EMP ENGINEERING SERVICES INC.

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To:
From: **D. K. Smithman**
Subject: **B Pusher Failure Report**
Date: **December 12, 2003**

Cc:

The B Pusher has been causing delays due to motor stalls and trips. This problem has come and gone at least once before this latest round of incidents.

The pusher consists of an 808 mill motor diving two rack and pinion pusher arms through a three reduction gearbox. The first stage of the reduction is beveled gearing and the other two stages are helical gearing. The pusher arms are each supported on four roller bearing supported rollers with four additional side rollers for lateral stability. (See attached layout).

Measurements of motor current on A and B pushers show that B pusher draws consistently higher current to perform the same function. (See attached sample).

It was noted that the motor failures occur mostly with the heaviest bars, which also require the greatest number of amps to move them. This is because the additional amps, along with an already high 'baseline' requirement relative to A pusher, take the system above it's fault points. The operators have compensated for this by increasing the speed of the pusher before contact, essentially getting a running start.

During a motor failure incident on 12/30/03, it was noted that the bar was not impeded by any bearing housings or other hardware. (See photo).

Since nothing is stopping the bar and higher amps are being drawn on all bars, this points to some sort of binding in the pusher arms or in the gearbox.

The gearbox sounds fair during operation. There is some thumping, but this is probably transmitted noise from the arms. There are no inspection ports so internal condition can't be assessed without disassembly. Vibration testing could help in diagnostics, but would require removing the arm jackshafts in order to run the gears long enough to make measurements. Since this is ½ of the work to simply changing the gear set, it seems that changing the gearbox would be advisable if the gears become the sole suspect.

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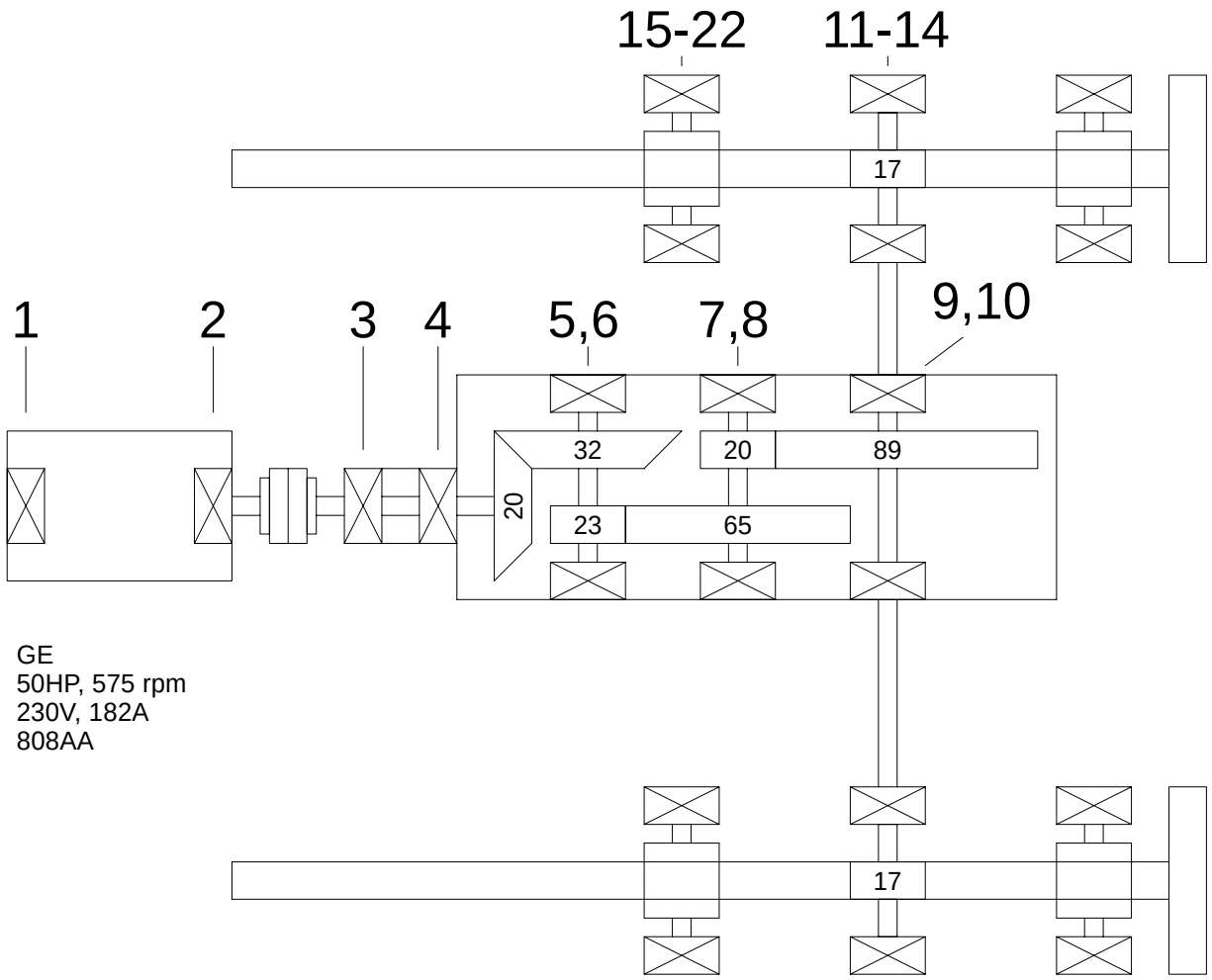
The other two options are the arms binding due to either being warped or having the rack and pinion gearing improperly set.

Bottom Line Recommendations

1. Check the rack and pinion gearing in both B pusher arms for interference.
2. Check the arm travel with dial indicators to determine if they run true and whether or not they are warped.
3. If steps 1 and 2 show no problems, change the gearbox.

A & B PUSHER

670-50-095
670-50-096



GE
50HP, 575 rpm
230V, 182A
808AA

1	2	3	4	5&6	7&8	9&10	11-14	15-22
		SKF	SKF	SKF	SKF	SKF	SKF	SKF
		30219	23222C	32313	22318	23030	23030	23120
		0.429	0.431	0.410	0.410	0.458	0.458	0.441
		3.300	3.481	2.627	2.635	5.865	5.865	4.129
		8.571	8.149	6.564	6.158	14.203	14.203	9.711
		11.429	10.806	9.436	8.843	16.797	16.797	12.289
		others	others	others	others	others	others	others

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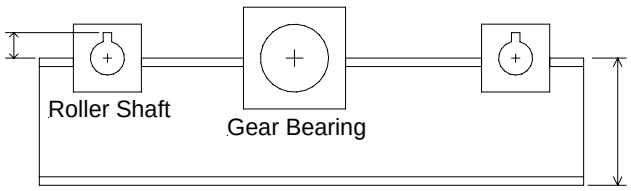
This is a follow-up to my report on the same subject dated 12/31/03.

Per recommendation #3, the gearbox was changed. The old box turns freely in both directions and has little apparent backlash. Subsequent current measurements are similar to those made prior to that change, so this wasn't the problem.

Further investigation has cast more suspicion on the interference fit in the rack and pinion gearing that drives the pusher arm.

1. Current measurements show that B draws more current than A but that this is most prominent during the pushing portion of the cycle. (See attached graph).
2. Current measurements made without a bar and during the push to the measure position show higher current draws on B than on A when the system isn't loaded. This indicates additional load from the mechanism. (See attached graph).
3. The drawings show that the support rollers and the spur gear centerlines are located from two different surfaces in the fabricated housing. This is poor design practice for two reasons. Locating critical dimensions from more than one surface allows for tolerance accumulation. Also, the location of these two un-machined surfaces is not well controlled since there is no reason to do so.



4. The drawings show that the spur gear outer diameter was reduced from 10.415" to 10.3044" five months after the drawing was originally issued.
5. I suspect that the drawing was changed after a pre-delivery assembly test identified interference problems created by the poor dimensioning of the foundation.
6. I also suspect that there is significant variation between A and B pusher foundations.
7. Finally, I suspect that at least one of the pushers on B is binding as a result of excessive interference in the rack and pinion gearing.

Bottom Line: The interference in the rack and pinion on both B pusher arms needs to be evaluated. Clean the teeth and inspect as well as possible. Bluing the teeth and running may give some insight as to the location of the pitch line (point of load transmission). Also, consider using plastigage to determine the depth of the root clearance. However, making firm measurements to the accuracy of 0.1" required may force disassembly.

Please call me if you have any questions in this matter.

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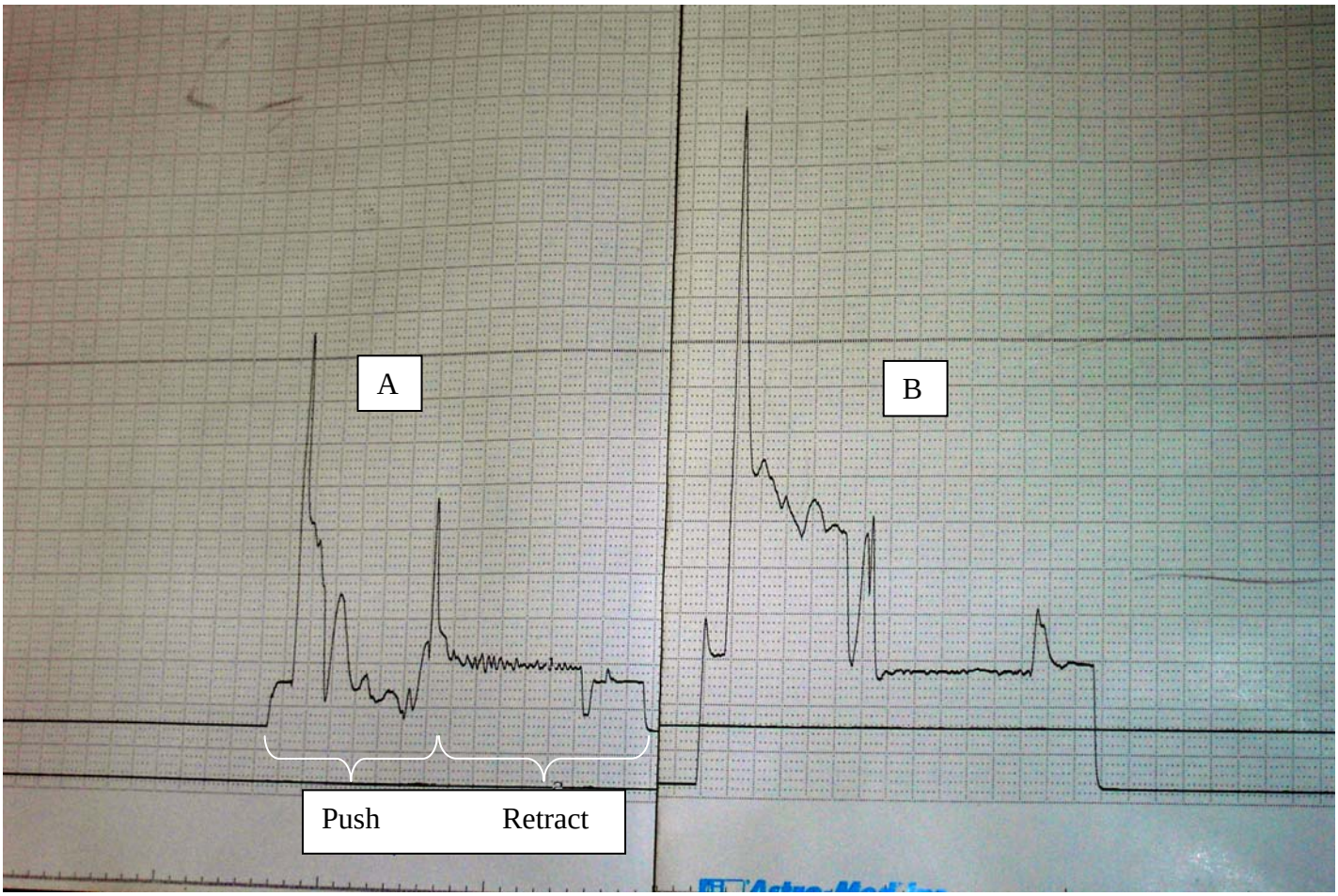

Current traces pushing in 25 ton bars. Note the elevated current on B during the push phase.

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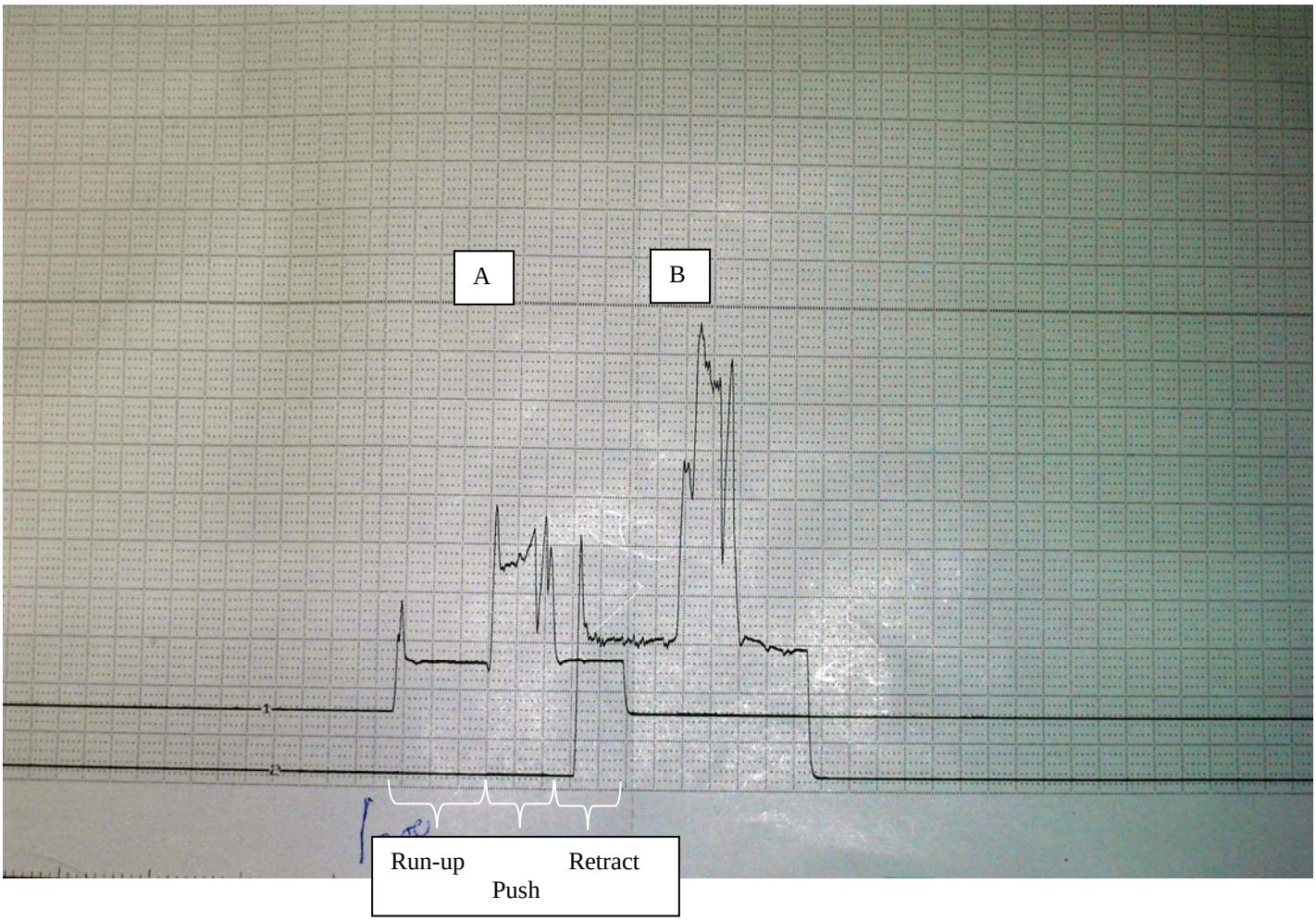

Current traces putting 26 ton bars in the 'measure' position. These are similar to the no-bar tests but the traces are less jumbled. They show that B has higher current during run-up and retract than A.