

MAR 7

14UD TANK OPENING REPORT No.2.

March 8th - 12th, 1976

During the February tank opening we believed we had cured the trouble on chain 2 which had caused charging current to fluctuate, at the same time generating electrical noise (see previous report). First tests after gassing up showed that the fault remained. We isolated chain 2 and ran without trouble on chains 1 and 3.

On March 7th the machine was running easily at 9.5 MV, with 3 shorting rods at each end. There was a very loud tank spark followed by obvious charging problems. We found that the tank feedthrough for the negative charging voltage had a short to ground when the cable was disconnected. We opened the tank and found chain 3 broken. The chain, one of the 3 new ones fitted in October 75, had run for 2143 hours.

In February, finding that no oiling had been taking place for some time due to chain stretch, we removed all 3 oiling pads; however, the pulleys were all given a conventional manual oiling before button-up. From then on the machine ran approximately 3 weeks until this new breakage, which also occurred in position 3.

The pellets of the newly broken chain were plated, not hardened as were those of the first occasion, and the general pattern of chain damage was different. Whereas there were many shattered pellets on the first occasion, this time there were none at all; however, a number of pellets were dented, the worst cases being found in the terminal, and down in the rim of the lowest spinning. We believe, without having any specific evidence, that the break occurred in the terminal. While there were fewer separate lengths of chain than before, in all cases the nylon links had broken at the neck; in other words there were no breaks above the pin, the theoretically weakest place in the links.

We found that parts of the blue nylon rims of driving pulleys 1 and 3 were crazed, and partly broken at the thinnest point of their lips into a sawtooth appearance. In places the crazing had worsened into tiny fractures and, by running a fingernail along the edge, one could easily feel the sawtooth. This crazing was on one side only of each pulley. For chain 1 it was on the side nearest to the motor and for chain 3 on the side furthest from the motor. No crazing was seen on corresponding pulleys in the terminal, or on either of the chain 2 pulleys which had hardly been run at all.

Both pulleys of chain 3 were taken out. The driving pulley of chain 1 was also replaced.

No idlers had been damaged in the breakage, but we took out all 6 chain 1 idlers in the 16 MeV casting (the first idler casting below the terminal) and put in the newer type with "energy-absorbing" tyres.

Since the new chains have been fitted the motors do not fall so much on starting as they did with the old chains, implying less stretch; however, the inelastic stretch of the new chains seems quite large because we have taken out 6 links for about 2000 hours running time.

We had sections of both the old broken chain and the new broken chain tested by an engineer who set them up correctly in a conventional tension testing machine. The old piece of chain parted at about 800 pounds through a break in a (hardened) metal pellet. The new piece of chain parted at about 920 pounds through a break in the weak part of the nylon link above the pin

where we have never before seen a breakage. In this case the pellets were not hardened ones.

The engineer who conducted the tests suggested that, when working with nylon, one is often deluded by its large tension strength under static load, perhaps not paying sufficient attention to its glasslike fragility under sudden sideways stress. With this concept in mind we are paying increasing attention to oscillations in the stiff direction of the chains. The engineer took a good look at our various bits of broken chain. He picked out one of the fractured nylon links that had a white, shell-like appearance on its broken surface and said that, if he had seen such a break in metals, he would have said that it was a case of fatigue failure. We pieced together, as well as possible, bits of broken chain and found that the most severe pellet dents occurred on the lip of the pellet with the fatigued nylon link. This pellet, and nearby ones, were found in the region of the terminal.

Chains 1 and 2 were each shortened by 1 link.

Prior to button-up, when chains 1 and 2 were tested, we observed that chain 2, which has been run very little since changing pulley wheels to the new design, runs essentially without oscillation in either plane. Chain 1 had an oscillation in the stiff direction (parallel to the motor shaft) which we seemed unable to moderate by moving the lead weights to vary tension.

Returning to other matters: on examining chain 2 when we first went into the tank the long-standing trouble which had affected charging currents, and produced electric noise, was quickly diagnosed and corrected. The inductors on chains 1 and 3 are maintained in correct aspect to the chains by balance weights. On chain 2 the aspect is maintained by a pantograph device, one arm of which moves sharply sideways. This movement, not visualized when the wires were re-routed some time ago, was provoking an effect ranging between an arc and a short circuit.

Oiling devices were fitted to all charging pulleys. They were mounted on brackets fitted to the motors and they present the oiling orifice in fixed relationship to the upper rims of the pulleys. A mist of oil is sprayed down onto the rims and the intention is to operate the spray when the pulleys are rotating, but without charging voltage being applied to the inductors.

We understand that it is necessary to lubricate the nylon rims to a degree that will transmit the lubrication to the terminal pulleys, but will not cause chain slip, undesirable self-charge effects or electrostatic problems which are hard to predict or analyze. Even N.E.C. are somewhat hesitant about making definitive statements concerning oiling. In Canberra we feel that "the right amount is correct for our machine", and we oil in accordance with results observed.

The new A.N.U. devices are of the aerosol type: gas, ( $\text{SF}_6$ ) is injected from a bottle outside the tank, exhausting into the tank so that  $\text{SF}_6$  is not lost, nor is the tank gas contaminated. The 3 chains can be oiled separately, or together. Vacuum oil (Turbo 29) was chosen because of its properties when the tank is evacuated. It was very difficult to test the efficacy of the oilers beyond observing the amount of mist emitted for a given gas pressure (using nitrogen). Eventually bursts of about 15 seconds at a pressure of 60 psi above tank seemed the best starting place. Frequency and duration are within our control when the tank is closed.

Before buttoning up the pulleys and chains were oiled manually in the conventional way, not so much out of reverence for this vanishing craft as belief that it would give the chains as good a start as we could provide.

OTHER MATTERS:

All points were examined and none needed replacing.

The platform control cable was found to be burnt half through where it enters the box on the platform. Though it had been shortened before a further 18 inches were cut off and, to prevent overrun from tearing out the cable, a microswitch was fitted to the counterweight rails to interrupt control when the platform reaches the lower door.

Terminal sublimers were not changed this time.

A new charging control panel was fitted. We now display both charging and suppressor voltages; also the current drawn from these supplies. The diagnostic value of the 3 extra parameters is considerable. While inductor current is not measurable, faulty cables, feedthroughs, internal spark loading and direct shorts show up immediately. The panel also has a meter which indicates the position of the stabilizing needles.

When the machine was gassed up, and volts put on, we noticed that there was no indicated self-charge. Hitherto this effect has almost always been evident.

We later found that the charging current on chain 1 would change by some 15-20% at irregular intervals. This effect has persisted during the week between initial tests and the time of writing.

After a few days a tank spark further damaged the platform cable to a degree not yet determined, but we know some conductors are shorted. We had already planned to bring the reel outside the tank and spend a few minutes making the 14 connections on the platform barrier strip; we now put this job at the top of the priority list.

The machine has been running almost continuously since button-up. On most days the chains have been oiled once by turning off the charging volts and operating the oilers for 20 secs. Today they were given a 20 sec burst with volts on; no ill effects were noticed.

THE SOURCE:

A thermocouple has been fitted in contact with the lithium oven and we are establishing operating temperatures, both for maximum performance and least likelihood of blocking the canal. The figure of 400 deg. C appears to be the best value for our oven design.

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22nd March, 1976.

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