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Report No. 344/60
Watertown Arsenal

February 18, 1938

EXAMINATION OF THE SURFACE OF "S" MONEL BEARING

PART I - AFTER PARTIAL TEST
PART II - AFTER FINAL TEST

Subject

Tests on training roller bearing for 3" .50 Cal. Wet Mount - Navy Department. The material is S Monel (See Ex. O. 875-A2, dated 8/6/37).

Object

To determine the tendency of the metal to gall or pick up under the load conditions imposed.

PART I

Conclusions

(1) At the completion of the first part of the test there is no tendency to gall or pick up.

(2) Very slight wear is exhibited on annular rings in the upper and lower races.

Details of Test

The S Monel races separated by K Monel rollers were tested in exactly the same manner as the original tests (covering K Monel races with K Monel rollers). The results and details of this test were rendered in Report No. 344/54, "Examination of the Surface of K Monel Bearing" by N. L. Reed, June 2, 1937.

This new bearing, with a 4542-pound load, was tested for a total of eight hours. There were 216 complete revolutions per hour, and after each hour the direction of rotation was reversed.

Discussion

At the completion of this part of the test, the bearing surfaces from both top and bottom race were carefully examined under the microscope and showed no evidence or tendency to gall or pick up.

Type S Monel has certain characteristics of manufacture that do not allow it to be forged. These rings were cast using the best foundry technique. The castings were received at Watertown Arsenal in a rough machined condition. Details of the castings and tests concerning them are given in Report No. 344/45, "High Si Monel Castings for Races" by P. R. Kosting. The non-bearing surface of the top race shows a small amount of fine porosity.

Under certain angles of lighting, a very faint trace of the cast structure could be seen. Where it was visible it showed a quite fine macrostructure with uniform length dendrite bodies appearing lighter colored than the surrounding material. See Figures I and II.

The bottom race appears to have slightly more wear than the top race. Figures III and IV show the character of the bearing surfaces at higher magnification.

References

The material was purchased from the International Nickel Company. The races were machined and finished by the Standard Machinery Company of Providence, Rhode Island.

PART II

Conclusions

(1) S Monel is a suitable metal for properly designed bearings needed to withstand corrosion.

(2) At the completion of the test there is no evidence of galling or pick up of the metal.

(3) In comparison with the K Monel bearing previously tested, this metal shows somewhat less wear.

(4) The S Monel is definitely harder than the K Monel as determined by the Rockwell Hardness Tester.

Details of Test

Additional testing in the same manner as noted in Part I was continued. Data concerning it are covered by Mr. M. F. Healy's report dated August 31, 1937, which is appended to this report. The bearing was tested for an additional time of 18-1/2 hours with an applied load of 5642 pounds. There were 216 revolutions per hour and direction of rotation was reversed each hour.

Discussion

The upper race showed a quite uniform although slight wear over the entire width of contact of the rollers. No pitting, galling, or pickup of any type was

noticed. There appeared to be less wear (Fig. V) on this race than on the K Monel race examined after complete testing. The lower race (Fig. VI) also shows very little wear. Only a slight dulling of the surface is apparent to the eye and the smooth finish is still present. The appearance of the surfaces at a magnification of 100 is given in the attached Figures VII and VIII.

The hardness determined on the outer annulus of the face of each ring is as follows:

Upper Race - Rockwell "C" Scale 38-39

Lower Race - Rockwell "C" Scale 39-40

The previous K Monel tested with an average of 32 "C" scale.

This type of Monel appears to be distinctly better than the K Monel after the same tests have been applied to each. The interdendritic material in the casting is apparently of nearly the same hardness and strength as the dendrites themselves, so that very little visible difference in wear is exhibited. The greater hardness should be a definite advantage for this type of material. The S Monel should be a satisfactory metal for use in properly designed bearings.

Respectfully submitted,

Norman L. Reed

Norman L. Reed,
Asst. Metallurgist.

Fig. I

Upper race - bearing surface after preliminary tests. Only a very slight dulling of the surface is noticeable. This is considerably less than shown by the K Monel bearing after its preliminary test.

(Negative 736-20)

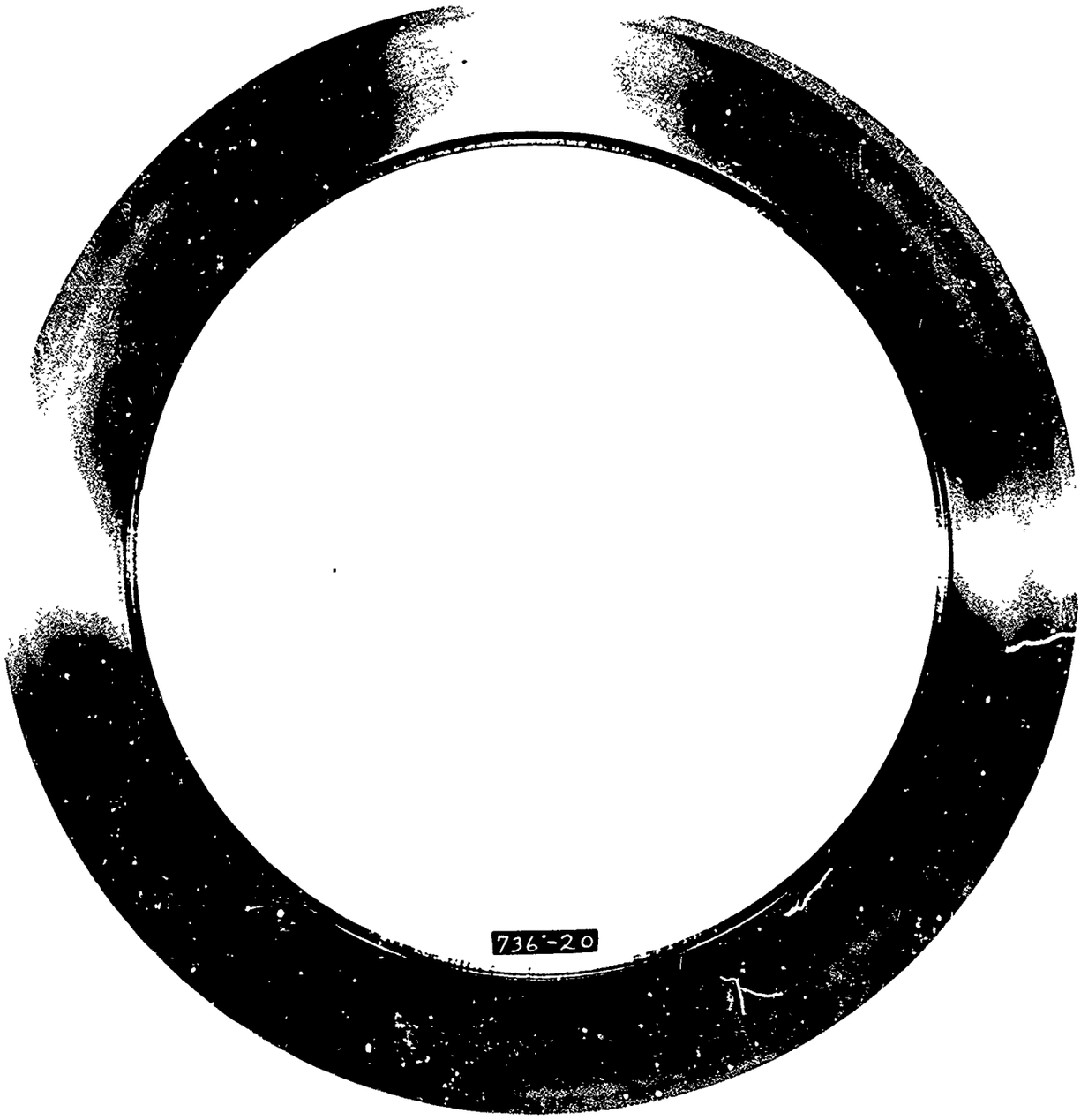


FIG. I

Fig. II

Lower race - bearing surface after partial test. The metal shows a small amount of dulled surface, and in the mid-wall section, just below the negative number, can be seen the faint traces of the dendrites as described in the text.

(Negative 736-21)

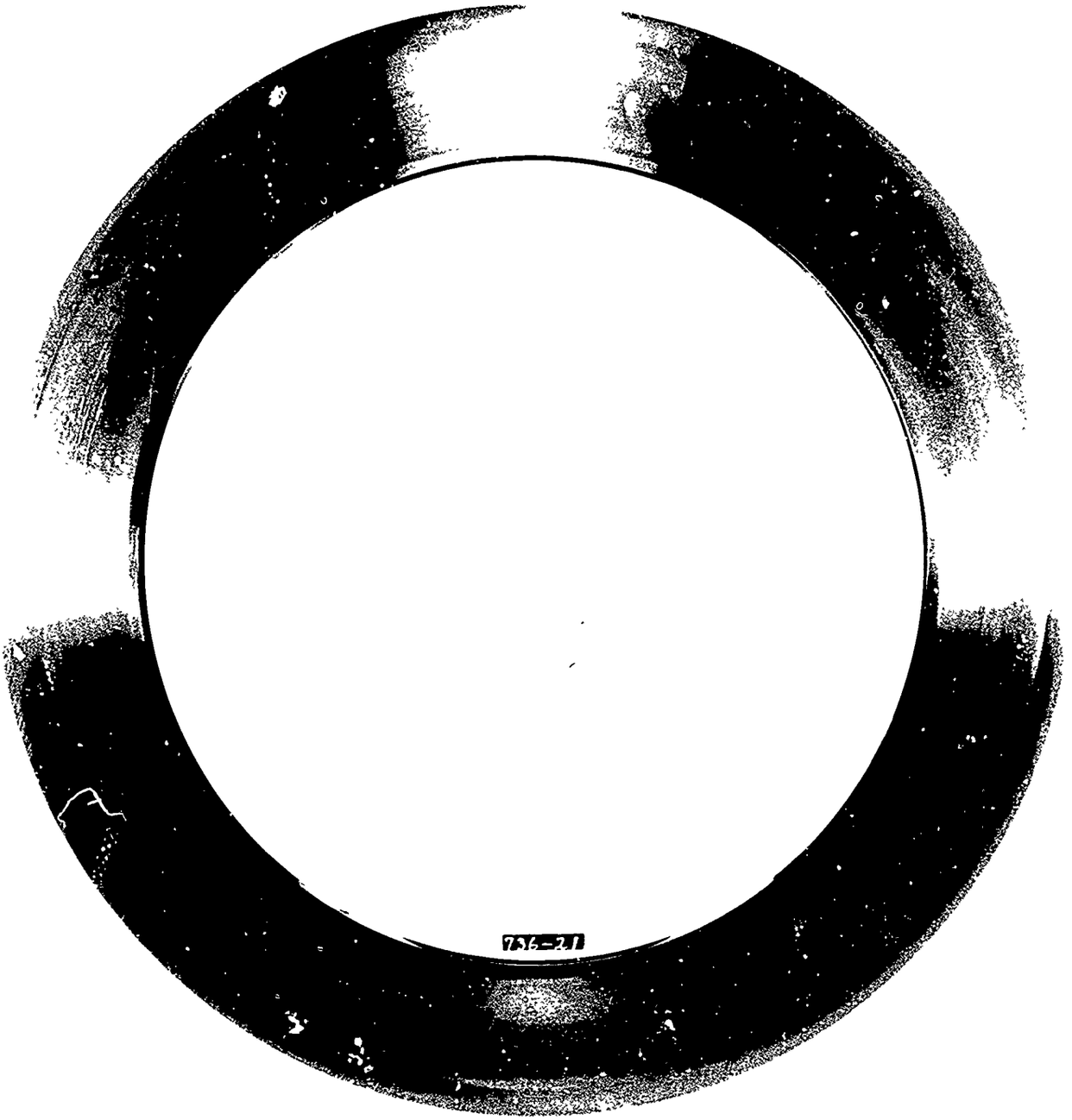


FIG. II

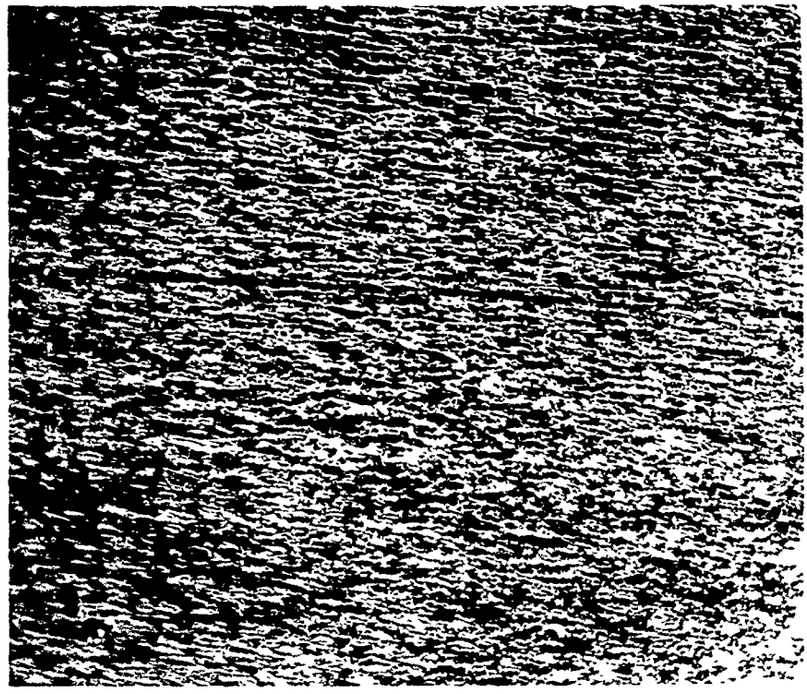
Fig. III

(A) Upper race, after partial test, .45" from the periphery at a magnification of 100 shows a uniform surface condition throughout.

(Negative MM-443)

(B) Upper race, after partial test, .20" from inner circumference at a magnification of 100 shows a few circumferential scratches and several small nearly round nonmetallics embedded in the metal.

(Negative MM-442)



A

B

Fig. 3 W.A. 639-965

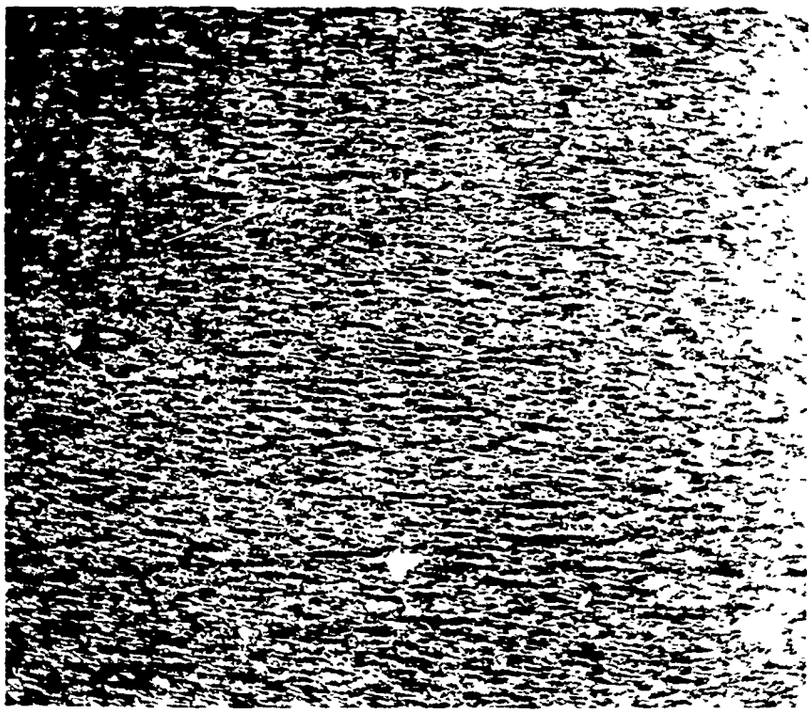
Fig. IV

(A) Lower race, after partial test, .45" from the periphery shows the same characteristic surface as the upper race in the part that has not been in contact with the rollers, magnification 100.

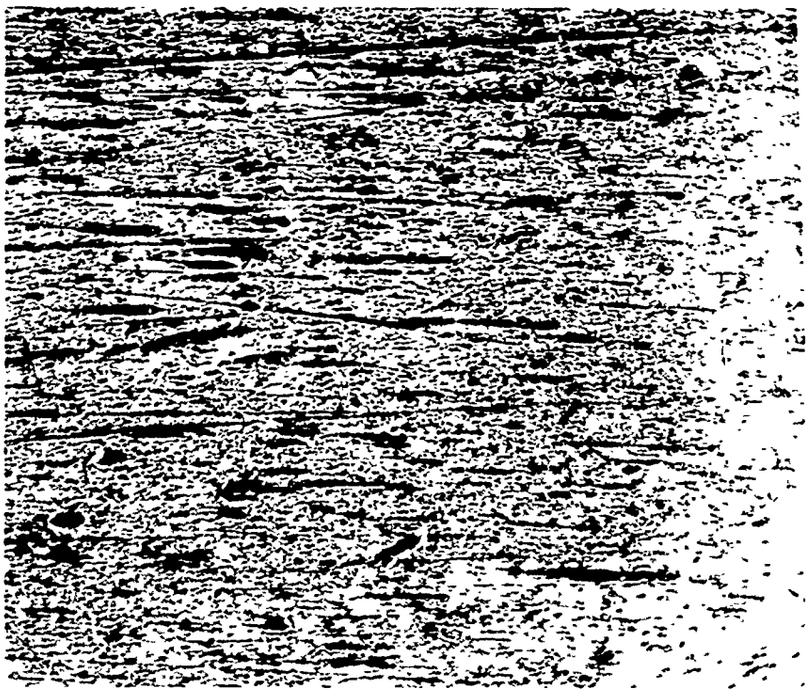
(Negative MM-445)

(B) Lower race, after partial test, .20" from the inner annulus shows some smoothing of the surface by wear - no galling is noticed. The scratches are becoming less prominent, magnification 100.

(Negative MM-444)



A



B

Fig. 4 W.A. 639-966

Fig. V

Upper race after completion of test. A very satisfactory surface remains. No pitting or galling is seen and only a general dulling of the surface is apparent.

(Negative 736-22)

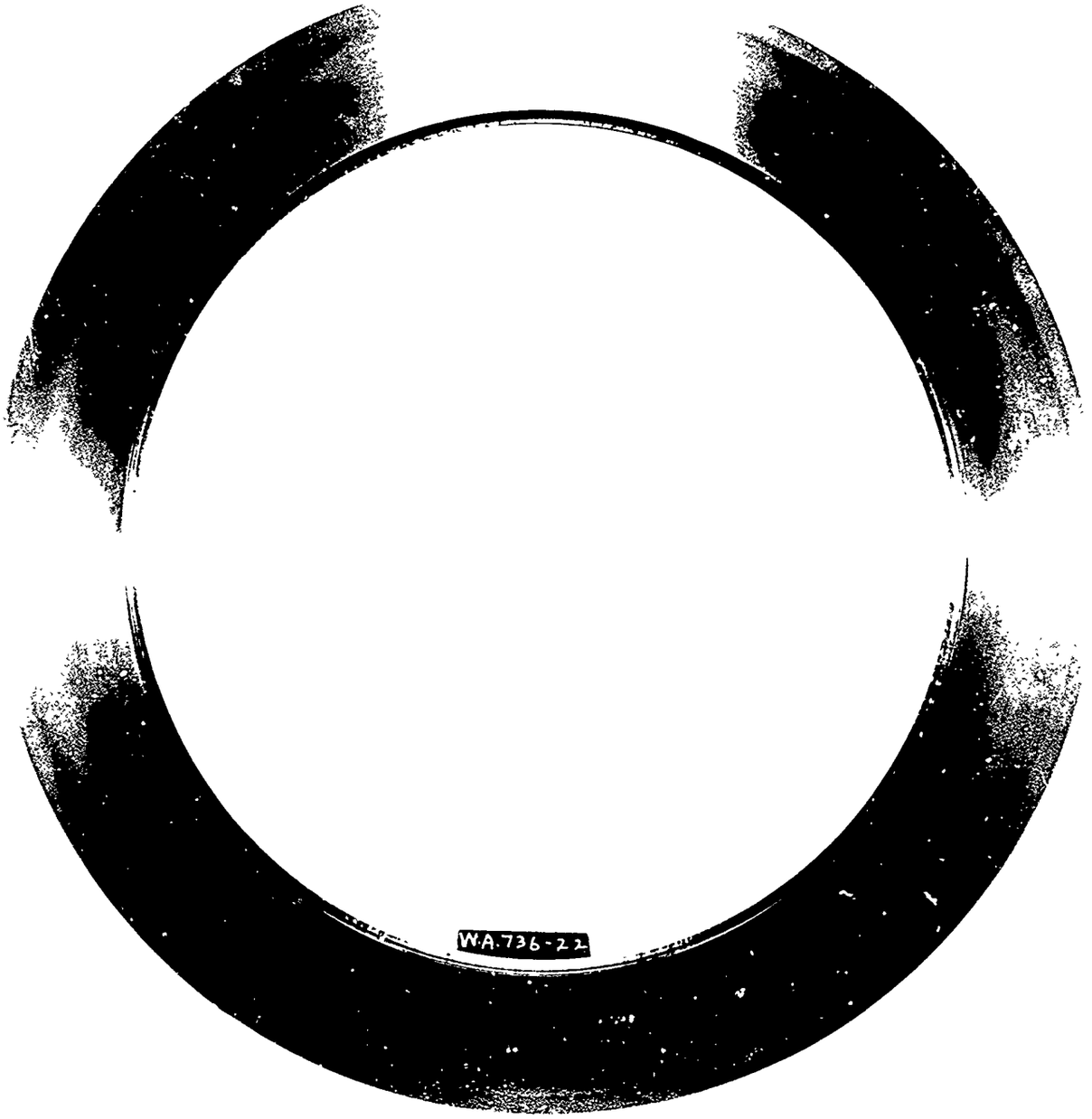


FIG. V

Fig. VI

Lower race after completion of test shows no areas of pitting or excessive wear. The faint dendrite bodies are no more prominent than after the partial test, indicating that the wear is nearly uniform on both dendritic and interdendritic material.

(Negative 736-23)

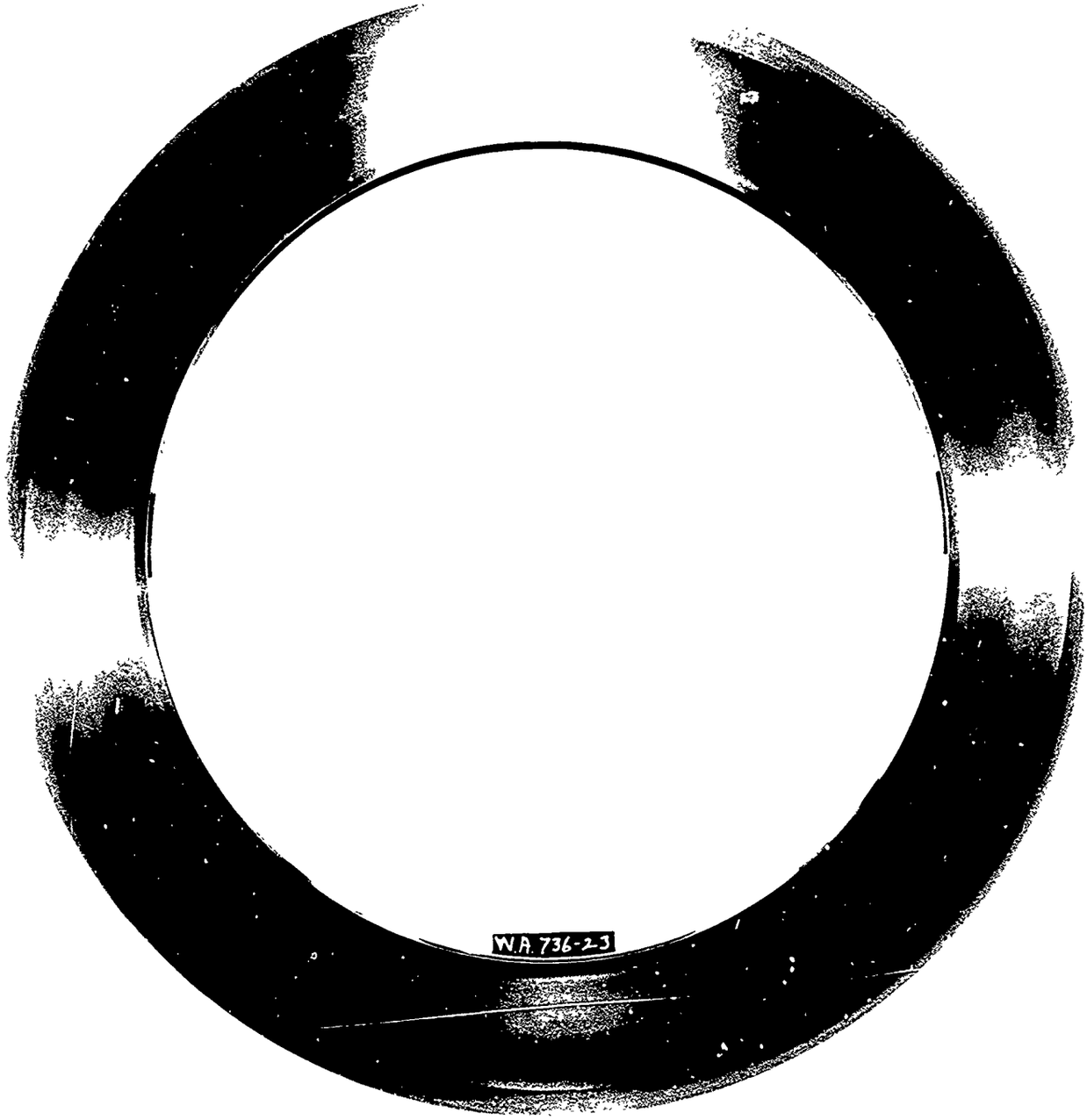


FIG. VI

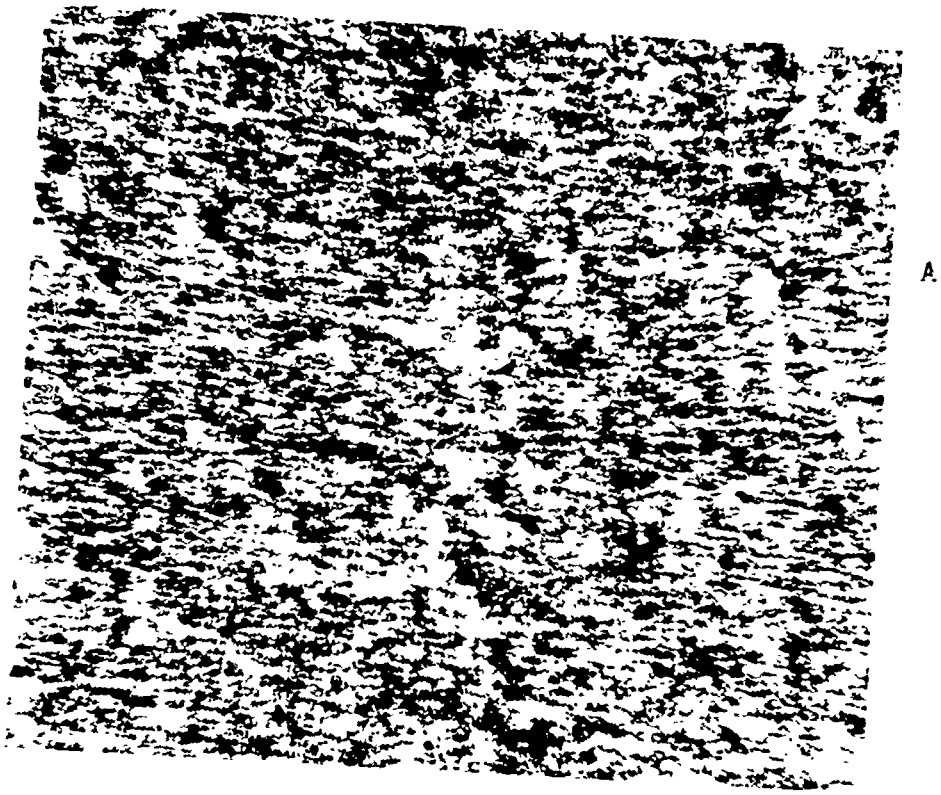
Fig. VII

(A) Upper race, after completion of test, .45" from the periphery shows at a magnification of 100 the uniform surface conditions existing in the S Monel.

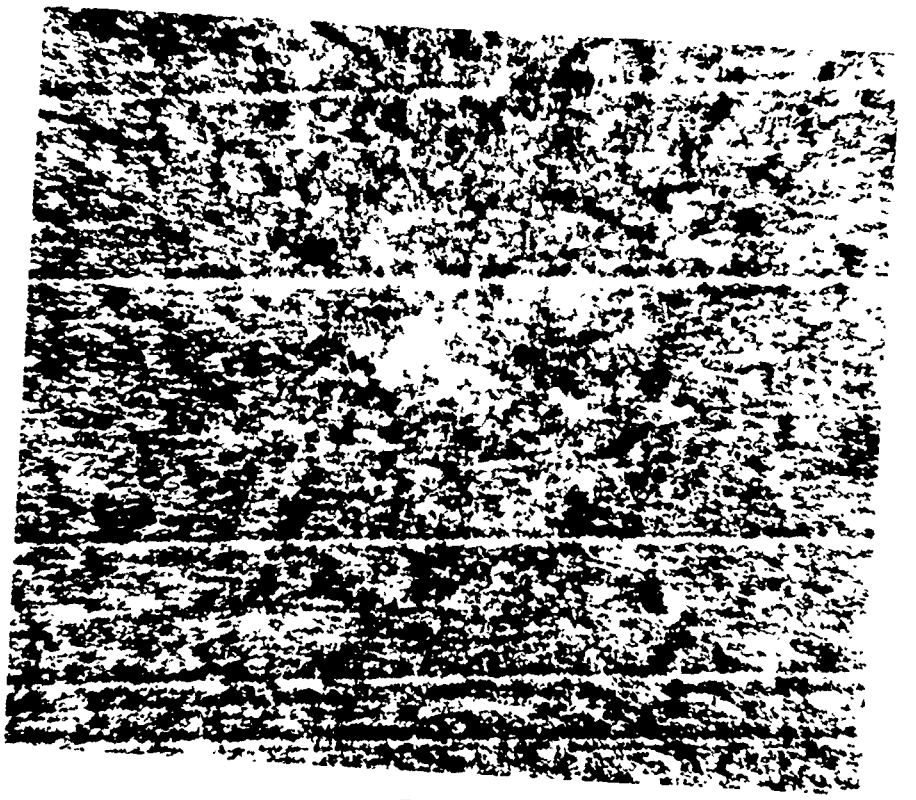
(Negative MM-452)

(B) Upper race, after completion of test, .20" from inner annulus shows at a magnification of 100 some variation in color (light reflecting value) and some not very sharp scratches. No pitting was observed and the surface is considerably smoother than the K M onel of the previous experimental test.

(Negative MM-453)



A



B

Fig.7 W.A. 639-967

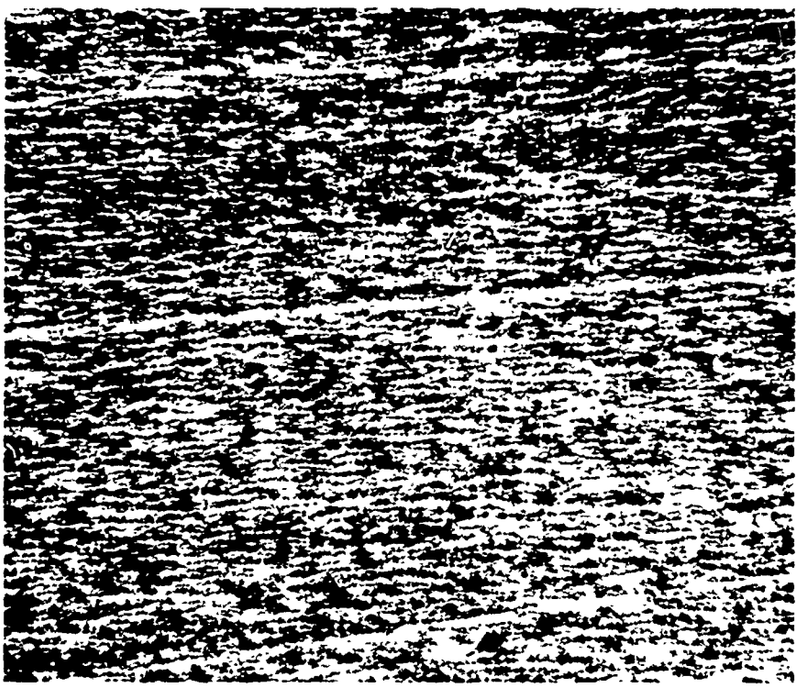
Fig. VIII

(A) Lower race, after completion of test, .45" from the periphery at a magnification of 100 shows extremely little change from the previous test (See Fig. III(A)).

(Negative MM-454)

(B) Lower race, after completion of test, .20" from inner annulus at a magnification of 100 shows the maximum wear exhibited by any part of the ring. It is uniform and not excessive, and considerably less than the K Monel under similar conditions.

(Negative MM-455)



A

B

Fig.8 W.A. 639-968

APPENDIX

MFH/mjg
August 31, 1937

Report of Test of S Monel Races for Training Roller Bearings for 3"/50 Cal. Wet Mount

Object of Test:

To determine the tendency to gall or pick up in Thrust Roller Bearings made of S Monel Metal (See Ex. Or. 875-A2). Also to compare the S Monel with similar size rings made from K Monel as covered by Laboratory Report 344/54.

The test was conducted in the same manner as described in the Laboratory report referred to, and given the same load and the same number of revolutions. The lubricant and other conditions were, as nearly as possible, the same.

The S Monel rings were furnished by the International Nickel Company and were finished and polished by the Standard Machinery Company.

The total number of revolutions was 5832, and the coefficient of friction determined at different intervals during the test is given in the following table:

With 4542 Lbs.

August 18 - 1 hr. - Start 47 ---------- Moving 45
C.of F. .0103 C.of F. .01
August 18 - 2 hr. - Start 45 ---------- Moving 37.5
C.of F. .01 C.of F. .0083
August 19 - 3 hr. - Start 43 ---------- Moving 30
C.of F. .0095 C.of F. .0066
August 19 - 2 hr. - Start 43 ---------- Moving 29
C.of F. .0095 C.of F. .0064

Disassembled

With 5642 Lbs.

August 25 - 4½ hr.- Start 62 ---------- Moving 47.5
C.or F. .011 C.of F. .0084
Last Reading-Start 58 ---------- Moving 41
C.of F. .01 C.or F. .0073

Additional 14 hr. Test:

August 27 - Start 49 lbs. ------ Moving 27 lbs.
C.of F. .0087 C.of F. .0048

The two rings have been turned over to Norman Reed for metallurgical examination.

M. F. Healy,
Eng. Div.

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