May 7, 1957 H. C. HANDY 2,791,034

SHRINK MICROMETER CALIPERS

Filed June 16, 1953

Fig. 1.

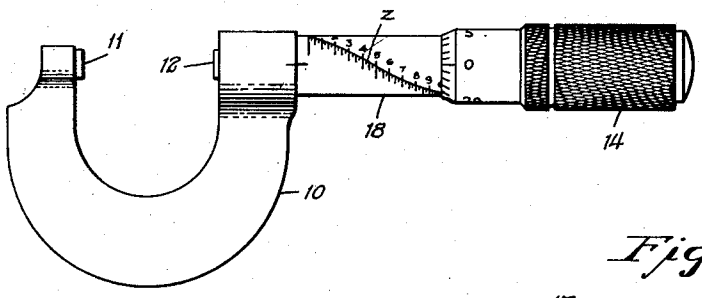


Fig. 2.

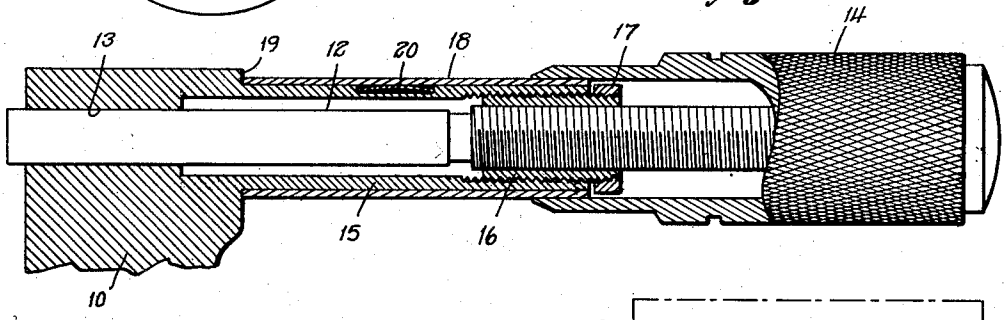


Fig. 4.

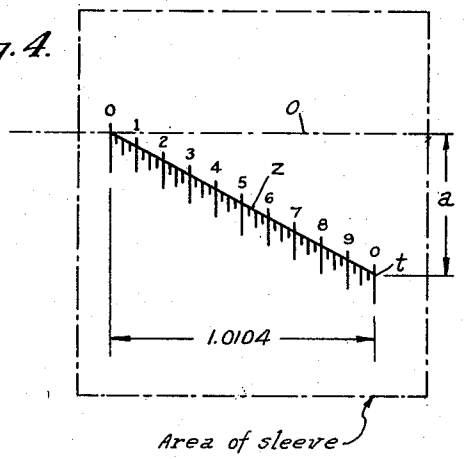


Fig. 3.

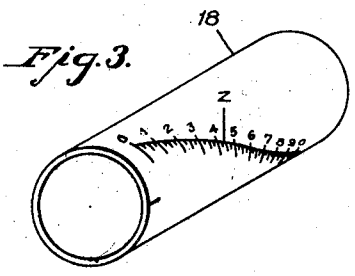
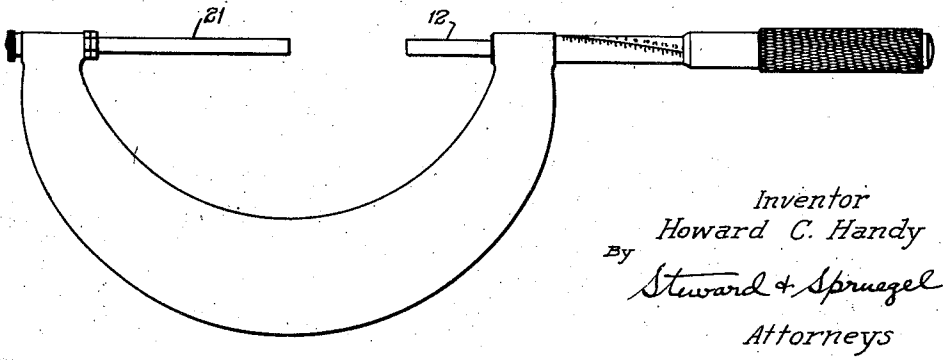


Fig. 5.



Inventor
Howard C. Handy
By Steward & Sprueger
Attorneys

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SHRINK MICROMETER CALIPERS

Howard C. Handy, Springfield, Mass.

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2 Claims. (Cl. 33—166)

The present invention relates in general to micrometer calipers and more particularly to an improved micrometer caliper, the readings of which include shrinkage allowances for various types of metals whereby the measurements of patterns, master patterns and transfer patterns for use in making castings of iron, brass, bronze, aluminum and other metals may be read directly from the micrometer.

An object of the invention is to provide an improved caliper, the scale of which includes shrinkage allowances corresponding to the shrinkage factor of a particular metal.

A further object of the invention is to provide an improved caliper, the scale of which may be readily changed to correspond to the shrinkage factor of a particular metal.

A still further object of the invention is to provide a micrometer caliper having interchangeable sleeves, the scales of which include shrinkage allowances corresponding to the shrinkage factors of various types of metal.

A still further object of the invention is to provide a micrometer caliper having a set of interchangeable sleeves, each sleeve having thereon a zero line which includes shrinkage allowances corresponding to the shrinkage factor of a particular metal.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a side elevation of a micrometer caliper, the sleeve of which has a pattern shrinkage-measurement zero line;

Fig. 2 is a vertical longitudinal section of the sleeve and thimble assembly of Fig. 1;

Fig. 3 is a perspective view of an interchangeable sleeve provided with a single pattern shrinkage-measurement zero line;

Fig. 4 shows the development of the zero line of a sleeve; and

Fig. 5 is a side elevation of an oversize micrometer caliper provided with one of the interchangeable pattern shrinkage-measurement sleeves.

In general, metal castings are made by either of two methods, namely, in a sand mold using a wooden pattern, or in a metal gate-mold which, itself, has been formed in a sand mold. In the first instance, all dimensions of the wooden pattern must be increased over the final dimensions of the cast metal article by an amount corresponding to the shrinkage factor of the particular metal being used, that is to say, if the cast article is to be made of brass, bronze or aluminum, then the measurements of the wooden pattern must be increased by substantially 0.0156 inch per inch, which, for clarity is referred to as the shrinkage factor of these metals. If the cast metal is cast iron, then the measurements of the wooden pattern must be increased by .0104 inch per inch, which is the shrinkage factor of cast iron. In instances where a metal gate-mold is used to make the final casting, the measurements of the wooden pattern for

casting the metal gate-mold must allow for both the shrinkage of the metal of the gate-mold itself and the shrinkage of the metal of the finished casting made in the metal gate-mold, that is to say, allowance must be made for double shrink. Moreover, it is apparent at once that the allowances for double shrinkage will vary, depending upon the types of metal involved. For example, the metal gate-mold may be formed of cast iron, while the casting to be made in the metal gate-mold may be bronze. Thus, in making the wooden pattern for the metal gate-mold, the dimensions of the wooden pattern must be increased to allow for the shrinkage factors of both the cast iron and the bronze.

Among pattern makers, it is the practice to use a conventional micrometer caliper for checking the measurements of a wooden pattern, the final dimensions of which are arrived at by mentally adding a shrinkage allowance to each basic dimension of the pattern. This practice is not conducive to accuracy of measurement in the finished pattern and has, in fact, resulted in many costly mistakes and waste of materials.

The present invention is the concept of providing a plurality of separate but interchangeable sleeves for a conventional micrometer caliper, each sleeve having a scale thereon, sometimes referred to hereinafter as a zero line, the readings of which include shrinkage allowances which are characteristic of a particular type of metal. Thus, by equipping a standard micrometer caliper with an interchangeable sleeve of this type, the pattern maker may "mike" a wooden pattern and read directly from the zero line of the micrometer caliper a measurement which will allow for the shrinkage factor of a particular metal such as, for example, cast iron. If, thereafter a wooden pattern is to be measured for making a bronze casting, then the sleeve having readings corresponding to the shrinkage factor of cast iron is removed and replaced by a sleeve having readings corresponding to the shrinkage factor of bronze. In order to permit such interchange of sleeves, the construction of each is identical except for the zero line inscribed thereon. It is therefore apparent that when applied to a sleeve the term "interchangeable" means that the particular sleeve mounted on the frame is adapted to be replaced by another sleeve whenever a change in the material to be cast requires a different shrinkage factor to be employed in measuring the pattern from which the casting is to be made.

The readings of the zero line of each sleeve will include the basic dimension of the pattern plus an amount corresponding to the shrinkage factor of a particular metal. For brevity, these readings are referred to as the pattern shrinkage-measurements.

Referring to the drawings, Fig. 1 discloses a micrometer caliper which comprises a frame **10** having a fixed anvil **11** at one end in axial alignment with which is a longitudinally movable spindle **12** which extends through an axially aligned aperture **13** in the opposite end of the frame and carries a thimble **14** at its outer or right-hand end, as viewed in the drawings for rotating the spindle **12**.

Rigidly secured to or integral with frame **10** is a tubular extension or barrel **15**, which is axially aligned with the aperture **13** and spindle **12**. The end of barrel **15** adjacent thimble **14** is internally threaded to receive a spindle nut **16** which is threaded both internally and externally. The outer end of the spindle **12** is provided with external screw threads which, as shown especially well in Fig. 2, are threadedly engaged in spindle nut **16**. By rotating the thimble **14**, the spindle **12** will thus be made to move longitudinally relative to the fixed anvil **11**.

The external threads at the outer end of spindle nut **16**

taper outwardly, and the spindle nut is slotted longitudinally at the end to permit it to be constricted slightly by an adjusting nut **17**. This is a common method of taking up any wear between the threads of the spindle **12** and the internal threads of the spindle nut **16**.

An interchangeable sleeve **18** fits snugly over the barrel **15** with one end abutting the shoulder **19** of frame **10**. In order to prevent sleeve **18** from being inadvertently moved longitudinally or rotated on barrel **15**, a barrel spring **20** is provided in a recess in barrel **15** so that it frictionally engages the inner surface of sleeve **18** to permit it to be moved only by means of a tool such as a pair of pliers. The thimble **14** is provided with a beveled edge at its inner end, which edge has a vernier scale marked thereon in conventional manner.

A characteristically novel feature of the invention is the provision of interchangeable sleeves **18** having zero lines, the readings of which include shrinkage allowances corresponding to the shrinkage factors of different types of metal. However, it will be appreciated that other forms of means for detachably securing the sleeves to the frame of the micrometer may be used than that shown and described hereinabove. It is intended, moreover, to provide sleeves having scales in accordance with this invention for any of the various common types of micrometers in which the sleeves may be removed. Furthermore, micrometers which do not have detachable interchangeable sleeves, but which incorporate a scale embodying the inventive concept hereinafter disclosed, are clearly within the purview of the invention.

As in conventional micrometer calipers, the pitch of the screw threads on the thimble-end of the spindle **12** is forty to an inch, so that one complete revolution of the spindle moves it longitudinally $\frac{1}{40}$ or twenty-five thousandths of an inch. The zero line on the sleeve **18** is marked in increments of twenty-five thousandths, plus an increment of a particular shrinkage factor, in the manner hereinafter described, while the beveled edge of the thimble **14** is divided into twenty-five divisions, every fifth line being numbered. Rotation of the thimble from one of its divisions to another will move the spindle longitudinally $\frac{1}{25}$ of twenty-five thousandths or one one-thousandth of an inch plus an increment of a particular shrinkage factor.

Referring especially to Fig. 3, each interchangeable sleeve of the micrometer caliper is provided with a zero line, the readings of which include a shrinkage allowance corresponding to the shrinkage factor of a particular metal. The zero line of a conventional micrometer caliper sleeve is substantially straight and divided into forty lines to the inch corresponding to the number of threads on the spindle. The zero lines of the interchangeable sleeves of this invention are similarly divided into forty substantially equal divisions, but the zero lines are substantially helical and the forty divisions of each zero line extend over a distance of one inch plus a shrinkage allowance corresponding to the shrinkage factor of a particular metal. For example, if an interchangeable sleeve is for use in measuring patterns for brass, bronze and aluminum castings wherein the shrinkage factor is substantially 0.1875 inch per foot or 0.0156 inch per inch, then the forty divisions on the helical zero line of an interchangeable sleeve span a length of one inch plus 0.0156 inch.

The development of the zero line on the sleeve, such that each division of the zero line will equal twenty-five thousandths of an inch plus an increment of the shrinkage factor, is geometric in principle and can be done in any one of several ways. For example, referring to Fig. 4 which represents a sleeve opened up, and assuming by way of example a shrinkage factor of 0.0104 inch per inch, this means then that in making a measurement of one inch on a pattern, the thimble will be turned out until the distance between the fixed anvil and the adjacent end of the spindle is exactly 1.0104 inches at which time the zero of the thimble, indicated at *t* in Fig. 4, would be in

advance of the zero line of an ordinary micrometer sleeve by an angular amount indicated at *a* in Fig. 4 and corresponding to 1.0104 inches of travel longitudinally of the sleeve. Now by dividing the distance *a* into the number of divisions desired on the zero scale, which in the example shown is forty, and drawing horizontal lines from each of these divisions transversely to intersect a diagonal line connecting the zero *o* of the scale, with the zero *t* of the thimble, a zero line *z* is formed which is divided into forty equal increments each equivalent to twenty-five thousandths of an inch plus one fortieth of the increment of 0.0104 inch. When this opened sleeve is made cylindrical, the zero line *z* has a helical form such as shown in Fig. 3.

The development of the zero line on the interchangeable sleeves may be carried out in substantially the same way for sleeves which are to be used in measuring patterns for castings of other types of metals such as, for example, brass, in which case the shrink factor is 0.0156 inch per inch.

Further, the zero line of a sleeve may be developed for use in making direct pattern shrinkage-measurements of double shrinks as, for example, when casting a metal gate-mold. If the metal gate-mold is to be made of cast iron and to be used for forming cast iron castings, then the shrinkage factor is double that for a single cast iron shrink or 0.0208 inch per inch. On the other hand, if the metal gate-mold is to be made of aluminum for use in forming cast iron work-pieces, then there will be a double shrinkage factor which is equal to the sum of 0.0156 inch per inch for the aluminum and 0.0104 inch per inch for the cast iron or 0.026 inch per inch. In each of the foregoing instances, the development of the zero line on an interchangeable sleeve of the micrometer caliper is carried out in the manner hereinabove described.

While Figs. 1 through 4 serve to illustrate the invention as applied to a one-inch micrometer, the invention is applicable also to micrometers having a relatively large frame such as shown in Fig. 5. Micrometers of this size are provided with interchangeable anvils such as illustrated at **21** to increase the range of usefulness of the micrometer. The term "interchangeable" as applied to anvil **21** means that each anvil may be readily replaced in frame **10** by another anvil of the same construction but having a different length to compensate for a desired change in the range of measurement. Where a micrometer having a range of from one inch to six inches is used for measuring from zero to one inch, a standard five inch interchangeable anvil is used in conjunction with an interchangeable sleeve such that the distance between the end of the anvil and the opposite end of the spindle will be substantially one inch plus the allowance for shrinkage when the thimble has been turned to the ten position on the zero line of the sleeve.

It will be noted that the zero line of each interchangeable sleeve is developed on the basis of the amount of shrink per inch. Consequently, when measuring distance greater than one inch, additional allowance must be made for the shrinkage factor. For example, cast iron has a shrink factor of substantially 0.0104 inch per inch, which for two inches would be 2×0.0104, or 0.0208 inch. In adapting the shrink micrometer of Fig. 5 for measuring from one inch to two inches, in conjunction with a sleeve having a zero line for cast iron shrinkage factor, an interchangeable anvil **21** would be used, the over-all length of which would be substantially four inches minus 0.0104 inch. Thus, when the thimble is retracted to its number ten division of the sleeve, the total distance between the end of the anvil and the corresponding end of the spindle is substantially 2.0208 inches.

Similarly, for measurements between zero and three inches, the shrinkage factor for cast iron will be 3×0.0104 or 0.0312 inch per inch. Hence, the length of the interchangeable anvil **21** will be three inches minus 0.0208 inch, so that when the thimble is fully retracted,

the total distance between the end of the anvil and the end of the spindle will be 3.0312 inches.

In brief then, to use the micrometer caliper for measuring a wooden pattern to be used in making an iron casting, the pattern maker checks his micrometer to see that it is provided with an interchangeable sleeve having a zero line characterized by shrinkage allowances corresponding to the shrinkage factor of cast iron. If it is so equipped, he may then measure his wooden pattern and read the measurements directly from the helical zero line of the sleeve knowing that each measurement makes allowance for the shrinkage factor of cast iron. Should he then wish to use the micrometer for making measurements of a pattern to be used in forming a casting of a different type of metal, such as, for example, brass, bronze or aluminum, the pattern maker then disassembles the micrometer and replaces the interchangeable sleeve by one having a zero line characterized by shrinkage allowances corresponding to the shrinkage factor of brass, bronze or aluminum. If measurements greater than one inch are to be made, he must also be sure to have the proper anvil which will allow for shrinkage of the particular metal for each inch in excess of one. After reassembling the micrometer, the pattern maker may then proceed to measure the wooden pattern with the assurance that each measurement makes allowance for the shrinkage factor of brass, bronze or aluminum. Although cast iron and such metals as brass, bronze and aluminum have been mentioned, it will be appreciated that a single micrometer may be readily converted for making direct measurements of the patterns for use in casting these as well as other types of metals, that is to say, by providing a micrometer with four, five or even more interchangeable sleeves and anvils, a single micrometer may be used to accurately measure patterns for a large variety of metals.

In assembling the sleeve on the micrometer, the sleeve **18** is worked over the barrel **15** with the spring **20** in place until one end of the sleeve is in firm abutment with shoulder **19** of the frame **10**. This may be done by using a pair of pinchers or pliers having jaws made of a comparatively soft material for gripping the sleeve without damaging its surface. The sleeve is then rotated on the barrel by means of the pinchers to approximately its correct relative position with respect to the frame of the micrometer. This position may be indicated by reference marks on the frame and sleeve respectively, which marks are lined up in order to quickly arrive at the approximate positioning of the sleeve. The pattern maker then corrects this setting in the same manner that is used in assembling conventional micrometers, that is, by turning the spindle up against the anvil and noting the reading of the zero on the thimble with respect to the *o* on the scale of the sleeve. The spindle is then backed off and the sleeve rotated in the proper direction by means of the pinches an amount equal to the initial error and the setting again checked. This is continued until an accurate reading is made.

Although the zero lines of the interchangeable sleeves have been developed on the basis of the English system of measurement, it will be understood that the same principle may be used to develop a zero line based on the metric system. Further, although the pattern shrinkage-measurement scales are shown used on interchangeable sleeves of a micrometer caliper, it will be understood that it is within the purview of the invention to provide other types of gauges with interchangeable pattern shrinkage-measuring sleeves or the equivalent as, for example, vernier calipers, gauges, indicators, inside micrometers, height gauges and similar measuring instruments.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. An instrument for measuring the dimensions of a master pattern in terms of the final dimensions of the castings to be produced from the pattern comprising a frame having an interchangeable anvil at one end thereof, an element movably mounted in said frame opposite said interchangeable anvil for movement longitudinally relative thereto, an interchangeable cylindrical sleeve detachably secured to said frame coaxial with said element, a helical zero-line inscribed on the surface of said sleeve and divided into a plurality of dimensional readings, rotatable measuring-means secured to the end of said element beyond said sleeve, a helical zero-line inscribed on the surface of said sleeve and divided into a plurality of equal dimensional readings, said interchangeable anvil being of a predetermined length to correspond with the total number of said divisional readings on said interchangeable sleeve and include a shrinkage allowance dependent on the helical length of said zero-line, and a circumferential scale on the end of said measuring-means adjacent said sleeve, said scale having a zero index adapted to cooperate with said zero-line on said sleeve for reading shrinkage measurements directly therefrom, said helical zero-line being formed with such slope that the longitudinal movement of said measuring-means required to bring said zero index of said circumferential scale into correspondence with each of said dimensional readings exceeds the actual numerical value thereof by an amount equivalent to the shrinkage factor of the particular material from which the casting is to be made.

2. In a micrometer caliper for measuring the dimensions of a master pattern in terms of the final dimensions of the castings to be produced from the pattern, the combination including a frame having an interchangeable anvil at one end thereof, a spindle rotatably mounted in the opposite end of said frame substantially in axial alignment with said anvil for movement longitudinally relative thereto, an interchangeable cylindrical sleeve detachably secured to the spindle-end of said frame substantially coaxial with said spindle, a helical zero-line inscribed on the surface of said sleeve and divided into a plurality of equal dimensional readings, rotatable measuring-means secured to the spindle-end of said frame, said interchangeable anvil being of a predetermined length to correspond with the total number of said divisional readings on said interchangeable sleeve and include a shrinkage allowance dependent on the helical length of said zero-line, and a circumferential vernier scale on the inner end of said measuring-means adjacent said sleeve, said scale having a zero index adapted to cooperate with said zero-line on said sleeve for reading shrinkage measurements directly therefrom, said helical zero-line being formed with such slope that the longitudinal movement of said measuring-means required to bring said zero index of said circumferential scale into correspondence with each of said dimensional readings exceeds the actual numerical value thereof by an amount equivalent to the shrinkage factor of the particular material from which the casting is to be made.

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