

Coke Cutting Assembly Hoist & Rigging Failure

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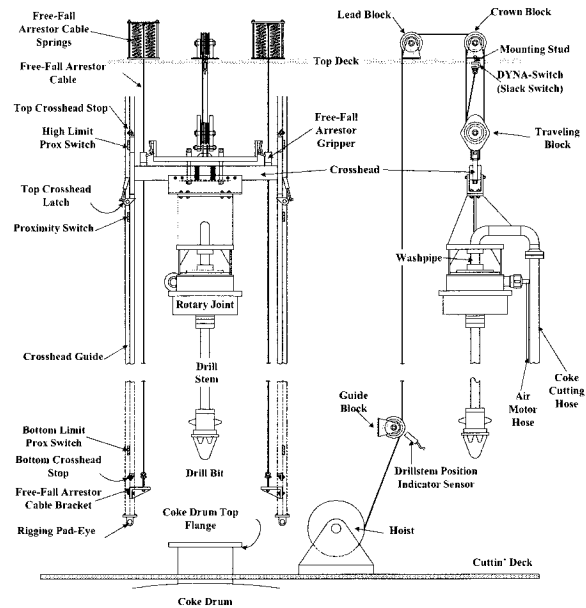
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Coke Cutting Assembly Hoist & Rigging Failure Outline

- **Drilling Assembly Overview**
- **Event Description**
- **Description of Failed Components**
- **Hoist Spline Failure**
- **Free Fall Arrestor System Failure**
- **Braking Systems Failure**
- **Summary**
- **Recommendations**
- **Free-Fall Arrestor Static Test**
- **Acknowledgements**

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Figure #1: Drilling Assembly



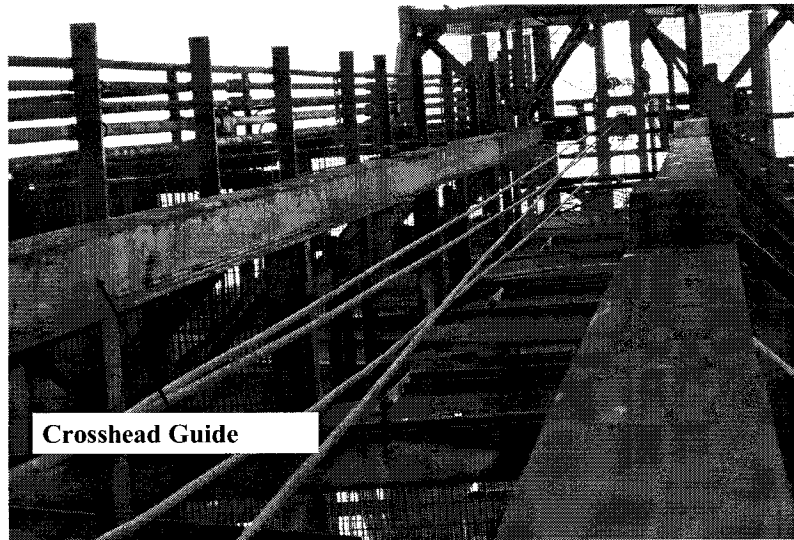
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Event Description

- The Delayed Coker Operator raised the drilling assembly from the #2 coke drum after cutting the pilot hole thru the coke bed and switched the drill bit from the initial pilot (bore) cutting mode to the main cutting mode on December 7th, 2005.
- Shortly after the drilling assembly was lowered into the coke drum and the jet pump started for the main cut, the drilling assembly began to “free-fall” into the coke drum.
- The Operator tried to apply the hoist hand brake – but it did not appear to stop or slow down the descent of the drilling assembly.
- As the drilling assembly dropped it struck the bottom mechanical stops – shearing them from the support structure.
- As the drilling assembly continued to plunge it broke both free-fall arrestor cable brackets as well as snapping both free-fall arrestor cables.

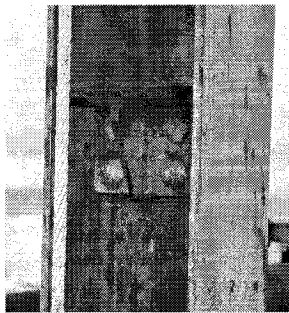
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Figure #2: Crosshead Guides

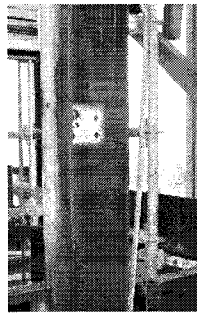


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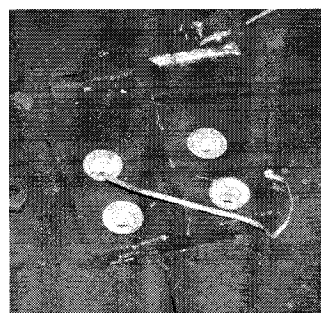
Figure #3: Bottom Mechanical Stop



As Installed



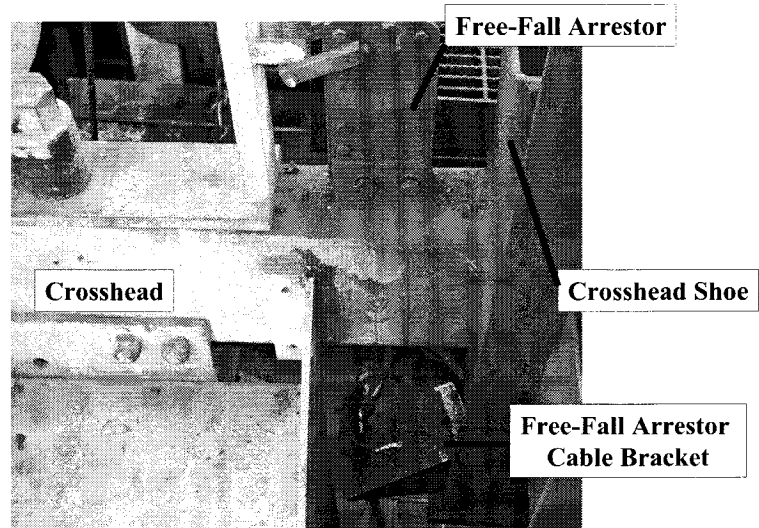
After Event



Bottom Stop at Rest

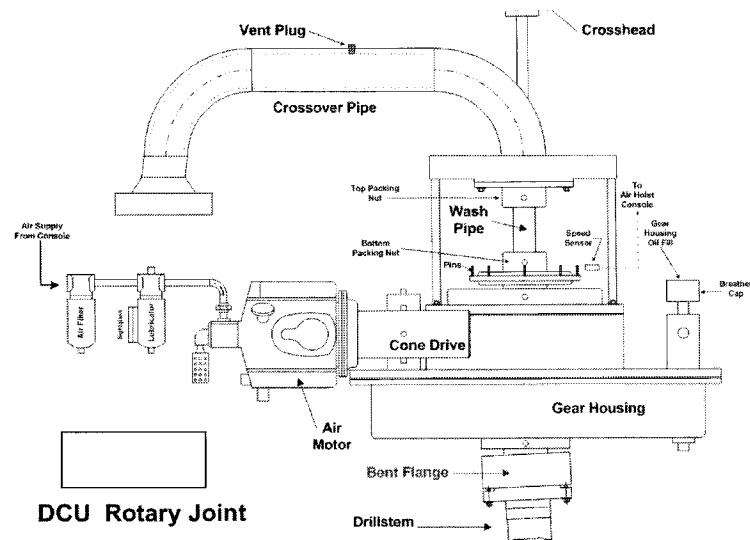
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Figure #4: Free-Fall Arrestor Cable Bracket



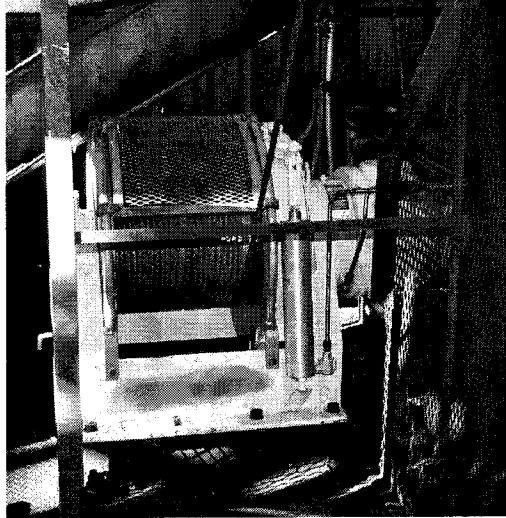
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Figure #5: Rotary Joint Damage



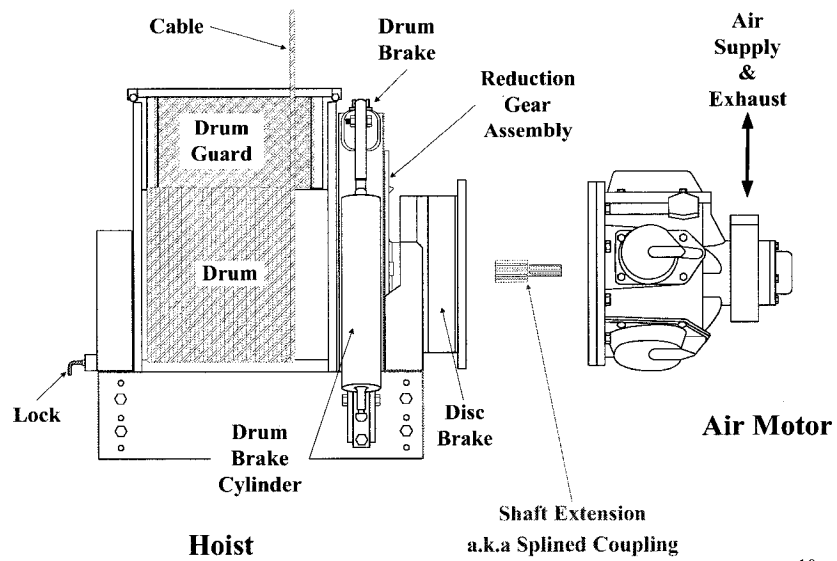
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Figure #6: Hoist Overview



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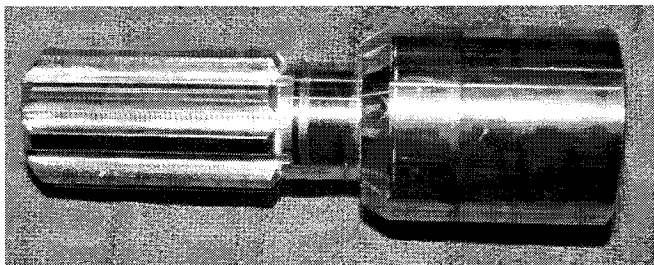
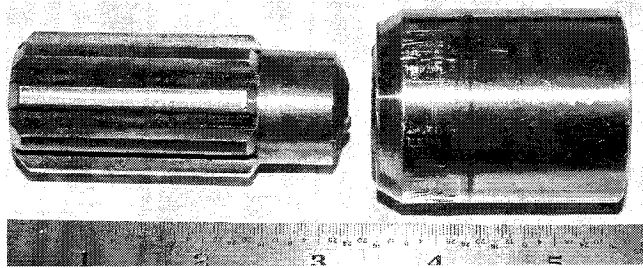
Figure #7: Decoking Air Winch



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Figure #8: Splined Coupling

Failed Spline

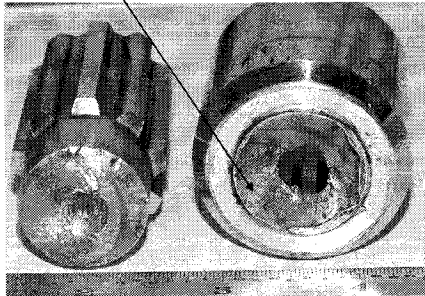


As Supplied

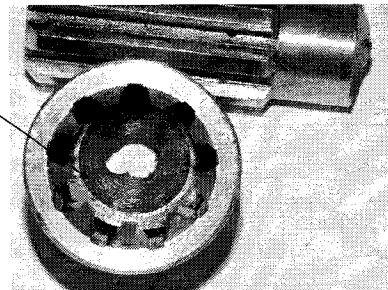
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Figure #9: Coupling Detail

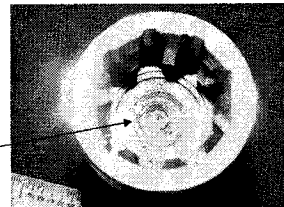
Fracture Surface



Over-drilling



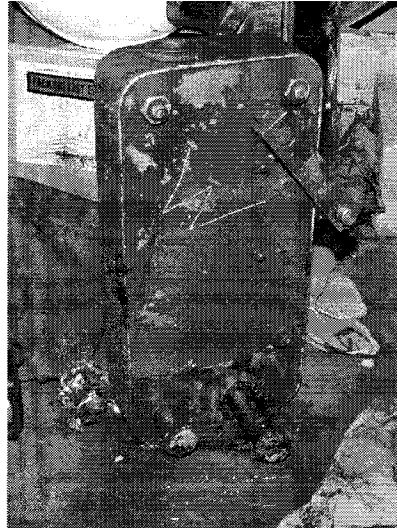
**Undamaged coupling
from another hoist.**



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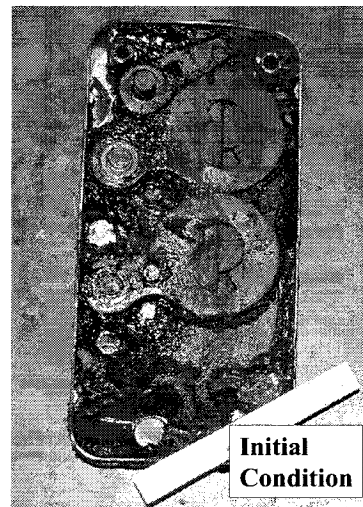
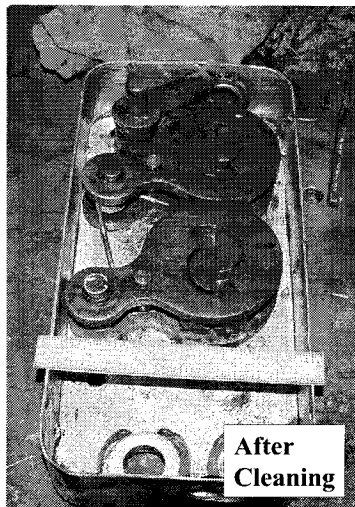
Figure #10: Free-Fall Arrestor Failure

Why did the Free-Fall Arrestor Cable Gripper Fail to Grip the Cables and Stop the Drilling Assembly Descent?



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Figure #11: Gripper



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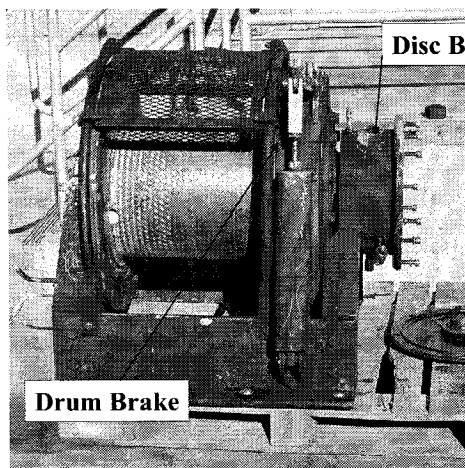
Figure #12: Free-Fall Arrestor Cable



Coke & Grease on Cable

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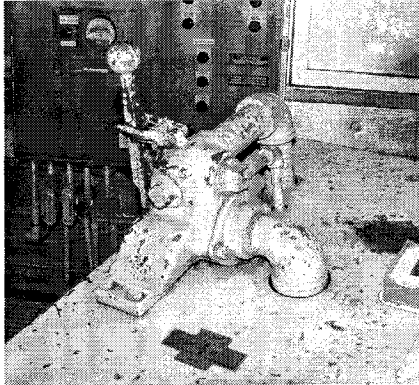
Figure #13: Hoist Brakes



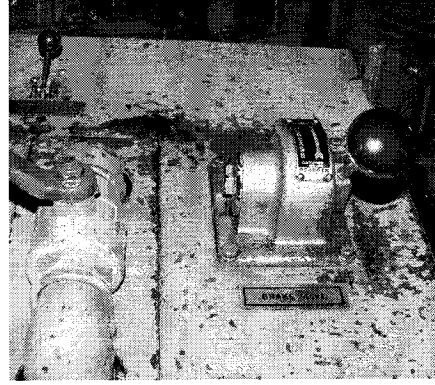
Why didn't the hoist brakes stop or slow the descent of the drilling assembly?

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Figure #14: Hoist Control Panel



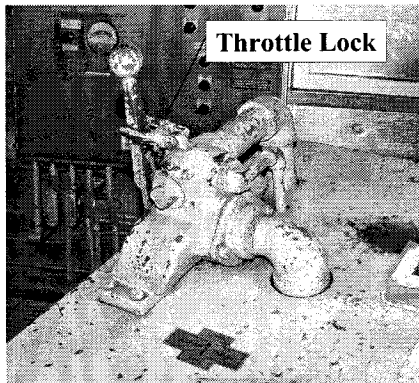
Hoist Throttle



Brake Release

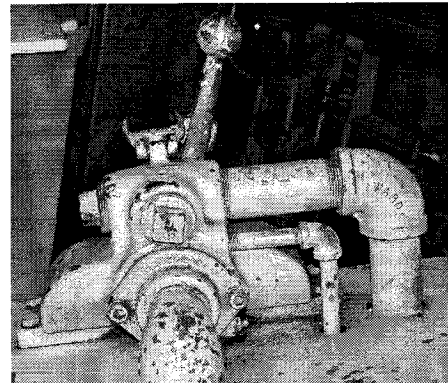
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Figure #15: Hoist Throttle



Throttle Lock

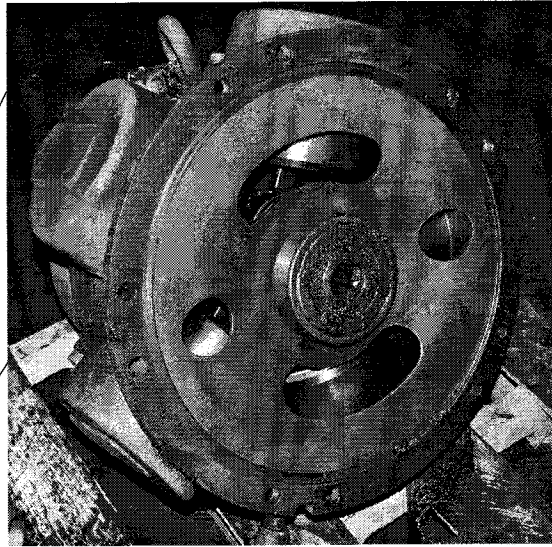
Throttle Locked in Neutral



Throttle Active

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Figure #16: Air Motor



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Summary

- **Failure of the hoist splined coupling was the initiating event for this failure. Coupling failed in fatigue after approximately 7 years of service. Local repair shops had previously repaired this hoist without oversight such that there were no records of shop qualifications or repair history. Thus it is not known what inspections or modifications may have been performed on the splined coupling.**
- **Free-Fall Arrestor cable grippers will not properly function if packed with hard grease & coke. Subsequent testing by Flowserve demonstrates cable “slippery-ness” has no effect on gripping ability.**
- **Coke cutting operators were not aware that both hoist brakes are disengaged whenever the hoist throttle is active.**
- **Subsequent testing revealed that the hoist internal disc brake was damaged and not functional. The drum brake was fully functional and could have stopped the hoist if applied quickly.**

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Recommendations: Hoist

- **Secure the drilling assembly in a safe manner. Disconnect the air motor from the hoist. Inspect the splined coupling for cracks or dimensional defects. Replace coupling if found defective. This inspection should be performed every two to three years.**
- **Review maintenance practices to ensure hoist inspections and repairs are performed by a qualified repair shop, repairs are fully documented and the entire hoist assembly is subjected to a full load test after repairs. Hoist inspections every three to five years would be prudent.**
- **Review the operation of the hoist brakes for your system with your Operating personnel. Emphasize that hoist brakes are disengaged whenever the throttle is active and that jamming the throttle open may prevent brake engagement in an emergency.**
- **Consider converting the existing hoist air-motor to an electro-hydraulic system to improve Coke Cutting Operator ergonomics.**

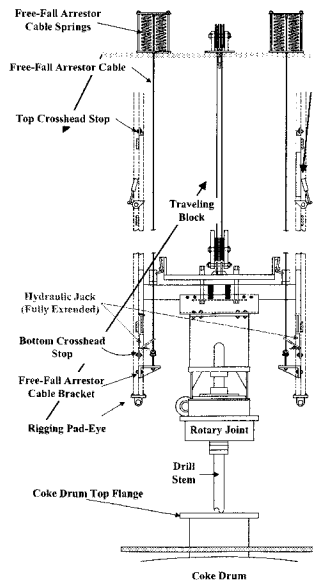
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Recommendations: Free-Fall Arrestor

- **Lubricate the Free-Fall Arrestor Grippers every 3 to 4 months with the appropriate low temperature grease.**
- **Visually inspect the entire Free-Fall Arrestor system for missing and/or damaged components every 6 months. This includes a visual inspection of the Free-Fall Arrestor gripper linkages, springs and bolting as well as cables and connections.**
- **Visually inspect each Free-Fall Arrestor cable for damage as well as excessive dirt & debris every 6 months. Clean cables to remove excessive coke and dirt to prevent contamination of the grippers.**
- **Conduct a static test of the Free-Fall Arrestor system once every year.**
- **Completely replace the Free-Fall Arrestor gripper assemblies and springs every 5 years.**

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Figure #17: Free-Fall Arrestor Static Test



Empty coke drum.

Replace bottom stops with fully extended hydraulic jacks.

Lower crosshead onto jacks until Free-Fall Arrestor linkages activate.

Slowly lower hydraulic jacks observing for gripper slippage.

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Acknowledgements

The author would like to thank the following individuals for their kind help in reviewing this presentation:

- **Mr. Steve R. Mershon, Project Manager - Decoking Winches Winch and Hoist Solutions, Ingersoll-Rand Company, Seattle, Washington, USA.**
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