Jan. 27, 1948. E. G. FORSSELL 2,435,134

METHOD FOR DETECTING FLAWS IN TUBULAR STEEL CASTINGS

Filed Sept. 18, 1944 2 Sheets-Sheet 1

Fig. 1

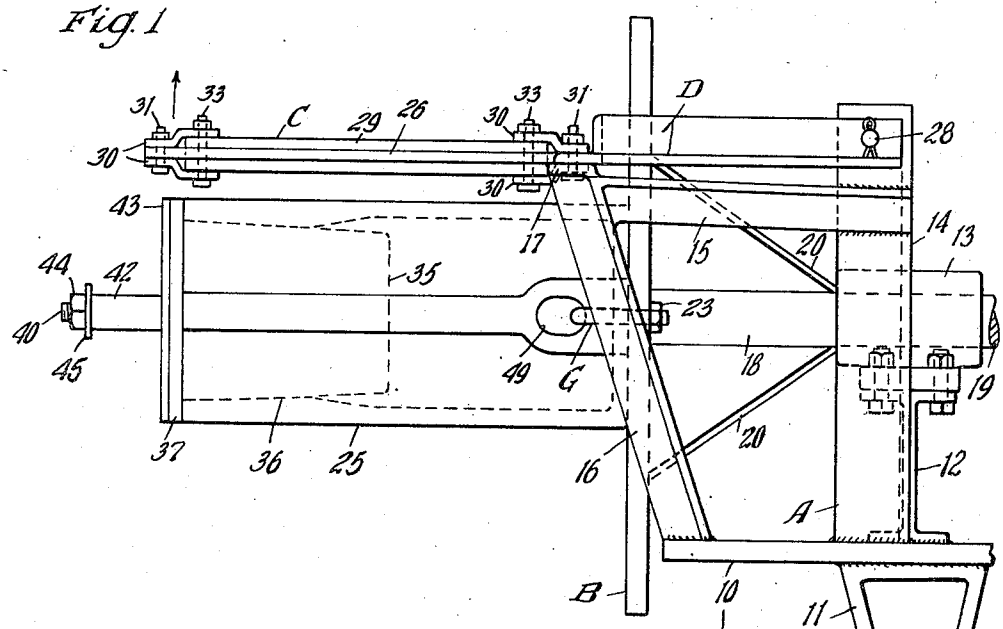
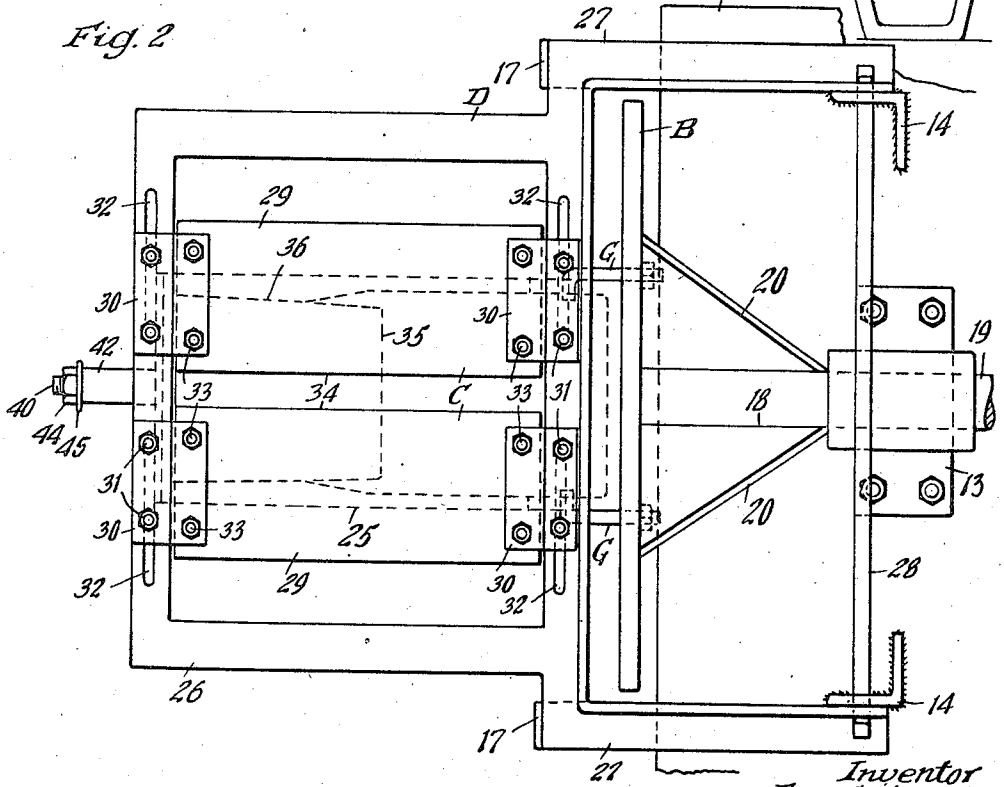


Fig. 2



Inventor
Eric G. Forssell

By Henry Fuchs.
Atty.

Jan. 27, 1948. E. G. FORSSELL 2,435,134

METHOD FOR DETECTING FLAWS IN TUBULAR STEEL CASTINGS

Filed Sept. 18, 1944 2 Sheets-Sheet 2

Fig. 4

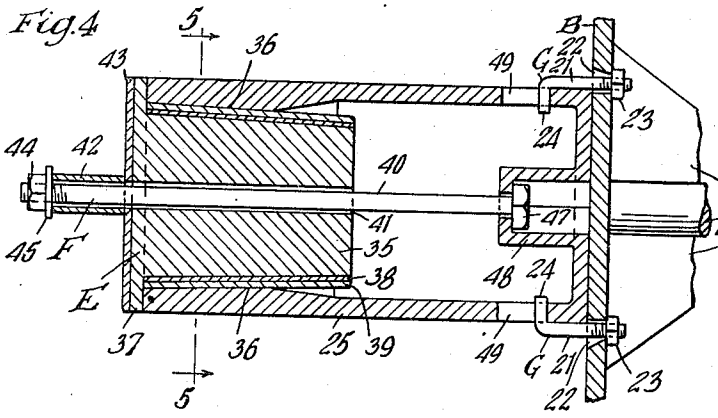


Fig. 5

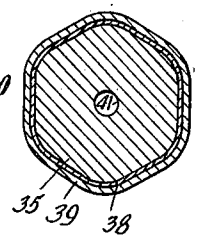
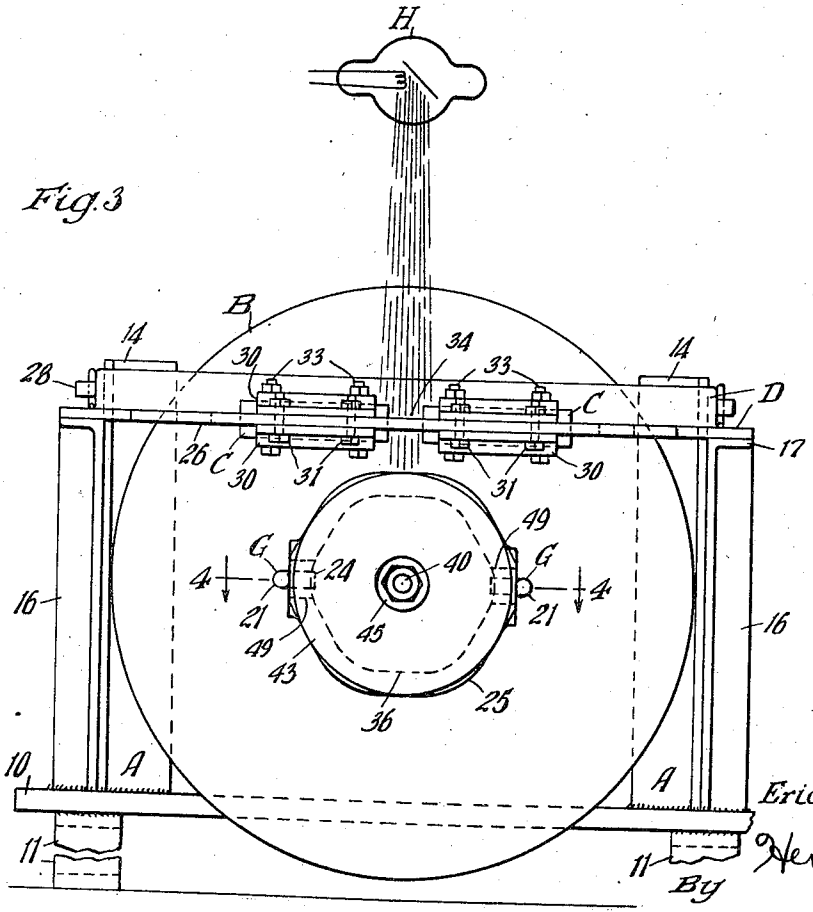


Fig. 3



Inventor
Eric G. Forssell
By Henry Fuchs
Atty.

Patented Jan. 27, 1948

2,435,134

UNITED STATES PATENT OFFICE

2,435,134

METHOD FOR DETECTING FLAWS IN TUBULAR STEEL CASTINGS

Eric G. Forssell, Kenmore, N. Y., assignor to W. H. Miner, Inc., Chicago, Ill., a corporation of Delaware

Application September 18, 1944, Serial No. 554,593

2 Claims. (Cl. 250—53)

1

This invention relates to improvements in Method for detecting flaws in steel castings, and more particularly steel castings of tubular shape.

Various methods and means have been employed in foundry practice for detecting flaws in steel castings, including the examination of the castings through the use of X-rays by photographing on a sensitized film, the developed photographic film presenting a visual reproduction of the texture of the metal, thereby giving a graphic picture of the condition of the castings, which clearly indicates any flaws which may exist. This X-ray photography of castings is generally known in this art as X-radiographing.

The main object of my invention is to provide a reliable method of detecting flaws in tubular steel castings by X-ray photographing, on a continuous film, extensive portions of the casting, thereby providing a single continuous picture of the entire area under consideration.

A further object of the invention is to provide simple and efficient means for carrying out the method set forth in the preceding paragraph.

Another object of the invention is to provide a method of X-radiographing tubular steel castings comprising the following procedure. Mounting a continuous film within the tubular steel casting member in close proximity to the interior surface of the side walls thereof and extending entirely around the tubular member, rotating the tubular member and the film in unison therewith about the central longitudinal axis of said member, and exposing said tubular member to the effect of the rays of an X-ray apparatus, thereby progressively exposing successive portions of the tubular member to the source of said rays.

A still further object of the invention is to provide an apparatus for carrying out the method as set forth in the preceding paragraph comprising a rotary table or chuck on which the tubular steel casting is secured for rotation therewith, a source of X-rays radial to the axis of rotation of the table and tubular member, a photographic film holder telescoped within the tubular member for holding a continuous film in close proximity to the inner face of the annular side wall of the member, and a lead screen between the tubular member and the source of X-rays, the screen having a lengthwise extending, narrow opening therethrough, permitting the free passage of the X-rays, thereby confining the action of the effective rays to elongated, relatively narrow field, and means for rotating the table and member thereof while exposed to the effect of the X-rays as permitted by said screen.

2

Still another object of the invention is to provide means in an apparatus as set forth in the preceding paragraph for effectively screening the film adjacent the wall of the tubular member opposite to the wall portion being subjected to the effect of the X-rays.

Other objects of the invention will more clearly appear from the description and claims hereinafter following.

In the drawings forming a part of this specification, Figure 1 is a side elevational view of the improved apparatus or mechanism employed in carrying out my improved method. Figure 2 is a top plan view of Figure 1. Figure 3 is a front end elevational view of Figure 1, looking from left to right in said figure, the X-ray apparatus which is the source of the X-rays employed in connection with my improved method and apparatus being illustrated diagrammatically in this view. Figure 4 is a longitudinal vertical sectional view, corresponding to the line 4—4 of Figure 3 of the tubular member and the film holder contained therein, the table or chuck of the apparatus being broken away and other parts of the mechanism being omitted. Figure 5 is a transverse, vertical sectional view, corresponding substantially to the line 5—5 of Figure 4.

As shown in the drawings, my improved apparatus by which the improved method is carried out comprises broadly a supporting frame A; a rotary table or chuck B; a screen C; a hinged supporting table D for the screen; a film holder E; retaining means F for clamping the film holder within the tubular steel casting; clamps G—G for fixing the casting on the rotary table B; and an X-ray apparatus H.

The supporting frame A comprises a horizontal, platform 10, the front end of which only is shown in the drawings. The table 10 is provided with supporting feet at its corners, one of which is shown in Figure 1 and is indicated by 11. The frame A has a supporting standard 12 carrying a bearing member 13 for a rotary shaft hereinafter referred to. The frame is also provided with upstanding columns 14—14 at opposite sides of the platform 10. The columns 14—14 have forwardly extending arms 15—15 near the upper ends thereof. The arms 15—15 are slightly inclined upwardly toward their outer ends. Inclined bracing struts 16—16 extend from the outer edge of the base 10 to the arms 15—15 and support the latter. The bracing struts 16—16 project slightly above the arms 15—15 and said projecting portions are provided with flat, horizontal end faces 17—17 forming abutments for

supporting the table D. The columns 14—14 project some distance above the level of the arms 15—15, as clearly shown in Figures 1 and 3.

The rotary table or chuck B is in the form of a flat, disclike plate having a rearwardly extending axial sleeve 18 formed integral therewith, adapted to receive the end of a shaft 19 which is fixed thereto by being keyed or secured in any other suitable well-known manner. The disc or chuck B is preferably reenforced by a plurality of radial webs 20—20 formed integral with said disc and the sleeve 18. The shaft 19 is rotatably mounted in the bearing 13, thus supporting the table or chuck B for rotation about a horizontal axis. The driving means for the shaft is not illustrated but it is such that the shaft 19 is rotated at relatively slow speed, and the driving means may be in the form of an electric motor and any well-known type of reduction gearing interposed between and connecting the motor to the shaft 19.

The rotary table B carries the clamps G—G, which are disposed at opposite sides of the center of rotation of the table and are in the form of hooks having straight shank portions 21—21 extending through openings 22—22 in the table B. The shank portions 21—21 are threaded at their outer ends to receive clamping nuts 23—23. At the opposite end, each clamp G has an angularly bent portion 24 substantially at right angles to the shank thereof forming the hook proper of the clamp.

The clamps G—G are especially designed to securely mount the particular type of tubular steel casting 25 herein illustrated, namely, the casing of a railway friction draft gear, of well-known design, on the table B. As will be understood, other types of tubular members than the draft gear casting or casing 25 may be supported for rotation by the table B, the clamping means being suitably modified to suit conditions, the draft gear casing being merely illustrative of one type of steel casting which may be rotatively supported by the table. The well-known railway friction draft gear, of which the casing 25 forms a part, comprises briefly the casing 25 and a spring resisted friction clutch slidable in the casing, the casing 25, as illustrated, being of standard design.

The supporting table D comprises a rectangular open frame 26 having rearwardly extending, spaced side arms 27—27 offset laterally outwardly from the sides of the frame 26. The arms 27—27 at their rear ends embrace the outer sides of the columns 14—14 and are hinged thereto at the upper ends thereof by a pivot rod 28 extending through suitable openings in said standards and arms. In the operative position of the screen supporting table D, the front ends of the arms 27—27, that is, the ends thereof where they join the frame 26, are adapted to rest on the supports formed by the flat abutment faces 17—17 at the upper ends of the struts 16—16 to maintain the table in horizontal position above the tubular casting 25 and parallel to the axis of rotation of said casting. As will be seen upon reference to Figure 2, the arms 27—27 are spaced apart a sufficient distance to clear the upper portion of the rotary table B when the table D is swung to its horizontal position, as shown in Figures 1, 2, and 3.

The screen C, as illustrated, comprises two relatively thick, rectangular lead plates 29—29, which are clamped within the opening of the frame 26 of the table D. The lead plates 29, as

shown, are relatively long and are arranged in the frame 26 lengthwise of the axis of rotation of the draft gear casing or tubular steel casting 25, and are clamped within said frame by top and bottom clamping plates 30—30 arranged at opposite ends of said frame and secured thereto by bolts 31—31 extending through said plates and through slots 32—32 in the transverse members of said frame. The clamping plates 30—30 overlap and embrace the lead plates at the top and bottom sides of the latter and are preferably secured thereto by bolts 33—33 extending through said clamping plates and the lead plates. The slots 32—32 provide for lateral adjustment of the lead plates 29—29 within the frame 26, sufficient clearance for this purpose being provided between the outer side edges of the plates 29—29 and the side members of the frame 26. In the operative position thereof, the lead plates 29—29 are so adjusted that they are laterally spaced apart, as shown most clearly in Figure 2, to provide an opening 34 therebetween, extending lengthwise of the frame 26 and parallel to and in vertical alignment with the axis of rotation of the draft gear casing 25.

The X-ray apparatus employed in my improved method in connection with my improved apparatus may be of any well-known type, and is indicated by H, and as shown in Figure 3 is located above the screen C. The X-ray apparatus H is in vertical alignment with the axis of rotation of the draft gear casing 25 and the opening 34 of the screen C.

The film holder E comprises a plug 35 fitting within the open end of the casing 25. The standard friction gear casing 25 herein shown is of hexagonal, interior cross section providing six flat friction surfaces 36—36. The friction surfaces 36—36 converge inwardly of the casing, and the pluglike film holder E is made of hexagonal transverse cross section and tapered to properly fit the hexagonal opening of the casing. The plug 35 of the film holder E is preferably in the form of a lead block and has a laterally, outwardly extending, peripheral flange 37 at the outer end thereof adapted to bear on the front end of the casing 25, that is, it overlaps the end edge of the hexagonal side wall of the casing. The photographic film employed, which is in the form of a continuous strip 38, is wrapped around the hexagonal plug 35 and is covered by a thin tubular lead shell 39, which also may be in the form of a strip or sheet surrounding the film covered block 35. The film holder E including the lead shell or cover 39 and loaded with the film 38 closely fits the interior of the casing 25 and is clamped in position by the retaining means F.

The retaining means F comprises a bolt 40 extending through an axial opening 41 in the plug 35 and projecting beyond the front end of said block; a tubular sleeve 42 surrounding the projecting end of the bolt; a disclike washer 43 interposed between the inner end of the sleeve 42 and the flanged end of the plug 35; a retaining nut 44 on the outer end of the bolt; and a washer 45 interposed between the nut and the sleeve. The bolt is headed at the rear end, as indicated at 47, and said headed end is anchored in an inwardly projecting hollow boss 48 provided on the standard friction draft gear casing 25. As will be evident, the nut 44 when tightened serves to hold the film holder E tightly within the casing 25.

As hereinbefore stated, the casing 25 to be X-rayed is mounted on the rotary table or chuck

B, being held thereon by the retaining clamps G—G, the angularly bent portions 24—24 of which are hooked into diametrically opposite openings 49—49 of the standard casing 25.

In carrying out my improved method, the operation is as follows: The film holder E with the film loaded therein is first placed within the tubular steel casting 25 and secured in place by the clamping bolt 40. The casting 25 is then clamped on the rotary table B, while the hinged screen supporting table D is in position swung up out of the way to facilitate mounting the casting on the rotary table B. The screen supporting table is then swung down to its operative horizontal position above the casting, as shown in Figure 1, the slit or opening in the screen C having been adjusted to the proper predetermined width. Power is then applied to the driving shaft 19 to slowly rotate the same and the table B together with the casting 25 thereon. At the same time the electric current is supplied to the X-ray apparatus H, thereby exposing the casting 25 and the photographic film in the film holder E to the rays emanating from the X-ray apparatus.

In this connection it is pointed out that the lead plug 35 of the film holder E properly screens that portion of the photographic film at the side of the film holder opposite to that exposed to the source of X-rays during rotation of the tubular casting, thereby preventing marring of the exposure which otherwise might occur by diffused rays reaching this portion of the film.

From the preceding description taken in connection with the drawings, it will be evident that I have provided a simple and efficient method and means for producing X-ray photographic records showing the cross sectional, internal structure of the walls of tubular steel castings, thereby giving a graphic representation in the form of a map embracing the entire circumference of the tubular member, which reveals any defects which may exist in the casting. It will be further evident that the accuracy of the resulting X-ray photograph is greatly increased through my improvements by confining the exposure of the casting to the rays emanating from the X-ray source to a relatively narrow, elongated field lengthwise of the tubular member, parallel to its axis, by means of the slitted lead screen which filters out diverging rays and by limiting the diffusion of the rays by means of the thin lead outer covering strip and the inner lead core of the film holder.

I have herein shown and described what I now consider the preferred manner of carrying out my invention, but the same is merely illustrative and

I contemplate all changes and modifications that come within the scope of the claims appended hereto.

I claim:

1. A method of producing X-ray photographs of tubular steel castings comprising the following procedure: Placing a photographic film on the inner side of substantially the entire circumferential side wall area of the tubular casting to be photographed in close proximity to said wall, said film being coextensive with said wall area, screening the inner side of said entire film from the effect of the X-rays, slowly rotating the tubular casting and film about its central longitudinal axis while exposed to a X-radiation from a fixed source of X-rays exterior to said tubular casting, and screening the rays emanating from said source of X-rays to restrict the rays reaching said casting to an elongated narrow field.

2. A method of producing X-ray photographs of tubular steel castings comprising the following procedure: Placing a photographic film on the inner side of substantially the entire circumferential side wall area of the tubular casting to be photographed with a thin lead screen interposed between the film and the inner surface of said wall area, said film being coextensive with said wall area, screening the entire inner side of said film against the effect of X-rays, slowly rotating the tubular casting and film about its central longitudinal axis while exposed to X-radiation from a fixed source of X-rays exterior to said tubular casting, and screening the rays emanating from said source to restrict the rays reaching said casting to an elongated narrow field extending lengthwise and parallel to said axis of rotation.

ERIC G. FORSSELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,563,362	Herradora	Dec. 1, 1925
2,025,488	Yap	Dec. 24, 1935
2,306,194	Swaisgood	Dec. 22, 1944
2,340,923	Boucher	Feb. 8, 1944
2,396,069	Zapp	Mar. 5, 1946

OTHER REFERENCES

"Industrial X-ray Units," Pub. 7A–700, General Electric X-Ray Corp. Copy received in Patent Office on June 15, 1942. (Copy in Div. 54.)