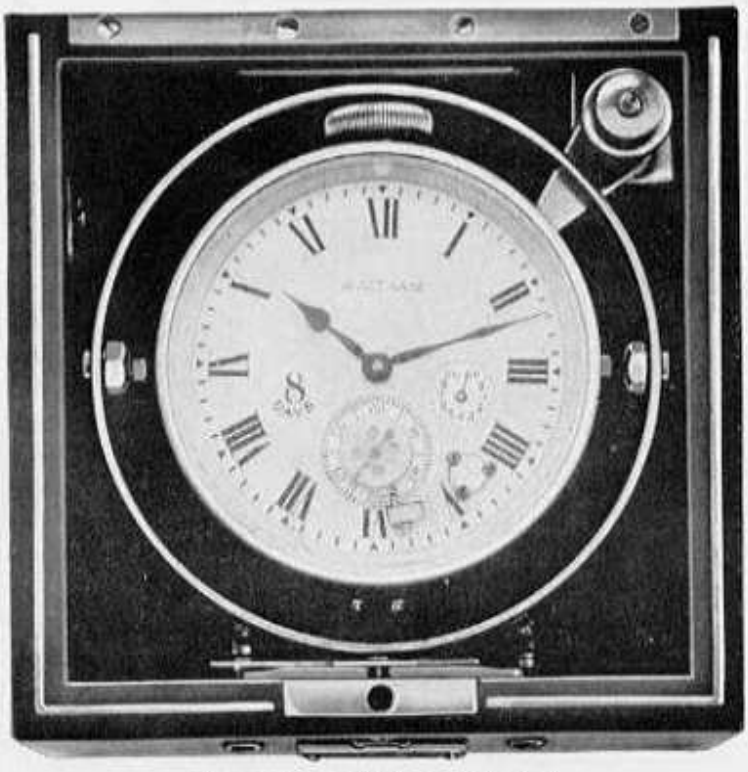
The escapement is of the Graham Dead Beat type, and the movement is made by the Howard Clock Co. according to our specifications.

The dial is 13" in diameter, enameled on zinc with all divisions accurately spaced. The hands are made of blued steel.

The hour and the minute hand are excentric, while the large second hand is concentric and can be seen from a considerable distance; a feature specially desirable in astronomical and other uses.

The pendulum beats full seconds. The rod is made of invar. The coefficient of thermal expansion for this material is 0.0000009 per unit length per degree Centigrade.

The body of the pendulum consists of a heavy lens shaped brass shell 8" in diameter and lead filled. A platinum contact is attached to the end of the rod.



Chronometer with Seconds Contact.

The mercury contact is provided with the same possibilities of adjustments as described on the B-1012 pendulum clock.

The special feature of this construction is to effect readily all these adjustments including that for the size of the mercury meniscus from the outside of the clock case.

To eliminate excessive sparking at the mercury contact a condenser and a resistance coil is provided.

The electrical connections are independent of the movement and brought to binding posts on the outside of the case.

The case is substantially built of well-seasoned birch, mahogany finished, 60" high, 17" wide and 7" deep, and is fitted with glass paneled door with lock.

The clock will keep accurate time to within ± 3 seconds per month **$280.00**

B-1013b. Regulator Clock B-1013 with Magnetic Contact as described on page 17..... **$310.00**

B-1013c. Regulator Clock with Photoelectric Contact as described on page 17..... **$360.00**

B-1010 Seconds Pendulum with electrical contact. This pendulum takes the place of a contacting regulator clock for periods not exceeding an hour. The pendulum consists of a heavy cast-iron bob attached to an invar rod suspended from a hardened steel knife edge. The electrical contact is similar to the one used on our regulator clock, consisting of an adjustable mercury well and a platinum contact attached to the end of the rod. The pendulum and contact are suitably mounted on a channel iron for wall mounting. For accurate work a cabinet or suitable protection against air current should be provided **$30.00**

PRECISION CHRONOMETERS

and various types of

STOPWATCHES

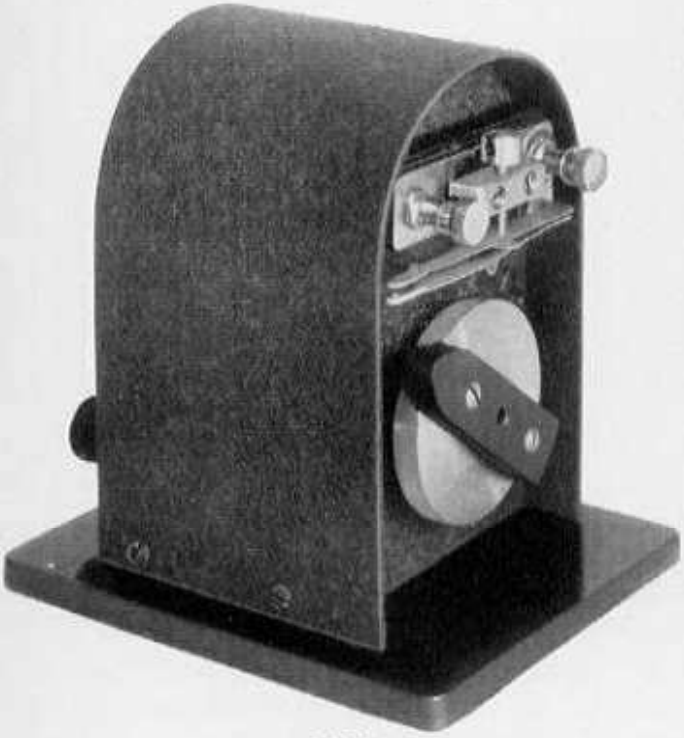
for specialized use

Description and Prices Will Be Sent on Request

B-3015 SYNCHRONOUS MOTOR CONTACTOR

This contactor is especially valuable in connection with tuning forks or cycle records and permits a fast determination of the length of periods. It is as well suited for all other circuits where a dependable source of timed impulses is required.

The contactor is driven by a slow speed synchronous motor with enclosed gear train. Its operation is necessarily uniform because it derives its energy from a source of controlled frequency.



B-3015

The synchronous motor operates a fast acting adjustable contact. The contactor can be made for any of the following intervals: ¼, ½, 1, 15, 30, and 60 seconds.

B-3015 Synchronous, motor contactor, 110 volts 60 cycles (other voltage on request). State time interval when ordering..... **$50.00**

POWER AMPLIFIER

B-2010. Amplifier. 14 Watt Output, for 105-125 volts, 60 cycle AC. When used with our Vacuum Tube Controlled Tuning Fork, this amplifier will drive the 12 watt Telechron Motors on our chronographs to assure accurate paper tape speeds.

The Amplifier has four stages of amplification and a power consumption of 100 watts. The output transformer is tapped for impedances of 3, 6, 250 and 500 ohms.

Price, less tubes..... **$60.00**
Set of Tubes for Amplifier..... **10.00**

SENSITIVE RELAY

B-10149

This high sensitive relay is designed for direct current circuits, where the available power for operation is relatively small.

Its low power consumption makes it ideal for operating chronograph recording elements from delicate contacts on chronometers and clocks, in vacuum tube amplifier circuits, or other devices which cannot carry the larger currents required.

The relay is rated at 11.25 milliwatts for positive operation and it may be adjusted to operate on as little as 1.25 milliwatts.

Four different coil resistances are available, covering most of the operating current and voltages required in sensitive relay applications. Standard values are: 1,000, 2,500, 5,000 and 10,000 ohms.

The contact assembly is mounted as an integral part of the relay. The contacts are of sterling silver capable of interrupting an inductive load of 3 amperes at 6 volts for which spark protection is provided.

Each relay is mounted in a protecting case with cover to permit easy access. External terminals are provided.

B-10149 Sensitive Relay..... **$25.00**
(State coil resistance)

PHOTOELECTRIC RELAYS

The Photoelectric Relay is a useful accessory to our chronographs for recording and timing events that can be marked by the interruption of a light beam. It is especially adapted for timing the motion of very delicate apparatus without disturbing its operation.

Some typical applications are the study of moving parts on machinery or laboratory apparatus, determination of velocities of moving parts or objects, determination of psychological reaction times, timing of races or speed tests, production operations, etc. A suitable light source can be furnished for any of these applications.

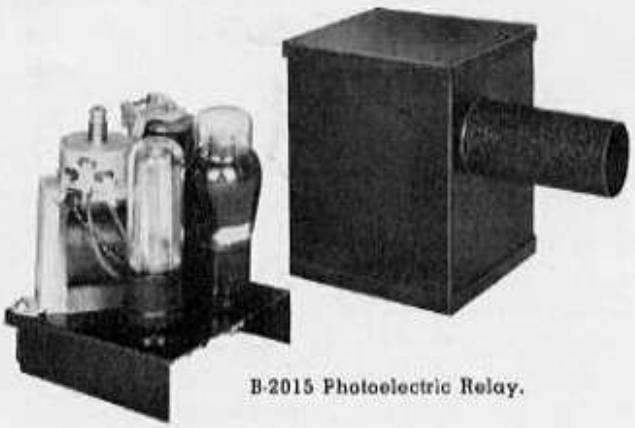
The Photoelectric Cell, Amplifier Tube, Transformer, Potentiometer, Electromagnetic Relay, and other parts are mounted on a base which fits into a case 4" x 4" and 5" high. The light is admitted through a 1⅜" diameter shielding tube. The relay closes one circuit and opens another when the light beam is intercepted. A convenient grid bias adjustment permits selection of the light level at which the relay operates.

Six terminals on the base, and a six-foot cord and plug for necessary connections are provided. Finished in durable black crystal enamel.

B-2015A. Photoelectric relay, for 110 volts, 60 cycle AC, power consumption 5 watts. The relay in this unit controls up to 200 watts non-inductive load and has a set of normally open and normally closed contacts **$32.00**

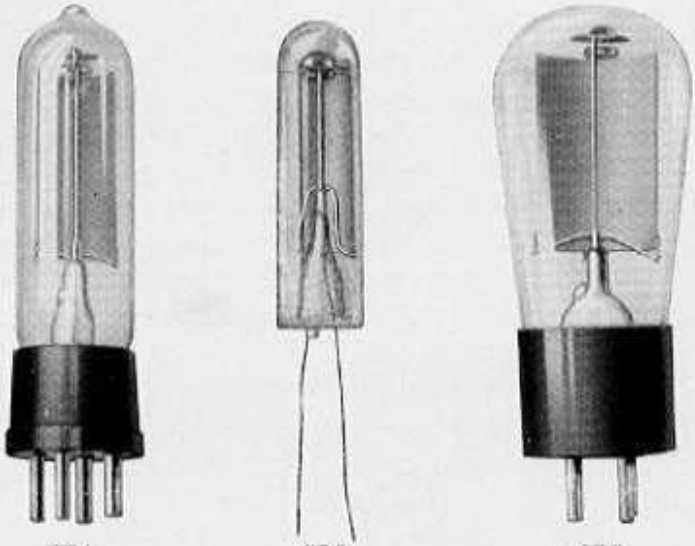
B-2015B. Photoelectric relay, for 110 volts, DC, power consumption 12 watts. Relay contacts are the same as on Model B-2015..... **$32.00**

B-2015C. Photoelectric relay operates on either 110 volts AC or DC, power consumption 12 watts. The relay contacts in this unit will break 75 watts non-inductive load..... **$22.00**



B-2015 Photoelectric Relay.

PHOTOELECTRIC CELLS



CE-1 CE-5 CE-7

These Cells have a wide range of commercial and laboratory applications. We have watched the development of Photoelectric Cells and are pleased to offer this excellent line. The cells are manufactured under patented processes which give a uniformity heretofore not attained, and a higher sensitivity at normal operating voltage (90 volts) coupled with high ionization voltage. These Cells will withstand an ambient temperature which has proved destructive to other similar Cells. Unless otherwise specified, the Cells are filled with Argon gas at a low pressure.

The vacuum cells have approximately one-quarter the sensitivity of the corresponding gas cell. Complete technical details on request.

CE-1 Photoelectric Cell, Gas Filled. This Cell is universally used for general photoelectric work. The cathode is 1½" long and has an effective width of ⅝".

CE-1V Photoelectric Cell, Vacuum, same dimensions as the CE-1 Cell.

CE-5 Photoelectric Cell, Gas Filled. Unmounted, two lead wires coming from the stem. The cell is applicable where space is at a premium. The cathode is 1" long and has an effective width of $\frac{3}{16}$".

CE-5V Photoelectric Cell, Vacuum, same dimensions as the CE-5 Cell.

CE-7 Photoelectric Cell, Gas Filled. For all purposes and general uses where large plate area can be used. The length of the cathode is 1⅝" with an effective width of $\frac{1}{16}$".

CE-7V Photoelectric Cell, Vacuum, same dimensions as the CE-7 Cell.

NOTE: Prices of cells depend on sensitivity and range from $1.50 up. Bulletin on request.

ELECTRIC MOTORS

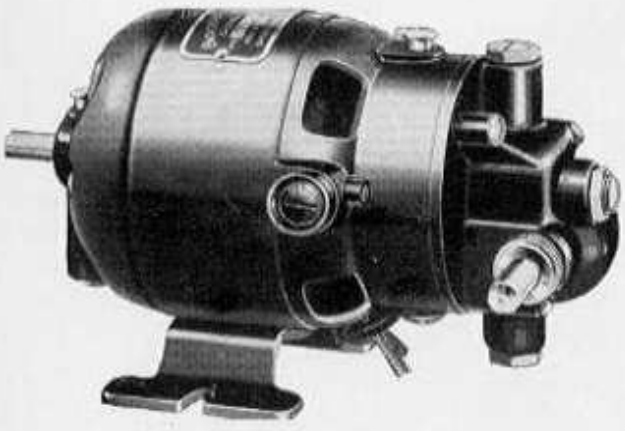
SPEED REDUCER MOTORS

Variable Speed Universal Ball Bearing Motor. 115V A.C. or D.C., with high and low speed shaft. Rated 1/80 H.P. at 5000 R.P.M. The high speed shaft can be varied from 5000 to 2000 R.P.M. by means of the B-322 Rheostat listed below. The R.P.M. of the gear reducer shaft is given below and can be varied in the same proportion. Great flexibility of application is possible by this variety of speeds. Shaft diameter $\frac{3}{16}$", high speed shaft height 2", reducer speed shaft height $1\frac{3}{32}$", overall length $6\frac{3}{32}$", height $3\frac{3}{32}$", width $3\frac{3}{64}$". Finished in glossy black baked enamel.

Cat. No.	R. P. M.	Speed Reducer Shaft R. P. M.	Price
B-1520	5000	7	**$16.70**
B-1527	5000	35	**16.70**
B-1529	5000	200	**15.00**
B-1533	5000	500	**15.00**

Shaded Pole Induction Motor, 110V, 60 cycle, A.C., with high and low speed shaft. Rated 1/400 H.P. at 1600 R.P.M. Speed reducer shaft speeds are listed below. Shaft diameter $\frac{3}{16}$", high speed shaft height $1\frac{3}{16}$", reducer speed shaft height $1\frac{3}{32}$", overall length $6\frac{3}{32}$", height 3½", width 3⅛". Finished in glossy black baked enamel.

Cat. No.	R. P. M.	Speed Reducer Shaft R. P. M.	Price
B-1582	1600	2.6	**$11.50**
B-1586	1600	11.	**11.50**
B-1590	1600	45.7	**10.25**
B-1594	1600	207	**10.25**



B-1520 Variable Speed Motor.

Single Phase Induction Motors, 110V, 60 cycle, A.C., split-phase type. An exceptionally sturdy motor for constant speed and continuous duty on demonstration apparatus and experiments. Shaft diameter ⅜", shaft height 2⅝", overall length 6⅝", height 4⅞", width $4\frac{13}{16}$". Finished in glossy black baked enamel.

Cat. No.	Full Load Speed R. P. M.	H. P.	Price
B-4158	1125	1/40	**$10.30**
B-4208	1725	1/20	**9.00**
B-4258	3450	1/20	**12.60**

B-4158 Induction Motor.

B-3013 Electric Motor. 115 volt AC. A small 22 pole synchronous clock motor of low power consumption and extremely compact construction which can be driven directly from the L-3012-50-100 Tuning Fork for stroboscopic discs, contact devices, small timing equipment or other purposes. Makes one revolution for each 11 cycles of the fork..... **$2.50**

B-2000. Laboratory Motor, Governor Controlled, adjustable speed 115V, AC or DC, with high and low speed shaft. A definite need for a governor controlled, Universal, variable speed motor has been most efficiently met for laboratory experiments and demonstration by this sturdy and dependable motor.

Controlled by an electrical contacting governor, the speed of one of the two shafts can be almost perfectly set between 85 R.P.M. and 2500 R.P.M. The governor is so sensitive that the slightest change in the speed interrupts the normal flow of current in a special winding at a rate of 150 to 480 times per second (determined from oscillograph records). The

governor contacting unit is well protected against excessive sparking by a shunt condenser and resistance, thereby greatly lengthening the life of the unit. A small box on the motor housing contains the condenser and the toggle switch for starting and stopping the motor. The resistance units are mounted within the motor. The motor is of approximately 1/50 H.P., varying somewhat, however, with the gear ratio and speed.

The motor is designed with two shaft extensions, each fitted with a pulley. Chuck threads are on each spindle, and diameters up to ¼" can be accommodated on either shaft by interchanging the chuck collar. The overall dimensions of the motor without chuck are as follows: length 8", width 6 1/16", height 5 3/16".

The motor is provided with two 19mm holes at right angles to each other, and a clamp screw, thus permitting mounting in a horizontal or vertical position on our standard laboratory supports or clamps. The illustration shows the motor mounted on our standard elevating stand.

The motor is finished in glossy black enamel and furnished complete with two pulleys, chuck, plug, and 10 feet of rubber covered connecting cord, but with no support..... **$54.50**

B-2001. Laboratory Motor. Governor Controlled, adjustable speed, 220V, AC or DC. Same as B-2000 except for higher voltage..... **$56.50**

B-2004. Shunt Wound DC Motor, 12V. A sturdy and well built motor for general utility in the laboratory and shop. Speed 1725 R.P.M., 1/20 H.P. Shaft diameter ⅜", shaft height 2⅝", overall length 7⅛", height 4⅞". Finished in glossy black baked enamel **$21.85**

B-322 Speed Control Rheostat. 50 watt, 225 ohms. For use with B-1520-1533 Series Wound Motors to vary the shaft speeds down to 40% of the rated full load speed. The resistance is wound on a circular porcelain core and mounted on a porcelain base. A bakelite knob controls the rotation of the roller contact **$4.00**

E-422 Pulley. Single, iron, with set screws. Shaft diameter 5/16". Grooved for ¼" round belt. Pitch diameter 1" **$0.40**

B-2000 Governor Controlled Motor.

PARTIAL LIST OF GAERTNER CHRONOGRAPH USERS

ADLER PLANETARIUM,
Chicago, Ill.

AMTORG TRADING CORPORATION,
New York, N. Y.

UNIVERSITY OF CALIFORNIA,
Los Angeles, Calif.

CARLETON COLLEGE,
Northfield, Minn.

CATHOLIC UNIVERSITY OF AMERICA,
Washington, D. C.

UNIVERSITY OF CHICAGO,
Chicago, Ill.

COMBUSTION UTILITIES CORPORATION,
New York, N. Y.

CITY OF DAYTONA BEACH,
Daytona Beach, Fla.

DUKE UNIVERSITY,
Durham, N. C.

GENERAL ELECTRIC COMPANY,
West Lynn, Mass.

GENERAL RADIO COMPANY,
Cambridge, Mass.

GEORGETOWN UNIVERSITY,
Washington, D. C.

HARTFORD EMPIRE COMPANY,
Hartford, Conn.

UNIVERSITY OF ILLINOIS,
Urbana, Ill.

JOHNS HOPKINS HOSPITAL,
Baltimore, Md.

UNIVERSITY OF KENTUCKY,
Lexington, Ky.

UNIVERSITY OF MAINE,
Orono, Me.

METRIC METER WORKS,
Erie, Pa.

MIAMI UNIVERSITY,
Oxford, Ohio

UNIVERSITY OF MINNESOTA,
Minneapolis, Minn.

UNIVERSITY OF MISSISSIPPI,
University, Miss.

MITCHELL FIELD,
Garden City, L. I., N. Y.

NATIONAL AERONAUTIC ASSN.,
Washington, D. C.

NAVAL RESEARCH LABORATORY,
Bellevue, Anacostia, D. C.

N. Y., N. H. & HARTFORD R. R. CO.,
New York, N. Y.

NORTHWESTERN UNIVERSITY,
Evanston, Ill.

OHIO STATE UNIVERSITY,
Columbus, Ohio

GEORGE PEABODY COLLEGE,
Nashville, Tenn.

UNIVERSITY OF PITTSBURGH,
Pittsburgh, Pa.

PITTSBURGH EQUITABLE METER CO.,
Pittsburgh, Pa.

POS LABORATORIES,
Portland, Ore.

RCA COMMUNICATIONS, INC.,
New York, N. Y.

SIGNAL CORPS LABORATORY,
Fort Monmouth, N. J.

SPRINGFIELD ARMORY,
Springfield, Mass.

BUREAU OF STANDARDS,
Washington, D. C.

STANOTYPE COMPANY,
Indianapolis, Ind.

THE TEXAS COMPANY,
New York, N. Y.

UNITED GAS IMPROVEMENT CO.,
Philadelphia, Pa.

U. S. COAST & GEODETIC SURVEY,
Washington, D. C.

U. S. DEPT. OF COMMERCE,
Washington, D. C.

U. S. NAVAL OBSERVATORY,
Washington, D. C.

WESTERN ELECTRIC COMPANY,
Chicago, Ill.

WESTERN ELECTRIC COMPANY,
Chicopee Falls, Mass.

WESTINGHOUSE ELEC. & MFG. CO.,
Springfield, Mass.

WHEATON COLLEGE,
Wheaton, Ill.

WIRED RADIO, INC.,
Ampere, N. Y.

UNIVERSITY OF WISCONSIN,
Madison, Wis.

WITTENBERG COLLEGE,
Springfield, Ohio

U. S. AIR CORPS,
Wright Field,
Dayton, Ohio

COMISION COLOMBIANA DE LIMITES COM EL BRASIL,
Manaos, Brazil

NATIONAL OBSERVATORY,
Rio de Janeiro, Brazil

CHINESE ENG. & DEVELOP. CO.,
Tientsin, China

SUNSTAR SCIENTIFIC CO.,
Tientsin, China

FUTABA AND COMPANY, LTD.,
Tokyo, Japan

TAKATA AND COMPANY,
Tokyo, Japan

DE ESTUDIOS GEOGRAFICO Y CLINEATOLOGICOS,
Tacubaya, Mexico

ALPHABETICAL INDEX

CORRECTIONS

Page 8 B 372 (tape speed 12·60 mm) should read B 372a
Page 9 Sample Record Tape, item 2 should read B 3003
Page 14 under B 3004, line 6, should read B 3003
Page 15 B 3004·50, should read B 3004·60
Page 16 B 3012·500, should read 500 vps
Page 16 B 1012 a, line 2, should read B 1012
Page 17 reference to L 1012 should read B 1012