Angle Measuring Instrument for Conical Male Object

R. Saravana
Graduate
Department of Mechanical Engineering
NSCET-Theni, Tamilnadu, India

Abstract— The given name of the new angle measuring instrument is Tanmeter. An instrument for angle measurement based on micrometers readings has been designed. It has the advantage of simplicity, and consequently provides easy operation and an inexpensive instrument. Measurement technique is based on two micrometer readings. That micrometers used to measure the conical object specific height and length. That readings applied to Tangent formula then find the angle of conical male object.

Key words: Cone Angle Measuring Instrument, Angle Measuring Instrument, Tanmeter, Taper Angle

I. INTRODUCTION

Tanmeter is an instrument, It is used to measure the taper angle of the conical male object. A large scale industries used several methods to measure the angle of conical male object like as CMM, Sine bar, Profile projector. But small scale industries not possible to buy a kind of machines. Because its price range and working time is very high.But this measuring instrument exited the kind of problems. Even not to need skilled employee, unskilled employee easy to operated this instrument. One of the major advantage of this measuring instrument is fully worked on manually.

II. EXISTING MEASURING INSTRUMENT

Already the several conical male object measuring methods available in the industries. But the manual measuring methods are very few in market. Mostly sine center used to manually for measure the angle of conical male objects.

A. Sine Centre

The sine centres are used to measure the angle accurately or for locating any work to a given angle within much closed limits. Sine centre are made from High Carbon, High Chromium corrosion resistant steel, hardened, ground and stabilized. A special type of sine bar is sine centre which is used for conical objects. It cannot measure the angle more than 45 degrees. Two cylinders of equal diameter are attached at the ends, the axis of these two cylinders are mutually parallel to each other and also parallel to and equal distance from the upper surface of the sine center. The distance between the axes of the two cylinders is exactly 50 or 100 in British system and 100, 200, 300, mm in Metric system. Some holes are drilled in the body of the bar to reduce the weight and to facilitate handling. Sine centre itself is not a complete measuring instrument. Another datum such as surface plate is used as well as auxiliary equipment notably slips gauges. Sine centre is basically a sine bar with block holding centres which can be adjusted and rigidly clamped in any position. These are used for inspection of conical objects between centres. These are used up to inclination of 45°. Rollers are clamped firmly to the body without any play. This is a very useful device for testing the conical work cantered at each end.

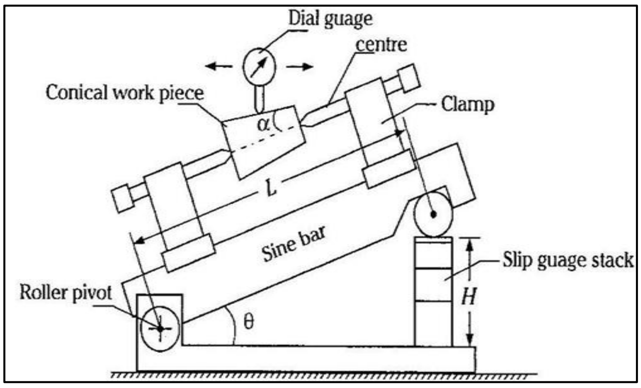


Fig. 1: Sine Centre

B. Problem Identification of Sine Centre

1) High cost of measuring instrument.
2) Operation time is high.
3) Working principle is difficult.
4) Cannot measure the angle more than 45 degrees.
5) Source of errors in sine centre
   a) Error in distance between roller centers.
   b) Error in slip gauge combination.
   c) Error in checking of parallelism.
   d) Error in parallelism of roller axes with each other.

C. Solution of the Problem

1) Instrument price is reduced.
2) The problem of measuring time is reduced.
3) Easy manual working method.
4) Accuracy is increased.
5) Angle measuring limit 0 to 70 degrees.

III. BLOCK DIAGRAM OF TANMETER

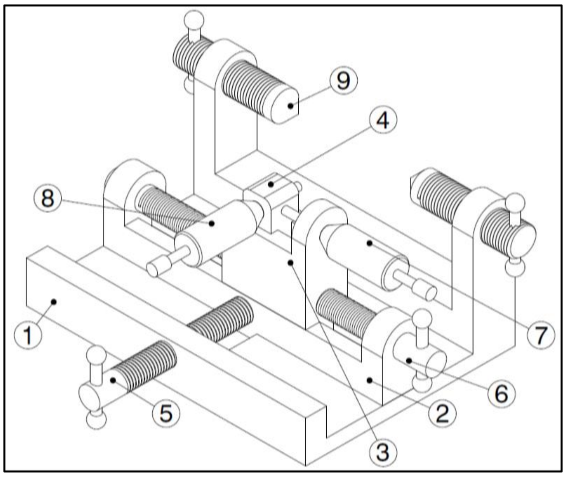


Fig. 2: Tanmeter Block Diagram

1) Base
2) Primary Carriage
3) Secondary Carriage
4) Tertiary Carriage
5) Primary Lead Screw

6) Secondary Lead Screw
7) Primary Micrometer
8) Secondary Micrometer
9) Catching Centres

IV. DESCRIPTION OF IMPORTANT PARTS

A. Base of Tanmeter

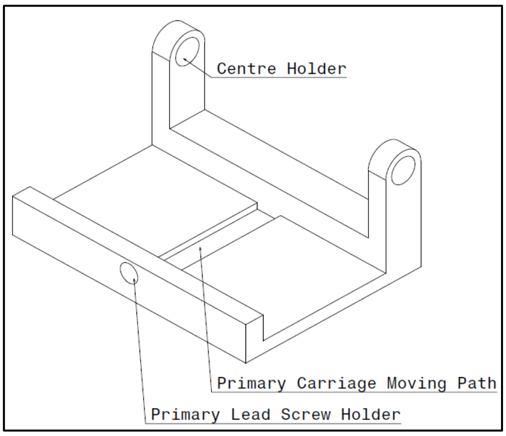


Fig. 3: Base of Tanmeter

The tanmeter Bottom base is made of hardened, corrosion-resistant stainless steel with a satin chrome finish that helps reduce glare. That bottom surface has one flat guide way or linear guide way. It's used to guide the primary carriage to linearly.

B. Primary Carriage

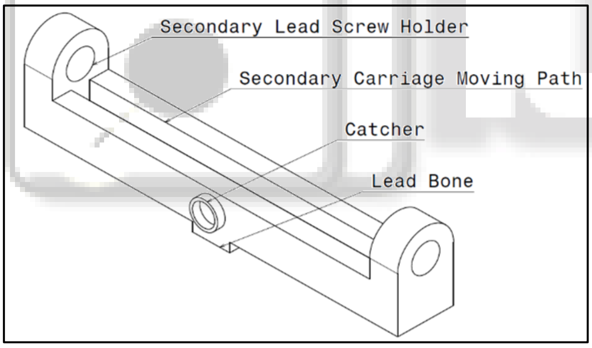


Fig. 4: Primary Carriage of Tanmeter

Primary carriage moving over the bottom linear guide way. The primary carriage lead bone placed between the bottom linear guide way. This primary carriage has one flat guide way in top side. It's used to guide the secondary carriage parallel to the workpiece. Catcher is used to join the rotational lead screw and carriage.

C. Secondary Carriage

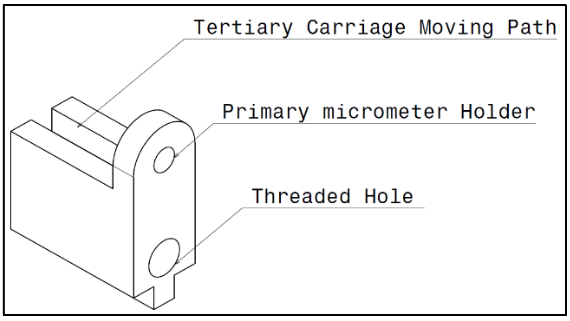


Fig. 5: Secondary Carriage of Tanmeter

Secondary carriage moving over the primary carriage. The secondary carriage lead bone placed between the gap of primary carriage guide way. This secondary carriage has one flat guide way. It's used to guide the tertiary carriage. In this secondary carriage has one threaded hole. That hole used to allow the secondary lead screw inside the secondary carriage.

D. Tertiary Carriage

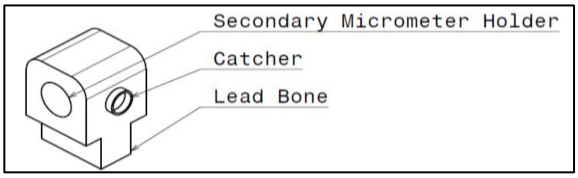


Fig. 6: Tertiary Carriage of Tanmeter

Tertiary carriage moving over the secondary carriage. That tertiary carriage lead bone is placed between the gap of secondary carriage guide way. This tertiary carriage has a holder of secondary micrometer. Its catcher is used to join the primary micrometer rotational spindle and carriage.

E. Lead Screws

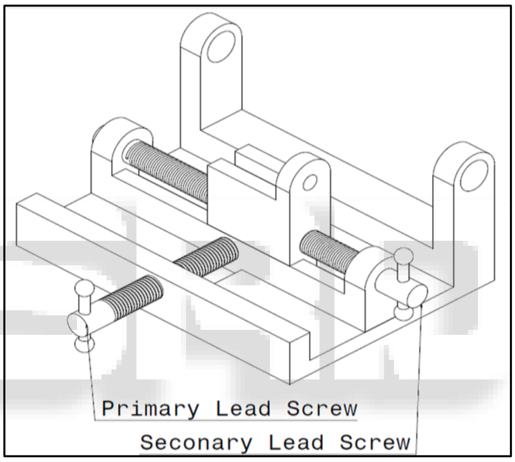


Fig. 7: Lead Screws of Tanmeter

Primary lead screw used to pull and push the primary carriage. Secondary lead screw used to pull and push the secondary carriage.

F. Micrometers

Fig. 8: Micrometer

Tanmeter used two micrometer heads. One is called primary micrometer and another one is called secondary micrometer.

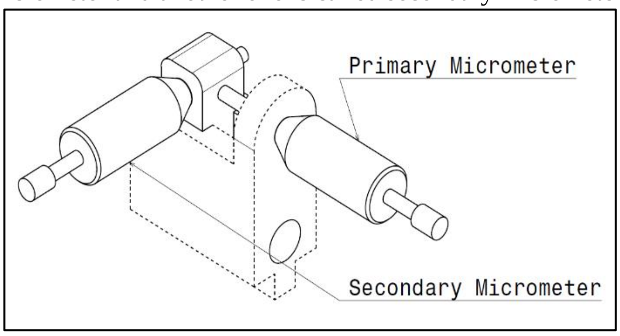


Fig. 9: Tertiary Carriage of Tanmeter

The primary micrometer is fitted in secondary carriage. The primary micrometer is used to pull and push the tertiary carriage. Secondary micrometer spindle is direct contact to measure the readings of the conical object.

G. Catching Centres

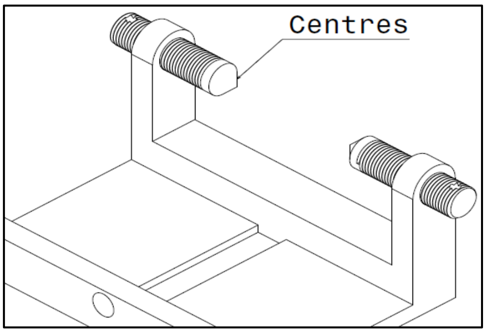


Fig. 10: Catching Centres

That centres used to catch the centre point of conical male objects.

V. WORKING PROCEDURE OF TANMETER

1) Fit the conical male object in tanmeter by the use of catching centers.

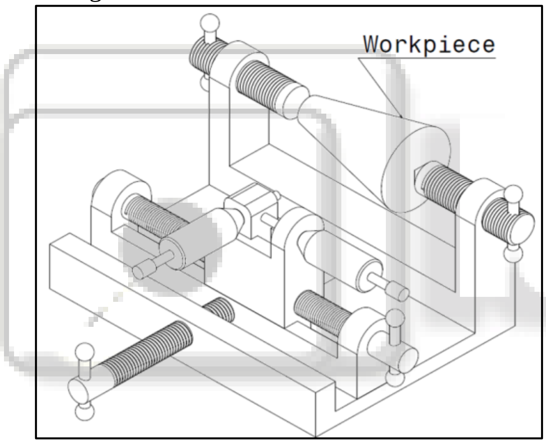


Fig. 11: Workpiece Catching Method

2) To move the primary, secondary and tertiary carriages near to the conical object (or) workpiece by adjust the primary lead screw, secondary lead screw and primary micrometer.

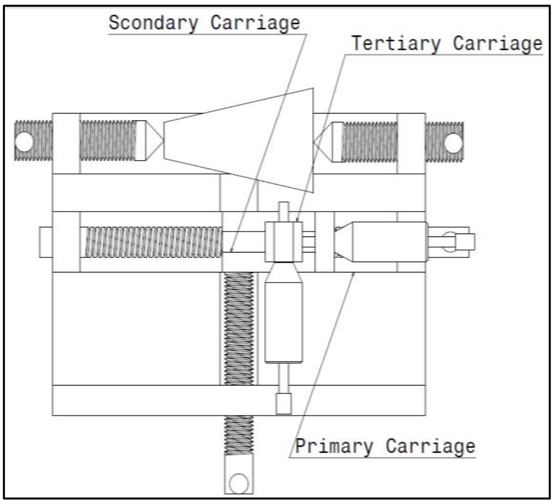
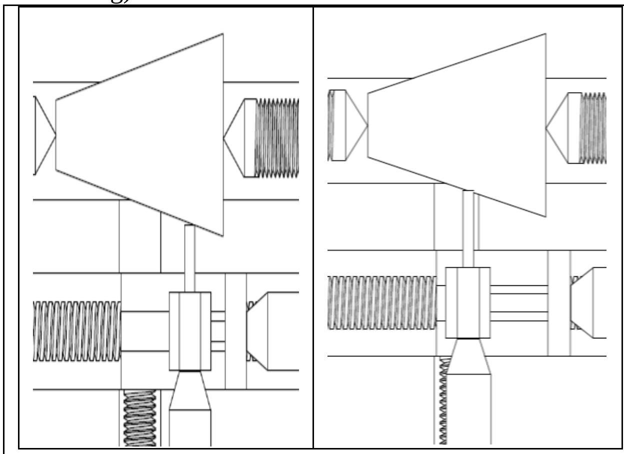


Fig. 12: Tanmeter Initial Arrangement

3) Rotate the secondary micrometer thimble after the initial carriage arrangement. That secondary micrometer spindle touch the workpiece. Note the initial readings of primary micrometer and secondary micrometers. It is denoted by PM1 and SM1. (PM1 = Primary Micrometer Initial Reading, SM1 = Secondary Micrometer Initial reading)



a) Initial Reading b) Final Reading

Fig. 13: Tanmeter Measuring Method

4) Next rotate the primary micrometer thimble after the measured the initial readings. That primary micrometer spindle directly attached to the tertiary carriage, so that spindle rotation moves the tertiary carriage to another position. Now rotate the secondary micrometer thimble. That secondary micrometer spindle touch the workpiece another time. Note the final readings of primary micrometer and secondary micrometers. It is denoted by PM2 and SM2. (PM2 = Primary Micrometer Final Reading, SM2 = Secondary Micrometer Final reading)
5) The readings are tabulated and calculated.

		MSR (mm)	VSD (mm)	VSR (div)	T (mm)	DIF (mm)
PM (mm)	PM_1					
	PM_2					
SM (mm)	SM_1					
	SM_2					

Table.1. Find the Primary and Secondary Micrometer Readings

PM → Primary Micrometer
SM → Secondary Micrometer
PM_1 → Primary Micrometer Initial Reading
PM_2 → Primary Micrometer Final Reading
SM_1 → Secondary Micrometer Initial Reading
SM_2 → Secondary Micrometer Final Reading
MSR → Main Scale Readings in mm
VSD → Vernier Scale Division
VSR → Vernier Scale Reading in mm
T → Total Reading in mm
DIF → Difference of Initial and Final readings

$$VSR = (VSD \times LC) \text{ in mm} \quad (1.1)$$

LC → Least Count of Micrometer in mm

$$\text{Total Reading} = (MSR + VSR) \text{ in mm} \quad (1.2)$$

$$\text{Difference} = (\text{Initial Readings} \sim \text{Final Readings}) \quad (1.3)$$

$PM = (PM_1 \sim PM_2)$ in mm (1.4)

$SM = (SM_1 \sim SM_2)$ in mm (1.5)

6) After the tabulation we get the two accurate micrometer readings. One is primary micrometer reading and another micrometer one is secondary micrometer reading. That two readings are consider as adjacent and opposite sides of the triangle. Now that readings are apply the given tangent formula. Finally we get the angle of the conical male object.

$$\text{The tangent of the angle} = \frac{\text{length of the opposite side}}{\text{length of the adjacent side}} \quad (1.6)$$

$$\tan\theta = (\text{Opposite} / \text{Adjacent}) = (SM / PM) \quad (1.7)$$

$$\tan\theta = (SM / PM) \quad (1.8)$$

$$\theta\ (\text{angle}) = \tan^{-1}(SM / PM) \quad (1.9)$$

VI. Three Dimension Model Photograph

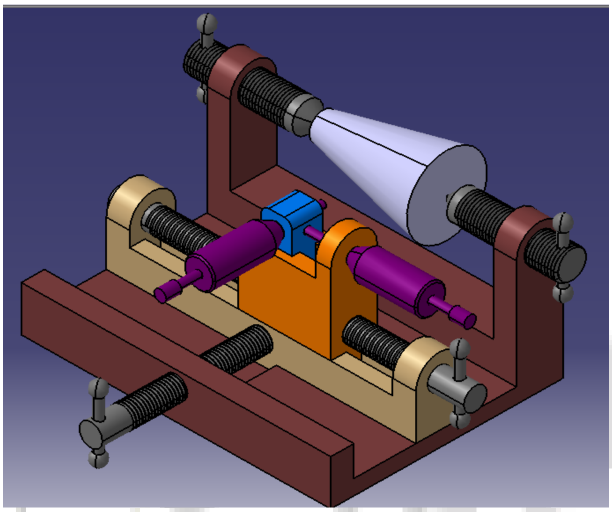


Fig. 14: 3D Model of Tanmeter

A. *Advantages*

1) High degree of accuracy.
2) Simple in construction.
3) Easy to measure the angle.
4) Low cost of instrument.
5) Fully worked on manually.

B. *Disadvantage*

1) Not measure the conical female objects

VII. Conclusion of Paper

Now a days large scale industries are using a coordinate measuring machine to measure the angle of conical male objects. But it's fully worked on electric power and small scale industries not possible to buy an expensive machines. Available manual measuring machine are few in the market like as sine centre method. But its working procedure is very difficult, number of the components and cost also high. Tanmeter introduced by the solution of that kind of problems.

References

[1] Encyclopedia Americana (1988) "Micrometer" Encyclopedia Americana 19: 500ISBN 0-7172-0119-8.
[2] "What is a Micrometer & How it historically develops?" SG Micrometer.
[3] "Whitworth's workshop micrometer", The Practical Mechanic and Engineer's magazine, Nov 1844, pp43-44.
[4] Loo Kang, Wee; Hwee Tiang, Ning (2014), "Vernier caliper and micrometer computer models using Easy Java Simulation and its pedagogical design feature-ideas to augment learning with real instruments", Physics Education, 49 (5), arXiv:1408.3803 ,doi:10.1088/0031-9120/49/5/493.
[5] BS EN ISO 3650: "Geometrical product specifications (GPS). Length standards. Gauge blocks" (1999)
[6] http://engineeronadisk.com/book_implementation/metrollogya8.html

