July 28, 1936. C. H. LITTLE 2,049,302

PROTRACTOR

Original Filed April 1, 1931 4 Sheets-Sheet 1

Fig. 1.

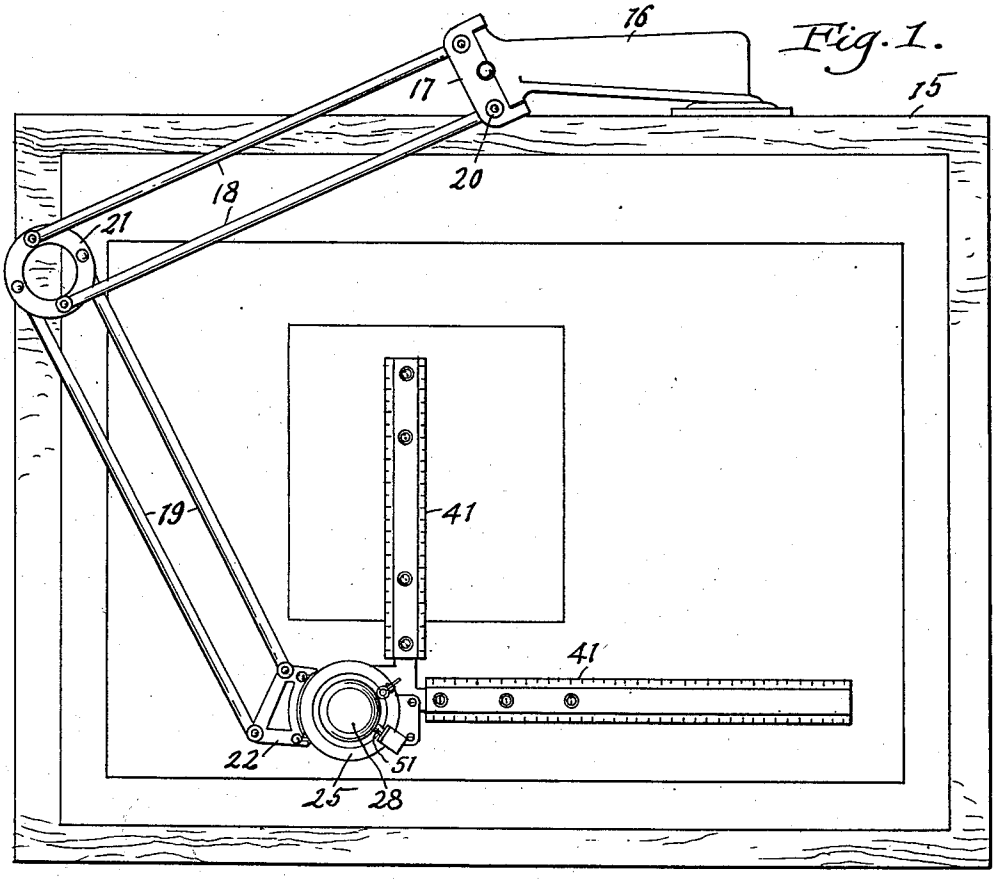


Fig. 6.

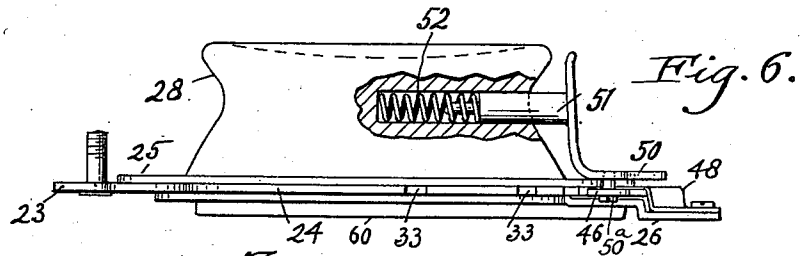


Fig. 7.

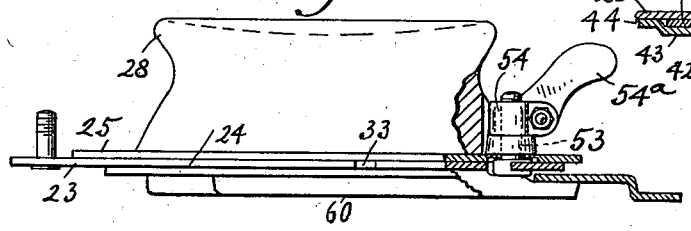
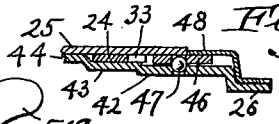


Fig. 8.



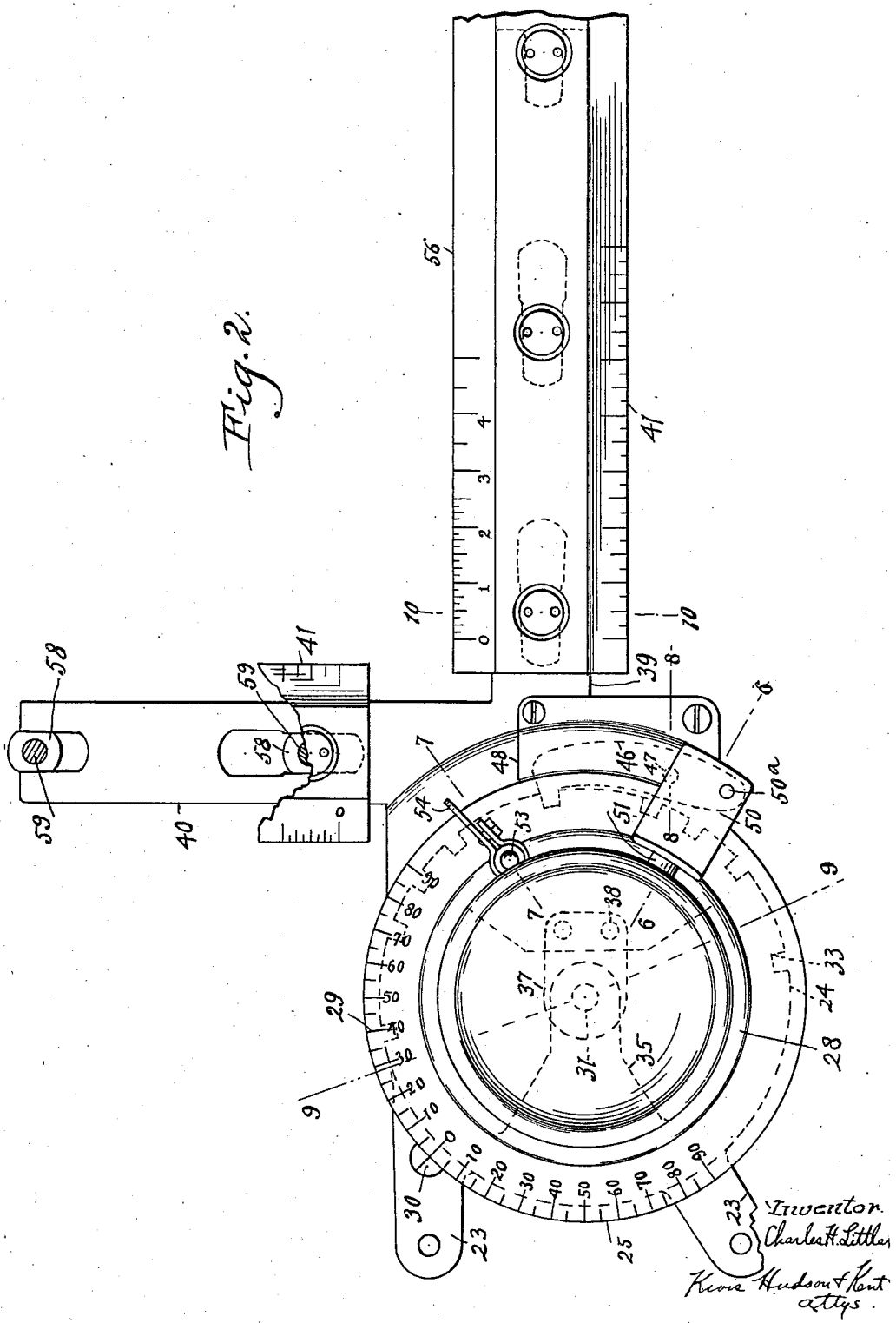
Inventor:
Charles H. Little
Rines Hudson & Kent
attys.

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Fig. 2.



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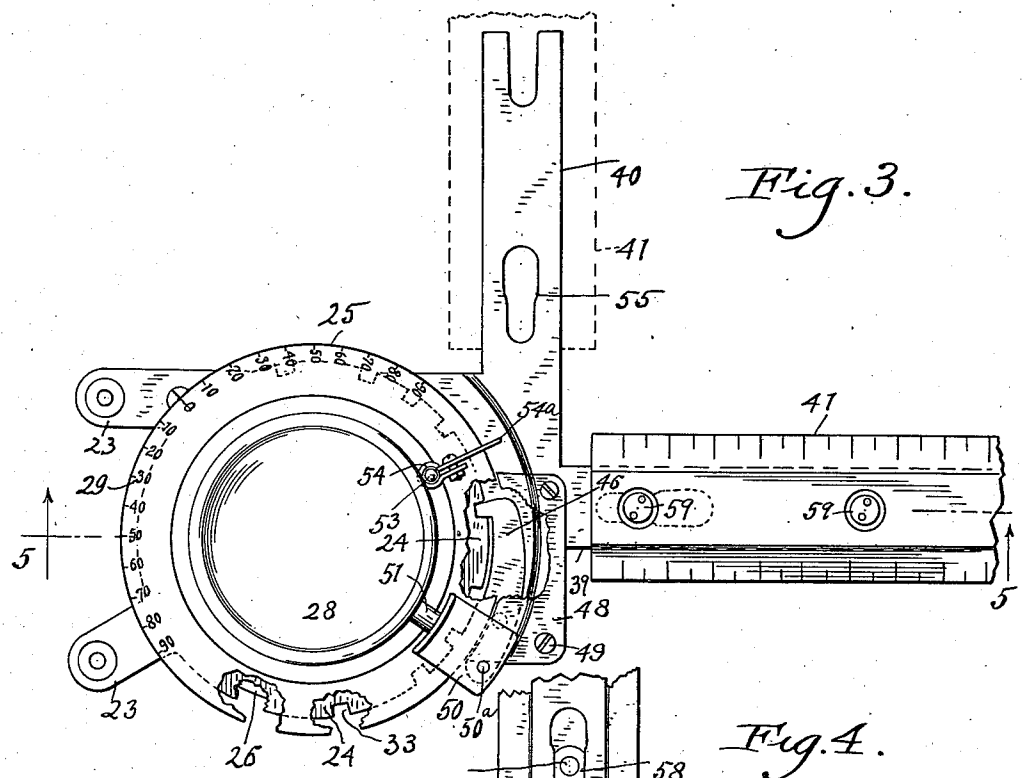


Fig. 3.

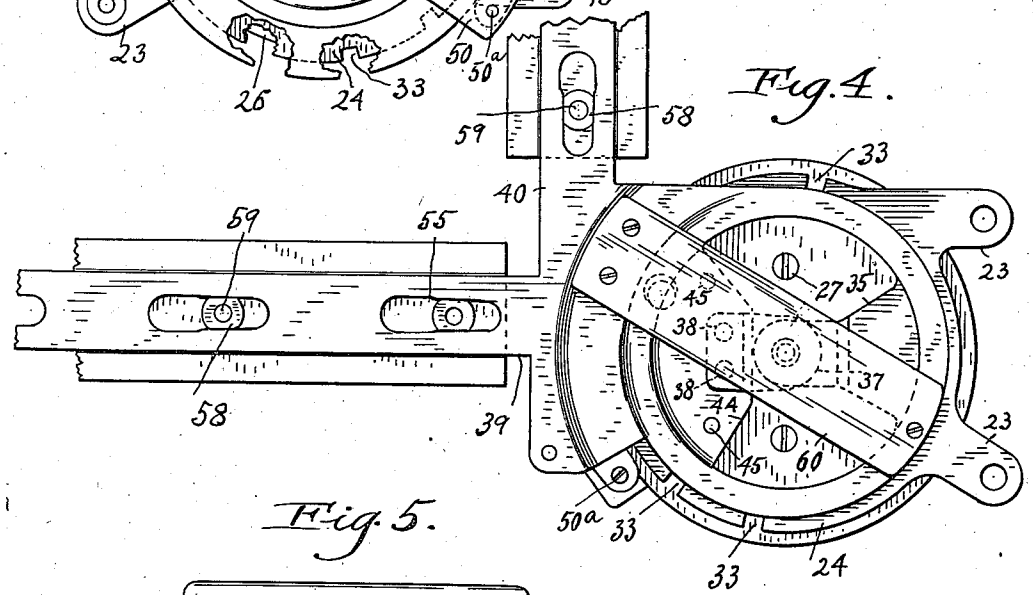
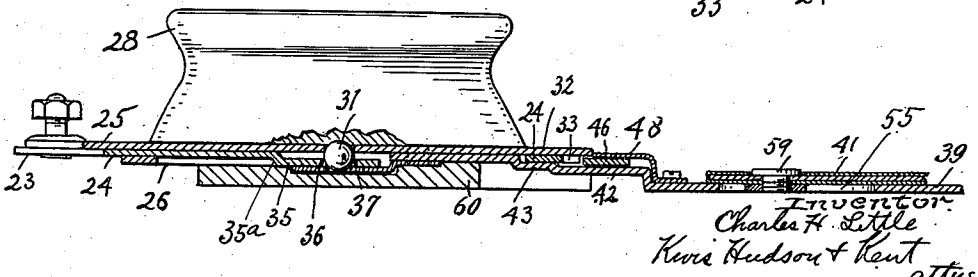


Fig. 4.

Fig. 5.



Inventor
Charles H. Little
Kerr Hudson & Kent
attys.

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Fig. 11.

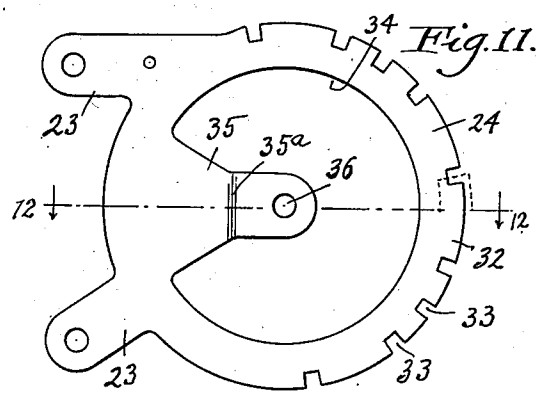


Fig. 13.

Fig. 12.

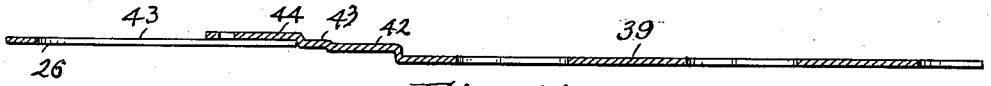


Fig. 14.

Fig. 9.

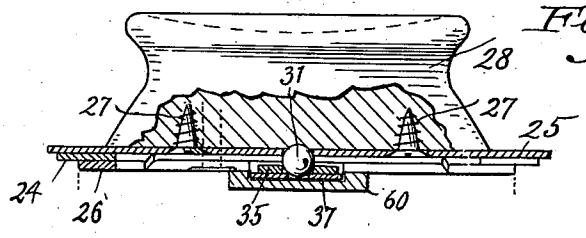


Fig. 10.

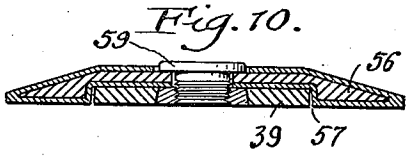
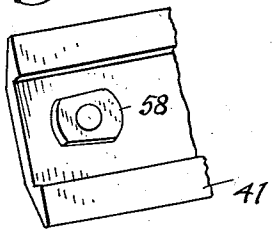


Fig. 10a



Inventor
Charles H. Little
Kerr Hudson & Kent
attys

Patented July 28, 1936 2,049,302

UNITED STATES PATENT OFFICE

2,049,302

PROTRACTOR

Charles H. Little, Cleveland Heights, Ohio

Application April 1, 1931, Serial No. 526,912
Renewed January 3, 1936

20 Claims. (Cl. 33—79)

This invention relates to protractors and especially to a drafting instrument consisting of a protractor with provision for receiving and holding rulers which are rotatable as a unit with the protractor plate.

The invention finds particular utility in a protractor which is connected to a drawing board with a suitable parallel motion mechanism such as that composed of a pair of parallelograms or of the jointed arm type known as Universal drafting machines covered by numerous patents heretofore granted to me, among which I might mention Patent No. 1,208,340, granted Dec. 12, 1916. The invention, however, is not necessarily confined in its use in connection with a parallel motion mechanism particularly of the kind referred to.

The principal objects of the present invention are to provide improved ruler holding facilities, greater rigidity and accuracy, greater convenience in operation, a simpler and less expensive instrument to manufacture, reduced number of parts, decreased weight, improved appearance, and automatic take-up for wear between certain of the parts.

The above and other objects are attained by the present invention, an embodiment of which is illustrated in the accompanying sheets of drawings which, for convenience in explaining the construction and advantages of my improved protractor, show the latter applied to a drafting machine of the Universal type.

In the drawings,

Figure 1 is a plan view of a drafting machine of the Universal type applied to a drawing board;

Fig. 2 is an enlarged plan view of the protractor showing portions of two rulers applied thereto in their usual right angle relationship;

Fig. 3 is a view similar to Fig. 2 on a smaller scale and with parts broken away;

Fig. 4 is a bottom view of the protractor;

Fig. 5 is a sectional view substantially along the line 5—5 of Fig. 3;

Fig. 6 is a side view of the protractor with parts broken away substantially along the line 6—6 of Fig. 2;

Fig. 7 is a similar view with parts in section taken substantially along the line 7—7 of Fig. 2;

Fig. 8 is a detail sectional view substantially along the line 8—8 of Fig. 2;

Fig. 9 is a transvese sectional view substantially along the line 9—9 of Fig. 2;

Fig. 10 is a transverse sectional view through one of the rulers and through one of the two or more chucks carried by the ruler as well as through the corresponding chuck arm of the protractor at the chucking point. For convenience, the section may be assumed to be taken along line 10—10 of Fig. 2.

Fig. 10*a* is a perspective view of the under side of a short section of one of the rulers;

Fig. 11 is a detached view of a notched plate which, for convenience, will be termed the holding plate, to the center of which the protractor plate has a ball pivot connection;

Fig. 12 is a sectional view taken substantially along the line 12—12 of Fig. 11;

Fig. 13 is a detached view of a chuck arm plate which, as will be explained, is attached to the protractor plate and turns as a unit therewith; and

Fig. 14 is a sectional view taken substantially along the line 14—14 of Fig. 13.

As above stated, I have illustrated my invention in the protractor applied to a drafting machine of the Universal type, this being illustrated in Fig. 1, wherein the drawing board is designated 15. The machine is secured to the board by means of an anchor 16 here shown as a mid-anchor, but, of course, any suitable anchor may be employed. As is customary in machines of this type, the jointed arm is attached to the anchor through the medium of an anchor plate 17 which, in this instance, is pivoted to the anchor to swing about an axis of about 60° with the top edge of the drawing board. The upper parallelogram includes the two parallel rods 18 and the lower parallelogram includes the two parallel rods 19. The anchor plate 17, which is detachably connected with the anchor 16, forms the connecting member for the upper parallelogram, the rods 18 being pivoted thereto. At the joint between the two pairs of parallel rods, an annulus 21 is provided to which the adjacent ends of the two pairs of rods are pivoted and the lower ends of the rods 19 are pivoted to a plate 22 which is an extension of and is secured to arms 23 on the notched holding plate 24, shown in Figs. 4 and 11.

The protractor includes three principal members which are stamped from sheet metal. These consist of the protractor plate 25 which is a circular disk (see particularly Figs. 2 and 9), the chuck arm plate 26 (see Fig. 13), and the holding plate 24 (Fig. 11). In the assembled protractor, the protractor plate 25 and the chuck arm plate 26 turn as a unit and receive between them the holding plate 24. In order that the protractor plate and associated chuck arm plate may be turned conveniently, the protractor plate has se-

cured to it centrally thereof by screws 27 a wooden handle 28, the protractor plate having at its periphery graduations 29 which cooperate with an indicating line on a member 30 secured to the holding plate, the member 30 being in engagement with the periphery of the protractor plate. The protractor plate, or rather the unit composed of the protractor plate and the chuck arm plate, is pivoted for rotary movement and accurately centered with respect to the holding plate 24 by a ball pivot 31 which is best illustrated in Fig. 9. The manner in which this ball is supported and the parts held in proper relationship will be referred to presently.

Taking up next the holding plate 24 (Fig. 11) it will be observed that the major portion of it is in the form of an annulus 32 with notches 33 at the outer periphery thereof for engagement with the nose of a ratchet pawl which is adapted to position the protractor plate in the angles most commonly used. Inside this annulus there is an annular opening 34 of somewhat less than 360° in extent, the continuity of this annular opening being interrupted by an inwardly extending arm 35 on the holding plate, the sides of the arm being tapered or inwardly convergent and the inner portion of this arm being offset downwardly somewhat, as indicated at 35a in Fig. 12 and being provided at the center of the holding plate with a beveled opening 36 into which the pivoting ball 31 is seated. This ball also engages in a beveled opening at the center of the protractor plate (see Fig. 9) which lies immediately above the holding plate and at its periphery projects outwardly beyond the annular portion of the holding plate so as to completely cover and conceal the notches 33. The portions of the protractor plate and holding plate which engage the ball are held in close but practically frictionless engagement with the ball by a spring plate 37 (see particularly Figs. 4 and 5) which projects from a portion of the chuck arm plate and engages under the inner end of the arm 35 of the holding plate and presses the same upwardly against the pivoting ball 31 and keeps the latter closely seated in beveled seats of the protractor plate and holding plate. While I regard it as within the invention to make this spring plate a part of the chuck arm plate, it is in this instance a separate member secured to a portion thereof by screws 38.

Taking up next the construction of the chuck arm plate, it will be observed that this plate and the chuck arms are in one unitary stamping which may be formed of stainless steel, this being, to the best of my knowledge, the first instance wherein the two chuck arms for an instrument of this kind are formed integrally of one piece. As will be observed from Fig. 13, the two chuck arms 39 and 40 are, as usual, at right angles to each other, these two chuck arms being adapted to receive rulers 41 and to hold them in their right-angular relationship in a very novel manner to be explained presently. One of the chuck arms is, in this instance, longer than the other inasmuch as it is customary that what is termed the horizontal ruler, i. e., the one held by the chuck arm 39, be longer than what is commonly called the vertical ruler which is held by the chuck arm 40. The two chuck arms and the portions of the plate or stamping adjacent thereto lie in one plane and the bottom surfaces of these arms and the portion referred to may engage the drawing paper held on the board 15, but preferably they are very slightly above the lower surfaces of the rulers and therefore slightly above the drawing paper.

Next to the portion of the chuck arm plate which engages the drawing paper, as just explained, there is an arc-shaped upwardly offset portion 42, this being close to and, in fact, extending under the peripheral portions of the protractor plate and of the holding plate 24 and constituting a support for the ratchet pawl (to be referred to presently) which cooperates with the notches 33 of the holding plate. Next to the upwardly offset portion 42 there is a substantially annular upwardly offset portion 43 which engages the under surface of the holding plate 24 inwardly somewhat of the periphery of the latter, this portion in the assembled protractor being concentric with respect to the center or pivotal axis of the protractor plate. Inwardly of the upwardly offset portion 43 there is a third upwardly offset portion 44 which extends inwardly of the annulus 43 in the form of an arm having tapered sides and embracing in circumferential extent slightly more than 90° of the inner periphery of the annular portion 43. The upper surface of this upwardly offset portion 44 of the chuck arm plate lies flat against the lower side of the protractor plate and it is secured thereto by screws 45. It is to this portion 44 of the protractor plate that the spring plate 37 is secured by the screws 38, this spring plate virtually forming an offset extension of the portion 44 of the chuck arm plate.

Thus it will be seen that the chuck arm plate, through the medium of the portion 44 thereof, engages the protector plate for a substantial extent with the engaging portions firmly secured together so as to secure these two plates together so that they will turn as a unit. At the same time there is obtained by the offsetting described, a bearing by the inner annular portion 43 on the lower side of the holding plate, the amount of the offsetting between the parts 43 and 44 being equal substantially to the thickness of the holding plate so that the protractor plate and the chuck arm plate receive the holding plate between them with a close fit but nevertheless one which allows the desired freedom of movement of the protractor plate and chuck arm plate unit. By this construction, assisted by the centralizing and holding action of the pivoting ball, the assembly has a high degree of rigidity, all loose play is eliminated, and no relative movement permitted except the desired rotary movement of the protractor plate and chuck plate arm about the vertical axis of the ball pivot. Obviously also the number of parts is reduced to a minimum.

An additional advantage of the ball pivot forming the center and axis of rotation of the protractor plate on the notched holding plate lies in the fact that it greatly facilitates obtaining proper centers, i. e., bringing the protractor plate and holding plate in true central relationship with respect to each other. Should the beveled ball seat in either plate be out of alignment even the slightest extent, it can be brought into exact alignment by applying a fine reamer to one of the beveled seats and slightly crowding it toward the side where the metal is to be removed. This gives a method of obtaining true centers between plates having notches at certain angles and the graduated protractor plate. The greatest difficulty would be experienced in centering these two plates, i. e., in centering the notches and gradu-

ations with any other kind of a pivot, such as a pin pivot. It is to be noted further that the inwardly extending portion **44** of the chuck arm plate and the inwardly extending arm **35** are in the same plane except for the offset inner end of the arm **35**. Notwithstanding the fact that these portions of the two plates are in the same plane, by tapering their opposite sides as illustrated, the bases or relatively wide portions of these two inwardly extending parts are sufficient in their circumferential extent to give the required rigidity, and at the same time, when the protractor is in zero position shown in Figs. 3 and 4, the oppositely disposed openings or spaces between the inwardly projecting parts **44** and **35** (see Fig. 4) are somewhat more than 90° and consequently the protractor can be turned or rotated through somewhat more than 90° in both directions from zero position, the protractor being preferably graduated through an arc of 180°.

Taking up next the ratchet pawl and its support, it will be noted that the first upwardly offset arc-shaped portion **42** (Figs. 13 and 14) has mounted on it the ratchet pawl **46**, the pawl extending somewhat circumferentially of the protractor plate and its nose being adapted to snap into any one of the peripheral notches **33** of the holding plate, the thickness of the ratchet pawl being such that it will have freedom of movement on the portion **42** of the chuck holding plate beneath the protractor plate so that its nose may snap into any one of these notches. It is a feature of the present invention that this ratchet plate has a ball pivot **47** on the portion **42** of the chuck arm plate (see Fig. 8), the ball engaging beveled openings in the ratchet pawl and in the plate. Special attention is called to the fact that the offsetting in the chuck arm plate is such as to provide between the lower surface of the protractor plate and offset portion **47** of the chuck arm plate (see Fig. 8) a space sufficient to accommodate the pawl **46** with an additional space below the pawl to accommodate the ball pivot, as clearly illustrated in the figure just referred to. A spring plate **48**, which is secured by screws **49** to the upper face of that portion of the chuck arm plate which is just inwardly of the chuck arms and in the same plane therewith, constitutes a cover for the ratchet pawl and bears thereon so as to hold the pawl and the portion of the chuck arm plate to which it is pivoted to the ball **47** in their proper relationship. A thumb-piece **50** is attached to the end of the pawl at **50a** just beyond the spring plate **48** and extends inwardly over the protractor plate parallel thereto and upwardly and has near its upper end a plunger-like extension **51** extending into a cylindrical recess formed in the handle **28** into engagement with a coil spring **52** seated therein (see Fig. 6). This spring, therefore, acts on the ratchet pawl so as to press the nose thereof toward the notched edge of the holding plate **24** and enables the nose of the pawl to snap into the notches when the protractor plate is rotated. It is to be noted that the thumb-piece is offset from the line of the chuck arm **39** and therefore from the longer scale or ruler which is normally the horizontal ruler. This arrangement I find adds much to the convenience of the operator in manipulating the thumb-piece with his hand which engages the handle **28**, i. e., with his hand on the top of the handle and his thumb on this offset thumb-piece, he can readily release the pawl from the notched holding plate and turn the protractor to the desired extent.

I regard the ball pivot for the ratchet pawl as important over an ordinary pin pivot inasmuch as it automatically takes up for wear and through the medium of the overlying spring plate the parts are held closely together but still with the desired freedom of movement so far as the pawl is concerned irrespective of wear. Also with this type of pivot, together with the action of the spring plate, the ball and pawl may yield slightly with a shock absorbing function in the event that the protractor is thrown around or rotated too fast and too roughly, thus reducing the likelihood of injury.

As before stated, the notches are so located that when the pawl snaps into them the protractor will be held at the angles most commonly employed, such as 0°, 30°, 45°, 60°, etc. When the protractor is positioned at some other or intermediate angle and drafting work is done at that angle, it is desirable that the protractor plate be clamped in that position. For this purpose I employ a type of clamp previously used by me but arranged in a new way. In this instance the clamp consists of a stud **53** with a slot at its lower end and with a threaded shank engaged by a nut **54** having a wing **54a** conveniently located for manipulation by one of the fingers of the operator's hand engaging the handle. The slot at the lower end of the stud in this instance engages the inner unnotched periphery of the annular portion of the holding plate **32** (note particularly Fig. 7). That is to say, this holding plate has an annular portion which lies immediately under the protractor plate and the outer periphery of this holding plate is notched to receive the nose of the ratchet pawl and the inner periphery smooth so that it may be engaged by the clamp. It will be understood, of course, that when the operator turns the wing of the nut so as to screw the nut down the protractor is clamped and when the wing is turned in the reverse direction it is released. A movement of a few degrees of the clamp nut is sufficient to clamp the protractor in place or to release it.

I will next explain one of the most important features of the invention, i. e., a new way of chucking the rulers and the construction of both the chuck arms and rulers by which this is brought about. As protractors, particularly of drafting machines, have heretofore been constructed, the chuck arms themselves were elevated from the drawing paper about the thickness of the rulers and the rulers were provided on their top surface at each end with a chuck which slid into a chuck receiving groove formed on the under side of the chuck arm, each chuck bearing at three points in the groove of the chuck arm. In this instance, the chucking is done on the lower side of the rulers instead of on the upper side as heretofore, the rulers having channels on their lower surface for this purpose, and each ruler has two or more individual chucks lying in the channel and adapted to engage in suitably shaped chuck receiving slots of the chuck arm. While chucking on the lower side of the rulers is important and desirable, the use of two or more independent chucks at each end of the ruler can be used to advantage with chucking at the top. While the length of the chuck arms and the number of chuck receiving slots and the corresponding number of chucks on the rulers may be anything desired, i. e., two or more chuck receiving slots in each chuck arm and a corresponding number of chucks on the ruler engageable with the arm, I prefer to provide three

chuck receiving slots 55 in the relatively long chuck arm 39 and two such slots in the relatively short arm 40, these slots being elongated slots on the center lines of the chuck arms and extending transversely therethrough. The slots 55 have tapered sides (Fig. 13), their narrower ends being preferably toward the protractor, and, as shown in Fig. 10, the inner side walls of the slots are somewhat undercut or tapered, i. e., the slots on the under side of the chuck arms are somewhat wider than on the top side. As only the narrower portions of the slots, i. e., the portions nearer the protractor, are engaged by the chucks carried by the rulers when the latter are in clamping engagement with the chuck arms, the outermost slot in each arm need not be a full slot as is indicated in Fig. 13. With the chuck receiving slots formed as described, a novel form of ruler is employed. The construction of the ruler per se is not claimed herein but forms the subject matter of a companion application Serial No. 526,913 filed of even date herewith and hence only a brief description of the ruler will be given but the combination of the novelly constructed chuck arms with the channeled rulers carrying individual chucks on their under channeled side form important parts of the present invention.

By reference to Fig. 10 it will be seen that the ruler has a metal core 56 and this metal core is wholly encased in a non-metallic covering, such as celluloid or pyralin, which is molded around the core by heat and pressure in the manner described in my Patent No. 1,728,420. On the under side of the ruler there is a channel 57 which in width is more than half the total width of the ruler and which has slightly tapered sides. The cross-sectional shape of the channel corresponds substantially to the cross-sectional shape of the chuck arm and when the chuck arm is fitted into the channel it substantially fills the same, the lower side of the chuck arm then being flush with or slightly above the lower surface of the ruler which engages the drawing paper. It will be understood that the non-metallic covering covers the lower channeled side as well as the other portions of the ruler.

Each ruler is provided centrally of the channeled side with a plurality of chucks 58 the number of which corresponds to the number of chuck receiving slots in the chuck arm which is to receive the ruler, it being understood that one of these chucks is adapted to be received into each of the chuck receiving slots of the chuck arm. These chucks are held up against the under side of the ruler centrally of the channel by screws 59 which engage threaded holes formed in the chucks. These screws pass transversely through the ruler and have at their upper ends heads which fit in openings formed in the non-metallic covering of the ruler. The openings formed in the top surface of the ruler and through the body of the ruler are somewhat larger than the head and threaded shank of the screw so that a limited adjustment of the chuck is possible by first loosening and then tightening the screw after the chuck has been positioned. It should be clear that this adjustment permits the chucks to be moved slightly both laterally and lengthwise of the ruler, in fact universally, and the object is to get a perfect fit between the sides of the chuck and the side walls of the chuck receiving slots in the chuck arms. The opposite sides or edges of the chuck are tapered to conform to the taper in the opposite longitudinal edges of the slots and the edges are slightly beveled to conform to the undercutting of the side walls of the slots. The larger outer ends of these slots are somewhat wider than the chucks so that in chucking the ruler the chucks are placed into the wider portions of the slots and then the ruler is pushed inwardly toward the protractor and this causes the chucks to tightly engage the sides of the slots. With two chucks there are, therefore, four bearing surfaces (instead of three as heretofore) between the two chucks and the chuck arm, and with a ruler having three chucks there will be six such bearing surfaces. It will be understood that if any chuck does not bear equally on the two sides, the proper bearing can be obtained by giving a slight adjustment to the chuck. The chucks preferably have the same thickness as the chuck arms and occupy the full depth of the slots. Obviously this permits the use of thinner and therefore lighter chuck arms than is the case when chucks are employed which slide into grooves which extend only part way through the chuck arms.

As the chucking is done on the under side of the ruler, the upper side is left free, which adds materially to the appearance and convenience in using the rulers of the protractor. The chucking and unchucking is easy to accomplish, and the adjustment, if necessary, can be readily made so that the rulers are in true right-angular relationship, and so that the different chucks will have the same chucking action in the slots of the chuck arms. A further important advantage of this method of chucking lies in the fact that there are more points of engagement between the chucks and rulers and they are distributed farther lengthwise of the rulers, this being particularly true of the longer rulers, resulting in a more secure holding effect and a greater stiffness and less lateral spring, particularly as a result of lateral pressure applied to the ruler near its outer end. The fact that the holding surfaces of the chucks are right at the screws which secure them to the ruler instead of at a distance therefrom obviates bending in the chucks, this bending occurring at times with chucks formerly used. Where the ruler has three chucks engaging the chuck arm, relative bending between the chuck arm and ruler in the space between the innermost and outermost chucks is eliminated because the intermediate chuck makes the chuck arm and ruler act as a unit where the bending stresses are greatest. The use of a plurality of chucks at each end of the ruler has further advantages over a single long chuck as the former are lighter, permitting the use of heavier and more durable metal. As the chuck arms also may be made thinner, the rulers and protractor may both be made lighter when the present invention is utilized.

As before stated, the rulers engage the drawing paper for their full length, and in order that the protractor may have a good bearing on the drawing board beneath the handle and protractor plate, I prefer to secure to the bottom of the protractor unit one or more board engaging members the lower surfaces of which are in the same plane with the board engaging surfaces of the rulers. This is accomplished in this instance by securing to the lower side of the chuck arm plate where it underlies the protractor plate a wooden or other non-metallic strip 60 which is preferably diagonally disposed and recessed where necessary to provide clearance for the spring plate 37, the diagonal disposition being such that when the protractor is moved to and partially beyond the

edges of the paper on the drawing board there is less likelihood that the strip will pass beyond the paper and therefore less likelihood that the edge of the paper will be torn by the protractor in moving it back onto the drawing.

It will thus be seen that the present invention resides in many features of the protractor, including the arrangement and manner of connecting the protractor plate, the holding plate and the chuck arm plate, in the manner of supporting the ratchet pawl, the disposition of the thumb-piece therefor and the manner of supporting it, in the arrangement of the clamp with the inner periphery of the notched plate, in the unitary form of the two chuck arms, and in the shape of the different portions of the chuck arm plate, and in the new method of chucking the rulers, including the means by which the chucking can be accomplished on the lower side of the rulers through the medium of the chuck receiving slots and the separate chucks provided in the ruler channel which receives the chuck arm of the protractor.

While chucking in the channel on the lower side of the ruler as herein explained is highly desirable, nevertheless I do not desire to be confined to that method of chucking. For example, the use of two or more separate and independently adjustable chucks at each end of the ruler is important whether bottom chucking or top chucking is employed. These chucks might be secured on the top side of the ruler with the heads of the screws engaging the top wall of the channel and the chuck arm would extend over the ruler and engage them as before, but, of course with that arrangement only part of the herein-mentioned advantages would be attained as compared with the preferred construction herein described.

It will be seen, therefore, without a repetition of the statement of the advantages, that the objects of the invention enumerated in the early part of the specification are attained by the very novel protractor construction which I have herein illustrated, and while I have shown and described only the preferred construction, it will be understood that modifications may be made in many of the details without departing from the spirit and scope of the invention, and I therefore aim in my claims to cover all such modifications which come within the scope of the invention.

Having thus described my invention, I claim:

1. A protractor comprising a frame, a rotatable protractor plate connected to said frame, a ratchet pawl for holding said protractor in various positions, said pawl being provided with means for automatically taking up wear, and notches provided beneath the protractor plate in said frame for engagement with said pawl.

2. In a protractor, a holding plate notched at various angles, a graduated protractor plate, means for rotatably connecting said plates including a single ball pivot between them, and means supported by said protractor plate for engaging said notches.

3. A protractor comprising a holding plate, a protractor plate above said holding plate, a ball pivot between said plates, a ruler supporting member connected to said protractor plate, and a spring arm on said member extending beneath said holding plate adapted to hold the protractor plate and holding plate in engagement with said ball pivot.

4. A protractor comprising a holding plate with a cut-out portion, a protractor plate above said holding plate and pivoted thereto, and a chuck arm plate beneath the holding plate and having a portion extending into the cut-out portion of the holding plate and secured to the protractor plate.

5. A protractor comprising a holding plate having a substantially annular portion with an arm extending to the center thereof, a protractor plate above the holding plate, a ball pivot between said arm and the center of the protractor plate, and a plate bearing chuck arms below said holding plate and secured to the protractor plate in the opening of the holding plate.

6. A protractor comprising a holding plate having a substantially annular portion with an arm extending to the center thereof, a protractor plate above the holding plate, a ball pivot between said arm and the center of the protractor plate, a plate bearing chuck arms secured to the protractor plate in the opening of the holding plate, and a spring arm connected to said last mentioned plate adapted to hold the protractor plate and arm of the holding plate in engagement with said ball pivot.

7. A protractor comprising a frame, a member rotatably connected to said frame, a handle on said member coaxial therewith, a pawl for holding said rotatable member in different angular positions, and a thumb-piece linearly movable laterally of the axis about which said member rotates, said thumb-piece being operatively connected with said pawl and in engagement with said handle.

8. A protractor comprising a frame, a member rotatably connected to said frame, a plurality of rulers connected to said member, one of said rulers being longer than the other, a handle on said member coaxial therewith, a pawl for holding said rotatable member in different angular positions, a thumb-piece linearly movable in a direction transverse of the longitudinal axis of the long ruler, said thumb-piece having sliding engagement with said handle and being operatively connected to said pawl, and a spring in said handle acting on said thumb-piece.

9. In a drafting instrument, a protractor having a ruler supporting arm provided with a plurality of tapered chuck receiving slots.

10. In a drafting instrument, a protractor having a ruler supporting arm, said arm having a longitudinally extending undercut chuck receiving slot extending therethrough.

11. In a drafting instrument, a protractor having a ruler supporting arm, said arm having a plurality of longitudinally extending undercut chuck receiving slots extending therethrough.

12. In a drafting instrument, the combination of a protractor having a ruler supporting arm, a ruler having a channel adapted to receive the ruler supporting arm, and means for chucking the ruler to the ruler supporting arm, said means comprising a chuck positioned in the channel and secured to the ruler.

13. In a drafting instrument, the combination of a protractor having a ruler supporting arm, a ruler having a channel adapted to receive the ruler supporting arm, and means comprising a plurality of chucks positioned in the channel and adjustably secured to the ruler for chucking the ruler to the ruler supporting arm entirely within the channel.

14. In a drafting instrument, the combination of a protractor having a ruler supporting arm provided with a plurality of chuck receiving slots, a ruler, and a plurality of separate chucks attached to the ruler and adapted to engage in the

slots and act simultaneously in chucking the ruler to the ruler supporting arm.

15. In a drafting instrument, the combination of a protractor provided with a ruler supporting arm having a plurality of chuck receiving slots, a ruler, and a plurality of individually adjustable chucks attached to the ruler adapted to engage in the slots and act simultaneously in chucking the ruler to the ruler supporting arm.

16. A protractor comprising a holding plate provided with a plurality of openings, a member having ruler supporting arms rotatably connected to said holding plate, a ratchet pawl adapted to engage said openings and hold said member in various angular positions, and a single ball pivot for rotatably supporting said pawl in said member.

17. A protractor assembly comprising a frame, a member connected to said frame, a ruler supported by said member, and a rectangular work engaging member having a large surface supported by said frame diagonally with respect to said ruler.

18. In a drafting instrument the combination of a parallel motion arm, a ruler supporting arm operatively connected to said parallel motion arm, a ruler having an aperture therein adapted to receive the ruler supporting arm, and means wholly within said aperture for detachably securing said ruler to said ruler supporting arm.

19. In a drafting instrument the combination of a parallel motion arm, a ruler having a channel therein, a ruler supporting arm operatively connected to said parallel motion arm with the free end thereof positioned in said channel, and a member within said channel and attached to said ruler for connecting said ruler to said ruler supporting arm in tight gripping but separable relation.

20. In a drafting instrument, the combination of a parallel motion arm, a ruler supporting member operatively connected to said parallel motion arm, a ruler member having a channel adapted to receive the ruler supporting member, one of said members having an elongated undercut chuck slot therein, a chuck secured to the other of said members and adapted to engage in said elongated undercut chuck slot in the other of said members.

CHARLES H. LITTLE.