

New Inventions for Extending The Service Life of Coke Drums

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Overview

Three issued and pending HES patents in last two years aimed at mitigating or minimizing classic coke drum failures:

- Non-welded skirt attachment
- Non-bolted skirt anchors
- Fatigue-resistant shell

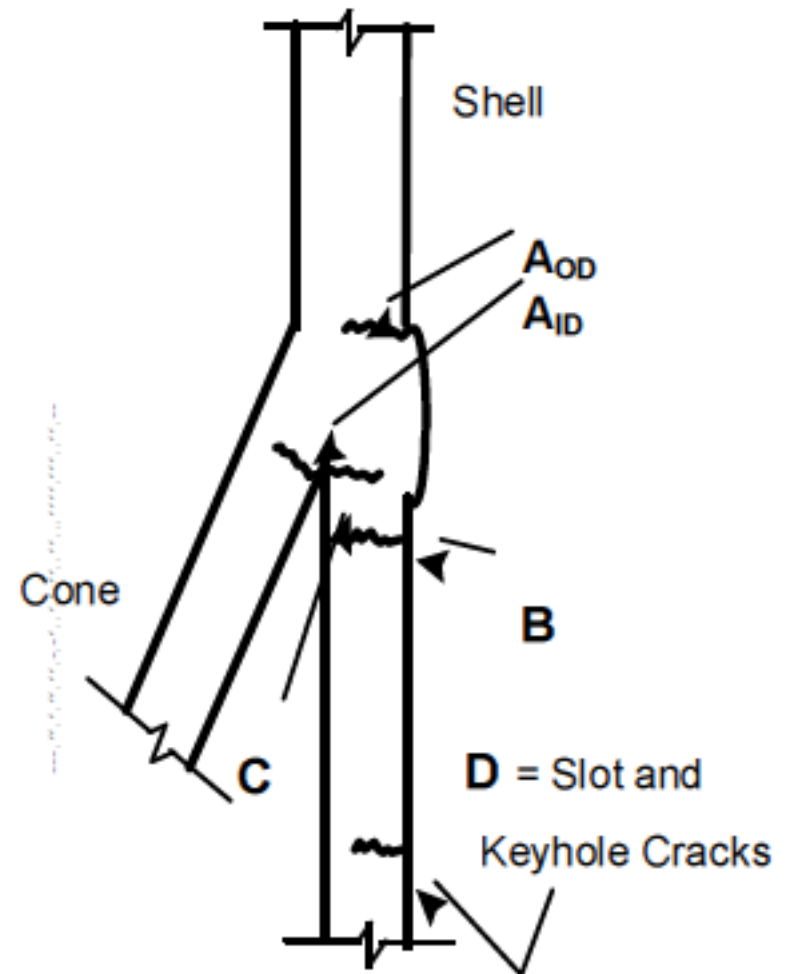
Non-welded skirt attachment

Skirt Attachment Cracking

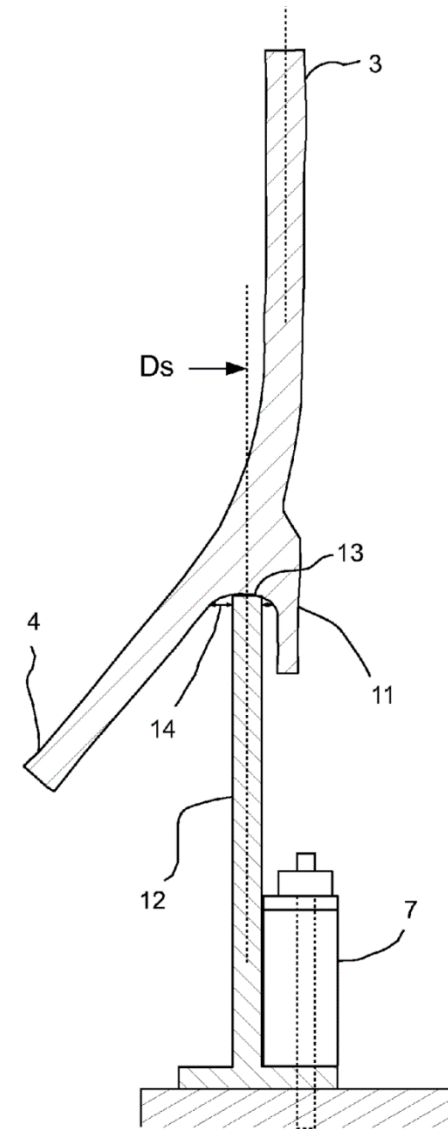
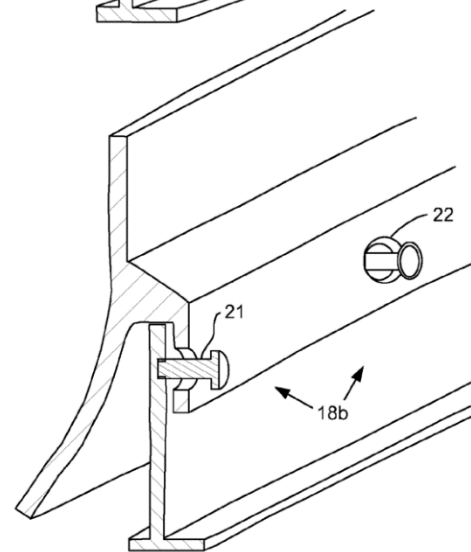
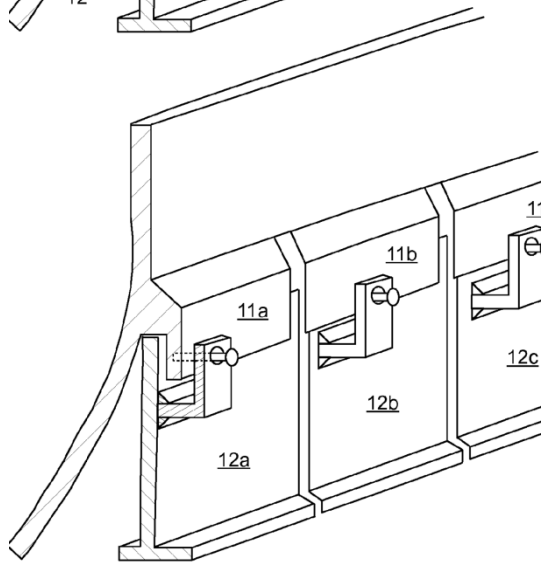
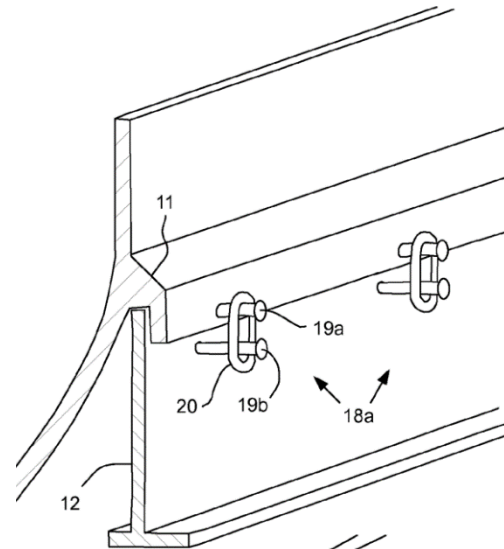
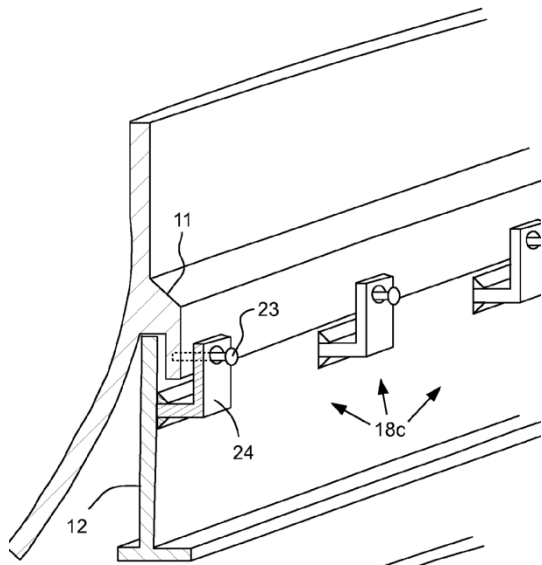
API 1996 Survey

Skirt Cracking Results

Description	Location	Percent Cracking
Cracking at Weld	A, B&C	56%
Cracking into Shell	A	43%
Cracking from Skirt OD	B	63%
Cracking From Skirt ID	C	26%
Cracking at Slots / Keyholes	D	76%
Total Cracking in Skirts	A, B, C, & D	78%



HES Tongue-and-Groove Skirt

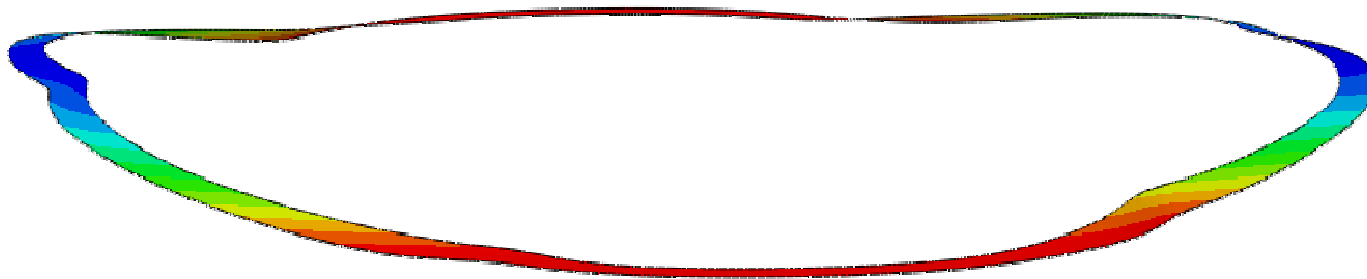
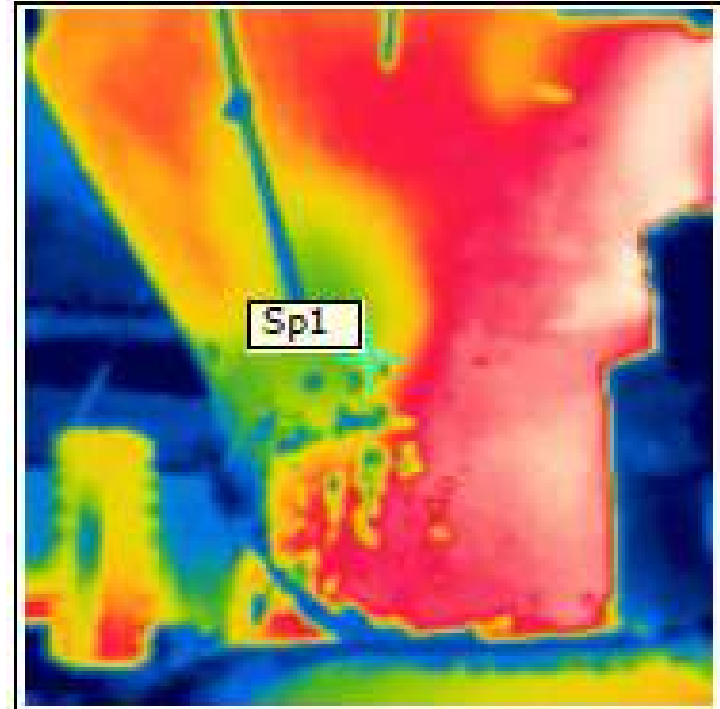
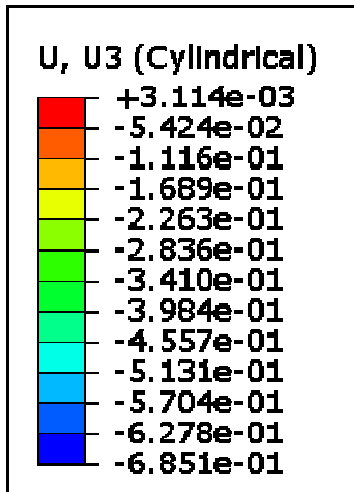


Status

- Precedents:
 - Sliding skirt 2002 (24+ drums in operation)
 - Retrofit 2011 - in operation
 - Undocumented set 30+ years in operation
- Being implemented

Non-bolted skirt anchors

Skirt Bolt failures



HES Clearance-Restraint Anchors

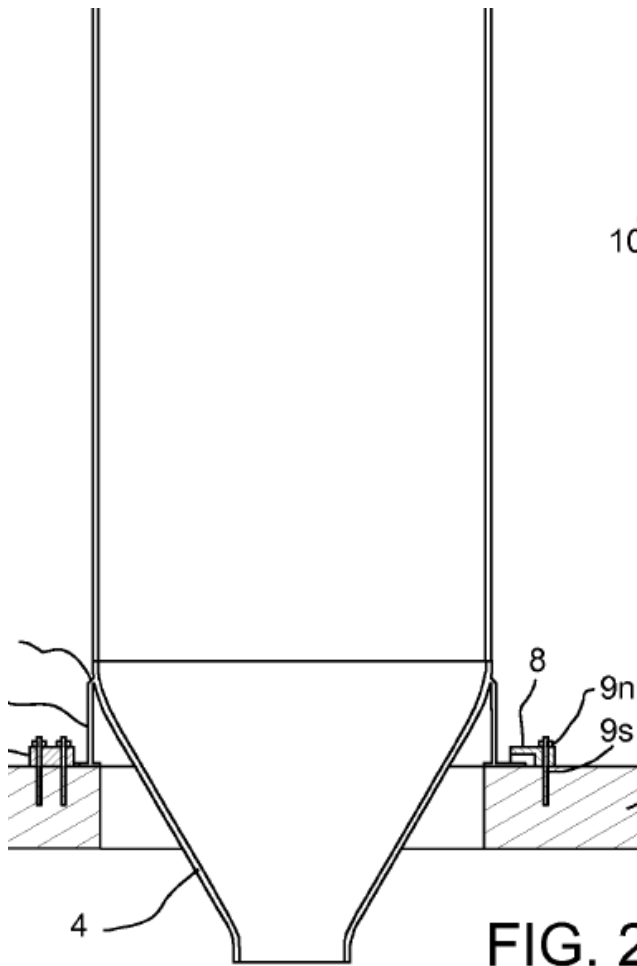


FIG. 2A

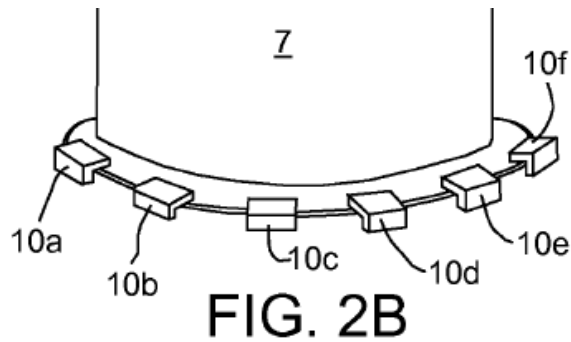


FIG. 2B

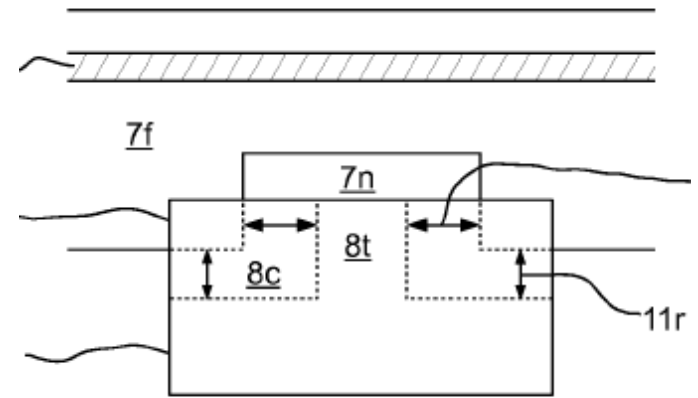
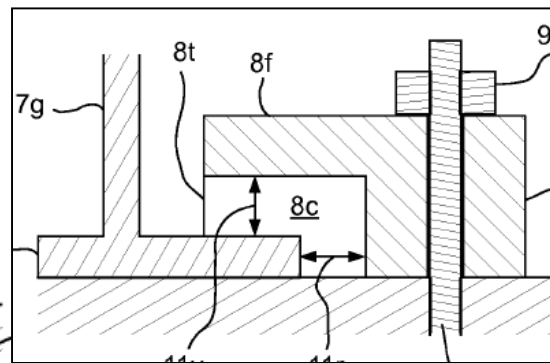
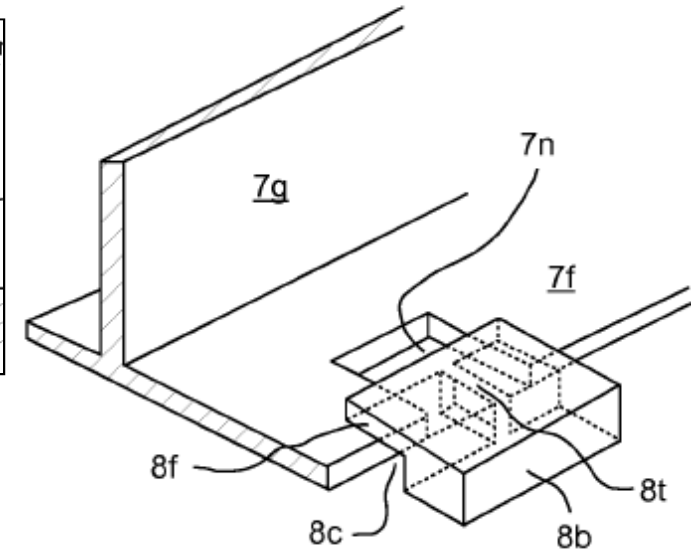


FIG. 3B

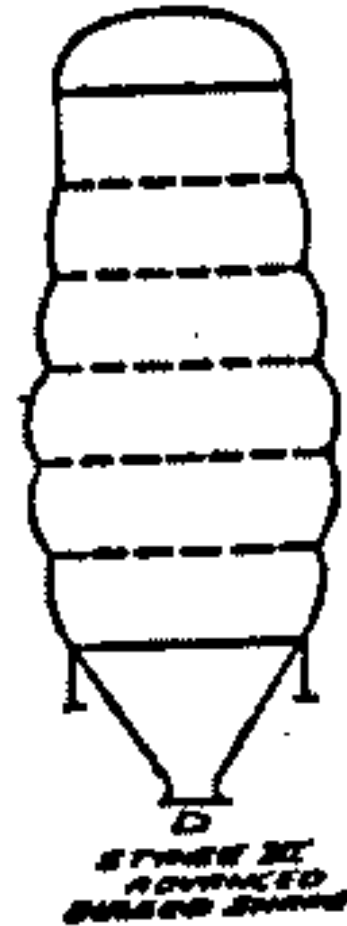
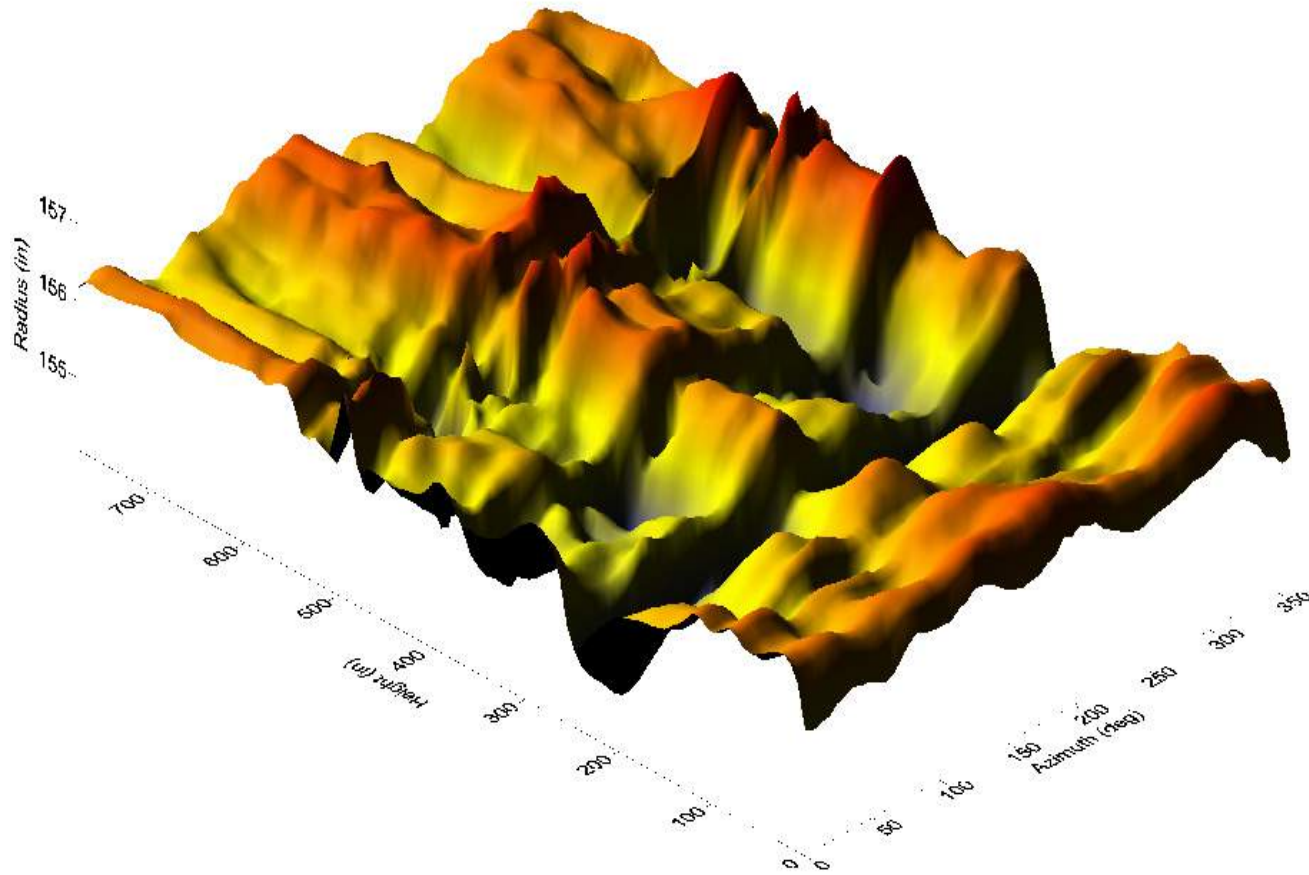


Status

- Not aware of any precedents
- Being implemented

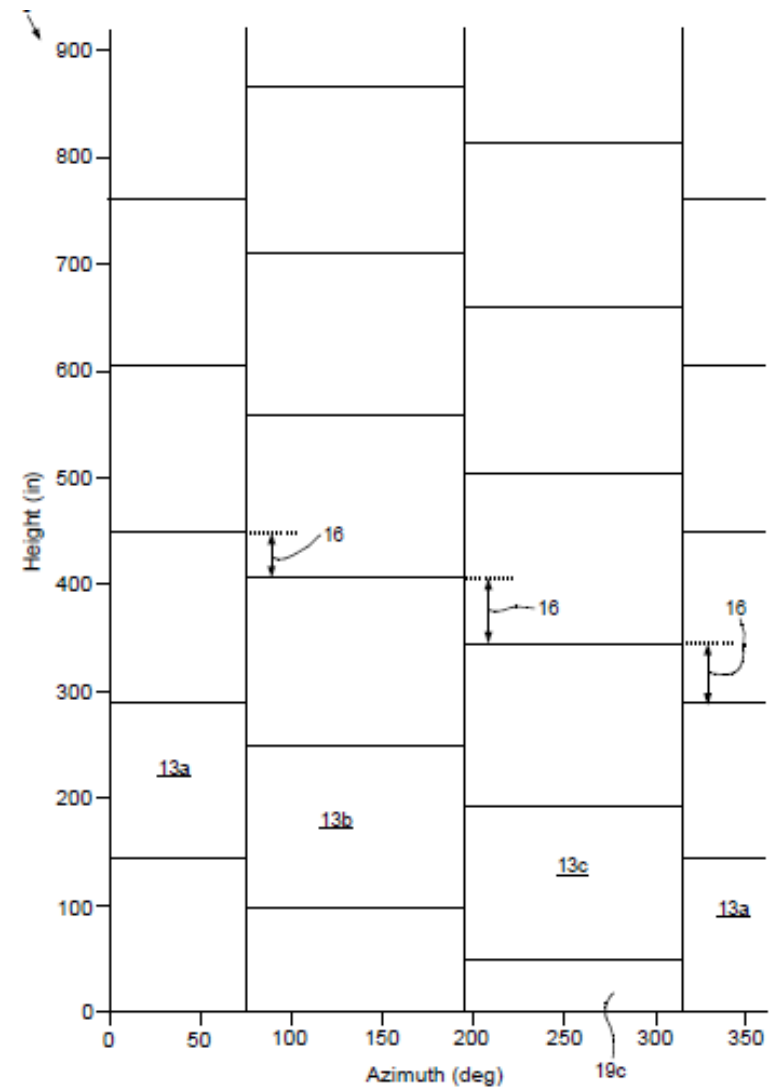
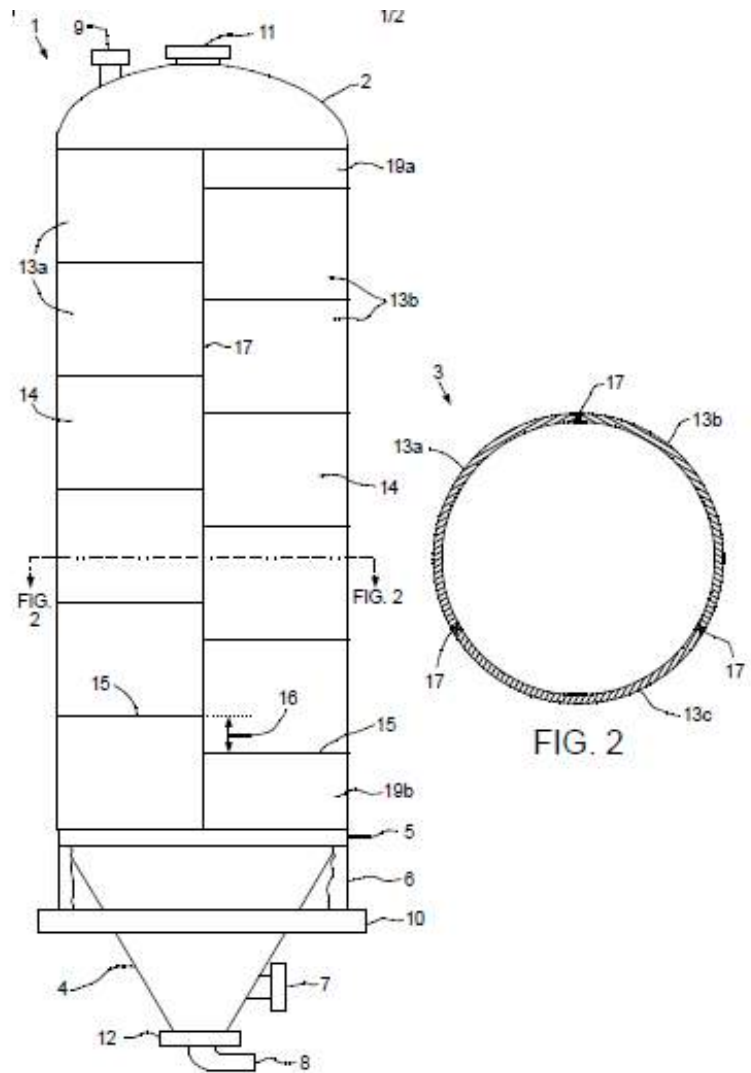
Fatigue-resistant shell

Seam Bulging



Weil & Rapasky 1958

HES Staggered-Seam Shell



Status

- Not aware of any precedents
- No pending implementation

Summary

Three issued and pending HES patents in last two years aimed at mitigating or minimizing classic coke drum failures:

- Tongue-and-Groove skirt attachment
 - Being implemented
- Clearance-Restraint skirt anchors
 - Being implemented
- Staggered-Seam shell design