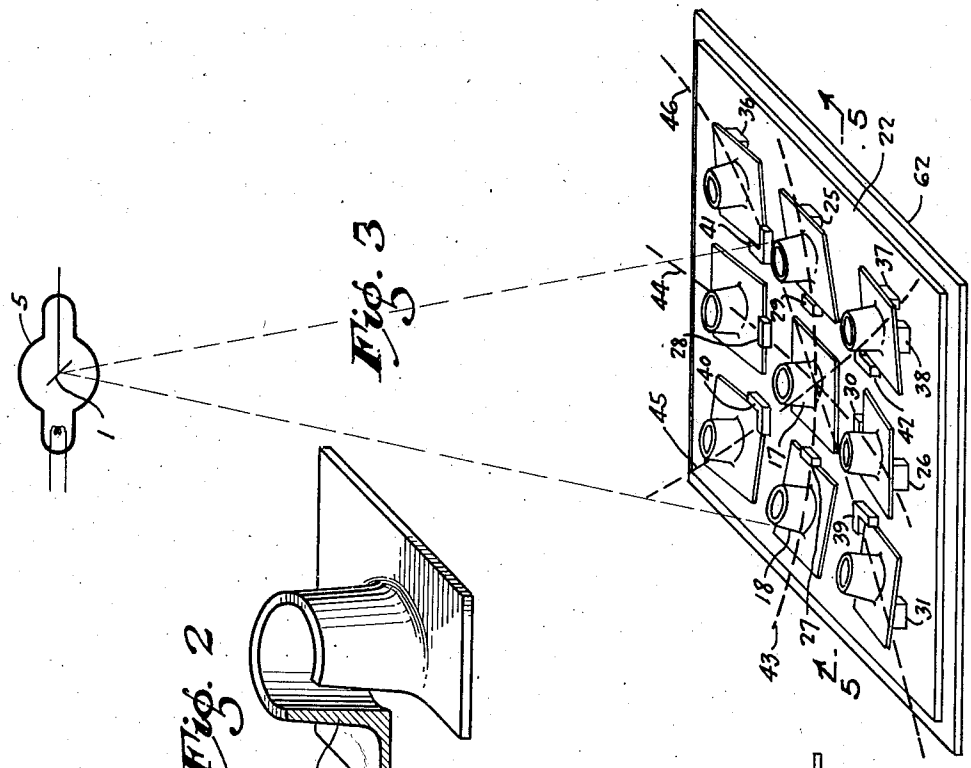
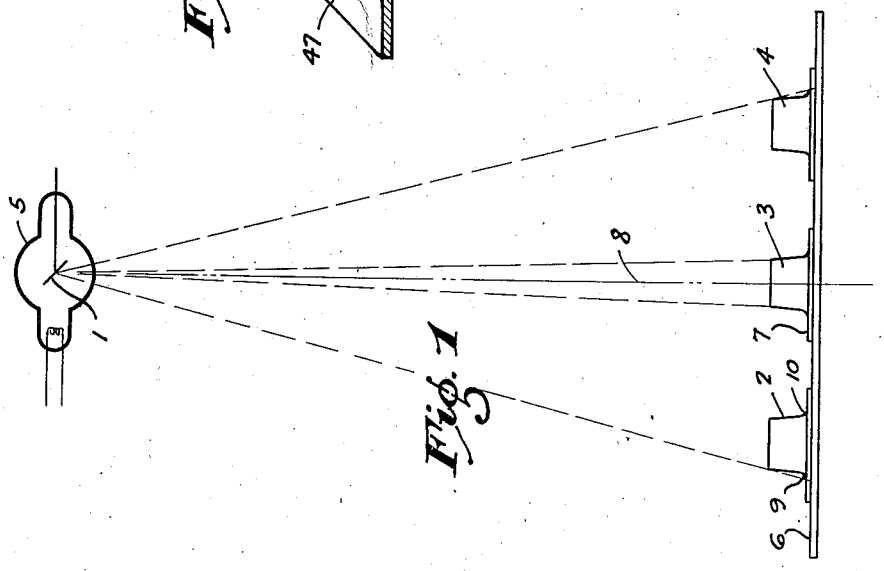
Aug. 22, 1944. J. G. SCHNEEMAN 2,356,358

MEANS AND METHOD FOR MAKING INDUSTRIAL RADIOGRAPHS

Filed March 27, 1943 2 Sheets-Sheet 1





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Fig. 7

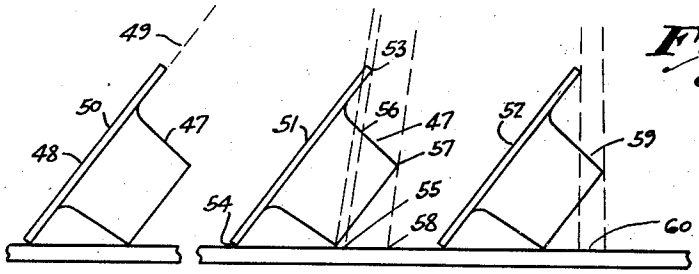


Fig. 8

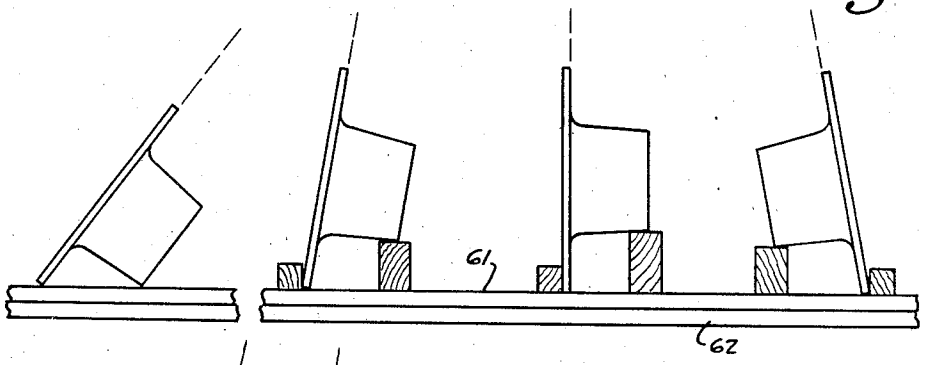


Fig. 5

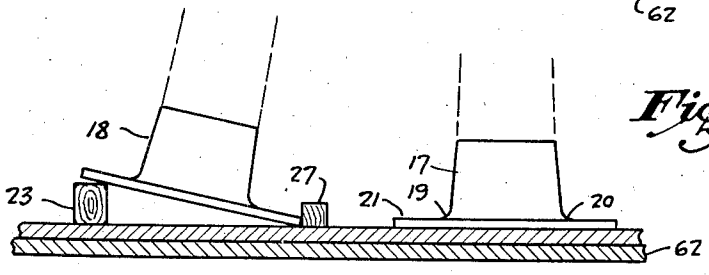


Fig. 6

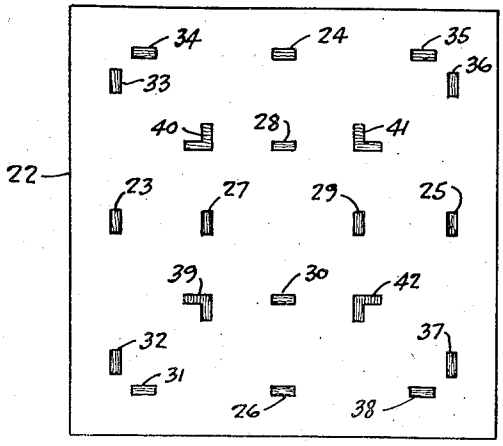
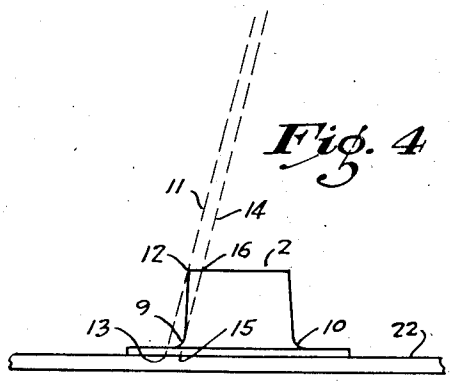


Fig. 4



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Patented Aug. 22, 1944

2,356,358

UNITED STATES PATENT OFFICE

2,356,358

MEANS AND METHOD FOR MAKING INDUSTRIAL RADIOGRAPHS

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Application March 27, 1943, Serial No. 480,867

3 Claims. (Cl. 250—51)

The invention herein disclosed pertains to means and methods for making industrial radiographs.

In industrial roentgenology, the part or parts to be radiographed are placed between the target of the X-ray tube and the X-ray film, or, in the case of fluoroscopy, between the target and the fluorescent screen. In the instance of photo-fluoroscopy, the image on the screen is photographed on to an X-ray photographic film, usually much smaller than the screen, by means of a camera.

In any of the above mentioned procedures it is desirable to position the parts so as to obtain the best possible image of the particular section or sections of the part or parts to be inspected.

In previous practice, the operator has placed such parts on the envelope containing the X-ray film, and has propped them individually in the desired angular position by means of saw dust, wooden blocks, or other material that is relatively transparent to X-rays. The propping of each part has heretofore been an independent job individual to such part, and has required handling and positioning each such support, the entire job being repeated for each successive film.

This previous technique has been slow and cumbersome, and the resulting radiographs have not been uniform when exposures for identical parts have been successively made, and particularly when a long interval has elapsed since the previous radiographing of a group of identical or similar parts. Uniformity has not even been present when a plurality of parts have been simultaneously radiographed.

Castings of various kinds form a large portion of the parts that are customarily X-ray inspected. Each particular method of making castings such as those that use sand, permanent, semi-permanent or metal molds; those employing gravity or centrifugal equipment; or the die cast method in which the metal is forced into the mold under pressure, has its peculiar problems and will produce castings that may be found defective in certain sections only, because of the particular method employed in making such parts.

Radiographing of the first group of castings of a given design, generally referred to as a "radiographic foundry control," will at times require that only part of a certain casting be subjected to radiographic inspection. In other instances, the entire casting may have to be radiographed from various angles to permit radiographic inspection of all parts or sections.

In the case of highly stressed castings, such as are used in the construction of airplanes, it is customary to X-ray inspect a percentage or all of the castings of a given design or kind.

In the inspection of the majority of such castings, each one must be completely X-ray inspected, which requires views from various angles in order to obtain a complete analysis of every section.

The afore-mentioned considerations require that castings of the same design and shape be so placed in the X-ray beam that identical views will be obtained. Otherwise, the person examining the radiographs would not be aware of the magnitude or significance of any deflect that might be present. The present invention greatly increases the speed, efficiency, accuracy and effectiveness of industrial radiographic technique, and also correspondingly reduces the cost.

One of the objects of the present invention is to speed up the positioning of the parts to be inspected.

Another object is to secure greater uniformity in such positioning, to the end that diagnoses will be more accurate.

Another object is to assure substantially identical or similar orientation of a plurality of such parts with respect to the incident X-rays.

Another object is to secure such substantially identical or similar orientation in case identical parts are radiographed at a later time.

Another object is to attain uniformity in such positioning and in the resulting radiographs regardless of whether the work is done by the same or a different operator.

Another object is the elimination of unclear radiographs due to vibration or rocking of the parts that are being radiographed.

Another object is to secure accurate and respectively similar views of certain or all fillets and sections in a plurality of parts to be radiographed.

Another object is the provision of a method of making radiographs which makes it possible to alter to any desired degree the view of parts to be inspected by merely altering the supporting structure on the fixture.

An additional object is the reduction of the skill required on the part of the operators making the radiographs.

A further object is the provision of fixtures whereby the attaining of one or more of the aforementioned objects may be facilitated.

A still further object is the provision of a type of jig by means of which a plurality of parts may be suitably positioned in order to obtain satisfactory images on a single film.

Yet additional objects will appear as the specification proceeds.

In the drawings:

Fig. 1 illustrates, partly diagrammatically, the common method heretofore used for making a radiograph of a plurality of parts on a single film.

Fig. 2 is an oblique projection, partly broken away, of a casting shown in the various figures for the purpose of illustrating the present invention.

Fig. 3 illustrates the means and method of my invention, and shows a plurality of castings arranged on a fixture constructed according to my teachings, the fixture and castings being superimposed over a holder containing an X-ray film, the relationship of the castings, fixture and film with respect to the tube and the X-rays being indicated diagrammatically.

Fig. 4 is an enlarged view of a portion of Fig. 1, showing more clearly the casting at the left in Fig. 1 in its relation to the X-rays.

Fig. 5 is a partial section through the lower part of Fig. 3, taken substantially on line 5—5 thereof and shows the center casting and the one to the left thereof in their relation to the X-ray beam.

Fig. 6 is a plan view of the fixture that supports the castings in Fig. 3.

Fig. 7 illustrates the common past method that would have been used to secure an additional view of a plurality of castings of the type shown in the various figures.

Fig. 8 illustrates my method of obtaining the corresponding additional view of such castings, and also shows a portion of the required fixture constructed according to my invention.

The X-ray beam originates at the target of the X-ray tube, its actual source. For the purpose of illustrating my invention, it may be considered as a point source, although in practice it varies from one-half millimeter to ten millimeters in diameter, depending upon the type of X-ray tube target employed. In Figs. 1 and 3 the target is indicated diagrammatically by the diagonal line 1.

In Fig. 1, three castings 2, 3 and 4 are symmetrically arranged beneath the tube 5 on the film-containing holder 6, in a manner heretofore common. It will be observed that the center casting 3 is positioned directly beneath the target 1 and that the central rays 8 are substantially parallel to the vertical axis of the casting. The rays are also normal to the base 7 of casting 3. Castings 2 and 4, however, are not so arranged with respect to the rays. Not only does this result in distorted radiographic images; it causes an overlapping of shadows that prevents an accurate diagnosis. This will be more apparent from an examination of Fig. 4.

A great many of the defects in castings occur in the fillets and other places where sections come together or change their direction. Fillets such as 9 and 10 in Fig. 4 must therefore receive a thorough inspection. This cannot be done satisfactorily when the parts are merely lined up as shown in Fig. 1, for the reason that there will be too much superimposition of the shadows of certain portions. Because casting 2, Figs. 1 and 4 is not directly beneath the tube target, it receives the X-rays from an oblique angle. Ray 11, which passes through the edge of the casting at 12, strikes the film at point 13; and ray 14, which passes through the portion of the fillet 9 that lies furthest to the right, strikes the film at point 15. The shadow and image of the fillet 9 lies between points 13 and 15; but a shadow of all the parts of the casting that lie within the triangle 12, 15, 16, also falls on the film between points 13 and 15, thus spoiling a proper image of the fillet 9.

Such difficulties as this can be avoided by disposing the parts on a specially prepared fixture 22, as shown in Fig. 3, so that they all receive the X-rays from substantially the same angle. The advantages of such positioning are evident in Fig. 5, which shows castings 17 and 18 of Fig. 3 from a front elevation. Casting 17, being directly beneath the target, is properly disposed in the beam for a view of the fillets 19 and 20 and the base 21; and casting 18 has been given a similar relationship with respect to the X-rays by elevating it by means of block 23. Block 27 assists in positioning casting 18 and also keeps it from sliding.

Fig. 6 is a plan view of the fixture shown in use in Fig. 3. Supports 23, 24, 25 and 26 are all of substantially equal height, because the castings supported thereby, as shown in Fig. 3, are all substantially equi-distant from the center where the rays are perpendicular to the fixture. Braces 28, 29 and 30 are respectively similar to support 27 and serve the same purpose. The castings in the four corners are slightly further from the center than those supported by members 23, 24, 25 and 26 and they must therefore be tilted a greater amount. Supports 31 to 38 must consequently be of a height that will accomplish this. Braces 39, 40, 41 and 42 serve to position the corner castings and to prevent sliding.

Broken lines 43, 44, 45 and 46 are arcs of radii whose center is the target 1, and these arcs may therefore be considered as lying on the surface of a sphere whose center is the target. It will be observed from this figure that a correct positioning of the castings shown, requires that their bases be substantially parallel to planes tangent to this sphere at the points thereon which are respectively nearest to the bases.

For purposes of illustration it may be assumed that the bases and fillets of these castings are not the only things to be inspected, and that defects may also be reasonably expected in the barrels or upper portions 47. This requires that additional radiographs of these castings be made from angles that will give the most unobstructed views of the upper sections. They must therefore be oriented substantially at right angles to the positions illustrated in the figures just described.

In the older practice, such castings would be disposed for this purpose somewhat as illustrated in Fig. 7. Casting 48 in this figure is favorably situated with respect to the X-rays 49, which fall parallel to the base 50, but castings 51 and 52 receive the rays from a very bad angle. The image of the base of casting 51 will appear on the film between points 54 and 55, but all portions of the barrel lying within the triangle 54, 53, 55 will also fall between the points 54 and 55 on the film, with the result that the various shadows will be superimposed. Only the section between points 56 and 57, the shadow of which falls between points 55 and 58, will be properly radiographed. Matters are even worse

for casting 52, for here only the portion 59 between the indicated rays is favorably situated, and the only portion of the radiograph of this casting that will be free from unnecessary overlapping images will be the relatively small area 60.

Figure 8 shows how such castings are positioned for inspecting the upper sections according to my method. The illustration shows a fixture 61 having upright members arranged to hold the castings in the most favorable positions with respect to the incident rays, according to the pattern and method already explained. The advantages of this positioning will be evident from the figure, which shows the incident rays.

In the laboratory where my method of making radiographs is now in every day use, separate fixtures are usually made for each view. The base of the fixtures should be as transparent as possible to the X-rays, and they are therefore currently made of cardboard. The supports and braces should also be substantially transparent to the X-rays, and for this purpose balsa and yucca wood has been found satisfactory. The braces and supports must not be attached by means of brads, nails, or screws, as these would appear in the radiographs. I therefore prefer to use an X-ray transparent adhesive, such as Duco cement.

In designing and making the fixtures, it is convenient to place the base beneath a point source of visual rays and determine the heights of the supports by tilting the objects to be inspected until all shadows disappear or reach minimum sizes.

After a fixture has been completed, it may be used whenever castings of the type for which it was made are to be radiographed.

My preferred method of making the radiographs after the fixture has been completed, is as follows:

An unexposed X-ray film, usually in an envelope or folder opaque to visual rays, is placed in a holder of relatively substantial material, such as cardboard. The fixture is then placed on top of the film holder, and then the parts to be inspected are properly arranged on the fixture. This entire assembly is then so disposed beneath the target of the X-ray tube that the rays fall on the objects at the angles contemplated when the fixture was constructed. The exposure is then made.

A variant from this method is to arrange and set-up the entire assembly beneath the tube in the first place. If time is not important, this plan is satisfactory; but my preferred method makes it possible to set up one group of castings while another group is being radiographed.

Various modifications may be made from the type of fixture and from the methods described without departing from the broad spirit of my invention as set forth in the appended claims.

My claims are:

1. A fixture for use in industrial radiography, comprising: a base of X-ray-transparent material, and a plurality of X-ray-transparent supporting members attached to the upper surface thereof, at least a portion of said members of such heights that the objects supported thereby will vary in their relative orientation substantially according to the direction of the incident X-rays.

2. The method of making industrial radiographs which includes: placing an X-ray transparent fixture on a container containing an unexposed X-ray film, said fixture comprising a plurality of supporting members each having such height that an object at least part of which is to be supported thereby will be so oriented that the section to be X-ray inspected will lie in a plane substantially tangent to the surface-portion nearest said section on a mathematical sphere-segment having its convex side toward the upper surface of said film; placing the objects to be inspected upon said fixture; so disposing said container, film, fixture and objects in their recited relationships beneath an X-ray tube that the X-rays therefrom will be normal to the surface of said segment; and making the exposure while said container, film, fixture and objects are in the last recited positions.

3. The method of making industrial radiographs which includes; placing a container containing an X-ray film beneath an X-ray tube; placing an X-ray transparent fixture on said container, said fixture comprising a plurality of supporting members each having such height that an object at least part of which is to be supported thereby will be so oriented that the section to be inspected will lie in a plane substantially tangent to the nearest portion to said section on the surface of a segment of a mathematical sphere having its convex side toward the upper surface of said film; placing the objects to be inspected upon said fixture; and making the exposure when the recited parts are in the recited positions.

JUSTIN G. SCHNEEMAN.