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DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

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Ottawa, November 28, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2142.

Metallurgical Examination of a Defective Cast Bronze Screen Plate.

(Copy No. 5.)

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Cast Bronze Screen Plate.

Introduction:

On October 21, 1946, a defective bronze plate section was received from the Union Screen Plate Company of Canada, Limited, Lennoxville, Quebec. In an accompanying letter, Mr. A. S. Mitchell, General Superintendent, requested that the origin of these defects be determined, if possible, and asked whether means could be suggested for eliminating such defects, which are exposed upon machining. These plates cannot be used in this condition.

It was stated that this defect is not new and forms, generally, in the middle of the 12" x 43" x 3/8" thick bronze plate. It has occurred again, after an

(Introduction, cont'd) -

absence of a few years.

The melting and casting procedure used at present by the company was described as follows:

> The metal used consists of machine chips, scrap screen plates from the paper industry, and new ingot material which should have the approximate final analysis of copper 88 per cent, tin 3½ per cent, lead 5 per cent, zinc 2½ per cent and nickel 1 per cent.
>
> The metal is heated in a Detroit Electric Rocking furnace to a temperature of 1200° C. (2200° F.) and when poured into the pots is treated with a 'Blanc Fixe'; 1/4 pound of zinc and 2 ounces of phosphor copper are added per 100 pounds of metal. The metal is allowed to cool approximately 55 degrees centigrade (100° F.) and is then skimmed. The pouring temperature is 1145° C.(2090° F.).
>
> The castings are poured with a full gate. Sand moulds are made of a synthetic sand mixture having a moisture content of 4.4 per cent, a permeability of 44, and a green strength of 13.3.

Various attempts had been made to eliminate this defect by -

(i) alterations in sand mixes,
(ii) increasing and decreasing addition of refining agents.
(iii) increasing and decreasing melting temperatures.

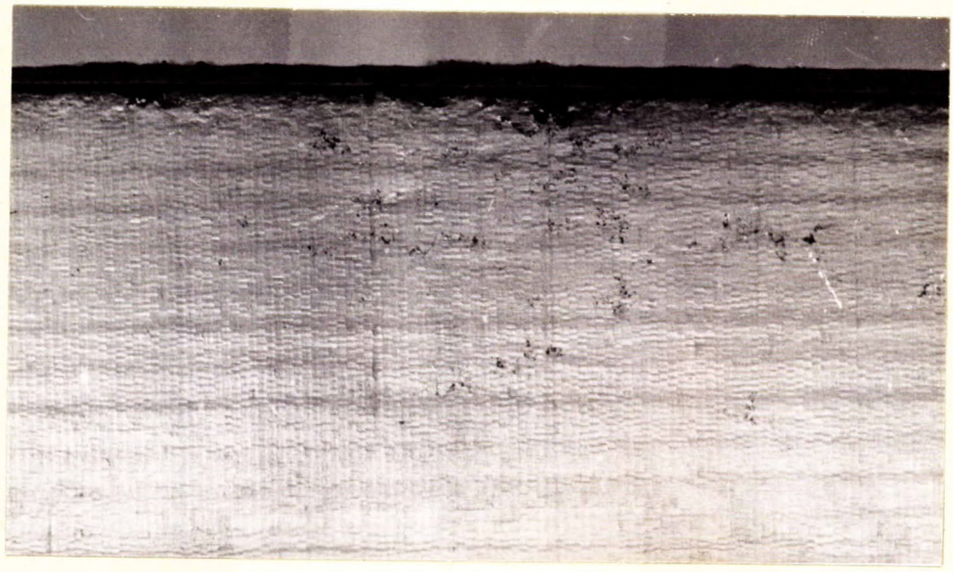
None of these had overcome the defect entirely.

Figure 1 shows part of a section through the defective central area of the plate.

(Figure 1 follows, on Page 3.)

(Introduction, cont'd) -

Figure 1.



PART OF A SECTION THROUGH THE DEFECTIVE CENTRAL AREA OF PLATE.

-

TESTING RESULTS:

1. Chemical Analysis -

Drillings were taken distant from the defective area, with the resulting analysis:

		Per Cent
Copper	-	86.05
Tin	-	3.70
Lead	-	4.94
Zinc	-	4.77
Nickel	-	0.40
Iron	-	0.05
Phosphorus	-	0.03
Aluminium	-	Less than 0.005
Silicon	-	" " 0.005
Manganese	-	None detected.

The results of the analysis appear to be satisfactory.

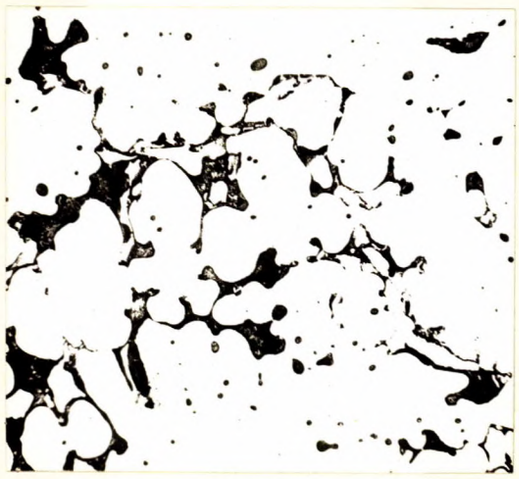
2. Metallographic Examination -

A small section, approximately a half-inch square, was cut from the defective area for microscopic examination. A photomicrograph of the defective area is shown below:

(Continued on next page)

(Testing Results, cont'd) -

Figure 2.



X75.

PHOTOMICROGRAPH OF DEFECTIVE AREA.

Fracture Tests -

Fracture tests were made on the defective bronze plate, through the defective area and through an area not showing any surface imperfections.©

The appearance of the fracture through the sound metal was of a uniform buff colour and also fine grained. The fractured surface through the defective area, however, exposed an inner surface which was reddish-brown in colour in addition to appearing coarse grained.

This local concentration of discoloured metal of a reddish-orange appearance, generally occurring in the middle of the bronze plate, is believed to be due to entrapped gases of an oxidizing nature. The gas, which may possibly be steam-generated from the sand mould, might easily become entrapped between two masses of molten metal and form gas pockets and fissures, oxidizing the nearby metal surfaces, thus causing the discolourations.

© This test was carried out in the presence of Mr. A. Mitchell, of the Union Screen Plate Company of Canada, Ltd., Lennoxville, Quebec, and Mr. Wm. Bond, of the Ottawa Car and Aircraft Ltd., Ottawa.

Discussion of Results:

The microscopic examination and the fracture tests show that the defects in the casting are caused by oxides accumulated in the centre of the cast plate.

The source of these oxides may easily be from entrapped air, from gas-forming compounds, or from steam generated from the moisture added. The escape of gases or steam formed may not be sufficiently facilitated, for such reasons as (a) the particular shape of the casting with its large surface area, (b) the gating or pouring methods employed, (c) possible varying sand conditions.

Judging from the mass of locally concentrated oxidized metal within the centre of this cast plate, the source of the trouble appears to lie not in the melting or deoxidizing practice used at present but rather in some variables in the sand practice or in the moulding or gating operations.

Definite and constant control over moisture content, mould hardness, ramming and venting should be maintained so that these control factors can be established at safe operating limits.

Slight changes in casting practice, such as mould drying, mould tilting, placing of "whistlers" or small vents at the casting end, or use of dry sand cores, may help to alleviate the effect of oxidation.

Conclusions:

The defective area in the submitted cast plate was caused by an accumulation of oxide inclusions.

It appears that changes in the moulding and casting practice would be beneficial in avoiding these defects.

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