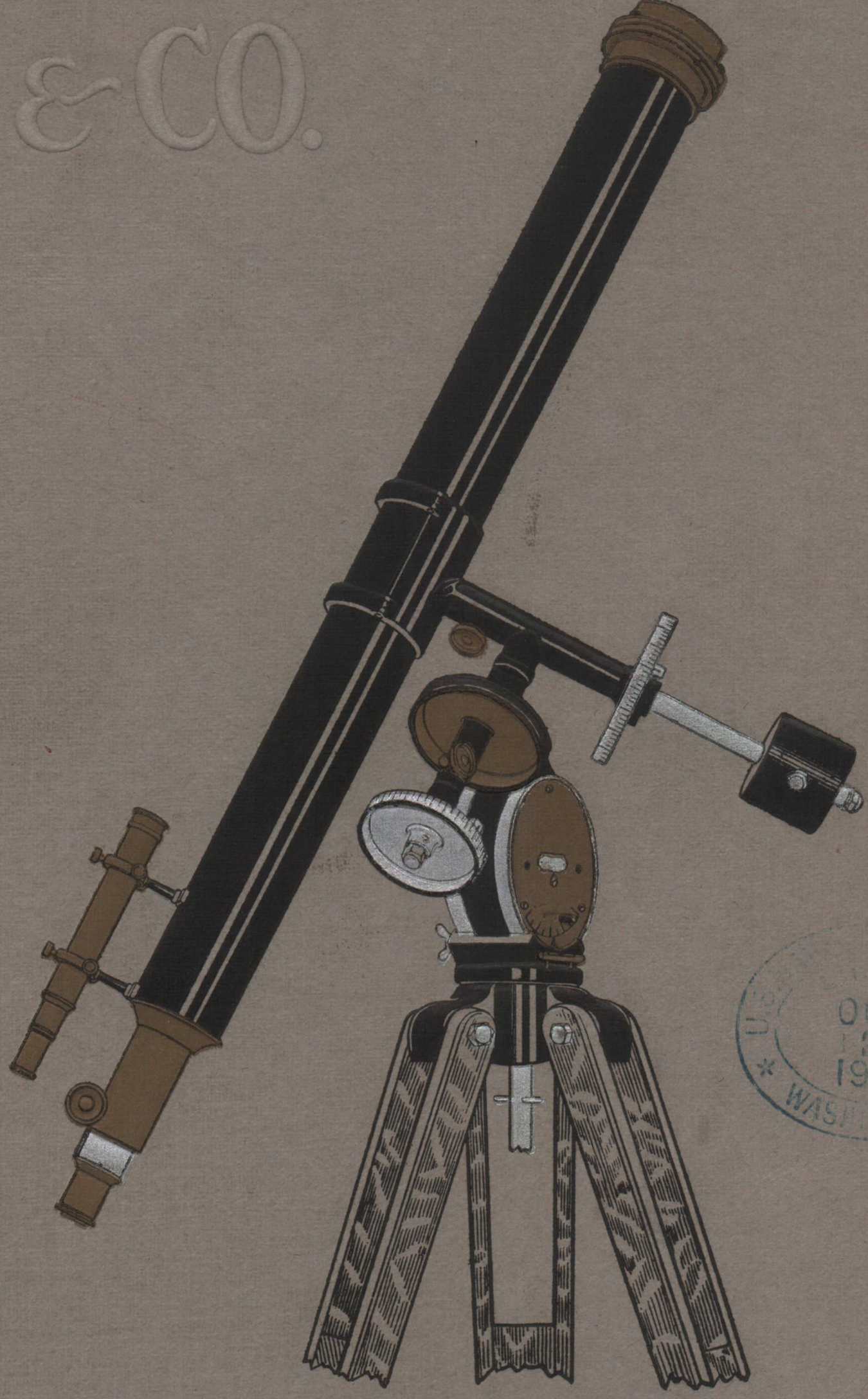
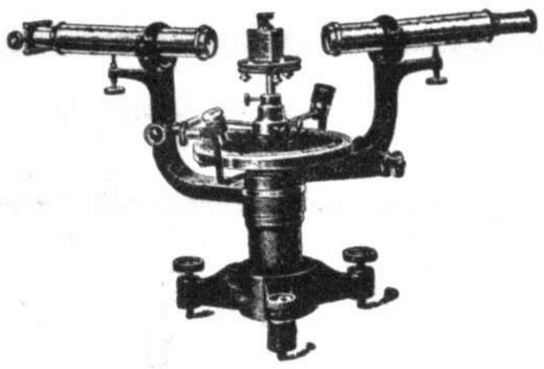
Gaertner & Co.

WM. GAERTNER & CO.



CHICAGO

52523



FROM

Wm. GAERTNER & CO.

Scientific Instruments

5345-49 Lake Park Ave. Chicago, Ill.

To Prof. Asaph Hall,

U.S. Naval Observatory,

Washington, D.C.

Astronomical

and

Astrophysical Instruments

"—that yearning eyes
beyond the bounds restraining mortal's sight
may penetrate where far above the night
the stars in mystic splendor stud the skies . . ."

A. N. W.

Wm. Gaertner & Company
Chicago

TERMS

Ordering. In ordering give catalog number and name of article.

Shipments. In the absence of definite instructions we use our best judgment as to method of shipment. Small orders and delicate apparatus will be sent by express or by parcel post. The smaller instruments are usually shipped completely assembled and ready for use. The larger instruments have to be dismounted and the parts are packed separately. Full instructions for mounting and adjusting are sent with each instrument and if desired experienced men can be furnished to take care of the erecting.

Packing. Packing will be done with the greatest care and is charged for at cost.

Time of Delivery. The smaller telescopes can usually be shipped within a few weeks from receipt of order. If specially requested we confirm time of delivery on larger instruments, and every effort will be made to fulfill our promises.

Prices of all instruments and accessories listed in this catalog are given on a separate price sheet and are based on the latest cost of production. The prices are net cash, no discount being allowed for payment in advance. Orders for larger instruments, constructed to order, must be accompanied by a remittance covering one-third of the purchase price. Government institutions and customers having established credit are excepted from these terms.

We do not deal in second hand instruments nor do we take instruments in trade.

We shall be glad to answer any inquiries concerning our instruments but we request our correspondents to first look over the pages of this catalog which give details of construction and specifications.

WM. GAERTNER & CO.

INTRODUCTION

The instruments described in this catalog include the standard types of astronomical telescopes, astrophysical instruments, the most desirable accessories and other apparatus which will be found useful by astronomers. Astronomical instruments for which the demand is very limited have not been listed, as such apparatus is constructed to order only and to suit special requirements, but we illustrate some of the many different kinds of instruments which we have constructed and shall be glad to send to interested parties further particulars and quote prices. We are prepared to furnish complete observatory outfits including domes, observing chairs, etc. Estimates and specifications on such equipments we shall be glad to furnish on application.

For the selection of a telescope equipment we refer to pages 11 to 13 and trust that the information concerning adaptability and use of the different instruments, and the specifications covering design and construction, together with the illustrations, will be of interest and assistance to the prospective purchaser. We shall be very glad to give more detailed information about our instruments, and advice in regard to selection of a suitable outfit. It will be of material assistance if we are advised as to the intended purpose.

Every effort is made to produce instruments of the highest quality, which will meet the most exacting requirements, and special attention is paid to the design in which not only all essential requirements are carefully considered but at the same time it is aimed to give each part and the whole instrument a graceful and elegant appearance. The most suitable materials are carefully selected for the construction of our astronomical instruments and the best workmanship of mechanical and optical parts is assured.

We have many years of experience in the construction and designing of high grade astronomical apparatus of great variety and have had and still have the valuable advice and assistance of many foremost astronomers and physicists. Being excellently equipped with modern facilities for economical and precise manufacture and having the assistance of a carefully trained staff of able scientists, skilled instrument makers and opticians, we can produce instruments of the highest excellence. Before an instrument leaves our works it is subject to a rigid test in the laboratory and in actual use on the stars, and assurance is given that all parts are in perfect adjustment. If the customer desires he may inspect and test the instrument at our works before it is shipped or he may appoint some one to act as his agent in which case we shall be glad to give every possible assistance.

Many valuable suggestions have come to us from prominent practical astronomers which have been of material help to us in developing new designs and in producing instruments which meet all modern demands. We take this means of thanking our friends and patrons for their kind assistance and for the confidence bestowed on us in the past and wish to assure them that all efforts will be made to deserve their continued patronage.

WM. GAERTNER & CO.

GENERAL SPECIFICATIONS

The specifications given below cover in general the design and construction of all our astronomical telescopes and accessories regardless of size and style. The specified mechanical and optical equipments of the various telescopes listed are selected with the view to furnish an instrument as complete as consistent with the size of the objective and we advise the purchase of the instrument complete with the accessories as listed in the catalog. One or the other of the accessories may, however, be omitted and others substituted and as they are listed separately, the price of the equipment can be ascertained.

Astronomical telescopes are classified according to optical equipment as Refracting and Reflecting, and as Visual and Photographic telescopes; as to style of mounting as Alt Azimuth, Equatorial, Transit, Zenith telescopes, etc. and in respect to size according to the diameter of the objective, or as Portable, Semi-Portable, and Stationary instruments. In this catalog we list a complete line of refracting telescopes with alt azimuth and equatorial mountings, also the most desirable accessories and some special instruments. We shall be glad to send specifications and prices on reflecting telescopes and on other astronomical instruments.

The Alt Azimuth Mounting has a vertical (azimuth) axis and a horizontal (altitude) axis which latter carries the telescope. This style of mounting permits the easy setting of the telescope on any object and is recommended for terrestrial use, for star gazing and comet seeking, but it is not well suited for longer observations of planets or stars as it does not permit one to follow their apparent daily motion caused by the rotation of the earth. Delicate adjustments for both motions may be provided and are of great convenience.

The Equatorial telescope has one axis (polar axis) which is adjusted parallel to the earth's axis, which means it is directed toward the north star, and the other (declination axis) at right angles to it. The telescope is mounted at right angles on this latter axis. Both axes are usually fitted with graduated circles, which enable the observer to find any celestial object of which right ascension and declination are known.

In order to keep the object in the field of the telescope it is necessary that the telescope follow the apparent motions of the stars, which means that the polar axis has to be rotated at a velocity of one revolution in 24 hours. This motion is usually accomplished by attaching to the polar axis a wormwheel in which engages a worm, the latter being turned either by hand or by clock work. The larger telescopes of this type are constructed with the polar axis fixed for the latitude of the place where the instrument is mounted. The smaller sizes are made adjustable for different latitudes.

The Portable Equatorial Telescopes from 3 to 4 inches aperture (76 to 102 mm.) fitted with circles and driving clock, are distinctly new in design and a decided advance over anything similar offered elsewhere. The latest models (type A120-A122) are the result of many years of study of the requirements for such instruments, and of efforts at perfecting their design in every detail. On account of their general usefulness, their great convenience, their excellent optical performance, and their elegant appearance, they have become recognized throughout the world. These telescopes are easily portable, quickly adjusted to any latitude, and may be changed to Alt Azimuth mounting within a few seconds. For school observatories a large number of these telescopes have been furnished. They are giving the best of satisfaction and in many cases have taken the place of the more expensive stationary mounted instruments. For the amateur astronomer, for country houses or hotels, these instruments offer special advantages as will be explained in the detailed description on later pages.

Larger Portable Telescopes from 5 to 6 inches in aperture (127 to 152mm.) are mounted on a steel pedestal fitted with casters and leveling screws. The steel pedestal when locked to a solid foundation, will give the same stability as an iron pillar and has the important advantage that it does not require an expensive observatory dome. Such an instrument when not in use, is kept in shelter near the observing platform, and can be made ready at a moment's notice. These telescopes are furnished if desired with clock, circles and slow adjustments, similar to those used on stationary mounted instruments. For terrestrial observatories they are equally well adapted since a vertical axis is provided on which the whole instrument can rotate.

Stationary Mounted Telescopes. Telescopes of 6 inches (152mm.) aperture and larger cannot very satisfactorily be used on portable stands; they are usually mounted on an iron pillar and properly housed in order to get all the advantage of their greater aperture. Our larger telescope mountings are designed with special regard to stability, durability and ease of manipulation. The stationary parts are given all the necessary weight to assure rigidity, the moving parts are made amply strong without adding unnecessary weight, and screws and solder joints have been avoided wherever possible by joining as many parts as practical in one casting. The driving clock is designed to be especially powerful so as to carry easily not only the telescope but also any attachments which may be added. All delicate parts are carefully covered. The delicate motion adjustments are in very convenient reach at the eye end of the telescope. On the larger sizes, from 10 inches up, a sidereal clock dial and setting wheel for right ascension are placed on the north side of the pillar at convenient heights.

DETAILS OF CONSTRUCTION

The Objectives with which our telescopes are fitted are usually of the standard doublet type and have a focal length equal to about fifteen times their aperture. The objectives are constructed of the best optical glass, selected with due regard to durability, and they are corrected to eliminate the chromatic and spherical aberrations as completely as thorough computation and the greatest patience in making will permit. All objectives up to nine inch aperture are mounted in brass cells, the larger one in cells of iron or steel, and all are fitted with adjustment for collimation. The telescopes can be furnished with triplet objectives of short focus (ratio about 1 to 8), with objectives corrected for photography, or with objectives free of secondary spectrum (ratio 1 to 18).

The Eyepieces which we regularly furnish with the telescopes are of the Huygenian type (negative) and up to 1½ inches (38 mm.) focus are of standard size, diameter 1.25 inch (32 mm.). An eye cap, which can be unscrewed and interchanged with a dark glass for solar or lunar observation is provided. The Huygenian eyepiece gives an inverted image, which, however, is not objectionable in astronomical work. It gives a large flat field of vision and is free from interior reflections. As the image is located between the lenses, it cannot be conveniently used with cross wires. With the smaller portable telescopes a set of 3 or 4 eyepieces of different magnifying power, a Zenith prism, and suncap are furnished. They are packed in a neat case which can be attached to the steel frame of the tripod so that the eyepieces are always within convenient reach.

The Ramsden Eyepiece (positive) has the image in front of the field lens, and can therefore be provided with cross wires. Its field is flat but not quite as large as in the Huygenian; it is used on Transits, with Filar Micrometers, etc.

The Zenith Prism Adapter is furnished with all our astronomical telescopes, since it is almost indispensable and a necessity for observing stars near the Zenith. This attachment consists of a total reflecting prism mounted in a case with two tubular extensions. One of these is of the standard outside diameter and fits in the telescope draw tube; the other is of proper size to receive the standard eyepieces. The prism is made of the best clear optical glass with accurate optically flat surfaces so that there is little loss of light and no loss of definition whatever.

For Solar Observation special eyepiece attachments are required. A sun cap of dark glass to be placed in front of the oculars is always included in the equipment. To avoid cracking of the eyepiece lenses and sun glass due to the focused heat rays, it is necessary that the aperture of the objective be reduced to about two inches. A diaphragm is furnished for this purpose.

The Reflecting Solar Eyepiece Adapter consists of a single wedge prism which reflects about four percent of the sunlight to the eye. This adapter is suitable for telescopes of small apertures, but can be used on larger telescopes in connection with a sun cap.

A more satisfactory polarizing eyepiece adapter for use with larger telescopes consists of three prisms of which the last one can be rotated (with reference to the other two) so that the intensity of the light may be reduced to any desired degree.

The Triple Revolving Adapter is a very desirable attachment to the telescope eye end. It is designed to hold three eyepieces of different powers and permits a quick change from lower to higher powers, a convenience which every observer will appreciate.

The Erecting Prism Adapter serves together with any celestial eyepiece as a terrestrial eyepiece. It consists of two large right angle prisms mounted together in a case, which is attached to the eye end of the telescope and has a tubular extension for receiving any of the standard eyepieces. This form of terrestrial eyepiece is in many respects preferable to the four lens eyepiece; as it is more compact, requiring instead of an extension a shortening of the draw tube.

The Telescope Tubes of the smaller instruments are made of hard drawn brass tubing. The larger telescopes are made of double conical steel tubes, designed so as to give the greatest strength with minimum weight. All tubes are provided with a sufficient number of diaphragms. The brass tubes are finished in a bright black japan, which is baked on and very durable. The tubes of the portable equatorials are easily removable from their mountings. They are provided with an adjustable collar which clamps around the tube and serves as a stop against the cradle, so that the telescope always comes back in the same position and in balance.

Focal Adjustment. The eye end is fitted with an extra long draw tube of large diameter having a strong diagonal rack and pinion which gives a soft and smooth motion. The range is sufficient to accommodate the different eyepieces and adapters without using an extra draw tube. On the larger telescopes a clamp screw is provided to secure the position of the draw tube after focusing. The adapter for the eyepiece can be unscrewed and a micrometer, spectroscope, or other attachments may be fitted in its place.

Finders. In order to locate the star, or any object in the field of a larger telescope, it is necessary to have a small, low power telescope which gives a bright image and large field, mounted to the large one so that their optical axes are parallel. The eyepiece of the finder is provided with a set of cross wires and if a star is brought near the intersection of these wires it will be visible in the field of the larger telescope. The finder is mounted in two brackets so as to be adjustable. A finder of proportionate size is furnished with each telescope.

Micrometers. A position micrometer is one of the most desirable attachments to the telescope, as it gives excellent means of training the eye for close observations and is indispensable in making accurate measurements, which will always be of some scientific value even if made with a small telescope. The micrometer is used for measuring small angles, diameters of the sun, the moon, etc., and distances of double stars, which cannot be done with the divided circles of the telescope. The most commonly used and convenient type of micrometer is the Filar Screw Micrometer. The measurements are made by means of two or more threads in the field of the eyepiece. One or more threads are stationary; one or more are mounted on a carriage which is moved by a micrometer screw. The arrangement of the threads depends upon the measurements to be made, whether measurements of small angles in any part of the sky, time observations, or measurements of Zenith distances. In order to use the micrometer in any position in the heavens it is made to rotate on an axis parallel to the axis of the telescope and the angles can be read on a divided circle (position circle). The micrometer threads are illuminated in order to be visible in the dark field of the eyepiece, which is accomplished by a small electric lamp attached to the instrument. The accuracy of the measurements depends (not considering the experience and skill of the observer) on the accuracy of the micrometer screw and on the design. We have studied the problem of producing precision screws for many years and are in position to guarantee our micrometer screws to be of the highest precision obtainable. The Repsold design of micrometer is recognized the best and has been adopted by us.

A position micrometer can only be used with satisfaction on a substantially mounted equatorial telescope fitted with driving clock and slow motions but even our smaller telescopes (Type A120-A122) are well suited for carrying a position micrometer.

Photographic Attachments. In modern astronomy, photography has largely superseded visual observations since a photographic plate once made may contain the equivalent of hundreds of visual observations. The plates can be studied at leisure and in comfort and with the aid of an accurate comparator, and for this reason will generally give equally or even more accurate results than those obtained by measuring devices attached directly to the telescope. Stellar photographs can only be satisfactorily taken with telescopes fitted with clock work and delicate motion adjustments but photographs of the sun and the moon can be taken with instantaneous exposure. Our small three to four inch portable equatorial telescopes can be used for celestial photography either by attaching a regular photographic camera to the body of the telescope or by using the telescope objective as a photographic lens, and the photographic plate at the eye end. In the former case, the telescope is fitted with a positive eyepiece and cross hairs and is only used for guiding, that is, the observer while exposing the photographic

plate, views at the same time a star, and by using the delicate motions keeps it exactly on the crosswires. When the telescope lens is used as photographic objective the accuracy of the driving clock must be depended upon and in this case only short exposures can be given even with the best of clocks.

Larger telescopes intended for photography are fitted with a double slide plate holder with guiding eyepiece which allows of selecting and following a star in the field while the plate is being exposed. In this manner exposures of any length of time may be given. If the objective is corrected for visual observations, a color screen should be used in the path of the rays in order to obtain sharp photographs. If larger images are desired, a negative amplifying lens in front of the plate or a Huygenian eyepiece can be used.

Spectroscopic Accessories can be fitted to any of our telescopes but satisfactory observations can only be obtained with larger stationary equatorials. For the smaller 3 to 4 inch telescope the simple form of direct vision spectroscope fitted with prism or a grating is recommended. The larger spectroscopes can be fitted with several prisms and photographic camera. Several of the large spectrographs in use at the Solar Observatory of the Carnegie Institute were constructed by us and we shall be glad to give estimates on such.

The Tripods intended to carry telescopes up to 4 inch aperture are designed to give the greatest strength, rigidity and convenience. The tripod legs are made of well seasoned red birch finished in natural color and are fitted with iron shoes. A folding steel frame attached in the middle of the legs allowing them to spread the proper distance and keeping them firmly locked in position, adds considerably to the rigidity.

The Pedestal for Larger Telescopes (5 to 7 in.) is substantially constructed of steel tubing and carries on top a light but strong iron head to which the equatorial mounting is attached. At about the middle, the three pedestal legs are connected by a frame of steel tubing. The three feet are fitted with shoes which carry casters and strong leveling screws.

The strength and stiffness of this pedestal is equal to that of an iron pillar and a 6 or 7 inch telescope can be supported with entire satisfaction. This form of support has many advantages over the tripod and over the stationary iron pillar. The instrument can be taken from the housing without removing the telescope and can be rolled onto a platform. The platform should be only large enough to support the three legs of the pedestal so that the observer will stand on an independent floor and not transmit any vibration to the instrument. The telescope can be made ready for observing in a few minutes and can be used as satisfactorily as a permanently mounted instrument. The instrument if exposed to the wind, should be protected by a shield of wood or canvas in order to prevent vibration. The pedestal is very elegant in appearance, the steel tubing being durably enameled.

The Pillar for supporting larger stationary telescopes is a hollow iron casting of rectangular cross section. It is designed to assure the greatest strength and stiffness and the walls are of sufficient thickness to give ample weight. The clock weights run inside the pillar and a door at a convenient height allows access. The clock case and bearing for polar axis are in the smaller instruments (up to 8 in.) cast in one piece. This casting is attached to the pillar by four strong screws but a slight adjustment in azimuth is provided. The rough adjustment is made by turning the pillar on the foundation. We also furnish a pillar for our smaller equatorial telescopes (A120-A122) which may be erected in a suitable spot in the open air and will not need protection as it is the intention to keep the telescope in the house and only mount it on the pillar when wanted for use. The pillar top is of the same size as our standard tripod head and is fitted with an adjustable stop which will bring the telescope always in the same position so that the adjustment for azimuth need only be made once. The cross section of the pillar is circular.

The Axes and Bearings of our telescopes are made of ample length and diameter to assure rigidity. Such materials are selected as will give the best wear and least friction and will not easily be affected by changes of temperature. On the larger telescopes these axes are fitted with anti-friction roller or ball bearings.

The Driving Clock is one of the most important parts of an astronomical telescope. Our clocks are designed to give ample power to carry the telescope with all accessories. The smaller clocks used for the portable 3 to 4 inch telescopes are fitted with two strong helical springs and with a friction governor which controls the speed very closely so that a star can be kept in the middle of the telescope field for from 15 to 20 minutes. These clocks will not transmit the least vibration to the telescope and they will give satisfaction in every respect. They run about one hour without rewinding. Our weight driven clocks as used on the larger telescopes are calculated to give an excess of power and to carry about one half the weight of the telescope in addition. The friction governor of this clock is of our own improved design and gives remarkably accurate control. An electrical control as sometimes used with clocks of this kind has never been found necessary with our clocks as no vibration in speed can be noticed even when using a high power eyepiece. These clocks run from two to three hours and can be rewound while running without affecting the speed.

The Worm and Worm Gear, to which the motion of the clock is transmitted by means of a train of gears, are cut with the greatest care and accuracy and both are carefully protected from dust and injury by strong metal shields. The worm is made of tool steel and the worm gear of hard bronze except on the larger instruments on which it is cast iron.

The Circles of our smaller telescopes are made of Magnalium, a very strong, white and light non-corrosive alloy. The larger circles on stationary

instruments, where weight is no objection, are made of bronze or cast iron. The circles have usually only a coarse division on the edge for quick setting, while the larger circles have sometimes a second fine division on an inlaid silver ring. The fine graduation is read by means of two verniers fitted with magnifying glasses and electric illumination, but experience has shown that these finely divided circles are hardly ever used, the measurement of small angles being done by means of the micrometer. The omission of the fine divisions means a saving worth while to consider. Electric illumination for reading the coarse circles is provided on all larger telescopes.

Delicate Adjustments fitted to one or both axes are a great convenience for small telescopes and are a necessity for larger instruments. Our portable equatorials without clock are provided with worm gear and worm screw for slow motion of the polar axis. The screw is connected by means of a universal joint to a handle which is in convenient reach of the observer and may be attached on the east or west side of the instrument.

The portable equatorial telescopes with clock motion are fitted with a delicate motion adjustment which can be used without disengaging the clock.

On the larger telescopes the clamps and the delicate motions for polar and declination axis are transmitted by means of gears to the eye end of the telescope where they end in different shaped handles so that the observer can easily distinguish the different motions in the dark.

Setting Wheels for turning the telescope in right ascension and declination are very desirable for larger telescopes (10 in. aperture and over). These hand wheels are placed on the north side of the pillar in convenient reach.

Finding Circles to indicate the hour are placed near the hand wheels. The right ascension dial can be fitted with a clock driven pointer which will permit setting the telescope in right ascension without calculating the hour angle. Such an attachment is of great convenience.

THE SELECTION OF AN ASTRONOMICAL TELESCOPE

As the selection of an astronomical telescope presents a problem to the amateur or teacher who has never used a telescope and is not familiar with what can be expected of the different sizes and styles of instruments, we trust that the information given below will be of some assistance. If the intended use of the telescope has been decided upon, a suitable equipment can easily be selected and the size and completeness of the accessories will only depend on the funds which can be invested. The equatorial mounting is most desirable for astronomical observations as it permits easy following of the apparent motion of the stars. If only a moderate sum is available for the purchase of a telescope, we advise the selection of a smaller

instrument completely equipped with circles, clock, etc., rather than one of larger aperture and plain mounting, as we know it will give more satisfaction. The beginner not familiar with the construction of astronomical instruments often makes the mistake of purchasing a plain mounted telescope of larger aperture expecting to add clock, circles, slow motion, etc., later on. Astronomical instrument parts are not manufactured on a large scale on interchangeable methods but are usually built individually to order; to furnish such parts as clock or circles later on means not only a higher cost, since it is necessary to have the instrument or part of it sent back, but it will also deprive the owner of the use of the instrument while the parts are being adjusted.

Many students of astronomy and smaller educational institutions are anxious to obtain a telescope but are under the impression that serious and original work in this most interesting science can only be done with a large instrument. Such, however, is not the case as the most fascinating and instructive astronomical observations and investigations can be made and have been made with instruments of small aperture. The principal advantages of the larger objective lie in the greater light gathering and resolving power which permits of higher magnifications and makes it possible to use larger and more powerful attachments on the eye end, such as spectroscopes, spectrographs, cameras, etc. The possible magnification of a telescope, however, does not stand in direct proportion to the apertures and it will be of interest to the novice to learn that a magnification of about 500 diameters is the highest power used with satisfaction on many of the largest telescopes while on an 8 inch telescope the same and higher powers can often be used on good nights.

Very satisfactory celestial photographs can be obtained with a small telescope either by using the telescope direct in connection with an amplifying lens at the eye end or by attaching a photographic camera to the tube and using the telescope for guiding. Valuable micrometer measurements of double stars can be made with telescopes from 4 to 6 inches aperture. The late Professor S. W. Burnham discovered and measured many hundred doubles with his 6 inch refractor, with which he established his world wide reputation.

In using a telescope for the first time, the beginner will often be disappointed in expecting to see a great deal more than the glass can possibly show and in turning to the high power eyepieces he will meet further discouragement and will imagine that his telescope is at fault. After he becomes accustomed to using his instrument and his eye is trained for the new task he will realize the great importance of atmospheric conditions and get a great deal of pleasure and instruction from his observations.

The explanation of magnifying power of an astronomical telescope and the information given as to what may be seen by a normal eye under good atmospheric conditions may be found of assistance in the selection of a

telescope. The magnification of an astronomical telescope depends upon the focal length of the objective and the equivalent focus (power) of the eyepiece and is equal to focal length of the objective divided by focal length of eyepiece. In the standard astronomical telescopes. the focal length of the objective is usually made to be equal to 15 times the aperture, thus a telescope of 4 inch (102 mm.) aperture will have a focal length of 60 inches (1524 mm.) and will give with an eyepiece of 1 inch (25.4 mm.) focus a magnification of 60 diameters. An eyepiece of ½ inch (12.7 mm.) focus on the same telescope will give a magnification of 120 diameters. Since areas such as the moon are proportional to the squares of their diameters, a 4 inch telescope and a ½ inch eyepiece will magnify its apparent area 14,400 times.

Any increase in the power of the eyepiece while increasing the magnifying power involves a sacrifice in the illumination. Moreover the image produced by even the most perfect objective will stand only a certain magnification owing to the fact that the image of a star or point on the object is not a point but a disc of a certain size surrounded by series of diffraction rings. Details on the object so close together that the discs of the two points overlap will not be seen as distinct, however high the power of the eyepiece. On this account there is no advantage for visual observation in having a higher magnifying power than the standard one for the given aperture. What can be accomplished by increasing the focal length of the objective can be accomplished by shortening the focal length of the eyepiece, and with much less trouble. Photographs taken with a long focus lens will be larger than those taken with the shorter but will require a longer exposure and will stand less enlargement. This, of course, does not mean that a 2½ in. objective is as good as a 3 in. objective, for a larger aperture objective will stand a higher magnification.

An observer with normal eyesight on a clear night will be able to see by using a magnification of about 20 to 30 diameters four moons of Jupiter, the mountains and craters of the moon, etc;

With a magnification of 50 diameters, Saturn and his rings, the sun spots, more details of the moon, etc;

With a magnification of about 100 diameters, the belts of Jupiter, the planet Uranus, the companion of Polaris, double stars of a few seconds separation, the discs of Neptune and Uranus;

With a magnification of 200 diameters the separation of Saturn's rings, separation of double stars of one or two seconds, the polar caps of Mars, etc.

A103

PORTABLE ALT AZIMUTH TELESCOPES

A102. Alt Azimuth Telescope 3 inch (76 mm.) clear aperture, with finder, three celestial eyepieces, powers, 45, 90, 135, Zenith prism adapter and suncap.

Approximate Net Weight ..... 36 Lbs.
Approximate Shipping Weight ..... 75 Lbs.

A103. Alt Azimuth Telescope 3½ inch (89 mm.) clear aperture. Equipment the same as with A102, powers of eyepieces 50, 100, 150.

Approximate Net Weight ..... 40 Lbs.
Approximate Shipping Weight ..... 85 Lbs.

A104. Alt Azimuth Telescope 4 inch (102 mm.) clear aperture. Equipment the same as with A102, powers of eyepieces 60, 120, 180.

Approximate Net Weight ..... 48 Lbs.
Approximate Shipping Weight ..... 100 Lbs.

A107

A106. Alt Azimuth Telescope 3 inch (76 mm.) clear aperture with delicate motion adjustment for both axes, with finder, three celestial eyepieces, powers 45, 90, 135, Zenith prism adapter and suncap.

Approximate Net Weight ..... 40 Lbs.
Approximate Shipping Weight ..... 80 Lbs.

A107. Alt Azimuth Telescope 3½ inch (89 mm.) clear aperture with delicate motion adjustment. Equipment the same as with A103.

Approximate Net Weight ..... 50 Lbs.
Approximate Shipping Weight ..... 90 Lbs.

A108. Alt Azimuth Telescope 4 inch (102 mm.) aperture with delicate motion adjustment. Equipment the same as with A104.

Approximate Net Weight ..... 55 Lbs.
Approximate Shipping Weight ..... 110 Lbs.

A111

PORTABLE EQUATORIAL TELESCOPES. (UNIVERSAL MOUNTING)

A110. Equatorial Telescope 3 inch (76 mm.) clear aperture, with polar axis adjustable for any latitude, with delicate motion adjustment for right ascension, finder, three celestial eyepieces, powers 45, 90, 135, Zenith prism adapter and suncap.

Approximate Net Weight ..... 50 Lbs.
Approximate Shipping Weight ..... 100 Lbs.

A111. Equatorial Telescope 3½ inch (89 mm.) clear aperture. Equipment the same as with A110. Powers of eyepieces 50, 100, 150.

Approximate Net Weight ..... 55 Lbs.
Approximate Shipping Weight ..... 110 Lbs.

A112. Equatorial Telescope 4 inch (102 mm.) clear aperture. Equipment the same as with A110. Powers of eyepieces 60, 120, 180.

Approximate Net Weight ..... 60 Lbs.
Approximate Shipping Weight ..... 120 Lbs.

A121

PORTABLE EQUATORIAL TELESCOPES WITH DRIVING CLOCK AND CIRCLES

A120. Equatorial Telescope 3 inch (76 mm.) clear aperture. Polar axis adjustable for any latitude, graduated latitude arc, clock motion and independent delicate motion for right ascension. Declination circle reading

to single degrees, right ascension circle to 5 min. With finder, three celestial eyepieces, powers 45, 90, 135, Zenith prism adapter and suncap.

Approximate Net Weight ..... 55 Lbs.
Approximate Shipping Weight ..... 110 Lbs.

A121. Equatorial Telescope 3½ inch (89 mm.) clear aperture. Equipment the same as with A120. Powers of eyepieces 50, 100, 150.

Approximate Net Weight ..... 60 Lbs.
Approximate Shipping Weight ..... 120 Lbs.

A122. Equatorial Telescope 4 inch (102 mm.) clear aperture. Equipment the same as with A110 but four eyepieces. Powers of eyepieces 60, 120, 180, 240.

Approximate Net Weight ..... 70 Lbs.
Approximate Shipping Weight ..... 160 Lbs.

A125. Delicate Motion for Declination with handle near eye end, fitted to Telescopes A120, A121, A122.

A128. Pillar for A120 to A122 Telescopes. The telescope can be quickly attached and removed as only one strong screw holds it in place. The top is fitted with adjustment for Azimuth. The more delicate parts are carefully protected to withstand outdoor exposure.

Approximate Net Weight ..... 300 Lbs.
Approximate Shipping Weight ..... 350 Lbs.

EQUATORIAL TELESCOPES ON STEEL PEDESTAL

A130. Equatorial Telescope 5 inch (127 mm.). Telescope fitted with finder, four celestial eyepieces, powers 50, 75, 150, 225, Zenith prism adapter and suncap. Delicate motion for right ascension.

Approximate Shipping Weight ..... 500 Lbs.

A131. Equatorial Telescope 6 inch (152 mm.) aperture. Equipment the same as with A130. Powers of eyepieces 60, 90, 180, 270.

Approximate Shipping Weight ..... 640 Lbs.

A135. Delicate Motion for Declination with handle near eye end, fitted to Telescope A130 or A131.

A138. Equatorial Telescope 5 inch (127 mm.) aperture, with strong weight driven clock, circles and delicate motion for right ascension and declination. Other equipment the same as with A130.

Approximate Shipping Weight ..... 600 Lbs.

A139. Equatorial Telescope 6 inch (152 mm.) aperture, with clock, circles and delicate motion. Equipment the same as A131.

Approximate Shipping Weight ..... 750 Lbs.

The handles for clamp and delicate motion for declination on Telescope A138 and A139 are near the eye end of the telescope.

A128

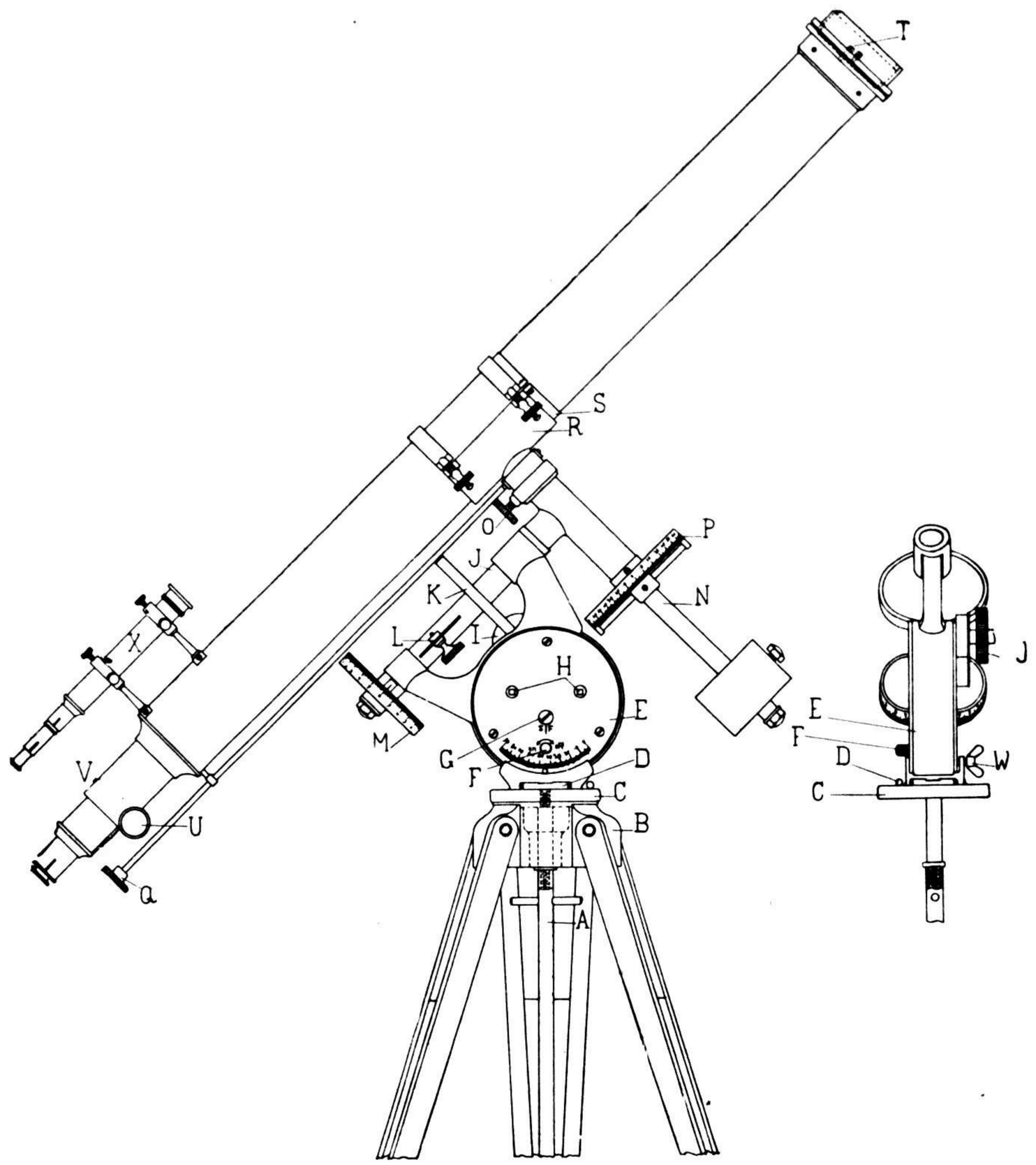
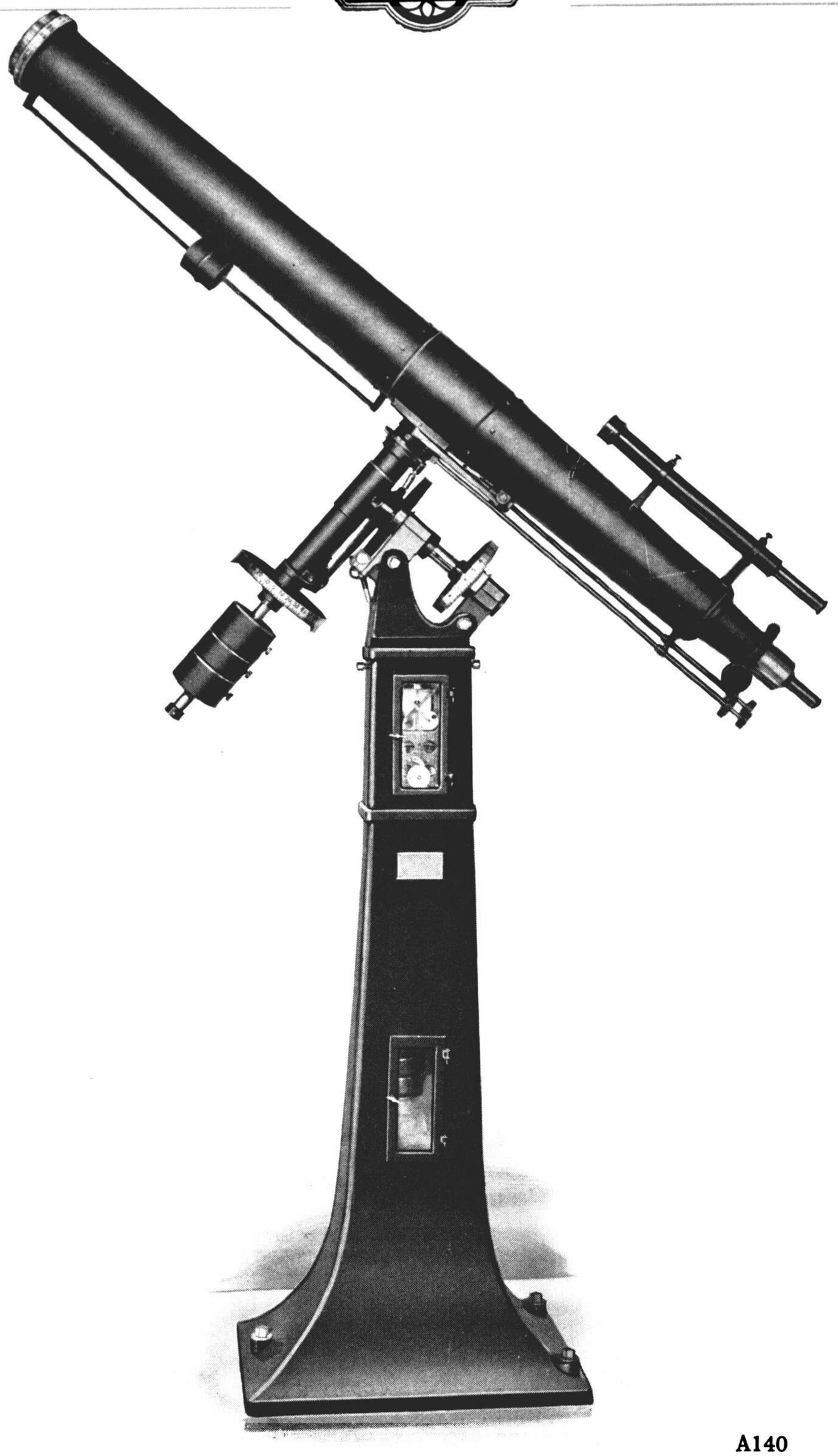


DIAGRAM SHOWING CONSTRUCTION OF PORTABLE EQUATORIAL TELESCOPES A120, A121, A122

A—Screw for attaching Cradle to Tripod.
B—Tripod Head.
C—Cradle supporting Equatorial Head.
D—Levels.
E—Clock Case.
F—Stop-and-Start Lever for Clock.
G—Screw for regulating Clock.
H—Clock-winding Keyholes.
I—Delicate Motion Handle for Right Ascension.
J—Polar Axis
K—Wormwheel with Housing.
L—Clamp for Right Ascension Axis.
M—Right Ascension Circle (also called Hour Circle).
N—Declination Axis.
O—Clamp for Declination Axis.
P—Declination Circle.
Q—Delicate Motion Handle for Declination.
R—Cradle for Telescope Tube.
S—Adjustable Stop Ring for balancing Telescope Tube.
T—Collimation Adjusting Screws for Objective.
U—Focusing Head (Rack and Pinion).
V—Draw Tube, operated by Rack and Pinion.
W—Clamp Screws for locking Latitude Position.
X—Finder.

A130



A140

GAERTNER

ASTRONOMICAL INSTRUMENTS

A144

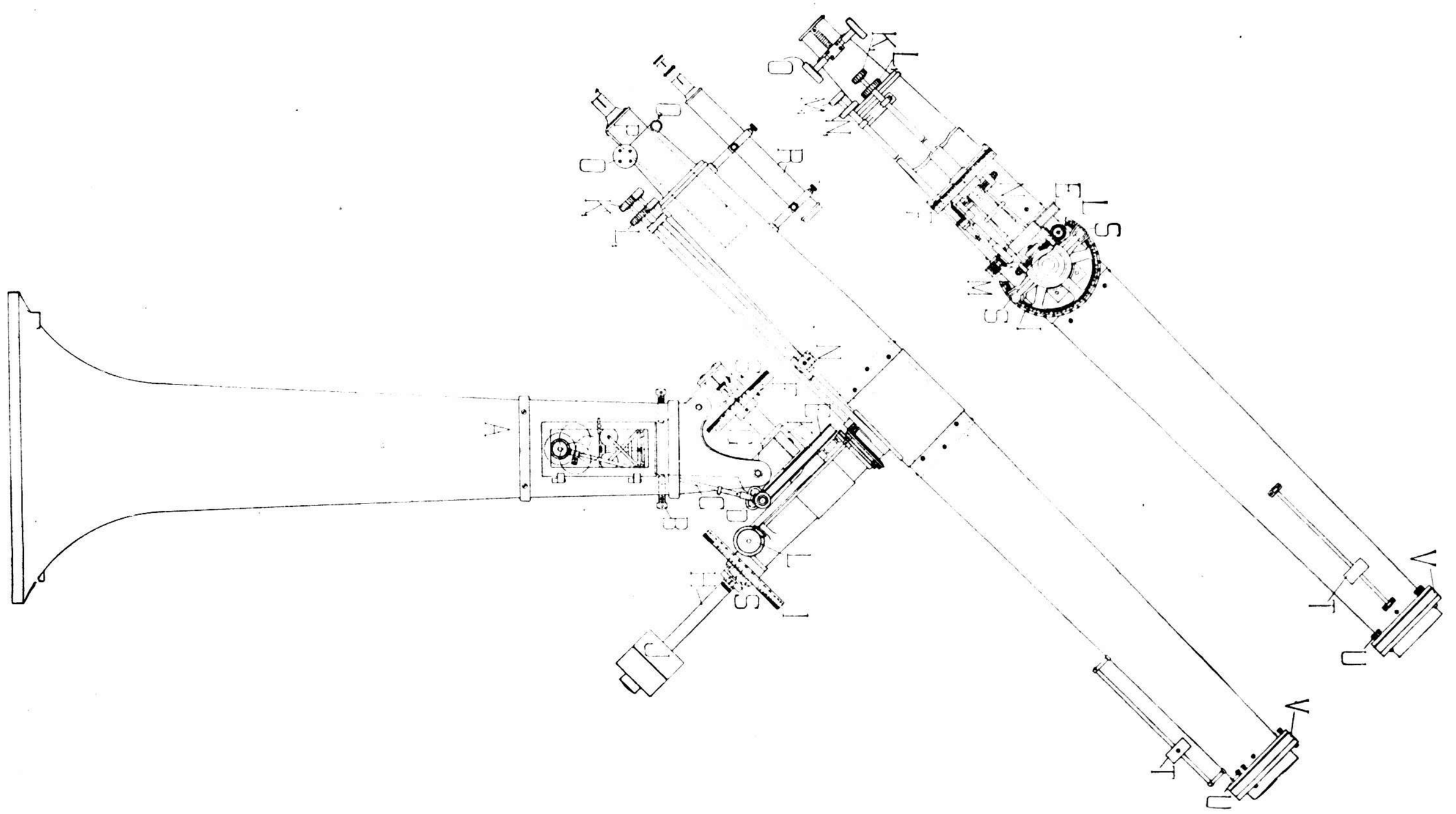


DIAGRAM SHOWING CONSTRUCTION OF TELESCOPE A131

A—Pillar.
B—Adjusting Screws for Latitude.
C—Clock Shaft connecting to Worm.
D—Worm Wheel.
F—Hour Circle.
G—Polar Axis.
H—Declination Axis.
I—Declination Circle.
J—Counterweights for Telescope.
K—R. A. Clamp.
K_1—Handle for R. A. Clamp.
L—Delicate Motion for R. A.
L_1—Handle for Delicate Motion.
M—Declination Clamp.
M_1—Handle for Declination Clamp.
N—Delicate Motion for Declination.
N_1—Handle for Delicate Motion.
O—Focusing Screw.
P—Draw Tube.
Q—Clamp for Draw Tube.
R—Finder.
S—Verniers.
T—Counterweight for Declination.
U—Adjusting Screws for Collimation.
V—Adjustable Ring supporting Objective.

STATIONARY EQUATORIAL TELESCOPES

A140. Equatorial Telescope 6 inch (152 mm.) clear aperture, mounted on heavy iron pillar, with driving clock, circles on right ascension and declination axis. The delicate motions and clamps for right ascension and declination are in convenient reach near the eye end. Telescope equipped with finder, five celestial eyepieces, powers 60, 90, 130, 180, 270, Zenith prism adapter and suncap.

Approximate Shipping Weight .....1200 Lbs.

A142. Equatorial Telescope 8 inch (203 mm.) clear aperture. Equipment the same as with A140. Powers of eyepieces 60, 80, 120, 240, 360 and 480.

Approximate Shipping Weight .....1500 Lbs.

A144. Equatorial Telescope 10 inch (245 mm.) clear aperture. Equipment the same as with A142. Powers of eyepieces 75, 100, 150, 200, 300, 450, 600 and 750.

A146. Equatorial Telescope 12 inch (305 mm.) clear aperture. Equipment the same as with A144. Powers of eyepieces 90, 120, 180, 270, 360, 540, 720 and 900.

A150. Setting Wheel and Finding Circle for Right Ascension placed on north side of pillar attached to A144.

A152. Setting Wheel and Circle for A146.

ACCESSORIES TO TELESCOPES A102-A146

Eyepieces

Huygenian Eyepieces, Standard, diameter of sleeve 1.25 inch (31.75 mm.)

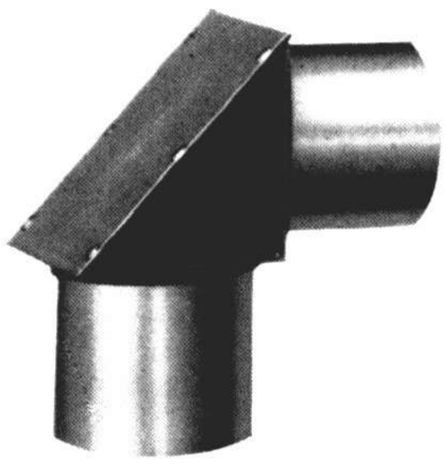
A180. Equivalent Focus 0.2 in. (5 mm.).
A182. Equivalent Focus 0.25 in. (6.3 mm.).
A184. Equivalent Focus 0.33 in. (8.5 mm.).
A186. Equivalent Focus 0.5 in. (12.7 mm.).
A188. Equivalent Focus 0.75 in. (19 mm.).
A190. Equivalent Focus 1 in. (25.4 mm.).
A192. Equivalent Focus 1.25 in. (32 mm.).
A194. Equivalent Focus 1.5 in. (38 mm.).

Huygenian Eyepieces, diameter of sleeve 1.75 inch (44.5 mm.).

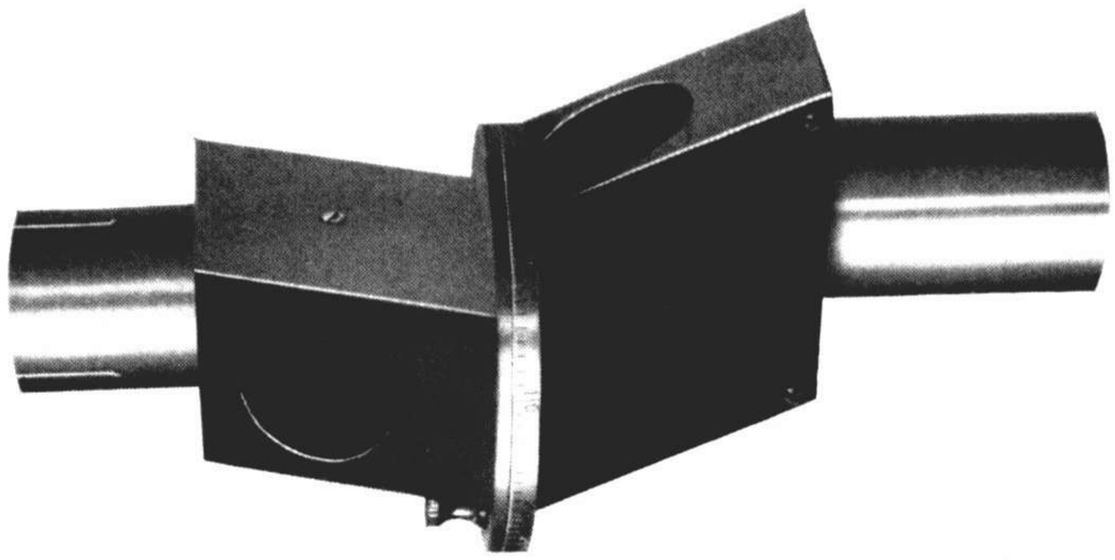
A200. Equivalent Focus 1.75 in. (44.5 mm.).
A202. Equivalent Focus 2 in. (50.8 mm.).
A206. Equivalent Focus 2½ in. (63.5 mm.).
A208. Equivalent Focus 3 in. (76 mm.).

Note: Eyepieces A206 and A208 are made with screw thread to fit direct to draw tube of telescope.

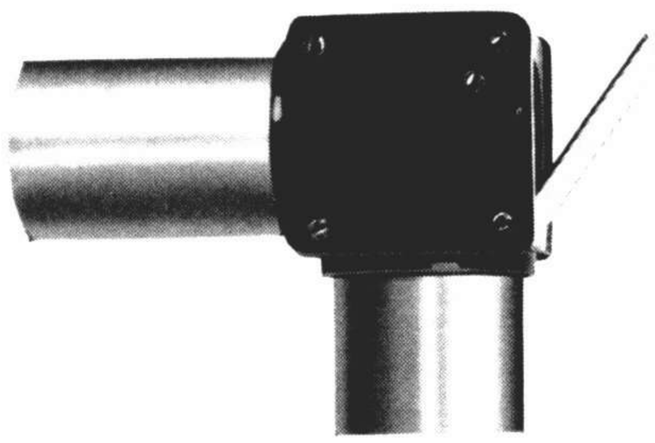
A210. Microscopic Eyepiece with standard 1¼ inch sleeve. Equivalent focus $\frac{1}{8}$ inch (3.4 mm.).



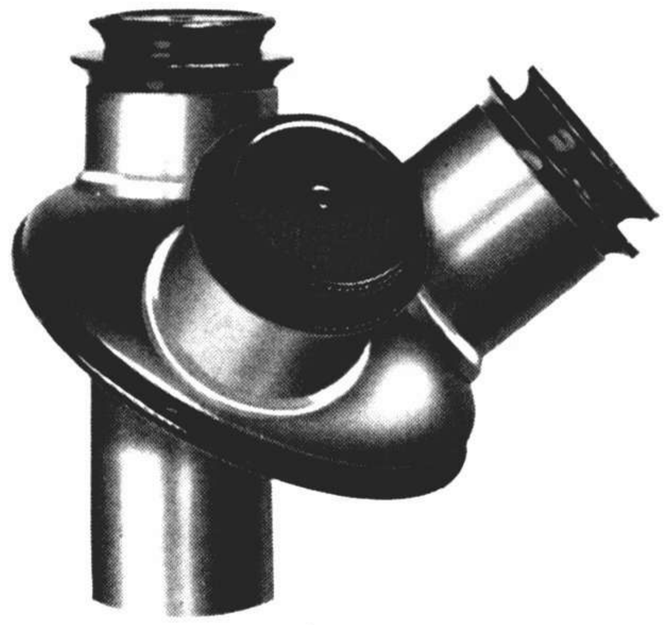
A220



A228



A224



A236

A220. Zenith Prism Adapter. Prism of 1¼ inch (31.75 mm.), sleeve to fit telescope eye end 1¼ inch (31.75 mm.) diameter, to hold Eyepieces A180—A194.

A224. Solar Prism Eyepiece Adapter with one wedge prism, sleeve 1¼ inch (31.75 mm.) diameter, to hold standard eyepieces. Suitable for telescopes to 6 inch (152 mm.) aperture.

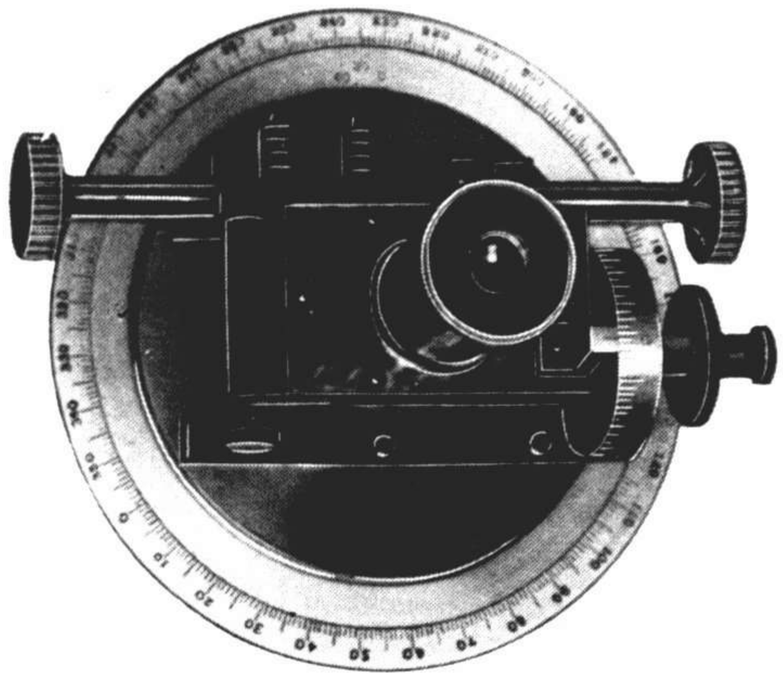
A226. Polarizing Prism Eyepiece Adapter for Solar Observations. Suitable for telescopes from 6 to 8 inch aperture with three wedge prisms, one of these mounted in a sleeve which can be rotated to vary the intensity.

A228. Polarizing Prism Eyepiece Adapter, similar to A226 but with four prisms, suitable for telescopes of 12 inch aperture and larger.

A230. Collimating Eyepiece consisting of a plane mirror mounted under 45° in a tube, fitted with diaphragm of various apertures and small electric lamp and illumination, useful for adjusting the collimation of the objective. Diameter of the tube according to specifications.

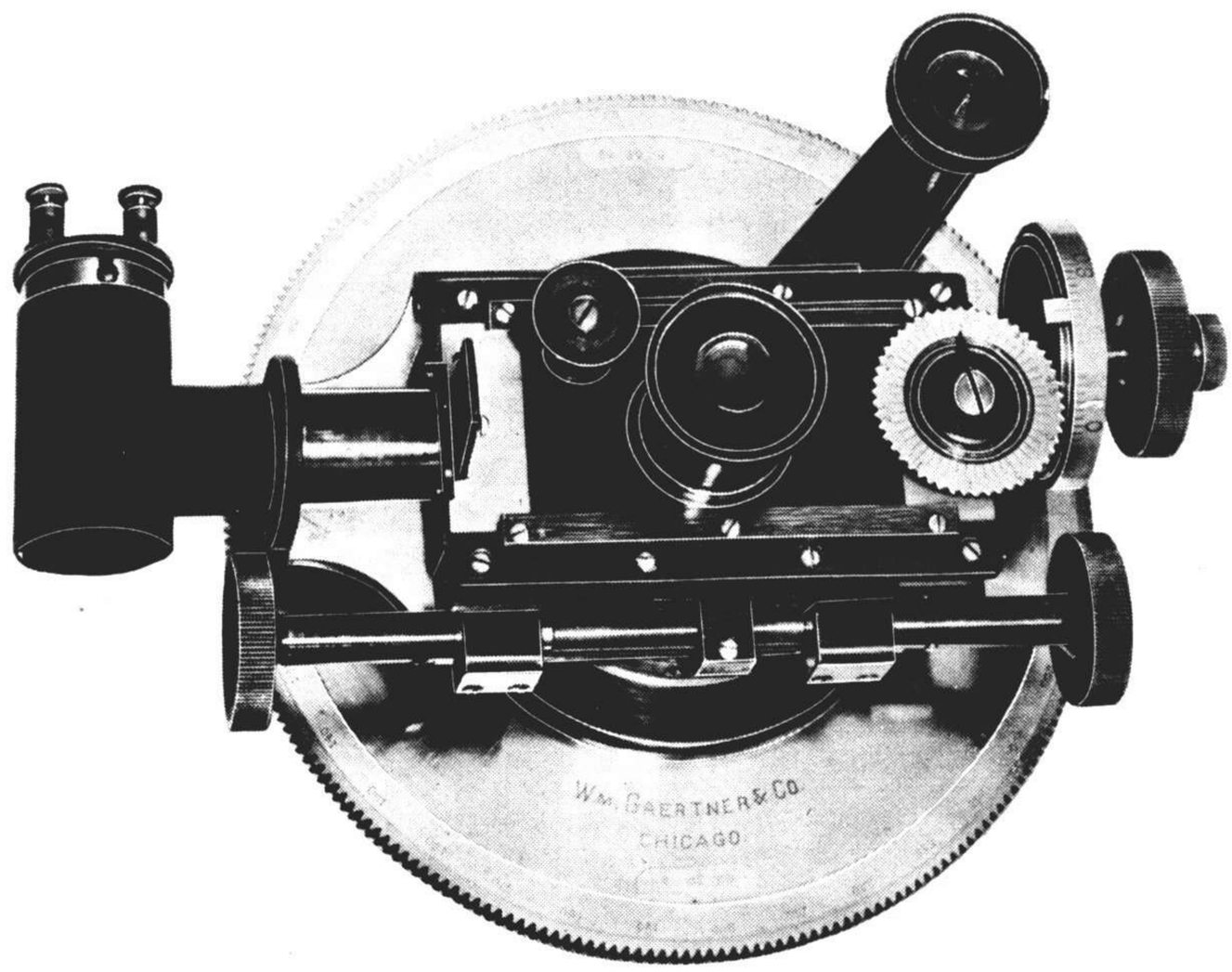
A232. Erecting Prism Adapter fits draw tube of any of our telescopes and holds standard eyepieces of 1¼ inch diameters.

A236. Triple Revolving Adapter for standard eyepieces 1¼ inch diameter.



A250

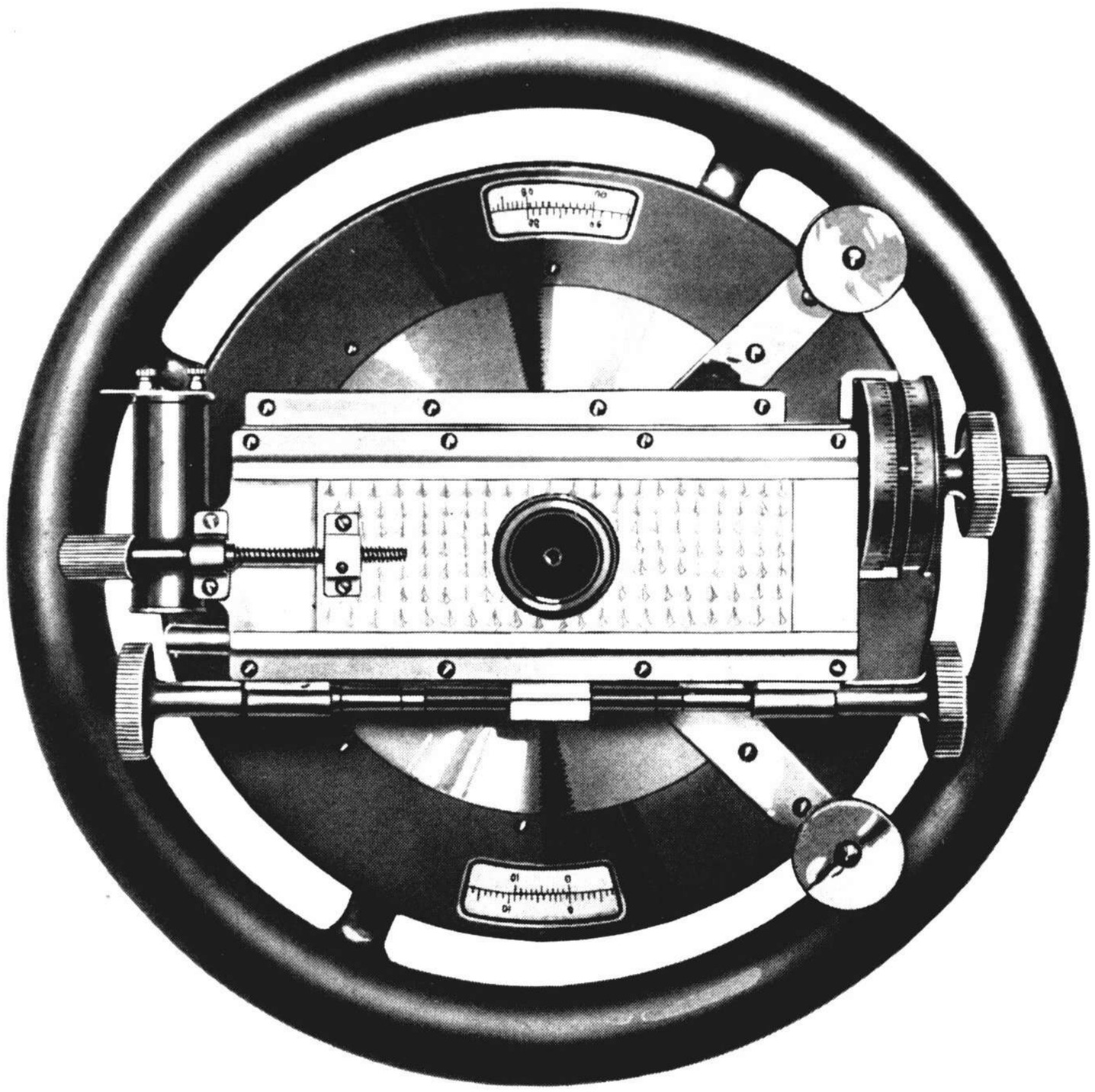
A250. Position Filar Micrometer. Suitable for telescopes from 3 to 6 inch aperture. The screw has a pitch of 0.25 mm. and a range of 10 mm. One fixed and one movable wire which are illuminated by a small electric lamp. The micrometer head has 100 parts, full revolutions of the screw are counted on a comb mounted in the field. The micrometer is mounted on a slide with 12 mm. motion fitted with micrometer screw of 0.25 mm. pitch. The circle is 12 mm. in diameter and the vernier reads to 0.1 degree. With eyepiece of 25 mm. equivalent focus.



A252

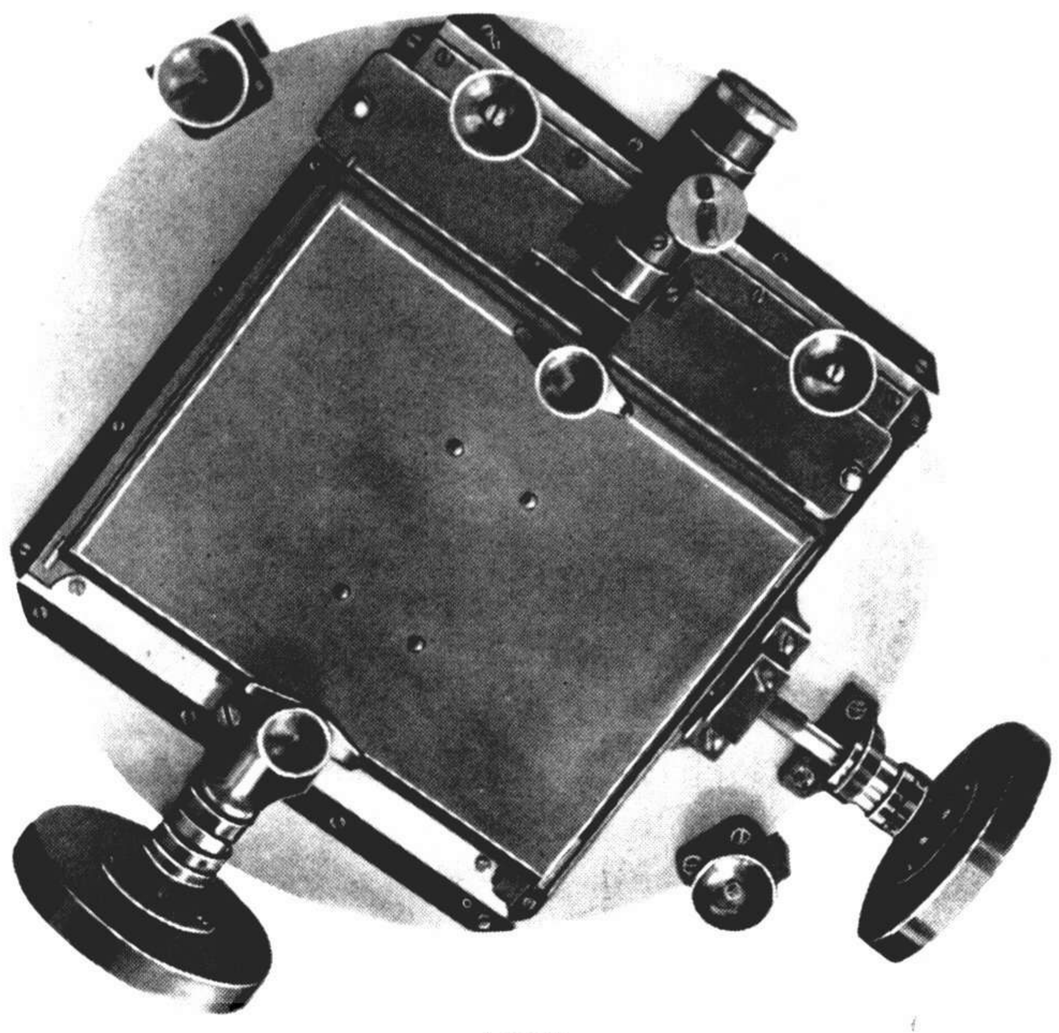
A252. Position Filar Micrometer for telescopes from 6 to 12 inch aperture. The micrometer screw has a pitch of 0.25 mm. and a range of 20 mm.

The screw head is divided into 100 parts and full revolutions are read on an index wheel. The eyepiece is movable over the field by means of a coarse screw. The wires are illuminated by a small electric battery lamp. The circle is 15 cm. in diameter, the divisions are on solid silver and the two verniers read to 0.1 degree. Delicate gear motion for rotating the micrometer is provided. The micrometer is furnished in a hardwood case with three eyepieces. Focal length 25 mm., 18 mm., 12 mm.



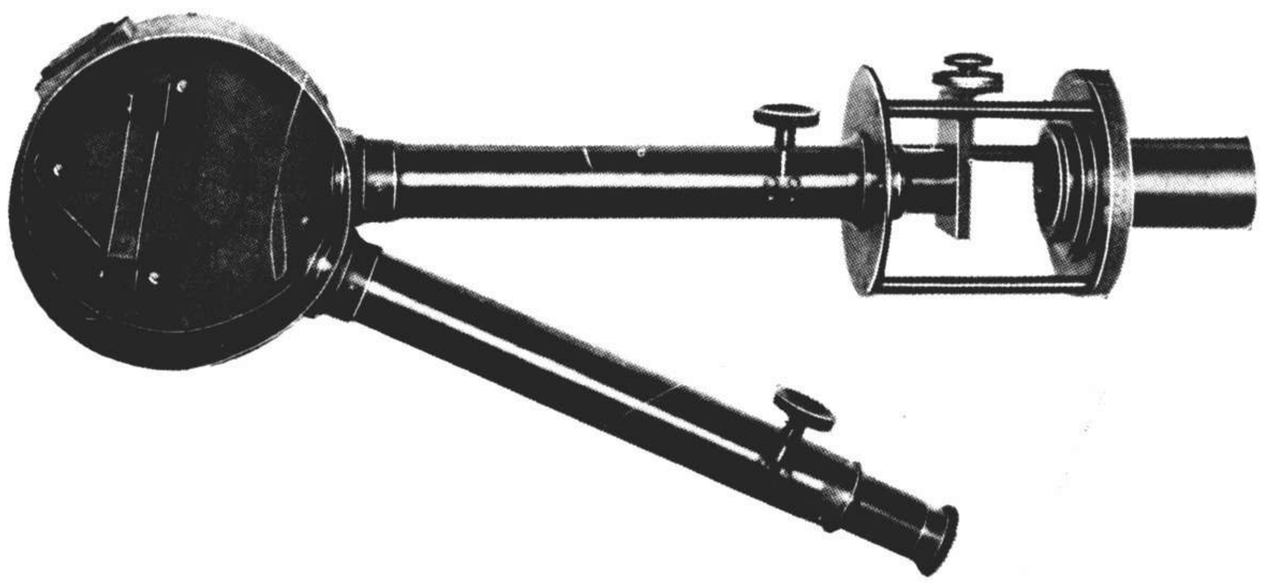
A254

A254. Position Filar Micrometer for telescopes 15 to 25 inch aperture. Specifications on application.



A260

A260. Double Slide Plate Holder for plates 4 x 5 inches to be attached to the eye end of the telescope. Fitted with position circle and delicate screw motion for the two cross slides. The eyepiece for setting on the guiding star has fine cross hairs and electrical illumination. It can be shifted on a separate slide which carries a division in millimeters.



A275

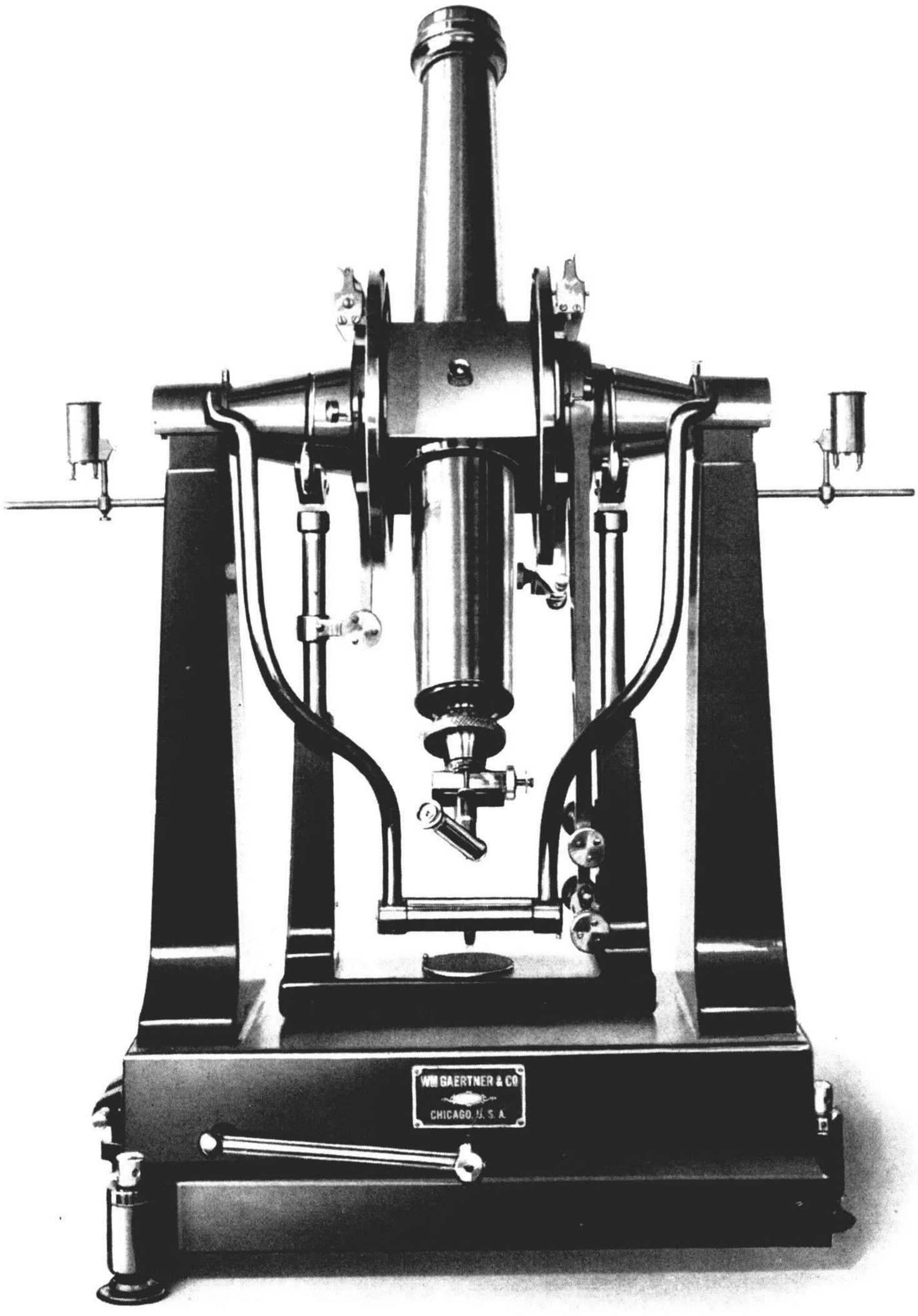
A270. Direct Vision Spectroscope to fit in place of eyepiece, with direct vision prism (quintuple) adjustable slit and plano convex lens.

A275. Star Spectroscope for use with telescopes from 4 to 8 inch aperture. Collimator and observing telescope have apertures of 25 mm., the telescope has rack and pinion adjustment. The spectroscope is screwed direct to the draw tube, or may be fitted in the eyepiece adapter and held in place by a clamp collar. The instrument can be rotated and clamped at any angle and is provided with a position circle reading to degrees. Slow motion for rotation and all necessary adjustments for the prism support are provided. With one heavy flint glass prism.

Other sizes and forms of spectroscopes or spectrographs constructed to order.

A280

A280. Solar Camera. This attachment can be used with any of our Equatorial Telescopes from 3 to 4 inch aperture and consists of a frame with funnel end, which carries the photographic plate 4 x 5 inch. An enlarging lens system with instantaneous shutter are mounted in a tube which fits in place of the eyepiece. A color filter and ground glass for focusing are included.



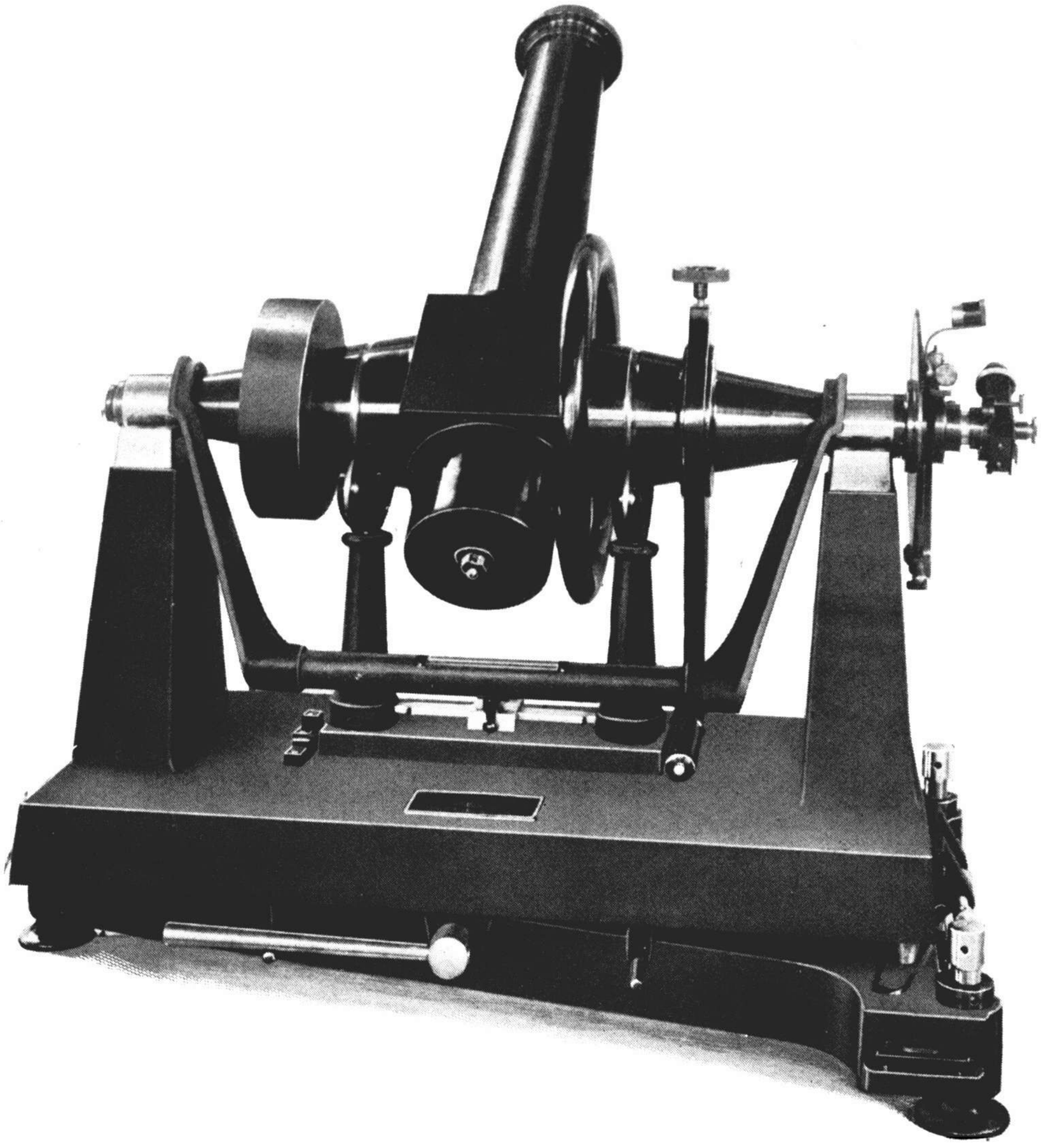
A300

A300. Transit and Zenith Telescope 3 inch (76 mm.) aperture. The heavy cast iron base is fitted with leveling screws and adjustment for azimuth. Bed plate and pillars are very heavy to assure steadiness. The telescope axis is of bronze and is fitted with hardened steel pivots which rest on hard bronze bearings. The weight of the telescope is to the largest part taken up by anti-friction rollers. The apparatus for reversing the telescope can be operated from either side of the pier. The hanging level remains in position while reversing the telescope and is counterbalanced to hang vertical. Dust shields attached to the Y's of the level protect the steel pivots. The instrument is fitted with two circles of 12 inches diameter, one reading to 1 minute, the other for Zenith observations reading to 10 seconds. The graduations are on inlaid silver. Corresponding coarse and delicate levels with clamp and tangent screws are fitted to the circles. The screws for the fine circle have double heads so as to be in easy reach from both sides of the instrument. The micrometer can be rotated through 90 degrees and adjustable stops are provided. Three plain eyepieces of powers 36, 72, 108 and one prism eyepiece of 72 power are included. The illumination of the cross hairs is by means of electric lamp. A mercury horizon is provided for in the base of the instrument.

A310. Prism Transit 3 inch (76 mm.) clear aperture. The frame of the instrument with the pillars is cast in one piece and rests on a heavy base plate fitted with leveling screw and azimuth adjustment. The axis is of gun metal and is fitted with hardened steel pivots. The bearings are of hard bronze. The reversing arrangement is operated by means of excenter and lever. The hanging level has a sensitiveness of about 1.5 seconds and remains in place while reversing the telescope. Most of the weight of the telescope is taken off from the bearing by means of a roller system and a strong spring. The setting circle is 20 cm. in diameter and divided to 10 minutes, the vernier reads to one minute. The wooden hand wheel, clamp and tangent screw are on the side near to the observer. The micrometer can be rotated between adjustable stops through an angle of 90 degrees. The micrometer screw has .25 mm. pitch; electric illumination for the cross wires is provided. Three eyepieces giving magnifications of 36, 72 and 108 diameters are included.

A315. Prism Transit, 2 inch (51 mm.) clear aperture. The instrument is similar in construction to the 3 inch Prism Transit. It is fitted with hardened steel bearings and striding level. Micrometer and circle are the same as furnished with A310 Transit. The instrument is mounted on a heavy iron base on which it can be rotated between adjustable stops 180 degrees apart. A reversing apparatus is not provided as the telescope can be easily handled.

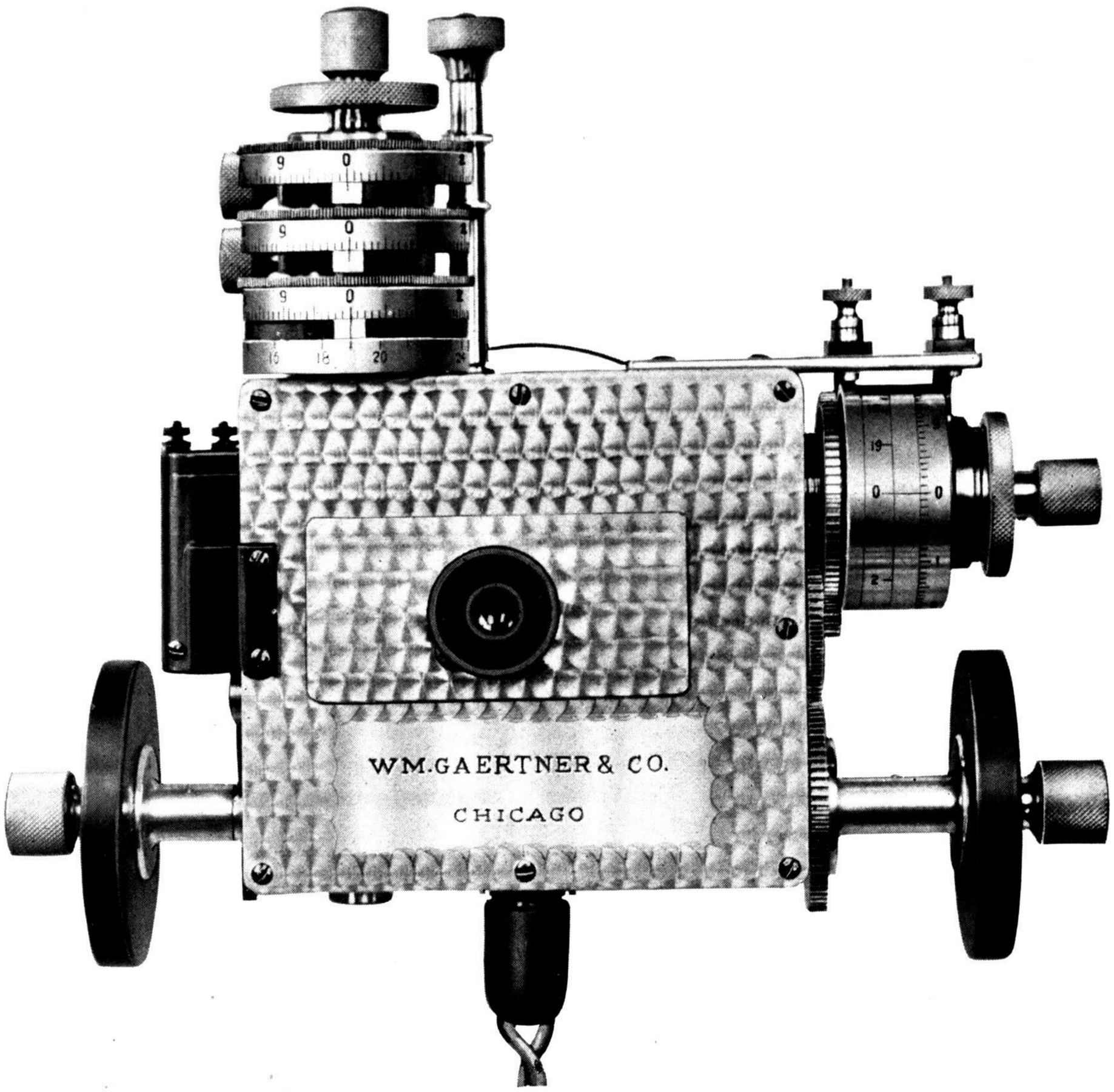
ASTRONOMICAL GAERTNER INSTRUMENTS



A310

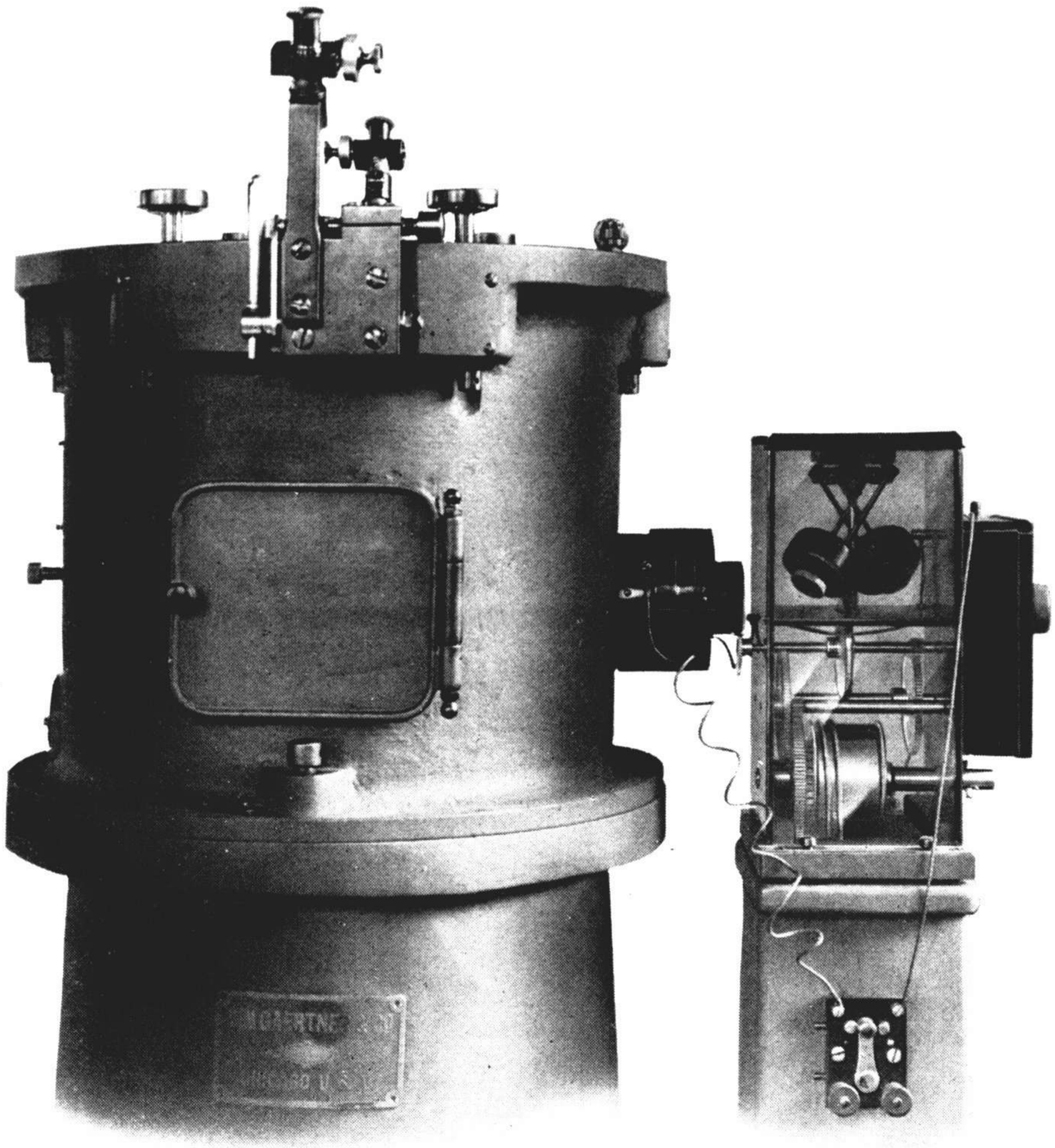
Astronomical Regulator Clocks

We are in position to supply sidereal and mean time regulator clocks of various standard makes and will send specifications and estimates on request.



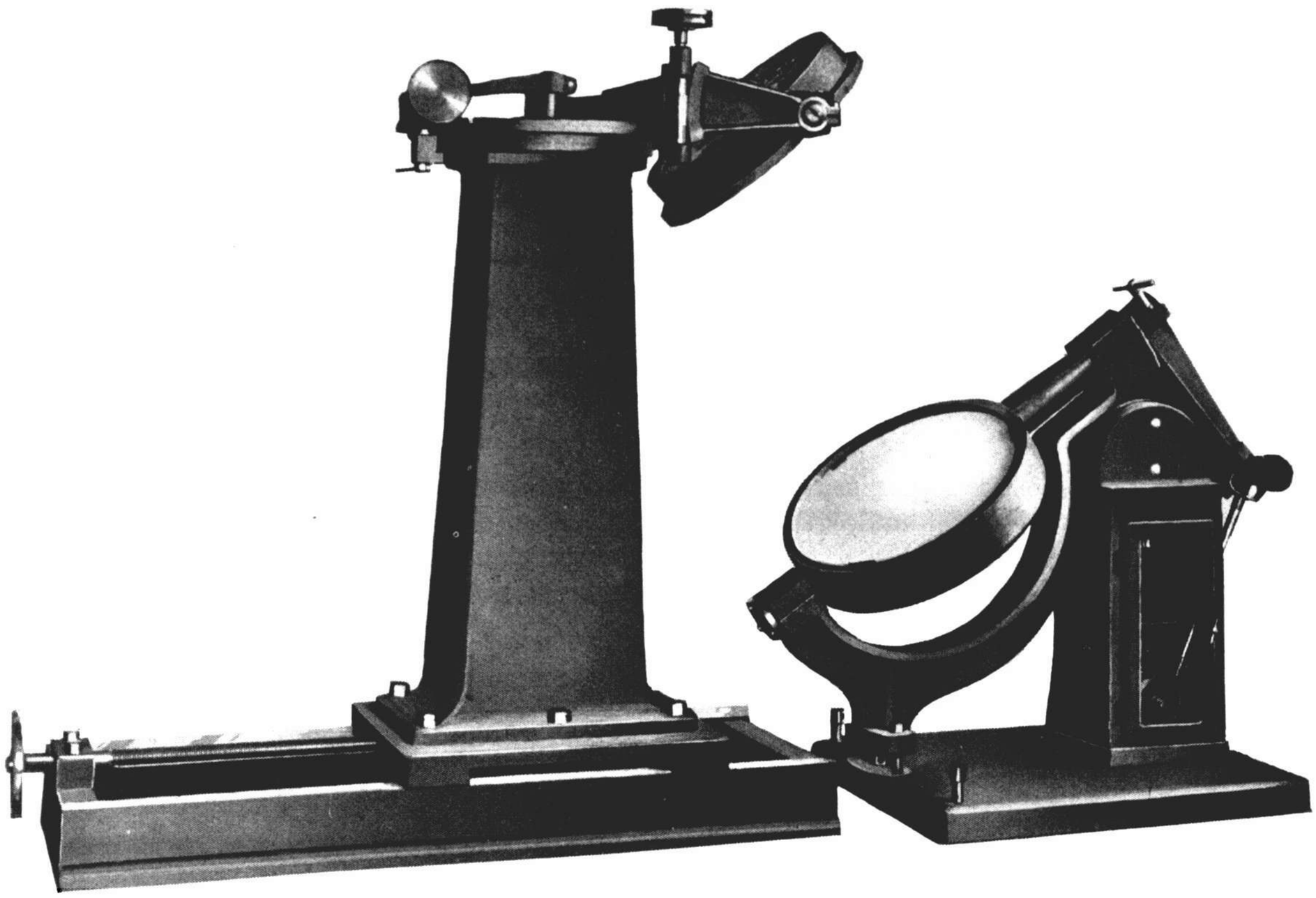
RECORDING MICROMETER WITH MOTIONS IN RIGHT ASCENSION AND DECLINATION

Constructed for the Cincinnati Observatory.



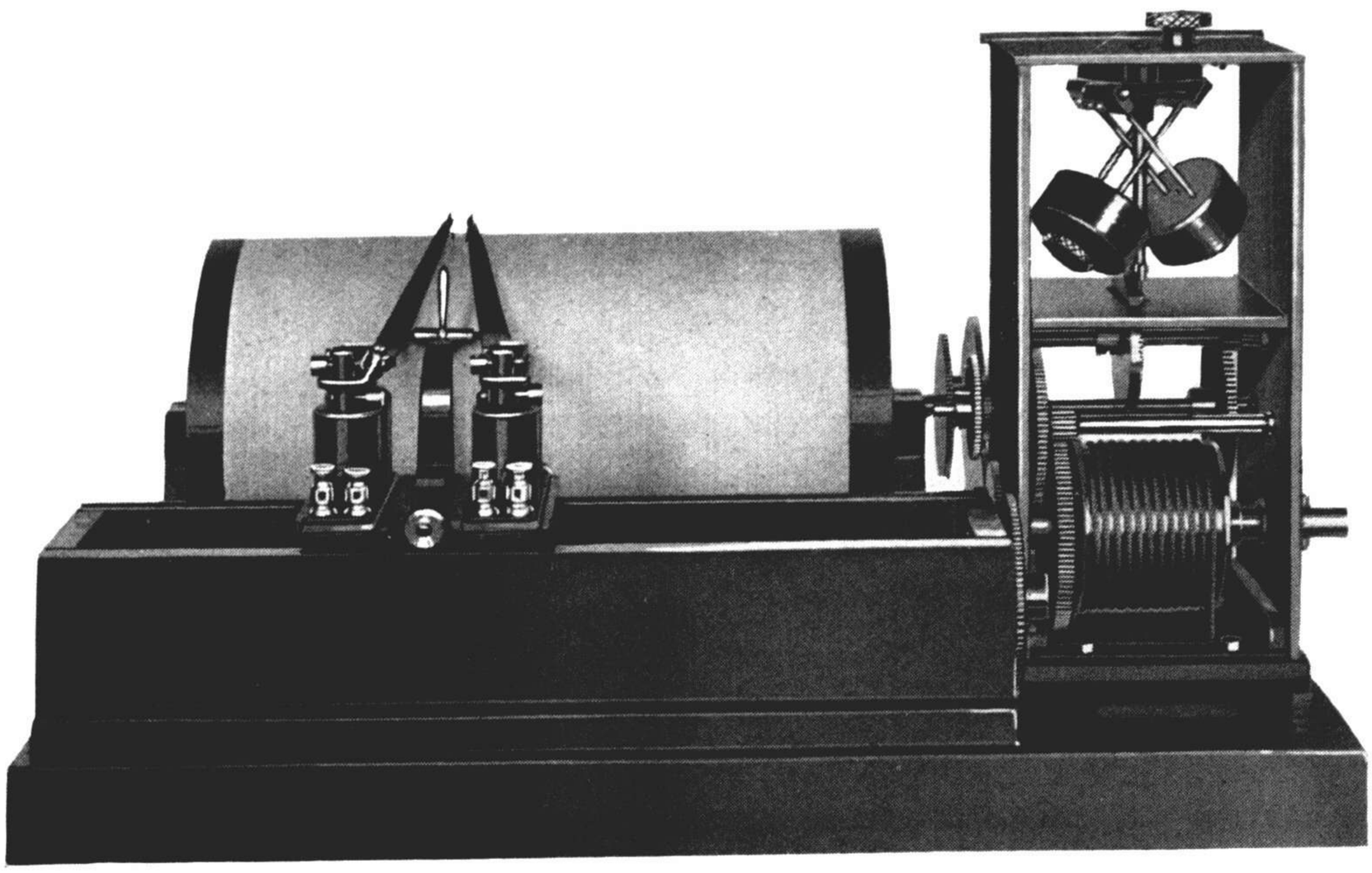
FIGHT INCH PHOTOGRAPHIC ZENITH TELESCOPE

Constructed for the International Geodetic Association according to the plans of Dr. Frank E. Ross and mounted at Gaithersburg, Md., U. S. A. A detailed description of this instrument is given in "A Report to the Seventeenth General Conference of the International Geodetic Association" by O. H. Tittmann, Superintendent, Coast and Geodetic Survey.



A340

A340. Coelostat. The rotating mirror has a diameter of 30 cm. and is carefully mounted. The driving clock is placed in a dust-proof case. The worm sector is accurately cut and is of sufficient length to allow a run of several hours without resetting. Delicate motion for the mirror independent from the clock is provided. Clock and mirror frame are mounted together on a heavy iron base which is fitted with adjusting screws. An independent adjustment for latitude is provided. The fixed mirror has a diameter of 25 cm. and is mounted on a heavy iron pillar which slides on a bed plate of 120 cm. length. The fine adjustments of the mirror are given by two worm sectors and worm screws.



A352

CHRONOGRAPHS

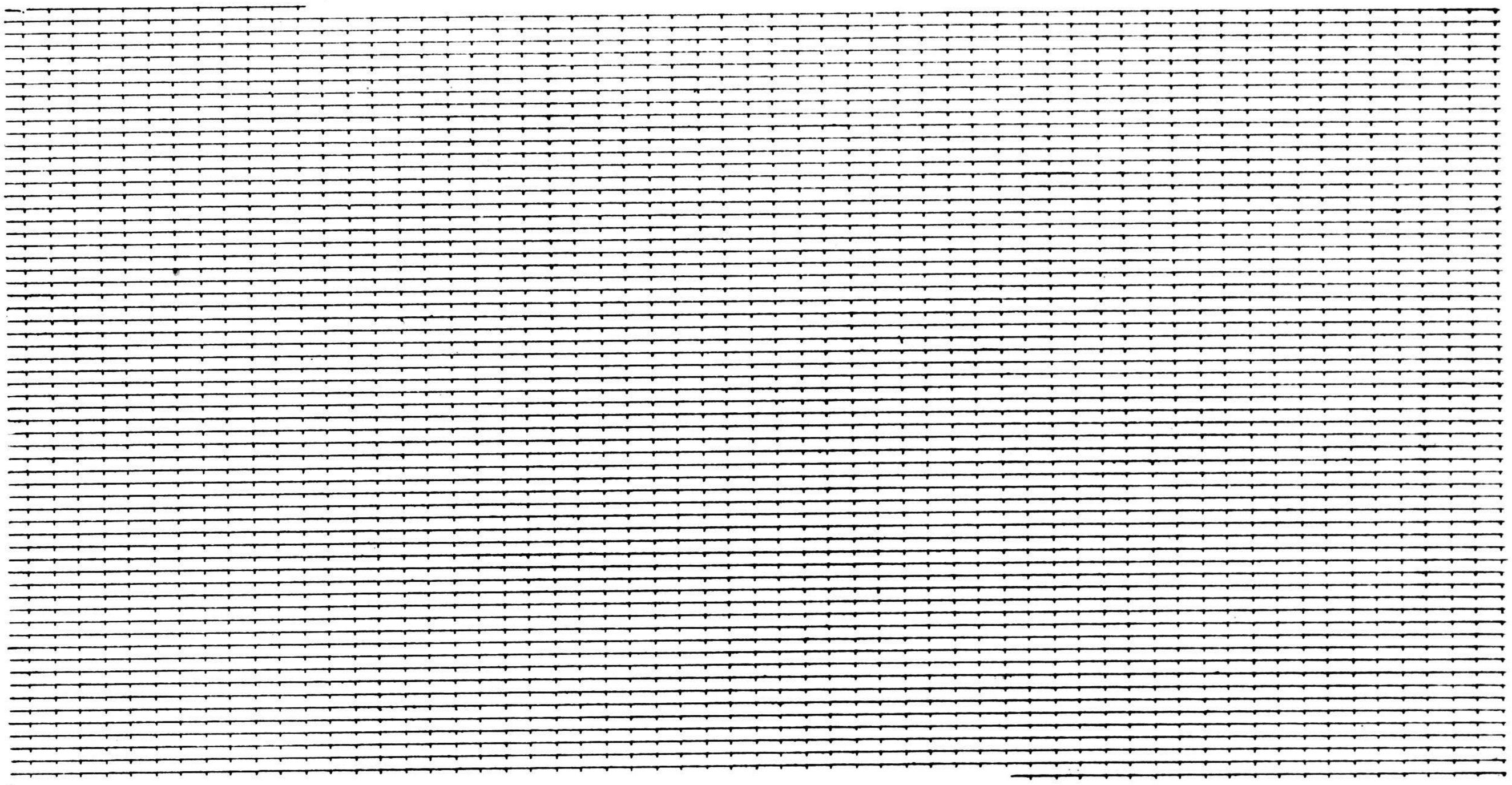
A350. Drum Chronograph with One Recording Pen. The clock, the most important part of the chronograph, is fitted with a friction governor of our own design and allows such perfect regulation that the second records come out in a beautiful straight line along the cylinder, not showing a variation of 0.05 of a second in a full hour's run. The clock is dustproof enclosed and the whole instrument is protected by a glass case when not in use. The drum is 152 mm. in diameter and 250 mm. long and is geared for two speeds 60 and 30 seconds per revolution. Using the slow speed (60 sec. per rev.) the drum will run for a full hour and the space between two seconds is exactly 8 mm. The carriage for the pens travels on a substantial bed plate and is moved by a screw from which it can be easily disengaged. The pens are provided with every necessary adjustment and are operated by electromagnets on either closed or open circuit. The records are traced on a special paraffine coated paper, the tracing points being of hardened steel. 100 sheets of special record paper are included.

A352. Chronograph with Two Pens, glass case, 100 sheets of paper.

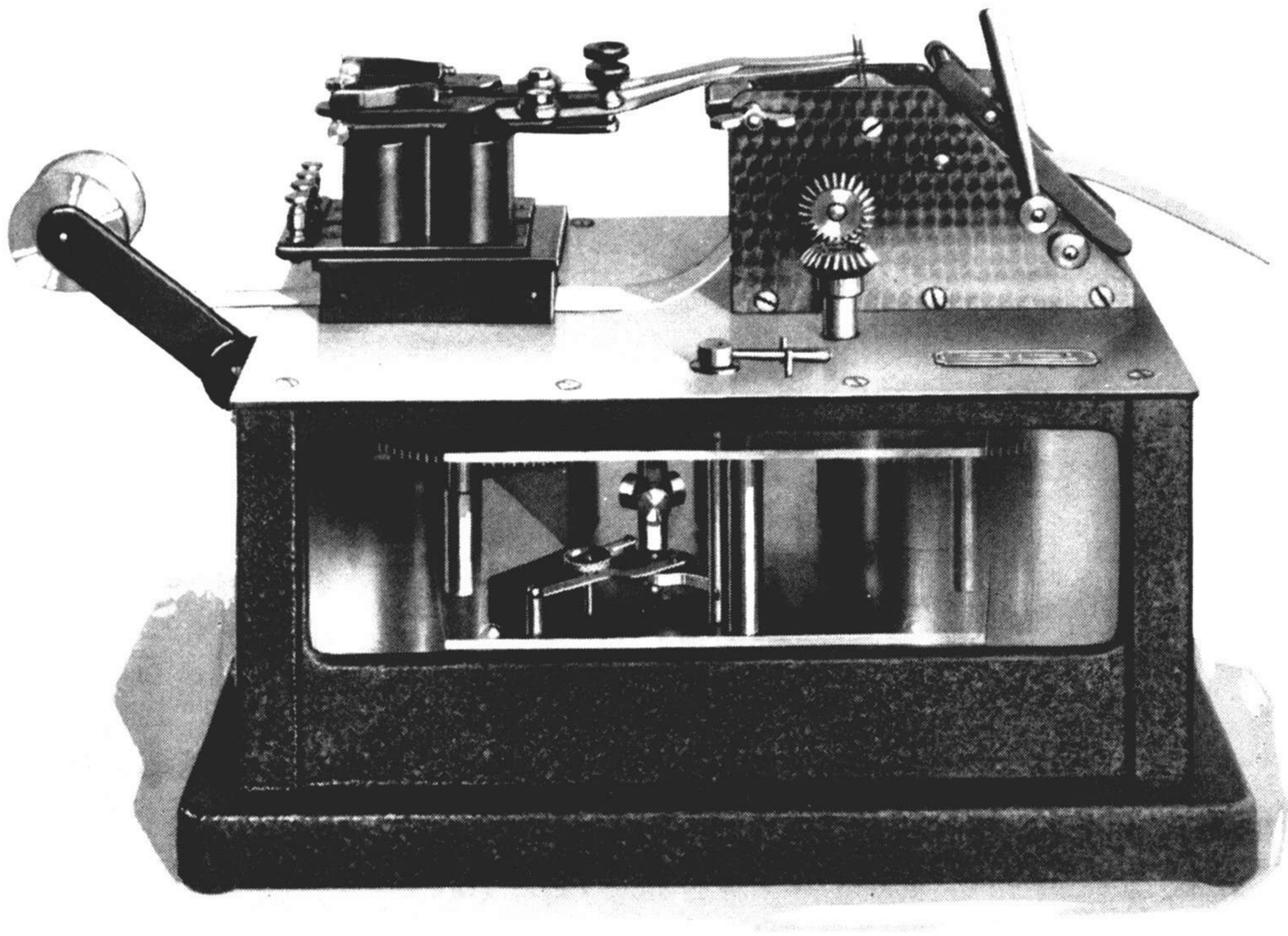
A354. Chronograph with Three Pens, Drum 35 cm. long, glass case, 100 sheets of paper.

A360. Reading Scale for Chronograph Sheets, 60 seconds long divided to 0.1 seconds.

A362. Record Paper, per 100 sheets.



Etching made direct frcm one of our chronograph sheets (reduced about 8:3), showing the accuracy of the clock work.



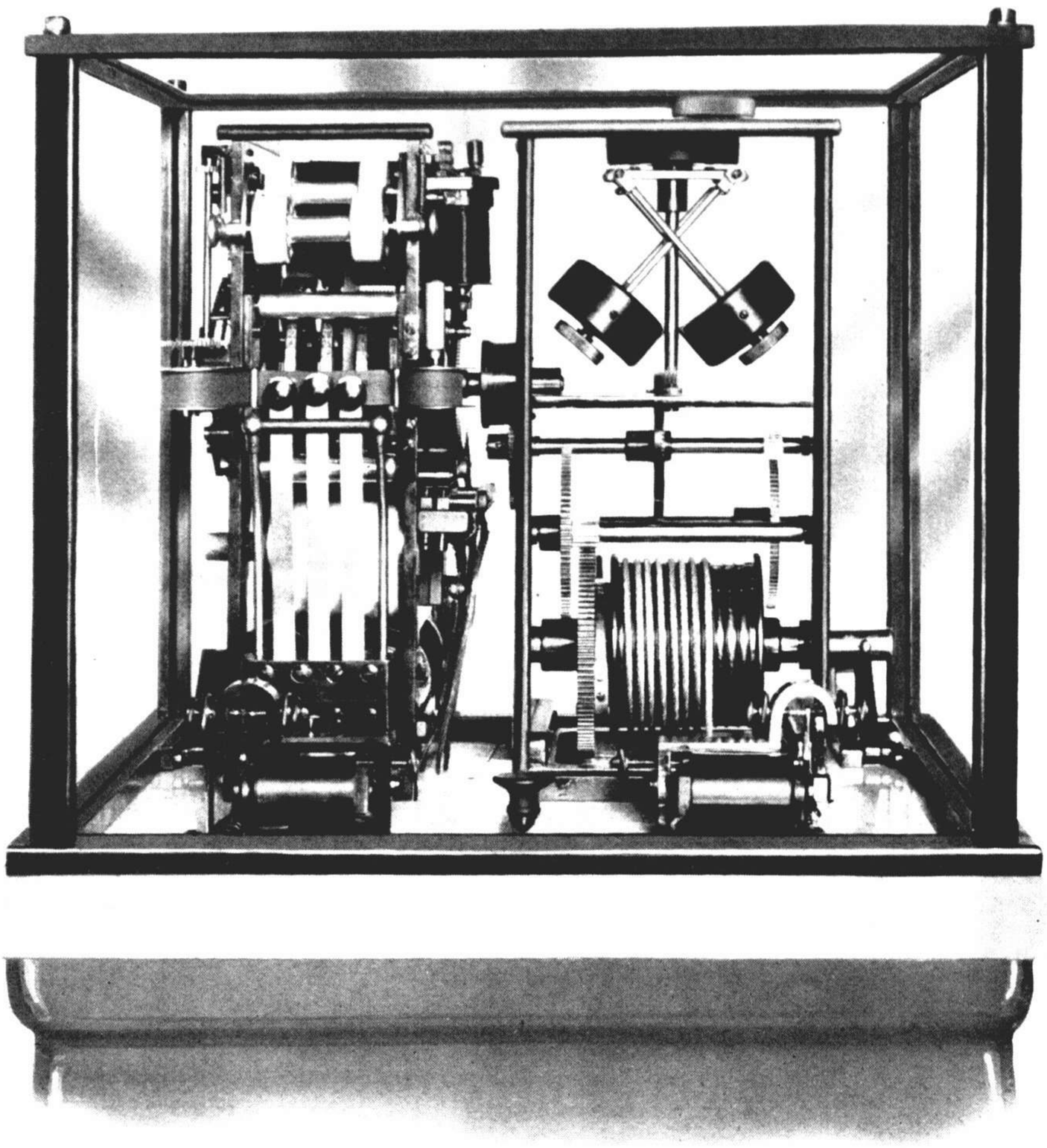
A365

A365. Chronograph with Two Pens. The record is made on a moving tape of coated paper, operated by a strong spring driven clock movement, regulated by friction governor. The tape travels at a speed of 10 mm. per second and at this rate the clock will run about one hour at uniform speed. Slower or higher speeds can be obtained by adjusting the governor.

This form of chronograph is very convenient to use and easily portable.

A366. Roll of Paper for use with Chronograph A365, 28 mm. wide about 50 meters long.

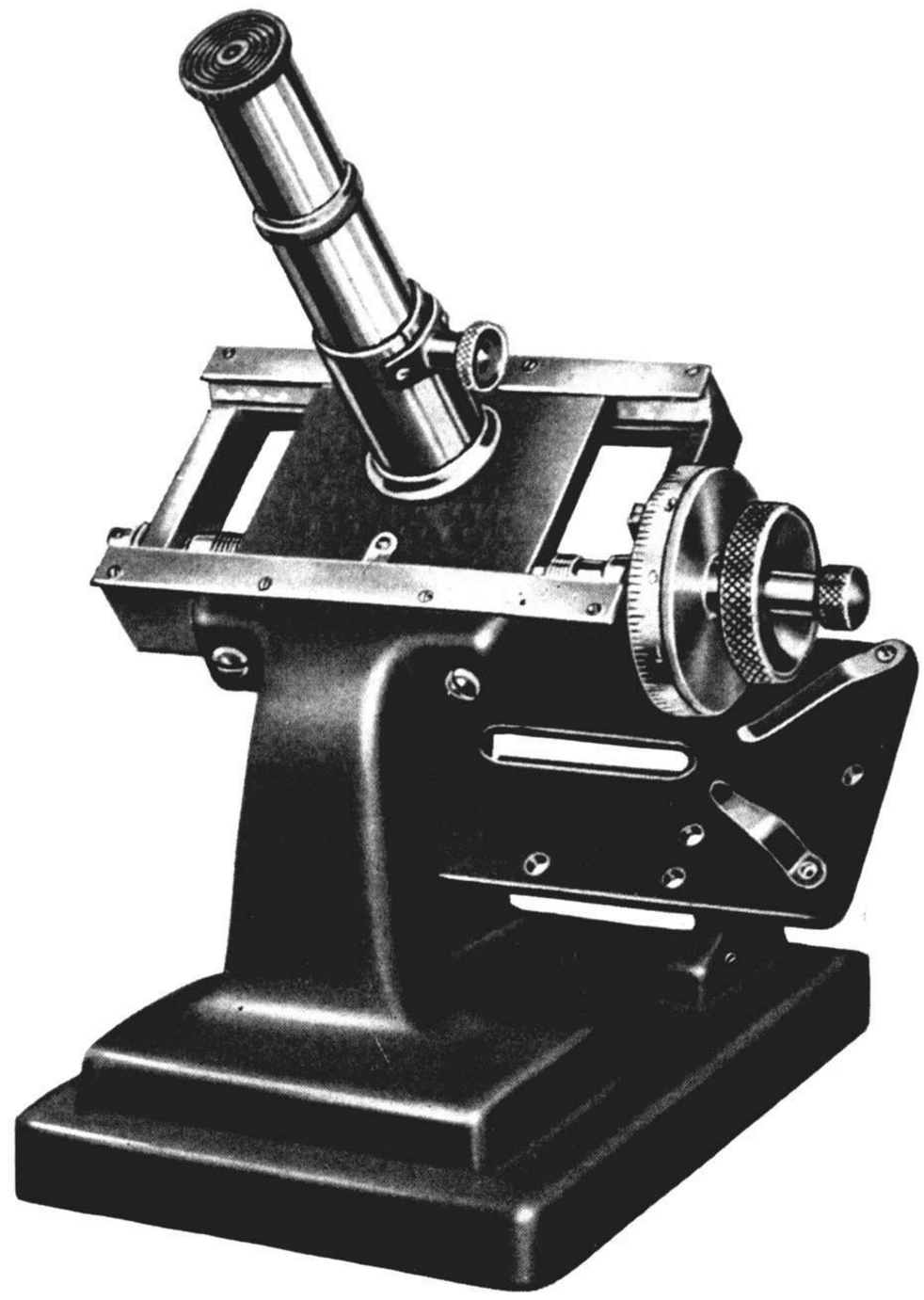
Note: Chronograph A365 can be furnished with three or four recording pens, or arranged for different speeds. We also construct chronographs with electrically maintained tuning forks for recording time intervals of 0.001 seconds with the greatest precision and shall be glad to give detailed information.



A380

A380. Printing Chronograph. This chronograph was designed by us and furnished to the U. S. Naval Observatory, the Washburn Observatory of the University of Wisconsin and the U. S. Army. The instrument will save the difference in its cost in a short time if observations are made regularly. The minutes, seconds and hundredths of seconds are printed in figures on a narrow strip of paper and several thousand observations can be recorded before the paper has to be renewed. The space required for two records is about 1 cm. An astronomical regulator clock is used in connection with the instrument, it controls the speed of the driving clock of the chronograph which is similar to the one as used with our drum chronographs. This control assures an absolute accuracy of 0.01 seconds. The instrument is mounted on an iron pillar which gives room for the clock weights and may also hold the necessary batteries.

Note: Details of this instrument, with diagrams, etc., will be sent to interested parties.

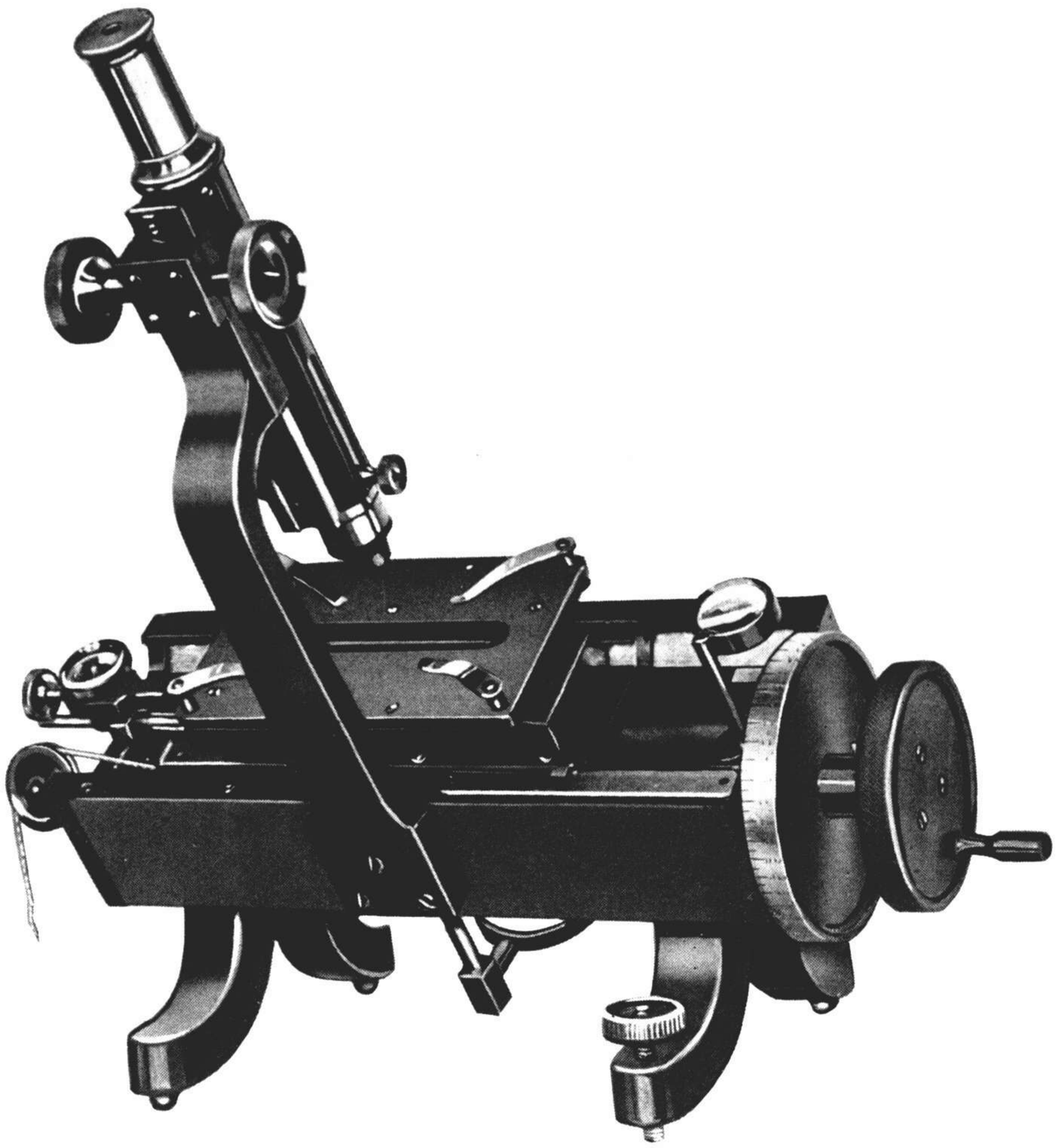


A1200b

A1200b. Comparator for Spectra Photographs, Gratings, etc. The microscope travels on a carefully straightened guide and is moved by a micrometer screw having 50 mm. range and a pitch of 0.5 mm. The micrometer head is about 50 mm. in diameter and divided in 100 parts. Each division equals 0.05 mm. and thousandths of millimeters can be easily estimated. The magnification of the microscope is about 25 diameters. The stage is 150 mm. by 75 mm. and fitted with holders for the plate and adjustable mirror.

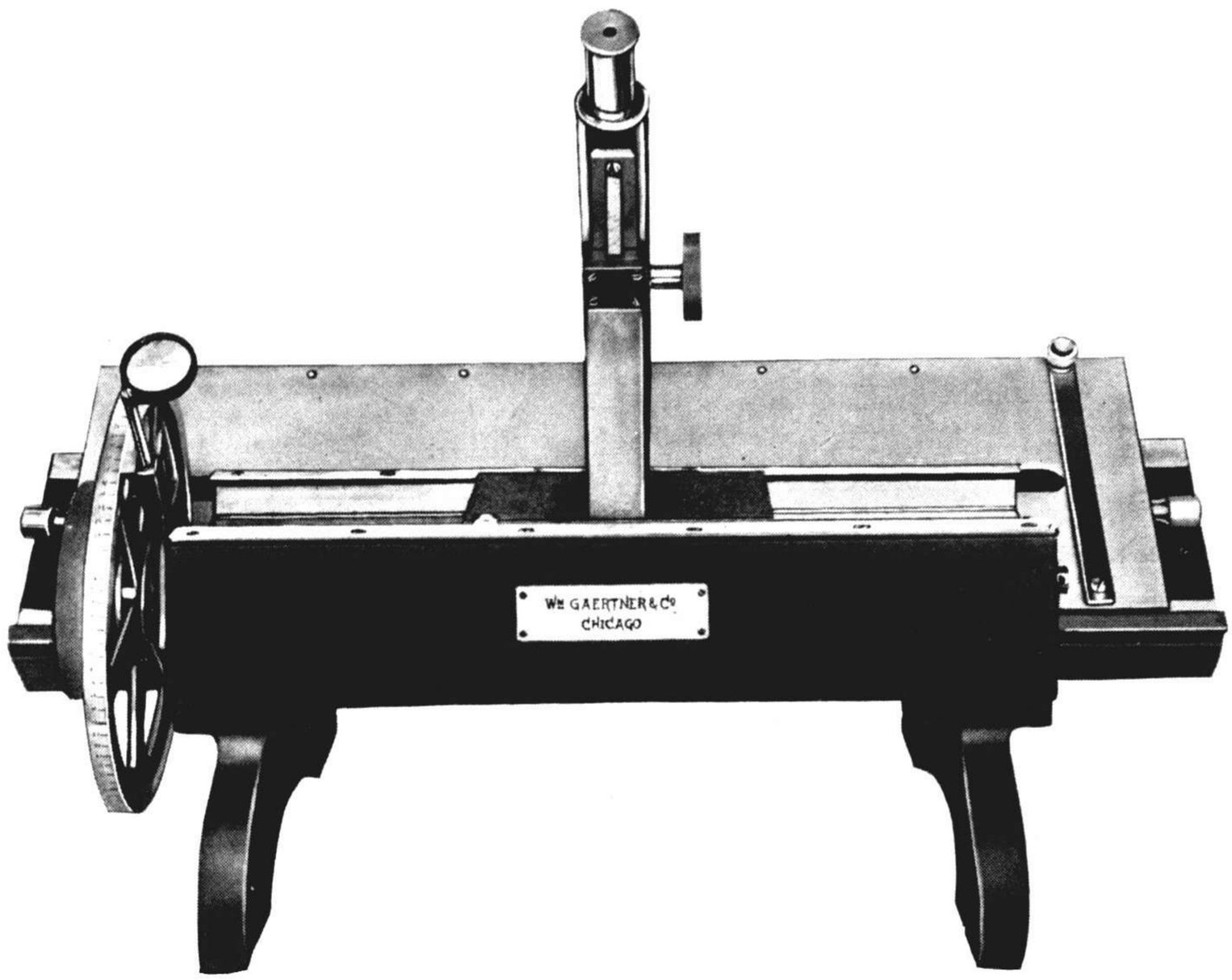
A1200c. Comparator is the same as A1200b but has rack and pinion motion on microscope.

A1201. Comparator, 80 mm. Range. This instrument is intended for measuring spectra photographs, gratings, scales or such objects as can be focused by the microscope and will allow rapid measurements of the highest possible accuracy. The micrometer screw has a pitch of 0.5 mm. and diameter of 15 mm. The index head has a diameter of 80 mm. and is fitted with a



A1201

nickel silver rim which is graduated in 500 parts. The full revolutions are read by means of a scale in front of the instrument. The bed plate is heavy, made of cast iron and the guides are carefully scraped true within 0.001 mm. The carriage has a movement of 80 mm., is made of gun metal and fitted exactly to the bearing; it is provided with a second carriage with 40 mm. motion. The extra carriage can be moved by hand and accurately set by means of a micrometer screw. The microscope is fitted with extra draw tube for variable magnifying power and is focused by rack and pinion. Illumination for transparent objects is given from below by means of a plane mirror. The instrument is mounted on heavy supports, set at an angle convenient for the observer.



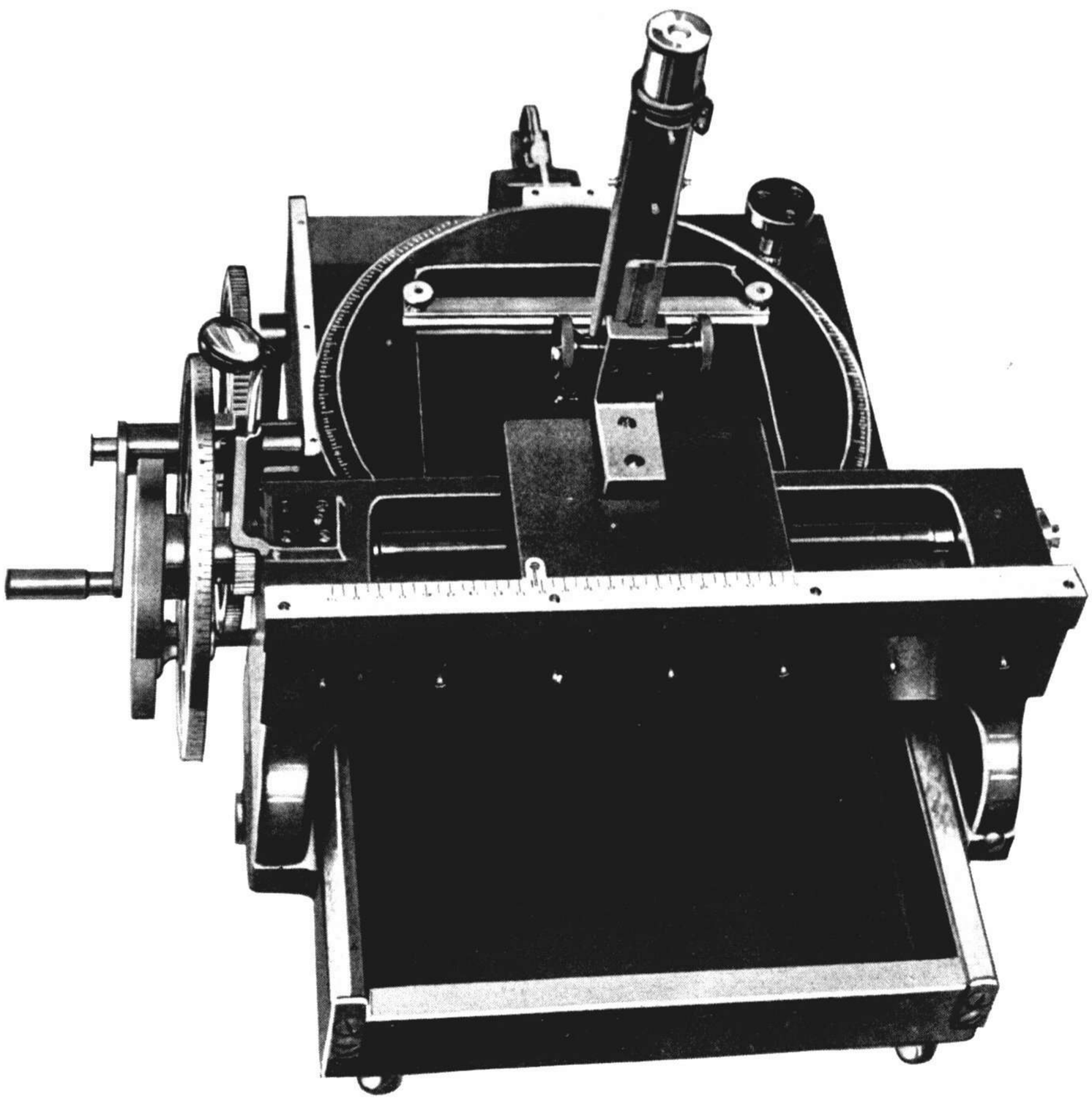
A1205

A1205. Comparator, 200 mm. Range. This comparator is fitted with a screw of 1 mm. pitch and has a micrometer head of about 180 mm. diameter divided to 1000th parts, with graduations on nickel silver. The head and handle are placed on the left side of the comparator so as to leave the right hand free for taking notes. The microscope is of our standard type, fitted with an arrangement for varying the magnifying power from 10 to 25 diameters and is mounted on the movable carriage. The carriage which holds the spectrum plate will accommodate any size plate up to 24 inches long and more, and any width up to 2½ inches. This carriage is mounted on a separate slide, parallel to the slide which carries the microscope and can be shifted sideways and clamped securely so that any part of the spectrum plate may be quickly brought under the microscope. The screw is of the highest accuracy and very carefully corrected.

Note. We undertake the construction of Comparators of any description and shall be glad to correspond with interested parties.

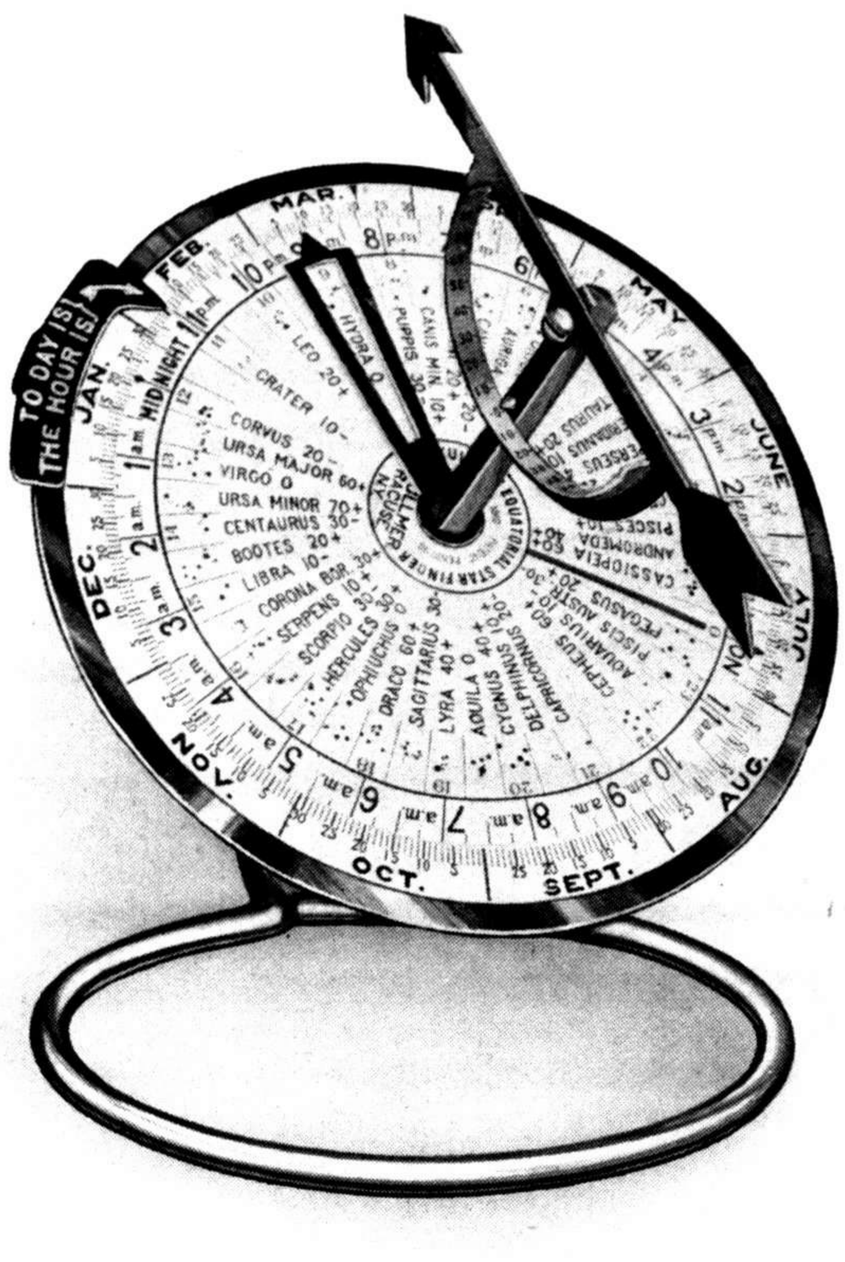
Microphotometers (Hartmann).

Astrophotometers (Pickering).



A1230

A1230. Comparator for Star Photographs. This comparator will hold any size plate as large as 8 in. by 10 in. The plate is supported by hardened steel clips with the film side facing the microscope. The divided circle on which the plate is mounted has its bearing in the cast iron carriage and is rotated by means of gear and pinion motion. The divisions are in single degrees and the vernier reads to 6 min. The carriage travels on a vertical guide inclined 35 to 45 degrees. Motion is given by rack and pinion with an operating handle on each side. The range of the carriage is 180 mm. and a scale divided in millimeters is provided. The opening in the circle is 170 mm. by 170 mm. The horizontal guide with the microscope carriage is securely attached to the lower carriage and provision is made to adjust the same accurately at right angles to the lower guide. Both guides are carefully straightened to about 0.001 mm. The range of the microscope carriage is 200 mm. and the readings on the large divided head are to 0.001 mm. A set of change gears for fast motion of the microscope carriage is provided. The screw is of the highest accuracy. The tube length of the microscope is adjustable to give magnification of from 5 to 30 diameters.



A1500

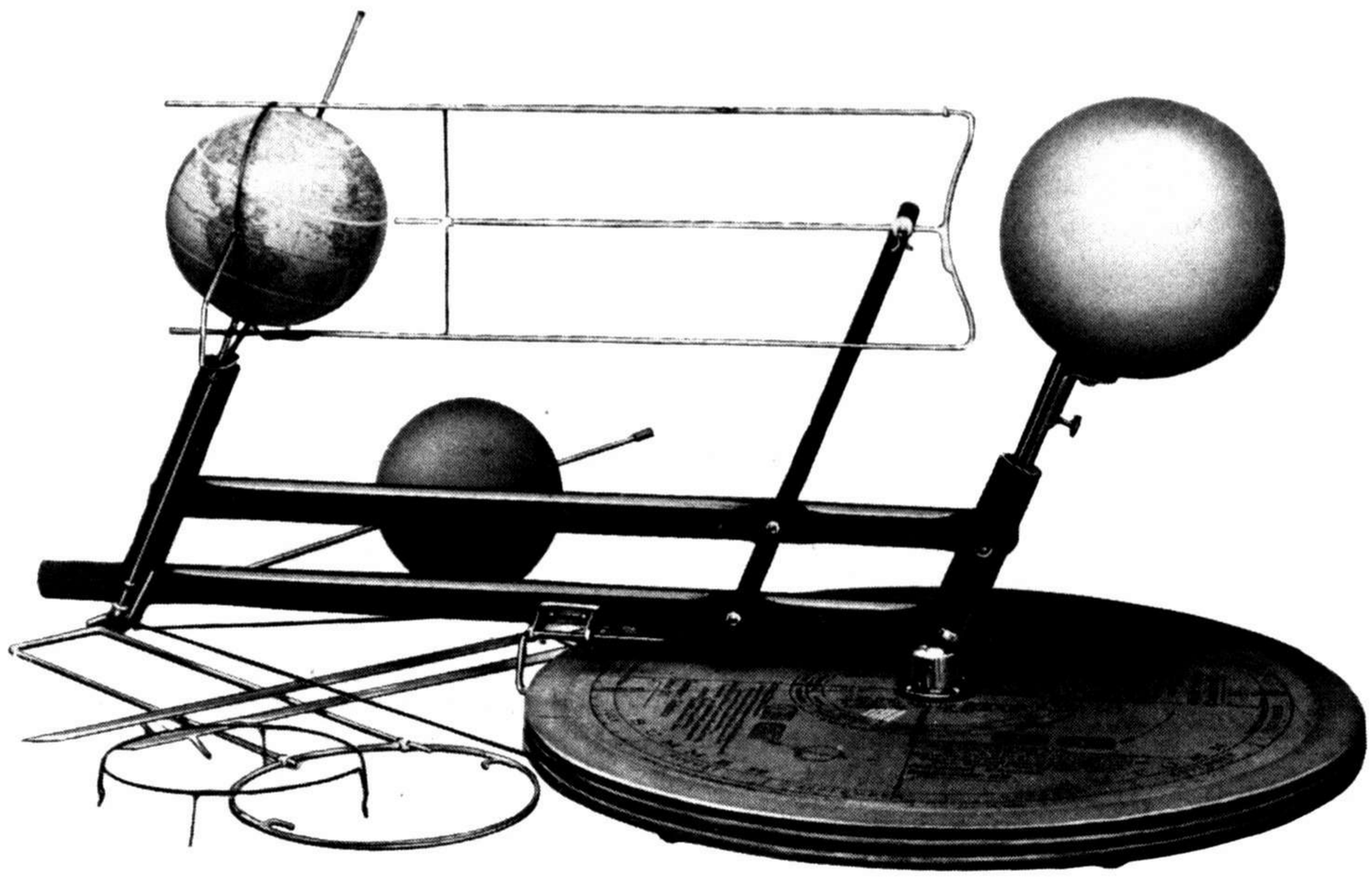
A 1500 Kullmer's Star Finder with Star Maps. The instrument is based on the principle of equatorial telescope mounting, an arrow taking the place of the telescope.

Placing the instrument with its axis towards the pole star the arrow, properly set according to the directions given with the instrument, will point towards any required constellation.

Thus, anyone, without previous knowledge of astronomy may easily become acquainted with the stars and their apparent daily and yearly movements.

Directing the arrow towards any other celestial object (sun, moon, planets, comets), the instrument allows an approximate measurement of their right ascension and declination; plotting these data in the star maps (furnished with each instrument), a most direct and thorough study of these more complicated movements can be carried out which makes the instrument highly valuable for the teaching of astronomy.

We adjust each instrument for any northern latitude.



A1510

A1510. Gardner's Season Apparatus. Revolving the earth around the sun a cord automatically rotates the earth around its axis; this axis being kept parallel to itself by means of a frame, all the main features of the earth's movements are represented in the model.

The three wires, parallel to the ecliptic, give the direction of the sunrays throughout the year and thus demonstrate in an excellently clear way the causes of the change of seasons, the origin and true meaning of the climatic circles and the typical differences of conditions in the various climatic zones.

By means of other attachments (illumination circle, twilight circle, atmospheric circle), the varying length of day and night, of twilight, the influence of the atmosphere on the heating effect of the sunrays are demonstrated.

An especially instructive feature of the apparatus lies in the possibility of tipping the earth to any other inclination thus showing the dependency of all our climatic conditions upon the angle of 23½ degrees.

The map globe may easily be interchanged with a slate globe for the development of the subject in chalk.

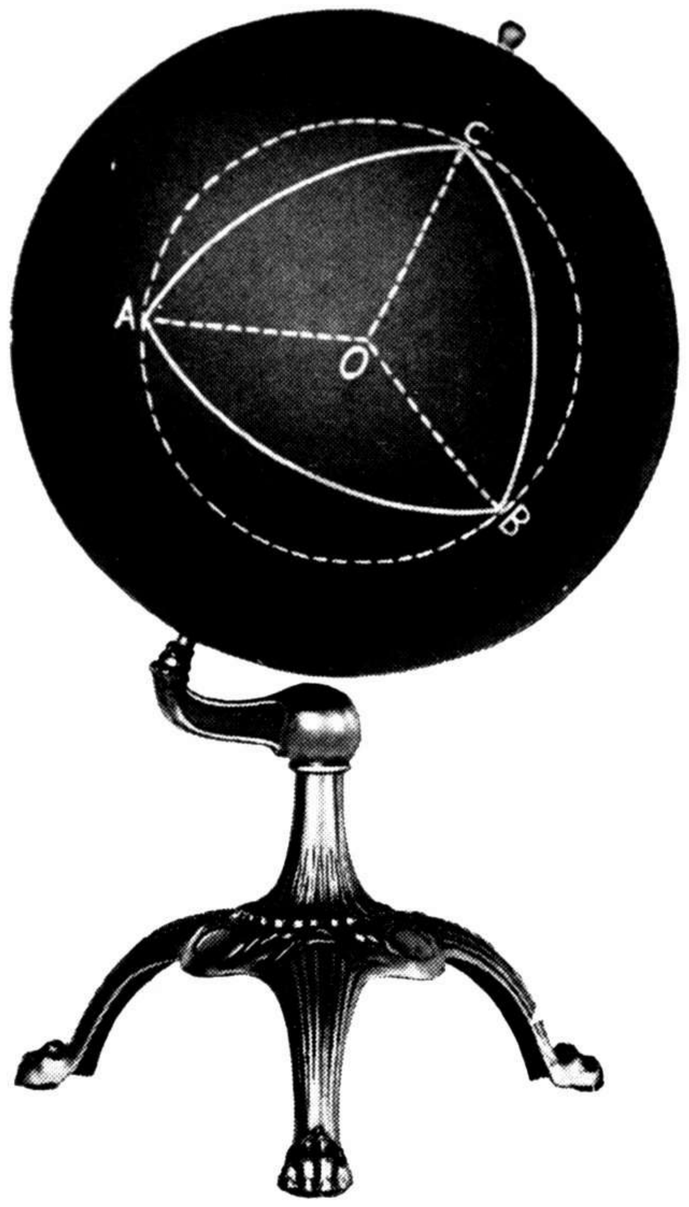
A1583

CELESTIAL GLOBES

The 12 Inch Globe is plotted on the Ecliptic System, showing celestial latitude and longitude. It can be mounted either with the axis going through the poles of the Ecliptic or through the Celestial poles. Unless otherwise specified, it is mounted with the axis going through the Celestial pole. It shows the constellation figures in bronze. The names of the constellations are shown in gold letters. All stars down to the ninth magnitude are shown. They are named by letters of the Greek alphabet and figures prefixed from the British catalog. All important nebulae are shown. A cloth bound manual accompanies each globe.

The 18 Inch Globe is plotted on the Equatorial System, showing declination and right ascension. It is mounted with the axis going through the Celestial poles. It shows the stars in white on a blue background. All stars down to the sixth magnitude are shown. The constellation figures are shown in bronze and the names of the constellations in clear, gold lettering. Important nebulae, double stars and star clusters are also shown. A cloth-bound manual accompanies each globe.

A1580. **12″ Celestial Globe,** Fixed Meridian.
A1581. **12″ Celestial Globe,** Movable Meridian.
A1582. **12″ Celestial Globe,** Fixed Meridian and Horizon.
A1583. **12″ Celestial Globe,** Movable Meridian and Horizon.
A1584. **18″ Celestial Globe,** Fixed Meridian.
A1585. **18″ Celestial Globe,** Movable Meridian.
A1586. **18″ Celestial Globe,** Fixed Meridian and Horizon.
A1587. **18″ Celestial Globe,** Movable Meridian and Horizon.



A1602

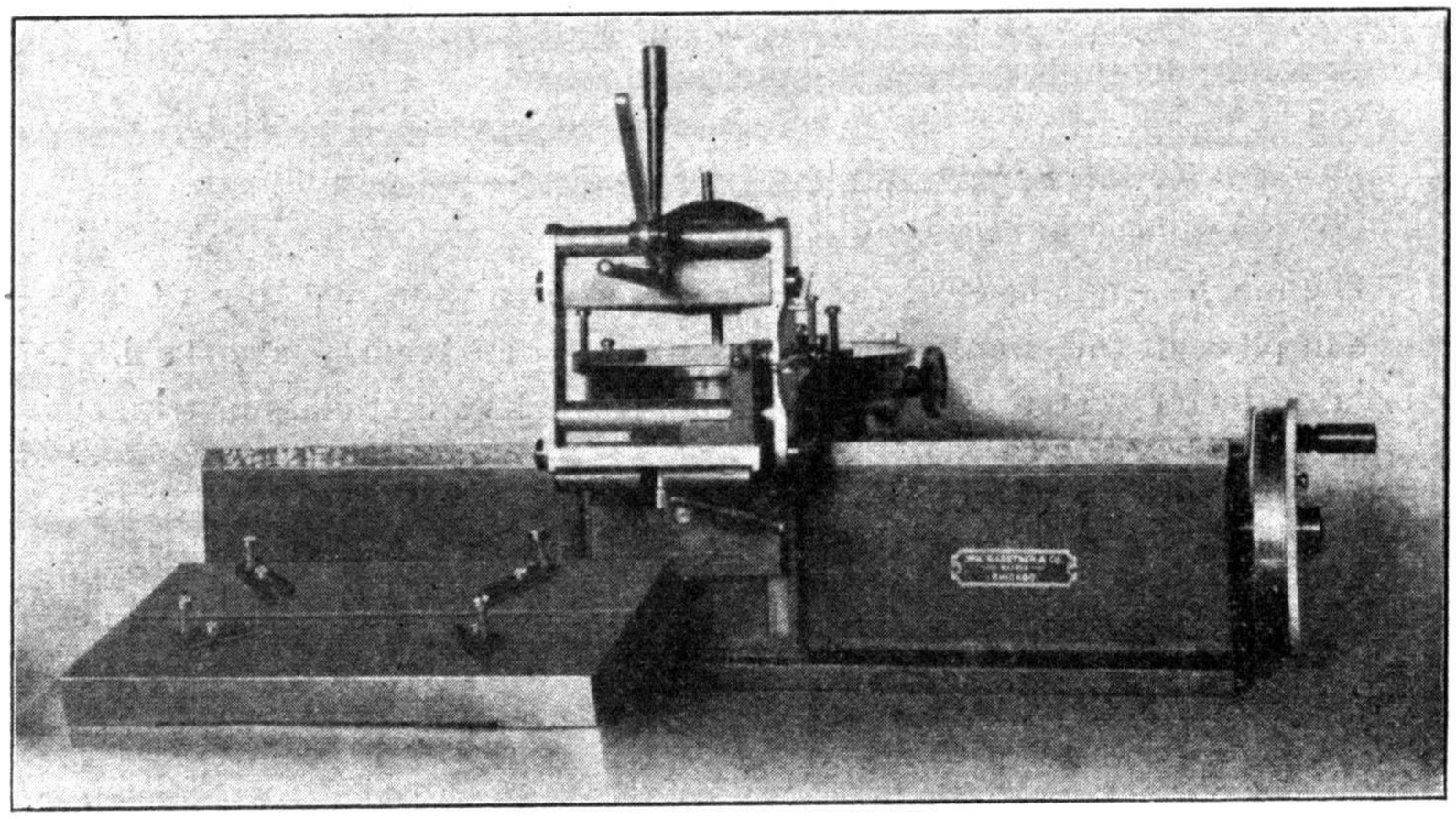
Slated Globes. These globes have a slated surface which takes crayon and slate pencil marks and are very useful in giving instructions involving meridians and parallels, etc. The most difficult theorems in astronomy, spherical geometry, trigonometry and navigation, are visualized, when studied on the black globe and become easily intelligible.

A1600. **Slated Globe** 8″ Plain.
A1602. **Slated Globe** 12″ Plain.
A1604. **Slated Globe** 18″ Plain.
A1606. **Slated Globe** 8″ with movable meridian.
A1608. **Slated Globe** 12″ with movable meridian.
A1610. **Slated Globe** 18″ with movable meridian.

Wm. Gaertner & Co.

Astronomical, Physical and Physiological Apparatus

5347-5349 LAKE AVENUE
CHICAGO



Linear and Circular Dividing Machine

Cat. M1301 This machine is specially designed for the use in the laboratory and particular attention has been paid to convenience, durability and accuracy. The machine can be changed from linear to circular dividing within a few seconds and its range of work is such as to cover about 90 per cent of all dividing required in the laboratory. It is in

many cases more advantageous to use than the more expensive semi-automatic machines, as the adjustments are of the simplest kind, easily understood and quickly made.

The linear range of machine is 20 cm. and it will work with equal rapidity and accuracy in either direction, backwards or forwards. The carriage is 21 cm. long and is provided with a groove for the convenient holding of glass tubes, etc. Automatic stops for dividing full millimeter and 0.1 mm. are provided. The screw has a pitch of 1 mm. and is corrected through its whole length to about 0.005 mm. The divided head has 100 parts.

The construction of the dividing head is such as to enable with equal convenience the dividing of fine lines with a diamond on glass as well as the heavy dividing of a steel scale. The length of lines can be changed as may be desired for every second, third, fourth or any other mark, by simply turning a small lever which is in convenient reach. This arrangement saves much time in the first adjustment of the machine.

The circular dividing arrangement consists of a bronze worm wheel having 360 teeth in which engages a worm screw having a divided head with 60 parts. An automatic stop is provided for quick dividing of full degrees. The range of this attachment is from 4 cm. to 25 cm. of diameter. The accuracy of worm wheel is about 20 seconds.

The machine can be easily arranged as a comparator by fitting a microscope in place of the circular dividing attachment. It may also be fitted with an interferometer attachment and will make a first class instrument of the kind.

Price of machine complete.....$125.00 net.

Glass case for above.....4.50 net.