May 27, 1941. F. G. EUBANKS 2,243,731

DRAFTING MACHINE INDEXING MEANS

Filed Dec. 6, 1939 4 Sheets-Sheet 1

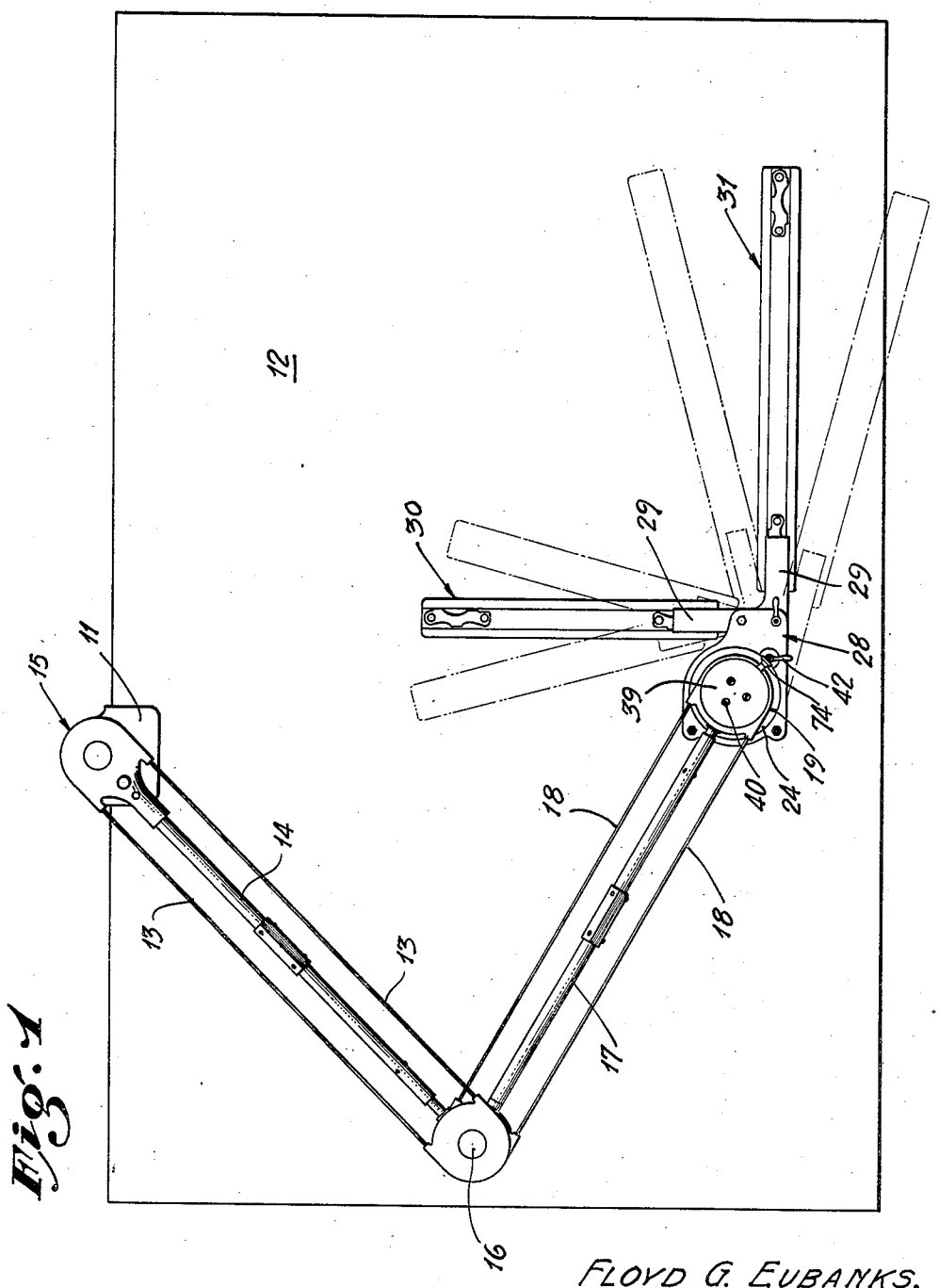


Fig. 1

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DRAFTING MACHINE INDEXING MEANS

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Fig. 2

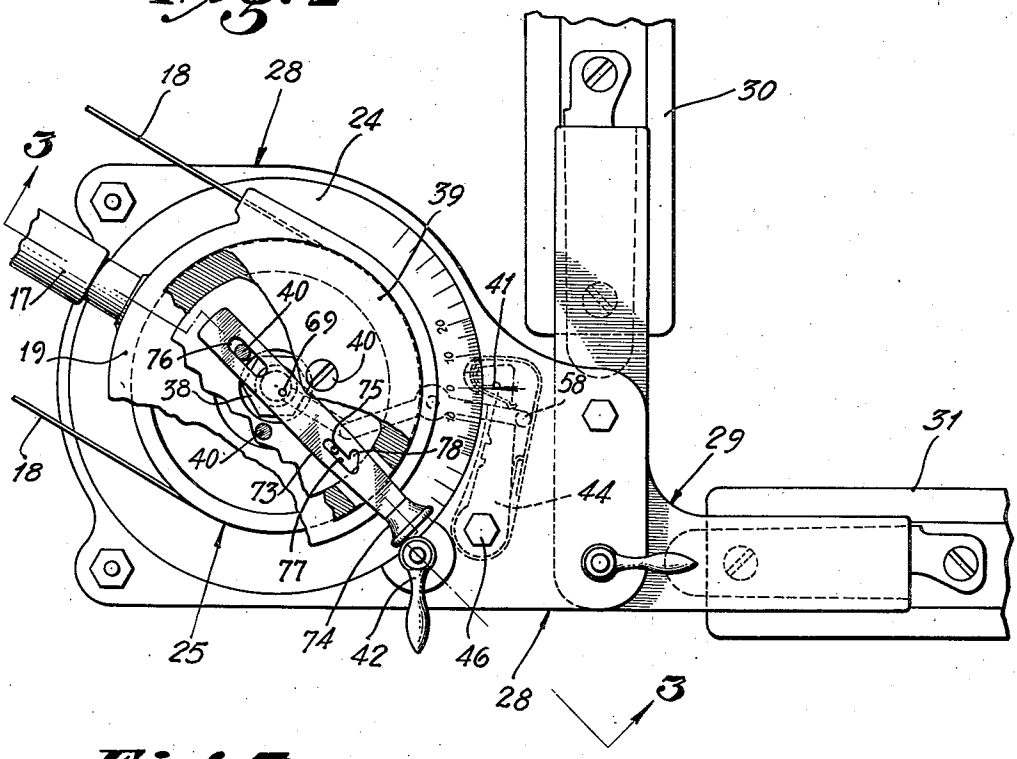
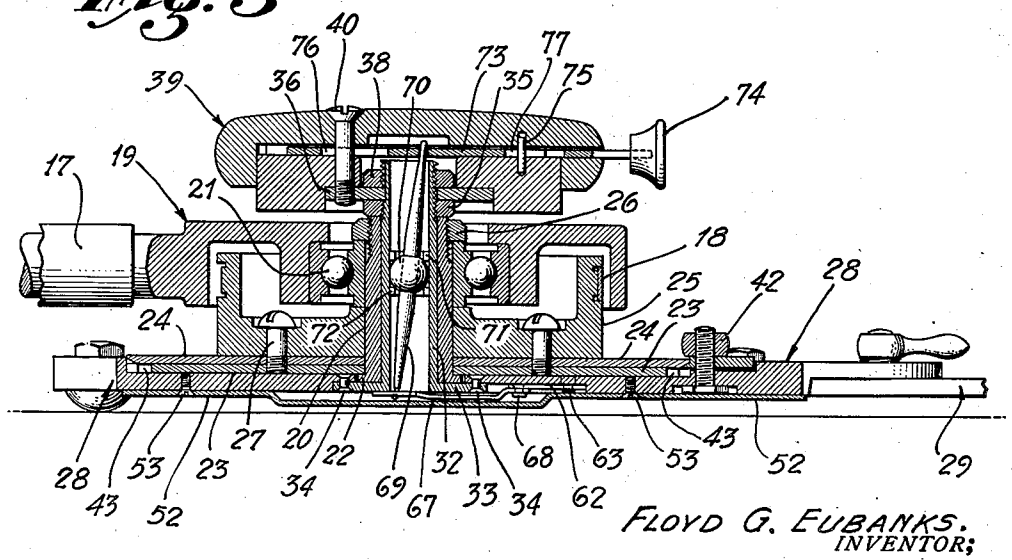


Fig. 3



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DRAFTING MACHINE INDEXING MEANS

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Fig. 4

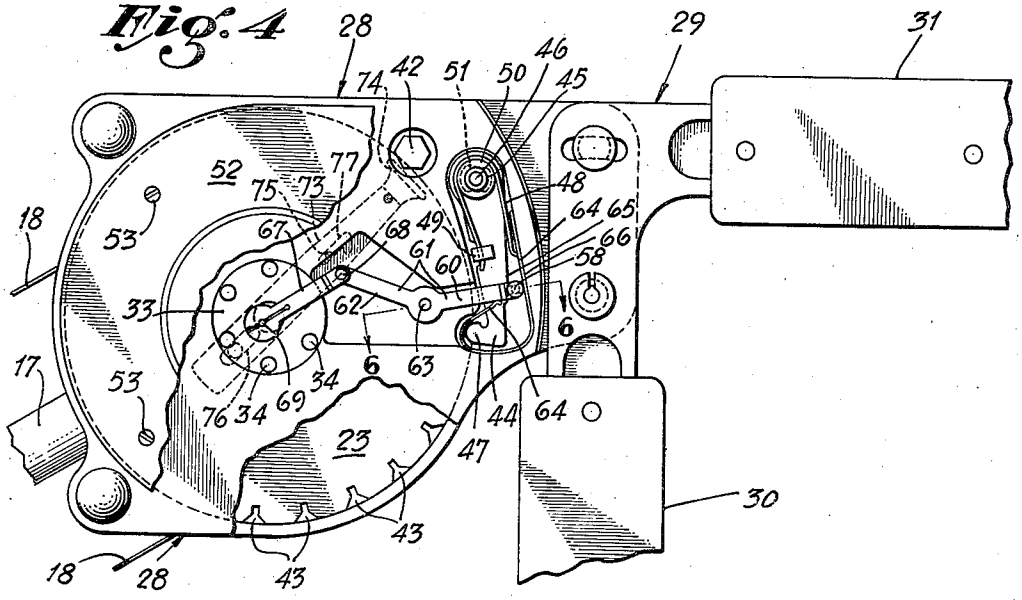


Fig. 5

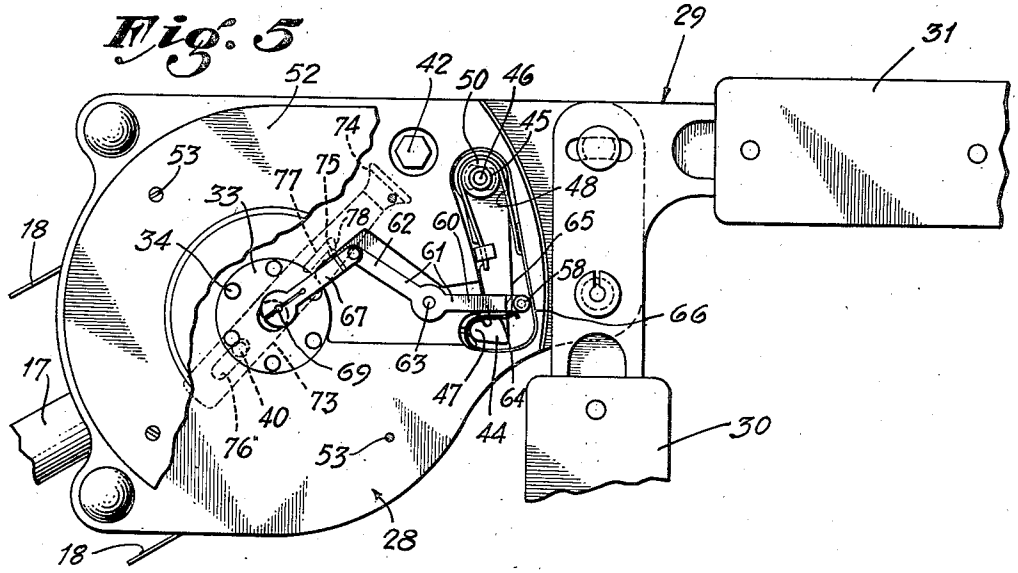
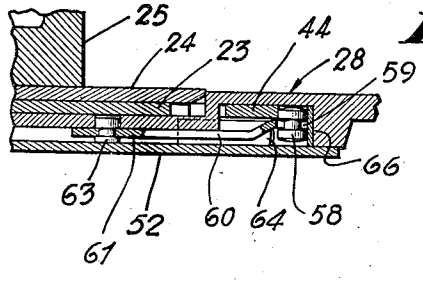


Fig. 6



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DRAFTING MACHINE INDEXING MEANS

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Fig. 7

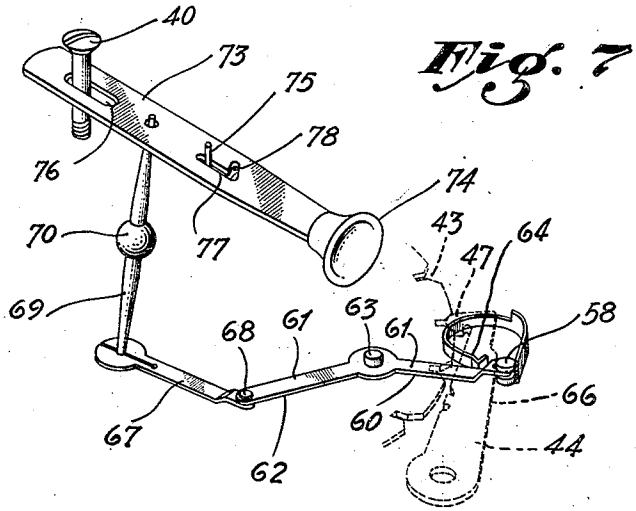


Fig. 9

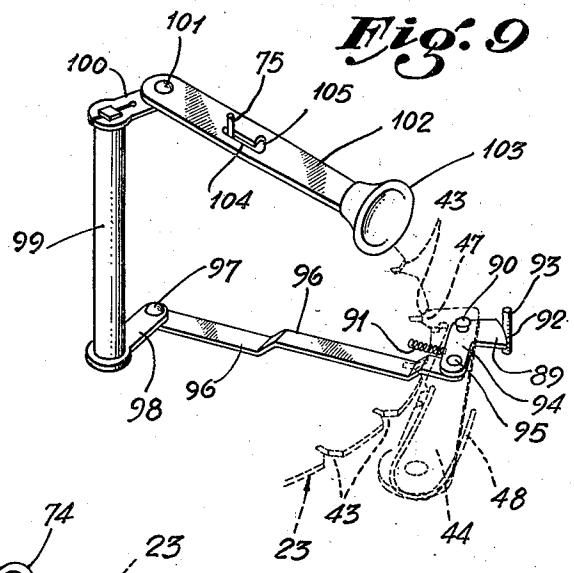
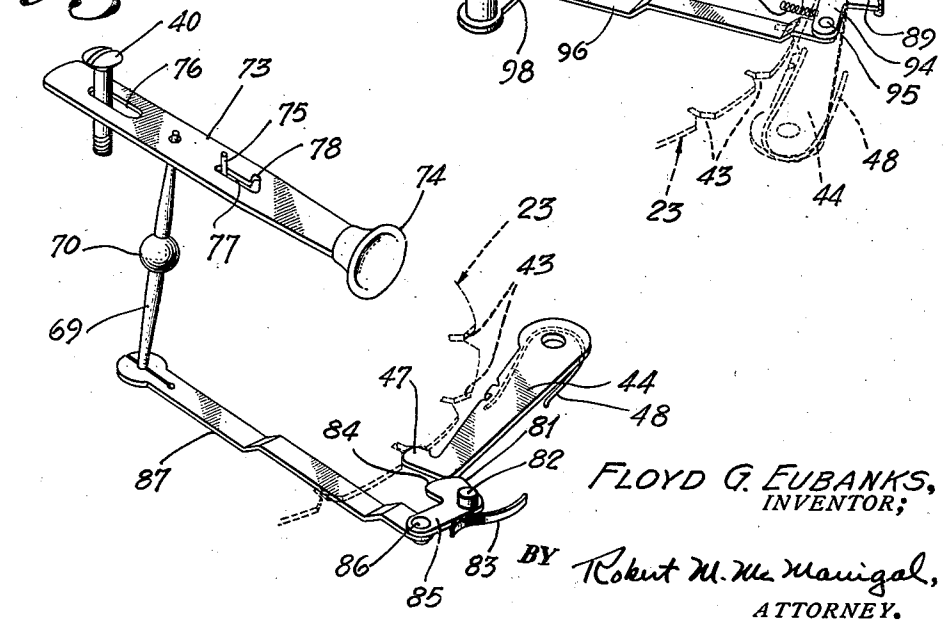


Fig. 8



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Patented May 27, 1941

2,243,731

UNITED STATES PATENT OFFICE

2,243,731

DRAFTING MACHINE INDEXING MEANS

Floyd G. Eubanks, Pasadena, Calif., assignor of forty-seven and one-half per cent to Francis E. Vaughan, Pasadena, Calif., and five per cent to Robert M. McManigal, Compton, Calif.

Application December 6, 1939, Serial No. 307,816

18 Claims. (Cl. 33—79)

My invention relates to a drafting machine comprising a fixed member clamped to a drawing board, an arm pivoted at one end to the fixed member, a second arm pivoted at one end to the moving end of the first arm, and a drafting head carried at the free end of the second arm and movable over the drawing board. The drafting head includes a protractor and a protractor arm provided with a vernier or witness point and with means for holding one or more rulers or straight edges which can be rotated about the protractor. As the drafting head is moved over the drawing board, orientation of the protractor is held constant either by some combination of pulleys and bands or by some combination of parallel arms.

The machine is provided with automatic indexing means; that is to say, the protractor arm is rotatable with respect to the protractor and is adapted to be automatically held in the most used positions when the usual stresses are applied to said protractor arm in moving said protractor arm over the drawing board, but is released when greater stresses are applied for the purpose of changing the angular position of said protractor arm with respect to said protractor. As described in my co-pending application Serial No. 283,628, filed July 10, 1939, this automatic indexing is accomplished through an index plate, having V-shaped notches in the most used positions in its periphery, secured to the protractor and a spring-pressed pawl pivoted to the protractor arm, said pawl having a rounded nose which is adapted to engage said notches. When the nose of said spring-pressed pawl engages one of said notches the protractor arm is held in position with respect to the protractor while the usual stresses are applied to said protractor arm in moving it across the drawing board. When greater stresses are applied to the protractor arm for the purpose of changing its angular position the pawl rises from the notch against the force of the spring and permits easy rotation of said protractor arm.

The object of my invention is to provide, in an automatic indexing drafting machine, locking means for locking the releasing mechanism of the automatic indexing device and rendering it inoperative. In one form of my invention a spring-pressed lever carries a roller between the indexing pawl and the side of the recess provided for said pawl in such a manner as to prevent said pawl from rising out of any one of the notches in the index plate when engaging said notch. In another form of my invention a spring actuated cam is turned into such a position as to prevent the indexing pawl from rising out of any one of the notches in the index plate when engaging said notch.

Another object of my invention is to provide means for controlling the locking means for locking the releasing mechanism so that said locking means may readily be rendered operative or inoperative at will. In one form of my invention this is accomplished by a lever arrangement, actuated by pressing a movable member in the handle of the drafting head, which is provided for pushing the roller, cam, or other means, out of the way of the indexing pawl, thus releasing said pawl and permitting it to work in and out of the notches of the index plate as the protractor arm is rotated with respect to said index plate. The movable member on the handle of the drafting head is provided with holding means for holding said member in the depressed position when this is desired. Said holding means also can be released readily.

My invention has many other objects, advantages, and features, some of which, with the foregoing, will be apparent from the following description and accompanying drawings of what are now considered to be preferred embodiments of the invention. It should be understood, however, that these particular embodiments of the invention are chosen for the purpose of exemplification, and I do not limit myself to the forms shown, since the invention, as set forth in the claims, may be embodied in a large plurality of forms.

Referring to the drawings:

Figure 1 is a plan view of a drafting machine of the pulley and band type embodying my invention.

Figure 2 is a plan view of the drafting head of the machine showing certain details of construction.

Figure 3 is a sectional view taken along the line 3—3 in Figure 2 and showing further some of the details of the machine.

Figure 4 is a fragmentary plan view of the under side of the protractor arm showing the index plate, the pawl for engaging notches in said index plate, and locking means with control for same in locked position.

Figure 5 is a fragmentary plan view of the under side of the protractor arm showing the index plate, the pawl for engaging notches in said index plate, and locking means with control for same in unlocked position.

Figure 6 is a sectional view taken along the line 6—6 in Figure 4 and showing details of the locking means.

Figure 7 is a perspective of the parts of the locking mechanism, with control for same, and the automatic indexing device.

Figure 8 is a modification of my invention with a cam operating against the pawl to lock the latter.

Figure 9 is a modification of my invention with a cam mounted on the pawl itself and operating against a pin to lock the pawl. In this modification the movement imparted to the movable member in the handle operates the cam through a partial rotation of a vertical shaft through the axis of the drafting head.

Any conventional means can be used to hold the protractor in constant orientation as it is moved over the board. In Figure 1 of the drawings, I have shown a band and pulley arrangement for illustrative purposes only.

Referring to said drawings, the numeral 11 indicates any conventional clamp for holding the drafting machine to a drawing board 12. The clamp 11 carries a pivot shaft rising perpendicularly to the board, to which is rigidly affixed a single groove pulley (not shown) which is engaged by a band 13. An arm 14 is pivoted to the shaft by a suspension head 15 in such a manner that it can be rotated about said shaft. At the other end of the arm 14 is a two groove pulley (not shown) which is mounted on the axis of articulation at 16 between the arms 14 and 17. The band 13 engages one groove of this pulley and a band 18 engages the other groove.

As shown in Figure 3, the other end of the arm 17 is connected to a pulley housing 19 which in turn is mounted on a hollow shaft 20 by means of ball bearing 21. The hollow shaft 20 is provided with a flange 22 at its lower end and threads at its upper end. Also mounted on said hollow shaft 20 are an index plate 23, a protractor 24, and a pulley 25 which, together with the above-mentioned ball bearing 21, are held in position by means of nut 26. The index plate 23, protractor 24 and the pulley 25 are adapted to be held together as a unit by means of screws 27. The band 18 engages the pulley 25.

As clearly shown in the drawings, a protractor arm 28 extends beneath the protractor 24 and a part of the protractor arm 28 encircles the protractor, serving as a guard. Mounted upon the protractor arm 28 by means of ruler holder 29 are rulers 30 and 31.

The protractor arm 28 is adapted to be rotated with respect to the protractor 24. As an instance of this arrangement, disposed in the hollow shaft 20 is a smaller hollow shaft 32, secured to the lower end of which is a disk 33, which is secured to the protractor arm 28 by means of rivets 34. The upper end of the shaft 32 is threaded and a nut 35 screwed lightly down against the upper end of the hollow shaft 20 holds the protractor arm 28 up against the index plate 23, but permits said protractor arm 28 to be rotated with respect to said index plate and protractor.

Above the nut 35 is a disk 36 with splines fitted into grooves cut in the shaft 32 to hold said disk oriented with respect to said shaft. A nut 38 acts as a lock to hold the nut 35 and the disk 36 firmly upon the shaft 32. A handle 39 is fastened to the disk 35 by means of screws 40, by means of which the protractor arm 28 is adapted to be rotated.

A vernier or witness point 41 is indicated upon the protractor arm 28. The protractor arm 28 is also provided with a conventional brake 42, close to the protractor 24, by means of which the protractor arm can be locked in any position about the protractor.

Means are also provided for holding the protractor arm firmly in any one of the most used positions with respect to the protractor, when the usual stresses are applied to said protractor arm in moving said protractor arm over the drawing board, but releasing said protractor arm when greater stresses are applied for the purpose of changing the angular position of said protractor arm.

As an instance of this arrangement, and as shown in Figure 4, notches 43 are provided in the periphery of the index plate 23 in the most used positions. In the example shown, said notches 43 have been provided at 15 degree intervals, starting with the rulers in positions parallel to the edges of the drawing board, and the witness point indicating zero on the protractor. Obviously, the notches in the index plate can be provided at any desired positions.

The notches 43 are preferably V-shaped with the sides of each one at approximately 90 degrees to each other and with a recess at each apex so as to facilitate accurate grinding of said notches. Each notch is so positioned that the bisector of the angle between the two sides, that is to say the bisector of the 90 degree angle, is a radius of the index plate.

A pawl 44 lies in a recess in the under side of the protractor arm 28 and is pivoted about a post 45 which is secured to the protractor arm 28 by means of screw 46. The pawl 44 is provided with a nose 47 which is adapted to be forced toward the index plate 23 by means of a spring 48, one end of which engages a hook 49 on the pawl 44, the central portion of which is looped around a ring 50 on the post 45, and the other end of which presses against one side of the recess occupied by the pawl. The working face of the nose 47 is formed to approximate a large arc of a small circle. The nose 47 is adapted to be forced into the notches 43, and to make a stable two point contact against the sides of said notch when the protractor arm 28 carrying the pawl 44 is suitably oriented with respect to the index plate 23. The spring 48 is of such strength that the nose of the pawl in one of the notches 43 of the index plate 23 will hold the protractor 24 firmly with respect to the index plate 23 and therefore with respect to the protractor 24 when the usual forces are applied to it in moving it across the drawing board; but the nose of the pawl 44 will be forced up the sloping side of the notch and out of the notch when greater stresses are applied to the protractor arm 28 for the purpose of changing its angular position relative to the protractor 24. The hole 51 through the pawl through which the pivotal post 45 is inserted, has slightly tapering sides, the wide end being toward the index plate 23, so that the spring 48 forces the sides of the hole in the pawl 44 against the post 45 and eliminates all play tangential to the periphery of the index plate.

A cover 52 is attached to the protractor arm 28 by means of screws 53.

The automatic indexing device per se as set forth above does not comprise a part of the present invention, but said indexing device is described and claimed in my above-mentioned copending application. The present invention is directed to a locking means for locking the re-

leasing mechanism of the automatic indexing device and rendering it operative or inoperative at will.

One form of such a locking means is shown in Figures 2 to 7, inclusive. In Figure 4 a roller 58, whose diameter is reduced in the central part as indicated by the numeral 59 in Figure 6, is carried in a slot at the moving end of one arm 60 of a lever 61 which is pivoted at 63. A spring 64 presses against the lever arm 60 so that the roller 58 is interposed between the face 65 on the outer side of the pawl 44 and the adjacent side 66 of the recess cut in the protractor arm 28 to receive the pawl 44. The spring 64 is bent around the free end of the pawl 44 and against the side 56 of the pawl recess where it is held by the pawl spring 48. The spring 64 against the side 66 provides a hard surface for the roller 58 to bear upon. The face 65 of the pawl and the side 66 of the recess are at an angle to each other such that the roller 58, pressed by the spring 64, becomes wedged between them and locks the pawl when it drops into one of the notches 43 in the index plate 23.

Referring to Figures 3, 4 and 5, one end of a link 67 is pivoted to the other arm 62 of the lever 61 at 68. A small hole through the link 67 near its other end receives and thereby engages the lower end of a rod 69. The rod 69 passes through and is affixed to a ball 70 which fits freely in the hollow shaft 32 where it is held loosely in its vertical position by the rings 71 and 72. The upper end of the rod 69 passes through a small hole in a thumb bar 73 at one end of which is a thumb piece 74. The thumb bar 73 lies in a recess in the handle 39 which is adapted to receive it. One of the screws 40 and the pin 75 pass through slots 76 and 77 respectively in the thumb bar 73 and restrict its movements.

In actual use the drafting machine is affixed to the board 12 by means of the clamp 11, as in Figure 1, the drafting head being adapted to be moved over the board while the orientation of the protractor 24 is maintained through the pulley and band arrangement. The orientation of the protractor arm 28 with respect to the protractor 24 is maintained through the pawl 44 and notch 43 mechanism. During much of the ordinary routine work, the orientation of the protractor arm 28 is such that the rulers thereon are parallel to the sides of the drawing board and to the primary lines of the drawing itself. At the same time the protractor reading is zero. As it becomes desirable to draw lines in the directions thus indicated at various positions on the board, the drafting head can be moved across the board by taking hold of the handle 39 or of one or the other of the rulers 30, 31 and pushing it into position. During this procedure it is usually desirable to have the pawl 44 locked by the roller 58 as shown in Figure 4.

If it is desired to draw a line making an angle of 15 degrees with one of the primary directions, the left hand is placed upon the handle 39 and the thumb piece 74 is pressed by the left thumb. This causes the thumb bar 73 to move longitudinally carrying with it the upper end of the rod 69. This latter acts as a lever the fulcrum of which is determined by the ball 70. The lower end of the rod 69 then moves in the direction opposite to the movement of the upper end and carries with it the link 67 and the end of the lever arm 62 which is pivoted to said link at 68. This causes the lever 61 to turn upon the pivot 63 and to carry the roller 58 clear of the face 65 of the pawl 44, as is shown in Figure 5, so that the pawl is now held in the notch 43 by the pawl spring 48 only. By holding the handle 39 with the left hand and one or the other of the rulers 30, 31 with the right hand, pressure is applied to force the ruler to take the desired position. When sufficient stress is applied the pawl 44 rises from the notch 43 in which it is seated and the entire protractor arm 28 moves. The thumb piece 74 can now be released. When the 15 degree position is arrived at, the pawl 44 falls into the corresponding notch 43 and the roller 58, carried by the lever arm 60, acting under pressure applied by the spring 64, again locks said pawl 44 as in Figure 4 so that the protractor arm 28 is securely locked in its new position. In like manner the rulers can be set to draw lines in any of the most commonly employed directions. It is clear that when operated as thus described the machine has all of the advantages of any drafting machine with a thumb release as well as many other advantages. One such advantage is that the angle through which the protractor is turned is indicated by the number of clicks resulting from the pawl 44 passing notches 43 in the index plate and the protractor 24 need not be read as often as otherwise.

If the direction of the protractor arm is being changed frequently the device for locking the pawl 44 can be kept inoperative. This is accomplished by pressing the thumb piece 74 and moving the thumb bar 73 longitudinally as before and then moving the thumb piece laterally so that the notch near the end of the slot 77 engages the pin 75 as shown in Figure 5. The thumb is now removed from the thumb piece 74. The roller 58 will remain clear of the face 65 of the pawl 44 until the thumb bar 73 is released by a lateral movement imparted through the thumb piece 74. While the locking device is inoperative as described, the protractor is held in the most used positions by the pawl 44 pressed into one of the notches 43 by the spring 48 only. Then when sufficient stress is applied to rotate the protractor arm 28, the pawl 44 rises from the notch 43 in which it is seated and the entire protractor arm moves. When the 15 degree position is arrived at, the pawl 44 falls into the corresponding notch 43 and the protractor arm is held in position. In like manner the rulers can be quickly set to draw lines in any of the most used positions. It will be noted that the entire manipulation as regards motions of both translation and rotation from one to another of the most used positions can readily be accomplished while holding one of the rulers 30, 31 only. It is clear that when the machine is operated in this manner the indexing device is entirely automatic.

When a line is desired in any position intermediate between those provided for by the indexing mechanism, either when thumb release indexing or automatic indexing is being used, the ruler is brought into said intermediate position and the brake 42 is set to lock the protractor arm 28 in said position.

Obviously, the machine can be modified so that the automatic indexing feature is omitted and so that the machine can only be operated by the thumb releasing mechanism. The only change required to make this modification from the machine heretofore described is to eliminate the spring 48. The operation of this modification is as follows:

In order to rotate the protractor arm 28, the

thumb piece 74 is pressed, thereby carrying the roller 58 clear of the face 65 of the pawl 44, leaving said pawl entirely free to rise out of the notch 43. When the pawl 44 rises in this manner it will stay clear of the notches 43 as long as the thumb piece 74 is depressed. When the thumb piece 74 is released the roller 58 is carried by the lever arm 60, pressed by the spring 64, against the pawl 44. Said pawl is thus urged against the index plate 23 in such a manner that its nose 47 will fall into the next notch 43 as the protractor arm is rotated. The roller 58 will then be carried by the arm 60 and wedged between the face 65 of the pawl 44 and the side 66 of the recess, thereby firmly locking the pawl in the notch in which it is seated.

Another modification of my invention is shown in Figure 8. The rod 69 passing through the ball 70, the thumb bar 73, and the thumb piece 74 are of the same construction and arrangement as already shown and described. A cam 81, pivoted at 82, is pressed by a spring 83 so that its face 84 bears against the pawl 44 locking the nose 47 of said pawl in one of the notches 43 of the index plate 23. An arm 85 on the cam 81 is pivoted at 86 to one end of a link 87. A small hole through said link near its other end receives and thereby engages the lower end of the rod 69. As shown in Figure 8 the pawl 44 is locked in one of the notches 43. It is clear that when the thumb piece 74 is pressed the cam 81 will be turned about its pivot 82 and its face 84 will be moved away from the pawl 44 so that said pawl can rise out of the notch in the index plate when sufficient force is applied to the protractor arm to overcome the force exerted by the spring 48. When the thumb piece 74 is depressed it can be moved laterally so that the notch 78 at one end of the slot 77 engages the pin 75. The locking device will then remain inoperative until the thumb piece 74 is moved so as to disengage the notch 78 from the pin 75. The construction of the remainder of this modification and the use and operation of said modification are deemed to be apparent from the description of the indexing means shown in Figures 1–7 inclusive and will therefore not be repeated herein.

Still another modification of my invention is shown in Figure 9. A cam 89, pivoted to the pawl 44 at 90, is pressed by the spring 91 so that its face 92 bears against the pin 93 thus locking the pawl 44 with its nose 47 in one of the notches 43 of the index plate 23. An arm 94 on the cam 89 is pivoted at 95 to one end of a link 96. The other end of said link is pivoted at 97 to the bell crank 98 affixed to the lower end of the shaft 99. Another bell crank 100 is mounted on the upper end of the shaft 99 and pivoted at 101 to one end of a thumb bar 102, said thumb bar carrying at its other end the thumb piece 103. A slot 104 in the thumb bar receives and is guided by the pin 75. As shown in Figure 9 the pawl 44 is locked in one of the notches 43. It is clear that when the thumb piece 103 is pressed the shaft 99 will rotate and move the link 96 in such a manner as to rotate the cam 89 about its pivot 90 so that its face 92 is moved away from the pin 93. The pawl 44 will then be free to rise out of the notch in the index plate when sufficient force is applied to the protractor arm to overcome the force exerted by the spring 48. When the thumb piece 103 is depressed it can be moved laterally so that the notch 105 at one end of the slot 104 engages the pin 75. The locking device will then remain inoperative until the thumb piece 103 is moved so as to disengage the notch 105 from the pin 75. From this description it is clear that the actual manipulation of this device is practically the same as in operating either of the two devices already described and shown in Figures 2 to 8 inclusive even though its mechanism is somewhat different.

From the foregoing description taken in connection with the accompanying drawings, the uses, advantages, and operation of the drafting machine of my invention will be readily understood by those skilled in the art to which the invention appertains. While I have described the principle of operation together with the forms of my invention which I now consider to be the best embodiments thereof, I desire to have it understood that the machine shown is merely illustrative and that the invention is not to be limited to the details disclosed herein, but is to be accorded the full scope of the appended claims.

I claim:

1. The combination of a member movable over a flat surface while its orientation with respect to said flat surface is maintained through mechanical linkage to said flat surface, a second member attached to the first member and rotatable with respect to said first member, holding means operating between said two members for holding said members in any one of a plurality of prescribed angular relationships to each other, said holding means being releasable by forcibly rotating the second member, and locking means acting directly on said holding means for preventing the release of said holding means.

2. In a drafting machine, the combination of: a protractor movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, a protractor arm rotatable with respect to said protractor and having means for holding one or more rulers, holding means operating between said protractor and said protractor arm for holding the protractor arm in any one of a plurality of fixed angular relationships with respect to said protractor while the usual stresses are applied to said protractor arm in moving it across said board, but releasing said protractor arm when greater stresses are applied to said arm for the purpose of changing its angular position, locking means adapted to press against said holding means for preventing the release of said holding means and means for controlling the operation of said locking means.

3. The combination of a member movable over a flat surface while its orientation with respect to said flat surface is maintained through mechanical linkage to said flat surface, a second member attached to the first member and rotatable with respect to said first member, holding means operating between said two members releasable by forcibly rotating the second member, locking means acting directly on said holding means to positively prevent the release of said holding means and means for controlling the operation of said locking means through the manipulation of a single member.

4. The combination of a disk movable over a board while its orientation with respect to the board is mantained through mechanical linkage to said board, an arm rotatable about said disk, holding means operating between said disk and said arm comprising V-shaped notches in said disk, a pawl pivoted to said arm, said pawl having a nose adapted to be received by said notches,

a spring forcing the nose of said pawl against the periphery of said disk, and locking means adapted to press against and lock said pawl in holding position.

5. The combination of a disk movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, an arm rotatable about said disk, holding means operating between said disk and said arm comprising V-shaped notches in said disk, a pawl pivoted to said arm, said pawl having a nose adapted to be received by said notches, a spring forcing the nose of said pawl against the periphery of said disk and locking means for preventing the release of said holding means, said locking means comprising a locking member urged against the pawl in such a manner as to prevent any movement of the nose of said pawl from the notch in which it is seated.

6. The combination of a disk movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, an arm rotatable about said disk, holding means operating between said disk and said arm comprising V-shaped notches in said disk, a pawl pivoted to said arm, said pawl having a nose adapted to be received by said notches, a spring forcing the nose of said pawl against the periphery of said disk, locking means for preventing the release of said holding means, said locking means comprising a locking member urged against the pawl in such a manner as to prevent any movement of the nose of said pawl from the notch in which it is seated, and means for controlling the operation of said locking means comprising a lever system adapted to move the locking member through the manipulation of a single member.

7. In a drafting machine, the combination of: a protractor movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, a protractor arm rotatable with respect to said protractor and having means for holding one or more rulers, holding means operating between said protractor and said protractor arm for holding the protractor arm in any one of a plurality of fixed angular relationships with respect to said protractor, said holding means comprising a disk secured to said protractor, V-shaped notches around the periphery of said disk, a pawl having a nose adapted to engage said V-shaped notches, a spring urging the nose of said pawl against the periphery of said disk, locking means for preventing the release of said holding means, said locking means comprising a locking member adapted to be urged against the pawl in such a manner as to prevent any movement of the nose of said pawl from the notch in which it is seated, resilient means urging said locking member against said pawl, and means for controlling the operation of said locking means.

8. In a drafting machine, the combination of: a protractor movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, a protractor arm rotatable with respect to said protractor and having means for holding one or more rulers, a handle connected to said protractor arm, holding means operating between said protractor and said protractor arm for holding the protractor arm in any one of a plurality of fixed angular relationships with respect to said protractor, said holding means comprising a disk secured to said protractor, V-shaped notches around the periphery of said disk, a pawl having a nose adapted to engage said V-shaped notches, a spring urging the nose of said pawl against the periphery of said disk, locking means for preventing the release of said holding means, said locking means comprising a locking member adapted to be urged against the pawl in such a manner as to prevent any movement of the nose of said pawl from the notch in which it is seated, resilient means urging said locking member against said pawl, and a movable thumb piece operatively connected with said locking member and in engagement with said handle.

9. In a drafting machine, the combination of: a protractor movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, a protractor arm rotatable with respect to said protractor and having means for holding one or more rulers, a handle connected to said protractor arm, holding means operating between said protractor and said protractor arm for holding the protractor arm in any one of a plurality of fixed angular relationships with respect to said protractor, said holding means comprising a disk secured to said protractor, V-shaped notches around the periphery of said disk each of whose sides are at approximately ninety degrees to each other and so positioned that the bisector of each notch is a radius of the disk and each notch having a recess at its apex, a pawl having a nose adapted to engage said V-shaped notches, a spring urging the nose of said pawl against the periphery of said disk, locking means for preventing the release of said holding means, said locking means comprising a locking member adapted to be urged against the pawl in such a manner as to prevent any movement of the nose of said pawl from the notch in which it is seated, resilient means urging said locking member against said pawl, and means for controlling the operation of said locking means comprising a lever system adapted to move the locking member through the manipulation of a thumb-piece located adjacent to the handle.

10. In a drafting machine, the combination of: a disk movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, an arm rotatable about said disk and provided with means for holding one or more rulers, holding means operating between said disk and said arm for holding said arm in any one of a plurality of fixed angular relationships with respect to said disk, said holding means embracing V-shaped notches around the periphery of said disk each of whose sides are at approximately ninety degrees to each other and so positioned that the bisector of the angle between the sides of each notch is a radius of the disk and each notch having a recess at its apex, a pawl having a nose adapted to engage said V-shaped notches, a spring urging the nose of said pawl against the periphery of said disk, and manually controlled means for locking the nose of said pawl in any one of said notches.

11. The combination of a member movable over a flat surface while its orientation with respect to said flat surface is maintained through mechanical linkage to said flat surface, a second member attached to the first member and rotatable with respect to said first member, holding means operating between said two members,

and locking means adapted to press against and prevent release of said holding means.

12. The combination of a member movable over a flat surface while its orientation with respect to said flat surface is maintained through mechanical linkage to said flat surface, a second member attached to the first member and rotatable with respect to said first member, holding means operating between said two members comprising a holding member and a locking means acting directly on said holding means for locking said holding member in the holding position, and means for controlling the operation of said locking means through the manipulation of a single member.

13. The combination of a disk movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, an arm rotatable about said disk, holding means operating between said disk and said arm comprising V-shaped notches in said disk, a pawl pivoted to said arm, said pawl having a nose adapted to be received by said notches, and locking means for urging the nose of said pawl against the periphery of said disk and preventing any movement of the nose of said pawl from the notch in which it is seated.

14. In a drafting machine, the combination of: a protractor movable over a board while its orientation with respect to the board is maintained through mechanical linkage to said board, a protractor arm rotatable with respect to said protractor and having means for holding one or more rulers, a handle connected to said protractor arm, holding means operating between said protractor and said protractor arm for holding the protractor arm in any one of a plurality of fixed angular relationships with respect to said protractor, said holding means comprising a disk secured to said protractor, V-shaped notches around the periphery of said disk and a pawl having a nose adapted to engage said V-shaped notches, locking means securing said holding means, said locking means comprising a locking member adapted to be urged against the pawl in such a manner as to seat the nose of said pawl in any one of the notches in said disk and to prevent any movement of the nose of said pawl from the notch in which it is seated, resilient means urging said locking member against said pawl, and a movable thumb piece operatively connected with said locking member and in engagement with said handle.

15. The combination of a disk movable over a surface, mechanical linkage for maintaining the orientation of said disk with respect to the surface, an arm rotatable about said disk, holding means embracing a detent for maintaining said arm in any one of a plurality of prescribed angular positions with respect to said disk, locking means adapted to act directly on said detent and lock said holding means in operative position and means for controlling the operation of said locking means.

16. A drafting machine comprising a disk movable over a drafting surface, mechanical linkage for maintaining the orientation of said disk with respect to the drafting surface, a ruler carrying arm rotatable about said disk, holding means for holding said arm in any one of a plurality of prescribed angular positions with respect to said disk, said holding means embracing notches in said disk, a pawl pivoted to said arm, said pawl having a nose so constructed and arranged as to fit into holding position in any one of said notches and locking means adapted to act directly on said pawl to lock the same in holding position.

17. A drafting machine comprising a disk movable over a drafting surface, mechanical linkage for maintaining the orientation of said disk with respect to the drafting surface, a ruler carrying arm rotatable about said disk, holding means for holding said arm in any one of a plurality of prescribed angular positions with respect to said disk while the necessary force is applied to said arm in moving it over the drafting surface and for releasing said arm when greater force is applied to said arm for the purpose of changing its angular position with respect to said disk, said holding means embracing V-shaped notches in said disk, a detent carried by said arm, said detent having a nose of arcuate form so constructed and arranged as to fit into and make stable two-point contact with the sides of any one of said notches, and locking means adapted to lock said detent in holding position in any one of said notches.

18. A drafting machine comprising a disk movable over a drafting surface, mechanical linkage for maintaining the orientation of said disk with respect to the drafting surface, a ruler carrying arm rotatable about said disk, holding means embracing a detent for maintaining said arm in any one of a plurality of prescribed angular positions with respect to said disk, and locking means adapted to act directly on said detent and lock the same in operative position.

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