

Portable
TRANSIT
INSTRUMENTS

ASKANIA-WERKE A.G.
BERLIN-FRIEDENAU



PORTABLE TRANSIT INSTRUMENTS AND MERIDIAN CIRCLES.

*T*ransit instruments are used for determining time and the operation of astronomical clocks or the geographical latitude and longitude of a place on the earth, by observing the transits of stars, mostly in the meridian or in a vertical. They are employed extensively in geodesy for longitude determinations. Meridian circles, on the other hand, are employed in astronomy mainly for determining the fundamental positions of the fixed stars.

In addition to large transit instruments and meridian circles intended for permanent erection on a pre-arranged stone foundation, we also make portable instruments in which the bearings and pivoting equipment are constructionally embodied in a base structure. Hence simple mounting on a stone pier or on a sufficiently heavy stand is rendered possible.

Our portable transits which are universally known and are to be found in all parts of the world, are now made in 4 sizes in which the objectives have free apertures of 50, 70, 90 and 100 mm. respectively, while we construct the portable meridian circles normally with apertures of 90 and 100 mm.

After extensive experience acquired in the course of about sixty years, the instruments have been carefully redesigned, but the fundamental arrangements and sizes have been retained, as they have proved entirely successful.

The important components have been so remodelled that they may be cast without fear of internal stresses and hidden defects, this being accomplished by providing more regular shapes and greater uniformity in the wall thicknesses. At the same time improved enamelling applied by baking, renders the instruments more proof against the influences of weather, and therefore considerably simplifies the attention. Particular care has been devoted to the design of the axis. The spherical shape of the central portion of the axis whilst facilitating the casting operation, also enables every trace of the casting film to be removed by machining. The wall thicknesses of the entire axis are much more uniform, and there are no projecting portions to cause trouble. The pivot bearing rings, the condition of which is of utmost importance, are made of high-grade steel specially produced for the purpose. Due to the new design, it has been possible to reduce the weight of every instrument and at the same time to increase the rigidity of the axis.

The spherical center portion of the axis has in its interior a prism which refracts the beam of light coming from the objective and passes it through the hollow axis to an eyepiece at one end. Thus the observer retains the same position relative to the instrument for all zenith distances occurring.

As heretofore, the prism rests without stress on a special carrier connected to the objective tube, so that any variation in the collimation error is precluded. This arrangement has proved successful for many years.

The trunnions themselves are relieved of load by two pairs of friction rollers arranged symmetrical to the center of the axis, these rollers being held in turn by supports which are borne at the two ends of a balance beam resting in the middle on a knife-edge bearing. A spiral spring with a regulating screw takes up the greater portion of the pressure of this bearing from below through a vertical cylinder



guide. Thus a symmetrical relieving of the pivot is always ensured. Connected to this relieving device is the reversing mechanism which can easily be operated by a lever with an eccentric.

The pressure of the declination clamping on the axis has been substantially reduced without the certainty of clamping being sacrificed, so that flexure of the axis is entirely eliminated.

Much greater rigidity has been given to the suspension level. It is now possible to change the glass guard of the level and the latter itself, without having to take the frame apart.

The altitude circle for setting the desired zenith distance is arranged conveniently accessible at the eyepiece end of the telescope.

Time calculations determined with our portable instruments are almost as accurate as those arrived at with the much larger fixed instruments and attain a mean error of ± 0.02 second of time.

Whilst the 50 mm. transit, particularly intended as a handy and light instrument for travelling purposes, reveals a very large number of stars, the 70 mm. instrument, due to the excellent quality of the optical system, allows a person with fair sight to observe all stars up to the seventh magnitude, that is, all stars of the new fundamental catalogue (*Berliner Astronomisches Jahrbuch*) as used for accurate time determinations.

The 90 mm. aperture is guaranteed to disclose all fundamental stars of interest in actual practice, and this applies still more so to the 100 mm. aperture of greater light-transmitting power.

Accompanying each instrument is a set of 4 suitable orthoscopic eyepieces. In the larger instruments, the use of a magnification of 100 has been found expedient. Suitable field and web illumination is provided in all instruments.

Each instrument may be furnished with a Horrebow-Talcott level for determining pole altitudes by the Horrebow method. The 50 mm. transit is equipped with a single Horrebow level and the three larger instruments have a double Horrebow level.

All eyepiece micrometers are provided with a micrometer screw of 0.25 mm. pitch. The reticle of the eyepiece micrometers is specially calculated for the focal lengths of the various instruments. Also the micrometer drums are so divided that their individual intervals give suitable arc values. The motion of the eyepiece is coupled to the micrometer screw in order to prevent parallax of the field of view so that the movable measuring webs are always in the center of the field of view.

The recording micrometers have agate cylinders and ten platinum-iridium contacts spaced at 36 degrees apart. The zero contact is identified by three directly adjacent contacts. The micrometer screws of these micrometers have a pitch of 0.5 mm. In the case of these micrometers also, the eyepiece and the reticle plate are coupled to the movable threads.

The eyepiece micrometer and the recording micrometer may be fixed to any instrument and are easily interchangeable.

A detailed description, together with instructions for use and directions for manipulation is given with each instrument.

The sensitivity of the levels, the quality of the lenses, the shape of the trunnions and the quality of the eyepiece micrometer screws of our transits will be carefully tested if desired, at the Institute of Geodesy, Potsdam, on payment of the costs incurred, the results being confirmed in a separate certificate accompanying each instrument.

We reserve the right to make alterations in the design of the instruments; illustrations and data concerning dimensions and weights are therefore not binding.



No. 1. Transit Instrument, Type Ap 50.

This instrument is intended to do full justice to travelling requirements and therefore in order to obtain the most compact arrangement, the entire optical axis is situated in the pivotal axis.

The instrument is provided with an eccentrically refracting telescope having an objective of 50 mm. free aperture and 45 cm. focal length. The path of light in the optical axis coincides to a large extent with the axis of rotation. The squat and compact form thus obtainable makes it possible to

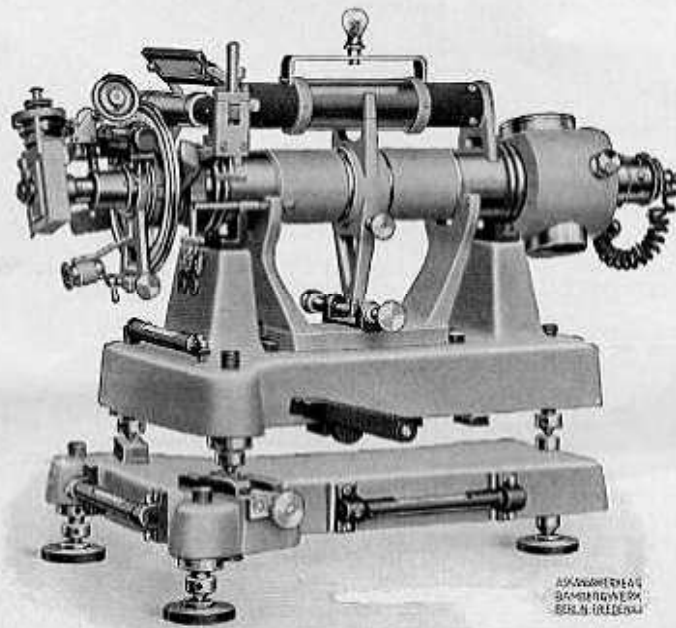


Fig. 1. Transit Instrument Ap 50 with the Döllner Azimuth Base. Type Adu 50

accommodate the instrument in one small case. There is also the great advantage that the axis consists of a single piece of steel and on account of its perfectly uniform shape can be hardened entirely free from internal strain. Owing to the smaller weight of the axis, it has been possible to dispense with a weight relieving arrangement. In conjunction with the objective, the four orthoscopic eyepieces give the following optical values:

Focal length	6	8	10	15 mm.
Magnification	75	56	45	30 diameters
Field of view	35'30"	44'	55'	83'
Exit pupil	0.67	0.9	1.1	1.6 mm.

The focal length $f = 45$ cm. in the plane of the eyepiece micrometer, which is rotatable through 90 deg. gives a linear measure of 0.13088 mm. for 1', so that 1.1" corresponds to one graduation of the 100 division drum. (Fig. 15, page 18).



The electrical illumination of the field of view is fixed in front of the prism cube and the instrument is carefully protected from the transmission of heat. The current for the lighting of the field of view and for the hand lamp passes through slip rings on the axis. The bridge-type level has a sensitivity of 2'' and a scale of 40 Paris graduations; it is numbered in a double row from 0—40. The level on the base has a sensitivity of 20''. The finder circle has a diameter of 110 mm. and is divided on silver in $\frac{1}{6}^\circ$ and numbered from 0—180 in a clockwise and anti-clockwise direction. With the aid of the index and magnifying glass, a direct reading of 10' is possible. The level alidade is equipped with a 60'' level. The reversing mechanism is actuated by a lever. The instrument is supplied in a case of 63×42×27 cm. (2'1''×1'4½''×10½'') with lock and 2 carrying handles.

The accessories supplied are:

- | | |
|-------------------|-----------------------------|
| 1 Objective cover | 5 Tommy pins |
| 1 Dew cap | 1 Oil bottle |
| 3 Foot plates | 1 Dusting brush |
| 2 Colored glasses | 1 Key for case |
| 2 Socket wrenches | 1 Flex and plug for battery |
| 1 Square spanner | 1 Electric hand lamp |
| 2 Screw-drivers | 2 Spare bulbs |

Supplementary apparatus (at an extra charge).

No. 2: Döllén base, Type Adu 50 with 6 deg. azimuth setting and an accuracy of adjustment of 10', in trapezoidal case 45×38 (20)×13 cm. (1'6''×1'3''×8''×5'') with lock (Fig. 3, page 6).

No. 3: Horrebow-Talcott Level, Type Ahtn 50 with chambered vial having a sensitivity of 2'' and 1 reading mirror, divided into 30 standard Paris graduations and 2 rows of figures from 0—30 in mirror-script.

No. 4: Impersonal recording micrometer, Type Amir 20 with agate drum and 10 platinum-iridium contacts, spaced at 36 deg. (the zero contact is triple). Also a counter-balance for compensating the extra weight of this micrometer (Fig. 16, page 18).

No. 5: Electrical illumination, Type Atb of reading drum of eyepiece micrometer.

No. 6: Oil illumination, Type Aöb with 2 stands.

No. 7: 3 sack cells in case, Type Ael.

No. 8: Leather cover, Type Alb 50: At extra cost, all cases may be supplied covered with leather.

Dimensions:

Instrument:

Total height to center of axis (with foot plates)	22,5 cm. (9 in.)
Total height to edge of objective with telescope vertical.....	26 cm. (10¼ in.)
Total length	59 cm. (23 in.)
Maximum width of base plate	24 cm. (9½ in.)

Döllén base:

Total height	8,5 cm. (3½ in.)
Total height with foot plates	10 cm. (4 in.)
Total length	41 cm. (16 in.)
Maximum width	31 cm. (12 in.)

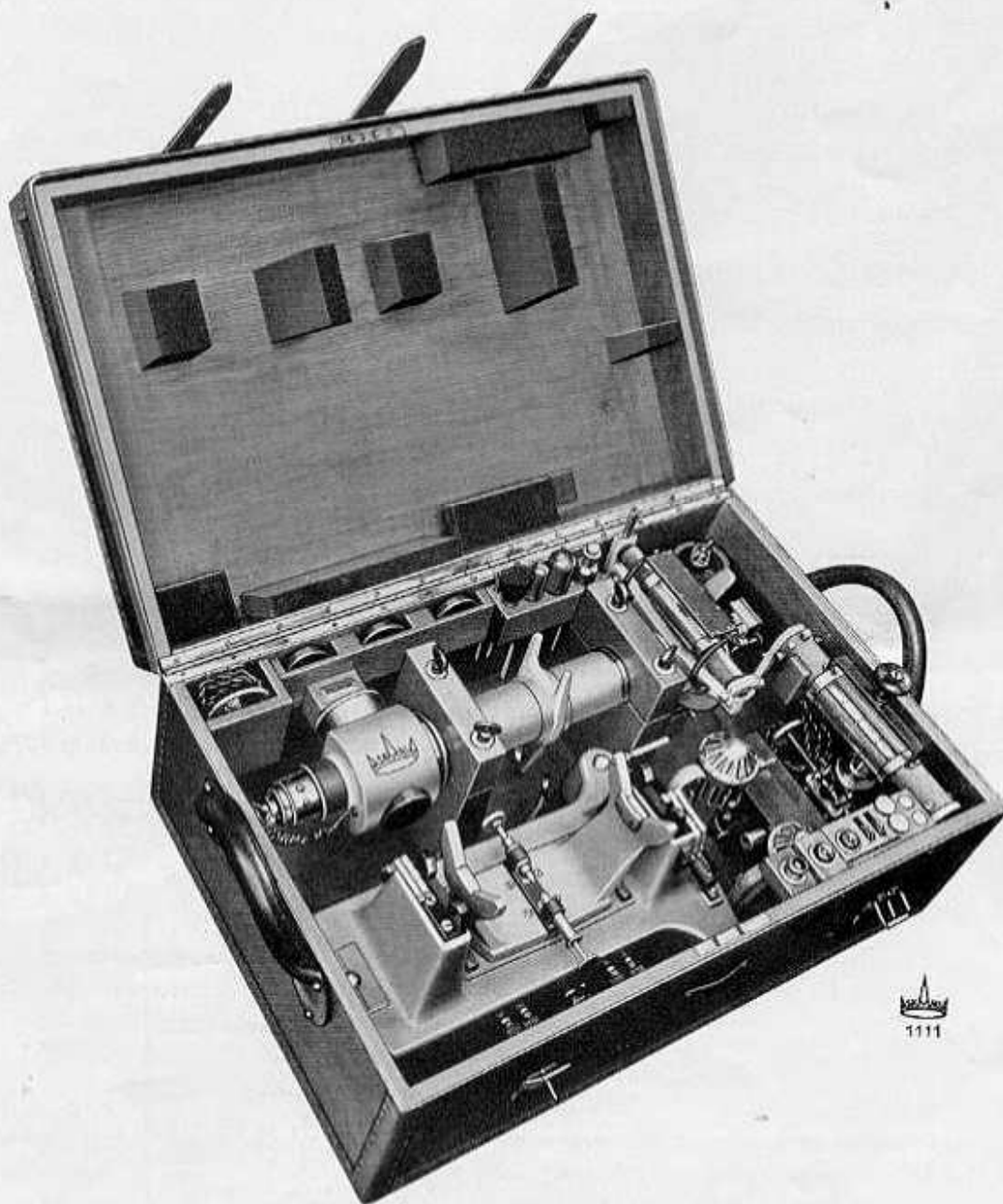


Fig. 2. Transit Instrument. Type Ap 50 in leather-covered, case.



Fig. 3.
D511en Azimuth Base
Type Adu 50 in
leather-covered case.

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**Cases for Ap 50
and weights of same.**

1. Case for azimuth base (Fig. 3).....	3.5 kg. (7 ³ / ₄ lbs.)	
Contents: Azimuth base.....	8.0 kg. (17 ¹ / ₂ lbs.)	
2. Case for instrument (Fig. 2)	11.0 kg. (24 lbs.)	
Contents: Undercarriage.....	12.6 kg. (28 lbs.)	
Top	8.3 kg. (18 ¹ / ₂ lbs.)	
Bridge level.....	1.1 kg. (2 ¹ / ₄ lbs.)	
3 Foot plates		} 0.5 kg. (1 lb.)
Dew cap		
Electric hand lamp		
2 Colored glasses		
3 Eyepieces		
5 Tommy pins.....		
2 Screw-drivers		
1 Dusting brush.....		
1 Oil bottle		
2 Spare bulbs		
1 Square spanner		
1 Socket wrench		

When recording micrometer is used, 1 counter-
balance

0.3 kg.	(³ / ₄ lb.)
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No. 9. Transit Instrument, Type Ap 70.

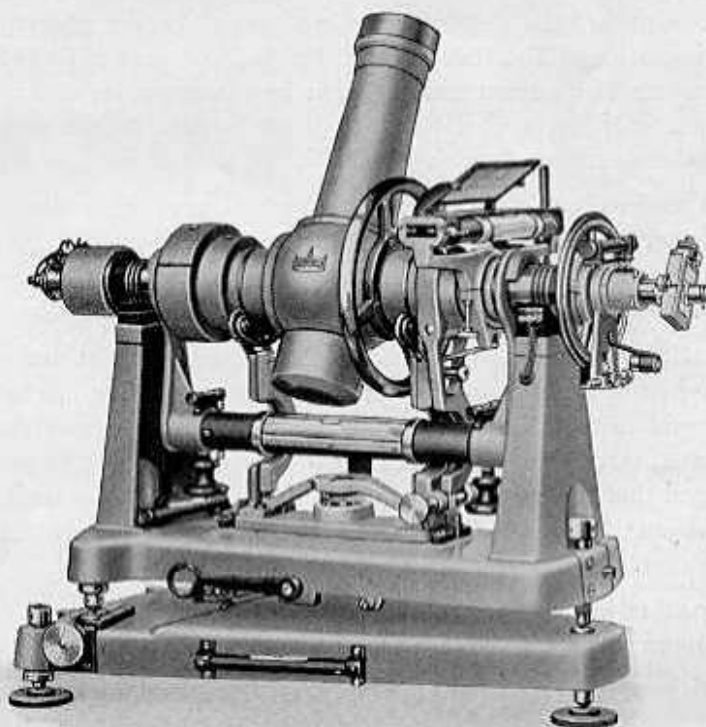


Fig. 4. Transit Instrument, Type Ap 70 with Döllner Azimuth Base, Type Adu 70.

As heretofore, the Ap 70 transit is provided with a centrally refracting telescope having an objective of 70 mm. free aperture and 64.45 cm. focal length, the path of light passing through a right-angled prism in the hollow axis, at one end of which is the eyepiece with the eyepiece micrometer. In conjunction with the objective, the 4 orthoscopic eyepieces give the following optical values:

Focal length	6	8	10	15 mm.
Magnification	107	81	65	43 diameters
Field of view	16'30"	29'20"	36'40"	55'
Exit pupil	0.7	0.9	1.1	1.6 mm.

Two colored glasses which may be slipped on the eyepieces complete the optical equipment.

The focal length $f = 64.45$ cm. in the plane of the reticle of the eyepiece micrometer, which is rotatable through 90° , gives a linear measure of 0.1875 mm. for 1', with a screw pitch of 0.25 mm., so that one graduation of the 100 division drum corresponds to 0.8". The 19 fixed webs are arranged at a distance of 0—30'. The two fixed horizontal webs have a spacing of 1.4' (Fig. 15, page 18).

The axis of the instrument rests in robust bearings integral with the undercarriage. In order to relieve the bearings of weight, a special central balance beam device is provided, so that both trunnions always rest with the same pressure on the bearings. The central spring may be regulated within the necessary limits. The weight-relieving member is mounted on the axis-reversing device. Raising is



brought about by a hand lever on the undercarriage, the pivot resting on special padded bearings or relieving roller supports. The axis mounting is checked by means of a suspension level, whose suspension arms are rigidly connected to the tube containing the level, which has an accuracy of 1" and a continuous scale of 0—70 Paris graduations. The level is mounted in its socket entirely free from strain and is protected from temperature fluctuations and radiation by a cloth cover and a glass tube. By means of adjusting screws, the axis of the level may be set exactly parallel to the axis of the telescope. The undercarriage and base levels have a sensitivity of 20".

Rigidly connected to the pivot is the finder circle which has a diameter of 135 mm. and a silver scale graduated in $\frac{1}{6}$ deg. and numbered every 5th deg. from 0 to 360. A circle reading with an accuracy of 1' is made possible by a vernier and magnifying glass which are secured to the level alidade, the latter having a spirit level with a sensitivity of 60".

The field illumination is effected through the hollow axis from the end opposite the eyepiece, either by an electric lamp or by an oil lamp with a ball-bearing suspension. Its intensity is made variable at will by a modifying grid in the interior of the axis. The lighting current from a 4-volt battery is supplied to the instrument through a triple plug socket through the slip rings on the telescope axis. The circuit is so arranged that the current is supplied to the handlamp as well as to the field of view illumination and micrometer. Illumination of the micrometer drum is only provided when expressly desired and at an extra cost.

The instrument is packed in 2 cases of 82×50×20 cm. ($2'8\frac{1}{4}'' \times 1'7\frac{3}{4}'' \times 11\frac{3}{4}''$) and 64×45×38 cm. ($2'1\frac{1}{4}'' \times 1'5\frac{3}{4}'' \times 1'3''$) and these may be covered with leather if desired.

The Döllén azimuth base is arranged in a special case. For travelling with pack animals in trackless country, the instrument may be supplied packed in 5 cases, at an extra cost (weight of each case is 30 to 35 kg. [66 lbs to 77 lbs]).

The accessories supplied are:

1 Objective cover	4 Tommy pins
1 Dew cap	1 Oil bottle
3 Foot plates	1 Dusting brush
2 Colored glasses	2 Keys for cases
2 Socket wrenches	1 Flex and plug for battery
1 Square spanner	1 Electric hand-lamp
5 Screw drivers	10 Spare bulbs

Supplementary apparatus (at an extra charge).

No. 10: Döllén base, Type Adu 70 with 6° azimuth setting, on which the instrument may be adjusted exactly in the meridian to 1' second of time = 15 seconds of arc (Fig. 10, page 12).

No. 11: Circle base, Type Aku 70 with a circle divided into $\frac{1}{5}^\circ = 20'$, which may be read by a vernier with an accuracy of 1'. It is provided with quadruple clamping and slow motion as well as with 2 adjustable levels arranged offset 90 deg. apart and having a sensitivity of 5". (Fig. 5, page 9 and Fig. 11, page 12).

No. 12: Horrebow-Talcott Level, Type Ahtn 70 for determining the pole altitude by the Horrebow-Talcott method with 2 chamber vials of 1" sensitivity and a mirror-script numbering of 0—40 and 50—90 Paris graduations. The reading is carried out from the eyepiece end of the axis through a mirror which may be tilted at will.

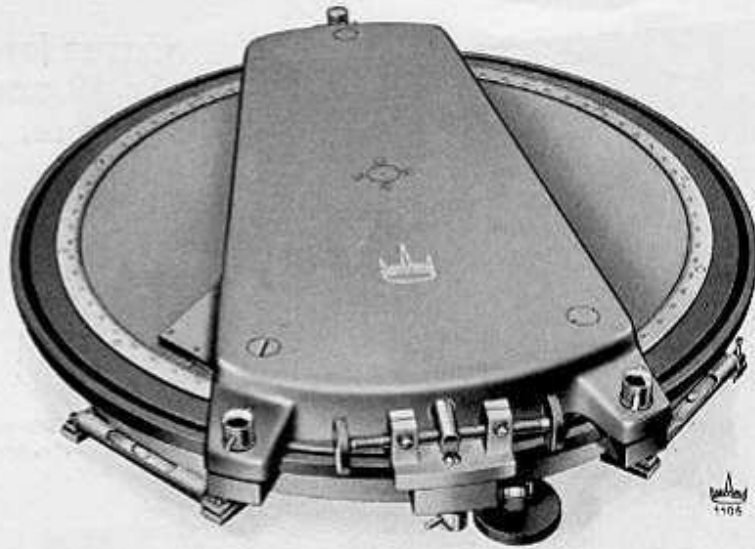


Fig. 5. Circle Base for Ap 70, 90 and 100.

Nr. 13: Impersonal Recording Micrometer, Type Amir 24 with agate drum and 10 platinum-iridium contacts, for which a chronograph lead is provided on the slip rings of the axis (Fig. 16, page 18). In case.

Nr. 5: Electrical Illumination of the Reading Drum, Type Atb of eyepiece micrometer.

Nr. 14: 2 Grid Diaphragms, Type Agb 70 for weakening by 2 and 4 classes of magnitude.

Nr. 15: Oil lamp with Ball-bearing Suspension, Type Aöbk 70.

Nr. 7: 3 Sack Cells, in box, Type Ael.

Nr. 16: Leather Covering, Type Alb 70 for the cases.

Dimensions:

Instrument:

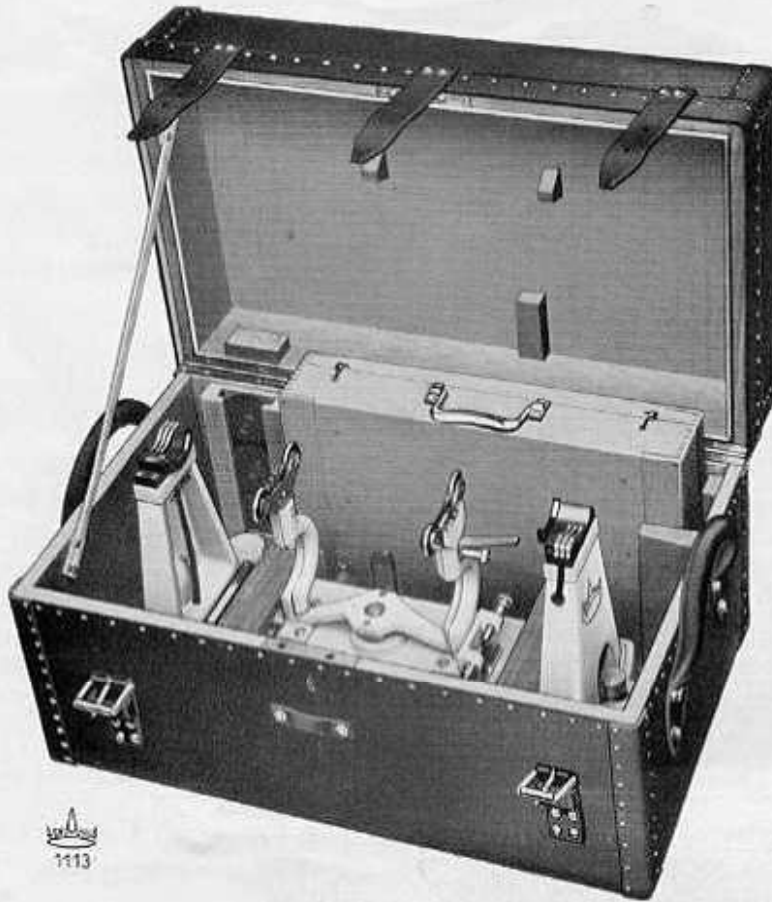
Height to center of axis, with foot plates.....	35 cm. (14 in.)
Total height to edge of objective with telescope vertical	63 cm. (25 in.)
Total length	79 cm. (31 in.)
Maximum width of base plate	30 cm. (12 in.)

Döllen base:

Total height	9 cm. (3 ¹ / ₂ in.)
Total height with foot plates.....	10.5 cm. (4 in.)
Total length	61 cm. (24 in.)
Maximum width	40 cm. (16 in.)

Circle base:

Maximum diameter	70 cm. (27 ¹ / ₂ in.)
Diameter of limb	53 cm. (21 in.)
Height	14.5 cm. (5 ³ / ₄ in.)



**Cases for
Ap 70 and weights
of same.**

Case 1 (Fig. 6) 16 kg. (35 lbs.)
Under-carriage 28.35 kg. (63 lbs.)
3 Foot plates ... 1.00 kg. (2¹/₄ lbs.)

Fig. 6. Leather-covered case I with undercarriage, foot plates and inner case 1 a.

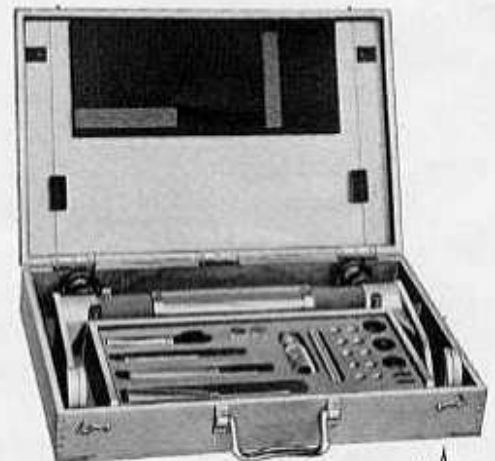

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Case 1 a (Fig. 8) 2.60 kg. (6 lbs.)
Suspension level 2.95 kg. (6¹/₂ lbs.)

3 Eyepieces	} 1.00 kg. (2 ¹ / ₄ lbs.)
10 Spare bulbs ...	
5 Tommy pins ...	
1 Oil-bottle	
1 Dusting brush .	
2 Square spanners	
3 Screw-drivers..	

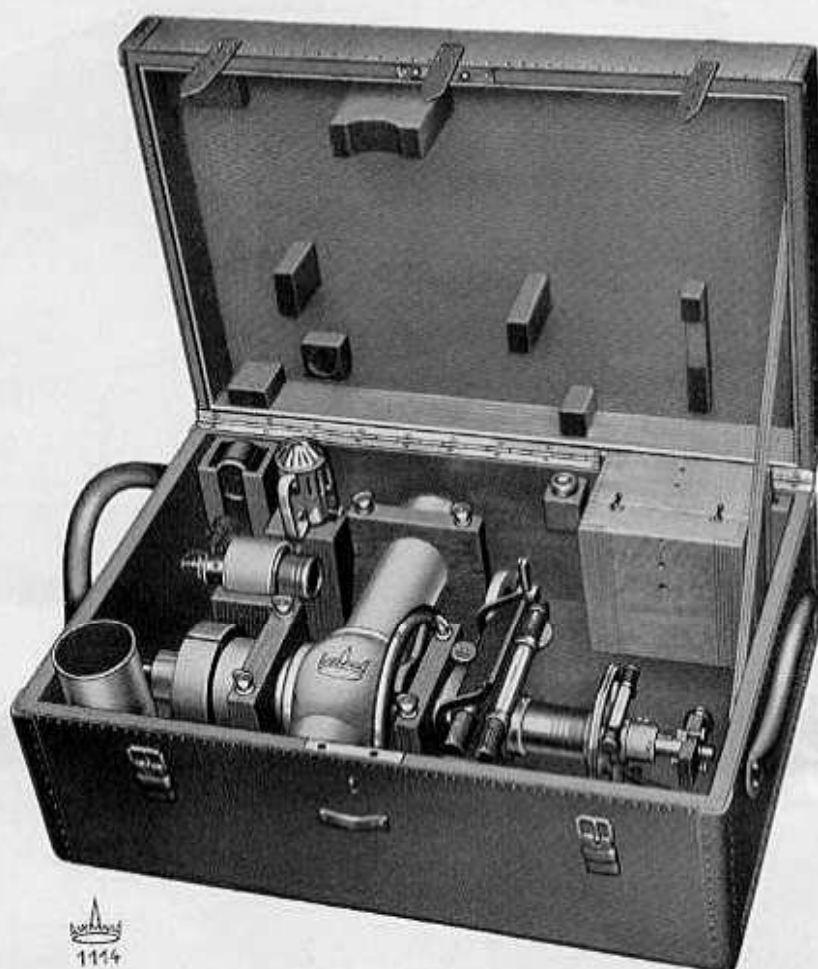


Fig. 7. Case for sack cells.




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Fig. 8. Case 1 a with suspension level and tools.




 1114

Fig. 9. Leather-covered case 2 with axis, telescope and recording micrometer in case.

Case 2 (Fig. 9)	16.70 kg. (37 lbs.)
Axis with telescope	25.80 kg. (57 lbs.)
Counter-balance with electrical illumination	3.10 kg. (7 lbs.)
Suspension for paraffin lamp	} 1.95 kg. (4 lbs.)
Paraffin lamp	
Electric hand lamp	0.19 kg. (7 oz.)
Dew cap	0.16 kg. (6 oz.)
1 Counter-weight (when recording micrometer is used)	0.28 kg. (10 oz.)
Case 2a (contained in case 2)	0.95 kg. (2 lbs.)
Recording micrometer	0.75 kg. (1 1/2 lbs.)



Fig. 10. Leather-covered case 3 with
Döllen Azimuth Base.



Case 3 (Fig. 10) 9.00 kg. (20 lbs.)
Azimuth base ... 17.55 kg. (39 lbs.)

Case 4 (Fig. 11) 29.70 kg. (65 1/2 lbs.)
Circle base 60.80 kg. (133 1/2 lbs.)



Fig. 11.
Leather-covered case 4 with
Circle Base, Type Aku 70.



No. 17. Transit Instrument, Type Ap 90.

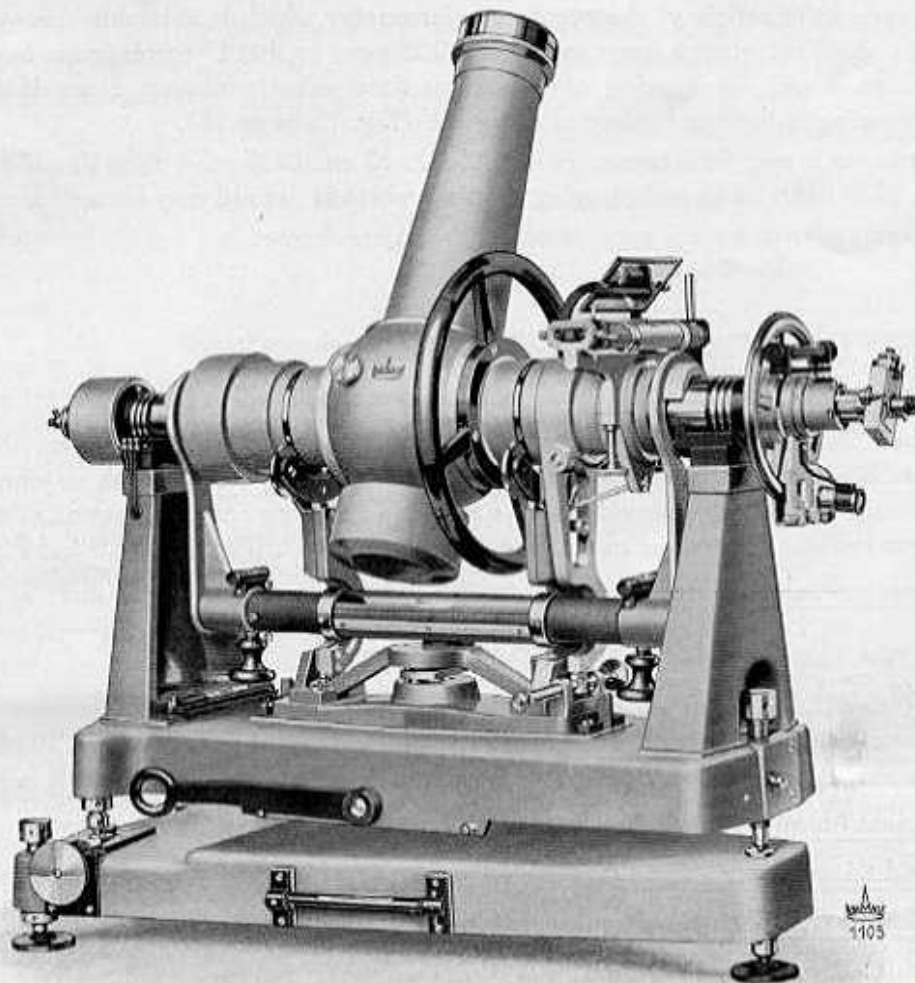


Fig. 12. Transit Instruments Ap 90 with Döllner Azimuth Base, Type Adu 90.

The Ap 90 transit is constructionally of the same design as the Ap 70 but in view of the greater accuracy and more powerful optical system, it is built to a larger scale. The objective has a free aperture of 90 mm. and a focal length of 85.9 cm.

The four orthoscopic eyepieces in conjunction with the objective, give the following optical values:

Focal length	6'	8	10	15 mm.
Magnification	143	107	86	57 diameters
Field of view	16'30''	22'	27'30''	41'20''
Exit pupil	0,6	0,8	1,0	1,6 mm.

The **finder circle** of this instrument has a diameter of 162 mm. and a silver scale graduated in $\frac{1}{6}$ deg. The reading accuracy with vernier and magnifying glass is also 1'. In addition to the field illumination as in Ap 70, this instrument also has a lighting for the webs, which may be varied in intensity at will by limiting the Ramsden circle.



The **suspension level** has a scale of 80 Paris graduations and a sensitivity of 1".

In the plane of the reticle of the eyepiece **micrometer** which is rotatable through 90 deg. the focal length $f = 85.9$ cm. gives a linear measure of 0.25 mm., so that 1" corresponds to one graduation of the 60 division drum. The spacing of the various fixed webs in minutes of arc is the same as for Ap 70. The spacing of the two horizontal webs is 1' (Fig. 15, page 18).

The instrument is packed in two cases of $100 \times 72 \times 32$ cm. ($3'3'' \times 2'4\frac{1}{2}'' \times 1'$) and $82 \times 48 \times 48$ cm. ($2'8'' \times 1'7'' \times 1'7''$) (with locks and carrying handles) which if desired may be leather-covered.

The **Döllén azimuth base** is accommodated in a special case.

Supplementary apparatus (at an extra charge):

No. 18: Döllén Base, Type Adu 90 with 6° azimuth setting, on which the instrument may be adjusted exactly in the meridian to 1' second of time = 15 seconds of arc (Fig. 10, page 12).

No. 19: Circle Base, Type Aku 90 with a circle divided into $\frac{1}{3}^\circ = 20'$, which may be read by a vernier with an accuracy of 1'. It is provided with quadruple clamping and slow motion as well as 2 adjustable levels arranged offset 90° apart and having a sensitivity of 5". (Fig. 5, page 9 and Fig. 11, page 12).

No. 20: Horrebow-Talcott Level, Type Ahtn 90 for determining the pole altitude by the Horrebow-Talcott method with 2 chamber vials of 1" and a mirror-script numbering of 0—40 and 50—90 Paris graduations. The reading is carried out from the eyepiece end of the axis through a mirror which may be tilted at will.

No. 21: Impersonal Recording Micrometer, Type Amir 30 with agate drum and 10 platinum-iridium contacts, for which a chronograph lead is provided on the slip rings of the axis (Fig. 16, page 18). In case.

No. 5: Electrical Illumination of the Reading Drum, Type Atb of the eyepiece micrometer.

No. 22: 2 Grid Diaphragms, Type Agb 90, for weakening by 2 and 4 classes of magnitude.

No. 23: Oil Lamp with Ball-bearing Suspension, Type Aöbk 90.

No. 7: 3 Sack Cells, in box, Type Ael.

No. 24: Leather-Covering, Type Alb 90 for the cases.

Dimensions:

Instrument:

Total height to center of axis including foot plates	44.5 cm. (17 1/2 in.)
Total height to edge of objective which telescope vertical	78.5 cm. (31 in.)
Total length	103 cm. (40 1/2 in.)
Maximum width of base plate	36 cm. (14 in.)

Döllén base:

Total height	12.5 cm. (5 in.)
Total height including foot plates	14.5 cm. (5 3/4 in.)
Total length	80 cm. (31 1/2 in.)
Maximum width of	48 cm. (19 in.)

Circle base:

Maximum diameter....	88 cm. (35 in.)
Diameter of limb	69 cm. (27 in.)
Height	16 cm. (6 1/4 in.)



Cases for Ap 90 and weights of same.

Case 1.....	23.30 kg. (51 ³ / ₄ lbs.)	Case 2.....	42.00 kg. (93 lbs.)
Under-carriage	65.65 kg. (146 lbs.)	Axis with telescope..	54.80 kg. (121 lbs.)
3 Foot plates	1.00 kg. (2 ¹ / ₄ lbs.)	Counter-weight with	
Case 1 a.....	5.70 kg. (12 ¹ / ₂ lbs.)	electrical illumination	2.80 kg. (6 ¹ / ₂ lbs.)
Suspension level	6.30 kg. (14 lbs.)	Paraffin lamp	2.25 kg.
3 Eyepieces	} 1.00 kg. (2 ¹ / ₄ lbs.)	Suspension for paraffin lamp	(5 lbs.)
2 Colored glasses		Dew cap	0.5 kg.
3 Diaphragms.....		Electric hand lamp	(1 lb.)
10 Spare bulbs.....		Case 2 a.....	1.00 kg. (2 ¹ / ₄ lbs.)
1 Oil bottle		Recording micrometer	0.75 kg. (1 ³ / ₄ lbs.)
1 Dusting brush	Case 3.....	14.15 kg. (31 ¹ / ₂ lbs.)	
3 Square spanners.....	Döllen base	36.80 kg. (82 lbs.)	
3 Screw drivers.....	Case 4.....	39.30 kg. (87 lbs.)	
3 Tommy pins.....	Circle base	95.40 kg. (211 lbs.)	

The instrument is packed like Ap 70.

No. 25. Transit Instrument, Type Ap 100.

(see Fig. 13, page 16)

The Ap 100 transit has an objective with a free aperture of 100 mm. and a focal length of 103.1 cm. The four orthoscopic eyepieces in conjunction with the objective give the following optical values:

Focal length	6	8	10	15 mm.
Magnification	172	129	103	69 diameters
Field of view	13'45"	18'20"	23'	34'25"
Exit pupil	0.6	0.8	1.0	1.5 mm.

In the plane of the reticle of the eyepiece micrometer which is rotatable through 90 deg. the focal length $f = 103.1$ cm. gives a linear measure of 0.3 mm. for 1', so that one graduation of the 100 division drum corresponds to 0.5". The spacing of the two horizontal webs is 1'.

The mechanical construction agrees with that of the Ap 90 transit. The instrument itself is packed in 2 cases of 120x75x40cm. (3'11¹/₂"x2'5¹/₂"x1'3³/₄"), which if desired may be leather-covered. Supplementary apparatus as for Ap 90 is recommended.

Dimensions:

The measurements of the instrument correspond with those of Ap 90, except that the total height to the edge of the objective when the telescope is vertical is 96 cm. 3 ft. 2 in. (caused by the greater focal length of the objective having a free aperture of 100 mm.)

Weight of instrument:

As for Ap 90, with the exception of the axis, together with the telescope, which weighs 63.7 kg. (140 lbs.) (instead of 54.8 kg. [122 lbs.]) owing to the longer focus and greater diameter of the objective.

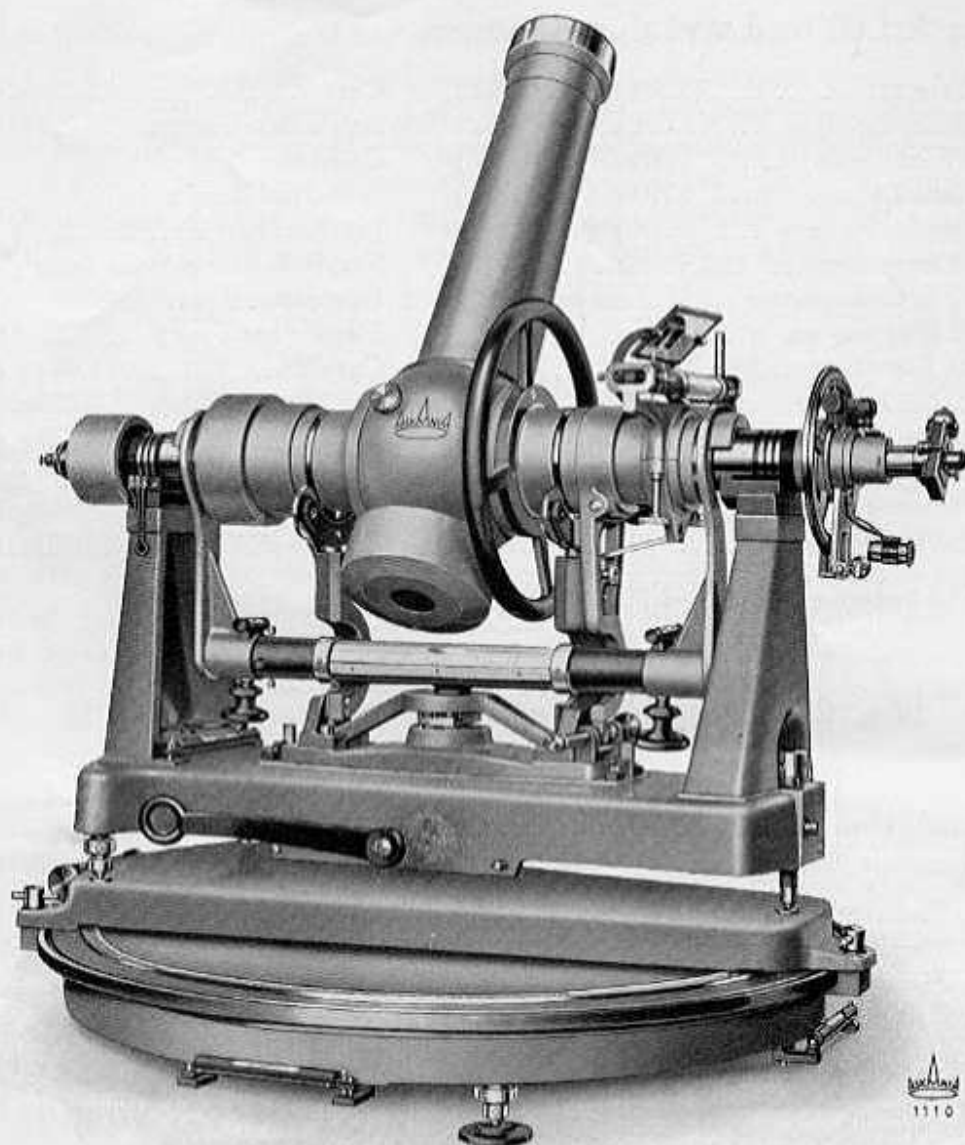


Fig. 13. Transit Instrument Ap 100 with Circle Base, Type Aku 90.

Portable Meridian Circles.

The precise and stable execution of our portable transit instruments makes it possible to provide them with a very accurately divided circle and a microscope mount so that they may also be employed as portable meridian circles. The transit instruments Ap 90 and Ap 100 as transit instruments Am 90 and Am 100, respectively, are therefore provided with a circle of 30 cm. diameter and scale graduation of $\frac{1}{15}^{\circ} = 4'$. The two micrometer microscopes on the microscope mount then permit a direct reading to $1''$. The microscope mount level is graduated in 50 Paris divisions and has a sensitivity of $1''$.

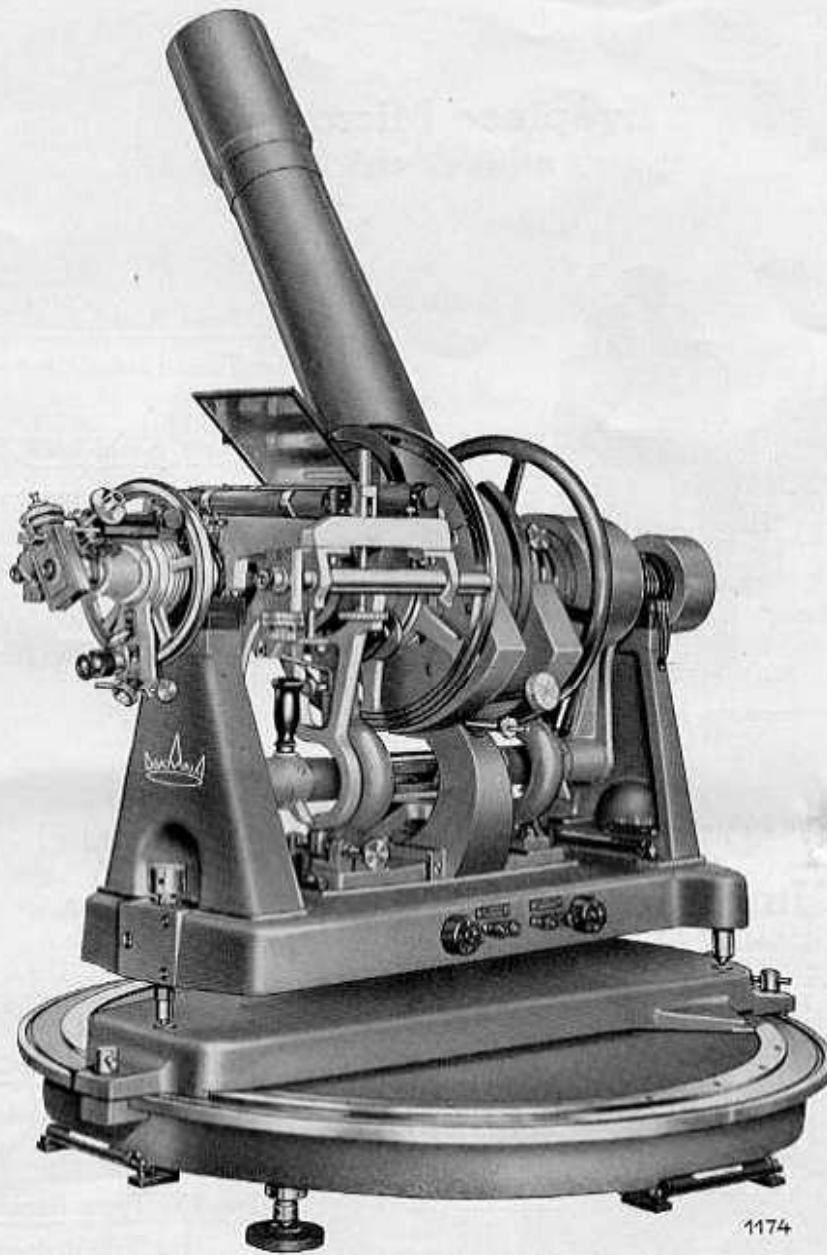


Fig. 14. Meridian Circle. Type Am 100 with Circle Base. Type Aku 90.

No. 26. Meridian Circle Am 90.
No. 27. Meridian Circle Am 100.

Dimensions:

The dimensions of the instruments correspond to those of the Ap 90 and Ap 100 types.

Weight of the instruments:

The weight is the same as Ap 90 and Ap 100, respectively, with the exception of the axis with telescope and microscope mount which weigh about 91 kg. (200 lbs.) and 100 kg. (220 lbs.) respectively.



Eyepiece Micrometer

rotatable through 90° .

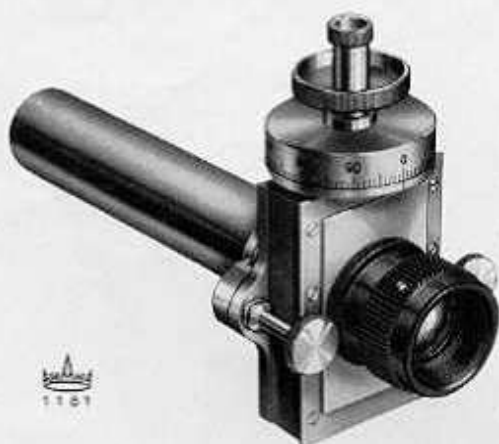


Fig. 15. Eyepiece Micrometer, about $\frac{1}{2}$ actual size.

No. 28: Type Amid 2/20

for Transit Instrument Ap 50

No. 29: Type Amid 1/24

for Transit Instrument Ap 70

No. 30: Type Amid 1/30

for Transit Instruments Ap 90 and Ap 100
and Meridian Circles Am 90 and Am 100.

Impersonal Recording Micrometer.

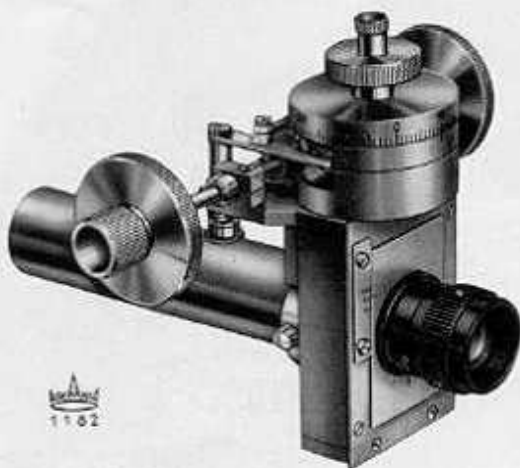


Fig. 16. Impersonal Recording Micrometer, about $\frac{1}{2}$ actual size.

No. 4: Type Amir 20

for Transit Instrument Ap 50

No. 13: Type Amir 24

for Transit Instrument Ap 70

No. 21: Type Amir 30

for Transit Instruments Ap 90
and Ap 100 and Meridian Circles
Am 90 and Am 100.



Finder Head, Wolf's design.

No. 31: Type Awk 70 for Transit Instrument Ap 70.

No. 32: Type Awk 90 for Transit Instruments Ap 90 and Ap 100.

In addition to a vernier with a lens for setting the finder circle, we can, at extra cost, also equip the Ap 70, 90 and 100 Transit Instruments with a finder head as designed by Wolf of Heidelberg for direct setting of the declination. The level alidade is in this case provided with 2 verniers, whose angular distance $\alpha = 2(90^\circ - \varphi)$ and which may be adjusted for the geographical Latitude $\varphi = 0^\circ$ to 75° . Thus for each of the two axial positions (finder circle east or west) there is a special setting vernier, so that after setting the telescope to the declination of a star in the east position of the finder circle and *before* observing the star, the observer can adjust the circle directly at the other vernier for observation in the west circle position. Then, after reversing the instrument, all that is necessary is to center the bubble of the alidade in order to make observations immediately in this position.

No. 33. Sighting Instrument and No. 34 Collimator.

In order that the fixed mounting of our portable transit instruments may be continually checked, we also supply as additional equipment 1 or 2 sighting instruments with collimator, as shown in the illustration. The instruments are equipped for fine adjustment base setting by means of screws, adjustment being lateral in the case of the sighting instruments and vertical for the collimators. They are mounted on iron base plates which are firmly cemented on the piers. The focal length of the collimator lens depends on the distance fixed by the possible mounting positions for the sighting instruments.



Fig. 17. Sighting Instrument.

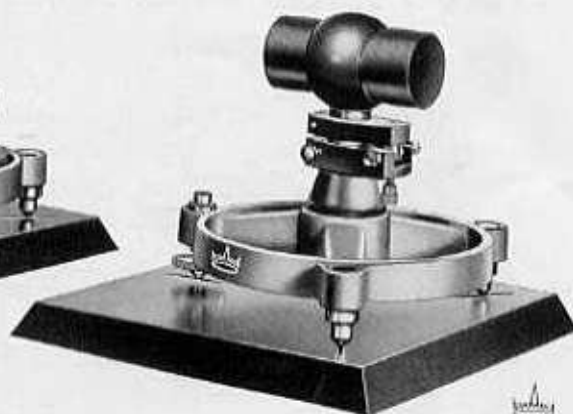


Fig. 18. Collimator.

Weights:

Each base plate 36×32 cm. (14 in. \times 12 1/2 in.)	114.3 kg. (252 lbs.)
Sighting device	37.5 kg. (83 lbs.)
Collimator lens device	9.6 kg. (21 1/2 lbs.)

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No. 35. Level Testing Apparatus, Type Glip.

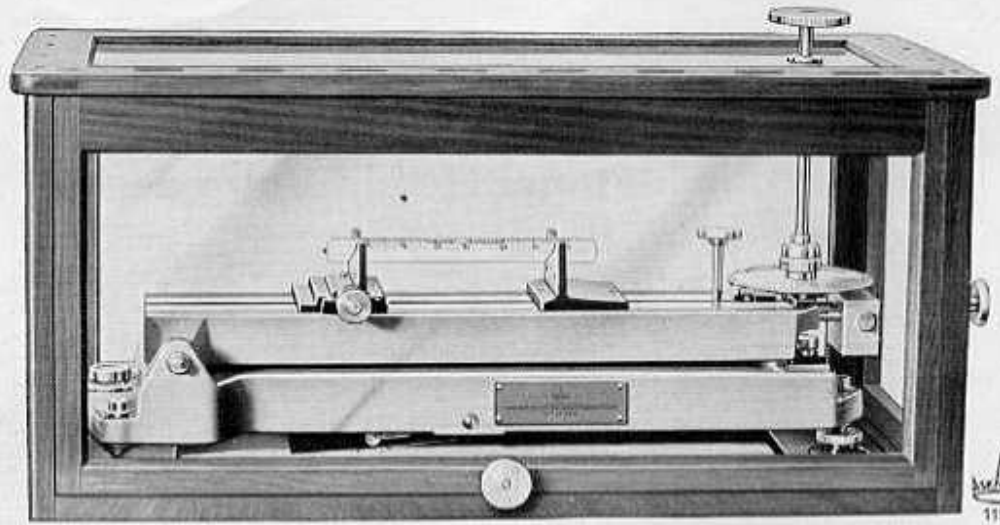


Fig. 19. Level Testing Apparatus.

For testing sensitive spirit levels. Housed in polished mahogany case to protect it from temperature effects. Base with circular level can be levelled by means of 3 footscrews. Tilting table is adjustable from the outside by means of a knurled knob. The measuring screw of the tilting table is provided with 120-division dial, one interval corresponding to 1". The width of an interval is about 2.6 mm. so that estimation to 0.1" is conveniently possible. Sliding weight for exactly balancing the tilting table with the test level in position. A slip-on weight provides always the same bearing pressure on the measuring screw. Locking screw for the measuring screw. Two sliding supports for the test level, one being provided with micrometric transverse adjustment. The base and tilting table are of robust construction so that levels may also be tested in their mountings.

Dimensions of case: 62 × 28 × 43 cm. (24 in. × 11 in. × 17 in.). Weight: 12 kg. (26 1/2 lbs.)
Protective case: 8 kg. (17 1/2 lbs.)

Accessory:

No. 36: Adjustable Holder and Auxiliary Tubular Support, Type Glip for testing striding levels in their mountings.

No. 37. Micrometer Testing Apparatus, Type Amp.

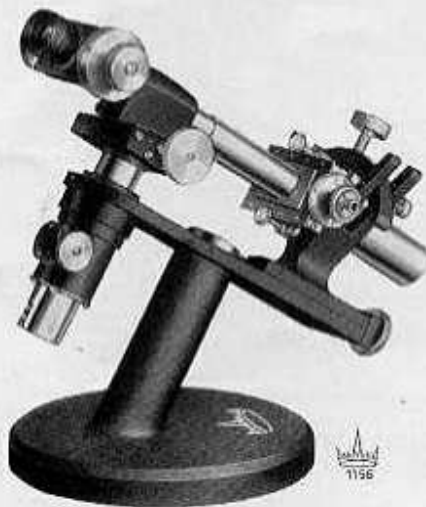


Fig. 20. Micrometer Testing Apparatus.

For examining all screw micrometers in the finished condition for periodic and progressive errors. The micrometer to be tested is fixed to the rear part of the apparatus. After removing the eyepiece of this micrometer, its graticule is observed through the screw micrometer pertaining to the testing apparatus, certain intervals are set on this latter micrometer and are measured by the micrometer undergoing test. Fine adjustments in each direction of the co-ordinates enable predetermined intervals to be measured in every position of the test screw.

Dimensions:

Length 28 cm. (11 in.), height 26 cm. (10 1/4 in.), diameter of foot 18 cm. (7 in.).
Weight: 7.6 kg. (17 lbs.).



Tape Chronographs.

No. 38: Tape Chronograph, Type Acf 2, with 2 recordings and spring drive.

No. 39: Tape Chronograph, Type Acf 3, with 3 recordings and spring drive.

No. 40: Tape Chronograph, Type Acf 4, with 4 recordings and spring drive.

No. 41: Tape Chronograph, Type Acg 2, with 2 recordings and weight drive.

No. 42: Tape Chronograph, Type Acg 3, with 3 recordings and weight drive.

No. 43: Tape Chronograph, Type Acg 4, with 4 recordings and weight drive.

The chronographs are supplied as usual with ink recording means or perforation of the paper strip. In addition, there is the method of recording by means of steel style on blue carbon paper. This is particularly recommended and gives very sharp records. If thin copying paper is used, it is possible to make duplicate carbon copies. The tape chronograph shown in Fig. 21 is provided with spring drive and siren spring governor ensuring absolutely uniform movement. The clockwork may be wound

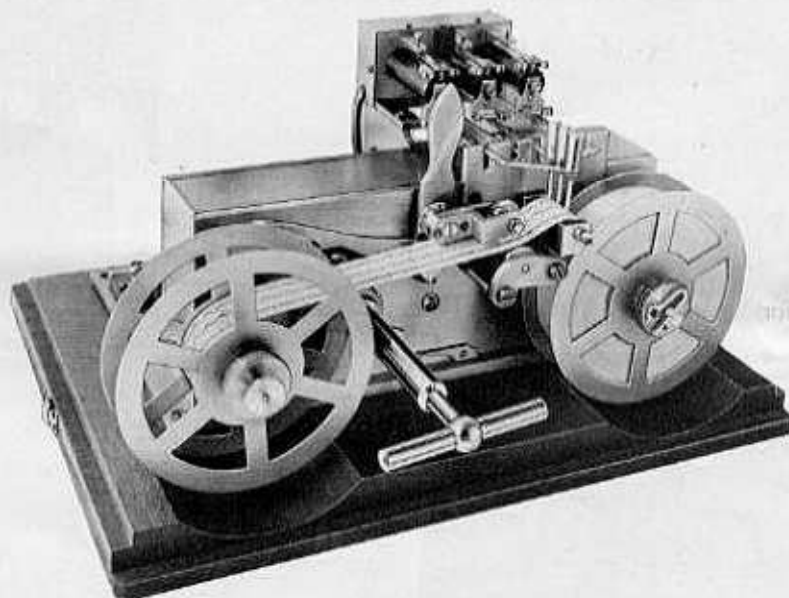


Fig. 21. Tape Chronograph with spring drive, about $\frac{1}{2}$ actual size.

up while the chronograph is working without any adverse effect on the transport of the paper. For a paper speed of 10 mm., the clockwork runs for 17 mins. The apparatus can be supplied for any other speed without any alteration in price, although there is of course a corresponding modification in the length of running time. If desired, more than two recording styles may be incorporated and a device may be provided for the selective use of two speeds, to be specified when ordering. The length of run of the clockwork may be doubled by employing stronger springs. By employing a weight-operated drive (see Fig. 22, page 22), the duration of the run may be increased from 17 to 40 mins. In this case also, there are more powerful types of apparatus with double the running time.

On request, remote-controlled starting, remote-controlled stopping and motor-driven wind-up device will be provided.

Weights :	Chronograph with 2 recordings: 10.5 kg. (23 lbs.)	} with spring drive.
	Chronograph with 3 recordings: 11.2 kg. (24½ lbs.)	
	Chronograph with 4 recordings: 12.0 kg. (26½ lbs.)	



Reading Apparatus.

No. 44. Oppolzer Reading Apparatus, Type Aabo.

The Oppolzer apparatus is for a paper speed of from 9 to 51 mm. per sec. The desired seconds length is adjusted by rotating the milled-head screw shown on the right hand side in fig. 23. It is possible to read half the hundredth part of a second.

Weight: with case 9.5 kg. (21 lbs.).

Accessories:

Spare reels, key, relay, if desired also dry cells, portable case.

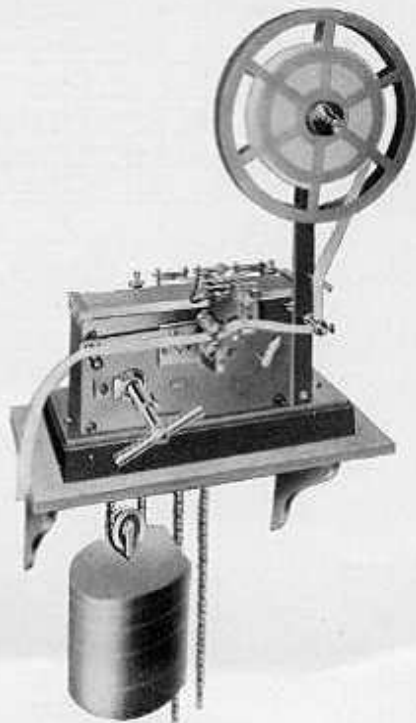


Fig. 22. Tape Chronograph with weight drive, about $\frac{1}{3}$ actual size.

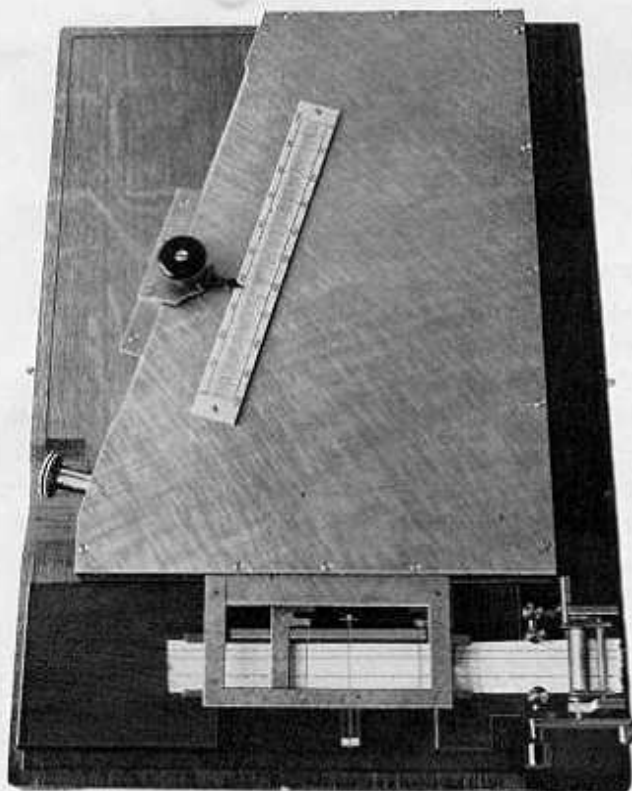


Fig. 23. Oppolzer Reading Apparatus, about $\frac{1}{3}$ actual size.