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O T T A W A October 2nd, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1504.

(Subsequent to Report of Investi-
gation No. 1485, Aug. 30th, 1943.)

Examination of Bombardier Snowmobile Bogie Wheel Suspension Assembly made with Improved Welding Technique.

(Copy No. 10.)

Bureau of Mines
Division of Metallic
Minerals

Ore Dressing
and Metallurgical
Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

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Introduction:

In August of this year examples of snowmobile bogie wheel assemblies from the Bombardier Snowmobiles Limited, Valcourt, Quebec, were submitted for examination. It was found that they contained numerous welding defects, such as lack of penetration, slag inclusions, undercutting, incomplete fusion, high piled-up welds, and poor fit-up. In the report covering this investigation (Investigation No. 1485, dated August 30th, 1943), photographs of these defects were shown and their probable cause and methods for elimination given. Subsequently, the writer visited the manufacturer's plant in an effort to assist in establishing a suitable welding technique.

The present report covers an examination of an assembly welded with a technique incorporating the writer's recommendations. It is shown that there has been a great improvement in the welding technique and, provided that the welding is maintained at this standard, the assemblies should prove satisfactory.

Origin of Material:

A previous examination of these assemblies (see Investigation No. 1485) revealed numerous welding defects attributable to a faulty welding technique. On August 25th, 1943, the writer visited the plant of the Bombardier Snow-mobiles Limited at Valcourt, Quebec, and endeavoured to demonstrate and explain the causes of the defects found, also methods for their elimination. Mr. H. J. Stevenson, Assistant Director General, Army Engineering Design Branch, Department of Munitions and Supply (Ottawa), who was present, suggested that another assembly, welded with a technique embodying the suggestions of the writer, be made and submitted for examination.

On September 7th, 1943, the assembly was received and its examination undertaken.

Object of Investigation:

1. To examine the welded assembly with a view to detecting any defects that might be present and determining their cause.

2. To compare the welding technique used to prepare this assembly with that employed on previously submitted assemblies.

3. To make further recommendations should this prove desirable.

Procedure:

(1). The assembly was subjected to a complete visual examination.

(2). The welds joining the shaft rings to the pipe frame were subjected to an X-ray examination at the National Research Council, Ottawa. Figure 1 is a print of an exograph of a fillet weld joining the shaft ring to the pipe frame at an area in which beads from two electrodes have been joined. Figure 2 is a print of an exograph of a weld joining the two ends of the strap joining the shaft ring to the pipe frame. In examining these prints it should be borne in mind that there is an

(Procedure, cont'd) -

inevitable loss of sensitivity in the reproduction process and that the colours are the reverse of the exographs themselves.

(3). Figure 3 shows the general shape of the assembly as received. It will be noted that the stiffeners and spring sockets have been omitted (compare with Figure 5 of Investigation No. 1485) and that both fillet weld and strap methods of attaching the shaft ring to the pipe frame have been employed for purpose of comparison.

Figure 4 is a photograph of the fillet weld joining the shaft ring to the pipe frame. Note smooth, regular weld. Compare with Figure 6 of Investigation No. 1485. Figure 5 is a photograph of a fillet weld joining a strap to a shaft ring. Note absence of undercutting and weld extending to top of strap material. Compare with Figure 10 of Investigation No. 1485. Figure 6 is a photograph of the weld joining the two ends of the strap joining the shaft ring to the pipe frame. The print of the exograph of this weld is shown in Figure 2.

(4). The assembly was sectioned through the welds joining the pipe frame to the shaft rings and through the weld joining the two ends of the strap in areas in which the X-ray examination revealed the presence of defects. Figure 7 shows these sections. Sections 9 and 10 should be compared to sections of the same numbers in Figure 13 of Investigation No. 1485.

The remainder of the assembly was sectioned at random to secure typical samples of each of the remaining joints. Figure 8 shows these samples.

Discussion:

A visual examination of the assembly indicates a considerable improvement over those previously examined. This is confirmed by comparing the macrophotographs of the two investigations.

The X-ray examination revealed a slag stringer in the root of the weld joining the ends of the strap. This strap joins the shaft ring to the pipe frame. The remainder of the welds on this strap are good and show no undercutting. The weld contours are smooth and the weld well positioned. The slag stringer noted above is probably the result of using too large an electrode in a narrow root gap.

An X-ray examination of the fillet weld joining the other shaft ring to the pipe frame reveals an entrapment of slag. This slag is located in an area in which the arc has been broken (probably to replace a used electrode) and then continued. The crater remaining after the arc was broken was not properly filled when welding was continued, allowing slag to be caught in the root of the weld (see Section 9, Figure 7).

All sections other than those referred to above have the following characteristics: Very good fit-up, fair penetration, economical use of weld metal, and smooth weld contour. A comparison of these with similar samples (of the same number) in Investigation No. 1485 reveals a great improvement in the welding technique.

It is our opinion that if the standard of welding exemplified by this assembly is maintained it should prove satisfactory. It is understood, of course, that precautions should be taken to eliminate the two defects found in the shaft ring welds.

CONCLUSIONS:

1. There is a considerable improvement in the welding technique used to fabricate this assembly as compared with the technique previously used.

2. Slag inclusions were found in shaft ring welds, indicating the need for greater care in laying root beads and in joining up two beads.

3. Provided that the above defects are eliminated, the present improved welding technique should prove satisfactory.

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Figure 1.

PRINT OF EXOGRAPH OF A FILLET WELD JOINING A SHAFT RING TO THE PIPE FRAME AT AN AREA IN WHICH BEADS FROM TWO ELECTRODES HAVE BEEN JOINED.

Arrows point to slag inclusions.

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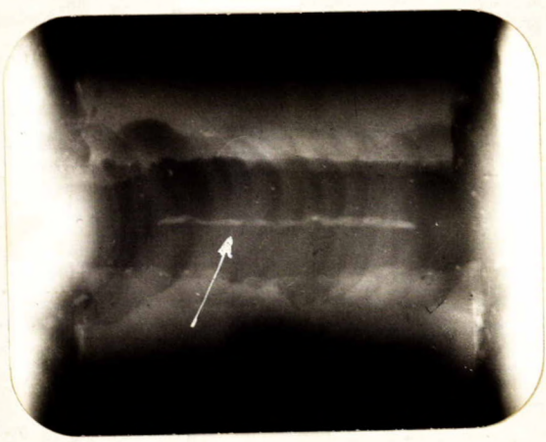
Figure 2.



PRINT OF AN EXOGRAPH OF A WELD JOINING THE TWO ENDS OF THE STRAP JOINING THE SHAFT RING TO THE PIPE FRAME.

Arrow points to slag trapped in the root of the weld. See Figure 6.

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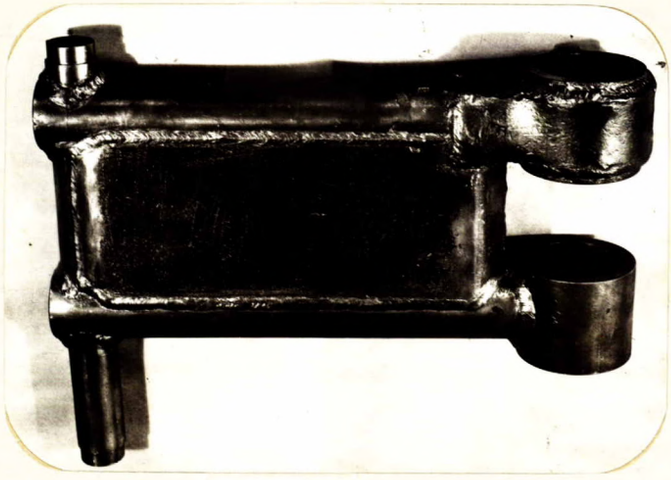
Figure 3.



PHOTOGRAPH OF THE ASSEMBLY AS RECEIVED.

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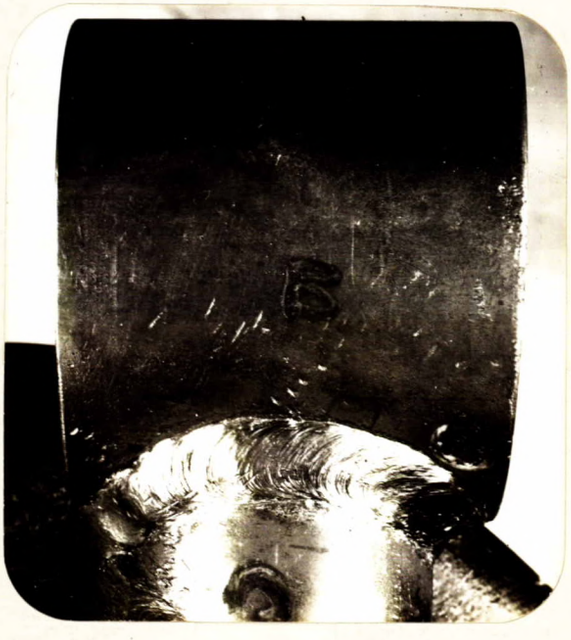
Figure 4.



PHOTOGRAPH OF FILLET WELD JOINING
SHAFT RING TO PIPE FRAME.

Note smooth, regular contour of weld.

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Figure 5.

PHOTOGRAPH OF A FILLET WELD
JOINING STRAP TO SHAFT RING.

Note absence of undercutting and that
weld extends to top of the strap material.

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Figure 6.

PHOTOGRAPH OF WELD JOINING
ENDS OF STRAP MATERIAL.

Note regular and smooth weld contour.

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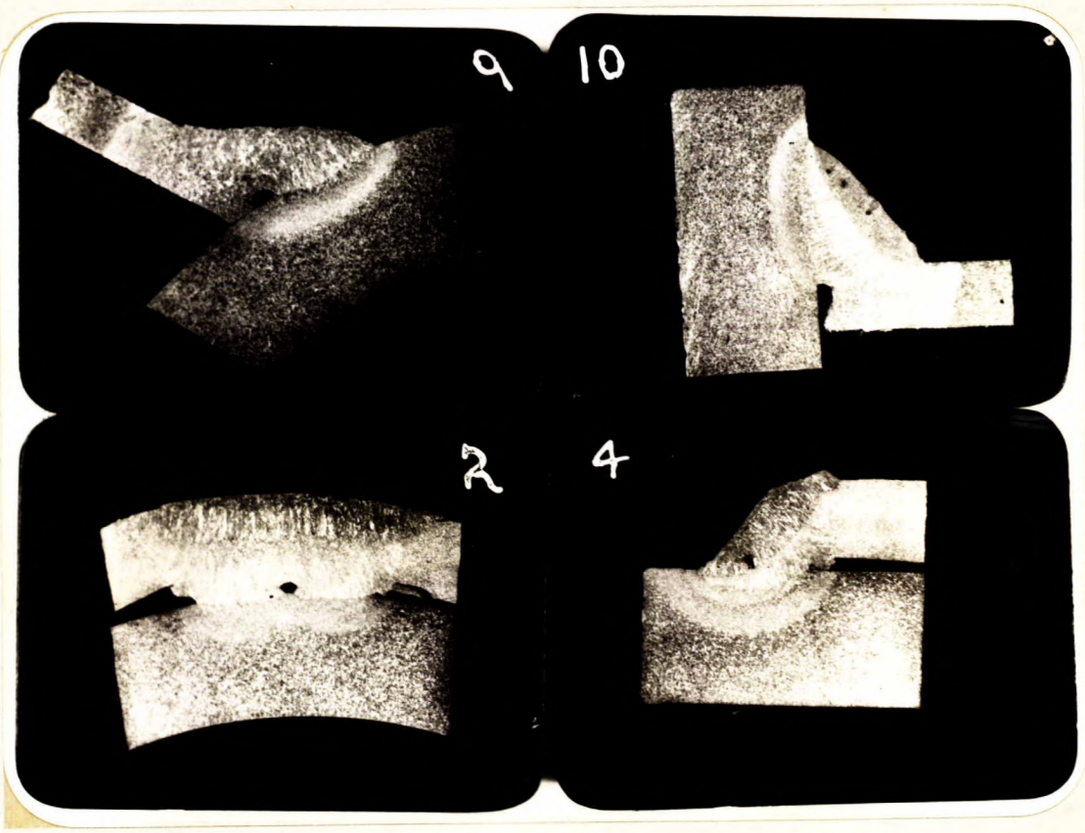
Figure 7.



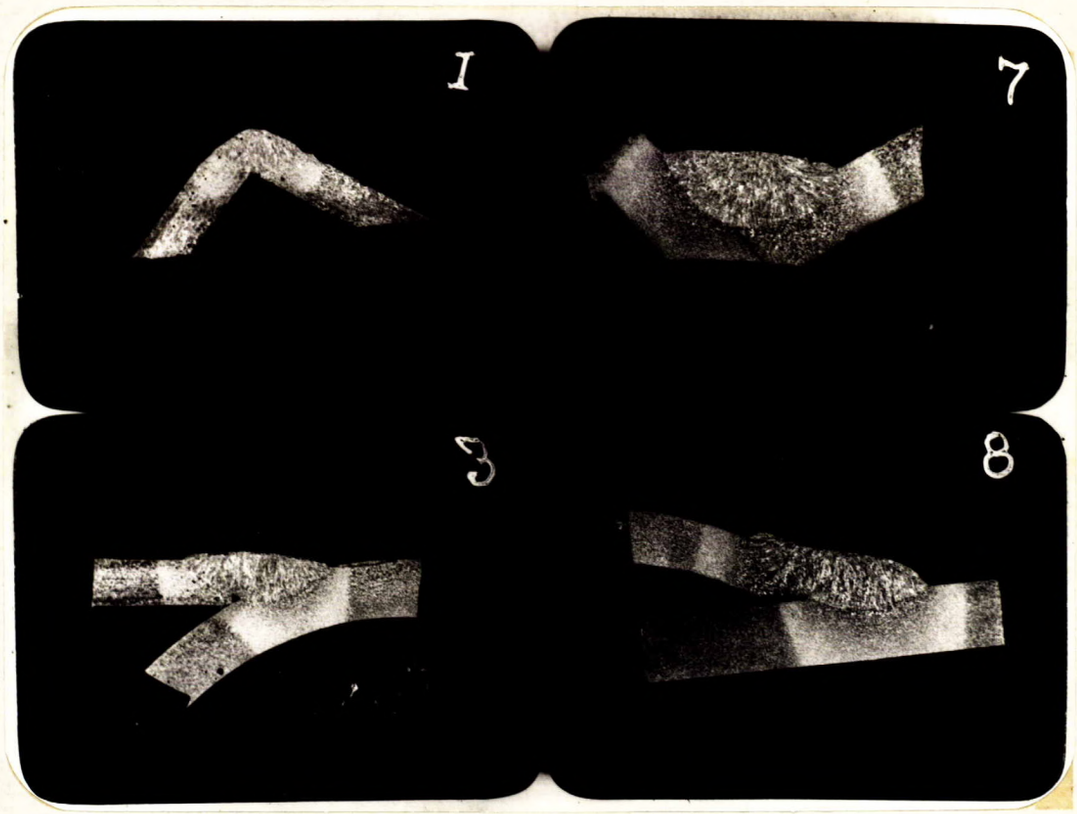
SECTIONS OF VARIOUS WELDED JOINTS.

Sections 9 and 10, from fillet weld joining shaft ring to pipe frame. Section 9, through area in which beads from two electrodes have been joined. Note slag trap at root of weld. Section 10, from same weld for comparison--weld smooth, penetration fair.

Section 2, from weld joining ends of strap material. The exograph of this weld is shown in Figure 2. Note slag trapped in root of weld.

Section 4, a typical section of fillet weld joining strap material to shaft ring. Contour and penetration good. Small gas inclusion.

Figure 8.



SECTIONS OF VARIOUS WELDED JOINTS.

Note good fit-up, fair penetration, economical use of weld metal, and smooth weld contours.

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