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PRECISION SPACING DIVIDERS

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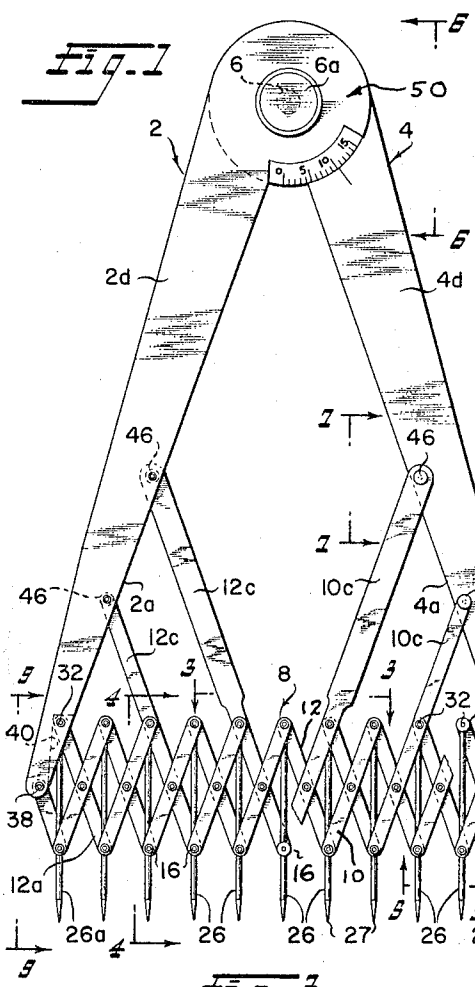


Fig. 1

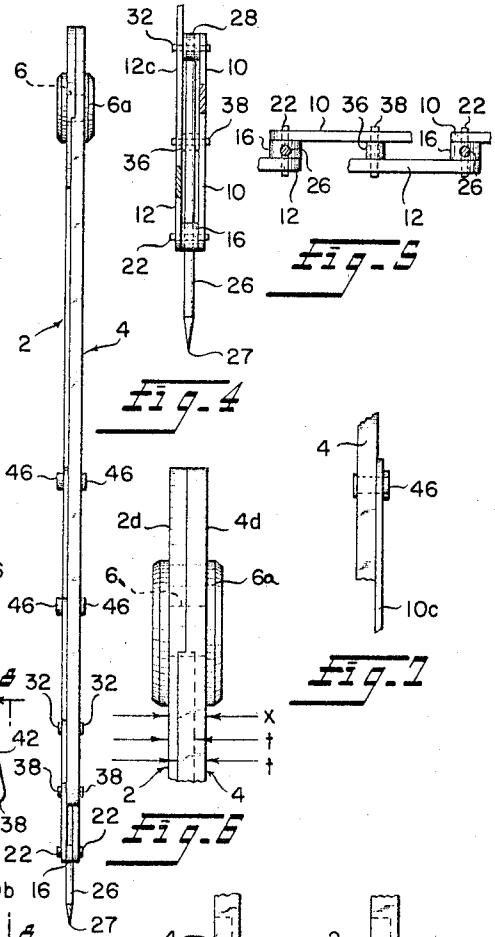


Fig. 2

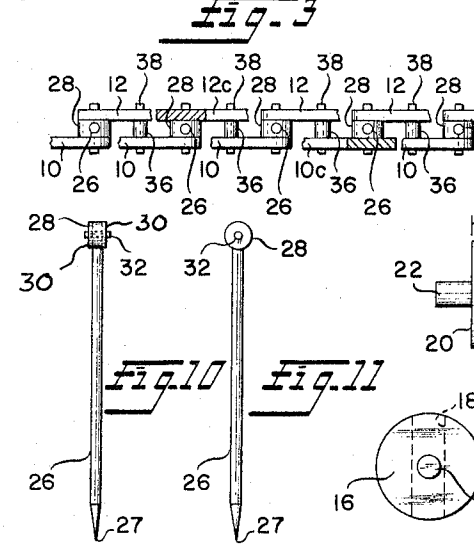


Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

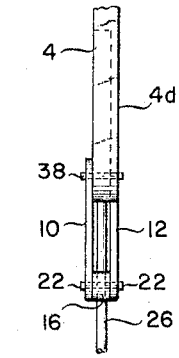


Fig. 8

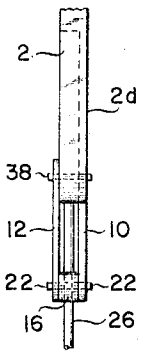


Fig. 9

Fig. 12

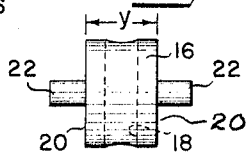


Fig. 10

Fig. 11

Fig. 13

INVENTOR
Nathaniel C. Ratner

Lawrence C. Laubscher
ATTORNEY

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PRECISION SPACING DIVIDERS

Nathaniel C. Ratner, 220 E. 63rd St., New York, N.Y.

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This invention relates generally to improved precision spacing or proportional divider apparatus, and more particularly to a spacing divider instrument including a pair of pivotally connected arms between the free ends of which are connected adjustable lazy tong means having two sets of links that are arranged in spaced parallel planes, respectively, and are pivotally connected by a plurality of coplanar parallel equally-spaced needles arranged therebetween.

Spacing or proportional dividers for automatically dividing given distances into equal incremental parts are well known in the geometrical instruments art. As evidenced by the Goldschmitt Patent No. 495,219 of April 11, 1893, it is known to provide a plurality of equally spaced marking elements on lazy tong means secured between the free ends of the pivotally connected legs of divider apparatus. As the legs are pivoted between open and closed positions, the lazy tongs are correspondingly expanded and contracted to vary the equal incremental spacing between the marking elements.

As shown by the Joy Patent No. 664,759 of December 25, 1900, it is also known in the proportional divider art to provide a plurality of parallel equally-spaced needles that are pivotally connected at one end to the links of lazy tong means and are guided intermediate their ends by guide means carried by the links. While the known devices afford generally satisfactory operation, their use is limited to applications where the precision of measurement is not particularly critical, where the range of measurement is relatively small, and where the ruggedness and durability of the instrument are of minor concern. The present invention was developed to avoid the above and other drawbacks of the known spacing divider instruments.

The primary object of the present invention is to provide an improved, rugged and extremely accurate spacing divider instrument including lazy tong means connected between the free ends of a pair of pivotally connected divider legs and provided with two laterally-spaced sets of coplanar links between which are mounted a plurality of parallel, equally-spaced coplanar needle elements. As a consequence of the arrangement of the needles between the two sets of links of the lazy tong means, the links protect the needles against damage when the instrument is in either a fully closed or an open position.

A more specific object of the invention is to provide guide means pivotally connecting the ends of lazy tong links arranged in parallel spaced planes, said guide means including body members containing cylindrical bores that slidably receive and guide the intermediate portions of parallel equally-spaced needles, respectively. At one end, the needle means carry enlargements that pivotally connect other portions of the laterally spaced links of the lazy tong means. The needle enlargements and the guide body members each include parallel planar end faces in contiguous engagement with the adjacent surfaces of the laterally spaced links, whereby not only are the lazy tong means strengthened and stabilized, but also are the respective needles accurately and precisely maintained parallel and equally spaced throughout the angular range of adjustment of the divider legs.

Another object of the invention is to provide proportional divider apparatus that is collapsible to an extremely compact condition for accurately dividing a relatively small distance into a plurality of equal increments. The

instrument is so designed that the lazy tong links are relatively narrow and collapsible to positions in which the lateral surfaces of the links of each laterally spaced set abut each other and the inner surfaces of the divider legs, respectively. Furthermore, in accordance with another feature of the invention, at their pivotal connection the legs are recessed so that the total thickness of the instrument is less than twice the thickness of a leg thereof. The apparatus is further designed to cause the outer surfaces of one set of links to be coplanar with the corresponding surface of one leg, and the outer surfaces of the other set to be coplanar with the corresponding surface of the other leg. In this manner, ruggedness and rigidity are imparted to the instrument in the aforementioned closed condition since the legs abut the lateral surfaces of the adjacent parallel links, thereby supporting and protecting the links, and the elements connected thereto, against shock, impact and damage that might normally occur during transport or handling of the instrument.

Other objects and advantages of the invention will become apparent from a study of the following specification when considered in conjunction with the accompanying drawing, in which:

FIGURES 1 and 2 are front and right side elevational views, respectively, of the precision spacing divider apparatus, certain links being broken away in FIGURE 1 for purposes of illustration;

FIGURES 3–5 are detailed sectional views taken along lines **3—3**, **4—4** and **5—5**, respectively, of FIGURE 1;

FIGURES 6–9 are detailed and elevational views taken along lines **6—6**, **7—7**, **8—8** and **9—9**, respectively, of FIGURE 1;

FIGURES 10 and 11 are side and end elevational views, respectively, of a needle element; and

FIGURES 12 and 13 are side and end views, respectively, of a guide member.

Referring first more particularly to FIGURES 1 and 2, the precision spacing divider apparatus comprises a pair of legs **2** and **4** pivotally connected at one end by the pivot shaft **6** having at each end enlarged circular flanges **6***a*. Connected between the free ends of legs **2** and **4** are lazy tong means **8** comprising a plurality of parallel coplanar first links **10** parallel with the inner surface **2***a* of a first leg **2**, and a plurality of parallel coplanar second links **12** parallel with the inner surface **4***a* of the second leg **4**. As shown in FIGURES 3–5, 8 and 9, the first and second links are coplanar and are arranged in parallel spaced planes, respectively.

Pivotally connecting the lower ends of associated pairs of first and second links are a plurality of guide members **16** each comprising a cylindrical body (FIGURES 12 and 13) containing a transverse through bore **18**. Extending axially from the planar parallel end surfaces **20** of the body **16** are pivot pins **22** that extend through corresponding openings in the first and second links and are maintained therein by enlarged portions at the extremities thereof. As will be described below, the end surfaces **20** of the body are contiguous with the adjacent inner surfaces of the associated first and second links.

Slidably mounted intermediate their ends in the bores **18** of the guide members **16** are a plurality of linear needles **26** that terminate at their lower ends in pointed extremities **27**. As shown in FIGURES 10 and 11, each needle **26** is provided at its upper end with a cylindrical enlargement **28** having parallel planar end surfaces **30** from which extend axial pivot pins **32**. These pivot pins **32** extend through corresponding openings in another associated pair of first and second links, as shown in FIGURE 4, and are secured therein by enlarged end portions.

Similarly, the intermediate portions of the first and second links are pivotally connected by cylindrical spaced bodies 36 having axial pivot pins 38 which rotatably extend through corresponding openings in the associated links as shown in FIGURES 4 and 5.

Referring again to FIGURE 1, the outermost pair of needles 26*a* and 26*b* are mounted at their upper ends in recesses 40 and 42 contained in the rear and front surfaces of legs 2 and 4, respectively. Thus, the needle 26*a* is pivotally mounted between leg 2 and the second link 12*a*, and the needle 26*b* is pivotally mounted between the first link 10*b* and the leg 4. The purpose of the recesses 40 and 42 is to receive the needles 26*a* and 26*b*, respectively, when the legs 2 and 4 are pivoted together to collapse the lazy tongs, as will be described below.

In order to stabilize intermediate portions of the lazy tong means, several of the first links 10 and second links 12 have extended portions 10*c* and 12*c* pivotally connected with the legs 4 and 2, respectively, by pivots 46 (FIGURE 7).

Referring now to FIGURES 2 and 6, the legs 2 and 4 have the same thickness *t* and the pivotally connected end portions of the legs 2 and 4 contain cooperating mating recesses, whereby the total thickness *x* of the dividers, is less than twice the thickness *t* of each leg. Moreover, the longitudinal dimensions *y* between the parallel end surfaces 30 of the needle enlargements and between the end surfaces 20 of the guide members 16 are equal and such that the sum of the thickness of a link (10 or 12) plus the length *y* of the body 16 (or the enlargement 28) equals the thickness *t* of a leg (2, 4). As a result of this dimensioning of the elements, the outer surfaces of the first links 10 are coplanar with the forward surface 2*d* of the leg 2, and the outer surfaces of the second links 12 are coplanar with the rear surface 4*d* of leg 4, as shown in FIGURES 8 and 9. This construction permits not only the pivotal connections of the extended portions of the first and second links 10*c*, 12*c* with the legs 4 and 2, respectively, but also permits the aforementioned collapsing of the lazy tong means to the point that the lateral surfaces of the first and second links are contiguous and supported by the inner surfaces of the legs, respectively.

Indicia 50 carried by the legs adjacent the pivot shaft 6 afford visible indication of the angular orientation of the divider legs 2 and 4, and consequently the distance between the outermost pair of needles 26*a* and 26*b*. Nine equally spaced needles are provided between the outermost needles for dividing the distance therebetween into ten equal increments, as is conventional in the proportional divider art.

In operation, opening of the legs 2 and 4 from the FIGURE 1 position causes separation of the points of needles 26*a* and 26*b*, expansion of the lazy tongs 8, and corresponding separation of the intermediate needles 26. The ten incremental spaces defined between the eleven needle elements has now increased in accordance with the incremental angular opening of the legs. During this opening movement of the legs, the guide members 16 slide upwardly on their associated needles and operate (in conjunction with the needle enlargements 28 and the link extensions 10*c* and 12*c*) to positively and precisely maintain all the needles parallel, coplanar and equally spaced as the incremental distances are increased. During closing movement of the legs 2 and 4 from their FIGURE 1 position, the guide members 16 slide downwardly along the needles as the lazy tong means are collapsed, thereby maintaining the needles coplanar, parallel and equally spaced as the incremental spacing distances are reduced. Upon complete closing of the dividers, the lazy tongs are collapsed until the lateral surfaces of the first links are contiguous and in supported abutment with the first leg surface 12*a*, and the lateral second links are contiguous and in supported abutment with the second leg surface 4*a*, the upper portions of the outermost needles 26*a* and 26*b* being received in the recesses 40 and 42, respectively. Owing to the provision of these recesses and the thin widths of the links, the spacing dividers of the present invention may be more completely collapsed than the known proportioning divider apparatus of the prior art.

While in accordance with the provisions of the Patent Statutes, I have illustrated and described the preferred form and embodiment of the present invention, it will be apparent to those skilled in the prior art that various modifications and changes may be made in the apparatus disclosed without deviating from the invention set forth in the following claims.

What is claimed is:

1. Proportional divider apparatus, comprising a pair of pivotally connected legs (2, 4); and lazy tong means (8) connected between said legs, comprising a plurality of coplanar first links (10) extending generally parallel with a first one (2) of said legs, a plurality of coplanar second links (12) extending generally parallel with the other of said legs (4), said first and second links being arranged in spaced parallel planes, respectively, means (26, 32) pivotally connecting at least some of said first and second links at the ends thereof adjacent the pivotal connection of said legs, respectively, said connecting means including a plurality of parallel linear elements (26) contained in a common plane between and parallel with the planes containing said first and second links, respectively, and a plurality of coplanar guide members (16) arranged between and pivotally connecting said first and second links at the ends thereof remote from the pivotal connection of said legs, respectively, at least some of said guide members containing bores (18) slidably receiving portions of said linear elements, respectively.

2. Apparatus as defined in claim 1, wherein each of said guide members comprises a body having parallel planar end surfaces contiguous with the adjacent surfaces of the associated first and second links, respectively, said body including pin means extending coaxially from opposite ends of said body for pivotal connection with said links, respectively.

3. Apparatus as defined in claim 2, wherein each of said linear elements comprises a needle carrying at said one end an enlargement having planar parallel end surfaces contiguous with the adjacent surfaces of the corresponding first and second links, respectively, and further including pin means pivotally connecting the ends of said enlargement with the associated links, respectively.

4. Apparatus as defined in claim 3, wherein the pivotally connected ends of said legs contain cooperating recesses the bottom surfaces of which are contiguous and normal to the pivot axis of said legs, the depth of said recesses being such that the total thickness of the apparatus is less than the sum of the thicknesses of the legs.

5. Apparatus as defined in claim 4, wherein the outer surfaces of said first links are coplanar with a corresponding surface of said first leg, and wherein the outer surfaces of said second links are coplanar with a corresponding surface of the second leg.

6. Apparatus as defined in claim 5, wherein a plurality of said first links are pivotally connected with said second leg and wherein a plurality of said second links are pivotally connected with said first leg, thereby stabilizing intermediate portions of said lazy tong means.

7. Apparatus as defined in claim 5 wherein all of said first and second links have the same thickness, wherein the length dimensions between the end surfaces of said guide bodies and said enlargements are equal, and further wherein the thickness of said legs equals the sum of the thickness of one link and the length dimension of the guide body.

8. Apparatus as defined in claim 7, wherein the lazy tong means includes an additional pair of outermost linear elements each of which is pivotally connected at one end in a recess contained in one of said legs, respectively.

9. Apparatus as defined in claim 8 wherein when said apparatus is in a completely closed condition, said first

links and the adjacent inner surface of said first leg are contiguous, respectively, and said second links and the adjacent inner surface of said second leg are contiguous, respectively.

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LEONARD FORMAN, *Primary Examiner.*