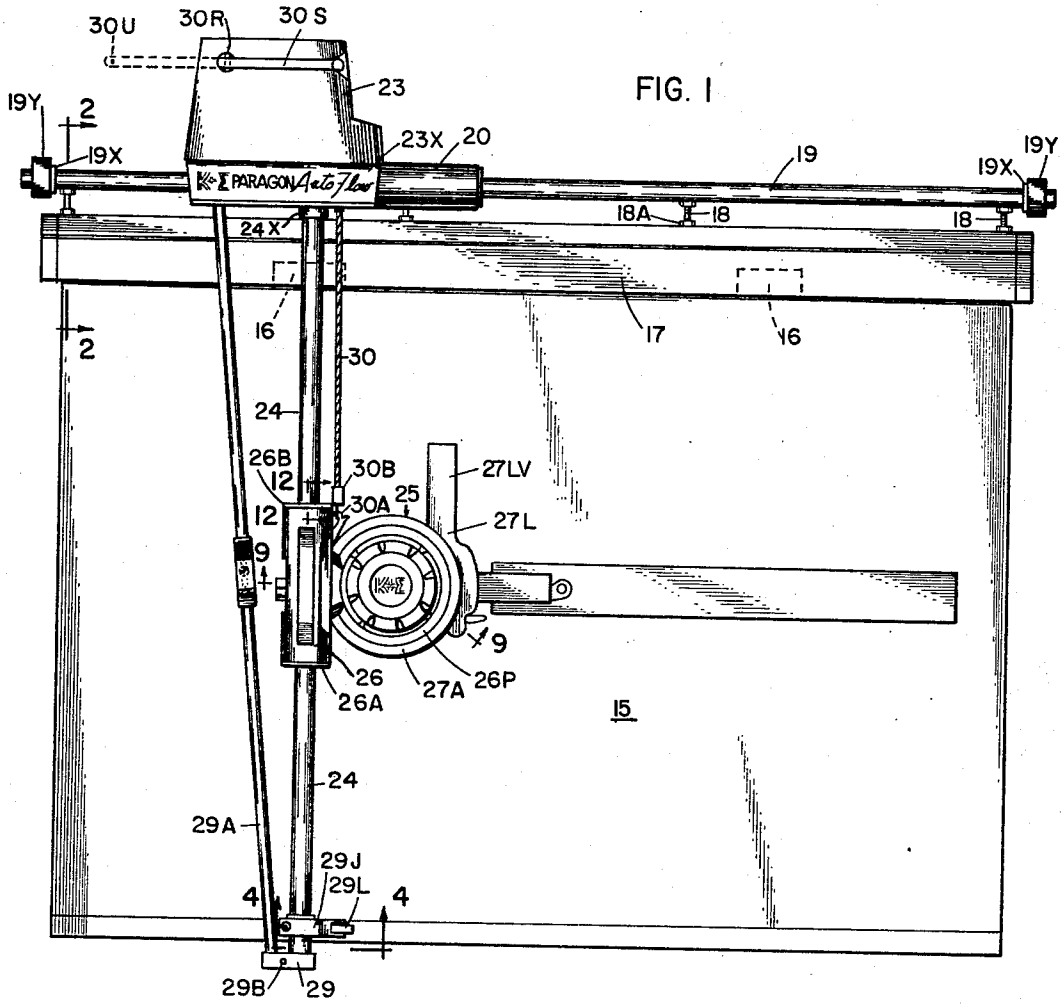
Oct. 18, 1966 M. ARDITO ETAL 3,279,073

DRAFTING MACHINE

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FIG. 1



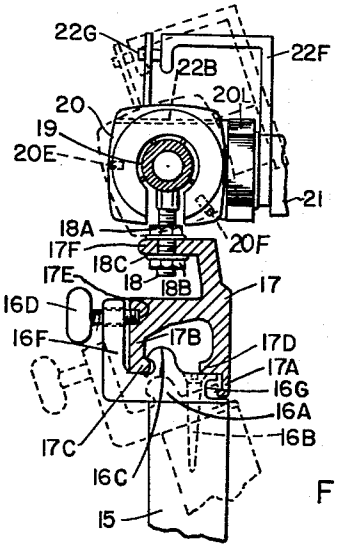


FIG. 2

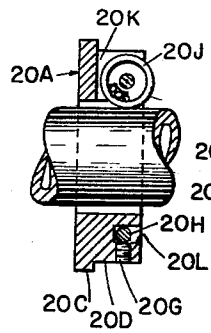


FIG. 8

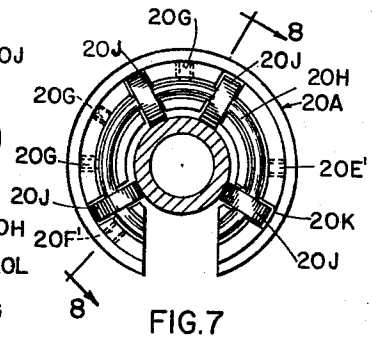


FIG. 7

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DRAFTING MACHINE

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FIG. 3

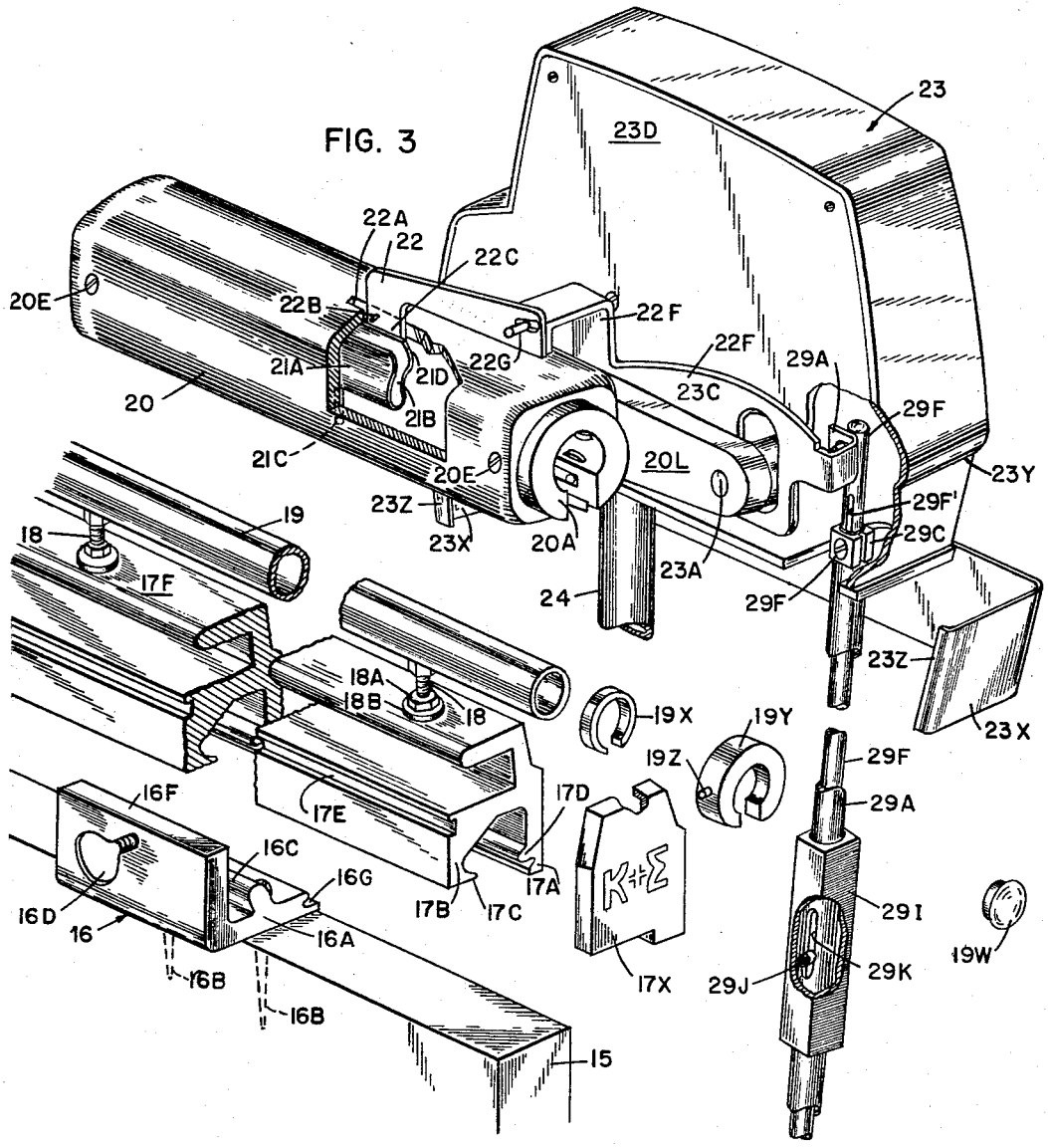
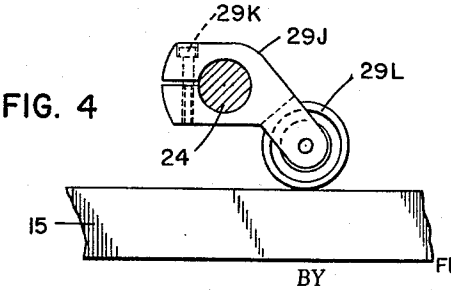


FIG. 4



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DRAFTING MACHINE

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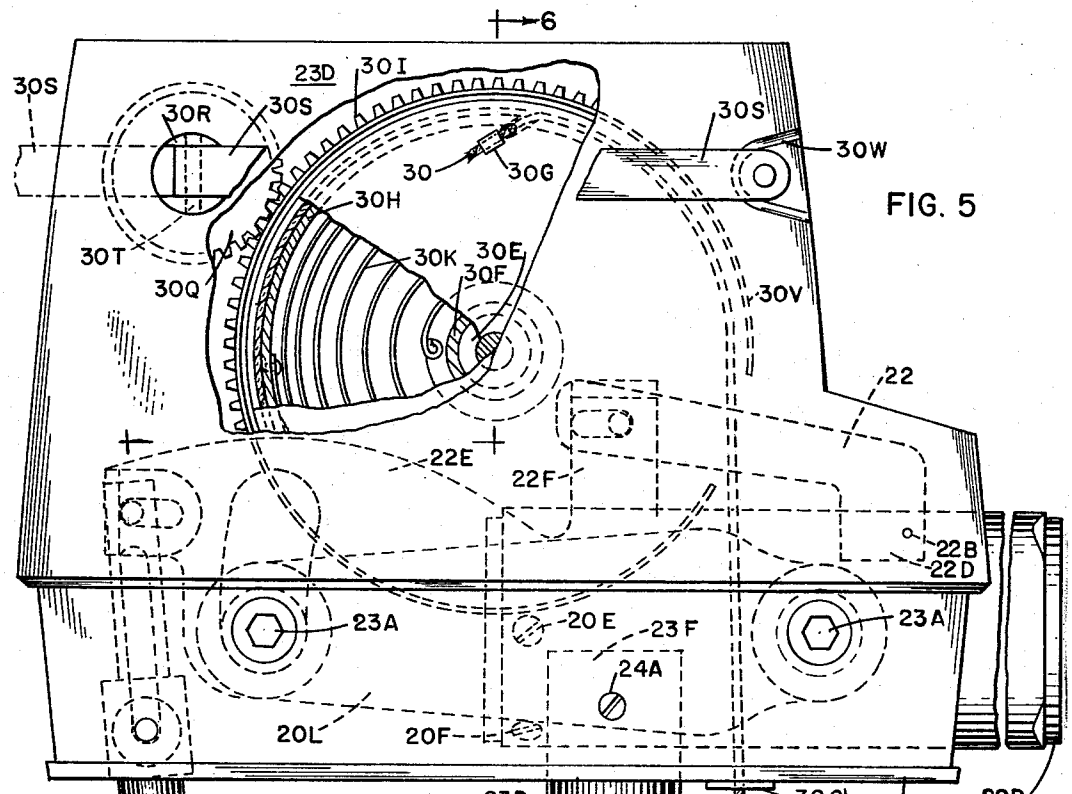


FIG. 5

FIG. 6

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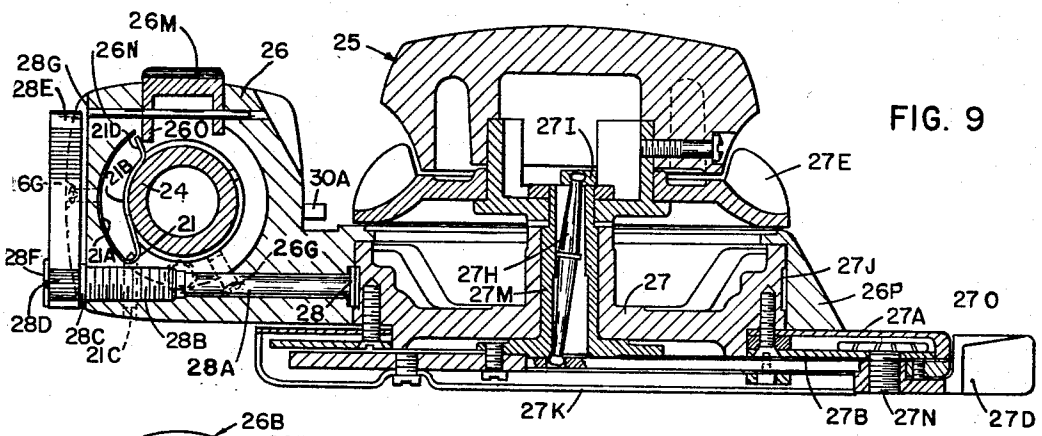


FIG. 9

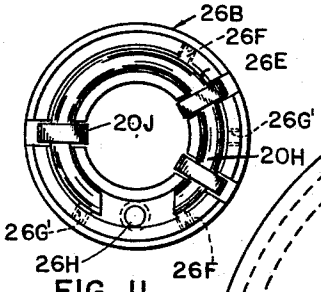


FIG. 11

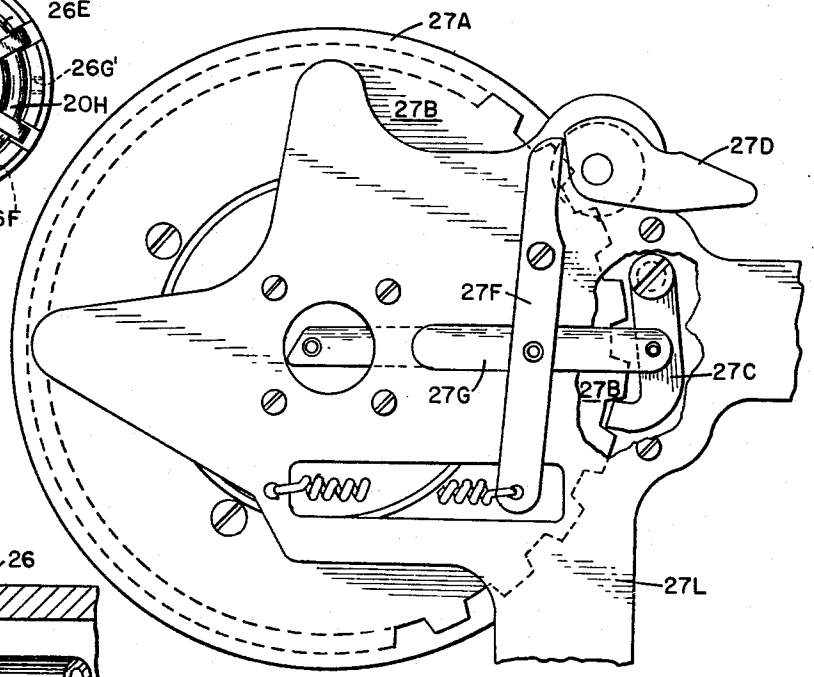


FIG. 10

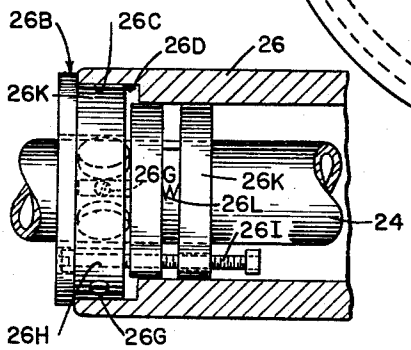


FIG. 12

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United States Patent Office 3,279,073 Patented Oct. 18, 1966

3,279,073

DRAFTING MACHINE

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Filed Nov. 15, 1963, Ser. No. 323,944
20 Claims. (Cl. 33—79)

The present invention relates to a drafting machine of the type described in Baker et al. application Serial No. 43,642 filed July 18, 1960 and more particularly to the type of drafting machine in which a straight line rail is mounted adjacent the top edge of the board on which a first carriage is movable in rectilinear motion and extending from the first carriage is a second rail perpendicular to the first rail on which second rail a second carriage is movable in rectilinear motion. The second carriage carries the line guiding ruling edges and a protractor with suitable controls therefor.

In the prior art drafting machines of this type it has been difficult to get the carriage guide rails in accurate straight alignment because of the flexibility and warping of the drawing board and the supports. It has also required a high degree of mechanical skill to correctly mount prior art drafting machines. The prior drafting machines have not been universally adaptable for vertically or horizontally positioned drawing boards and boards at intermediate angles as the bearing supports have been subject to non-uniform forces in the different positions and the counterbalancing structure has not been easily adjustable. Also the vertical movement has been unduly free making it difficult to accurately position the drawing head.

An object of the present invention is to provide a drafting machine which overcomes these problems.

A further object is to provide a drafting machine which can be mounted in accurate working position on a drafting board without requiring special skills.

Another object is to provide accurate guided and substantially frictionless movement for a drafting head of a drafting machine.

Another object is to provide a counterbalance means to counteract gravitational forces on the drafting head for all angular adjustments of a drafting board.

A further object is to provide friction means for controlling the force required to move the drafting head.

Another object is to provide clamping means for adjustably fixing the base line adjustment of the drafting head while permitting observation of a maximum portion of the protractor.

Other and further objects will be apparent as the description proceeds and upon reference to the accompanying drawings wherein:

FIG. 1 is a plan or elevational view of the drafting machine of the present invention mounted on a horizontally or vertically positioned drawing board showing a two bracket mounting system providing the sole means for removable and sliding attachment to the drawing board and showing an F-shaped beam mounted on the brackets and fixed to a trolley rail by studs providing with the rail a composite continuous beam.

FIG. 2 is a left end view of one bracket on a fragment of a vertically positioned drawing board and showing the F-shaped beam and trolley rail in section and showing the relative positions of the horizontally movable carriage and the trolley rail.

FIG. 3 is a fragmentary isometric exploded view from the back of a fragment of a drawing board showing one mounting bracket on the upper edge of the drawing board and showing the composite cooperating trolley rail and support beam and the horizontally movable carriage with parts broken away illustrating the brake operating mechanism in brake applying condition.

FIG. 4 is a detail of the guide roller adjustably secured to the free end of the second or vertical guide rail.

FIG. 5 is a front elevation of the horizontally movable carriage with the name plate band removed and with parts broken away showing the adjustable counter balancing arrangement and showing the lever and linkage mechanism for operating the horizontally movable carriage brake in locked condition.

FIG. 6 is a section taken generally along broken line 6—6 of FIG. 5 showing the frictional adjustment for the counterbalance control, and showing the brake operating mechanism in brake applying or locked condition.

FIG. 7 is a detail of the left end bearing arrangement of the horizontally movable carriage as viewed from the inside of the C-shaped sleeve showing the four ball bearing supported rollers engaging the trolley rail.

FIG. 8 is a section taken substantially on line 8—8 of FIG. 7 showing the means for attaching the ball bearing rollers to the bearing head.

FIG. 9 is a section through the drafting head and the vertical rail taken substantially on line 9—9 of FIG. 1 showing the novel clamping arrangement for the baseline adjustment of the protractor and also showing the brake locking the drafting head on the vertical rail.

FIG. 10 is a fragmentary bottom plan view of part of the mechanism of the drafting head with the bottom skid plate cover removed illustrating the releasing and clamping mechanism providing for intermediate adjustments of angles between the 15 degree positive notch adjustments.

FIG. 11 is a view from the inside of the upper bearing head for the second or drafting head carriage.

FIG. 12 is a fragmentary section taken substantially on line 12—12 of FIG. 1 showing the friction means bearing against the ball bearing supported rollers of the upper bearing head of the drafting head carriage.

Briefly the present invention provides for simple mounting of the drafting machine to the top edge of a drawing board by the use of two brackets attached to the top edge and supporting a reinforcing beam which carries a first or trolley rail with the beam and the trolley rail providing a rigid beam and guide structure on which a first carriage is horizontally rectilinearly movable.

Accurately supported from the horizontally movable carriage is a second guide rail extending perpendicular to said first rail and carrying a second carriage on which a drafting head is mounted for accurate rectilinear movement therealong. A separate brake is provided to lock each carriage in any desired fixed position, the controls for the brakes being closely adjacent the drafting head. The perpendicularly extending guide rail is braced by a diagonally extending tubular brace fixed at one end to the first carriage and fixed at its other end to the lower end of the perpendicularly extending guide rail. A single roller is adjustably secured to the free end portion of the perpendicular guide rail to provide for the accurate positioning of the second or drafting head carriage with respect to the drawing board so the line guiding edges carried by the drafting head will lie in the drawing plane of different sizes of drafting boards. The invention is adapted for use in vertical and horizontal drafting boards as an easily adjustable counterbalancing arrangement and friction producing means permits accurate control of the drafting head.

Referring particularly to the drawings, a drawing board 15 is assumed to be in a vertical plane for the purpose of

description, although it may be in a horizontal position or in any desired inclined position such as that shown in phantom lines in FIG. 2. Mounted on the top edge of the drawing board **15** are a pair of identical dihedral angle brackets **16** with one flange **16A** thereof secured by two attaching screws **16B** passing outwardly and downwardly with the top edge of the drawing board with their heads countersunk into the inner surface of flange **16A**. A longitudinally extending hook shaped rib **16C** projects from the inner surface of said one flange toward the other flange and a thumb screw **16D** is screw threaded from the outer side through the other flange **16F** for securing an F-shaped beam **17** in a manner hereinafter described.

The free edge of the one flange **16A** of the bracket is provided with a groove **16G** having the outer or lower wall thereof substantially wider than the inner or upper wall to provide for the reception of a J-shaped web extension **17A** of the stem of the F-shaped beam **17**, the F-shaped beam **17** having a downwardly extending flange **17B** extending from the lower cross member and an inwardly projecting rib foot **17C** on the bottom of flange **17B** which foot is received in the groove formed by the hook shaped rib **16C** of the bracket. Foot portion **17C** of flange **17B** and a foot rib portion **17D** on the bottom of the stem of the F-shaped beam rest securely against the accurate inner surface of the bracket flange **17E** in flange **17B** whereby when the screw **16D** engages into the groove **17E** the foot portion **17C** engages into the groove formed by rib **16C** thereby preventing further movement of the F-shaped beam away from the screw resulting in a cam action drawing the foot portions **17C** and **17D** of the F-shaped beam tightly against the inner surface of the bracket flange **16A** thereby securely retaining the F-shaped beam in fixed position relative to the bracket **16** and thereby in fixed position relative to the drawing board **15**.

A horizontally extending flange **17F** at the upper end of the F-shaped beam is provided with a series of slightly over-size equally spaced stud receiving apertures into which threaded studs **18** are slidably received to provide for limited radial and axial adjustment. The studs **18** are fixed to a tubular trolley **19** by any suitable means such as being welded thereto or threaded into threaded radial bores thereof. The trolley rail **19** is fixed in accurate alignment with respect to the F-shaped beam by means of the studs **18** and the adjusting nuts **18A**, **18B** and washers **18C**.

Mounted for movement along the trolley rail **19** is a horizontally movable carriage which includes a C-shaped sleeve **20** and a perpendicular rail supporting housing **23** bolted to a longitudinally extending member **20L** on the C-shaped sleeve. The C-shaped sleeve is provided with a C-shaped bearing assembly at each end to reduce friction and permit rotary movement. The left bearing assembly **20A** is shown in detail in FIGS. 7 and 8 and the right bearing assembly **20B** is a mirror image thereof. The bearing assembly **20A** includes an annularly grooved C-shaped ring having an outwardly projectly flange **20C** extending from a smoothly cylindrical surface **20D** which cylindrical surface is received in a cooperating counterbored cylindrical surface in the left end of the C-shaped sleeve **20**. The C-shaped ring is secured in position by means of headed attaching screws **20E** and **20F** passing through the wall of C-shaped sleeve **20** (FIG. 2) which have their inner ends screw threaded into tapped radial apertures **20E'** and **20F'** respectively. A plurality of other radially extending threaded apertures **20G** in the C-shaped ring receive short set screws **20G'** which in operative position lie completely beneath the cylindrical surface **20D**. Such set screws **20G'** engage a horseshoe shaped spring axle member **20H** which is received in an annular groove **20I** and such axle member **20H** supports four metal rollers **20J** located in radial slots **20K** as clearly shown in FIGS. 7 and 8. Each roller includes an inner race on axle **20H** and an outer race engaging trolley rail **19** with ball bearings between the races.

To lock the C-shaped sleeve in position on trolley rail **19** a U-shaped brake shoe **21** of spring material has an arcuate exterior leg **21*a*** which engages the inner periphery of the C-shaped sleeve **20** while the arcuate shaped inner leg **21B** engages the trolley rail **19**, the spring brake shoe being provided with a centrally disposed aperture in the bight portion. A pointed set screw **21C** of larger diameter than the aperture is threaded through a tangential tapped bore in C-shaped sleeve **20** projecting into the smaller aperture in the bight portion of the brake shoe **21** whereby adjustment of the screw **21C** adjusts the arcuate position of the brake shoe **21** thereby controlling the position of the cam shaped free end **21D** of the inner leg whereby the brake can be operated by engaging the cam surface **21D** with an L-shaped brake operating lever **22**.

The brake operating lever **22** is located in a longitudinally extending radial slot **22A** in C-shaped sleeve **20** and is pivotally mounted on a pin **22B** whereby the brake can be applied and released with a small motion of the brake operating lever **22** since the screw adjustment **21C** provides for accurately locating the position of interengagement of the cam surface **21D** of the brake shoe with the cooperating surface **22C** of the L-shaped lever **22**.

The C-shaped sleeve **20** carries a longitudinally extending member **20L** on which a vertical rail housing **23** is mounted by means of two mounting screws **23A**, **23A** each passing through a boss **23B** in the housing **23** and a cylindrical spacer **23C** into a cooperating threaded aperture in the corresponding end of the member **20L**. The vertical rail supporting housing **23** includes an integral front panel **23D** and a peripheral wall with the housing open at the rear with a rear closure plate **23E** detachably secured by screws. The pair of bosses **23B** in alignment with the screws **23A** are provided with countersunk Allenhead screw head receiving counterbores to provide a smooth exterior surface. The spacers **23B** are provided with reduced diameter portions contacting longitudinal member **20L** which are received in a pivot bore in the right end of a brake activating lever **22E** and an arcuate slot in the left end of the lever **22E**. A vertical extension **22F** of lever **22E** has a rearward and downward extension carrying a rearwardly extending stud **22G** which is received in a cooperating slot in the brake operating lever **22** whereby upward movement of the brake activating lever **22E** causes upward movement of the slotted end of lever **22** thereby releasing the engagement between cam surface **21D** of the brake shoe spring **21** and surface **22C** of lever **22** thus permitting the spring to expand applying the brake against trolley rail **19**. When the brake activating lever **22E** is moved downwardly the cam action at **21D** causes the spring brake shoe **21** to be moved to a position out of contact with the rail **19** thereby releasing the brake.

Integral with the housing **23** is a vertically extending hub **23F** which arcurately receives the upper end of a vertically extending rail **24** which is securely retained in position in the hub by securing screw **24A**. Mounted on the perpendicularly extending rail **24** is the drafting head **25** which includes a tubular sleeve **26** having a circular bearing assembly **26A** at the lower end and a circular bearing **26B** at the upper end. Both bearing assemblies are similar and the upper one **26B** includes an annular body having a peripheral flange projecting outwardly beyond a cylindrical portion **26C** which cylindrical portion is received in a cylindrical counterbore **26D** in the tubular housing **26**, the annular body being provided with an annular groove **26E** in the inner face thereof and a plurality of radially extending slots in which three ball bearing rollers **20J** are rotatably supported on a horseshoe shaped spring ring axle **20H** in a manner similar to that previously described. The horseshoe shaped spring axle **20H** is retained in position by means

of set screws 26F, 26F threaded through the outer wall of annular groove 26E into clamping contact with the horseshoe shaped spring axle 20H and lying entirely within said outer wall. The entire bearing assembly 26B is mounted in position by means of headed screws 26G, 26G passing through countersunk radial bores in sleeve 26 and threaded into radial screw threaded apertures 26G'. An axially extending aperture 26H in the lower portion of the ring assembly 26B slidably and rotatably receives a friction adjusting screw 26I as shown in FIG. 12. The lower bearing assembly 26A does not include the aperture 26H nor the friction adjusting screw 26I.

Within the tubular housing 26 are a pair of annular nylon rings 26J and 26K with compression springs 26L reacting therebetween, the screw 26I being screw threaded into a tapped axial aperture in the ring 26K and freely slidable and rotatable in the aligned aperture in ring 26J whereby rotation of adjusting screw 26I causes ring 26K to compress the springs 26L thereby producing a yieldable force on the ring 26J which force on the ring 26J is applied directly to the rollers 20J in the bearing assembly 26B thereby producing a uniform frictional drag on the rollers resisting unintentional displacement of the drafting head 25.

The drafting head is held in adjusted position by a brake shoe arrangement similar to that previously described and includes a U-shaped spring brake shoe 21 having its outer leg 21A in engagement with the inner periphery of the sleeve 26 and having its inner leg 21B adapted to selectively engage the perpendicular rail 24. A channel shaped double acting lever 26M is positioned in a rectangular slot in sleeve 26 and is pivotally mounted on a pin 26N. The flange 26O is of a shape to cooperate with cam surface 21D to cause disengagement of the brake and permit spring engagement thereof with perpendicular rail 24 in a manner similar to the coaction of lever 22 previously described. An adjusting screw 21C engages in a smaller size aperture of the bight portion of the spring brake shoe 21 to provide for the proper positioning of the brake shoe for cooperation with operating projection of flange 26O of the double acting lever 26M whereby the drafting head can be selectively moved along the rail 24 or locked in a definite position thereon. The frictional contact between levers 22 and 26M with their spring brake shoes is such that the lever and brake shoe will remain in the position set by the draftsman.

Projecting laterally from the tubular sleeve 26 is an annular drum receiving bearing 26P in which a rotatable drum 27 of the drafting head is mounted. Such rotatable drum 27 carries the usual protractor 27A and the notched ring 27B which are retained in adjusted position by a dog 27C which is selectively operated by a thumb lever 27D or a finger engaging ring 27E through a linkage system links 27F, 27G, 27H and 27I suitably linked together and to dog 27C by suitable lost motion connections in a known manner. To adjust the base line position of the drafting head and of the protractor 27A, provision is made for clampingly securing the drum 27 with respect to the sleeve 26 and the lateral drum carrying extension 26P. A generally arcuate shaped brake shoe plate 28 is fixedly carried on the end of cirucular rod 28A with the plate 28 engaging into a cylindrical groove 27J in the drum 27. The rod 28A is moved radially of the drum 27 by means of a screw 28B threaded into an aligned threaded bore in the sleeve 26 to produce longitudinal movement of rod 28A and thereby pressure of the brakeshoe 28 into the groove 27J of the drum 27 holding the drum 27 against rotation. The screw 28B is provided with a flange 28C and with an outwardly extending splined portion 28D which receives an inwardly splined aperture of a brake operating lever 28E which is held in an adjusted angular position by a screw 28F whereby the angular position of the lever 28E can be adjusted to the desired region to produce the necessary clamping action of the brake shoe 28 with drum 27 in the limited motion permitted by the lever receiving recess 28G in the side of the sleeve 26.

The bottom cover skid plate 27K is omitted in FIG. 10 to show the drafting guide supporting frame 27L to include the arms on which the line guide edges are mounted in a suitable manner. The frame 27L is secured to a central hub 27M which is rotatable in the drum 27 in a known manner and the relative position is determined by the positive interengagement of the detent 27C with one of the notches in the notched plate 27B while intermediate positions are obtained by a clamping action produced by the thumb lever 27D reacting through an adjustable screw 27N to obtain the desired clamping effect, the thumb lever 27D being mounted on the frame 27L adjacent the usual vernier scale 27O.

The lower end of the vertical guide rail 24 is provided with a two part clamp member 29 having grooves which embrace the free ends of the guide rail 24 and a diagonal brace tube 29A; the elements of the clamp member 29 are secured by a clamping screw 29B to both the rail 24 and the angular brace 29A. The upper end of the brace 29A is received in a split clamping block 29C having a cylindrical bore which snugly receives the upper end of the tube 29A and one surface of the clamping block engages a boss 29D on the inner surface of the front wall 23 of the housing while a screw 29E passes through the clamping block and is screw threaded into a threaded bore in boss 29D thereby providing a secure clamping action between the portions of the block 29C on each side of the slit so that the brace rod will be secure and the guide rail 24 will be in a true perpendicular position with respect to the trolley guide rail 19. When this condition is obtained the clamping screw 29E and the clamping screw 29B are securely adjusted during assembly so this adjustment is normally permanent for the life of the machine.

Within the diagonal brace tube 29A a brake operating rod 29F is slidably mounted with one end projecting beyond the upper end of the brace tube 29A. A pin 29G projects from the upper end of rod 29F into a slot in a reversely bent portion 29H of the lever 22F whereby longitudinal movement of rod 29F causes pivotal movement of brake operating lever 22F which in turn operates lever 22 to control the brake 21 of the horizontally movable carriage. To prevent rotation of rod 29F and to permit sliding movement an elongated slot 29F' receives the screw 29C.

To reciprocate the rod 29F a handle 29I is slidably mounted on the brace tube 29A and is connected to the rod 29F by means of a shouldered screw 29J having its head countersunk in a radial bore in the handle 29I and passing freely through a slot 29K extending longitudinally of the brace tube 29A and being screw threaded into the rod 29F for a limited distance determined by the shoulder, the screw 29J abutting the periphery of the rod 29F so 29I readily moves in a longitudinal direction. The handle 29I is provided with line knurling on both sides for assisting in the gripping thereof in a manner similar to the line knurling on the front and back of the lever 28E for controlling the base line adjustment.

When the drawing board is in a vertical position, the drafting head 25 is urged downwardly by the force of gravity equal to the weight thereof and to counteract this effect a counterbalancing arrangement is provided which includes a cable 30 having an eye 30C at its lower end which eye is received in an axially extending groove in the sleeve 26 and pivoted at its lower end so the hook end of the J-shaped hook normally lies within the groove. Above the eye 30C of the cable 30 a rubber bumper 30B is mounted, such rubber bumper being a resilient rubber-like sleeve which engages a guide grommet 30C' on the housing 23 when the eye 30C of the cable is disconnected from the hook 30A. To draw the cable 30 into the housing 23, a reel 30D is rotatably mounted on the large cylindrical portion of a stepped stub shaft 30E which is

fixed in a boss in the front wall 23D of the housing by a press fit between the bore in the base and a reduced diameter knurled end portion of the stub shaft 30E. The reel 30D has a tubular hub portion 30F freely rotatable on the large diameter cylindrical portion of the stub shaft and has outwardly projecting flange portions projecting radially beyond the cable receiving cylindrical surface 30H of the reel and one end of the cable 30 passes through an angularly disposed aperture in one flange of the reel 30D adjacent the front 23D with a suitable securing collar 30G or a knot or the like serving to retain the end of the cable 30 on the reel 30H. Upon the tubular hub portion 30F of the reel and upon the large diameter portion and upon a reduced cylindrical portion of the stub shaft 30E a gear 30T having a cooperating stepped bore central boss is rotatably mounted. Between the body of such gear and the web of the drum 30D a spiral clock type spring 30J is confined with the inner end of such spring having an eye formed therein which eye is received in an axially extending but radially offset bore in the outer periphery of the central boss of the gear providing a dovetail connection of the spring to the boss. The outer end of the spring 30J is secured by a rivet or the like to the inner periphery of the reel 30E whereby rotation of the gear or the reel produces a winding or unwinding action on the spring 30J. The free end portion of the reduced cylindrical portion of the stub shaft 30E is flattened as shown at 30L on opposite sides of the stub shaft and cooperating with such flattened portions are a pressure disc 30M and a roller retaining disc 30N each with a cooperating aperture preventing relative rotation between the discs and the flattened portion of the shaft. The roller retaining disc is provided with three radial slots in which rollers 30O are confined but are free to rotate. The surface of the gear 30I is provided with twelve indentations 30P which receive the rollers 30K in a semi-positive realtion whereby force is required to rotate the gear 30I.

Gear 30I is rotated by means of a pinion gear 30Q meshing with gear 30I and fixed to a stub shaft 30R which is rotatably mounted in a suitable boss in the housing 23 with the shaft 30R projecting through the front wall 23D of the housing. The forwardly projecting end of the shaft 30R is formed with a pair of ears receiving a crank arm 30S which is pivotally connected to ears by means of a pin 30T at right angle to the axis of shaft 30R. A generally spherical operating knob 30U is rotatably mounted on the other end of the arm 30S and is releasably received in a recess 30W in the housing 23 with the recess including a dimple receiving the knob and requiring a slight bending of the arm 30S for the spherical knob 30U to be engaged in the dimple whereby the crank-arm 30S is releasably secured by a snap action in the position shown in the drawings. To change the tension in the clock spring 30K and thereby obtain the desired counterbalancing effect in the cord or cable 30, the crank arm 30S is moved outwardly by releasing the knob 30U from its dimple and moving the handle to the phantom line position shown in FIG. 1 so the user of the machine can secure the desired counter-balancing effect to compensate for a vertical position such as that shown in full lines in FIG. 2 or in any inclined position of the drawing board 15.

In the horizontal position of a drafting board the counter-balancing effect of the cable 30 may not be needed and the cable 30 may be disconnected from the J-shaped hook 30A by moving the hook outwardly with the fingernail engaging in the small projection at the outside of the knee of the J-shaped hook and releasing the eye 30C from the hook and permitting rubberlike bumper 30*b* to engage the grommet 30C' at the bottom of the housing 23.

To assure that the cable 30 remains on the reel 30D, a surrounding web 30V is provided on the housing 23 with such surrounding web having a cutout portion to permit the cable 30 to pass vertically and tangentially from the reel 30E as clearly shown in FIG. 5.

To support the rail 24 at the lower edge of the drafting board a yoke member 29J is slidably and pivotally mounted on guide rail 24 and secured in adjusted position by the clamping action of a screw 29K. A roller 29L is rotatably mounted on a stud extending between the tines of a forked end of the yoke 29J with the axis of the stud parallel with the axis of the guiderail 24. The adjustment of the yoke 29J can be made to obtain the desired spacing so the rail 24 will be parallel to the drawing board 15 and the drafting head will slide smoothly over the surface of the drafting board in parallel relation thereto.

A rubberlike bumper 24X of circular cylindrical configuration is positioned in frictional engagement with the upper end portion of the rail 24 and is adapted to be engaged by the bearing supporting assembly ring 26B to prevent excessive forces in the event the drafting head is moved vertically beyond its normal range.

In mounting the drafting machine, the brackets 16 are secured to the upper edge of the drawing board 15 as explained above and the F-shaped support beam with the trolley rail 19 is positioned in substantially the relation shown by the dotted line showing of the bracket 16 and the drawing board 15 in FIG. 2 whereupon the F-shaped beam is rotated about the J-shaped extension 17A thereof and slot 16G of the bracket to the relative position shown in solid lines with the rib foot 17D snapping past rib 16C whereby retaining the F-shaped support beam 17 for sliding with respect to brackets 16. After the desired position is obtained the thumbscrews 16D are tightened so the inner ends thereof engage the groove 17E in the F-shaped beam 17 causing the feet 17C, 17D of the F-shaped support beam to tightly engage the inner surface of the flange 16A and accurately locate the beam 17 since the cam action of the C-shaped ribs 16C against the foot rib 17C produces force resulting from the screw force applied by the screws 16D thereby fixing the F-shaped support beam 17 and trolley rail 19 in fixed position on the drawing board.

The horizontally movable carriage with the vertical rail 24 and drafting head 25 attached is then moved axially from one end of the horizontal trolley rail 19 with the slot in the slotted sleeve 20 passing over the supporting studs 18. A rubberlike horseshoe bumper 19X is positioned on each end of the trolley rail 19 and a horseshoe shaped collar 19Y is secured outwardly of each rubber bumper on the rail 19 in proper position by means of its adjusting screw 19Z. The stops 19Y are positioned to obtain the maximum drawing area on the board 15. The vertical rail 24 may be moved as far to the left as necessary as long as the roller 29L remains on the board and the drafting machine can be moved to the right until the vertically extending guiding edge support 27LV has its right edge substantially on the right edge of the board.

It will be apparent that upon loosening the clamping thumb screws 16D, the F-shaped beam 17 with the trolley rail 19 may be moved along the board so a relatively short beam 17 may be used on a very long board by providing a suitable number of brackets 16 to support the beam 17. Also the drafting machine may be transferred from one board to another by loosening the clamping thumb screws 16D of the brackets 16 and tilting the F-shaped support beam with the trolley rail 19 about the J-shaped web 17A and after the foot portion 17C snaps outwardly past rib 16C the entire assembly including the F-shaped supporting beam with the trolley rail, the horizontal carriage, the vertical rail, and the drafting head can be removed as a unit and placed on another drafting board equipped with brackets 16 so a single drafting machine may be used with a number of different drafting boards. In normal use the brackets 16 are spaced apart one half the length of the support beam and trolley and one quarter the length of the support beam and trolley from the edge of the drawing board.

It will also be apparent that the beam **17** may be made of any desired length and the trolley rail **19** may be made of the same length or may be made in sections in a manner similar to that disclosed in the prior Baker et al. application.

To improve the appearance of the ends of the F-shaped beam **17E**, end covers **17X** having inwardly extending peripheral flanges are secured to the ends of the F-shaped beam **17** by a resilient gripping action produced by a snug fit and the resiliency in the flanges, and in addition a suitable adhesive may be used.

A U-shaped cover **23X** having inturned ribs **23Z** on the free ends of the legs and carrying the name of the equipment is retained in a groove **23Y** extending across the front and sides of the housing **23** and the inturned extremities **23Z** grip the back edges of the housing **23** thereby retaining the name plate, said plate hiding the securing screws thereby completely covering the structure to give a neat appearance.

To provide a neat appearance to the ends of tubular rail **19** and the lower ends of rail **24** and brace tube **29A** rounded caps that have shank portions extending into the tube ends thereby avoiding all sharp edges.

It will be apparent that the C-shaped sleeve **20** with the drafting head may rotate about the circular trolley rail **19** when the C-shaped sleeve **20** is located between adjacent studs **18, 18** since the C-shaped sleeve **20** is of appreciably less length than the distance between the studs **18, 18** so that the sleeve may rotate to the dotted line position as shown in FIGURE 2 and rotate to a further position in which the drafting head and the second rail **24** are entirely clear of the drafting surface of the drafting board **15**. The rigid beam **17** with the trolley **19** can be moved so that the trolley projects beyond the edge of the drafting board, thereby permitting the drafting head to be used over substantially the entire area of the drafting board.

To provide a drafting machine for left handed draftsmen the horizontal and vertical carriages are made in mirror images and assembled in a similar manner and it will be understood that the invention includes both right and left handed machines.

It will be apparent that changes may be made within the scope of the invention as set forth in the valid scope of the appended claims.

What is claimed is:

1. In a drafting machine comprising a pair of dihedral angle brackets for mounting to the top edge of a board substantially one-quarter the length from each end of the board, each bracket having a groove at the free edge of one flange, and an inwardly and angularly projecting rib on said one flange between said free edge and the knee of the bracket, means to adjustably attach said one flange to the top edge of the board, a single clamp screw on the other leg, an elongated F-shape beam, an inwardly extending rib on the stem flange, a downwardly extending flange on the lower transverse flange and having a rib adapted to engage the said one flange of said bracket and receivable in the recess of said angularly extending rib of said bracket, said downwardly extending flange from said lower flange having an outwardly opening slot for reception of said clamping screw of said bracket, the stem of said F-shaped beam being provided with a J-shaped hook receivable in the groove in the free edge of said one flange of said bracket, the upper flange of said F-shaped beam being provided with a plurality of radially aligned stud receiving apertures for freely receiving screw threaded studs therein, trolley supporting studs adjustably supported on said upper flange, a circular cross section trolley mounted on said studs in accurate alignment, a C-shaped sleeve of less length than the spacing between adjacent studs telescopingly mounted on said trolley, a C-shaped bearing support mounted on each end of said C-shaped sleeve and having an annular groove and a rabbet on one face thereof, each bearing support having four radial slots, a ball bearing supported roller in each slot, a C-shaped spring member in said groove, and passing through the inner race of said rollers, screws extending radially through said bearing support and securing said C-shaped spring whereby said rollers are maintained in operative positions, and means to secure said bearing supports in said C-shaped sleeve, a strip spring brake shoe of U-shape cross section having each leg of arcuate configuration for mounting of the outer leg against the inner periphery of the C-shaped sleeve, the inner leg being of arcuate configuration to seat against the trolley, said U-shaped spring having a stud engaging recess in the central bight portion thereof, a conical tipped screw threaded through said C-shaped sleeve and engaging the recess in the U-shaped spring, an L-shaped lever pivoted within a slot in said C-shaped sleeve on an axis adjacent the free end of the inner leg of said spring brake shoe, one arm of said L-shaped lever being engageable with the free end of the inner leg of said U-shaped spring to selectively permit said inner leg of said U-shaped spring to engage said circular trolley to retain said C-shaped sleeve in fixed condition or to positively move the inner leg of said U-shaped spring away from the trolley to permit free movement of the C-shaped sleeve with respect to said trolley.

2. Mounting structure comprising an angle bracket for mounting to the top edge of a board, an inwardly and angularly projecting rib on one flange between the free edge and the knee of the bracket and forming a recess with said one flange, means to attach said one flange to the top edge of the board, a clamp screw on the other flange, an elongated F-shape beam, an inwardly extending rib on the stem flange, a downwardly extending flange on the lower transverse flange and having a rib adapted to engage the said one flange of said bracket and receivable in the recess of said angularly extending rib of said bracket, said downwardly extending flange of said F-shape beam from said lower flange engageable with said clamping screw of said bracket, the stem of said F-shaped beam being provided with a shoulder to engage the inner surface portion of the free edge of said one flange of said bracket, the upper flange of said F-shaped beam being provided with a plurality of radially aligned stud receiving apertures for freely receiving screw threaded studs therein.

3. The combination with a drafting board of a drafting machine having line guiding means movable substantially parallel and substantially perpendicular to the upper edge of the board comprising dihedral angle bracket means mounted with the free edge of one flange closely adjacent the drawing supporting surface of the drafting board, means to secure bracket means in position with the other flange extending away from the upper edge of the board, a screw threadedly mounted adjacent the free edge of the other flange of said bracket means for engaging a flange of a beam, an inwardly and angularly directed rib on said one flange of said bracket means directed toward said other flange providing a foot rib receiving recess, a substantially rigid beam of a length in the order of the length of the drafting board and having a pair of supporting flanges with the free edge of one flange having an inwardly directed rib foot which is receivable in the recess formed by the rib on said one flange of said bracket means, and the free edge of the other flange of said beam engageable with the inner surface of said one flange of said bracket means adjacent the free edge, means to support a trolley from said beam in spaced relation thereto providing a composite rigid beam structure, a carriage mounted on said trolley for movement from one end to the other end, a second carriage supporting rail mounted on said first carriage and extending transverse to said trolley, a second carriage mounted for movement along said transversely extending rail, and means on said second carriage for guiding a marking device in a definite pattern.

4. The invention acording to claim **3** in which the bracket means includes a pair of brackets with one bracket spaced from the other bracket a distance appreciably less than the length of said beam.

5. The invention according to claim 3 in which counterbalancing means are mounted on said first carriage for balancing the force of gravity of said second carriage, and means at the front of the first carriage for adjusting the tension in the counterbalancing means.

6. The invention according to claim 3 in which friction means are mounted on said second carriage to control the force required to move said second carriage along said perpendicular rail.

7. The invention according to claim 3 in which brake means are provided for preventing movement of said first and said second carriage.

8. For use in a drafting machine for mounting on the top edge of a drafting board comprising dihedral angle bracket means one flange having a groove in the free edge thereof and an angularly extending rib on the inner surface of said one flange extending toward the other flange, a setscrew screw threaded into the other flange and projectable beyond the inner surface thereof whereby an object having a rib receivable in the recess formed by said rib and a foot engageable with said groove can be effectively supported for sliding movement or clamped in fixed position.

9. A carriage for operation on a circular trolley comprising a C-shaped sleeve for telescoping mounting on said trolley, a C-shaped bearing support mounted on each end of said C-shaped sleeve and having a circumferential groove and a rabbet on one face thereof, four radial slots in said bearing support, a ball bearing supported roller in each slot, a C-shaped spring member in said groove, and passing through the inner race of said rollers, screws extending radially through said bearing support and securing said C-shaped spring whereby said rollers are maintained in operative positions, and means securing said bearing supports to said C-shaped sleeve whereby said carriage can be moved along said trolley or may be rotated relative to said trolley.

10. A carriage for operation on a circular trolley comprising a C-shaped sleeve for telescoping mounting on said trolley, a C-shaped bearing support mounted on each end of said C-shaped sleeve and having a circumferential groove and a rabbet on one face thereof, four radial slots in said bearing support, a ball bearing supported roller in each slot, a C-shaped spring member in said groove, and passing through the inner race of said roller, screws extending radially through said bearing support and securing said C-shaped spring whereby said rollers are maintained in operative positions, and means securing said bearing supports to said C-shaped sleeve whereby said carriage can be moved along said trolley or may be rotated relative to said trolley, a strip spring brake shoe of U-shape cross section having each leg of arcuate configuration for mounting of the outer leg against the inner periphery of the C-shaped sleeve, the inner leg being of arcuate configuration to seat against the trolley, said U-shaped spring having a stud engaging recess in the central bight portion thereof, a screw threaded through said C-shaped sleeve and engaging the recess in the U-shaped spring, an L-shaped lever pivoted within a slot in said C-shaped sleeve, on an axis adjacent the free end of the inner leg so one arm of said L-shaped lever engages the free end of the inner leg of said U-shaped spring to selectively cause said inner leg of said U-shaped spring to move to a position for engagement with said circular trolley to retain said C-shaped sleeve in fixed position relative to said trolley.

11. A trolley and carriage structure comprising a C-shaped sleeve, a C-shaped support mounted on each end of said sleeve with the opening thereof in registry with the opening of said sleeve, said C-shaped bearing support having an annular groove in the surface thereof inwardly of the sleeve and radially extending roller receiving slots in said bearing support intersecting said annular groove, two of said slots being adjacent the opening of the sleeve and in a position to permit maximum clearance between the rollers to correspond with the clearance between the sides of the opening in the C-shaped sleeve, the other pair of slots being symmetrically arranged with respect to the opening in the sleeve and lying in the quadrants away from the opening in said sleeve, a roller having an inner and an outer race positioned in each slot, said rollers being rotatably mounted on an axis of a C-shaped spring member received in said annular groove and passing through the inner races of said rollers, means to secure said spring in a definite position with two of the rollers having their axes substantially fixed and the other two rollers adjacent the opening in said sleeve having limited radial movement permitted by the C-shaped spring.

12. The combination of an elongated carriage supporting rail, a sleeve surrounding said rail, a bearing support mounted on each end of said sleeve, a plurality of rail engaging rollers mounted in each bearing support for rotation in planes radial to said rail, the rollers of at least one of said bearing supports projecting inwardly of said at least one bearing support toward the other bearing support, friction producing means for engagement with the rollers of said at least one bearing support, said friction producing means including a pair of rail embracing members within the sleeve, yieldable means urging said rail embracing members in an axial direction, adjusting means reacting between said at least one bearing support and one of said rail embracing members to move said one of said rail embracing members towards said at least one bearing support and yieldably urge the other of said rail embracing members adjacent said at least one bearing support into uniform pressure contact with the rollers of said at least one bearing support thereby producing a uniform frictional resistance on said rollers.

13. A reel takeup comprising a housing, a stepped stub shaft fixed in said housing, a cable receiving reel having a hub with a cylindrical outer periphery rotatably mounted on said stub shaft, a gear of larger diameter than said reel rotatably mounted by its hub portion on said stub shaft and on the hub of said reel, a spiral spring keyed by its inner end to the hub portion of said gear, and secured to the periphery of said reel, said stub shaft having a non-circular portion, a roller retaining disc mounted on said stub shaft and prevented from rotation by said non-circular portion, said roller retainer disc having radial roller receiving recesses therein, a roller in each recess, a resilient pressure disc mounted on said stub shaft and prevented from rotation by said non-circular portion thereof and pressing against the rollers in said roller retaining disc, and means to retain the central portion of said pressure disc against axial movement, said gear having recesses in the surface thereof adjacent the roller retaining disc for reception of the rollers to semi-positively retain said gear in adjusted position, pinion shaft rotatably mounted in said housing, a pinion gear fixed on said pinion shaft and meshing with the aforementioned gear, a handle projecting outwardly of the housing and positively connected to said pinion gear shaft whereby the tension of said spiral spring may be adjusted, and means to retain the handle in an adjusted position.

14. The invention according to claim 13 in which the housing is provided with a web surrounding said cable receiving reel to prevent accidental displacement of the cable, said web being discontinuous for a limited distance to permit tangential extension and retraction of a cable wound on said reel.

15. The combination of a drafting machine having a first carriage including a C-shaped sleeve mounted on a trolley rail and a housing mounted on said sleeve, a vertical rail secured to said housing and extending substantially perpendicular to said trolley rail, a drafting head including a vertically movable carriage having a tubular sleeve and a laterally extending protractor drum receiving bearing, a drafting protractor and line guiding edge having a grooved drum mounted in said drum receiving bearing, a protractor position retaining brake including

a circular rod and a brake shoe mounted for sliding movement with said brake shoe in said groove, adjustable screw means mounted on said tubular sleeve to force said protractor brake shoe toward said protractor drum to secure said drafting head and protractor on a desired base line without influencing the position thereof, a diagonal brace extending between the free end of said vertical rail and said housing to secure said vertical rail in accurate position.

16. A non-influencing protractor base line adjustment for drafting machines in which a drafting head is movable in all directions and the base line can be adjusted in all directions comprising a draft head having a drum receiving bearing, a protractor drum rotatable in said drum receiving bearing, a brake shoe supporting rod mounted in said drafting head for radial movement with respect to said drum, an arcuate brake shoe mounted on said rod and engageable with said drum, means cooperating with said brake shoe supporting rod to move said brake shoe toward said drum, and handle means to operate said cooperating means to provide for operation of said brake shoe.

17. A drafting machine comprising a drafting board adapted for positioning and use in horizontal and vertical positions and any number of intermediate positions, a drafting machine including a first rail mounted along an edge of said drafting board, a first carriage including a housing having a cable and reel receiving cavity mounted for movement along said first rail, a second rail extending transversely to said first rail and mounted on said first carriage, a second carriage mounted for movement along said second rail, means to secure said carriages against movement along their respective rails including means accessible from the front surface of the drafting board to release said carriages for movement along the surface of the drafting board, a stepped stub shaft fixed in said housing, a cable receiving reel having a hub with a cylindrical outer periphery rotatably mounted on said stub shaft, a gear of larger diameter than said reel rotatably mounted by its hub portion on said stub shaft and on the hub of said reel, a spiral spring keyed by its inner end to the hub portion of said gear, and secured to the periphery of said reel, said stub shaft having a non-circular portion, a roller retaining disc mounted on said stub shaft and prevented from rotation by said non-circular portion, said roller retainer disc having radial roller receiving recesses therein, a roller in each recess, a resilient pressure disc mounted on said stub shaft and prevented from rotation by said non-circular portion thereof and pressing against the rollers in said roller retaining disc, and means to retain the central portion of said pressure disc against axial movement, said gear having recesses in the surface thereof adjacent the roller retaining disc for reception of the rollers to semi-positively retain said gear in adjusted position, pinion shaft rotatably mounted in said housing, a pinion gear fixed on said pinion shaft and meshing with the aforementioned gear, a handle projecting outwardly of the housing and positively connected to said pinion gear shaft whereby the tension of said spiral spring may be adjusted, and means to retain the handle in an adjusted position, said handle extending forwardly from said reel housing and accessible to adjust the tension of the reel from the front of the drafting board, and means to secure one end of the cable to the drafting head, whereby the tension on the cable can be adjusted for any inclination of the drafting board directly from the front of the drafting board.

18. A drafting machine comprising a drafting board adapted for positioning and use in horizontal and vertical positions and any number of intermediate positions, a drafting machine including a first rail mounted along an edge of said drafting board, a first carriage including a housing having a cable and reel receiving cavity mounted for movement along said first rail, a second rail extending transversely to said first rail and mounted on said first carriage, a second carriage mounted for movement along said second rail, means to secure said carriages against movement along their respective rails including means accessible from the front surface of the drafting board to release said carriages for movement along the surface of the drafting board, a cable take up structure in said first carriage cavity, means to adjust the tension of the cable whereby the drafting board can be positioned at any angle between the horizontal and vertical and the second carriage and drafting head may be accurately balanced, a handle extending forwardly from said reel housing and accessible to adjust the tension of the reel from the front of the drafting board, a drafting head on said second carriage, and means to secure one end of the cable to the drafting head, whereby the tension on the cable can be adjusted for any inclination of the drafting board directly from the front of the drafting board.

19. The invention according to claim **18** in which adjustable friction means are provided between the second rail and the second carriage.

20. A drafting machine comprising bracket means for securement to the top edge portion of a drafting board, a substantially rigid beam of a length not appreciably greater than the length of the drafting board, said beam being slidably mounted in said bracket means for movement along the top edge of the drafting board, said bracket means lying substantially entirely between the side edges of the drafting board and having a portion supporting the beam located approximately one-quarter the length of the beam inwardly from each side edge of the board whereby the beam will be effectively supported when approximately one-quarter of its length projects beyond the edge of the board, a circular trolley rail positioned in parallel relation to said beam, struts extending between said beam and said circular trolley rail at a plurality of spaced locations including at least a location adjacent the mid-portion of the circular trolley rail and beam fixedly securing said circular trolley rail to said beam, a C-shaped sleeve providing a carriage mounted on said circular trolley rail for movement along said circular trolley rail, a drafting head mounted on said carriage whereby the drafting head may be positioned at any location over substantially the entire area of the drafting board, said struts being spaced apart a distance greater than the length of the C-shaped sleeve whereby the drafting head may be pivoted about said circular trolley rail when the C-shaped sleeve is positioned between adjacent struts.

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