June 6, 1944. J. O. ALMEN 2,350,440

SHOT BLASTING TEST

Filed April 29, 1942

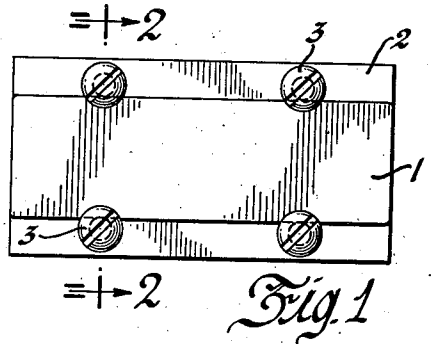


Fig. 1

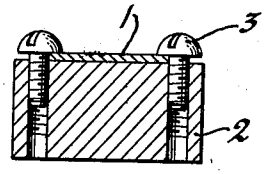


Fig. 2

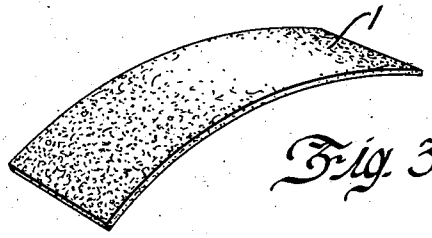


Fig. 3

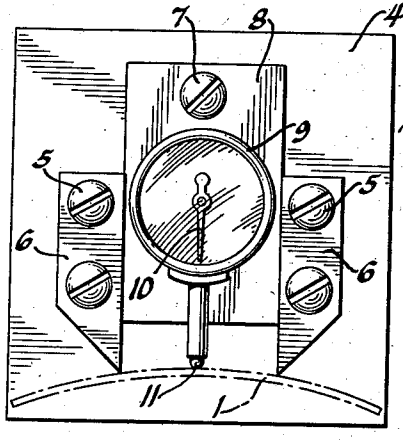


Fig. 4

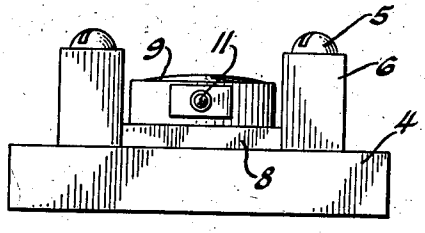


Fig. 5

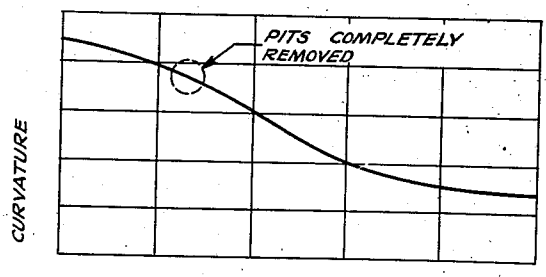


Fig. 6

Inventor

John O. Almen

By Blackmore, Spencer & Hurt

Attorneys

Patented June 6, 1944 2,350,440

UNITED STATES PATENT OFFICE

2,350,440

SHOT BLASTING TEST

John O. Almen, Royal Oak, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application April 29, 1942, Serial No. 440,987

8 Claims. (Cl. 73—51)

This invention relates to instrumentation and the method of use for measuring the intensity of a cold working operation and more specifically the shot blasting of metal parts.

As is well known, cold working by shot blasting improves fatigue durability of machine parts. Its effectiveness depends upon producing a thin surface layer stressed in compression by the peening action of the shot. This peening action varies with the velocity of the shot, with the size of the shot and with the number of shot directed at the work. To assure that the operation will be properly performed it is desirable to be able in a simple and inexpensive manner to measure intensity of shot blasting. Likewise it is necessary that manufacturing standards be set and that engineering specifications show the extent of shot blasting required for a given piece of work. To meet these demands the present invention has for its object the provision of instrumentation and a plan for use whereby the effectiveness of shot blasting can be easily and quickly measured.

In the accompanying drawing Figure 1 is a plan view of a fixture for securing a test specimen in the form of a thin flat plate having one face exposed to the shot blast treatment; Figure 2 is a transverse section on line 2—2 of Figure 1; Figure 3 is a perspective view illustrating the concavo-convex shape assumed by the shot blasted test specimen, the convex face being in a state of compression due to the peening action of the shot; Figures 4 and 5 are an elevation and a side view, respectively, of a gage for measuring the radius of curvature of a shot blasted plate and Figure 6 is a plot to illustrate removal of material from the shot blasted surface in successive steps and the radius of curvature at each stage.

When the effectiveness or intensity of a shot blast operation is to be determined, whether for initially setting standards or for checking to meet given specifications, it is here proposed to submit to the shot blast one face only of a thin flat steel plate and then gage the radius of curvature of the shot blasted specimen. Prior to the test the opposite faces of the flat blade have surface layers substantially free from unequal stress. Compacting or peening the surface on one side only creates an unbalance which causes the initially flat plate to bow. The extent of bowing is dependent upon the degree of compressive stress and therefore is a measure of the intensity of the shot blasting operation. Gaging the height of the arc between predetermined points indicates the radius of curvature of the test specimen and reflects the result of the peening action. After the procedure is accurately charted tests may be made quickly and without the exercise of special skill.

The test specimen selected and found satisfactory and convenient is a steel strip of slightly less than .05 inch thick and about 3 inches long and ¾ inch wide. It is represented by the numeral 1 in the drawing and is shown in the form of a flat plate in Figures 1 and 2 held in a metal block or fixture 2 with one face covered and the other face exposed. During the shot blasting operation the plate is retained under the heads of a number of screws 3 threaded into the block 2 at points spaced from the central region of the plate for full exposure to the shot.

Upon completion of the shot blasting operation and the release of the test specimen from the fixture the plate will assume, as seen in Figure 3, a curve or concavo-convex contour due to the difference in compressive stress in opposite faces of the strip with the treated surface on the convex side and the extent of curvature being directly related to the degree of compacting or compression of the surface layer. There now remains merely the measurement of the radius of plate curvature to obtain an indication of the effectiveness of the shot blasting operation. A reading can be taken with the device shown in Figures 4 and 5 and which is arranged to measure the height of the arc from a chord at the central region of the plate or that plate area which was presented and fully exposed to the shot blast between the holddown screws 3. Accordingly the base plate 4 has fixedly mounted thereon by screws 5 a pair of gage blocks 6 terminating in knife edge seats which are spaced apart a distance slightly less than the longitudinal spacing between the fixture holddown screws 3 and which are to be engaged by circumferentially spaced regions of a curved test plate. Also secured to the base plate 4 by a screw stud 7 is a mounting plate 8 for a dial indicator 9. The indicator 9 is of a conventional pattern and consists essentially of a pivoted dial pointer 10 operatively connected with a reciprocatory plunger or feeler 11. The tip of the feeler 11 projects centrally of the space between the knife edge gage blocks 6 and is engageable with the intermediate portion of a test plate seated on the stops or blocks 6 and by its adjustment causes the pointer 10 to swing away from zero position an amount corresponding to the height of the arc in the plate 1 between the knife edges of the blocks 6. Thus the radius of curvature is gaged and reflects the intensity of

the shot blasting operation performed on the test specimen.

As a laboratory check on the depth of the cold worked surface and its relation to the radius of curvature of the tested plate successive equal thickness layers of material can be removed from the shot blasted surface and the plate curvature noted at each removal until the plate resumes approximately flat form and indicates that substantially all stressed material has been eliminated and, therefore, the depth or intensity of peening. By recording the results in terms of curvature against depth of surface removed a curve can be plotted as shown in Figure 6.

From the above description it will be apparent that the amount of curvature in a specimen subjected to the same shot blasting as is given to a machine part gages the intensity of the peening action and gives an overall measure of the effect of velocity, size and quantity of shot and that such curvature may properly be incorporated as part of the production specifications and define a standard in the performance of a shot blasting operation.

While for the purpose of illustration the above description has dealt specifically with the measurement of the effect of shot blasting, the invention is applicable to other uses, such, for example, as the surface stress due to nitriding, machining operations which do not substantially remove material, surface rolling and the like. The arrangement has been successfully used for measuring the stress due to nitriding by which the amount of surface stress and the depth of the nitrided and prestressed layer was determined. The surface stressed produced by honing has been measured as well as the stress due to other operations, such as rolling by means of balls or rollers, swedging, peening, etc.

I claim:

1. The method for testing the intensity of any shot blasting operation comprising securing in a fixture a preselected thin flat sheet metal plate with one face exposed, subjecting the exposed face to the particular shot blasting operation to be tested, then releasing the plate from the fixture and gaging the height of the arc assumed by the plate as a result of the compressive stress set up in the shot blasted face as a measure of intensity.

2. The method of checking the intensity of shot blasting operations comprising performing a shot blasting operation on one face only of a thin flat plate of sheet metal whose shape is determined by relative stress in strata thereof, to set up compressive stress in the outer strata of said face under the peening action and cause bowing of the plate to arcuate shape, and then measuring the radius of curvature of the plate as an indication of intensity of that particular shot blasting operation.

3. The method of determining the intensity of a shot blasting operation comprising shot blasting a thin sheet steel test specimen on a face area thereof to stress said area in unbalanced relation to the remainder of the test specimen and thereby cause change in outline of said test specimen and then gaging the extent of such change as a measure of the effectivness of the shot blasting operation.

4. The method of determining the intensity of a shot blasting operation comprising selecting a test specimen of thin sheet metal whose shape can be varied by setting particles thereof under strain securing the same in a fixture with an exposed surface area, subjecting said area to the shot blast operation, then releasing the specimen from the fixture and allowing it to assume a different shape as a result of uneven stress between the shot blasted area and the remainder of the specimen and finally noting the difference in shape as a measure of shot blast effectiveness.

5. The method for determining the intensity of a shot blasting operation comprising subjecting one face of a thin steel blade to the shot blast operation after which the resulting compressive stress gives the blade a bowed contour, then measuring the height of the arc as reflecting the degree of compressive stress imparted to the blade in the shot blasting operation.

6. The method of checking the intensity of any shot blasting operation, including selecting a thin sheet metal plate whose opposite surfaces are under equal stress which gives the plate a flat contour, securing the flat plate in a fixture with one surface covered and its opposite surface exposed, subjecting said exposed surface, while the plate is in the fixture, to the particular shot blasting operation whose intensity is to be checked, then removing the plate from the fixture and allowing the plate to assume the curved contour natural to a plate having greater compressive strain in one surface than in the other surface and taking a reading of the plate curvature resulting from the shot blasting operation thereon and checking the reading with predetermined standards which reflect intensity of shot blasting operations in terms of curvature for the type of plate selected.

7. A method for setting measurement standards for various intensities of shot blasting operations to be performed on manufactured products and from which the operations can be checked, comprising selecting as a test specimen a type of thin metal plate whose free shape is determined by the relative strain in different strata thereof, subjecting a number of such similar plates to a corresponding number of shot blasting operations on one face only and each plate to a different operation whereby the several plates will be stressed each differently from the others and will assume accordingly differing new shapes, then recording the change in shape of each plate as indicative of the particular shot blasting operation performed thereon and against which future operations can be checked by like treatment of other similar test specimens.

8. The method for testing the effectiveness of a surface stressing operation, including subjecting only one face of a standard thin sheet metal test specimen, whose shape is dependent on the relative surface stresses in its opposite faces, to an operation which will produce surface stresses without substantial removal of material of said specimen then taking a reading of the difference in shape imparted to the test specimen by reason of the change in relative surface stress effected by said operation and checking said reading against a predetermined scale containing shape equivalents in terms of operation effectiveness.

JOHN O. ALMEN.