DIS METALLURGICAL SERVICE

Method of Eliminating the Heat Affected Zone in a Welded Crankshaft

DISFOR Process

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Who we are?

- DIS Metallurgical Service is a family owned company
- Dusan Milicevic, President & Founder
- We have US Patent(s):
- “Method of eliminating the heat affected zone in a welded crankshaft”, US 9,095,891 - August 2015
- “Method of eliminating the heat affected zone in a welded article”, US 9,254,518 - January 2016

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What we offer

- We offer US Patent(s):
  - "Method of eliminating the heat affected zone in a welded crankshaft", US 9,095,891 - August 2015
  - "Method of eliminating the heat affected zone in a welded article", US 9,254,518 - January 2016
- DISFOR is the method described within our patents.
- DISFOR answers the question of how to eliminate HAZ in a welded crankshaft and provide same or better metallurgical properties as a solid crankshaft produced by forging.
- The application describes implementation of full scale production.
- Proof of concept has been completed.

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Proof of Concept

- AISI 4340 was the material used in experiments.
- Crankshaft journals exhibited the following properties.
- Welded, quench, tempered: impact of 30 ft-lb at -20^{o}F.
- Welded, DISFOR treated, quench, tempered: impact 58 ft-lb at -20^{o}F.
- Welded, DISFOR treated ,quench, tempered: had the same mechanical properties as a solid forged crankshaft journal.
- Microstructure of welded, DISFOR treated, quench, tempered journal was the same/similar to the microstructure of a solid crankshaft having same thermal and forming history.

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Proof of Concept (cont.)

- There is evidence of HAZ in welded, quench and tempered journal.
- There is no evidence of HAZ in welded, DISFOR treated, quench and tempered journal.
- Welded DISFOR treated crankshafts have continuous grain flow CGF.
- All impact, mechanical and microstructural testing were completed by an independent metallurgical lab.
- All welding and DISFOR related processes were completed by US companies.

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What are we looking for?

- We are looking for an investor or partner
- To provide funding for commercialization of our innovative idea!!!
- We need to make crankshaft prototypes using our DISFOR method and test against state of the art forged crankshafts.
- Pilot production.
- Full scale industrial production.

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The goal of innovation

- **Provide significantly lower investment and manufacturing cost for crankshafts.**
- **Maintain the metallurgical quality of the crankshafts the same as when forged using existing processes.**
- **Replace existing crankshaft forging processes with DISFOR method.**
- **Heat treatment and machining is out of the scope of the innovation because they are the same as for current manufacturing process.**

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The current forging process

- Production line consists of up to 3 presses plus trimming press.
- Forging presses up to 18000T, up to 550 lbs crankshaft. [1]
- Forging line needs up to 2000T trimming press.
- Every 50 sec one shaft is produced.
- Big block Chevy engine 5.5” stroke cost $1,791.19 [2]
- High performance crankshafts cost from $300-$1700 [4], [5]
- US crankshaft consumption is about $12-15M per year based on automobile production.

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What is DISFOR process

- **DISFOR is an innovative method which completely eliminates HAZ in welded crankshafts or other welded products.**
- **DISFOR is the process described in DIS Metallurgical Service patent(s);**
  - **“Method of eliminating the heat affected zone in a welded crankshaft”, US 9,095,891 - August 2015**
  - **“Method of eliminating the heat affected zone in a welded article”, US 9,254,518 - January 2016**

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Example of current crankshaft forging method [1]

- Large flash which needs to be trimmed from crankshaft

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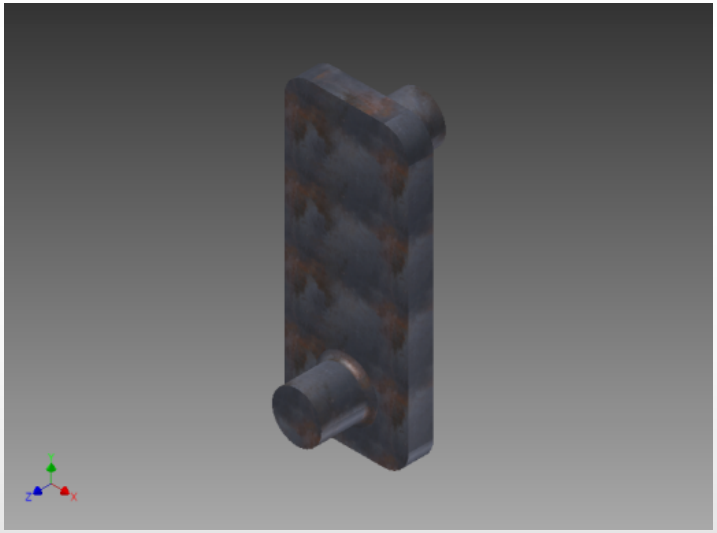
How to make the crankshaft using DISFOR process without large presses and without trimming

- All you need is crankshaft arm (link) + DISFOR PROCESS + induction heater.
- Link can be forged or machined from the billet



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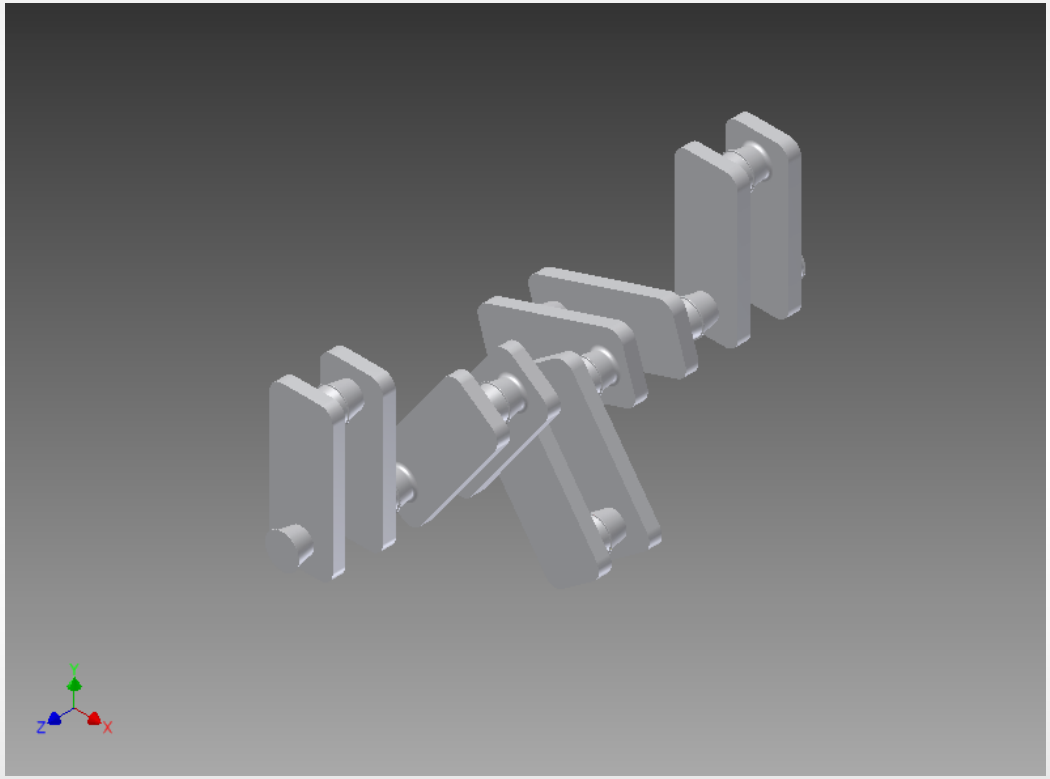
To make this

- **5 throw crankshaft, shape of this crankshaft is similar to the crankshafts produced by OEM**



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Required equipment to execute DISFOR process

- Equipment requires less that 50% of current investment in crankshaft production line.
- Relatively small forging press to forge links, friction welder, DISFOR Process and induction heater are required to make one crankshaft.
- Outside vendor can forge links, therefore press may not be necessary.

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Processes involved to make crankshafts

- Forging only links using existing forging methods.
- Connecting two links into throw by friction welding and applying DISFOR process to eliminate HAZ in throw journals.
- Connecting two throws by welding two sections of the main journals and eliminating HAZ using DISFOR process.
- Heat treating.
- Rough machining.

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Investment cost

- Only $0.5M tooling cost to make 60000 crankshafts.
- After production starts up to $30 million in sales.
- Return on Investment ROI > 50 % higher.
- Productivity (2-3 shafts per minute versus 1 in 50 sec).
- Significantly lower upfront investment.
- Low risk
- DISFOR method is suitable for any size of crankshaft.
- Goal is to target high performance crankshafts.

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Next step

- Making several Prototypes.
- Testing Prototypes against current state of the art forged crankshafts.
- Commercialization – pilot plant production.

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Conclusions

DISFOR Process provides:

- **Much lower investment cost.**
- **Lower than now operational cost.**
- **Better than now productivity.**
- **Better or same quality of crankshafts.**
- **DISFOR Process is suitable for manufacturing of any size crankshaft.**
- **DISFOR Process provides 10-20 % input materials savings due to absence of trimming operation.**

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QUESTIONS?

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metallurgical consulting and innovation

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References

1. www.forging.@schuller.com
2. WWW.cnc-motorsports.com
3. http://www.google.com/imgres?imgurl=http://static.traderscity.com/board/userpix14/4193-crankshaft-line-ton-ajax-mechanical-forging-press
4. http://www.summitracing.com/search/Part-Type/Crankshafts/?autoview=SKU&mbid=514179&page=7
5. http://www.coasthigh.com/chevy-big-block-forged-4340-crankshafts-s/1632.htm

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