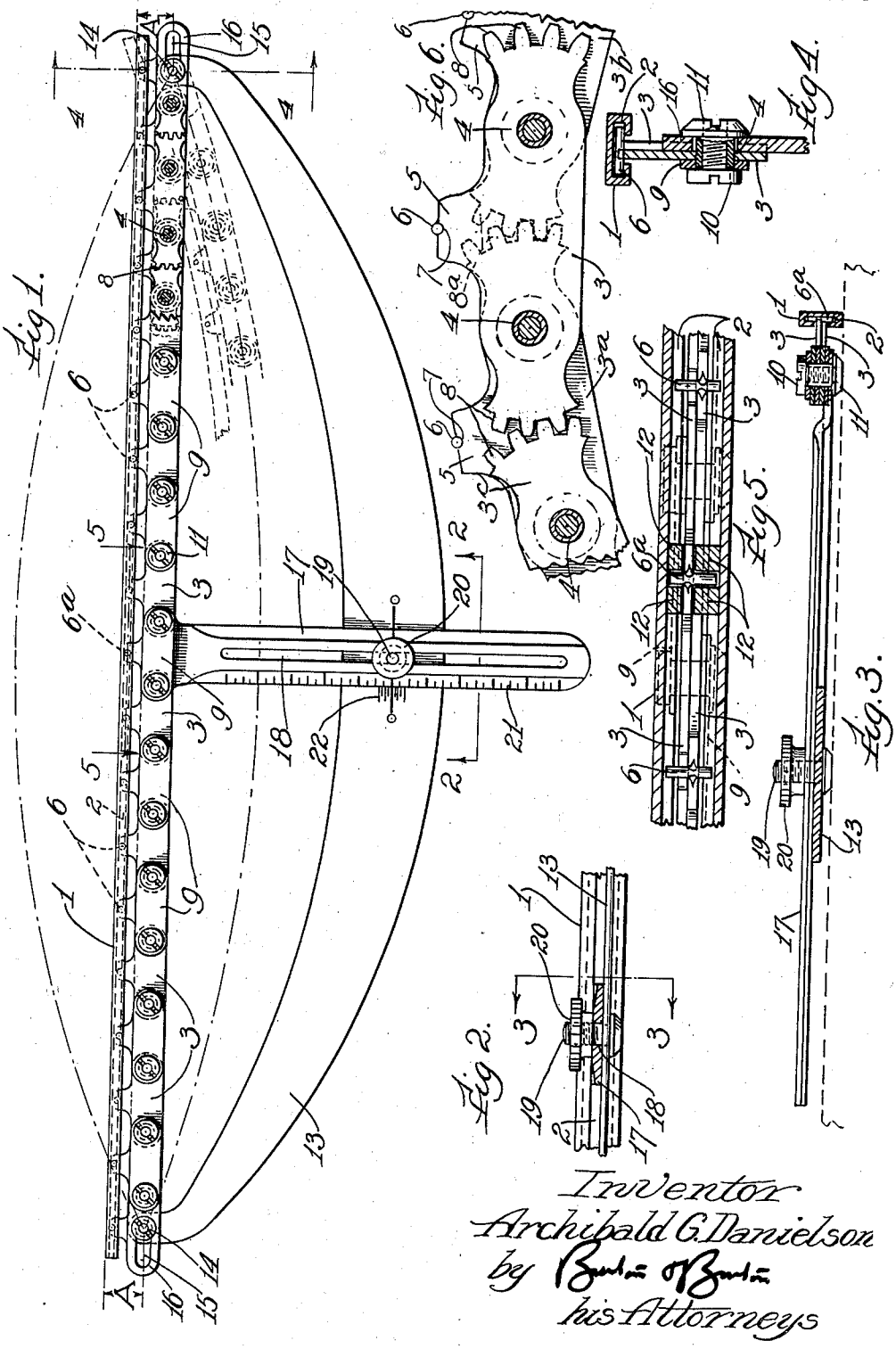
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ADJUSTABLE CURVED RULER

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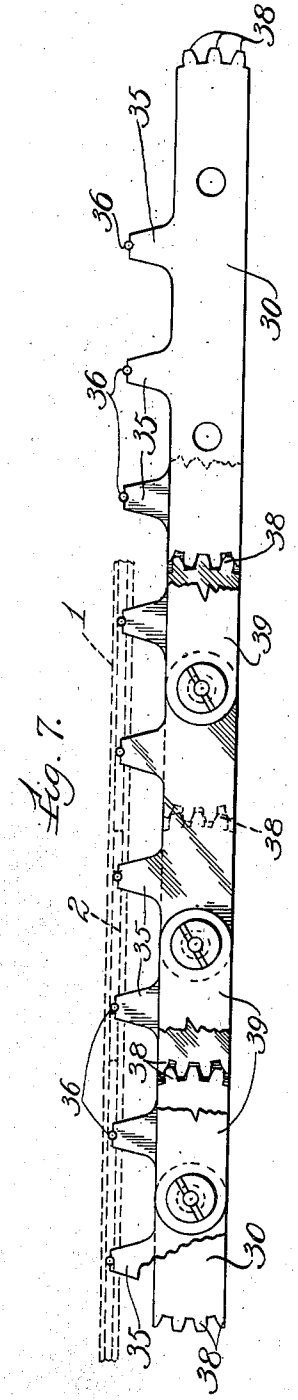


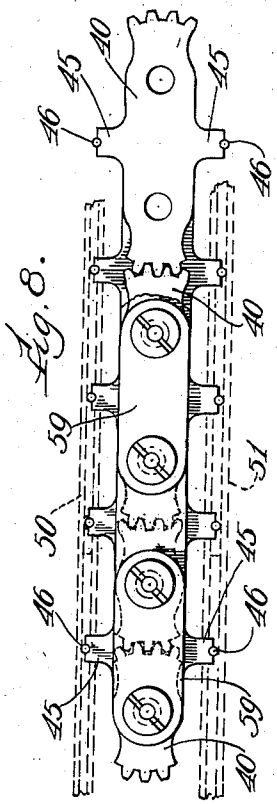
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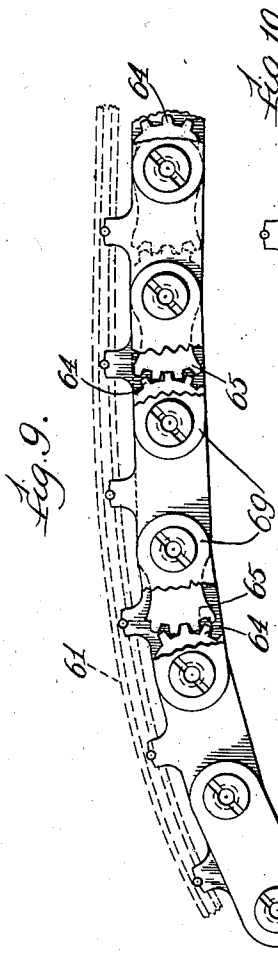
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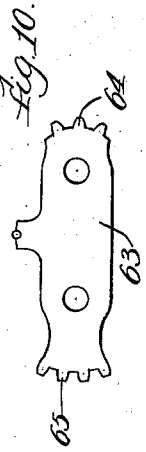
ADJUSTABLE CURVED RULER

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2,116,563

ADJUSTABLE CURVED RULER

Archibald G. Danielson, Riverside, Ill.

Application March 15, 1937, Serial No. 130,818

12 Claims. (Cl. 33—177)

This invention relates to adjustable curve scribers or rulers, particularly those adapted for use by draftsmen, pattern makers and mechanics, for ruling curves of large radius. One object of the invention is to provide a structure which can be quickly adjusted to any desired curvature within its range; another object is to ensure economy of manufacture by utilizing mechanical elements which can be produced and assembled readily and accurately. A further object is to provide a design which can be made of elements and materials adapted to resist wear, so that the accuracy of the device shall remain unimpaired after long-continued use. The invention consists in certain elements and features of construction in combination, as herein shown and described and as indicated by the claims.

In the drawings:

Figure 1 is a plan view of a flexible rule structure embodying this invention.

Figure 2 is a detail section taken as indicated at line 2—2 on Figure 1.

Figure 3 is a detail section as indicated at line 3—3 on Figure 2.

Figure 4 is a detail section taken as indicated at line 4—4 on Figure 1.

Figure 5 is a detail section taken as indicated at line 5—5 on Figure 1.

Figure 6 is an enlarged fragmentary plan view showing several links of the mechanism which controls the curvature of the rule.

Figure 7 is a fragmentary plan view showing a few links of a modified form of construction with a portion of the rule indicated in dotted outline.

Figure 8 is a view similar to Figure 7 showing a fragment of a modified form of the invention including two parallel rules spaced apart and indicated in dotted outline.

Figure 9 is a fragmentary side elevation of a further modification for producing a non-circular curvature whose radius varies in accordance with a definite rule.

Figure 10 is a plan or face view of one of the links employed in the rule shown in Figure 9.

In the form shown in Figures 1 to 6 the device consists of a single ruling member, 1, of flexible material such as celluloid, adapted to be bent in either direction from the straight form in which it is shown in full lines in Figure 1, so as to assume a curved shape adapted to guide a ruling pen or pencil in making drawings or scribing pieces of material to be worked upon. The curvature of the member, 1, at any position in its range of adjustment, is controlled by a system of rigid links to which the ruling member, 1, is attached at intervals in its length, and such attachment is made possible by forming the rule with an under-cut channel, 2, extending throughout its length. Each of the links consists of a plate, 3, which may be of sheet metal formed with pivot apertures, 4, and with a laterally projecting lug, 5, which carries a cross-pin, 6, to engage in the channel, 2, of the ruling member, 1. As one method of construction the cross-pin may be lodged in a semi-circular notch, 7, in the plate, 3, and spot-welded in position so as to become a rigid part of the link; it will be evident, however, that the pin, 6, may be secured by any other well-known method, or that it may be formed as an integral part of the member, 3, if preferred.

The flat links, 3, are connected in a continuous chain at their pivot apertures, the end portion of one link being overlapped upon the end portion of the next link. Each member, 3, has its extreme ends formed with gear teeth, 8, whose pitch radius is such that the teeth of alternate links of the chain inter-mesh, as seen in dotted outline at 8^a on Figure 6, intermediate the two pivot apertures, 4, 4, of the link which connects such alternate links. The alternate links are denoted as 3^a and 3^b, and it will be seen that by reason of the inter-meshing of their gear teeth, any angular movement of the link, 3^a, with respect to the link, 3, produces a corresponding angular movement of the link, 3^b, with respect to the link, 3. At the same time, due to the fact that the teeth, 8, of the link, 3, are inter-meshed with the teeth of adjacent links lying in the same plane as the link, 3, any angular movement of the link, 3, relative to the link, 3^a, will produce a correspondingly angular movement of an adjacent link such as 3^c. If the pitch radii of the teeth at both ends of each link are equal, these relative angular movements between connected links will all be equal, with the result that the cross-pins, 6, of the links will be shifted into a circular curve, and the radius of this curve at any position of adjustment of the links will vary with the degree of angularity between the links themselves.

In addition to the links, 3, the chain may include cover links, 9, each connecting two adjacent pivots and overlapping the inter-meshing gear teeth of a pair of links, 3, thus improving the external appearance of the device, and protecting the gears from particles of dust or grit, or from threads or other foreign matter which might become lodged between them so as to im-

pair their action. At each pivot point the interconnected links, 3, and the cover links, 9, are held together by two-part pivots each consisting of a headed screw, 10, and a hollow screw, 11, telescopically threaded together as clearly seen in Figure 4.

It will be understood that as the links are adjusted to cause curvature of the flexible rule, 1, in either direction, the cross-pins, 6, will be slidably shifted in the groove, 2, of the rule. To distribute this shifting of the pins and minimize it, I prefer to anchor the pin, 6^a, at the middle of the length of the rule, 1, as by securing in the groove, 2, the stop-blocks, 12, positioned at each side of the pin, 6^a, and suitably cemented or otherwise secured in fixed position in the rule member, 1.

At each of the pivotal connections any suitable form of friction washer, not shown, may be included to increase the pressure of the overlapped links upon each other, so that they will be held firmly at any position of adjustment. Furthermore, if desired, the links may be supported by a curved beam, 13, provided at opposite ends with pivots, 14, engaging slots, 15, in the terminal links, 16, of the series, and when such a beam is employed, a radial bar, 17, may be rigidly associated with the middle link of the series; as seen in Figure 1, this bar is formed with a longitudinal slot, 18, through which a clamp screw, 19, extends from the beam, 13, so that by means of a nut, 20, the bar, 17, may be clamped to the beam, 13, at any position of adjustment. The bar is preferably provided with a scale, 21, at one edge, and for extreme accuracy a vernier scale, 22, is carried on the beam, 13, adjacent the zero index mark thereon. These scales permit adjustment of the rule, 1, in terms of the height or distance of an arc from its chord. From the scale reading the radius of the arc may be determined readily by means of the formula

$$R=\frac{C^2+4H^2}{8H}+A$$

in which—

C=The chord
H=The height of the arc
R=The radius of the arc
A=The distance between the line of pivot centers of links, 3, and the ruling edge of member, 1.

It may be understood that, if desired, the scale, 21, may be calibrated to read directly in terms of the radius of the arc formed by the rule, 1, at any position of adjustment.

Figure 7 shows a slightly modified form of link, 30, which is particularly adapted for a structure to be used for scribing curves of large radius. Each of the links, 30, is formed with two lugs, 35, and each of these lugs is provided with a cross-pin, 36, for engagement in the under-cut groove of the ruling member indicated in dotted outline at 1. Opposite ends of the links are formed with gear teeth, 38, similar to the teeth, 8, of the links, 3, and inter-meshing with like teeth of adjacent links in the manner already described. Guard or cover links, 39, are also employed with this structure.

Figure 8 shows another modification in which the links, 40, are similar to the links, 3, of Figure 6, except that each link is provided with two lugs, 45, extending in opposite directions from the center line of the pivot apertures. Each lug, 45, supports a cross-pin, 46, and these pins engage respectively in two parallel ruling members, 50 and 51, which will assume parallel, curved contours whenever the links, 40, are angularly shifted with respect to each other. The links are geared together in the same manner as those shown in Figures 1 to 6, and the structure may include cover links, 59, overlapping the gear teeth.

Figure 9 shows a modification of the structure designed to control its flexible ruling member, 61, for producing curves of non-circular form, but in which the curvature varies at a definite rate. This is accomplished by using links, 63, whose gear teeth, 64, at one end have a different pitch radius from the gear teeth, 65, at the other end of the link. Thus the angular movement of any link about one of its pivots is transmitted to the next link to cause a shifting of the latter through a different angle. The angular movement of the second link will be greater than that of the first if its pitch radius is less, or will be less than that of the first if its pitch radius is greater. This angular movement will be similarly increased or decreased in transmission to the next succeeding link of the chain, and so on, throughout the entire structure, so that a very gradual curvature at one end of the rule member, 61, will be accompanied by a more sharply curved formation of the rule at its opposite end. The graduated or spiral curves thus produced are particularly useful in securing smoothly tapering or "stream-lined" effects in designing, primarily for appearance, where the essential mechanical form may be varied to some extent for the sake of smooth contours of pleasing design. In Figure 9 the cover links, 69, are shown with portions broken away to reveal the intermeshing teeth, 64 and 65, of connected links.

In all the forms of the device illustrated herein the links of the chain may be made as stampings of sheet steel of reasonable thickness, and in order that their gear teeth shall mesh accurately without back-lash, and shall be sufficiently wear-resisting to maintain this accuracy over a long period, the parts may be case-hardened in accordance with well-known methods. If desired, in the larger sizes of the device, the links may be laminated in two or three layers, or may be made of duplicate or triplicate construction with the layers laterally separated so as to provide ample bearing surface between the gear teeth and on the pivots.

It will be further understood that devices of this character, in addition to functioning as rulers or curve scribers in making drawings or marking out pieces of work, may serve as templates for transferring curved outlines from a drawing to a piece of work which has been marked out, or actually cut, so as to check the accuracy of the piece with the drawing or with another piece of like curvature.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and re-arrangements of the parts may be made without departing from the spirit and scope of the invention, and that the same is not limited to the particular forms herein shown and described, except in so far as indicated by the appended claims.

I claim:

1. In combination, a flexible rule and a chain of levers to control its contour, each lever having two pivots spaced apart and connecting it respectively with two similar levers, the latter having their mutually adjacent ends formed with

inter-meshing gear teeth, and means by which levers of the chain are slidably engaged with said flexible rule at intervals in its length.

2. In the combination defined in claim 1, the pivot centers of all the levers of the chain being equally spaced apart and the gear teeth all having the same pitch radius whereby, at any position of adjustment, the angles between all pairs of adjacent levers are equal, and all the pivot centers lie in a circular arc whose curvature may be varied by altering said angles between adjacent levers.

3. In the combination defined in claim 1, the pivot centers of all the levers of the chain being equally spaced apart and the gear teeth all having the same pitch radius whereby, at any position of adjustment, the angles between all parts of adjacent levers are equal, and all the pivot centers lie in a circular arc whose curvature may be varied by altering said angles between adjacent levers, and the slidable engagements of the rule with the chain being all equidistant from the arc of said pivot centers.

4. In combination, a flexible rule and a chain of levers to control its contour, each lever having two pivots spaced apart and connecting it respectively with two similar levers, the latter having their mutually adjacent ends formed with inter-meshing gear teeth, said rule having a longitudinally extending under-cut groove, and means extending rigidly from levers of the chain at regular intervals in its length and engaged slidably in said groove.

5. In the combination defined in claim 1, means anchoring the rule against longitudinal movement relative to one lever of the chain.

6. In the combination defined in claim 1, means by which one of the levers of the chain is anchored to the rule substantially at the middle of the length of said rule.

7. In the combination defined in claim 4, blocking means fixed in the groove of the rule to anchor therein the means which extends from one of the levers into engagement with the groove.

8. In combination, a flexible ruling member and a system of links to control its contour, each link having two pivots spaced apart and connecting it respectively with two similar links, the latter having end portions extending beyond their pivots and inter-connected to cause equal angular movements of said links with respect to the intermediate link to which they are pivoted, and means by which links of the chain are slidably engaged with said flexible ruling member at intervals in its length.

9. In combination, a flexible ruling member and a chain of flat links to control its contour, consecutive links being lapped flatly against each other and pivotally connected, and alternate links having end portions extending beyond their pivots and formed with mutually inter-meshing gear teeth, together with cover links each connecting a pair of adjacent pivots and overlapping the gear teeth of a pair of alternate links, and means by which links of the chain are slidably engaged with said flexible rule at intervals in its length.

10. In combination, a flexible ruling member and a system of links to control its contour, each link having two pivots spaced apart and connecting it respectively with two similar links, the latter having end portions extending beyond their pivots and inter-connected to cause equal angular movements of said links with respect to the intermediate link to which they are pivoted, and means by which links of the chain are slidably engaged with said flexible ruling member at intervals in its length, together with a beam extending laterally adjacent the ruling member and its chain of links, said chain including terminal links with pivot-and-slot connections to the ends of the beam respectively, and means associated with the beam extending transversely therefrom into connection with the middle link of the chain, said means being adjustable to vary the distance of said link from the beam and alter the curvature of the ruling member.

11. In combination, a flexible ruling member and a chain of flat links to control its contour, consecutive links being lapped flatly against each other and pivotally connected, and alternate links having end portions extending beyond their pivots and formed with mutually inter-meshing gear teeth, together with a curved beam extending laterally adjacent said chain, the chain including terminal links with pivot-and-slot connections to the ends of the beam respectively, and a bar extending transversely of the beam connected rigidly to the middle link of the chain and adjustable transversely of the beam, said bar and beam having cooperative scale and index features, and means for clamping the bar to the beam at adjusted position, together with means on the links of the chain slidably engaging the flexible ruling member at intervals in its length, whereby the curvature of the chain and of the ruling member may be varied by adjustment of the bar on the beam.

12. In combination, a flexible ruling member and a chain of levers to control its contour, each lever having two pivots spaced apart and connecting it respectively with two similar levers, the latter having their mutually adjacent ends formed with inter-meshing gear teeth differing from each other in pitch radius, whereby the angular movement of one lever about its pivot causes a different angular movement of the inter-meshed lever, and means by which levers of the chain are slidably engaged with said flexible ruling member at intervals in its length, whereby the curvature produced by angular adjustment of successive levers of the chain varies progressively along the length of the ruling member.

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