MULTI-PURPOSE VEHICLES

By

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This article is meant to introduce several types of special cars produced by the Hungarian automotive industry, offering a wide range of possibilities in the field of transport. Even this short description will manifest the advantages of special cars in comparison with the previously used, out-of-date transport methods. When designing these special purpose vehicles, increased attention has been devoted to the actual transport requirements. Thus, our special cars can fully answer the requirements of economic transport.

The quick transport of milk is nowadays inconceivable without up-to-date milk tank cars. Three different types are being built for this purpose.

A milk-tank body consisting of a double container with a total capacity of 4000 l is built on a Csepel D 450 chassis. The engine is a 4-cylinder diesel engine of 95 HP output. The containers are made of rustproof steel and are completely heat-insulated. The insulation is made of synthetic resin, with 0.5 "K" value. The car is also provided with a pump driven from the gearbox. This allows pumping up, respectively discharge of the milk. A vacuum-system pump is used, having the advantage that the milk is not passing through it and thus does not get churned. A further advantage is offered by the fact, that for cleaning the pump has not to be disassembled as it does not get into contact with milk. All drain tubes and fittings are made of stainless steel. Thus, for desinfection and sterilization alkaline and acid solutions may be employed in perfect compliance with the sanitary prescriptions. Pump capacity: 400 l/min., pumping depth: 6 m, delivery 4 m. A tank-trailer with a container of 3000 l capacity can be coupled to the car, thus simultaneously 7000 liters of milk can be transported. This model is excellently suitable for smaller milk collecting centres and the supply of milk bars.

Another type of milk transport tank is that mounted on the chassis type Csepel D 510 with a container of 6500 l capacity. The vehicle is powered by a 6-cylinder diesel engine of 145 HP output. The three-part container allows the simultaneous conveyance of three different milk sorts. This type, too, is fitted with a vacuum pump, driven from the gearbox. The perfect insulation ensures that the temperature and acid content of the milk are kept at a constant value which is of paramount importance. This car is designed for the quick transport of milk from collecting centres to remote industrial plants.

The third type is a milk tank mounted on a Csepel D 710 chassis. The car is driven by a diesel engine of 145 HP output. The body consists of two insulated containers with a total capacity of 6500 liters. The containers can be discharged independently from each other. The shape of the body harmonizes with the up-to-date lines of the driver's cab. The driver's cab has two rows of seats which in view of the long distances to be covered, can be transformed into couches for two persons. The panorama-windows of the cab offer the driver perfect sight in all directions and secure comfortable driving. A similarly insulated milk-transport trailer with 5500 l capacity can be coupled to the car, thus making possible the simultaneous transport of 12 000 l milk. This type can be well employed for the quick and hygienic transport of milk from rural dairy plants to larger cities and milk processing plants.

Further improvements of this special means of transport are being planned and the types to be turned out in the coming years will be fitted with plastic containers, which will have as result the reducing of dead weight and increase of payload.

In addition to milk transport the above vehicles may be used also for the conveyance of other perishable foods, where an increase of the temperature during transport is of harmful effect and must be absolutely avoided (wine, edible oil, distilled water etc.).

Csepel D 510 milk-tank car.

Exported by MOGÜRT
HUNGARIAN
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FOR MOTOR VEHICLES
Budapest 62, P. O. B. 249
HUNGARY

THE NEW PRODUCTS OF HUNGARIAN SURVEYING INSTRUMENT INDUSTRY

Tacheometer TA-D1

By

F. Pusztay

Diagram tacheometers are wide-spread in topographic surveying. The improvement of this type of instrument is a very important problem for every manufacturing company of surveying instruments. It is easily possible to comply with the requirements concerning the accuracy of measurements as a lower degree of precision is satisfactory in this field of surveying, but the rapidity of measuring has to be regarded for a question of capital importance in designing work. The greatest part of tacheometers generally used are of the diagram type, giving directly distances reduced to the horizontal and height differences. The multiplying constant in this type of instrument is usually 100 for measuring distances and may be chosen from 10, 20 and 50 for determining height differences.

The diagram tacheometer Ta-D1 (Fig. 1), developed in MOM, differs from the former types by making it possible to choose 100 or 200 for multiplying constant. This is an advantage, especially when measuring longer distances.

When the telescope is turned around its horizontal axis, the glass circle revolves to the opposite direction, its angular velocity being twice as much as that of the telescope. Using this ratio of angular velocities it was possible to substitute diagram curves with circles. As the diagram circles run all around the glass circle, the instrument can be applied to tacheometric measurements in both positions of telescope.

Its error of distance measuring does not exceed ±10—20 cm for measuring 100 m, depending on whether 100 or 200 is chosen for multiplying constant. When measuring height differences, its error is less than ±5—15 cm relating to a distance of 100

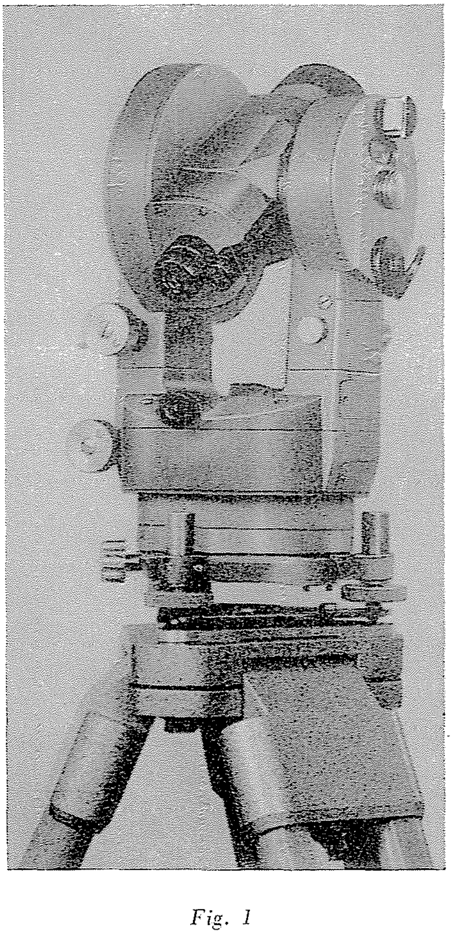


Fig. 1

metres, when 20 or 50 is used for altitude multiplying constant, the greater values of errors are corresponding to the greater multiplying constants in both cases.

The instrument can be used for any surveying work requiring a lower degree of precision. Its centring base makes it applicable even to traversing, too.

Reading the circles is carried out by a graduated microscope. Then mean error of pointing is between 6″ and 8″ measured in both positions of telescope.

Specification

Telescope

Magnification	24-fold
Aperture of objective	40 mm
Field of view	1°
Multiplying constant for measuring distances	100 and 200
Multiplying constant for measuring height differences	20 and 50
Additive constant	0
Shortest focusing distance	2.5 m

Levels (sensitivity pro 2 mm graduations)

Plate level	30″
Altitude level	30″
Accuracy of setting by coinciding bubble ends	about 1″
Circular level	7′

Graduated glass circles

Diameter of horizontal circle	84 mm	
Graduation interval	1°	1g
Interval of numbering	1°	1g
Graduation on reticule of microscope	1′	2c
Reading by estimation	0,1′	0,2c
Diameter of vertical circle (graduated and numbered like the horizontal one)	76 mm	
Magnification of circle reading microscope	67- and 76-fold	

Measures and weights

Weight of instrument	5.6 kg
Height of horizontal axis from base plate	200 mm
Length of telescopic tripod	940 mm
Weight of telescopic tripod	5.1 kg
Length of staff	1.5 m
Weight of staff	5.4 kg

Extra accessories

- Traversing equipment consisting of the following items:
  - 2 tripods
  - 2 targets in a common metal case
  - 1 vertical staff, 1.2 m long
- Wooden case with shoulder strap
- Tubular compass
- Prismatic compass

Characteristics of mechanical design

The fixing and slow-motion screws as well as the vertical axis system are just the same as that of the theodolite Te-C1. Its vertical circle is rotated by a spur gear turning $-2\,\alpha$ if we denote the corresponding value of rotation of its telescope by α. Practically no backlash can be perceived in the spur gear because of the preloaded spring device employed in this instrument. This spring device does not apply any force to the horizontal axis as the spring is not fastened to a fixed point. So the telescope can be turned around its horizontal axis.

As the diagram circle rotates having twice as great angular velocity as the telescope has, it is possible to determine a best fitting circle which within a given limit of error can be substituted for the distance measuring curve according to the well-known formula for horizontal diagram lines:

$$a = \frac{f_\infty \cdot \cos^2 \alpha}{k_t \pm \frac{1}{2} \sin 2\,\alpha}$$

where

a = distance of diagram curves,
f_∞ = resultant focus of telescope,
α = vertical angle of telescope,
k_t = multiplying constant for distance measuring.

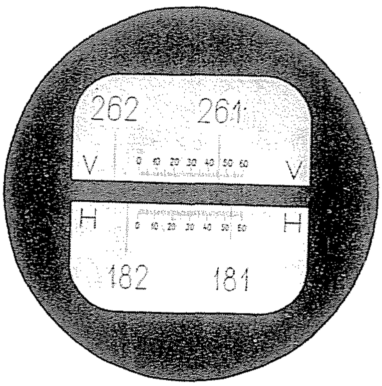
Each distance measuring curve and the corresponding best fitting circle have only 3 common points. Naturally, this causes an error in distance measuring, the maximal values of errors, however, occur at high values of altitude angle and only when the multiplying constant 200 is used. For example, choosing 200 for multiplying constant at an altitude angle of 30 degrees, the systematic error of distance measuring is 8 cm, at a distance of 100 m. This error is not too much because the altitude angles above 25 degrees are infrequent and the errors of estimation and of reading are considerably greater and even the sum of the maximal values of all these errors is still less than the allowed error limit.

Characteristics of optical design

The telescope of the instrument is anallatic. In the area between diagram lines it gives an accurate optically corrected image. The diagram lines are projected into the field of vision and can be observed together with the image of the staff. The optical system of the instrument and horizontal circle readings can be seen in Fig. 2. The telescope gives an erect image. In case of choosing 100 for multiplying constant, the base line is the lower diagram line. When measuring vertical angles the concentric diagram circle in middle of the field of view is to be used. The field of view of the telescope can be found in Fig. 3.

Circles are read on one side only. 1 minute can be directly read and 0,1 minute can be reliably estimated. In a series of five measurements the mean error of estimation of a simple measurement is less than $\pm 3.5''$.

The circles of the instruments, before building in, were subsided to thorough examinations. The method employed to investigate the errors due to misplacements of circle graduation is based upon the theoretical research work made by Dr. Heuvelink of Delft University. In the reading system there was an optical micrometer instead of a graduated microscope enabling the observer to read to 1′ and to estimate to 0,1′. The measured angle was 45°. The diametral errors denoted by $\Delta\varphi$ are included in Fig. 4. The τ errors, characteristic of the reliability of graduations are:



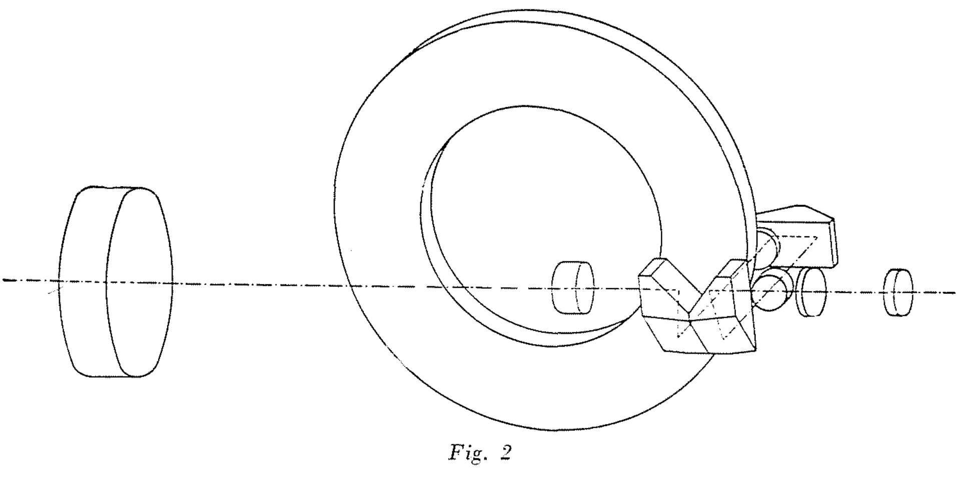


Fig. 2

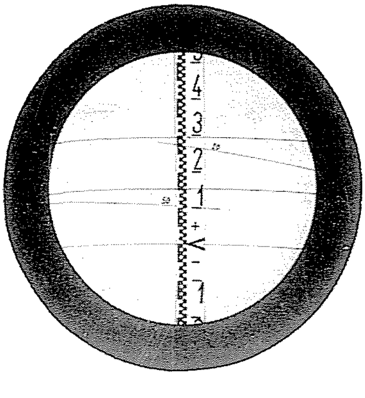


Fig. 3

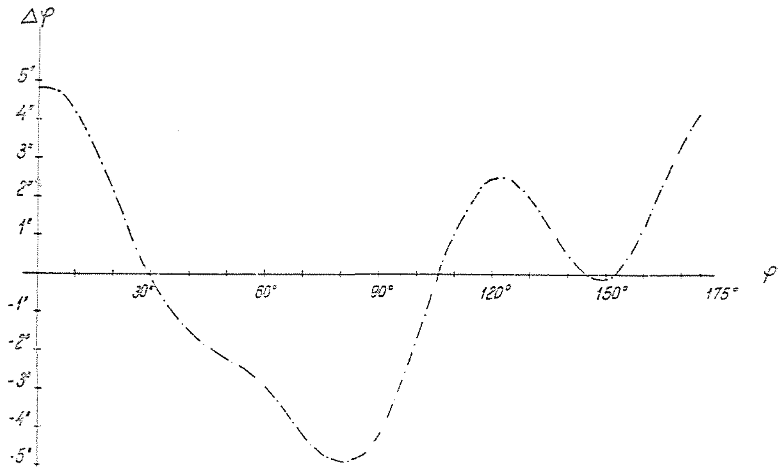


Fig. 4

$\tau = \pm 3.71''$ $\quad \mu = \pm 3.04''$

$\tau' = \pm 2.82''$

$\tau'' = \pm 2.34''$

$\tau''' = \pm 2.15''$

The instrument is supplemented by a telescopic staff for tacheometry. The height of the instrument can be adjusted on this staff.

2 m Invar subtense bar

Besides an up-to-date instrument, modern surveying work requires a series of accessories too. Hungarian Optical Works (MOM) developed a series of this accessories for use with their new and former theodolites. As an example of these supplementary instruments, now we introduce the new 2 m invar subtense bar (Fig. 5).

Its principle of measurement is the following: a theodolite is set up over one end of the distance to be measured, and a subtense bar is set up over the other end representing a constant base. The subtense bar should be horizontal and perpendicular to the said distance. Projecting the end marks of the subtense bar to the horizontal plane intersecting the centre of the theodolite, we obtain an isoceles triangle; its apical angle can be measured according to Fig. 6. The desired horizontal distance can be obtained as a function of this apical angle:

$$D = \frac{b}{2} \operatorname{ctg} \frac{\gamma}{2},$$

where

D = the distance to be measured reduced to the horizontal in metres,

b = length of bar in metres,

γ = apical angle in degrees or grades according to the theodolite used.

As theodolites measure a projection of the angle no further reduction to the horizontal is necessary.

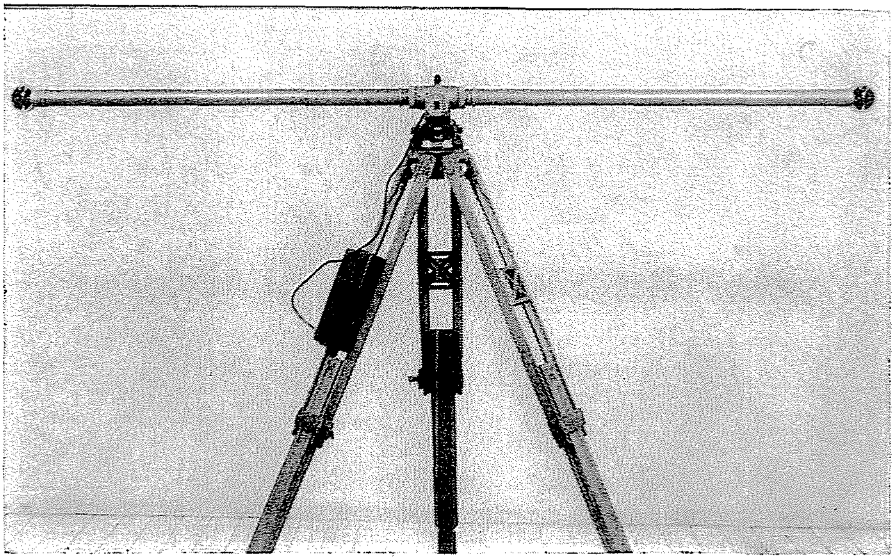


Fig. 5

The subtense bar has been designed for use with the theodolites Te-B1, Te-C1, and with the former types Te-D1, and 17 KS according to the precision of measurements required. When, for example, a distance of about 100 m is to be measured with an error remaining under 2 cm, then the error of angle measurement should remain less than 1″ as such a variation in apical angle would alter the computed distance as much as 2.5 cm. If results are to be obtained rapidly and precisely a one-second-theodolite, for example Te-B1 has to be used. The results of measurements can be obtained with the same accuracy when using an angle-multiplying repeating theodolite, for example 17 KS made by Hungarian Optical Works (MOM) but considerably more time will be required to reduce mean errors by multiple reading. This subtense bar is especially suitable for precise traversing, determination of the camera stations in terrestrial photogrammetry and of points of minor control for aerial photogrammetry. Use of invar rod ensure that the influence of temperature variations may be neglected.

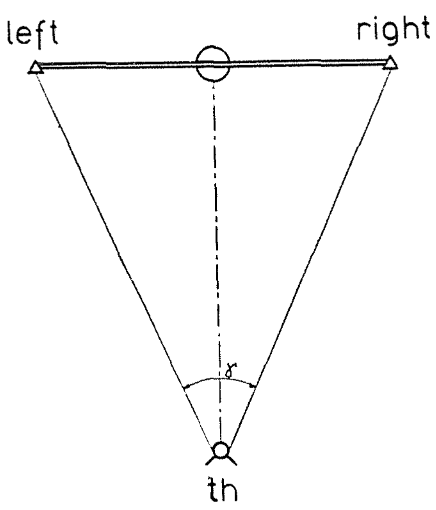


Fig. 6

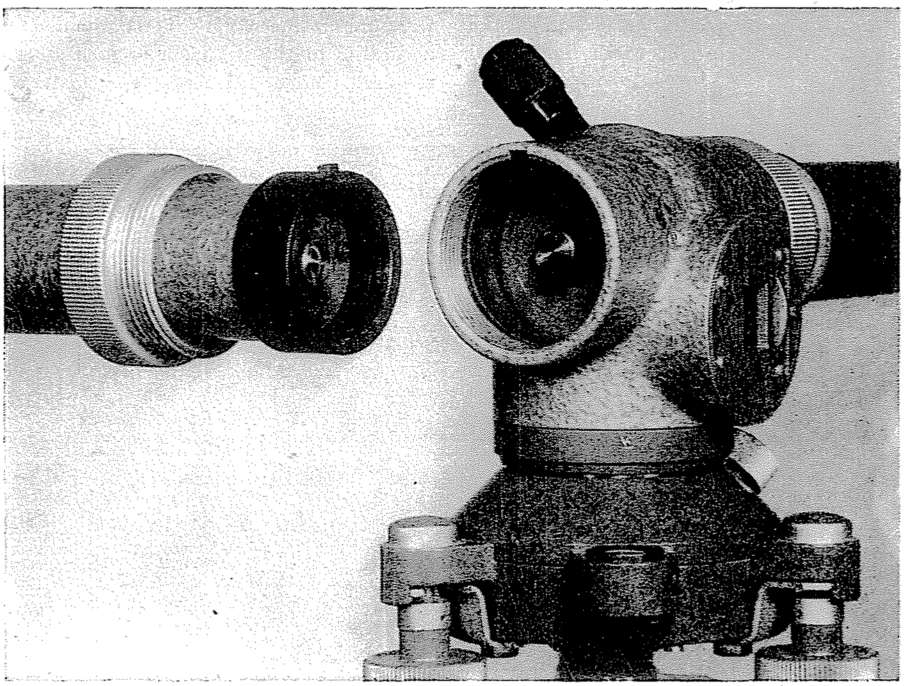


Fig. 7

Specification

Distance of target marks	2 m
Magnification of sighting device	2.7-fold
Field of view	6°
Overall length	207 cm
Weight of subtense bar	4 kg
Weight of subtense bar with canvas bag and centring base	6.5 kg
Dimensions of bag	120 × 18 × 15 cm

Characteristics of design

The 2 m invar subtense bar consists of two tubes made of aluminium alloy, a solid head in middle of the bar, and two housings for the target marks on the outside ends of the tubes. There is an invar rod in both tubes running along the axis of them somewhat less than 1 m in length. The tubes are connected to the head by means of bayonet-sockets to facilitate dismantling for transport purposes. The mark holders are designed to provide for temperature compensation. The inner ends of the invar rods are pressed together by a spring applying a constant force to the contact points. The length of the bar and the distance between end marks is therefore independent of changes in length of the tubes or of dilatation of the head. Two pairs of contact surfaces are placed in the inner end of the tubes making it possible to reestablish the exactly adjusted distance between target marks. One of both pairs has a flat contact surface and the other a spherical one, each precision manufactured (Fig. 7).

The effective distance between target marks can be adjusted by comparing it to an etalon one-metre rod. For this reason, the 2 m distance has to be divided into two 1 m parts by a mark in the head — it can be seen by removing the front plate of the head. Each 1 m rod can be separately adjusted by turning around the corresponding inner contact screw in the head. The distance between target marks is factory adjusted with great accuracy, so there is no need for readjusting by comparison even during a long period of work.

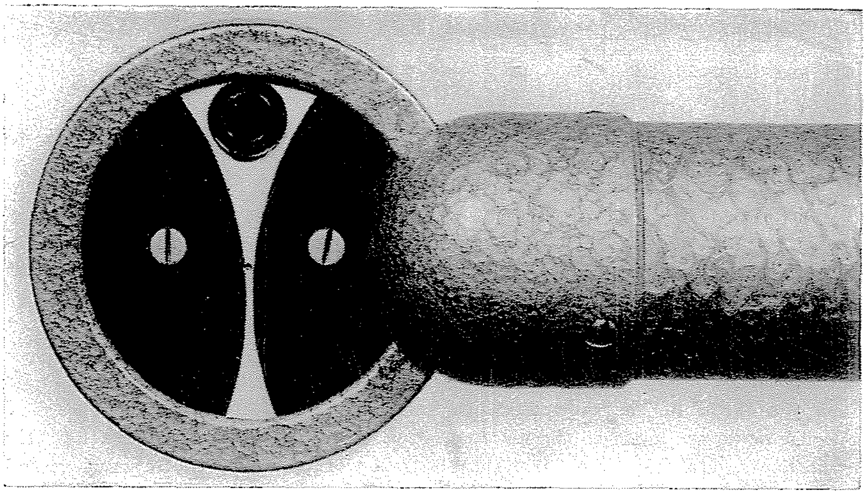


Fig. 8

The target marks on the outer end of both tubes include a metal plate bearing a mark (Fig. 8) painted in unglazed black and white for measurements by daylight and a boring in the target plate covered by a circular glass window with a point and a concentric circle on it to be illuminated for night work. The shape of the painted mark facilitates precise pointing with a singular cross-hair on short and long distances alike as human eyes are most susceptible to observing a symmetrical position.

The illuminated circular marks can be adjusted to agree with the painted targets as it is possible to turn them around with their eccentric setting thus altering the (horizontal) distance between them.

For source of current a large battery hangs on one leg of tripod. One pole runs through the head and both tubes, the other is conducted by the invar rods insulated from the body of the subtense bar. When any one of the contact screws would occasionally happen to fail to reestablish connection, the corresponding mark would remain dark preventing wrong measurements and indicating at the same time which contact screws are to be examined.

The sighting device of the subtense bar being in middle of the head assures its strict perpendicularity to the line to be measured. By rotating a prism the telescope can be pointed at the theodolite even when it is situated higher or lower according to field conditions.

The subtense bar can be applied to different types of theodolites as mentioned above. Different centring bases are suitable to the theodolites applicable ensuring interchangeability.

The subtense bar is transportable in a canvas bag the tubes taken apart from the head (Fig. 9).

Results of measurements

Several measurements were accomplished by the Geodetic Research Institute in Sopron

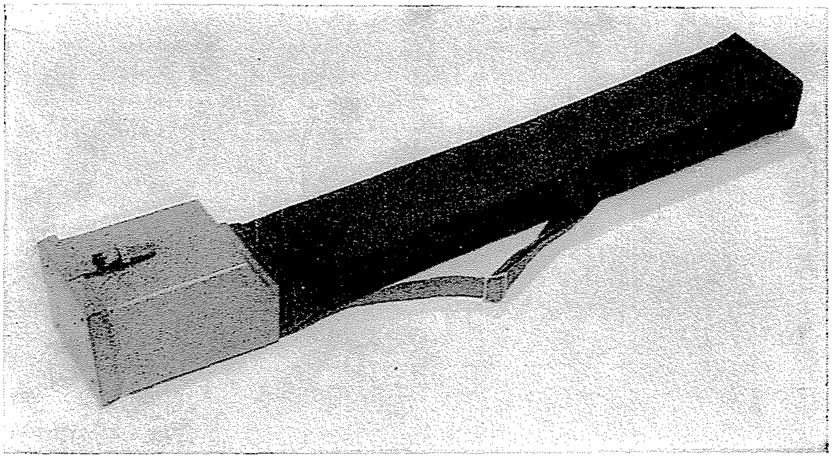


Fig. 9

with the prototype of the subtense bar. Acknowledgements are made to the director of the Institute, Dr. ing. h. c. dr. Antal Tárczy-Hornoch, member of the Academy of Sciences for his kind permission to accomplish these measurements. Of a part of these investigations relating to the examination of main parts of the subtense bar now we give a short summary. The results are arranged according to the different causes of errors.

Fig. 10

The influence of curvedness of the invar rod is negligible even after a long time of field work, because the measuring device is protected against mechanical effects by strong metal tubes and the measuring rod is supported in every 50 cm by discs.

The influence of deviation from the horizontal was examined by setting up two theodolites, each facing a target mark of the subtense bar as can be seen in Fig.10, at a distance of about 9.2 m from the marks. Choosing a point on each target mark easy to identify altitude angles were measured before and after removing both tubes, lifting the head up and replacing them again. This measurement was repeated ten times and the greatest angle difference was found to be 8 seconds. This gives an alteration in length of the measuring base no more than 0.000 03 mm. The unidirectional vertical deviation of end marks was found to give a difference as little as 0.000 06 mm in base length. The results show that this type of error remains within allowable limits.

The sighting device was examined also by a theodolite. A line was staked out exactly perpendicularly to the distance between the theodolite and the centre of the centring base of the subtense bar at the terminal (Fig. 11). The maximal deviation of the subtense bar from this line was found to be ± 8 minutes in direction causing no greater an error than ± 1.3 mm at a distance of 100 m. This result was controlled by an indirect measurement and results agreed within 20%. This was, however, an error of the prototype

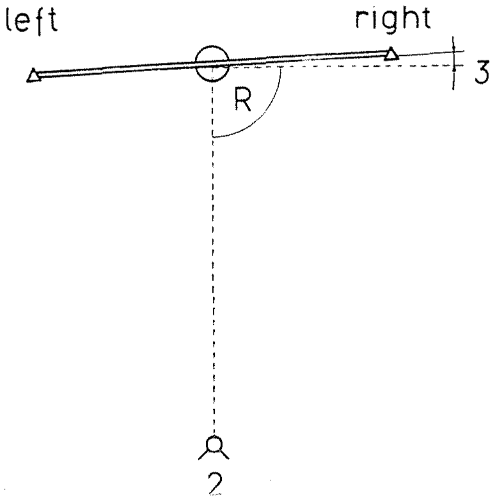


Fig. 11

that can be corrected by adjusting the sighting device within a possible limit no greater than 1′.

The variation of the distance of target marks because of erroneous assembling of tubes was examined according to Fig. 2. The angle γ was measured by a theodolite four times (to reduce errors of angle measurements). Then the tubes were removed from the head and replaced again and in this position was the angle γ measured also four times. This series of four measurements was repeated ten times. The theodolite was used without altering the position of the vertical axis to influence all results equally. It was found, that the mean error of base length was $\pm 0.5''$—$\pm 0.8''$ in the distance of 9.025 m. This causes a mean error as much as ± 2—± 3.5 mm in the distance when 100 m is directly measured in one step. The mean error was determined from the results by using the formula

$$\mu_i = \sqrt{\mu_t^2 - \mu_m^2}$$

where

μ_i = the mean error of base length caused by erroneous assembling of tubes in seconds; the corresponding linear value in mm can be computed if the distance between the theodolite and subtense bar is known,

μ_t = the whole mean error of a single measurement in seconds,

μ_m the mean error of pointing and reading in seconds.

The mean error μ_i is the greatest of those mentioned above, but yet much less than the mean error of angle measurements usual in practice, depending on the theodolite, this result, therefore, satisfies all practical requirements.*

If target marks are not symmetrical to the axis of the centring base, an error of excentricity is caused. This type of error, however, can be neglected as even at the very short range of 10 m it causes an error in the computed distance less than 1: 40 000th of the total length.

We hope, that this introduction of new instruments will give a help to the surveyors in practical work.

* All the measurements were carried out by theodolites giving direct reading to 0.1′.