June 27, 1939. C. H. LITTLE 2,164,216

DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 1

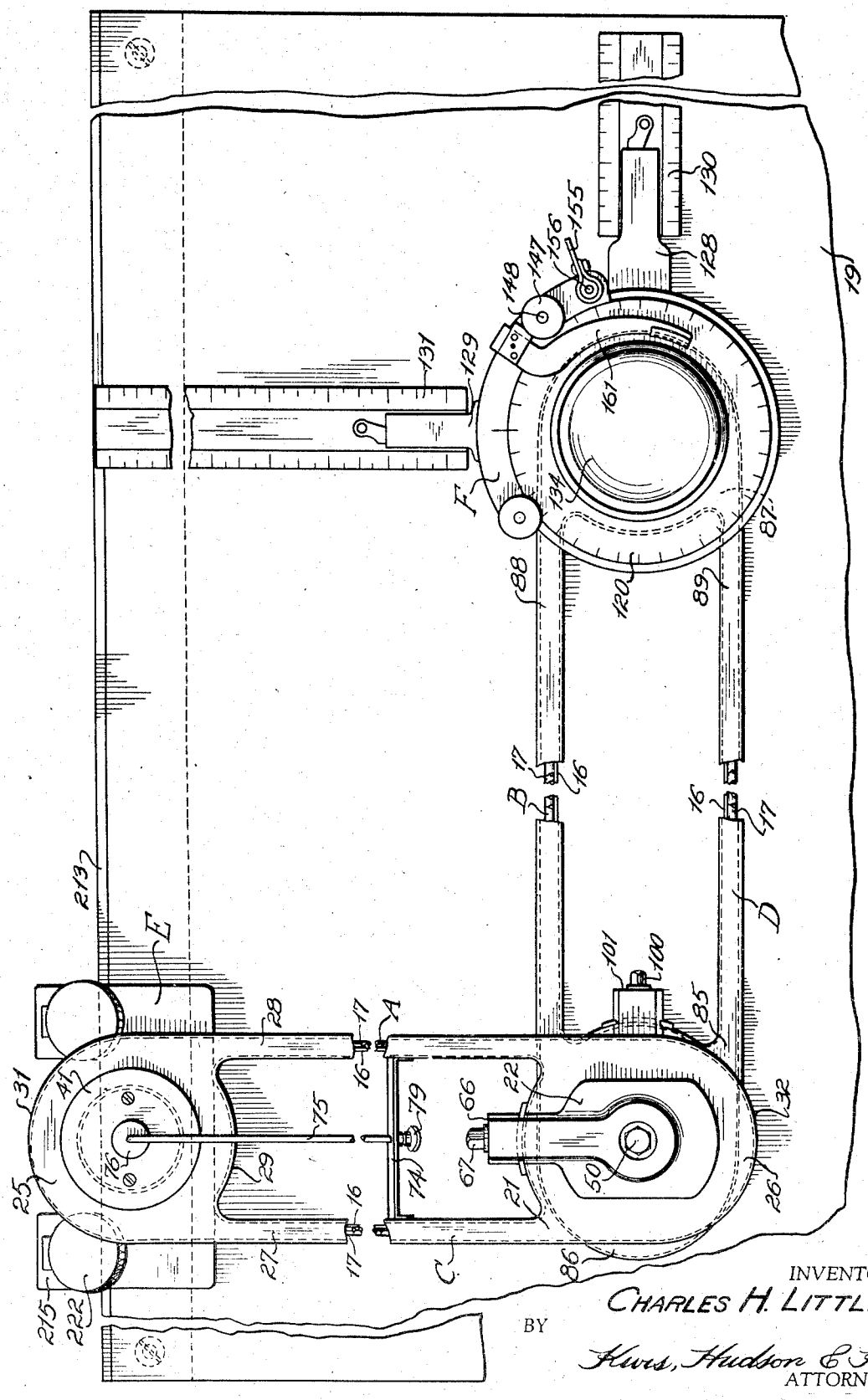


FIG. 1

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June 27, 1939. C. H. LITTLE 2,164,216

DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 2

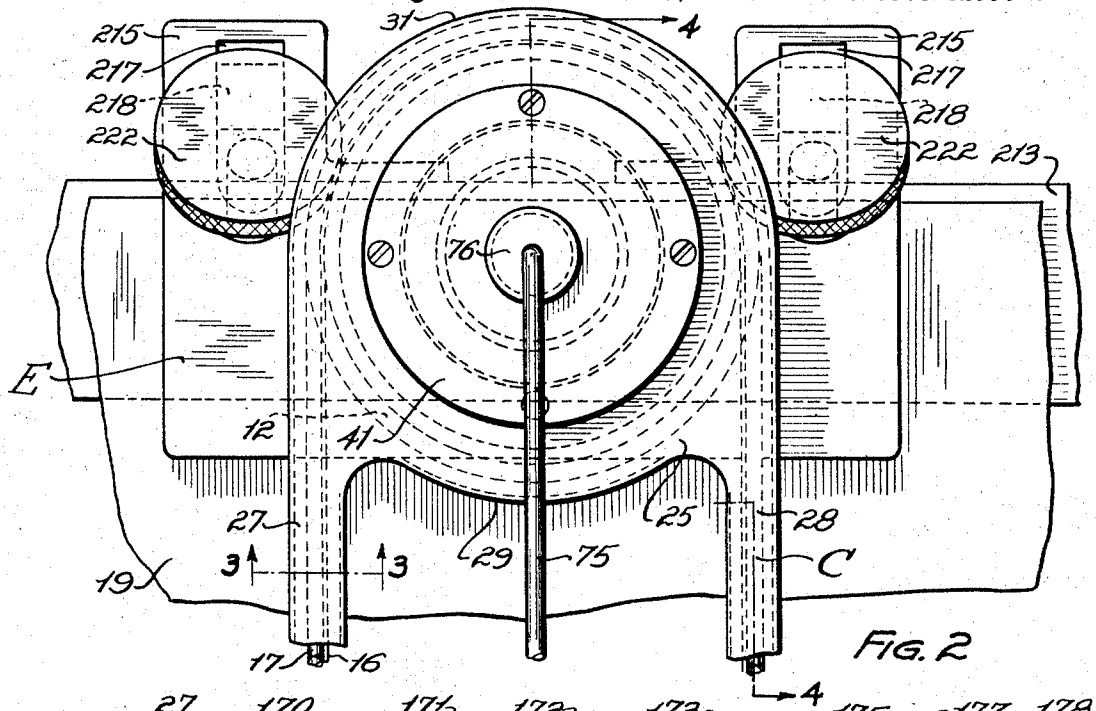


FIG. 2

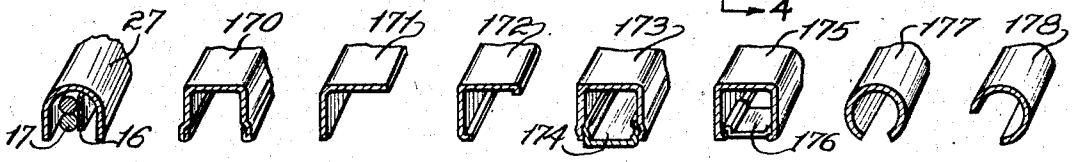


FIG. 3 FIG. 15 FIG. 16 FIG. 17 FIG. 18 FIG. 19 FIG. 20 FIG. 21

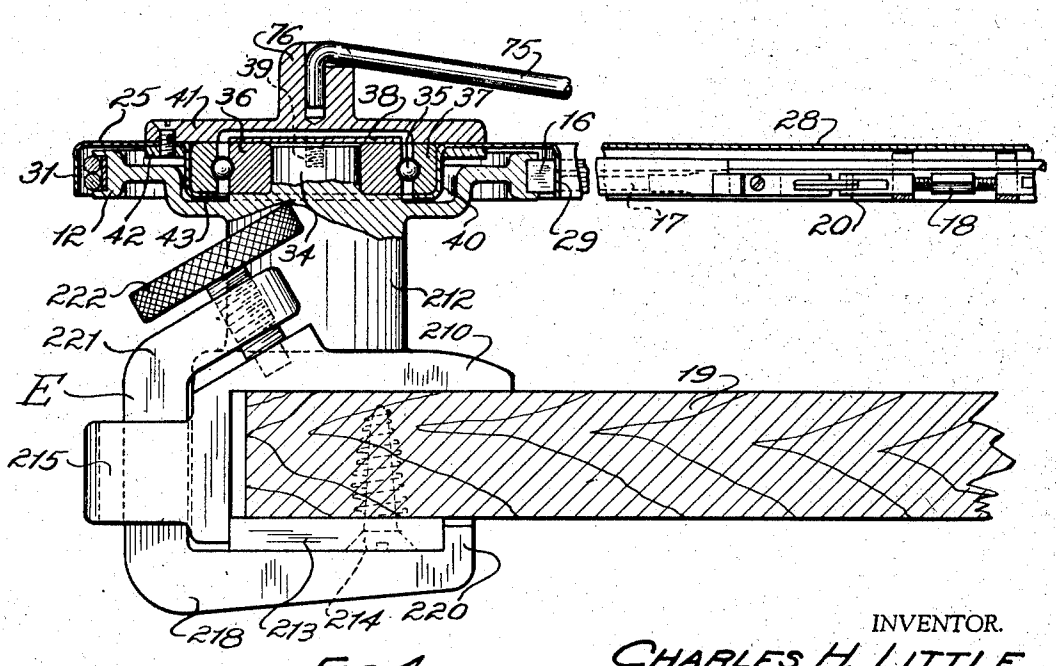


FIG. 4

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June 27, 1939. C. H. LITTLE 2,164,216

DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 3

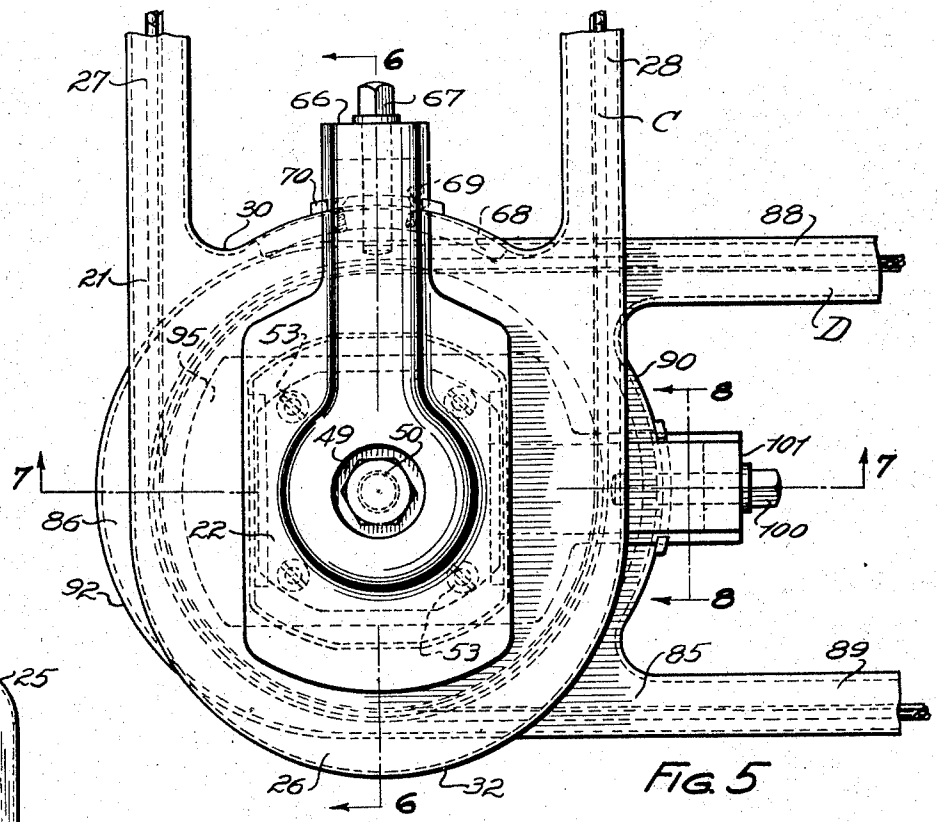


FIG. 5

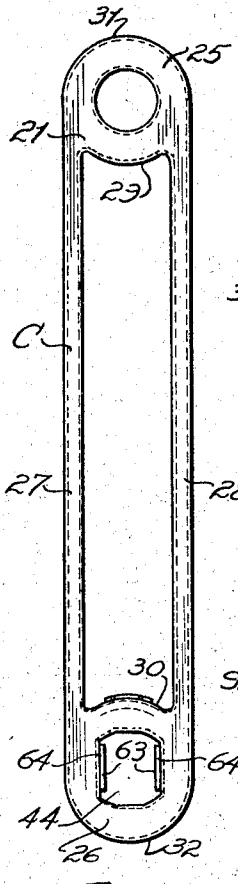


FIG. 9

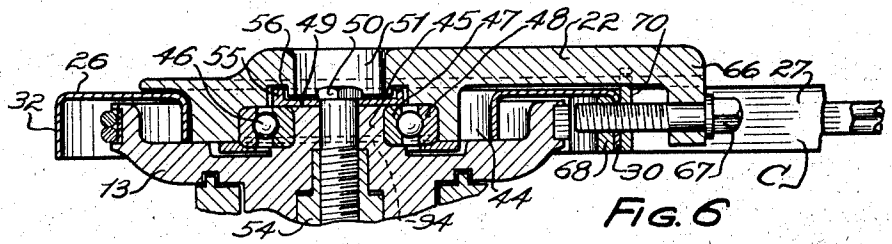


FIG. 6

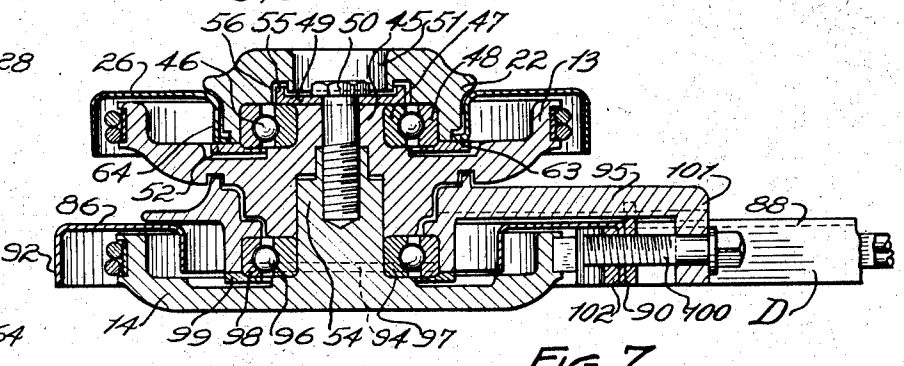


FIG. 7

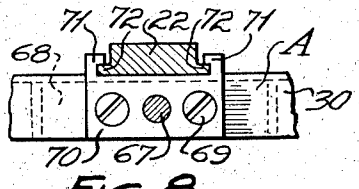


FIG. 8

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DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 4

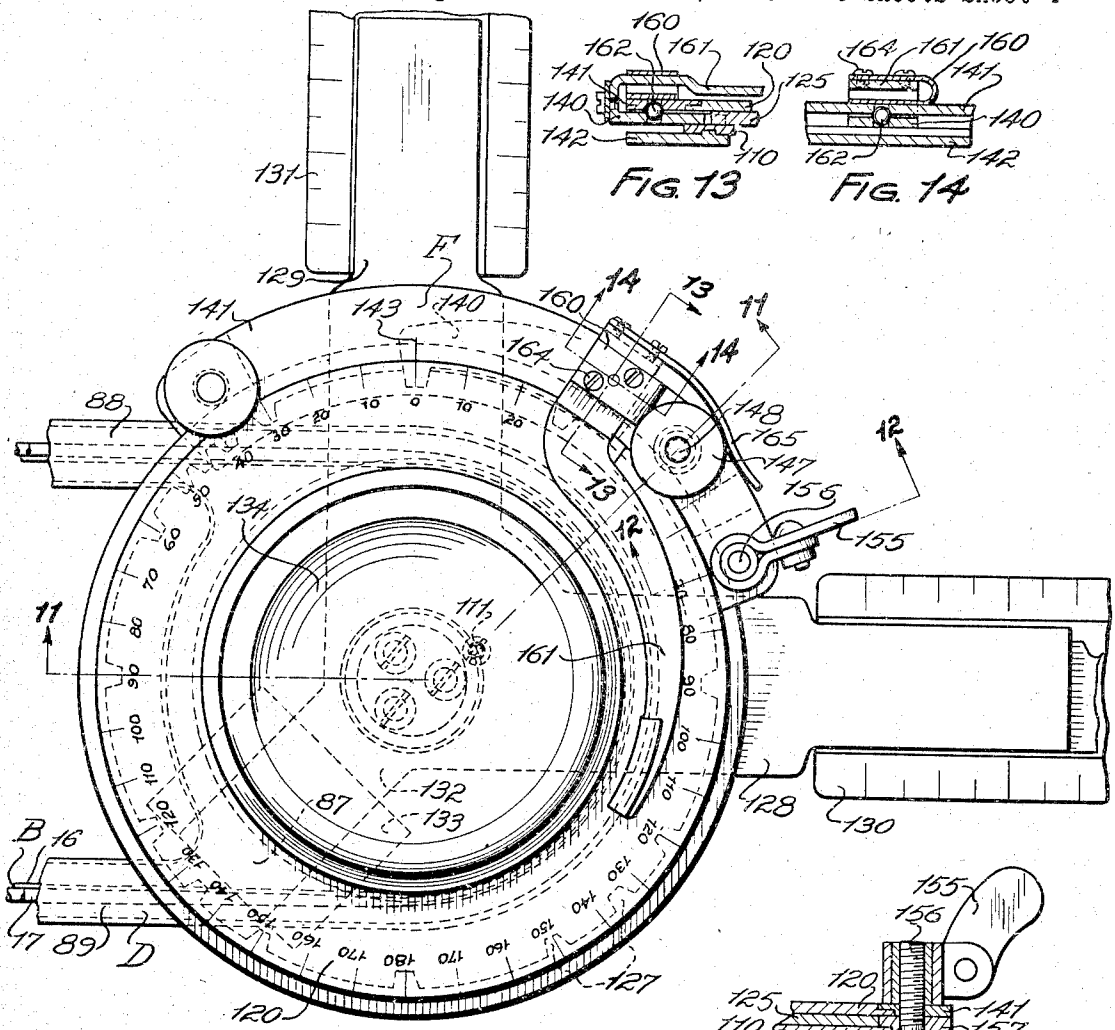


FIG. 13 FIG. 14

FIG. 10

FIG. 12

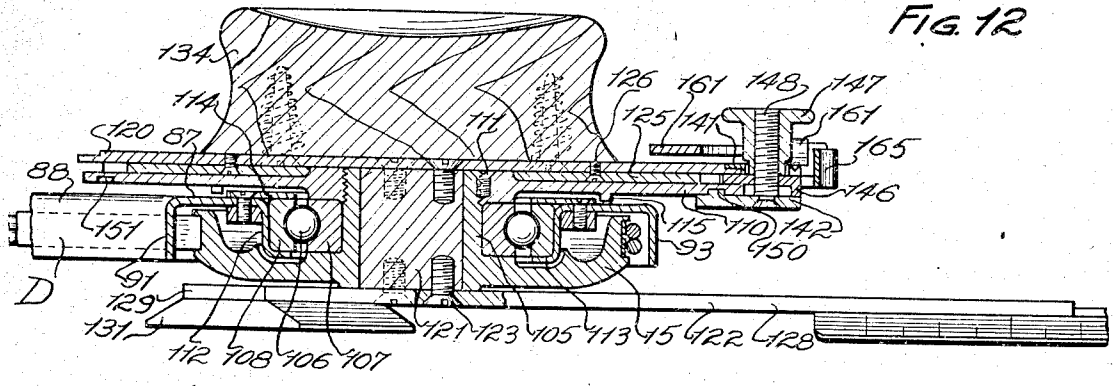


FIG. 11

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June 27, 1939. C. H. LITTLE 2,164,216

DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 5

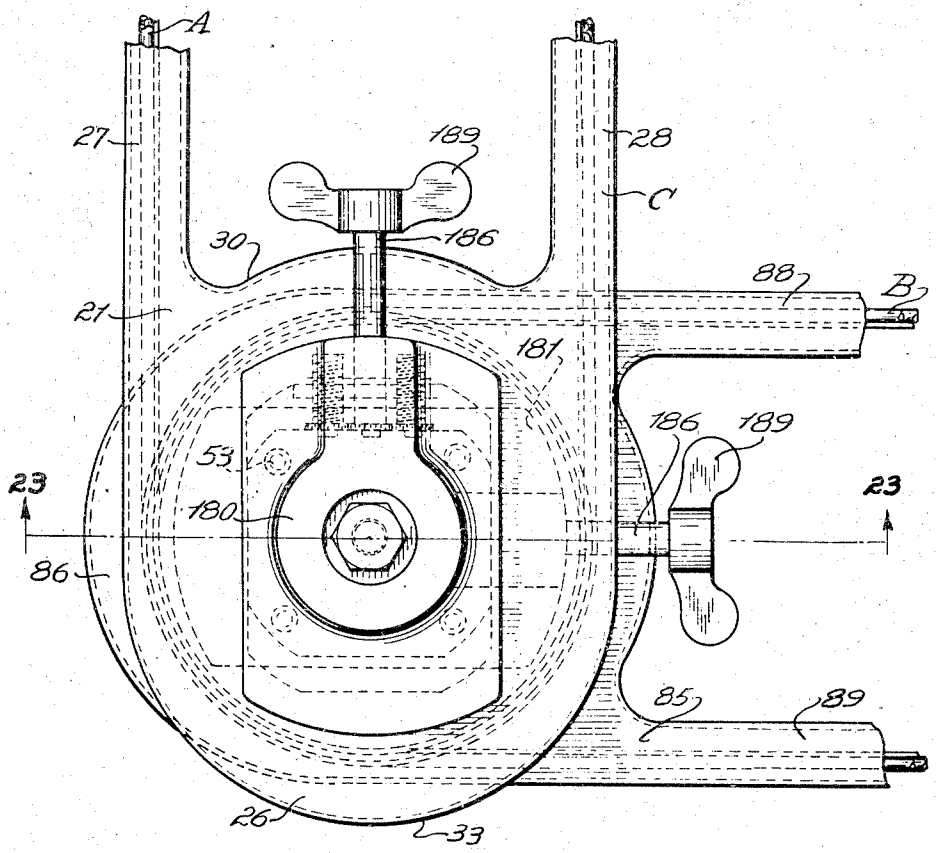


FIG. 22

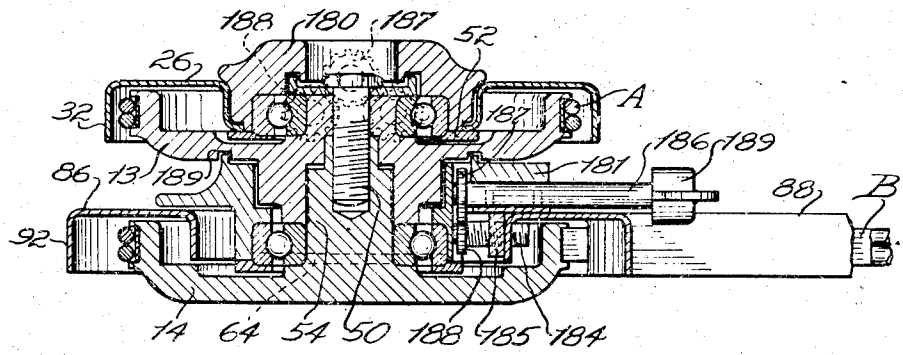


FIG. 23

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June 27, 1939. C. H. LITTLE 2,164,216

DRAFTING MACHINE

Original Filed Feb. 15, 1936 6 Sheets-Sheet 6

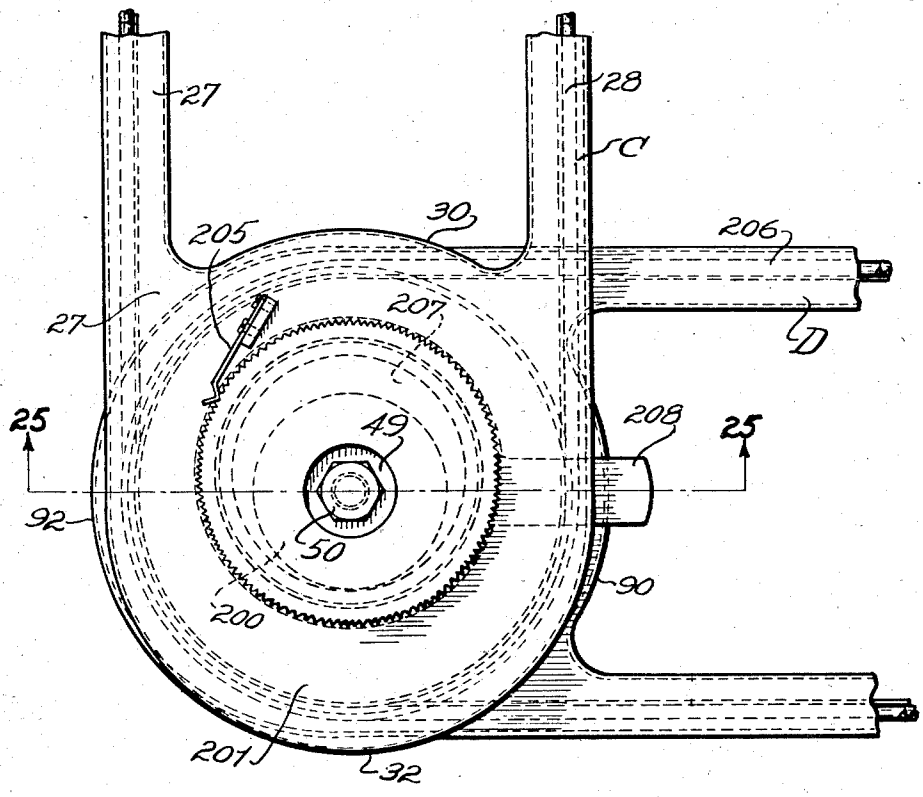


FIG. 24

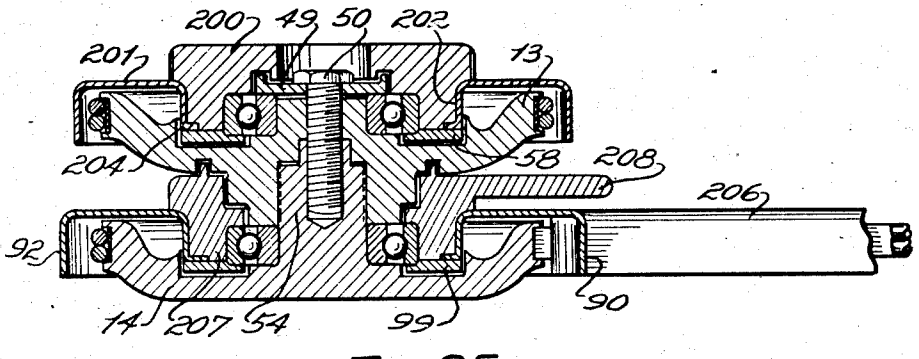


FIG. 25

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Patented June 27, 1939

2,164,216

UNITED STATES PATENT OFFICE

2,164,216

DRAFTING MACHINE

Charles H. Little, Cleveland Heights, Ohio, assignor of one-tenth to Charles Hubbard Little, Cleveland Heights, Ohio

Application February 15, 1936, Serial No. 64,139
Renewed May 12, 1939

15 Claims. (Cl. 33—79)

The present invention relates to drafting machines, and more particularly to drafting machines having the parallel motion arm or mechanism of the wheel and band type, wherein the parallel motion mechanism consists of a plurality of parallelograms comprising wheels operatively connected by flexible bands.

An object of the present invention is the provision of a novel drafting machine of the wheel and band type having struts which will not bend sidewise under the stresses to which they are subject in operation, and form covers for the top and outside of the bands but are open at the bottom, thereby being free of any tendency to collect and retain dirt, and facilitating assembly and adjustment of the band, etc.

Another object of the invention is the provision of a novel drafting machine of the wheel and band type having struts comprising end sections to which the wheels are operatively connected and side rods open at the bottom but enclosing the top and outside of the bands. The side rods are preferably formed integral with the end sections and have outside flanges which are continuous with outside flanges on the end sections thereby entirely surrounding the band on its outside.

Another object of the invention is the provision of a drafting machine of the wheel and band type provided with struts of novel construction wherein the operating center to center distances of the wheel can be readily adjusted.

Another object of the present invention is the provision of a novel drafting machine of the wheel and band type having an improved construction at the elbow of the arm.

Another object of the present invention is the provision of a novel drafting machine of the wheel and band type comprising means for adjusting both the length of the bands and the center to center operating distance of the wheels.

Another object of the invention is the provision of a novel drafting machine of the wheel and band type having a strut comprising an end section to which one of the wheels is adjustably connected, and side rods covering the bands, in combination with a band including a turnbuckle link for adjusting the length thereof, and operative connections between the bands and the side rods for preventing rotation of the band when the turnbuckle link is turned.

Another object of the present invention is the provision of a drafting machine of the wheel and band type provided with a parallel motion mechanism or arm provided with means for adjusting the operating center to center distances of the wheels for the purpose of tightening the band, etc., which, will be light in weight, rigid in construction, and inexpensive to manufacture, and wherein the struts of the respective parallograms are for the most part one-piece members preferably made of sheet metal or the like.

Another object of the invention is the provision of a novel anchor for attaching a drafting machine to a drawing board or table, which can be applied to boards of different thickness, readily adjusted along the upper edge of the board from the draftsman's position at the front thereof, and is not dependent upon the rear edge of the board for alignment as it is moved therealong.

Another object of the invention is the provision of a novel protractor assembly comprising a holding plate, a ruler assembly rotatably supported coaxial with said protractor ring, a protractor ring fixed to said ruler assembly, and a dead line mark carried by a member adjustable about the periphery of said holding plate, whereby the dead line mark may be set at any desired angle and the subsequent readings determined therefrom.

Another object of the invention is the provision of a novel protractor assembly comprising a ruler assembly adapted to rotate 360° and having means for quick settings of the rulers at the usual angles in each of the four quadrants of the protractor.

The present invention resides in certain novel details of construction, combinations and arrangements of parts, and further objects and advantages thereof will be apparent from the following description of the preferred embodiment thereof, described with reference to the accompanying drawings forming a part of this specification, in which similar reference characters designate corresponding parts throughout the several views, and in which:

Fig. 1 is a plan of a drafting machine embodying the present invention.

Fig. 2 is an enlarged plan of the anchor end of the drafting machine shown in Fig. 1.

Fig. 3 is a perspective view on the line 3—3 of Fig. 2.

Fig. 4 is a section on the line 4—4 of Fig. 2, with portions in elevation.

Fig. 5 is an enlarged plan of the elbow portion of the parallel motion arm of the drafting machine shown in Fig. 1.

Fig. 6 is a fragmental section on the line 6—6 of Fig. 5, with portions in elevation.

Fig. 7 is a section on the line 7—7 of Fig. 5, with portions in elevation.

Fig. 8 is a section on the line 8—8 of Fig. 5.

Fig. 9 is a plan of the strut shown in Figs. 1 to 8.

Fig. 10 is an enlarged plan of the protractor end of the drafting machine shown in Fig. 1.

Fig. 11 is a section on the line 11—11 of Fig. 10.

Fig. 12 is a section on the line 12—12 of Fig. 10.

Fig. 13 is a section on the line 13—13 of Fig. 10.

Fig. 14 is a section on the line 14—14 of Fig. 10.

Figs. 15 to 21 inclusive, are perspective views similar to Fig. 3 but showing side rods of modified construction.

Fig. 22 is a plan similar to Fig. 5 but showing a modified construction.

Fig. 23 is a section on the line 23—23 of Fig. 22.

Fig. 24 is a plan similar to Figs. 5 and 22 but showing a further modified construction, and

Fig. 25 is a section on the line 25—25 of Fig. 24.

The drafting machines herein illustrated and described are the preferred embodiments of the invention, but it is to be understood that they are only illustrative of the invention which can be otherwise embodied, and I do not wish to be limited to the particular construction shown.

Briefly stated, the drafting machine shown comprises a parallel motion mechanism or arm provided at one end with an anchor for attachment to a drawing board or table, and at the other end with a protractor assembly including rulers, etc. The parallel motion mechanism or arm consists of two parallelograms comprising flexible bands, designated generally by the reference characters A and B, encircling grooved wheels 12 and 13, and 14 and 15, respectively, of equal diameter and held apart or in spaced relation by frame members or struts C and D. The flexible bands which encircle the wheels may be of any desired construction. Preferably they are similar in construction to the bands disclosed in my copending application Serial No. 64,141 filed of even date herewith, and comprise flat steel bands 16 encircled by cable bands 17, and include take-ups in the nature of turnbuckle links 18 for adjusting the length thereof and equalizers 20 at opposite ends of the take-ups for equalizing the tension between the flat band 16 and the cable band 17. Another construction of band suitable for the present purpose wherein the single cable band encircling each flat band twice is replaced by two separate cable bands, is disclosed in my copending application, Serial No. 44,747, filed October 12, 1935.

The upper wheel 12 of the anchor parallelogram is formed integral with the anchor designated generally by the reference character E adapted to be detachably secured or clamped to the upper or rear edge of the drafting board 19 or the like, in a manner hereinafter more fully pointed out. The strut C which holds the wheel 12 in spaced relation to the wheel 12 is made in two parts 21 and 22 adjustable relative to each other for the purpose of adjusting the operating center to center distance of the wheels 12 and 13. The member 21 is preferably stamped from sheet metal and comprises two disk-like end sections 25 and 26 connected by channel-shaped side rods 27 and 28 of inverted U-shaped cross-section formed integral therewith. The inside flanges of the rods continue around the inside of the disk-like end sections forming thereon flanges 29 and 30, respectively, and the outside flanges of the rods continue around the ends of the strut forming outside flanges 31 and 32 on the end sections 25 and 26, respectively. The construction of the strut C may be varied from that shown as will be apparent to those skilled in the art, and the rods 27 and 28 may be of different cross-sectional shape, as suggested by Figs. 15 to 21, hereinafter specifically referred to.

The upper end of the strut C is pivotally connected, concentric with the wheel 12, to a cylindrical projection or member 34 formed integral with the anchor, through the medium of an anti-friction bearing comprising balls 35 retained between inside and outside races 36 and 37, respectively. The inside race is forced onto the member 34 and secured thereto by a plate 38 attached to the upper end of the member by a screw 39. The outside race 37 is positioned within an aperture in the disk-like end section 25 of the strut and defined by a flange 40 formed integral therewith, and is retained therein between a casting 41 bolted to the upper side of the strut by screws threaded into a ring 42 engaging the underside of the strut and an inwardly projecting flange 43 formed integral with the flange 40.

For the purpose of adjusting the tension of the band in the event that no take-ups are directly employed therein, or for supplementing the adjustment obtained by said take-ups if employed, the wheel 13 is supported in the strut C in such a manner that its axis of rotation can be moved lengthwise thereof. For this purpose the disk-like end 26 of the strut is provided with a rectangular aperture 44 within which the wheel 13 is rotatably supported and moved lengthwise of the strut through the medium of the member 22. The hub 45 of the wheel 13 is formed integral therewith and is rotatably supported in the member 22 by anti-friction bearings comprising balls 46 retained between inside and outside races 47 and 48, respectively. The inside race 47 is fixed to the hub 45 and retained in position thereon by a disk-like member 49 secured to the end of the hub 45 by a bolt 50 accessible through an aperture 51 in the member 22. The outside race 48 is located in a counterbore in the underside of the member 22 and retained in position therein by a ring-like member 52 secured to the member 22 by screws 53. The bolt 50 extends through an aperture in the wheel 13 and is threaded into the hub 54 of the wheel 14, which hub projects into a cylindrical counterbore in the lower side of the wheel 13. An upwardly projecting annular flange 55 formed about the periphery of the member 49 and projecting into an annular groove 56 in the underside of the member 22 excludes dirt from the bearing.

The member 22 is slidably supported in the aperture 44 by inwardly projecting flanges 63, formed integral with a downwardly projecting internal flange 64 and extending longitudinally of the strut along both sides of the aperture 44, which flanges engage in grooves formed by undercut portions of the member 22 and the ring-like member 52. The upper end of the member 22, as viewed in Fig. 5, projects in the direction of the anchor beyond the disk-like end section 26 and has a downwardly projecting flange 66 formed integral with its upper end. The entire assembly at the elbow of the arm including the wheels 13 and 14, and the member 22, etc., is adapted to be adjusted lengthwise of the strut by a screw 67 rotatably supported in the projection 66 and threaded into a plate 68 secured to the flange 30 by a plurality of screws 69 extending through an external plate 70 and the flange 30 and threaded into tapped apertures

in the plate 68. The screw 67 is provided with a flange against which the projection 66 abuts, and a hexagonal head or the like, to facilitate manipulation thereof. In order to help guide the member 22 and make the structure more rigid the external plate 70 is provided with projections 71 which overhang finished portions 72 of the member 22, see Fig. 8.

In the event that the entire weight of the arm and protractor assembly is carried from the anchor it is desirable to strengthen the strut C of the anchor parallelogram in some suitable manner. As shown the rods 27 and 28 are connected intermediate their ends by a cross member 74 which, in turn, is pivotally connected by a rod 75 to the upper end of a projection 76 on a casting 41 secured to the disk-like end section 25 of the strut above the wheel 12. A knurled nut 79 threaded on the lower end of the rod 75 provides means for adjusting the length thereof. If desired the bearing of the anchor can be raised above the center line of the band and the strut thereby stressed in a manner to reduce the sag at the elbow, as more fully pointed out in my aforesaid application Serial No. 64,141.

As previously stated the left hand wheel 14 of the protractor parallelogram has a cylindrical hub 54 formed integral therewith which projects into a suitable aperture in the lower side of the wheel 13 and within which it is secured by the screw 50. The protractor strut D is similar in construction to the anchor strut C and comprises a member 85 preferably formed from sheet metal consisting of two disk-like end sections 86 and 87 connected by channel-shaped side rods 88 and 89 of inverted U-shape cross-section formed integral therewith. The inside flanges of the rods continue around the inside of the disk-like end sections forming flanges 90 and 91 thereon, and the outside flanges of the rods continue around the ends of the strut forming outside flanges 92 and 93 on the disk-like end sections 86 and 87, respectively. The left hand end of the strut D is provided with an aperture similar to the aperture 44 defined by a flange 94 and is pivotally connected concentric with the wheel 14 through the medium of a member 95, preferably made of cast metal, slidably attached to the member 85 in a manner similar to that in which the member 22 is slidably attached to the member 21. The member 95 is rotatably supported about the hub of the wheel 14 through the medium of an anti-friction bearing comprising balls 96 retained between inside and outside races 97 and 98, respectively. The inside race 97 is positioned on the hub 54 and retained in position thereon by the wheel 13 and the outside race 98 is secured within a counterbore in the underside of the member 95 by a ring-like member 99 secured to the member 95 by a plurality of screws. The member 95 can be readily adjusted or moved relative to the member 88 by a screw 100 rotatably supported in a downwardly extending flange 101 on the member 95 and having threaded engagement in a plate 102 fixed to the flange 90. A cooperating annular tongue and groove formed on the adjacent sides of the member 95 and the wheel 13 excludes dirt, etc., from the bearing.

The wheel 15 is provided with an upwardly extending tubular hub 105 of relatively large diameter formed integral therewith and through the medium of which the wheel is rotatably supported in the right hand disk-like end section 87 of the strut D by an anti-friction bearing comprising balls 106 retained between inside and outside races 107 and 108, respectively. The inside race 107 is forced onto the tubular hub 105 of the wheel and retained thereon by a holding or wheel plate 110 threaded on the upper end of the hub 105 and, in turn, retained in position thereon by a lock screw 111. The outside race 108 is secured within a downwardly extending flange 112 formed integral with the disk-like end section 87 between an inwardly projecting flange 113 on the lower end of the flange 112 and a ring-shaped member 114 secured to the upper side of the member 87 and projecting slightly over the race. A downwardly extending annular flange 115 on the underside of the holding or wheel plate 110 which just clears the periphery of the member 114 cooperates therewith to exclude dirt from the bearing.

The protractor assembly comprises the disk-like plate 110 previously referred to, and which is herein referred to as the wheel or holding plate fixed to the hub 105 of the wheel 15 above the strut D, and a protractor plate 120 located above the holding plate, fixed to the upper end of a short shaft 121 of large diameter rotatably secured within the hub of the wheel 15 by the protractor plate attached to the upper end thereof and a ruler plate 122 secured to the lower end by screws 123. The protractor plate 120 is provided with the usual graduations which in the the present instance extend 360° around the same, and has a plate 125 secured to the underside thereof by screws 126. The plate 125 has apertures 127 therein at the 0°, 30°, 45° and 60° reading of the protractor in each of the four quadrants to facilitate setting the rulers, in any quadrant, at the most common angles. The arms 128 and 129 forming part of the ruler plate carry horizontal and vertical rulers 130 and 131, respectively, of conventional construction detachably connected thereto in any well known manner. A third arm 132 extending in a direction opposite to that of the other arms and provided with a foot member 133 provides a steady support for the protractor assembly. A hand grasp 134 secured to the upper surface of the protractor plate serves the usual purpose.

A pawl 140 adapted to engage in apertures 127 of the plate 125 is carried by a movable segment designated generally by the reference character F, comprising upper and lower plates 141 and 142, respectively, the former of which carries a dead line mark 143 with or without a vernier, and projects over the edge of the protractor plate 120, while the latter projects underneath the holding plate 110 which is of substantially the same diameter as the protractor plate. The plate 141 is undercut on its inner periphery and projects over the rim of the protractor plate, which is of reduced thickness but slightly greater in depth than the undercut in the plate 141 for a purpose hereinafter referred to. The construction is such that the upper surfaces of the protractor plate 120 and the plate or member 141 are substantially flush. The lower plate 142 is adapted to be clamped to the holding or wheel plate 110 by clamp washers or members 146 positioned between the plates 141 and 142 adjacent opposite ends thereof. The external ends of each of the clamp members 146 have a downwardly projecting flange which engages the upper surface of the plate 142 and about which they fulcrum, and the internal ends overlie the periphery of the wheel or holding plate. The clamp members 146 are operated to clamp the holding plate 110 against the plate 142, or in

other words, between the plate 142 and the members 146, by knurled nuts 147 threaded on the upper ends of screws 148 fixed to the plate 142 and projecting upward through the clamp members and the plate 141. The plate 141 is cut away adjacent the screws 148 leaving sufficient clearance for the reduced lower part of the nuts 147 to project therethrough and engage the clamp members 146. The clearance between the plate 141 and the nuts 147 is a minimum, since the upper plate 141 is held in assembled relation to the other members, in part by these nuts, which permit a limited movement thereof without at any time interfering with the free operation of the device.

The lower plate 142 has an arcuate projection 150 on the upper surface thereof which engages in an annular groove 151 formed in the underside of the holding plate 110 and holds the plate 142 and, in turn, the segment F in assembled position with reference to the wheel or holding plate 110, when the nuts 147 are loosened to permit angular movement of the sector about the periphery of the protractor and holding plates. Upon tightening the knurled nuts 147, the periphery of the plate 110 is securely clamped between the inner end of the clamp members and the plate 142 and the movable segment F secured in the position about the periphery of the plate 110 to which it has been moved or adjusted.

With the segment F secured in position the rulers can be clamped in any desired angular position by a winged nut 155 threaded on the upper end of a screw 156 fixed in the under plate 142, and projecting through the plate 141. The winged nut 155 engages the upper surface of the plate 141 and clamps the periphery of the protractor plate 120 between the latter and a spacer member or washer 157 interposed between the plates 141 and 142 surrounding the screw 156. As previously stated, the flange on the protractor plate 120 over which the plate 141 projects is thicker than the cut-out portion of the plate 141, which gives sufficient clearance between the plate 141 and the spacer member 157 to effect the clamping action.

The rulers are normally held in such a position with reference to the protractor plate that the zero mark on the protractor coincides with the dead line on the segment F and can be readily set in the other positions at which the apertures 127 are formed in the plate 125 by the pawl 140. The pawl 140 which projects between the holding plate 110 and the protractor plate 120 is formed integral with an operating lever 161, and pivotally supported in the movable segment F between the plates 141 and 142 by a ball pivot comprising a ball 162 interposed between the pawl 140 and the plate 141. The operating lever 161 extends across the top of the plate 141 and is continuously urged in an upward direction to maintain the ball pivot tight and take up wear, etc., by a U-shaped compression leaf spring 160, one leg of which is attached to the operating lever 161 by screws 164, while the other leg engages the upper surface of the plate 141. The pawl is continuously urged in a counter-clockwise direction, as viewed in Fig. 10, by a leaf spring 165, one end of which is attached to the outside of the operating lever 161, where it bends around the plate 141, while the other end engages the periphery of the plates 141 and 142.

As previously stated, the struts may be of any desired shape and this is especially true of the side rods. Preferably these side rods are open at the bottom so that they will not collect and retain dirt and are of such shape that they will cover the bands and partly, if not wholly enclose the same, thereby protecting the draftsman from being cut by the sharp edges of the band, getting caught between the band and other parts of the machine, or by the band flying, should the same break under the high tension to which it is subject. In the preferred embodiment illustrated the side rods are inverted U-shaped channel sections, and other forms are shown in Figs. 15 to 21 inclusive.

Fig. 15 shows a side rod 170 of inverted rectangular channel shape open at the bottom and having the edges thereof bent upwards to reinforce the same. A side rod 171 having a section substantially that of an angle iron positioned so as to extend over the top and outside of the band is shown in Fig. 16. This construction is quite satisfactory from the standpoint of protecting the operator, since the band is most apt to fly outwardly upon breaking. The side rod 172 shown in Fig. 17 is similar to that shown in Fig. 16, except that the sides thereof are both bent inwardly. Fig. 18 shows a side rod adapted to completely enclose the band, and comprising an inverted U-shaped channel 173 having a U-shaped closure 174 for the bottom adapted to be pressed or snapped into position between the sides of the channel 173 and retained therein by spring pressure. The adjacent sides of the channel members 173 and 174 may be formed to provide cooperating tongues and grooves to better retain the parts in assembled relation. The closure 174 as shown in Fig. 18, extends the entire length of the side rod, but substantially the same effect can be obtained by merely closing the channel at spaced intervals as illustrated in Fig. 19, which shows a side rod 175 of inverted U-shaped channel section provided with a small clip or member 176 positioned across the open part of the channel. Side rods of cylindrical section are shown in Figs. 20 and 21. As shown in Fig. 20, the side rod 177 is open at the bottom along its entire length which permits the band to be readily assembled or replaced. In Fig. 21 the opening in the side rod 178 is shown in the lower side but facing upwardly. Other forms of side rods will suggest themselves to those skilled in the art, and the present invention is not limited to the specific constructions shown.

It will be apparent to those skilled in the art to which the present invention relates, that the manipulation of a take-up in the nature of a turn-buckle link located in one side of the band only will result in an angular shifting of the rulers but that the tension in the band can be adjusted by moving the wheel lengthwise of the strut without this effect. I have found it desirable to have both adjustments in a single machine. On some occasions an angular adjustment of the rulers is necessary, while on other occasions a mere tightening of the bands is required. In any event a take-up directly in the band is desired for initially tightening the same when first assembled with the wheels, since the movement of the wheel lengthwise of the strut and in turn the amount of take-up obtained thereby is more or less limited in practical constructions where a compact, light arm is required.

A specific construction of arm comprising means for adjusting the operating center to center distance of the wheels has already been described in detail with reference to the preferred embodiment of the invention illustrated in Figs. 1 to 14 inclusive. A modification of the preferred

embodiment heretofore referred to is shown in Figs. 22 and 23, wherein the duplicate parts are designated by the same reference characters. In the present instance the castings 180 and 181 which correspond to the castings 22 and 95 in the preferred embodiment are similar in construction to the castings 22 and 95 with the exception that they do not extend as far towards the other end of the strut, and are slidably supported in the disk-like end sections of the struts in a like manner. The principal difference between the two constructions resides in the means for moving or adjusting the casting lengthwise of the strut. As shown in Figs. 22 and 23, this means comprises two short screws 184, one end of each of which is rotatably supported in a cut-out portion of the casting, while the other ends have threaded engagement with nuts 185 fixed to the flange 64. The screws 184 are adapted to be rotated in either direction for the purpose of adjusting the length of the strut by a short shaft 186 rotatably supported in the casting and provided with a gear wheel 187 on the inner end thereof continuously in mesh with two gears 188 formed integral with the screws 184. A knurled or winged grasp 189 is provided at the outer end of the shaft 186 for manual operation thereof. The castings 180 and 181 are alike with the exception that the sides of the under one are built out to accommodate an annular tongue 189 which projects into a groove in the underside of the wheel 13 and cooperates therewith to exclude dirt from the bearing.

Another modification of the construction heretofore referred to is shown in Figs. 24 and 25. As shown in these figures the wheel assembly at the elbow of the arm including the wheels 13 and 14, etc. is supported in the lower end of the anchor strut by a disk-like or cylindrical member 200 rotatably supported in the strut 201 eccentric to the bearing or, in other words, the counterbore within which the outside race of the bearing is located. The strut 201 is similar to the strut C previously described with the exception that the rectangular aperture 44 in the strut C is replaced by a cylindrical aperture defined by a downwardly extending annular flange 202 eccentric to the bearing. The member 200 is retained in the aperture in the strut by an inwardly projecting flange 204 formed integral with the flange 202 and engaged between an undercut portion of the member 200 and the ring member 58. The periphery of the member 200 is knurled or has a plurality of small V-shaped grooves therein which both afford a better grip in adjusting the same and cooperate with a spring ratchet 205 carried by the strut to maintain the member in any adjusted position.

The protractor strut 206 which is similar in construction to the strut 201 is rotatably supported coaxial with the wheel 13 by a member 207 similar to the member 200 rotatably secured within the aperture in the strut eccentric to the bearing. The member 207 is provided with a handle 208 for adjusting the same and a cooperating annular tongue and groove on the member 207 and the wheel 13 excludes dirt, etc., from the bearing. With this construction of arm it is especially desirable to employ bands including take-ups located directly therein since only a limited amount of adjustment can be obtained in the strut.

The present invention also contemplates the provision of an anchor that can be readily adjusted along the upper edge of the board without the draftsman leaving his position at the front, and one which does not take its alignment from the rear edge of the board. The preferred embodiment of anchor, see Figs. 2 and 4, comprises an L-shaped bracket 210 adapted to engage over the upper and rear edges of the board 19. The upper flange of the bracket 210 is provided intermediate its ends with a projection 212 with which the wheel 12 may be formed integral, as shown, or separate and connected thereto. The rear flange engages the rear edge of a rectangular plate 213 connected to the board 19 by two screws 214, one at either end of the plate which project slightly beyond the rear edge of the board for a purpose hereinafter apparent. The rear wall of the bracket 210 has two projections 215 formed integral therewith, provided with rectangular apertures 217 within which clamp members 218 are retained for limited movement. Each of the clamp members includes a bottom arm 220 which projects underneath the board 19 and engages or is hooked over the front edge of the plate 213, and a top arm 221 which projects over the bracket 210 at an angle of about 30° to the working surface of the board. Each of the arms 221 is provided with a thumb screw 222, one of which is preferably threaded left hand instead of right, and the lower end of which engages in cylindrical holes in the bracket 210. The construction is such that as the thumb screws 222 are tightened the bracket 210 is drawn against both the upper side of the board 19 and the rear edge of the plate 213, and in so doing the machine is securely attached to the board and automatically aligned with the rear edge of the plate 213. Since the plate 213 is secured to the board 19 at its ends only it will not be distorted by changes in the board, and as the anchor is moved to different positions along the upper edge of the board the machine will always be aligned with the undistorted rear edge of the plate 213 instead of with the rear edge of the board which is liable to change from time to time.

In adjusting the anchor along the upper edge of the board it will be obvious from the construction shown that the draftsman need not leave his position at the front of the board since the thumb screws 222 project above the board and are readily accessible from the front. After the screws 222 have been turned to release the clamp they can be used as handles for shifting the anchor which makes the operation very simple and reduces the time required to a minimum.

From the foregoing description of the preferred embodiments of the invention, it will be apparent that the objects of the invention have been accomplished and that a novel drafting machine of the wheel and band type has been provided wherein the bands are covered in a manner to present a finished appearance and protect the operator or draftsman against injury therefrom. Provision has been made for readily adjusting the drafting machine along the upper edge of the board and novel means provided for adjusting the tension in the bands, etc. The ruler assembly can be rotated 360° and quick settings obtained at the usual angles in each of the four quadrants of the protractor. In addition the dead line from which the protractor readings are determined can be adjusted to any desired position about the protractor since the same is carried on a floating segment.

Numerous changes in the construction in addition to those already referred to will be apparent to those skilled in the art to which the invention

relates, and it is my intention to cover all variations, adaptations, and uses thereof that come within the practice of those skilled in the art, and I particularly point out and claim as my invention the following:

1. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and a strut operatively connected to said wheels for maintaining the same in spaced relation, said strut comprising a member including end sections overlying said wheels and connected by a pair of side rods partially enclosing said band and having an opening along one side.

2. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut operatively connected to said wheels, said strut comprising a member having end portions overlying said wheels, a member connected to one of said end portions for adjustment longitudinally of the strut, and means for connecting one of said wheels to said last mentioned member.

3. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and a strut operatively connected to said wheels for maintaining the same in spaced relation, said strut comprising a member including end sections connected by a pair of side rods of inverted U-shaped section.

4. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut pivotally connected to said wheels for maintaining the same in spaced relation, said strut comprising: a member overlying one of said wheels, a second member slidably supported by said member, one of said wheels being pivotally connected to said second member, and screw means for producing relative movement between said members.

5. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut rotatably connected to said wheels for maintaining the same in spaced relation, said strut comprising: a member overlying one of said wheels, a second member slidably supported by said member, one of said wheels being rotatably connected to said second member, and a screw located between said wheels in the plane of the band for producing relative linear movement between said members.

6. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut pivotally connected to said wheels for maintaining the same in spaced relation, said strut comprising: a member overlying one of said wheels, a second member slidably supported by said member, one of said wheels being pivotally connected to said second member, and a screw located within the circumference of the last mentioned wheel for producing relative linear movement between said members.

7. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut rotatably connected to said wheels for maintaining the same in spaced relation, said strut comprising: a member overlying one of said wheels, a second member slidably supported by said member, one of said wheels being rotatably connected to said second member, a plurality of screws for producing relative movement between said members, and means for simultaneously rotating said screws.

8. A drafting machine comprising a plurality of wheels, a flexible band encircling said wheels, and an adjustable strut rotatably connected to said wheels, said strut comprising a member having an end section overlying one of said wheels and a second member rotatably supported in said end section and operatively connected to said wheel, the relative rotation between said member and said wheel being about an axis eccentric to the axis about which said member is rotatably supported in said end section.

9. A drafting machine comprising an anchor adapted to be attached to a drafting board or the like, a wheel fixed to said anchor, a strut including disk-like end sections connected by side members or rods and a member adjustably connected to one of said disk-like end sections, means for rotatably supporting one end of said strut concentric with said wheel, a second wheel, means for rotatably supporting said second wheel in the other end of said strut, a flexible band encircling said wheels, a third wheel fixed to said second wheel, a second strut including disk-like end sections connected by side members or rods and a member adjustably connected to one of said disk-like end sections, means for rotatably supporting one end of said second strut concentric with said third wheel, a fourth wheel, means for rotatably supporting said fourth wheel in the other end of said second strut, and a ruler assembly operatively connected to said fourth wheel.

10. An anchor for a drafting machine comprising a bracket, means for detachably securing said bracket to a drafting board, said means comprising a member on the upper side of said anchor accessible from the draftsman's position at the board for operating said means.

11. An anchor for a drafting machine comprising a bracket, means for detachably securing said bracket to a drafting board so that the anchor can be readily adjusted along the upper or rear edge thereof, said means comprising a member extending above the working surface of said board and accessible from the draftsman's position at the front of the board for operating said means.

12. An anchor for a drafting machine comprising a bracket, means for detachably clamping said bracket to the upper or rear edge of a drafting board, said means comprising a screw located above the working surface of the board and positioned at an angle thereto for drawing the anchor against the upper and rear surfaces of the board.

13. In a device of the character referred to the combination of a drafting board, a metal plate secured at the ends thereof to the underside of said board adjacent the rear edge thereof, a drafting machine comprising an anchor adapted to be detachably connected to said board and adjustable to different positions along the rear edge thereof, said anchor comprising a member adapted to engage the upper surface of said board and the rear edge of said plate, and a clamp adapted to engage said plate and force said member into engagement with both the upper surface of said board and the rear edge of said plate.

14. In a drafting machine the combination of a parallel motion arm, a holding plate operatively connected to one end of said arm, a ruler assembly rotatably supported in the same end of said arm, a protractor plate fixed to said ruler assembly, and a member carried by the periphery of said holding plate and adjustable angularly

about the periphery of said protractor and having a dead line mark thereon.

15. In a drafting machine the combination of a parallel motion arm, a holding plate operatively connected to one end of said arm, a ruler assembly rotatably supported in the same end of said arm, a protractor plate fixed to said ruler assembly, a member carried by said holding plate and adjustable angularly about the periphery of said protractor plate and provided with a dead line mark, said protractor plate having a plurality of apertures therein, and a manually operable pawl carried by said member for engaging in said apertures.

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