June 3, 1958 R. A. BARNETT 2,836,893

APPARATUS FOR MAKING PERSPECTIVE DRAWINGS

Filed Sept. 19, 1956 6 Sheets-Sheet 1

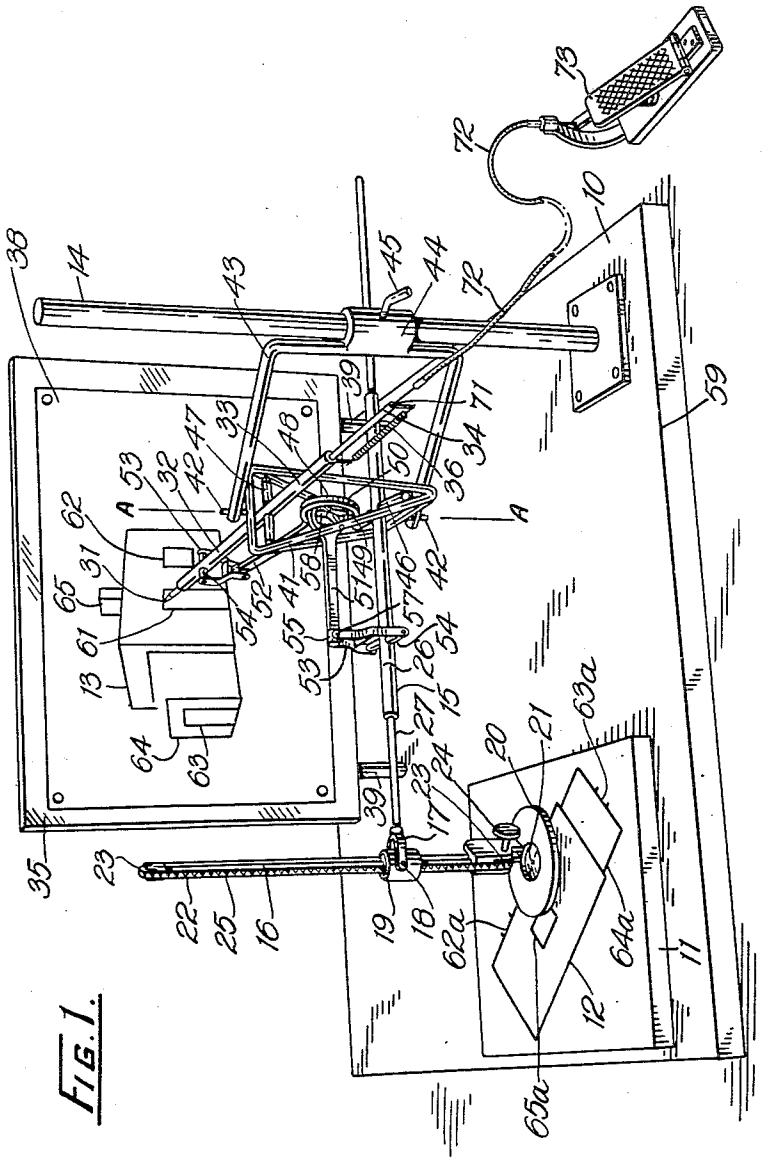

FIG. 1.

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FIG. 3.

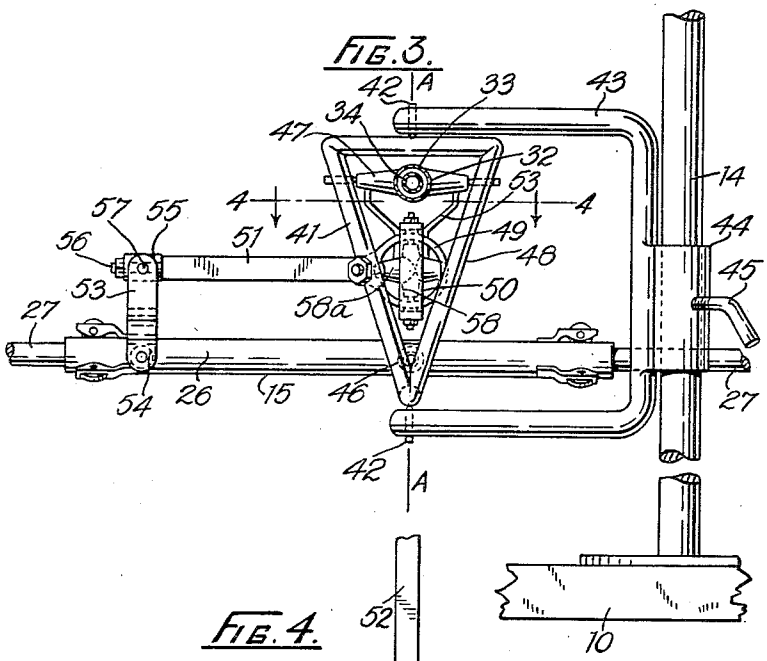


FIG. 4.

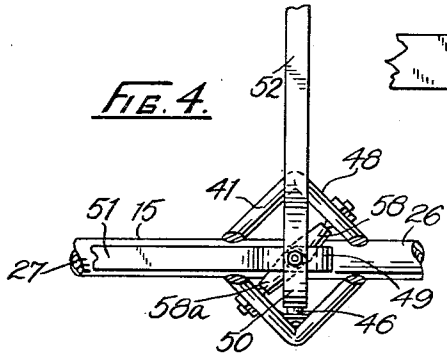
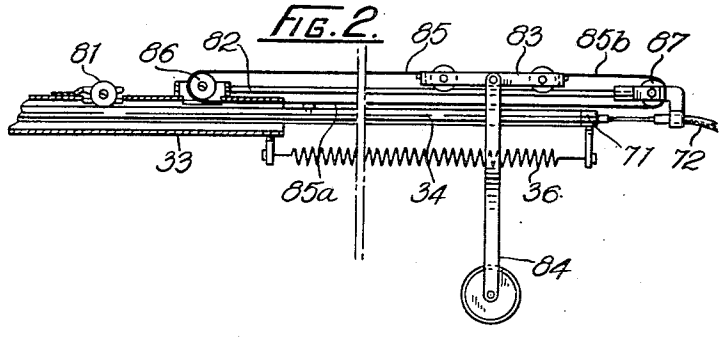


FIG. 2.



APPARATUS FOR MAKING PERSPECTIVE DRAWINGS

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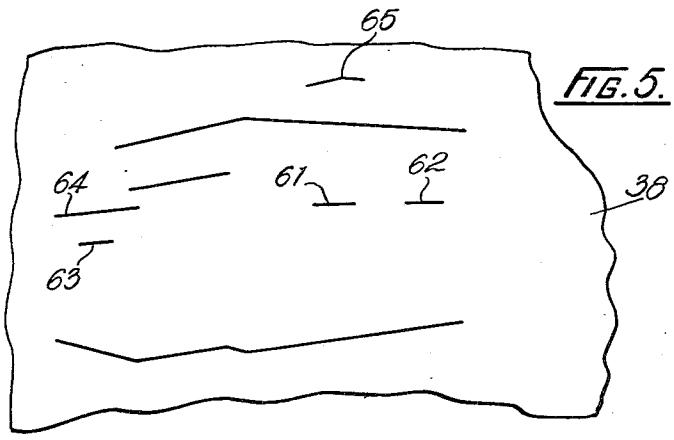

FIG. 5.

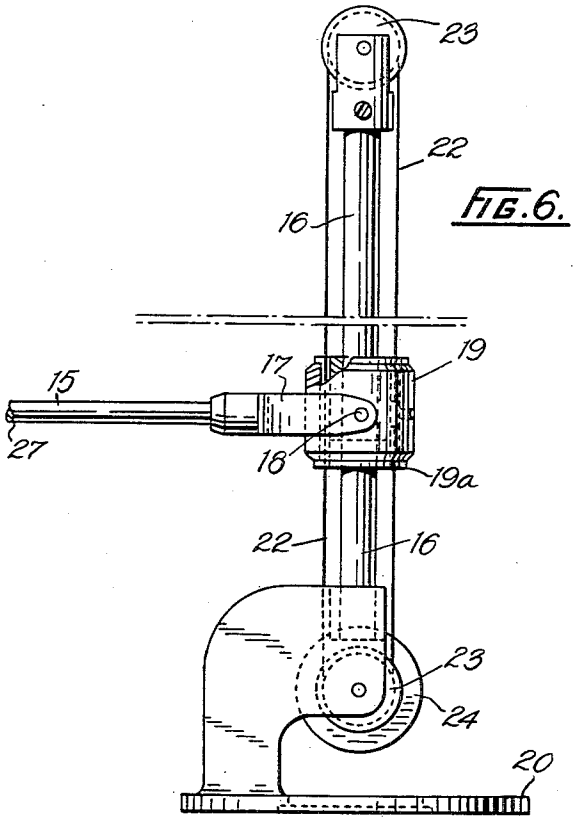

FIG. 6.

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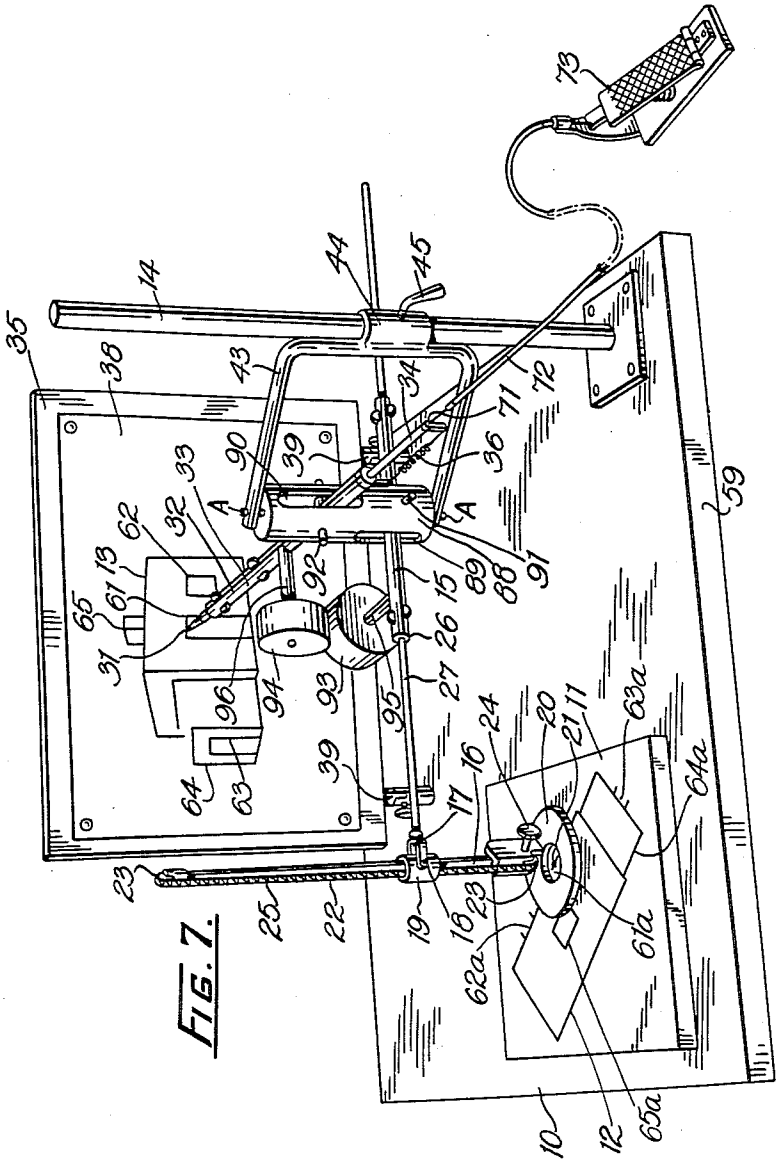

FIG. 7.

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FIG. 8.

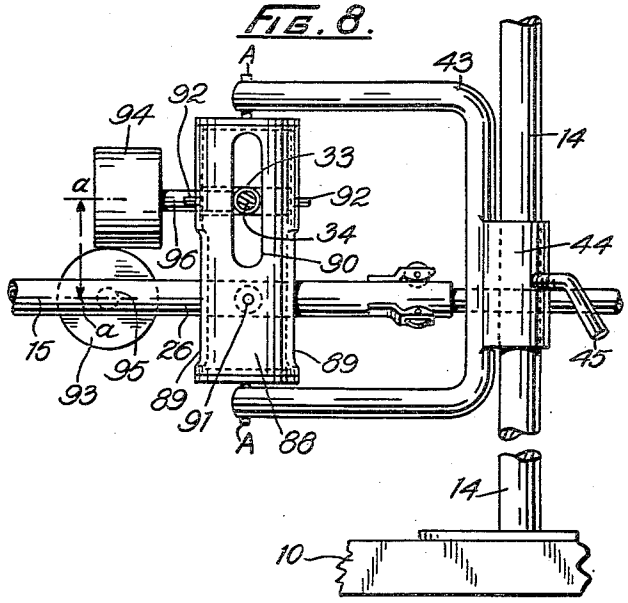


FIG. 9.

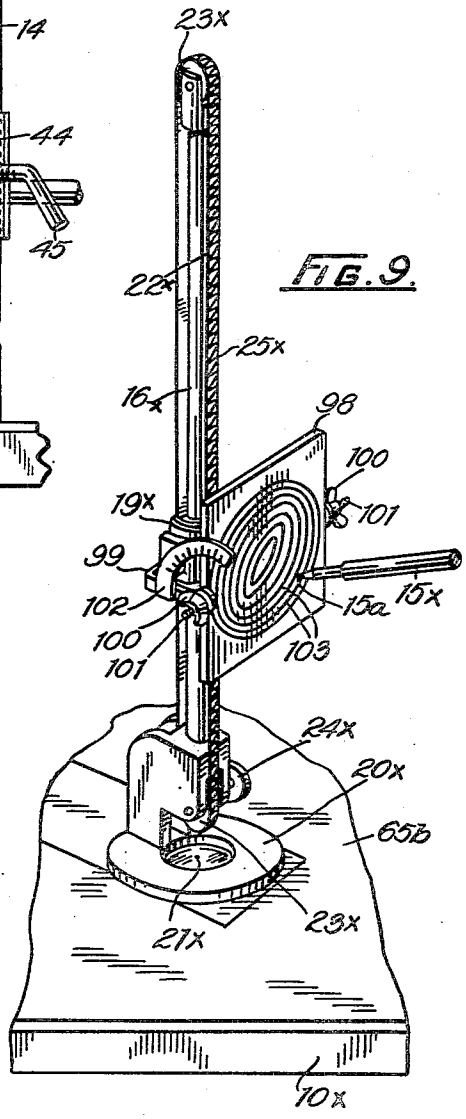
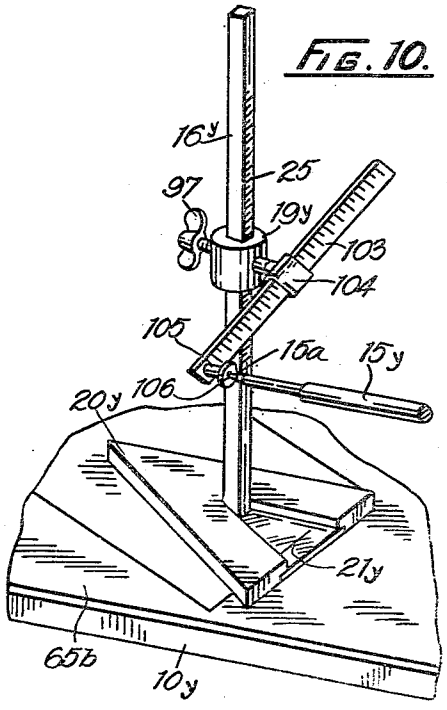


FIG. 10.



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Filed Sept. 19, 1956 6 Sheets-Sheet 6

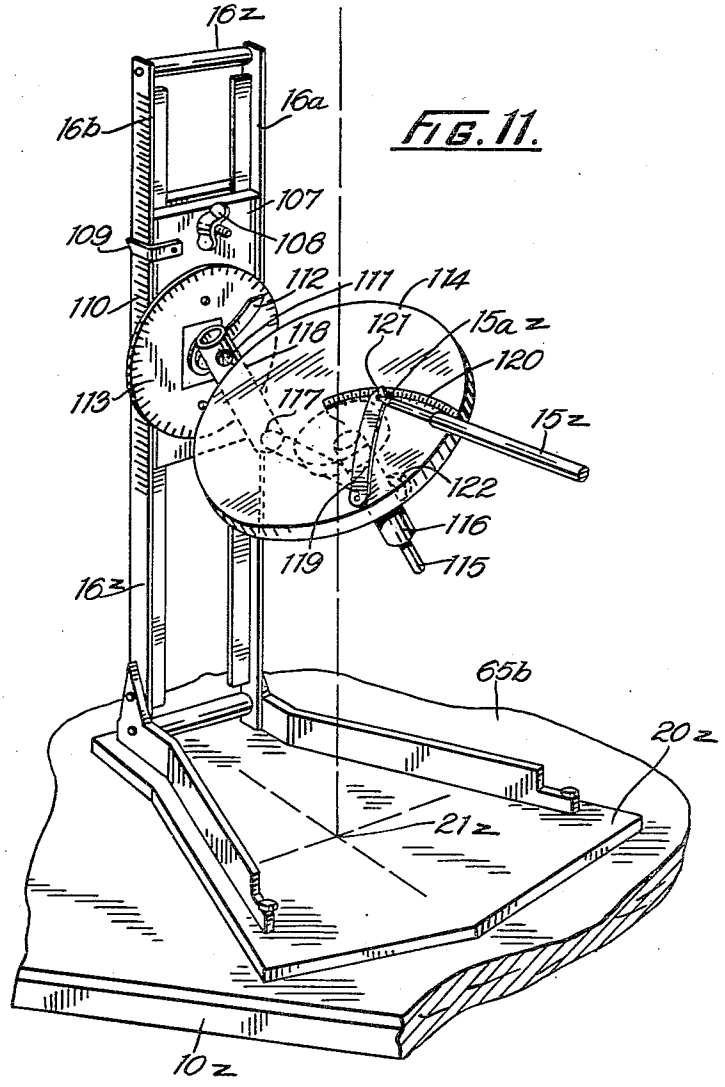

FIG. 11.

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2,836,893

APPARATUS FOR MAKING PERSPECTIVE DRAWINGS

Robert A. Barnett, Germiston, Transvaal, Union of South Africa

Application September 19, 1956, Serial No. 610,865

Claims priority, application Union of South Africa August 9, 1954

24 Claims. (Cl. 33—18)

This invention relates to perspective drawing machines of the kind in which the movements imposed on a tracing point are transmitted to a drawing point associated with a flat drawing surface, through an arm pivoted at the fixed station point. The station point is the equivalent of the eye of the observer and the object looked at is located to be scanned by the tracing point. In most cases the object is a plan view the altitudes of the various points of which are known and which is orientated in relation to the station point in conformity with the perspective view to be drawn. For convenience, the plan is usually laid on a horizontal surface and the tracing point is the lower extremity of a vertical column to which the arm is secured at a variable level. Altering the point of attachment of the arm to the column is equivalent to variation of the angle of sight in the vertical plane.

The basis upon which these machines proceed, in relation to the preparation of a perspective view derived from a plan and given data on altitudes, is that perspective projections are made in several horizontal planes at different altitudes, the inclinations of the arm being varied from plane to plane in conformity with the altitude of each plane. The several perspective views thus obtained are then amalgamated into a single perspective drawing by inserting the lines which are vertical or have a vertical direction component. In some cases the verticals are drawn by movement along the column end of the arm; in other cases the verticals are interpolated manually on the perspective drawing.

When the object is three-dimensional, the procedure is simplified in that, with the arm made variable in length and including the tracing point, the latter is caused to scan the object in the three-dimensions, as the eye does, and the drawing point produces the perspective view, as it is produced on the retina of the eye.

The failure of these machines to win general acceptance among architects and enginneers can probably be ascribed to any one or more of three factors; high cost due to complexity, complication in the use of the machine and disadvantages in the design of simple machines. These disadvantages may be inherent. For instance the persepective view may be produced on too large or too small a scale, or in reverse; or the drawing being made may not be visible to the operator while he is at work at the tracing position.

The object of the present invention is to produce a machine which eschews mechanical complication so that its cost is moderate, which is easy to operate, in which the scale of the perspective drawing is within the control of the operator, and in which the drawing being made is in the operator's view as he causes the tracing point to scan the object.

A perspective drawing machine according to the invention comprises a horizontal table, a vertical drawing board, an extensible tracing arm and an extensible drawing arm at right angles to one another in plan, a vertical column, a plinth supporting the column and standing

movably on the table, means swivellably connecting an end of the tracing arm to the column and movable up and down the column, a tracing point provided by the plinth, a writing instrument mounted at one end of the drawing arm, a coupling, rotatable about a vertical axis, connecting the drawing and tracing arms one above the other and constraining them against relative movement in the horizontal plane while permitting relative pivotal movement in vertical planes, a vertical post rigidly fixed to the table, means to support the coupling on the post at an adjustable height, and additional coupling means connecting the drawing and tracing arms, displaced in plan from the vertical axis of the coupling, spanning the vertical distance between them and comprising a universal joint.

Other features will be apparent from the following description of various embodiments of the invention.

Several embodiments of the invention are illustrated by way of example in the accompanying drawings in which

Figure 1 is a perspective view of one embodiment;

Figure 2 is an elevation, partly in section, of a counterbalancing means for the drawing arm;

Figure 3 is an elevation of the coupling device;

Figure 4 is a horizontal section on the line 4—4 of Figure 3;

Figure 5 is a view of a partly completed drawing;

Figure 6 is a detail view of part of the tracing column;

Figure 7 is a perspective view of another form of the invention;

Figure 8 is a fragmentary side view, partly in section of the coupling means of Figure 7;

Figure 9 is a perspective view of an alternative form of tracing column;

Figure 10 is a perspective view of another form of tracing column; and

Figure 11 is a perspective view of yet another form of tracing column.

In the drawings, 10 denotes a table on which the machine stands. On a section 11 of the table surface the object from or of which a perspective view is to be made is mounted. In the drawing this is shown as a plan view 12 of the building 13 shown in Figures 1, 5 and 7.

A vertical pillar 14 is mounted on the table and the tracing arm 15 is carried by it in a coupling device later to be described.

In the case of a flat object such as the plan view 12, the tracing point is provided at the lower end of a vertical tracing column 16 to which an end of the tracing arm 15 is secured by a swivelling clevis 17 engaging, through pivot pins 18, a collar 19 that rotates around a core 19*a* that slides on the column 16.

To ensure verticality of the column 16, it is based on a broad plinth 20, preferably of transparent material, on which the tracing point occurs as a spot 21.

The collar 19 is attached to one bight of an endless band 22, that passes around pulleys 23 mounted towards the ends of the column 16. One pulley is rotatable by means of a knob 24, operation of which varies the height of the collar 19 above the table level and thus the inclination of the arm 15.

The collar is associated with a scale 25 calibrated in units of height, for instance the scale is applied to the band 22.

To allow for lost motion between the tracing point 21 and the pivot of the arm 15—the station point—in the coupling device, the arm consists of a sleeve 26 held by the device and a rod 27 slidable in it; that is, so that the drawing arm will be unresponsive to movements of the point 21 transverse to the drawing arm and to the components of movement of the point in that direction.

The drawing point is a writing instrument 31 that terminates a drawing arm 32, which is carried by the

coupling device. The arm, like the tracing arm **15**, is constructed to allow lost motion between the device and the instrument **31**, and consists in a sleeve **33** held by the device, and a rod **34** slidable in it and carrying the instrument **31**. The latter is biassed towards a flat, upright, drawing board **35** mounted on the table **10** by a tension spring **36** or an elastic band, and is capable of retraction from the board against the resistance of the spring **36** or the band.

The outer end of the arm **32** may carry the counterbalance weight, shown in Figure 2 and described later.

The board **35** has a piece of drawing paper **38** pinned to it, on which the perspective view is to be made; and is mounted on posts **39**.

The core of the invention is the separation of tracing arm and drawing arm, and the motion-transmitting means between them that ensures that the drawing arm, despite the separation, will be the slave of the tracing arm.

In all embodiments, the arms are at right angles to one another and the drawing arm **32**, being the slave of the tracing arm **15**, remains at right angles to it whatever the behaviour of the tracing arm.

The particular motion-transmitting means illustrated in Figures 1, 2 and 3 is the coupling device which has been referred to above and which in this embodiment is a Hooke's joint device **48**. Its virtues are that it is uncomplicated and compact, not liable to go out of order, and that it imposes on the drawing instrument **31** movement that causes the instrument to depict the perspective drawing right side up and in free and close view of the operator.

The device consists in an open framework **41** that is pivotally supported on a vertical axis A—A by pin bearings **42** provided by a yoke **43** that is mounted on the pillar **14** by means of a slidable collar **44**, that can be locked in any position on the pillar by a locking screw **45**.

The sleeve **26** of the tracing arm **15** is connected to the framework by a horizontal spindle **46** that constrains it against all movement relatively to the frame other than pivotal movement about the axis of the spindle. Similarly the sleeve **33** of the drawing arm **32** is pivoted on a horizontal spindle **47**, set at an angle to the spindle **46** which, in the embodiment being discussed, is a right angle.

The arms **15** and **32** are directly connected together through the Hooke's joint device **48**. One element **49** of the outer member of the Hooke's joint is secured to a link **51** that extends parallel with the tracing arm **15** and the other element **50** is secured to a link **52** that extends parallel with the drawing arm **32**. Each link **51**, **52** is connected to its arm **15**, **32** by a clevised strap **53** that straddles the arm and is pivotally secured to it by cross pins **54**. The links are so connected to the straps by means of a head **55** that is rotatable on the reduced extremity **56** of each arm, the head being pivoted to the straps by spindles **57** held by the straps.

In order to transmit tilting movement of the tracing arm **15** to the drawing arm **32**, the limb **58***a* of the central member **58** of the Hooke's joint **48** is pivoted to the frame about a horizontal axis that is inclined to the axis of both arms **15** and **32**, to maintain the arms in their prescribed angular relationship. As this relationship is a right angle, the member is at an angle of 45° to each axis.

Consideration will show that the linkages described tie the arms **15**, **32** together in a rigid relationship in which neither arm is capable of movement not imposed on it by the other. Thus, when the tracing spot **21** is moved in the direction normal to the edge **59** of the table **10**, the motion is transmitted via the spindle **46** to the framework **41**, and by the framework to the drawing arm **32** through the spindle **47**. Assuming the arm **15** to be horizontal, as this motion is wholly normal to the planes of the pivotal movement permitted the arms **15**, **32** about the spindles **46**, **47**, the Hooke's joint **48** plays no part therein and the arms are solidly locked together. Movement of the spot **21** parallel to the edge **59** is thus transmitted to the drawing instrument **31** as a horizontal movement.

Movement of the point **21** in the direction parallel to the edge **59** either are ineffective to affect the drawing arm **32** if the tracing arm **15** is horizontal i. e. if the line of sight is horizontal, and the arm **15** is itself parallel to the edge **59**. If the arm **15** is inclined (i. e. if the line of sight is up or down), movements of the point **21** cause the tracing arm **15** progressively to vary its inclination to the horizontal as the distance between the column **16** and the station point progressively increases or decreases; that is, as the angle of the arm to the horizontal changes whereupon the linkages between the arms **15**, **32** (without moving the framework **41**) cause the drawing arm **32** to tilt correspondingly, upwardly, if the point **21** is approaching the station point (that is, if the angle of the arm **15** to the horizontal is increasing), downwardly if it is receding from it (that is, if the angle of the arm to the horizontal is decreasing).

Thus, every movement of the spot **21** in the plane of the table **10** is resolved into two direction components, one transmitted to the instrument **31** through bodily movement of the frame **41**, and the other through the Hooke's joint **48**. Since, in so far as both components of motion are concerned, the vertical and horizontal angular variations respectively of the arm **15** only are transmitted, irrespective of the distance in the plane of the table traversed by the spot, it follows that true recession of planes is achieved and that the instrument **31** will draw a true perspective representation of the two-dimensional plan **12** as seen from the station point.

The counterbalancing means mentioned above and shown in Figure 2 is necessary to counteract the tendency of the rod **34** of the drawing arm **32** from being gravitationally projected towards or away from the board **35** when the angle of inclination of the arm **32** to the horizontal exceeds the angle at which the rod **34** will slide gravitationally within the sleeve.

The rod **34** is shown as mounted for sliding movement within the sleeve **33** on rollers **81**, which are journaled in the sleeve. The sleeve carries an extension arm **82** on which a wheeled carriage **83** runs. The carriage supports a weighted pendulum **84**, the carriage and the pendulum being substantially equivalent in weight to the rod **34** and its attachments.

The carriage and the rod **34** are both tied to an endless cord **85** which passes round pulleys **86**, **87**, one **86** of which is mounted on the sleeve **33** and the other on the extension arm **82**.

When the arm **32** is inclined downwardly it urges the bight **85***a* of the cord downwardly, and the bight **85***b* thus tends to propel the carriage **83** upwardly. Contrariwise when the arm **32** is inclined upwardly, the carriage tends to be propelled downwards; so that in both cases a state of equilibrium of forces exists.

Without a compensating device of this sort, the drawing instrument **31** either digs into the paper **38** or falls away from it.

In the embodiment of Figures 7 and 8, the motion-transmitting means includes a coupling **88**, which is supported pivotally about a vertical axis A–A by a yoke **43** that is mounted on the pillar **14** by means of a slidable collar **44** that can be locked in any position on the pillar by a locking screw **45**.

The coupling **88** has two vertical slots **89**, **90**, at right angles to one another and one above the other, cut through it. The tracing arm **15** passes through the lower slot **89** and is pivotally connected to the coupling by the horizontal cross pin **91**. The drawing arm **32** passes through the upper slot **90** and is pivotally connected to the coupling by the horizontal cross pin **92**.

Thus both arms **15** and **32** are constrained against movements relatively to the coupling, otherwise than in

vertical planes at right angles to one another. Movements of the tracing arm in the horizontal plane or movements having a horizontal direction component cause rotation of the coupling about the axis A–A, which rotation is transmitted to the drawing arm **32** and causes corresponding horizontal displacement of the arm.

The motion-transmitting means includes also a pair of members which in the drawing are shown as contacting cylinders **93, 94**; one, **93**, mounted on a horizontal arm **95** projecting rigidly from and at right angles to the sleeve **26** of the tracing arm **15**, and the other **94** mounted on a horizontal arm **96** projecting rigidly from and at right angles to the sleeve **33** of the drawing arm **32**.

The centre of gravity of the arm **32** and the structure it carries is located between the pivot pin **92** and the board **35**, so that the two cylinders are held gravitationally in contact with one another. Thus each cylinder provides one element of a pair of contact surfaces held together and free to move in contact with one another as the movements of the tracing arm **15** dictate.

The members **93, 94**, are such that the distance "*a–a* Fig. 8," which is the vertical distance between the horizontal planes containing the two arms **95, 96**, is substantially the same at all times as the vertical displacement of the pin **92** above the pin **91**. This condition is satisfied by forming the members **93, 94** as cylinders, as illustrated, but could also be satisfied by making them conical with opposed tapers, or for that matter as flat contacting plates universally pivoted to the arms **95, 96**. However, the simplest form is that illustrated; and to minimise friction the cylinders, in the embodiment being described, are rollers.

It could also be that the members **93, 94** are held in contact by a spring if they are not biassed gravitationally together, but this again would introduce complexity.

As in the case of the embodiment of Figures 1–3 the structure described ties the arms **15, 32** together in a rigid relationship in which the drawing arm **32** is constrained to movement imposed on it by the tracing arm **15**. When the tracing spot **21** is moved in the direction normal to the edge **59** of the table **10**, the motion is transmitted via the pin **91** to the coupling **88** and by the coupling to the drawing arm **32** through the pin **92**. As this motion is wholly normal to the planes of the pivotal movement permitted the arms **15, 32** about the pins **91, 92**, the members **93, 94**, play no active part therein and the arms are solidly locked together. Movement of the spot **21** normal to the edge **59** is thus transmitted to the drawing instrument **31** as a horizontal movement.

Movements of the point **21** in the direction parallel to the edge **59**, if the arm is inclined, cause the tracing arm **15** progressively to vary its inclination to the vertical as the distance between the column **16** and the station point progressively increases or decreases; whereupon the members **93, 94** act to cause the drawing arm **32** to tilt correspondingly, upwardly, if the point **21** is approaching the station point, downwardly if it is receding from it, without movement of the coupling **88**.

Apart from the coupling means, the construction of the machine of Figures 7 and 8 is identical with that of Figures 1–3.

After the explanatory comments made above, the method of use of either apparatus will be reasonably clear. The perspective angle having been decided, the plan **12** is correspondingly oriented in relation to the station point. The yoke **43** is adjusted on the pillar **14** to correspond to the altitude of the station point, and the spot **21** and the collar **19** set for the co-ordinates of a central point of the drawing to be made. The collar **15** is moved to the altitude of the plane first to be regarded, the spot **21** is moved to scan the plan in the first plane; the collar is moved to the altitude of the next plane, the plan at that plane is scanned; and so on until all the necessary planes have been dealt with.

There then follows the amalgamation of the perspective plans. In so far as true vertical lines are concerned these are integrated into the perspective view by stationing the spot **21** on the appropriate point on the plan and turning the knob **24** to move the arm **15** upwardly or downwardly for the distance on the scale corresponding to the height of the lines.

As to lines having both vertical and horizontal components, these are necessarily interpolated into the perspective drawing manually, although, in the case of curved lines, a series of points in horizontal planes at different levels may be plotted to facilitate their insertion in the perspective drawing. Since at least in the case of an architectural drawing the preponderance of upward lines are truly vertical, the necessity to interpolate lines into the perspective drawings by hand is seldom burdensome.

Taking, as an example of the procedure discussed above, the house shown in perspective view in Figure 1, the plan view, shown in the tracing position in Figure 1, is prepared to show (at **61***a*, **62***a*, **63***a*) the location of the door **61**, the window **62** and the door **63** in the lean-to **64**. The plan is mounted on the table **10** in the determined orientation. Selecting a station point at, say lintel of the window **62**, the arm **15** is set on the pillar **14** at its altitude. The collar **19** is then dropped to ground level and the ground plan of the house is scanned, bearing in mind of course that portions of the plan will be hidden from sight by the superposed structure. The arm is then raised successively to the altitude of the window sill, the window lintel, the door lintels, the upper and lower roof levels of the lean-to, the roof and the chimney top. This will produce a perspective drawing as shown in Figure 1 or Figure 7.

The verticals are then introduced by location of the spot **21** successively at the corners of the building, and of the chimney **65** and at the stiles of doors and windows, and moving the arm **15** the distances appropriate to the several altitudes. The resulting perspective drawing, shown in Figure 1, or Figure **7** is complete save for the manual operation of adding the sloping roof of the lean-to.

As each successive operation in the preparation of a perspective drawing is completed, the writing instrument **31** is withdrawn from the paper **38** against the resistance of the biassing spring or band **36**. This may be done manually but it will be appreciated that a draftsman who has both hands employed in directing the tracing spot **21** along the object **12** will waste time and tend to lose concentration if his observation of the object and of the emerging perspective drawing be interrupted by the necessity to retract the instrument **31** by hand.

There is the provision of means whereby retraction of the instrument is effected by the foot. To this end, the rear end **71** of the arm **34** has attached to it a Bowden cable **72** which is led below the table **10** close to floor level, where it is attached to a foot pedal **73**. The operator, by treading on the pedal causes the instrument to be retracted without the necessity to disturb his concentration on the work in hand.

Many of the advantageous features of the invention have already been noted. Others which may be stressed are the compactness of the design, and the fact that the perspective drawing being made is under the observation of the draftsman at close hand, due to the mounting of the drawing arm **32** at an angle to the tracing arm **15** and of the board in an upright position facing the operator, a disposition which applicant believes to be new in the art. Furthermore, the scale of the perspective drawing vis-a-vis the object is infinitely variable over a wide range within the control of the draftsman merely by adjustment of the ratio of the effective lengths of the arms **15** and **32**, this adjustment being possible by reason of the slidability of the rods composing the arms within their sleeves.

The machine is highly flexible in that any perspective

view, exterior or interior, can be drawn in a fraction of the time necessary to do so by ordinary drafting methods.

A word may be said about three-dimensional objects. When these are to be drawn, the object may be located on the table **10**, the tracing arm **15** is withdrawn from the collar **19** to free it from the tracing column **16**, and a pointer secured to it; and after setting of the machine, the object is scanned, the instrument **31** producing a true perspective drawing of the object.

Developments of the invention are shown in Figures 9 to 11.

An elevational line that is vertical can be transmitted to the drawing arm **32** by moving the point of connexion of the tracing arm **15** along the column **16** for a distance corresponding to the height of the vertical line, while the spot **21** is kept stationary at the point on the plan **65***b* appropriate to the vertical line. If, however, the line be inclined to the vertical, it cannot be thus translated to the drawing arm **32**. The reason for this is that given above, that machines of the kind in question produce perspective views of the object being drawn in a number of horizontal planes intersecting the object, and the drawing is completed by connecting the series of views together by lines corresponding to the extent of the object in the third dimension. The verticality of the tracing column thus confines those lines which can be drawn by the machine itself to lines which are themselves vertical; so that the utmost aid that the machine can give for inclined lines is to facilitate plotting of the points of intersection of the lines with a succession of horizontal planes, the points then being joined together manually.

If the inclined lines be rectilinear this procedure presents no difficulty as has been seen, but this is not so when they are curvilinear. Thus the drawing in perspective of a circle (which is the usual curvilinear line encountered) that does not lie in a horizontal plane is beyond the scope of the machine.

The arrangements of Figures 9 to 11 are designed to deal with non-vertical and especially curvilinear lines, and each proceeds upon the basis that it provides means defining a path that is a simulacrum of the line, means to orientate the path in space in conformity with a plan view of the line, and means to constrain the tracing point of the tracing arm to move along the path.

Since the normal procedure will be first to scan the plan view, the orientation of the path will customarily be related to a plan view already located and scanned.

It will be apparent that the basis of the devices of Figures 9 to 11 is the simulation of a three-dimensional object, the plan representing two of the dimensions and the path the third. It follows that any line in the third-dimension, be it recti- or curvilinear, can be translated to the drawing arm **32**, within the practical limitations of defining the path.

In Figures 9 to 11 there is seen the end of a tracing arm **15**, **16** represents in all figures the vertical tracing column which in Figure 9 is like that illustrated in Figures 1 and 7, but is simplified in Figures 10 and 11. In Figures 9–11, reference numbers similar to those used in Figs. 7 and 8 are employed, with the addition of the suffixes "X," "Y" and "Z" respectively.

In Figure 10 the collar **19***y* is moved up or down directly by hand and can be secured at any height on the column by a thumb screw **97**.

In Figure 9 the collar **19***x* carries a plate **98** that is mounted on the collar **19***x* by means of a yoke **99** to which the plate is secured by wing nuts **100** that screw on to screw-threaded studs **101**, projecting from the plate **98** through the limbs of the yoke **99**. The inclination of the plate to the vertical may be adjusted by tilting the plate about the horizontal pivotal axis, provided by the studs **101**, the angle of inclination being indicated on a protractor **102**.

The plate **98** has cut into it a series of concentric circular grooves **103**, the radii of which correspond to the radii of circular lines most likely to be encountered in drawings of the kind to be dealt with.

Two or more plates may be provided, each with its series of grooves, if the series catered for in one plate is insufficient to deal with all probabilities, the appropriate plate being mounted on the column **16***x*.

In use the column is located on the table **10***x*, over the circle or arc that appears on the plan view which is drawn on the paper **65***b*. By means of a set-square, the groove of appropriate diameter on the plate **98** is adjusted (by rotation of the column **16***x* and tilting of the plate **98**) to occupy in space the same orientation as the circular or arcuate line to be drawn. Thereupon, the pointed end **15***a* of the tracing arm **15***x* is projected to enter the groove and the tracing arm **15***x* is rotated for the end to traverse the groove or such portion of it as is appropriate.

The device of Figure 10 is advantageous in that the circles that can be dealt with are of infinitely variable radius and not merely any one of a prescribed series. The device consists in a graduated crank arm **103** held slidably in a guide **104** that is rotatably mounted on the collar **19***y*. One end of the arm **103** carries a peg **105** pocked at **106** to receive the pointed end **15***a* of the tracing arm **15***y*.

In use the crank arm **103** is adjusted in the guide **104** for the throw of the arm to equal to radius of the circle to be dealt with. The arm **15***y* is clamped in the guide and the collar **19***y* on the column **16** by tightening the wing screw **97**. The column is then adjusted as above described in connexion with Figure 9, the end **15***a* is held engaged in the pock **106** and the arm **103** is rotated.

No provision is made in the device of Figure 10 for tilting of the crank arm **103**. Thus, as it is drawn, the device deals only with circles and arcs in vertical planes. However, the arm **103** could be mounted for tilting, like the plate **98** of Figure 9.

In Figure 11, the vertical column **16***z* is made up of two parallel rails **16***a*, **16***b* of T section that act as guides for a saddle **107** which can be clamped at any position along the height of the column by a thumbscrew **108**. The height of the saddle is set by means of a pointer **109** associated with a graduated scale **110**.

The device is mounted on the saddle for rotation about a horizontal pivot pin **111** and may be clamped in any angular orientation to the vertical by means of a thumbscrew behind the saddle. The angular position is indicated by a pointer **112** associated with a protractor **113**.

The device comprises a disc **114** which is rotatable about its axis on a spindle **115** within a sleeve **116**. The sleeve is carried at the end of a cranked bracket **117** of which the crank-arm **118** is mounted for rotation about the pivot pin **111**.

The bracket **117** is such that in all angular positions of the disc **114** the centre of the disc lies vertically above the tracing point **21***z*.

On the face of the disc **114** is pivotally mounted a pointer **119**, associated with an arcuate scale **120**. The pointer has a pock **121** which is designed to be engaged by the pointed end **15***az* of the tracing arm **15***z*.

In use the plinth base **20***z*, is placed on the plan drawn on the paper **65***b* and the disc **114** is adjusted at the correct altitude on the column **16** and in the correct orientation to conform with the circle or arc to be drawn. The pointer **119** is moved along the scale **120** till the radial distance of the pock **121** conforms with the radius of the circle or arc. Thereupon the pointed end **15***a* of the arm **15***z* is engaged in the pock and held in engagement while the disc **114** is rotated.

Thus, by orientation of the disc **114** and pointer **119** in space, a simulacrum of the circle or arc to be drawn is in effect defined and is translated by the tracing arm to the drawing arm.

If an object of irregular shape is to be scanned, a plan view thereof may be drawn and applied to the disc **114**, which is then orientated. The tracing point **15***az* is then caused to scan the lines of the drawing. To ensure that the plan is held immobile while this is happening, the spindle **115** may be clamped to the sleeve by means of a thumbscrew **122**.

I claim:

1. A perspective drawing machine comprising a horizontal table, a vertical drawing board, an extensible tracing arm and an extensible drawing arm at right angles to one another in plan, a vertical column, a plinth supporting the column and standing movably on the table, means swivellably connecting an end of the tracing arm to the column and movable up and down the column, a tracing point provided by the plinth, a writing instrument mounted at one end of the drawing arm, a coupling rotatable about a vertical axis, connecting the drawing and tracing arms one above the other and constraining them against relative movement in the horizontal plane while permitting relative pivotal movement in vertical planes, a vertical post rigidly fixed to the table, means to support the coupling on the post at an adjustable height, and additional coupling means connecting the drawing and tracing arms, displaced in plan from the vertical axis of the coupling, spanning the vertical distance between them and comprising a universal joint.

2. The machine of claim 1 including a yoke slidably mounted on the post and means to clamp the yoke to the post, in which the arms of the yoke are horizontal and in which the coupling is mounted between the arms.

3. A perspective drawing machine comprising a horizontal table, a vertical drawing board, an extensible tracing arm and an extensible drawing arm at right angles to one another in plan, a vertical column, a plinth supporting the column and standing movably on the table, means swivellably connecting an end of the tracing arm to the column and movable up and down the column, a tracing point provided by the plinth, a writing instrument mounted at one end of the drawing arm, a coupling rotatable about a vertical axis, connecting the drawing and tracing arms one above the other and constraining them against relative movement in the horizontal plane while permitting relative pivotal movement in vertical planes, a vertical post rigidly fixed to the table, means to support the coupling on the post at an adjustable height, and additional coupling means connecting the drawing and tracing arms and consisting in two parts each providing one element of a pair of surfaces biassed into contact but free to move relatively to one another, the parts being one above the other and such that their vertical displacement remains substantially constant in all positions of the drawing and tracing arms.

4. The machine of claim 3 in which the surfaces are biassed gravitationally into contact with one another.

5. The machine of claim 4 in which the contact surfaces are provided by the peripheries of two cylinders the axes of which are parallel with the tracing arm and the drawing arm respectively.

6. The machine of claim 5 in which the cylinders are rollers mounted on short beams projecting from the arms.

7. The machine of claim 6 in which the arms are at an angle to one another and the beams at right angles to the arms, and in which the rollers are located substantially on the line bisecting the angle formed by the two arms.

8. The machine of claim 1 in which the coupling is a body with two vertical slots, one above the other and at right angles to one another, and in which the drawing and tracing arms extend one through each slot and are pivoted on the slots about horizontal axes.

9. The machine of claim 1 in which the coupling is an open frame to which each arm is attached for pivotal movement in a vertical plane.

10. The machine of claim 9 in which the universal joint comprises a Hooke's joint, the central member of which is arranged vertically, with a horizontal limb fixed on the frame for pivotal movement about its axis which axis is inclined to the axes of both arms to transmit to one arm tilting movements of the other arm.

11. The machine of claim 10 including a link parallel with and pivoted to each arm and each fast with one of the outer members of the Hooke's joint.

12. The machine of claim 11 in which each link is arranged to be permitted rotational movement about its own axis relatively to its arm.

13. The machine of claim 1 including a collar on the column to which the tracing arm is swivellably connected, pulleys at the top and bottom of the column, an endless band around the pulleys, an operating knob for rotating one pulley to drive the band, and a calibrated scale on the band, the collar being attached to one bight of the band.

14. The machine of claim 1 including counterbalancing means mounted on the drawing arm consisting in a wheeled carriage that runs on the drawing arm, two spaced pulleys mounted on the drawing arm and an endless cord around the pulleys, one bight of which is secured to the carriage and the other to the rod.

15. A perspective drawing machine comprising a horizontal table, a vertical drawing board, an extensible tracing arm comprising a tracing point; and an extensible drawing arm at right angles to one another in plan, a vertical column, a plinth supporting the column and standing movably on the table, a tracing point provided by the plinth, a writing instrument mounted at one end of the drawing arm, a coupling rotatable about a vertical axis, connecting the drawing and tracing arms one above the other and constraining them against relative movement in the horizontal plane while permitting relative pivotal movement in vertical planes, a vertical post rigidly fixed to the table, means to support the coupling on the post at an adjustable height, additional coupling means connecting the drawing and tracing arms, displaced in plan from the vertical axis of the coupling, spanning the vertical distance between them and comprising a universal joint; and a device for translating to the drawing arm lines that are curved in plan view, consisting in means defining a path that is a simulacrum of the line mounted on the column and movable up and down on it; means to orientate the path in space in conformity with a plan view of the line, and means to constrain the tracing point of the tracing arm to move along the path.

16. The machine of claim 15 in which the defining means is a disc mounted for its height and for its orientation to be adjustable.

17. The device of claim 16 in which the defining means is a plate with a series of concentric grooves cut into it, and in which the tracing point is a stylus adapted to be engaged in any one of the grooves and to be constrained by the groove to move around the selected groove.

18. The machine of claim 16 in which the defining means is a disc mounted for rotation about its axis, and a means to engage the end of the tracing arm arranged on the face of the disc for its radial distance to be adjustable.

19. The machine of claim 18 in which the engaging means comprises a pointer associated with a scale graduated to show radial distances, and a pock in the pointer and in which the tracing arm has a pointed end that is adapted to be engaged in the pock in the pointer.

20. The machine of claim 19 including a spindle mounted on the column journalled in a cranked bracket that is adjustable in respect of its angular orientation to the vertical.

21. The machine of claim 18 including a spindle mounted on the column journalled in a cranked bracket that is adjustable in respect of its angular orientation to the vertical and in which the disc is rotatably mounted on the spindle.

22. The machine of claim 15 in which the defining means is a crank arm having means to engage the drawing point and in which the throw of the crank-arm is adjustable.

23. The device of claim 21 in which the engaging means is a pock in which a stylus on the tracing arm is engaged.

24. The machine of claim 1 including a spring biasing the writing instrument into contact with the drawing

board, and means to retract the instrument from the board comprising a pedal and a Bowden cable between the pedal and the instrument.

References Cited in the file of this patent

UNITED STATES PATENTS

704,307	Eichenberger	July 8, 1902
888,249	Meyer	May 19, 1908
962,439	Kirk	June 28, 1910

FOREIGN PATENTS

17,733	Switzerland	Oct. 3, 1898
176,067	Switzerland	June 17, 1935