

March 27, 1945.

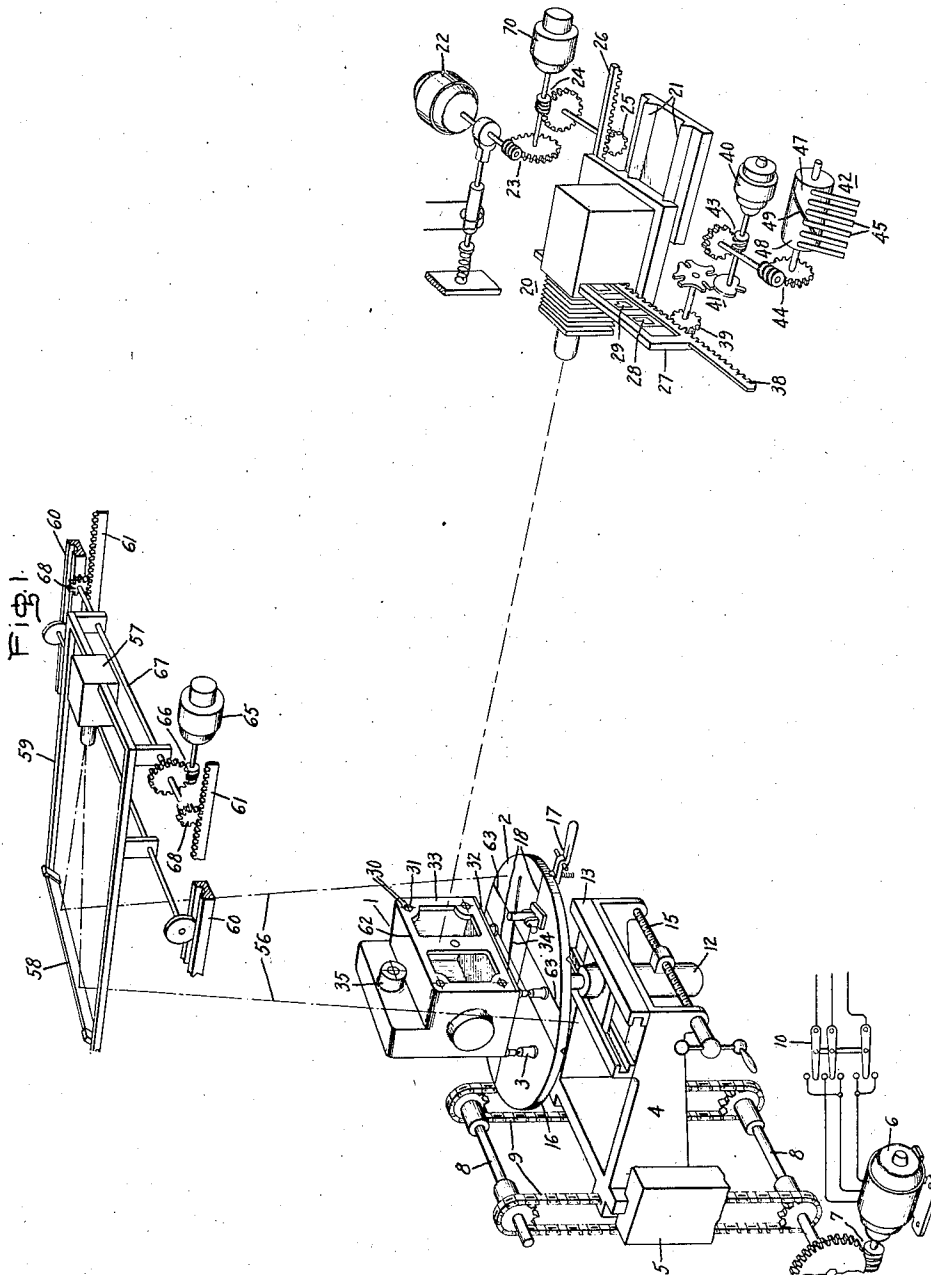
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2,372,494

INSPECTION AND LAY-OUT APPARATUS

Filed Oct. 2, 1942

2 Sheets-Sheet 1



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Fig. 2.

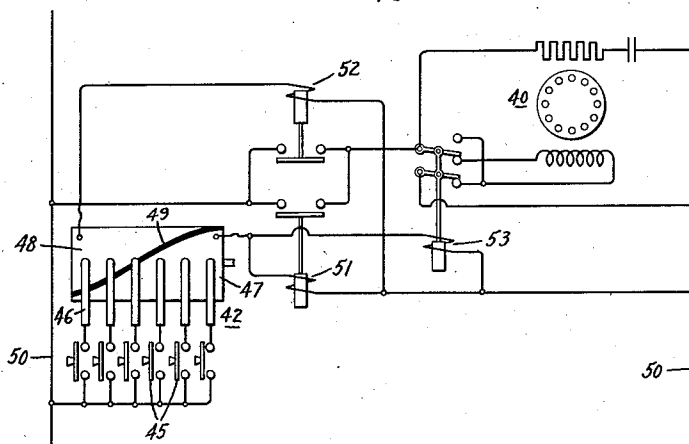
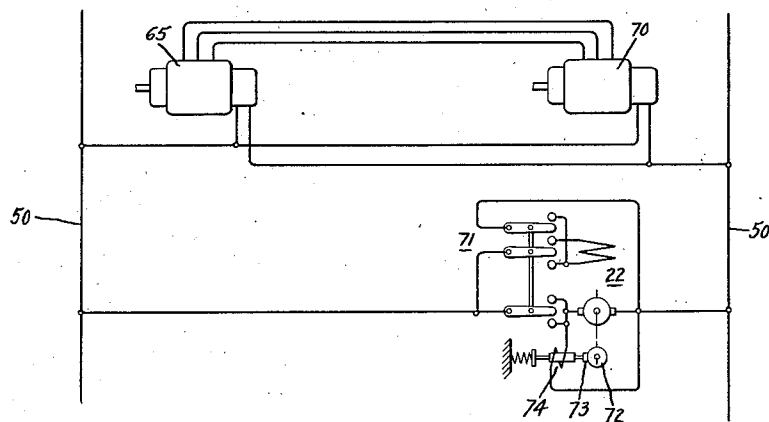


Fig. 3.



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UNITED STATES PATENT OFFICE

2,372,494

INSPECTION AND LAYOUT APPARATUS

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5 Claims. (Cl. 88—24)

In the laying out of machine castings preparatory to the machining of various parts thereof a common practice has been to lay out the surfaces and centers of parts to be machined with the casting resting upon a surface plate. The laying out operation would begin at some chosen point and proceed therefrom according to the dimensions prescribed by the drawing or print being followed. After the machining of the casting had been completed it not infrequently was found that the walls of the casting were decidedly thicker at one side of the casting than at the other or that the exterior surface of a boss was noticeably eccentric to the machined inner surface thereof. It thus became evident that in the original lay-out the surface or point of origin had not been well chosen. It may also have become evident that some part of the casting, such for example as a boss or other projection, was somewhat displaced from its correct position with reference to other parts of the casting.

Such inequalities in wall and boss thickness may of course be avoided should the workman engaged in the lay-out work make various partial or preliminary lay-outs starting from different points of the casting and then after comparing the results of the several lay-outs adopting one of them or a modification thereof as the one best adapted to give the desired uniformity. Such a procedure is not only time consuming, hence expensive, but in the case of large quantity production requires the services of many skilled workmen.

It is the object of our invention to provide improved apparatus which facilitates the inspection and the laying-out in a desired manner of three dimensional articles such as castings whereby the time and labor required are greatly reduced.

In accordance with our invention, briefly, we provide: a support for the article to be inspected and laid out which support may be adjustable in various directions and rotatable; a projector by which an image may be projected on the article showing the correct location of surfaces to be machined, centers of holes to be bored, etc.; means for indicating the focal plane of the image; and means operative simultaneously to shift the projector and the focal plane indicating means with reference to the article while maintaining a fixed distance therebetween.

Our invention will be better understood from the following description taken in connection

with the accompanying drawings and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a perspective view of a form of apparatus embodying our invention and Figs. 2 and 3 are circuit diagrams.

Referring to Fig. 1 an article to be inspected and laid out is represented at 1 which article may be constructed by casting, by fabricating or in any other manner. Inasmuch as we have used our invention more extensively in connection with cast articles and in view of the apparent absence of a generic term for all articles constructed by any of those methods, the term casting will be employed as such throughout the description and claims to follow. The casting 1 is supported on the turntable 2 by suitable adjustable means such as the three jacks 3. The apparatus by which the turntable is mounted permits the operator readily to adjust the height and lateral position of the turntable. This apparatus, as shown by the drawings, comprises the cross head 4 which slides in the vertical guides 5 and is raised and lowered by means of the three phase motor 6 operating through the worm gearing 7, the shafts 8, and the chains 9 which latter connect with the cross head. The running of the motor and the reversal thereof is controlled by the switch 10. The bearing 12 of the turntable pivot shaft is slidable laterally in the guides 13 forming a part of the cross head 4 and is arranged to be adjusted by the hand operated screw 15. The turntable is provided with notches 16 in its under face spaced 45° apart for convenience in orienting the casting to a new position. The spring actuated hand released detent 17 by engaging a notch 16 holds the turntable against rotation. For convenience in setting up the casting on the turntable the latter preferably is provided with cross lines such as indicated at 18.

The projector by which the image is thrown on the casting is represented at 20. It is of well-known construction except that it is arranged to be moved bodily toward and from an article on the turntable and has a special slide holder and operating mechanism therefor. The projector is supported as a whole on the guides 21 which extend toward the turntable and is caused to move thereon by the motor 22 acting through the worm gearing 23 and 24, the pinion 25, and the rack 26 fixed to the projector. The slide carrier 27 is of special form being constructed to receive several slides or transparencies, six in the present case, shown at 28, 29, etc. These slides are photographs of drawings of various faces or surfaces

of the casting showing those faces or surfaces at a definite reduced scale as they should appear when machined. They also include cross lines showing the centers of any holes that are to be bored. It is to be understood that in Fig. 1 the slide in projecting position is the one showing that face of the casting which then is turned toward the projector and that the vertical and horizontal cross lines 30 at the five bolt holes 31 and the base line 32 are lines being projected in the casting from that slide, the projector being focused on the face 33 of the casting. While the operator observes the casting in partial darkness with the image projected thereon he adjusts the vertical and horizontal position of the turntable by the means described above until the casting is made to occupy the desired position with reference to the image cast upon it. By means of the scribing tool 34 he may scribe a base line on the casting corresponding to the projected line 32 and he may also scribe cross lines for the holes 31 guided by the projected cross lines. Should the casting have a face or part such as the boss 35 which is located in a plane in front of or behind the plane of the face 33 the projector will of course be refocused in that face or part before it is inspected and laid out. The particular means which we have devised for readily determining the location of the focal plane of the projector will be described later. The inspection and laying out operation having been completed for that face of the casting the turntable is rotated to bring another face in position before the projector but without changing the elevation. For making an inspection or lay-out on each different face of the casting or on each different plane thereof a different slide is moved into projecting position. We shall now describe how from a remote point of control one may bring the particular slide desired into projecting position.

The slide carrier 27 in which the several slides 28, 29, etc. are mounted is provided with the rack 38 arranged to be engaged by the pinion 39 and moved thereby to certain predetermined positions. The pinion is driven by the reversible motor 40 through the Geneva movement 41. Control of the motor is effected through the drum switch 42 which is driven from the same motor through the worm gearing 43 and 44 and the several selector switches 45, see Fig. 2, each of which connects with one of the brushes 46 of the drum switch there being one switch 45 for each slide. The drum of the drum switch has a metallic face in two parts 47 and 48 separated by the insulating strip 49 extending spirally therebetween. As shown by Fig. 2 the selector switches connect with one side of a source 50 of alternating current supply and the parts 47 and 48 connect with the other side of the source through the windings of the relays 51 and 52 which control the circuit of the motor. Interposed in the motor circuit is the reversing switch 53 whereby the motor may be operated in the proper direction depending upon whether the desired slide is on one side or on the other of the slide then in the projecting position. It is thought that the operation of this part of the apparatus will be so obvious from the above brief description and the drawings that a detailed description thereof will be unnecessary.

The focus of the projector remains fixed, being such that the projected images of the slides on surfaces in the focal plane will be exactly full size. Where, as in the present case, a high degree of precision in the projected image is required it

becomes desirable that the operator be provided with some means of quickly and accurately locating the focal plane of the projector. We shall now describe that feature of our invention which facilitates the rapid and accurate relative positioning of the projector and the article to be inspected and laid out. We indicate the location of the focal plane of the projector by means of a thin, sheet-like light beam which is projected in a direction at right angles to the axis of projection and positioned at the focal distance from the projector. The light beam which is indicated by the dot and dash lines 56 is projected by the projector 57 and has its focal point slightly above the turntable 2. Such a projector may, for example, have a very narrow light slit which is arranged to be imaged at the aforesaid focal point. This projector preferably is positioned to project its focal plane indicating beam or "wand" in a downward direction and to conserve space may be arranged horizontally as shown by the drawing with a light reflector, such as the mirror 58, interposed in the path of the light beam. The projector and the mirror are supported in a fixed relative position by the frame 59 which is movable horizontally in the same direction as the projector 20 being supported by the tracks 60 and the racks 61. When the apparatus is used in a dark or semi-dark room the narrow light beam or "wand" projected by the projector 57 may readily be seen where it shines upon the turntable or the casting supported thereon. In the drawings it is represented as shining upon the casting at the top edge 62 of the front face 32, portions of the beam which spill over at the sides of the article showing at 63 on the turntable. When the main projector 20 is moved toward or from the casting to project images on its various faces or surfaces the thin light beam which indicates the position of the focal plane must move exactly with it. This movement is brought about by the use of a system for the transmission of angular motion comprising transmitting and receiving devices of the alternating current type such, for example, as is disclosed in U. S. Patents 1,612,117 and 1,637,039. The projector 57 and the mirror 58 are moved by the receiving device 65 of such a system which, through the worm gearing 66, turns the shaft 67 and pinions 68 thereon that mesh with the racks 61. The transmitting device 70 of the system is directly connected to a part of the drive connection between the motor 22 and the main projector 20. The construction of the transmitting and receiving devices and their respective connections with the projectors 20 and 57 are such that the projector 57 and mirror 58 are caused to have exactly the same movements as the main projector 20.

In Fig. 3 we have shown at 71 a combined starting, stopping and reversing switch for the motor 22, the motor and the transmitting and receiving devices being shown connected to be energized from the source 50. We have also shown the motor 22 provided with a common form of automotive brake comprising the drum 72, the spring applied brake shoe 73 and the retracting solenoid 74.

We have chosen the particular embodiment described above as illustrative of our invention and it will be apparent that various modifications may be made without departing from the spirit and scope of our invention which modifications we aim to cover by the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, means for supporting an article to be inspected, means for projecting an image thereon comprising a projector having a slide picturing said article as it should appear when an operation thereon is finished, means indicating the position of the outer focal plane of and extending in a direction at right angles to the axis of projection at the focal distance from said projecting means, and means for simultaneously moving said projecting means and said indicating means toward and from said article and for maintaining a fixed distance between said two means.

2. In combination, means for supporting an article to be inspected, means for projecting an image thereon comprising a projector having a slide picturing said article as it should appear when an operation thereon is finished, means for projecting a narrow light beam to indicate the position of the focal plane of and extending in a direction at right angles to the axis of projection at the focal distance from said projecting means, and means for simultaneously moving said image projecting means and said light beam projecting means toward and from said article, said last means including means operable to maintain a fixed distance between the two projecting means.

3. In combination, a rotatable member for supporting an article to be inspected, means for rotating said member to various angular positions, means for raising and lowering said member, a projector having a plurality of slides picturing said article as it should appear in various angular positions, means for bodily adjusting the position of said projector thereby to adjust the position of the focal plane with respect to said

article, means indicating the position of said focal plane, and means operative to adjust the position of said indicating means and to maintain it at a fixed distance from said projector.

4. In combination, means for supporting an article to be inspected and laid out, a first projector adjustably positioned with respect to said supporting means for projecting on said article an image depicting the correct appearance of the article, a second projector spaced from said first projector and arranged to project a sheet-like beam of light coincident with the focal plane of said first projector, and means for maintaining fixed the spacing between said projectors.

5. In combination, a turntable for supporting a casting to be inspected and laid out, means for raising and lowering said turntable, means for adjusting the turntable laterally, a first projector having a slide carrier adapted to hold a plurality of slides, remote control means for shifting said carrier to bring any desired slide therein into projecting position, motor mechanism for adjusting the position of said projector with respect to said casting, an adjustably mounted second projector for projecting a sheet-like beam of light to indicate the focal plane of said first projector, and interconnected electrical devices associated with said motor mechanism and said second projector for adjusting the position of the second projector in accordance with the adjustments of said first projector.

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