

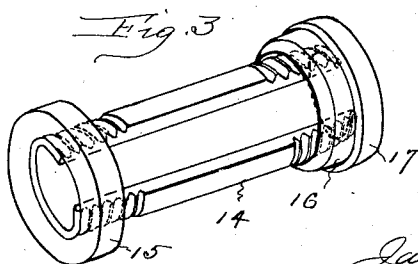
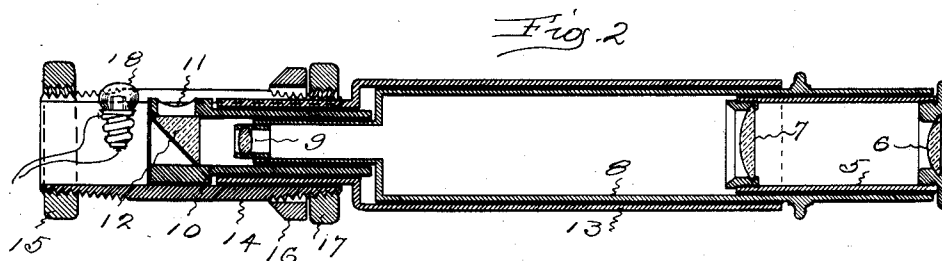
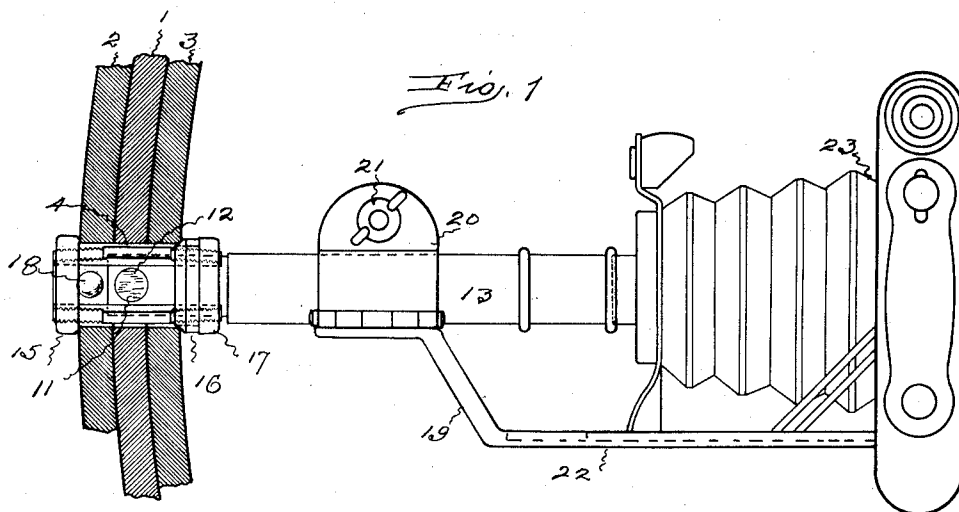
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INSTRUMENT FOR DISCOVERING AND RECORDING DEFECTS IN METAL PLATES

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INSTRUMENT FOR DISCOVERING AND
RECORDING DEFECTS IN METAL PLATES

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This invention relates to an instrument by which the walls of rivet holes or other holes in the plates of steam boilers or other pressure containing vessels may be examined for the purpose of discovering and recording the existence of defects, such as cracks, fissures or crevices in said plates. At commencement such defects are infinitesimal and rarely visible to the naked eye. They may be caused by strains due to so-called breathing of lap seam, butt seam or strap seam boilers. They may start in the solid plate and extend to rivet or other holes, or more frequently they may start at such holes and extend through the solid plates to adjacent holes or to the edges of the plates. One of the defects is known as embrittlement and while this instrument is capable of disclosing cracks, fissures and crevices in the walls of holes, due to any cause, it is described herein with relation to the disclosure and record of defects resulting from embrittlement.

The concentration of caustic soda used under certain conditions in steam boilers, evaporators and other vessels causes what is known as caustic embrittlement, that is, under heat and pressure the caustic slowly eats into, breaks down, disintegrates and destroys the elements which cement or bind together the crystals of steel in the plates or other steel parts, and cracks, fissures or crevices which are microscopic at start but which weaken the plates occur.

These cracks and fissures, though often commencing in the rivet or other holes of the plate are so concealed by the rivets, or by laps and straps of the boiler that their existence is not readily discoverable by ordinary examination, and when discovered, in view of the minuteness of the defects, it is often very difficult for an inspector to convince plant officials that these cracks exist and produce a dangerous condition which must be remedied by repairs or otherwise if the boiler or vessel is to continue in safe operation.

The object of the present invention is to provide an instrument by means of which boiler inspectors may readily detect and record cracks, fissures or crevices in the walls of rivet holes resulting from embrittlement or other causes, in their early stages so that the problem may be studied and plant officials be shown the possibilities and the advisability of making repairs before the disease has progressed to a dangerous point.

The instrument illustrated as embodying the invention comprises a microscope, combined with

an optical prism, that is capable of being inserted into rivet or other small holes and moved both longitudinally and rotatively so that the entire wall of the hole may be scrutinized. If a defect is discovered or indicated the microscope is focused on the locality and after being firmly clamped in that position a camera is focused on the eye piece of the microscope and a magnified photograph of the defect is obtained.

In the accompanying drawing Fig. 1 shows a side view of the instrument fixed to a section of a boiler in position to record a defect in a rivet hole.

Fig. 2 on larger scale shows a longitudinal section of the microscope which forms one element of the instrument, and the clamp which is provided for fastening the instrument in position for use.

Fig. 3 is a perspective view of the fixing clamp.

In the views 1 indicates a section of a boiler shell, 2 a section of an outer butt strap, and 3 a section of an inner butt strap, through which parts is a rivet hole 4 that is to be explored.

The microscope illustrated has an eye piece 5 with an eye lens 6 and a field lens 7. The eye piece is adjustably fitted in one end of a tube 8 in order that the focal distance between the eye piece lens and the object lens 9 at the other end of the tube, may be varied. Fitting a reduced end of the tube 8 and extending beyond the object lens is a tube 10 with a window 11 in one side. In the tube 10 opposite the window is an optical prism 12 located so as to reflect whatever is visible through the window 11 onto the object lens, the diagonal face of the prism being coated with a reflecting material for this purpose. Fitting the exterior of the tube 8 and the tube 10 is a sleeve 13. A reduced end of this sleeve and the projecting end of the tube 10 with the prism, extend into a clamp bushing 14 which is split longitudinally and has tapering threads on the exterior at its ends. Threaded on one end of this bushing is a nut 15, and on the other end of the bushing is a conical collar 16 and a nut 17, which nuts are employed for tightly holding the sleeve 13 in the bushing and for firmly securing the bushing in a hole. An electric lamp 18 may be located in the bushing 14 beyond the prism in such position that its rays will pass through the bushing slit and illuminate the wall of the opening that is to be inspected and in which the bushing is clamped, the lamp being connected with any convenient source of energy.

A bracket 19 is fastened to the tube 13 by a clamp 20. The clamp is secured by a screw and

thumb nut 21 which when loosened allows the clamp to be adjusted longitudinally on the tube 13. Removably placed on the horizontal arm 22 of the bracket is a camera 23 of a common type.

Whenever there is a suspicion of a defect or it appears advisable to search for defects in a plate of a boiler or other container for fluid under pressure, a rivet is removed and the wall of the rivet hole cleaned. The clamp bushing holding the object end of the microscope with its window opposite the slit in the bushing, is inserted in the hole, the nut 15 being removed to permit this. The inspector then rotates the bushing and microscope and at the same time moves the microscope back and forth in the bushing with his eye fixed to the eye piece of the microscope, and scrutinizes, with ample magnification, the entire surface of the wall of the rivet hole. Should a defect, crack or fissure be found, the clamp nuts are tightened so as to securely hold the microscope with the window opposite the crack or defect. After the lenses have been focused to give the desired magnification to the section of the wall being examined, the camera is placed upon the bracket and focused to the object shown on the eye piece of the microscope, and the picture is taken.

With this instrument the entire surface of the wall of a hole in a metal plate may be minutely inspected, and when it is desired to record the condition of any section of the wall a magnified photograph can be quickly taken so that ocular evidence of the exact condition of the plate at the hole may be had.

The invention claimed is:—

1. An instrument for inspecting and recording the condition of walls of openings in metal plates, which comprises a rigid tubular casing containing magnifying lenses and a reflector for directing light rays upon the lenses, said reflector adapted to be inserted into and moved longitudinally and rotatorily in the opening to be inspected, means adjacent to the reflector for firmly clamping said casing to the walls about the opening to be inspected with the reflector in the opening, and means for the attachment of photographing apparatus in front of the lenses.

2. An instrument of the character described which comprises a rigid tubular casing having an adjustable eye lens at one end and an object lens at the other end, with a reflector for directing light rays upon the object lens, said reflector adapted to be inserted into and moved longitudinally and rotatorily in the opening to be inspected, means adjacent to the reflector for firmly clamping said casing to the walls about the opening to be inspected with the reflector in

the opening, and means for the attachment of photographing apparatus in front of the eye lens.

3. An instrument of the character described which comprises a rigid tubular casing having an eye lens at one end and an object lens at the other end, said lenses being adjustable with relation to each other, with a reflector for directing light rays upon the object lens, said reflector being adjustable with relation to the object lens and adapted to be inserted into and moved longitudinally and rotatorily in the opening to be inspected, means adjacent to the reflector for firmly clamping said casing to the walls about the opening to be inspected with the reflector in the opening, and means for the attachment of photographing apparatus in front of the eye lens.

4. An instrument of the character described which comprises a rigid tubular casing containing adjustable magnifying lenses and a prism for directing light rays from one side to the lenses, said prism adapted to be inserted into and moved longitudinally and rotatorily in the opening to be inspected, and means adjacent to the prism for firmly clamping said casing to the walls about the opening to be inspected with the prism in the opening.

5. An instrument of the character described which comprises a rigid casing containing magnifying lenses and an eye with means for receiving and directing light rays from one side to the lenses, said eye adapted to be inserted into and adjusted longitudinally and rotatorily in the opening to be inspected, and means extending through the opening to be inspected for firmly clamping said casing with the eye in the opening to be inspected.

6. An instrument of the character described which comprises a microscope, a reflector for directing light rays upon the object lens of the microscope, said reflector adapted to be inserted into the opening to be inspected, means adjacent to the reflector for firmly clamping the microscope to the walls about the opening to be inspected with the reflector in an opening, and photographing apparatus detachably mounted in front of the eye lens of the microscope.

7. An instrument of the character described which comprises a microscope, a reflecting prismatic eye for directing light rays from one side to the object lens of the microscope, said reflecting eye adapted to be inserted into the opening to be inspected, means extending through the opening to be inspected for firmly clamping the microscope with said eye in the opening, and photographing apparatus mounted in front of the eye lens of the microscope.

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