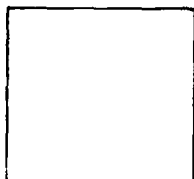


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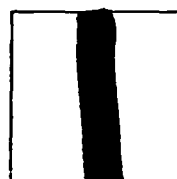
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Watertown Arsenal Labs



INVENTORY

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Rept. No. 316/28

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Report No. 316/28
Watertown Arsenal

March 2, 1936

Study of the Passivation of 18/8

Object

To study the comparative resistance to corrosion of passivated 18/8 and unpassivated 18/8.

Recommendation:

Since the advantage gained by passivating porous 18/8 castings is negligible in comparison to the danger of occluded nitric acid used in the passivating procedure, such castings should not be passivated.

Conclusions:

There is no difference in the behavior of clean passivated 18/8 and clean unpassivated 18/8 in a synthetic sea salt spray.

Nitric acid has an extensive solvent action on rust adhering to 18/8 specimens.

The final electrode potential of passivated 18/8 to synthetic sea water is negligibly higher (0.02 volts) than that of unpassivated 18/8.

The only advantage gained by the nitric acid treatment is removal of adhering impurities.

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welding and as directed

Rarely used

Introduction:

Alloys of chromium and nickel when exposed to oxidizing atmospheres, acquire a thin film of oxide which prevents further attack by oxidation. Such material is then in a passive state.

Although exposure to air is sufficient to impart this protective film, it has been found that stainless alloys which had been immersed in nitric acid solution are more satisfactory in service than untreated alloys. It is believed that the nitric acid dissolves adhering particles of iron or other impurities acquired during machining operations. Treating porous castings in this manner however, introduces the possibility of occluded nitric acid in the pores of the casting. The purpose of this investigation is to determine whether the advantage gained by passivation of porous castings is sufficient to warrant the risk of occluded nitric acid.

Method (Part a)

Three specimens of 18/8, each 1" by 2 1/2", were polished with 00 emery paper. One specimen was immersed in 20% nitric acid for 20 minutes. A second specimen was activated by dipping it into 1:1 hydrochloric acid for thirty seconds. The third

specimen was not treated in any way. All specimens were washed and then placed in separate solutions of synthetic sea water for measurement of electrode potential with a potentiometer. A saturated calomel electrode formed the second half of the cell in each instance. After each measurement the specimens were removed from the solutions, dried, and allowed to stand in air until the next measurements were made. Periodic measurements were made in this manner for 72 hours. For purposes of comparison polished specimens of zinc, brass, and steel were similarly used as electrodes for determining their potentials in synthetic sea water.

The entire procedure was repeated with specimens which were allowed to remain in the electrolyte continuously.

Results (Part a)

The results are shown graphically in Figure 1 in which electrode potentials are plotted against time. It will be noticed that the initial potential of passivated 18/8 is slightly higher than those of the specimens which had not originally been passivated. During the first four hours all specimens experienced a substantial increase. The difference in electrode potentials originally shown, 0.02 volts, is maintained

continuously, even after all values become constant at the end of about 70 hours.

A slightly different behavior was noticed when the specimens were immersed continuously. Although an initial variation was observed the potentials of all specimens became equal after sixteen hours of immersion. The final value, 0.20 volts, was slightly lower than that observed when the specimens were exposed to air between measurements, but a lower value was expected inasmuch as a greater degree of passivation would logically result in specimens exposed to air.

Method (Part b)

Eight plumb-bob shaped test specimens of 18/8 were dipped in 1:1 hydrochloric acid for 30 seconds washed, dried, and placed in a synthetic sea salt spray for 100 hours. Each similar specimen was immersed in a 20% nitric acid solution for 20 minutes, washed, and subjected to the attack of a synthetic sea salt spray for 100 hours. This procedure was adopted to determine the comparative behavior of passivated and unpassivated 18/8 in a sea salt spray.

Four specimens of 18/8 which had been allowed to corrode in salt spray for months were washed with

alcohol and ether, then allowed to stand in 40% nitric acid for one hour. The purpose of this procedure was to determine the solvent action of nitric acid on rust adhering to 18/8.

Results (Part b)

All specimens, activated and passivated, had a rating of A upon removal from the salt spray. No difference in the degree of corrosion was observed, showing that the nitric acid treatment has little effect on the behavior of clean 18/8 in a salt spray.

The solvent action of nitric acid on rust adhering to 18/8 was shown by the fact that whereas 2% to 75% of the original areas were rusted before immersion, the specimens upon removal had 0% to 15% rusted areas.

Discussion:

The chief advantage of nitric acid treatment lies in the solvent action of nitric acid on impurities adhering to the stainless alloy. Stainless specimens which have been treated in this manner are freed from particles, generally iron, which in service may become foci of corrosion. The formation of protective oxide surface films takes place just as readily on alloys which have not been passivated.

Although the chemical reactivity of unpassivated 18/8 is slightly greater than that of passivated 18/8 nothing is gained by passivating porous 18/8 castings because the danger of occluded nitric acid in the pores overcomes the advantage of lower chemical reactivity.

Respectfully submitted

P. R. Kosting

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M. B. Gruzdis

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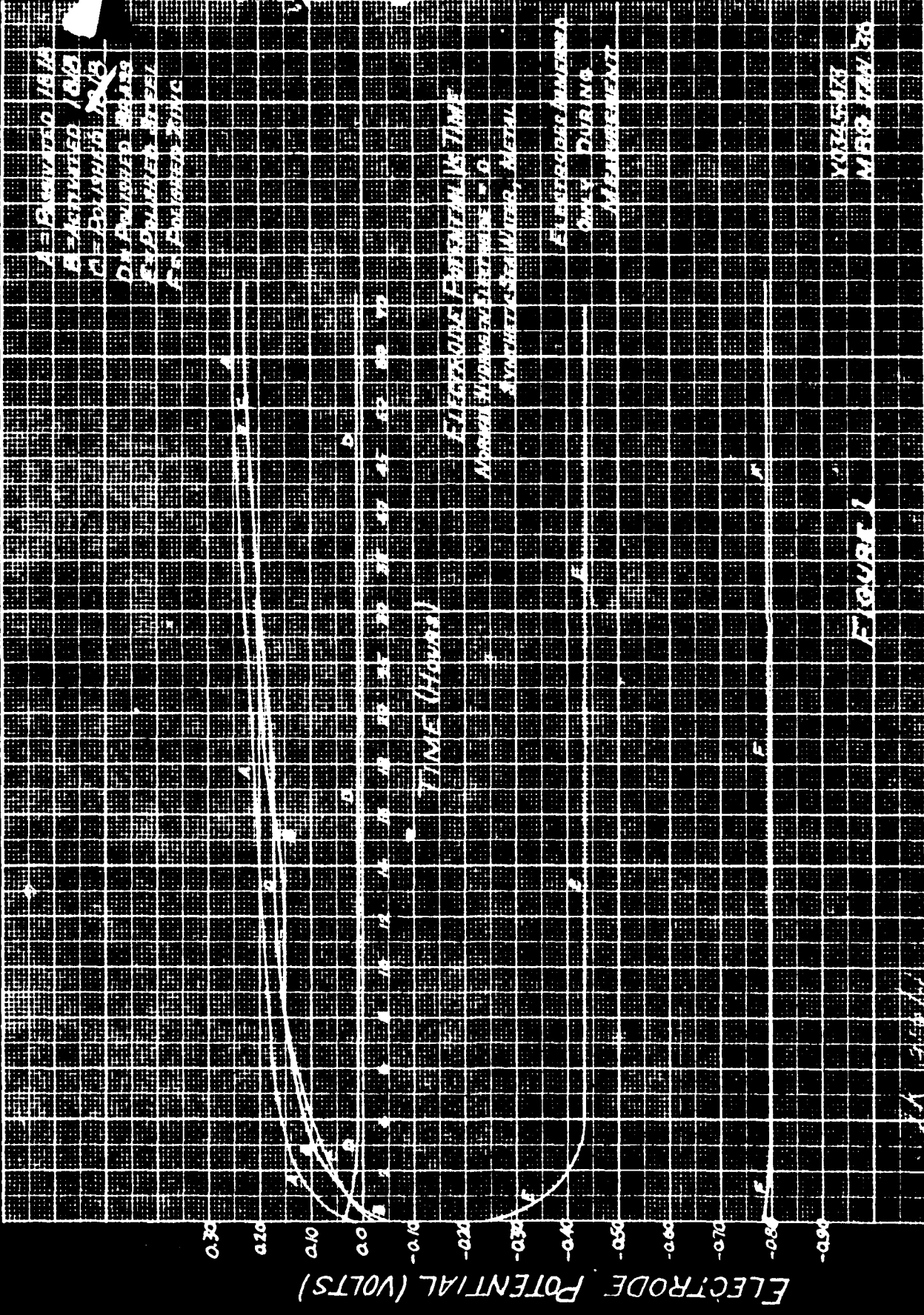
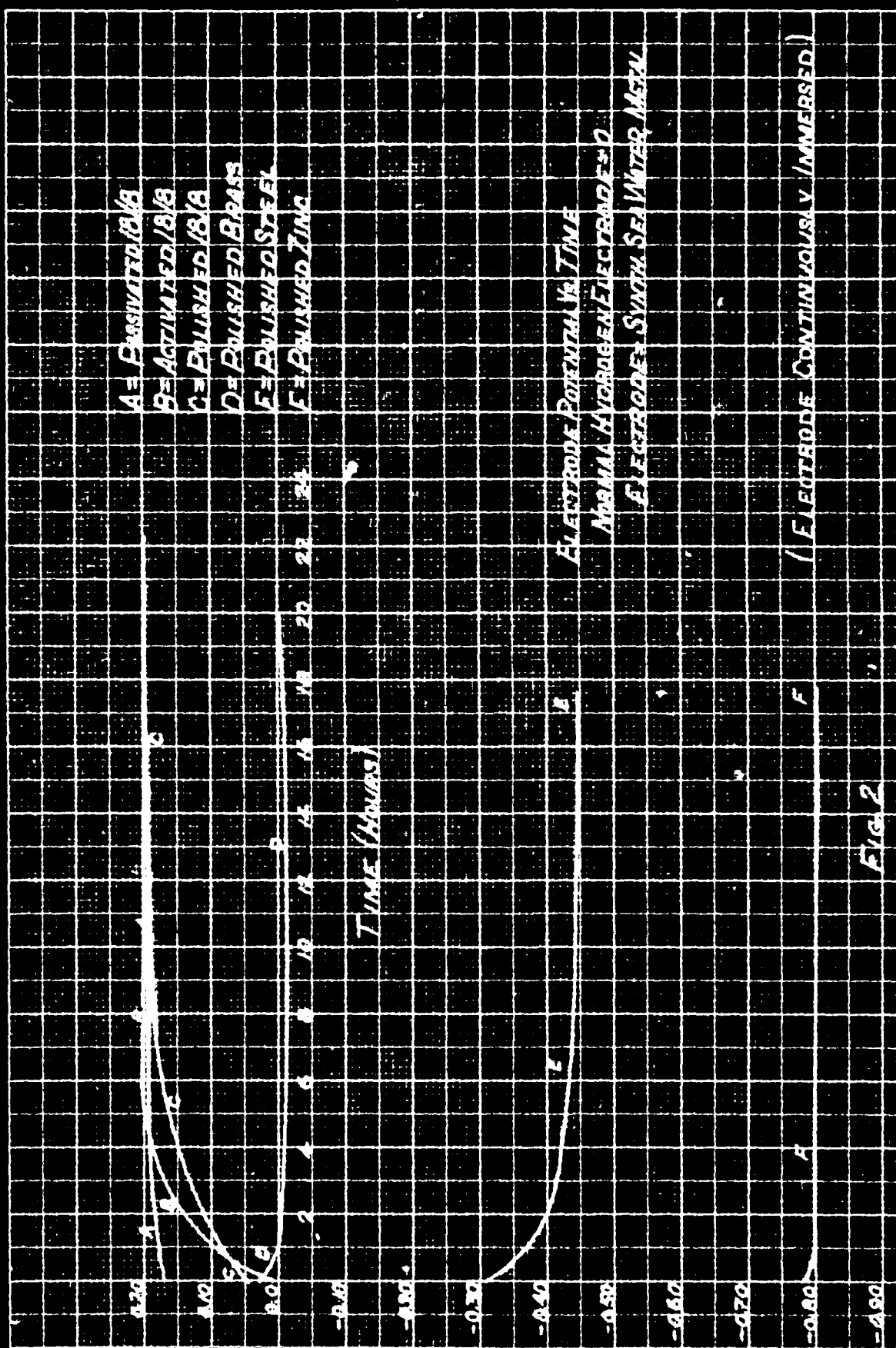


Figure 1

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ELECTRODE POTENTIAL (VOLTS)

TIME (HOURS)

A = PASSIVATED 18/8
 B = ACTIVATED 18/8
 C = POLISHED 18/8
 D = POLISHED BRASS
 E = POLISHED STEEL
 F = POLISHED ZINC

ELECTRODE POTENTIAL VS TIME
 NORMAL HYDROGEN ELECTRODES
 ELECTRODES SYNTH. SEA WATER METAL
 (ELECTRODE CONTINUOUSLY IMMERSED)

Fig. 2

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