July 18, 1961 F. C. RAINE 2,992,570

DRILLING MACHINES AND THE LIKE

Filed Oct. 2, 1959 4 Sheets-Sheet 1

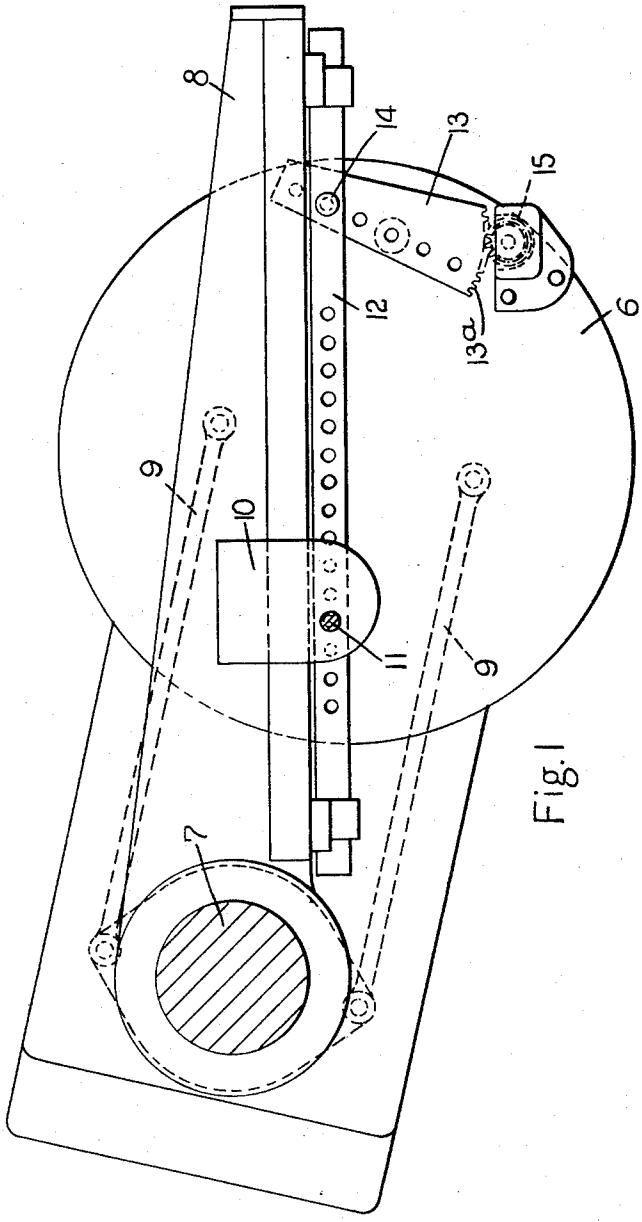


Fig. 1

Inventor
F C Raine
By Pascal Downing Seebold
Attys.

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DRILLING MACHINES AND THE LIKE

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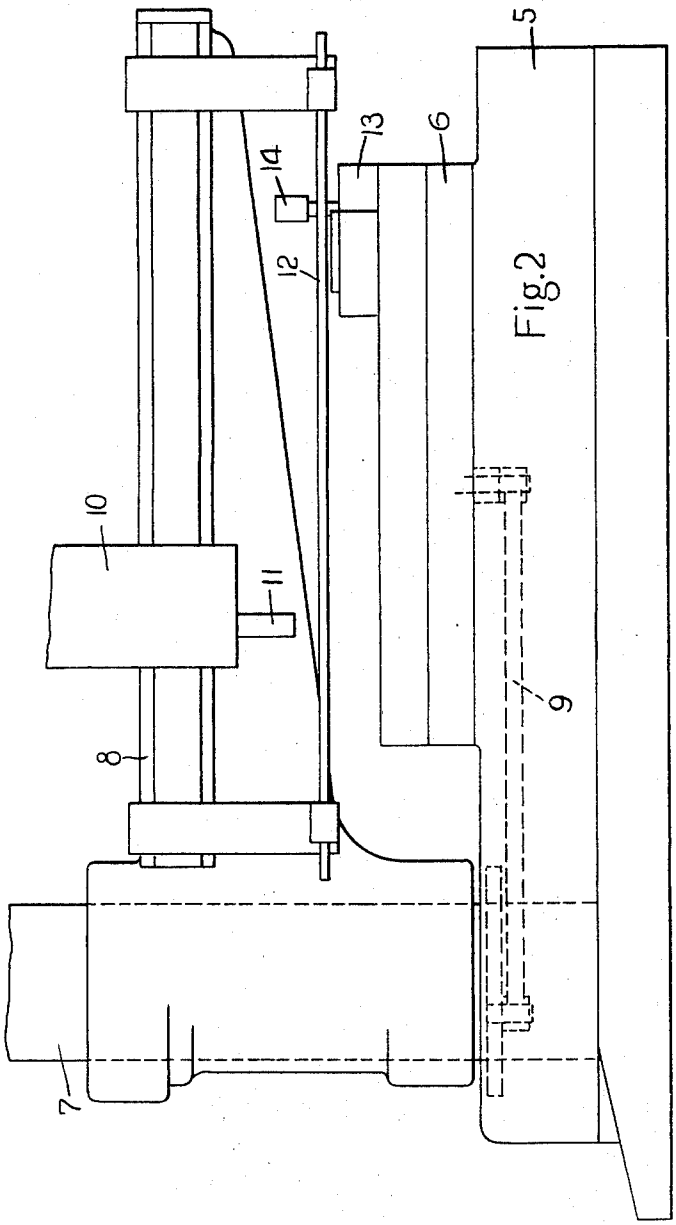


Fig.2

Inventor
F. C. Raine
By Glascock Downing Seibold
Attys.

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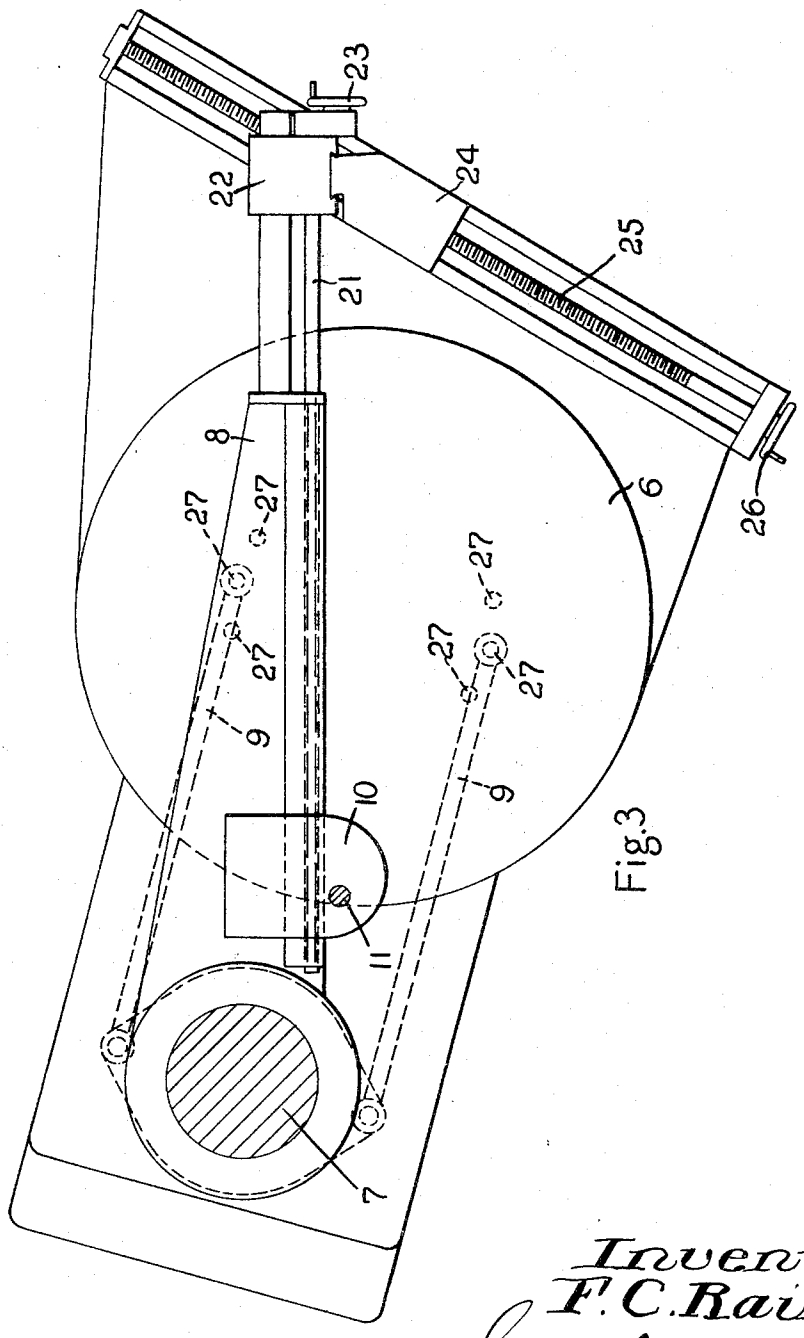


Fig. 3

Inventor
F. C. Raine
By Mason, Mousing, Seebold & Atty's.

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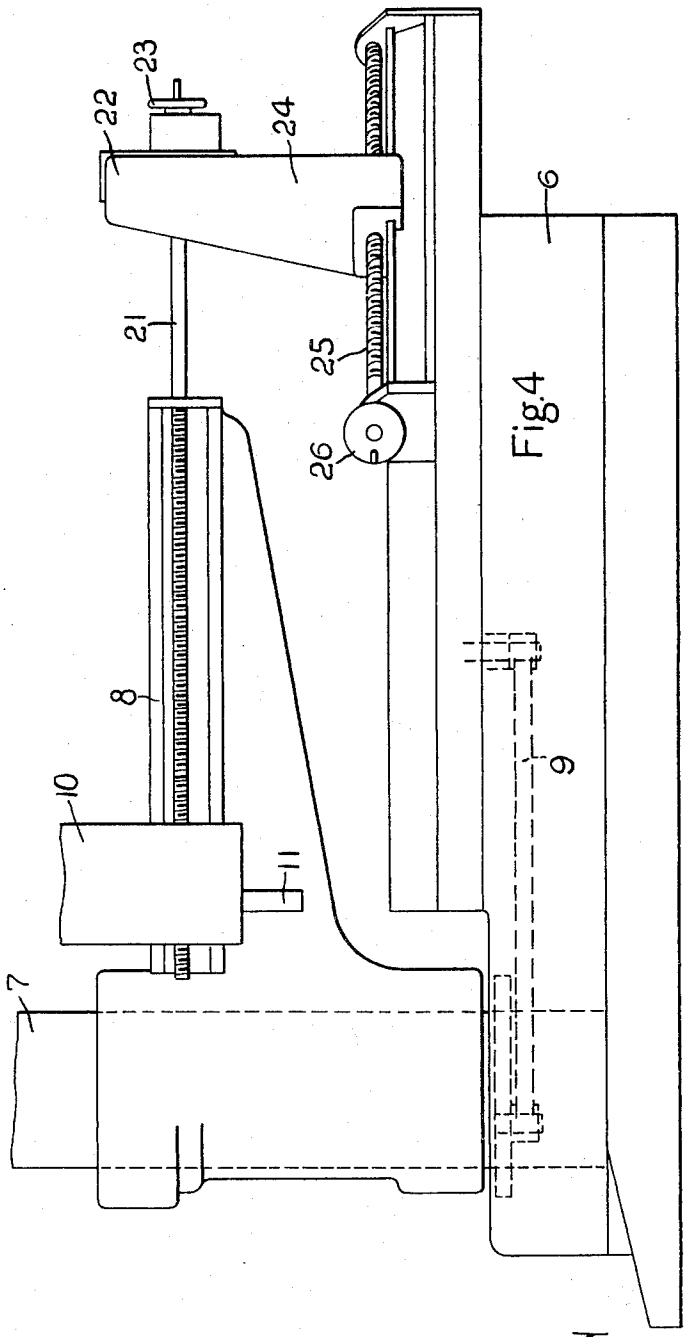


Fig.4

Inventor
F. C. Raine
By Mason, Mason & Co.
Attys.

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DRILLING MACHINES AND THE LIKE

Frederick Charles Raine, Neight Hill, Himbleton, Droitwich, England, assignor to James Archdale & Company Limited, Worcester, England

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Claims priority, application Great Britain Oct. 10, 1958
4 Claims. (Cl. 77—5)

This invention relates to machines for drilling, boring, reaming, screw-threading, honing or performing other operations apertaining to the formation or shaping of holes or recesses in work-pieces.

In the manufacture of condenser tube plates, flanges, and the like it is often required to form a plurality of holes or recesses in the work-piece at predetermined spacings and dispositions, and the object of the present invention is to provide means forming part of a machine, or for an attachment to a machine whereby these holes or recesses may be formed without the necessity for previously marking the positions of the holes or recesses, and without the use of jigs or templates.

Means according to the invention comprises in combination an angularly movable support for the workpiece, an arm angularly movable about an axis parallel to the axis about which the support is movable, a tool carrier transversable along said arm, means interconnecting the arm with the support whereby angular movement of the arm will be accompanied by an equal angular movement of the support, and tool indexing means traversable longitudinally relative to the arm.

In the accompanying drawings FIGURES 1 and 2 respectively are plan and a side view illustrating sufficient of one example for an understanding of the invention, whilst FIGURES 3 and 4 respectively are views similar to FIGURES 1 and 2 illustrating a modification.

In the example illustrated by FIGURES 1 and 2 there is provided a base **5** on which a support **6** for a work-piece is mounted for angular movement about a vertical axis. The support **6** may be in the form of a turntable, preferably, but not essentially of circular form, and provided with means (not shown) for securely locating the work-piece thereon. At one side of the support is a vertical post **7** on which an arm **8** is mounted for angular movement about a vertical axis parallel to that of the support. The arm **8** is arranged to extend across the support **6**, and is connected thereto through links **9**, or other convenient means whereby angular movement of the arm **8** will be accompanied by an equal angular movement of the support **6** in the same direction.

Traversible along the arm **8** is at least one carrier head **10** for one or more rotary tools **11** rotatable about a vertical axis, or vertical axes. The carrier head **10** may incorporate an electric motor for driving the tool or tools which is/are adapted for performing drilling, boring, reaming, honing or other operations appertaining to the formation of holes or recesses in a work-piece on the support **6**. Moreover, for moving the tool or tools into and out of contact with the work-piece the carrier head **10** or its spindle is vertically movable relative to the arm by power actuated screw or other means (not shown).

With a machine as thus far described it will be understood that, if a line of holes is drilled in a work-piece secured to the support **6** by moving the carrier head **10** to successive positions along the arm with the latter at one angular setting, any further line of holes similarly drilled in the work-piece with the arm set at another angular position will be parallel to the first line. However, it is often required that the holes in the second and subsequent rows should have a predetermined relative position with respect to the holes in the first row. For example, it may be required that the holes in susequent rows should lie in

lines passing through the holes of the first row and extending at right angles to the line of the first row to form a square arrangement of the holes. Alternatively, it may be required that the holes in subsequent rows should lie on lines extending obliquely at a predetermined angle to the line of the first row to form a diamond arrangement of the holes or other geometrical pattern. In order to facilitate the formation of the holes in such arrangements without the use of jigs, or templates, and without the necessity for previously marking the positions of the holes, tool indexing means is incorporated in the machine.

In the example illustrated in FIGURES 1 and 2 the indexing means comprises a bar **12** carried by the arm and extending parallel thereto at a position below the head **10**. In the bar are formed a plurality of longitudinally spaced holes through any one of which the rotary tool **11** can be engaged with a work-piece on the support **6**, bar **12** then serving to support the tool **11** from lateral movement. The bar **12** is longitudinally movable relative to the arm **8** and head **10** to predetermine the position of its holes relative to the work-piece. The outer end of the bar has connection with a datum device carried by the support **6**. This datum device comprises a strip **13** or the like incorporating a row of spaced holes or notches in any one of which a spring-loaded plunger **14** at the outer end of the bar **12** is engageable.

The initial setting of the strip **13** of the datum device (which is angularly movable with the support **6**) is adjustable relative to the support **6**. For this purpose the strip **13** may be pivotally connected to the support **6** and have at its one end teeth **13a** adapted to engage with a toothed pinion **15**, any convenient means being provided for locking the strip **13** in a desired position.

In order to drill parallel rows of holes in a work-piece on the support in the aforesaid square arrangement the strip **13** is set with the line of the holes or notches extending at right angles to the arm **8**. After drilling the initial line of holes through the holes in the bar **12** the arm **8** is set to a different predetermined angle by moving the pluger **14** to a new hole in the strip **13**. As a result not only are the arm **8** and support **6** moved through equal angles but the bar **12** is moved longitudinally along the arm **8** to correct the positions of the holes therein. In a similar manner if it is required to form parallel rows of holes in the work-piece in which the holes are arranged also in oblique rows at a predetermined angle to the lines in which they were formed, then this can be achieved by carrying out the same procedure with the strip **13** set at this predetermined angle relative to the arm **8**.

In the modification illustrated in FIGURES 3 and 4, parts similar to these in FIGURES 1 and 2 are designated with like numerals. In this example the indexing means comprises a screw-threaded shaft **21** extending parallel with the arm **8** and in engagement with a complementary screw-threaded hole extending through the head **10**. At one end of the shaft **21** is a part **22** incorporating a handle **23** whereby the shaft may be rotated to move the head **10**. Moreover, associated with the handle **23** is any convenient scale whereby to ensure accurate setting of the head **10**.

The part **22** is in connection with a datum device which may be similar to that described in the first example. Preferably, however, the part **22** is secured in any convenient manner to a captive nut **24** on a screw **25** carried by the support **6** and actuable by a handle **26**. The arrangement is such that after drilling a line of holes actuation of the handle **26** moves the arm **8** and support **6** angularly and in addition moves the shaft **21** axially relative to the arm **8** to correct the position of the head **10** relative to the aforesaid scale.

The initial setting of the screw 25 relative to the support 6 may be adjusted by pivoting the screw on the support in a manner similar to that described in the first example. Alternatively the initial setting may be adjusted by varying the angular setting of the support 6 relative to the post 7. For this purpose there may be provided in the support 6 two arcuate rows of holes 27 in any one complementary pair of which the links 9 are engageable.

It will be appreciated that, if desired, the datum device described in the second example could be employed in the first example.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A machine for performing a plurality of similar operations at different positions on a work-piece, comprising in combinaton an angularly movable work-piece support, an arm extending over said work-piece support and angularly movable about an axis parallel with that of said work-piece support, transmission means interconnecting said work-piece support and said arm so that angular movement of said arm is accompanied by equal angular movement of said work-piece support, a tool carrier traversible along said arm, and means carried in part by said arm and in part by said work-piece support for determining the tool-operative positions of said tool carrier relative to said work-piece support.

2. A machine according to claim 1, in which the means for determining the tool-operative positions of the tool carrier relative to the work-piece support include an endwise movable bar carried by the angularly movable arm in parallel relationship thereto, and provided with a plurality of longitudinally spaced holes through any one of which a tool carried by said tool carrier is movable into engagement with a work-piece on said work-piece support.

3. A machine according to claim 2, in which the means for determining the tool-operative positions of the tool carrier relative to the work-piece support also include an angularly adjustable datum device carried by said work-piece support, and provided with a row of spaced openings, and a plunger carried by the endwise movable bar and engageable with any one of said openings.

4. A machine according to claim 1, in which the means for determining the tool-operative positions of the tool carrier relative to the work-piece support comprise a rotatable screw-threaded shaft carried by the angularly movable arm in parallel relationship thereto and in screw-thread engagement with the carrier, and a datum device having a screw rotatably carried by said work-piece support, a non-rotatable nut mounted on and engaging said screw, and means attaching said nut to said arm and said shaft so that rotation of said screw causes angular movement to be imparted to said arm and work-piece support by said nut, and also causes endwise movement of said shaft relative to said arm.

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