June 16, 1964 V. GREEN ETAL 3,137,209

APPARATUS FOR MAKING TOPOGRAPHICAL MODELS

Filed July 27, 1961 2 Sheets-Sheet 1

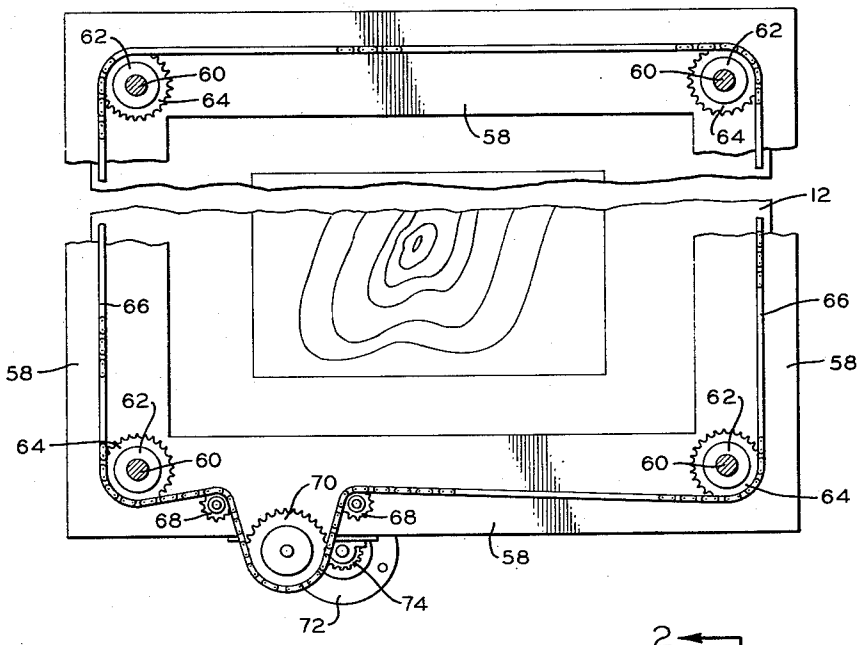


FIG. 5.

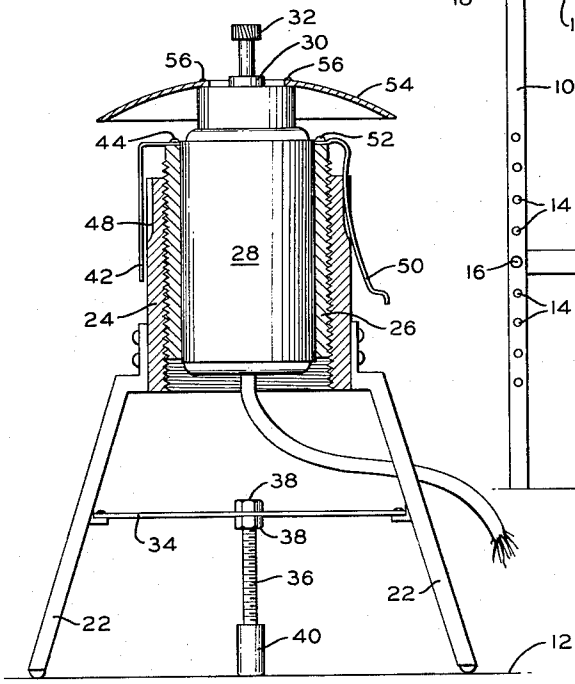


FIG. 2.

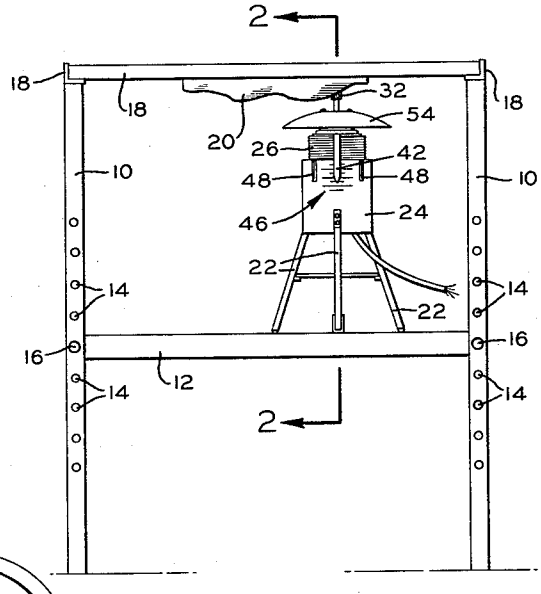


FIG. 1.

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APPARATUS FOR MAKING TOPOGRAPHICAL MODELS

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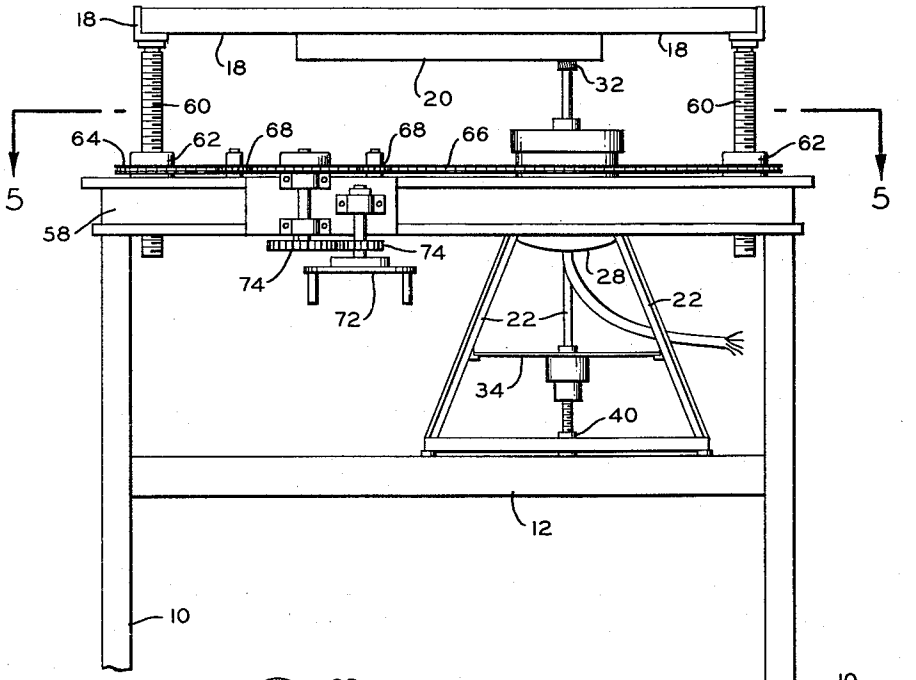


FIG. 3.

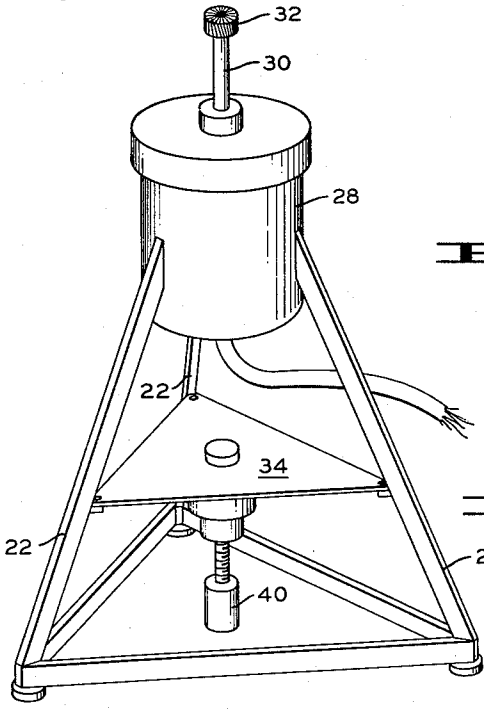


FIG. 4.

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APPARATUS FOR MAKING TOPOGRAPHICAL MODELS

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This invention relates to apparatus for making three dimensional models and more specifically to apparatus for making three dimensional topographical models from solid masses of material.

It is an object of this invention to provide apparatus for cutting three dimensional topographical models from solid blocks of material.

It is another object of the invention to provide such apparatus for making such models directly from conventional topographical maps.

It is another object of the invention to provide such apparatus of maximum accuracy and flexibility whereby a wide variety of such models may be made and the models will be very accurate three dimensional replicas of the topographical maps from which they are derived.

It is a principal object of the invention to provide such apparatus of maximum simplicity whereby accurate apparatus may be constructed economically and whereby the apparatus will have a minimum number of precision parts which could become defective.

It is another object of the invention to provide a tool for such apparatus which can be manufactured and sold as a single small precision unit and used with simple framework for producing such models.

Other objects and advantages of the invention will become apparent from the following description read in conjunction with the attached drawings, in which:

FIG. 1 is a view in side elevation of the preferred form of apparatus of this invention;

FIG. 2 is a view in elevation, and partially in section, of the working portion of the apparatus of FIG. 1;

FIG. 3 is a view in side elevation of an alternative form of apparatus of the invention;

FIG. 4 is a perspective view of the working portion of the apparatus of FIG. 3, and

FIG. 5 is a horizontal sectional view of the apparatus of FIG. 3 taken along the plane 5—5 of FIG. 3 and with the apparatus of FIG. 4 removed.

Referring now in detail to FIGS. 1 and 2, the preferred form of the invention illustrated therein comprises an upright frame **10** with a generally horizontal table **12** supported thereon. The frame **10** is provided with a plurality of apertures **14** therein through which pins **16** extend to permit incremental adjustment of the height of the table. The top of the frame **10** is preferably formed of four angle irons **18** joined into a rectangle and into which a work supporting plate may be fitted. A solid mass of material **20** such as polystyrene foam from which the model is to be made is mounted on the work supporting plate by suitable means such as cement or screws, with the mass of material **20** depending from the supporting plate above the table **12**. A topographical map is photographically enlarged or reduced to the desired size of the model and mounted on the table **12** directly below the mass of material **20**. Since the work is formed on the machine in an upside-down position while the map is supported rightside up, a reverse print of a conventional topographical map should be used.

A working tool shown in greater detail in FIG. 2 rests upon the table **12** and is freely movable thereover while the model is formed. The working tool comprises a tripod frame having legs **22** rigidly attached to a sleeve **24** with the sleeve **24** having a vertical cylindrical passageway therethrough which is internally threaded. An

externally threaded sleeve **26** is threadedly received in the sleeve **24**, and an electric motor **28** is rigidly mounted in the sleeve **26** with the armature of motor **28** supported for rotation about the axis of sleeve **24**. A tool receiving chuck **30** is mounted on the armature of the motor **28**, and a rotary cutting tool **32** is mounted on the chuck **30**. The chuck **30** may form any conventional means for rotatably mounting the tool on the motor, for instance, a conventional drill chuck or a screw in the end of the armature shaft, etc. In any event, it is preferred that the tool **32** be removable so that different diameter tools can be used in the device where topographical contour lines of different curvatures are to be followed.

A triangular plate **34** is mounted on the legs **22** below the motor **28** and carries a threaded rod **36** secured thereto coaxial with the tool **32** by bolts **38**. A cylindrical stylus **40** is threadedly received on the rod **36** adjacent to the surface of the table **12**, and the diameter of the stylus **40** is substantially equal to the diameter of the cylindrical cutting shape generated by the tool **32** when the motor is operated. A different diameter stylus **40** is provided for each corresponding different tool **32**.

An index arm **42** is mounted on the inner sleeve **26** by a screw **44** and extends over the outer surface of the outer sleeve **24**, and a scale of indicia **46** (see FIG. 1) is stamped in the outer sleeve cooperable with the index **42** to indicate the relative axial positions of the inner and outer sleeves, thereby denoting the distance of the cutter tool **32** above the table **12**. The graduations on the scale **46** are preferably placed one-sixteenth of an inch apart and the threads on the sleeves **24** and **26** are cut sixteen to the inch. In addition, means are provided for locking the inner and outer sleeves **24** and **26** against relative rotation in eight equally spaced rotational positions whereby the cutter head may be moved between different positions above the table **12** with the positions spaced as close as $\frac{1}{128}$ of an inch apart.

The means for locking the sleeves **24** and **26** together comprises eight notches **48** equally spaced around the periphery of the sleeve **24** and a spring latch **50** mounted on the sleeve **26** by a screw **52** and engageable in the notches **48** as best seen in FIG. 2.

A deflector disc **54** may be mounted on the top of the motor **28** by screws **56** to keep shavings away from the threaded sleeves **24** and **26**.

In the apparatus of the invention shown in FIGS. 2 to 5, the cutting tool **32** is mounted in fixed relation to the table **12** with the motor **28** being non-adjustably mounted on the legs **22** of the tool carrier. In this structure of the invention, however, rigid peripheral braces **58** interconnect the posts of the frame **10**, and four jack screws **60** adjustably support the angle irons **18** above the braces **58**. The jack screws **60** are rigidly connected to the angle irons **18** and are embraced by the threaded sleeves **62** adjacent to the braces **58**, the sleeves **62** carrying sprockets **64** which are connected by a chain **66** to drive the jack screws **60** in synchronization with each other.

A pair of sprockets **68** maintain the chain **66** under tension on a drive sprocket **70**, and the drive sprocket **70** is driven by a hand wheel **72** through gears **74**.

In operation of the devices of the invention shown above a topographical map, such as the map **76** in FIG. 5, is placed on the table **12** immediately under the mass of material **20** from which a model is to be made, and the stylus **40** is moved around one of the contour lines on the map with the cutter tool **32** in engagement with the material **20** and with the stylus **40** maintained on the "downhill" side (outside on a mountain or inside in a valley) of the contour line on the map so that the cutter forms an exact replica of the line in the material along a plane parallel to the table **12**. The distance of the

cutter 32 from the material 20 is then adjusted by moving the wheel 72 or by disengaging the spring catch 50 and moving it around the sleeve 24. The procedure is then repeated to cut at different levels in the material 20 corresponding replicas of the adjacent contour lines on the map until the desired three dimensional model is obtained. The steps between adjacent lines may then be contoured smoothly. In this manner exact models are obtained with maximum ease. The apparatus with which the models are made is very simple and dependable and can be constructed at minimum cost while obtaining a device of extreme accuracy. The preferred structure of FIGS. 1 and 2 is particularly advantageous from this standpoint because it employs a minimum number of precision made parts. The apparatus of FIGS. 1 and 2 is also very advantageous because it can be made and sold as a single small precision unit which can be used on a relatively simple framework, as shown in FIG. 1.

While two specific embodiments of the invention have been shown and described in detail herein, it is obvious that many modifications of the structures described may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for making three dimensional topographical models which comprises a support frame having a table thereon adapted to support a reverse print of a topographical map representing the model which is to be made, work holding means on said frame above said table for supporting above said table a mass of material from which said model is to be made, a tool carrier resting on said table and freely movable over the surface of said table, power means mounted on said carrier and movable therewith, a rotary cutting tool connected to said power means for rotation about a generally vertical axis with said tool being movable over said table with said carrier, a stylus mounted on said carrier adjacent to said table along said axis of rotation of said tool with both said tool and said stylus positioned between said table and said work holding means, and adjusting means for changing the distance between said cutting tool and said work holding means.

2. The apparatus of claim 1 characterized further in that said tool generates a generally cylindrical cutting shape when it is rotated about said axis; said stylus is generally circular and mounted coaxially with said cutting shape, and the diameter of said stylus is substantially equal to the diameter of said cutting shape.

3. Apparatus for making three dimensional topographical models which comprises a support frame having a generally horizontal table thereon adapted to support a reverse print of a topographical map representing the model which is to be made, work holding means on said frame above said table for supporting above said table a mass of material from which said model is to be made, a tool carrier resting on said table and freely movable over the surface of said table, an electric motor mounted on said tool carrier and having a tool receiving chuck mounted thereon for rotation about a generally vertical axis responsive to operation of said motor, a rotary tool received in said chuck and projecting upwardly from said motor and movable over said table with said carrier, said tool generating a cylindrical cutting shape responsive to operation of said motor, a generally circular stylus mounted on said carrier adjacent to said table with said stylus being coaxial with said axis of rotation of said chuck and having a diameter substantially equal to the diameter of said cutting shape with both said tool and said stylus positioned between said table and said work holding means, and adjusting means for changing the distance between said cutting tool and said work holding means.

4. Apparatus for making three dimensional topographical models which comprises a support frame having a generally horizontal table thereon adapted to support a reverse print of a topographical map representing the model which is to be made, work holding means rigidly mounted on said frame above said table for supporting above said table a mass of material from which said model is to be made, a tool carrier resting on said table and freely movable over the surface of said table, an electric motor mounted on said tool carrier and having a tool receiving chuck mounted thereon for rotation about a generally vertical axis responsive to operation of said motor, a rotary tool received in said chuck and projecting upwardly from said motor and movable over said table with said carrier, said tool generating a cylindrical cutting shape responsive to operation of said motor, a generally circular stylus mounted on said carrier adjacent to said table with said stylus being coaxial with said axis of rotation of said chuck and having a diameter substantially equal to the diameter of said cutting shape and with both said chuck and said stylus positioned between said table and said work holding means, and adjusting means forming a part of said carrier for changing the distance between said cutting tool and said table.

5. The apparatus of claim 4 characterized further in that said tool is mounted on said motor in fixed space relation to said motor axially thereof, and said adjusting means comprises means for moving said motor with respect to said carrier along a direction generally parallel to said axis of rotation.

6. The apparatus of claim 5 in which said means for moving said motor with respect to said carrier comprises an internally threaded sleeve rigidly mounted on said carrier, means threadedly receiving said motor in said sleeve, and releasable latch means for locking said motor against threading rotation in said sleeve.

7. The apparatus of claim 6 characterized further by the inclusion of an index member mounted on said motor and extending over a portion of the outer surface of said sleeve, and a scale of indicia on the outer surface of said sleeve cooperable with said index to indicate the relative axial positions of said motor and said sleeve.

8. The apparatus of claim 6 characterized further by the inclusion of means for incrementally adjusting the distance between said table and work holding means.

9. Apparatus for making three dimensional topographical models which comprises a support frame having a generally horizontal table thereon adapted to support a reverse print of a topographical map representing the model which is to be made, work holding means for supporting in depending relation therefrom a mass of material from which said model is to be made, adjustable support means mounting said work holding means on said frame above said table for adjustment of the distance of said work holding means above said table, a tool carrier resting on said table and freely movable over the surface of said table, an electric motor rigidly mounted on said carrier and having a tool receiving chuck mounted thereon for rotation about a generally vertical axis responsive to operation of said motor, a rotary cutting tool received in said chuck and projecting upwardly from said motor and movable over said table with said carrier, said tool generating a cylindrical cutting shape responsive to operation of said motor, and a generally circular stylus mounted on said carrier adjacent to said table with said stylus being coaxial with said axis of rotation of said chuck and having a diameter substantially equal to the diameter of said cutting shape and with both said stylus and said tool positioned between said table and said work holding means.

10. The apparatus of claim 9 in which said adjustable support means comprises at least three jack screws interconnecting said support frame and said work holding means, and means for rotating said jack screws in synchronization.

11. A tool for making three dimensional topographical

models which comprises a frame having a base portion adapted to rest on and be moved freely over a flat surface, an internally threaded sleeve rigidly mounted on said base portion and having a central axis generally perpendicular to said base portion, an electric motor threadedly received in said sleeve and having a tool receiving chuck extending therefrom away from said base portion and rotatable about said axis responsive to operation of said motor, a rotary tool received in said chuck and generating a cylindrical cutting shape responsive to operation of said motor, and a generally cylindrical stylus mounted on said frame between said base portion and said motor and having a generally circular stylus end adjacent to said base portion with said stylus end being coaxial with said axis and having a diameter substantially equal to the diameter of said cutting shape.

12. The tool of claim 11 characterized further by the inclusion of releasable latching means for locking said motor against rotation in said sleeve.

13. The tool of claim 12 characterized further by the inclusion of an index member mounted on said motor and extending over a portion of the outer surface of said sleeve, and a scale of indicia on the outer surface of said sleeve cooperable with said index to indicate the relative axial positions of said motor and said sleeve.

14. A tool for making three dimensional topographical

models which comprises a frame having a base portion adapted to rest on and be moved freely over a flat surface, a body portion mounted on the base portion, a router mounted on said body portion and having a cutting tool thereon facing away from said base portion with said router positioned for rotating said tool about an axis generally perpendicular to the flat surface on which said base portion rests, adjustable connecting means interconnecting said router and said body for adjustably positioning said router at a plurality of different positions along said axis, and a generally cylindrical stylus mounted on said base portion adjacent to the surface on which said base portion rests with said stylus having a circular end coaxial with said axis and equal in diameter to the diameter of said tool.

References Cited in the file of this patent

UNITED STATES PATENTS

1,443,624	Heise	Jan. 30, 1923
1,907,250	Shaver	May 2, 1933
2,314,499	Howard	Mar. 23, 1943
2,359,704	Woody	Oct. 3, 1944
2,472,273	Bates	June 7, 1949
2,693,737	Smith	Nov. 9, 1954
2,702,496	Davis et al.	Feb. 22, 1955