An Improved Oil Shale Retort

A Road Not Taken

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Outline

- Introduction
- Fluid Bed Retorts
- Fluid Catalytic Cracking
- Fundamentals
- Demo Plants
- Resolution

Synfuels Basics

- Oil shale
  - Kerogen
  - Heating (500°C or more)
- Oil sands
  - Bitumen
  - Water dissolution
- Oil and gas
  - No mining required
  - Generally higher quality products


WELL YOU HEARD WRONG! WE HAVEN'T ALL PULLED OUT!
CORE SAMPLE
LONE PINE
OIL
WOOL
LIPS
RUM
ALBANDS
CONSORTIUM
LIKE HEAVY OIL, MAN.

Challenges

Technology

- Large scale mining
- Whole mass must be heated
- Small unit sizes heretofore
- Recovery low (<~50% of organic C)
- Dusting into product oil
- Beneficiation has not been successful

Challenges

Other Areas

- Operational risks (need good demo plant)
- Environmental permitting/liabilities
- Uncertain public policy
- Lead time - design, permitting, construction
- Economics
  - Lots of iron and steel in plants
  - Ergo, oil price goes up, plant cost rise
  - Can’t get there from here

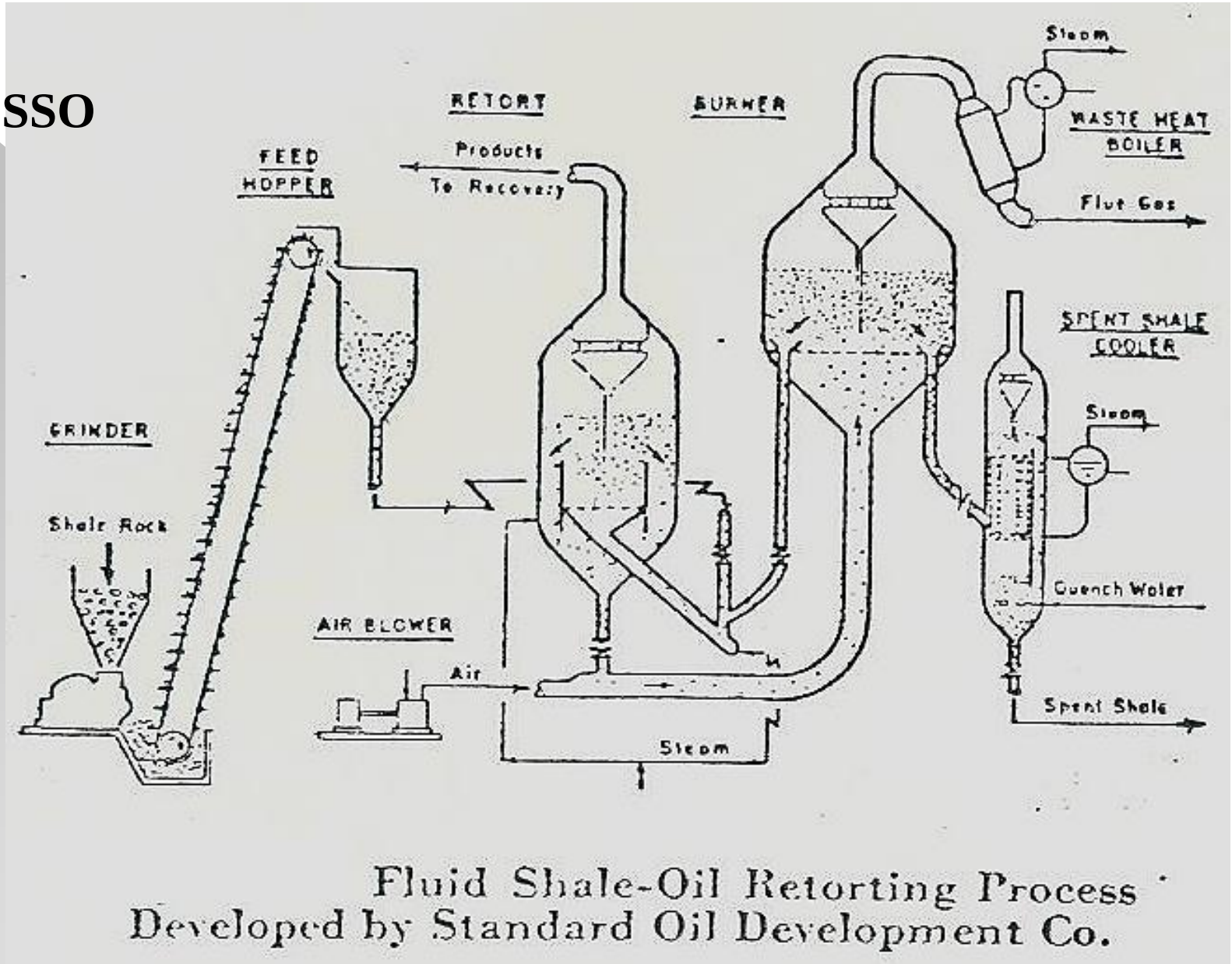
Fluid Bed Retorting

- Hytort
  - High pressure, hydrogen, misting
  - Not viable as moving bed - redesign
  - Fluid bed tried
- Chattanooga Energy
  - High pressure, hydrogen, spouted bed
- Ensyn/Ivanhoe
  - High velocity cyclonic vessel
  - Biomass, heavy oil, oil shale

Fluid Cat Cracking

- ESSO
  - 1940’s, Australian shales
  - Yield loss, dusting into product
- Sinclair
  - Hot gas from combustion to heat retort
  - Modify Gas Combustion
- METC
  - Stacked beds (Kellogg A)

ESSO

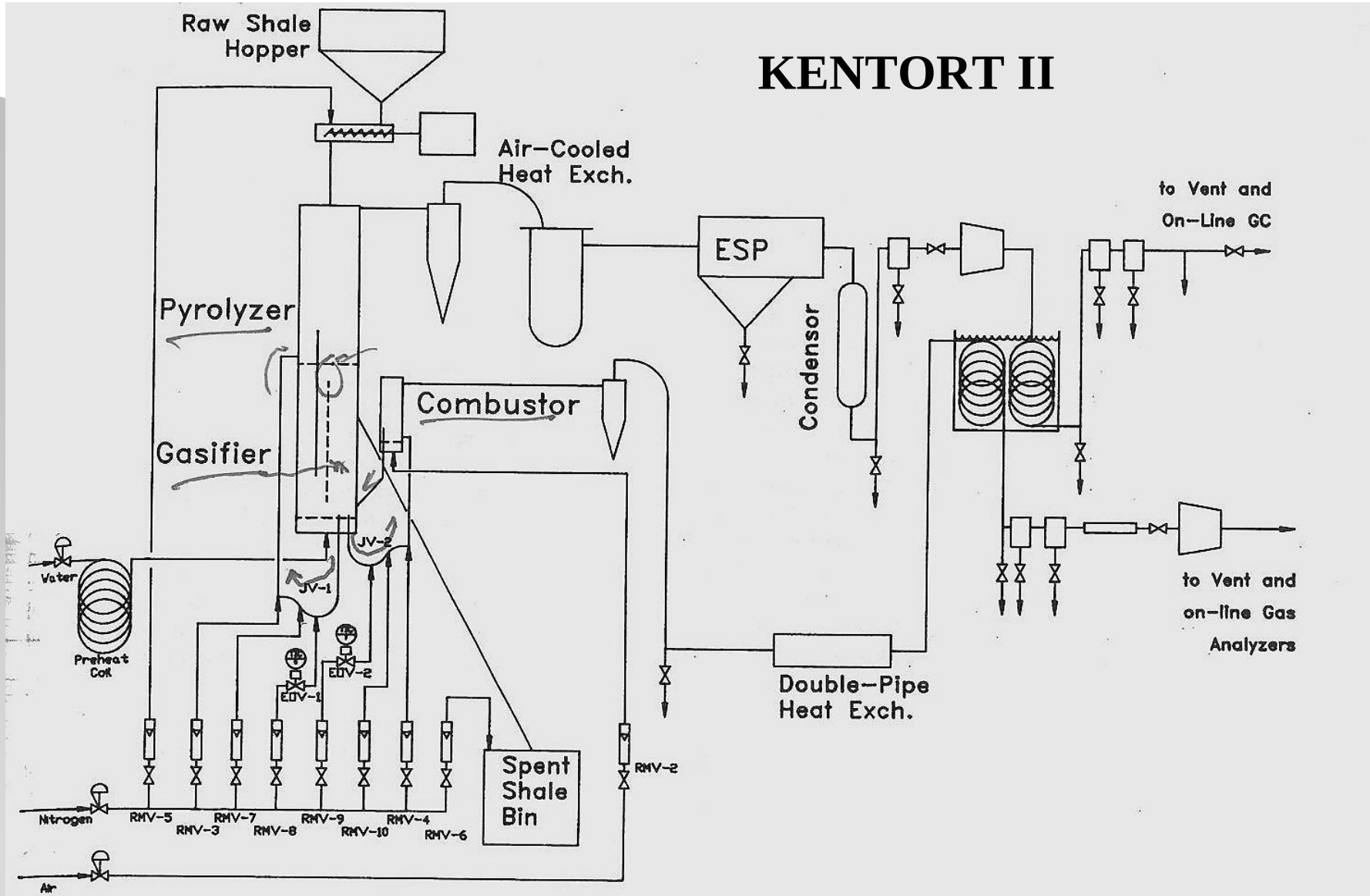


Fluid Shale-Oil Retorting Process
Developed by Standard Oil Development Co.

Advanced Concepts

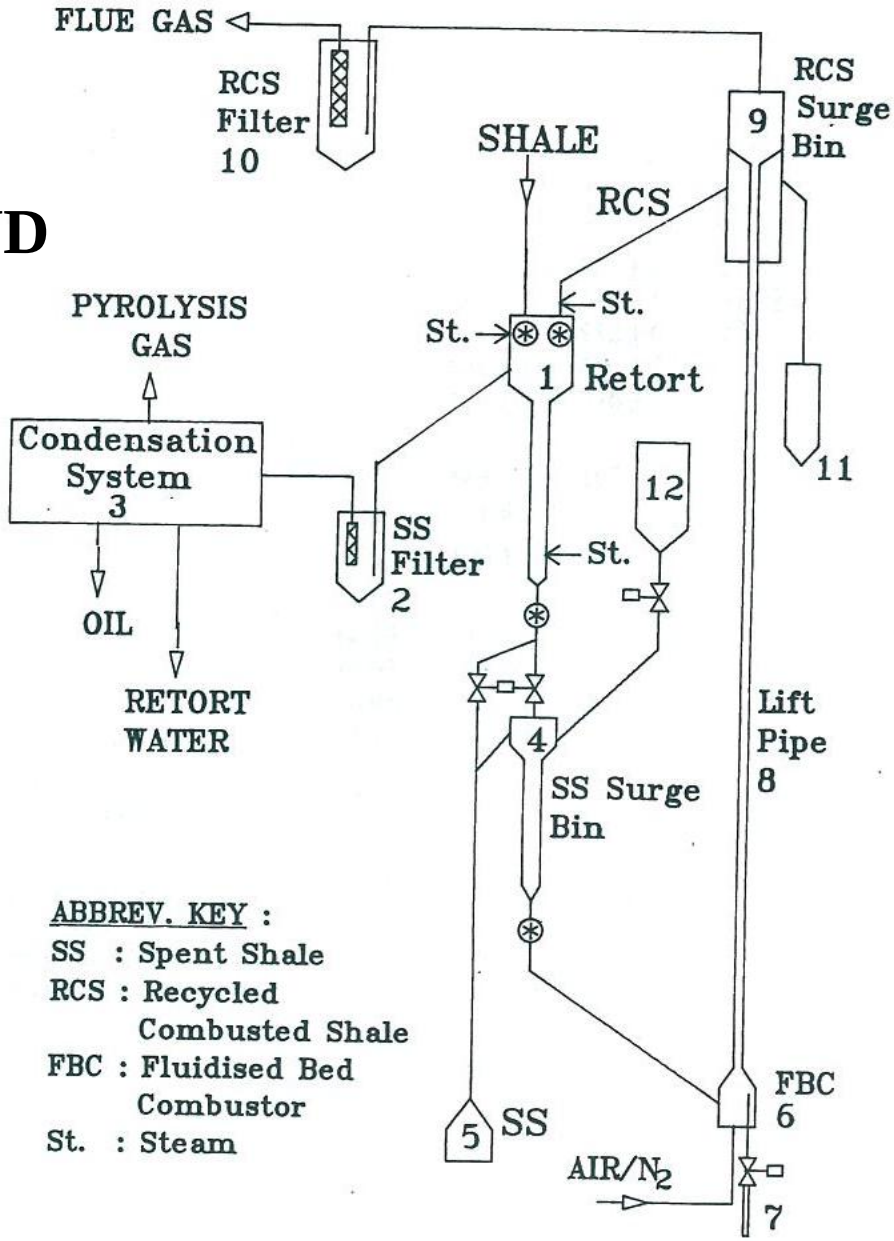
- Kentort II
  - Devonian, pyrolyzer, gasifier, combustor
  - Heat carrier, reactivity
  - Tarry, dirty oil
- Univ. of Queensland/CSIRO
  - Circulating beds: retort & combustor
  - Inert carrier, or well combusted spent shale
  - Higher temperature = higher yields
  - Rundle Twins - road not taken (ATP)

KENTORT II



Simplified flow diagram of the experimental KENTORT II multistaged system

CSIRO/ QUEENSLAND



Integrated retorting/combustion rig

Oil Company Entries

- Exxon
  - FCCU pilot plant, secretive
  - Green River shale, Rundle shale
  - Dusts into oil
  - Viewed as not viable
- Amoco
  - Circulating beds: Contactor, retort, combustor
  - Inert carrier or combusted spent shale
  - Basic data, shale holding time, strip vapors
  - Shale fines into product oil, same on Lurgi
  - Sand lost to system, replaced by spent shale
  - Viewed as not viable

Exxon

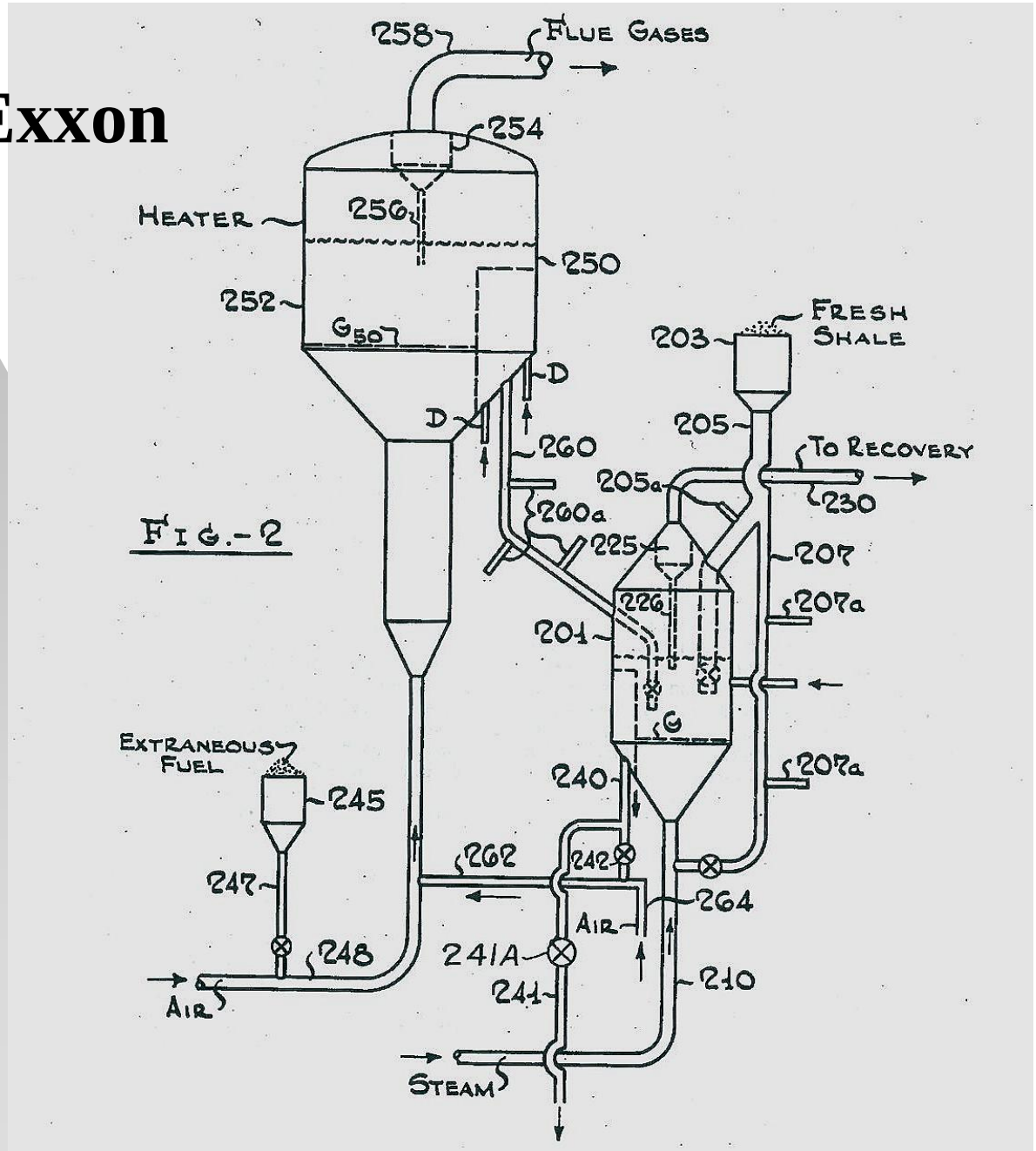

258
FLUE GASES
254
HEATER
256
250
252
G50
D
D
260
FRESH SHALE
203
205
TO RECOVERY
205a
230
260a
225
207
226
207a
201
G
EXTRANEOUS FUEL
245
240
207a
247
262
242
264
AIR
248
241A
210
241
AIR
STEAM

FIG.-2

AMOCO

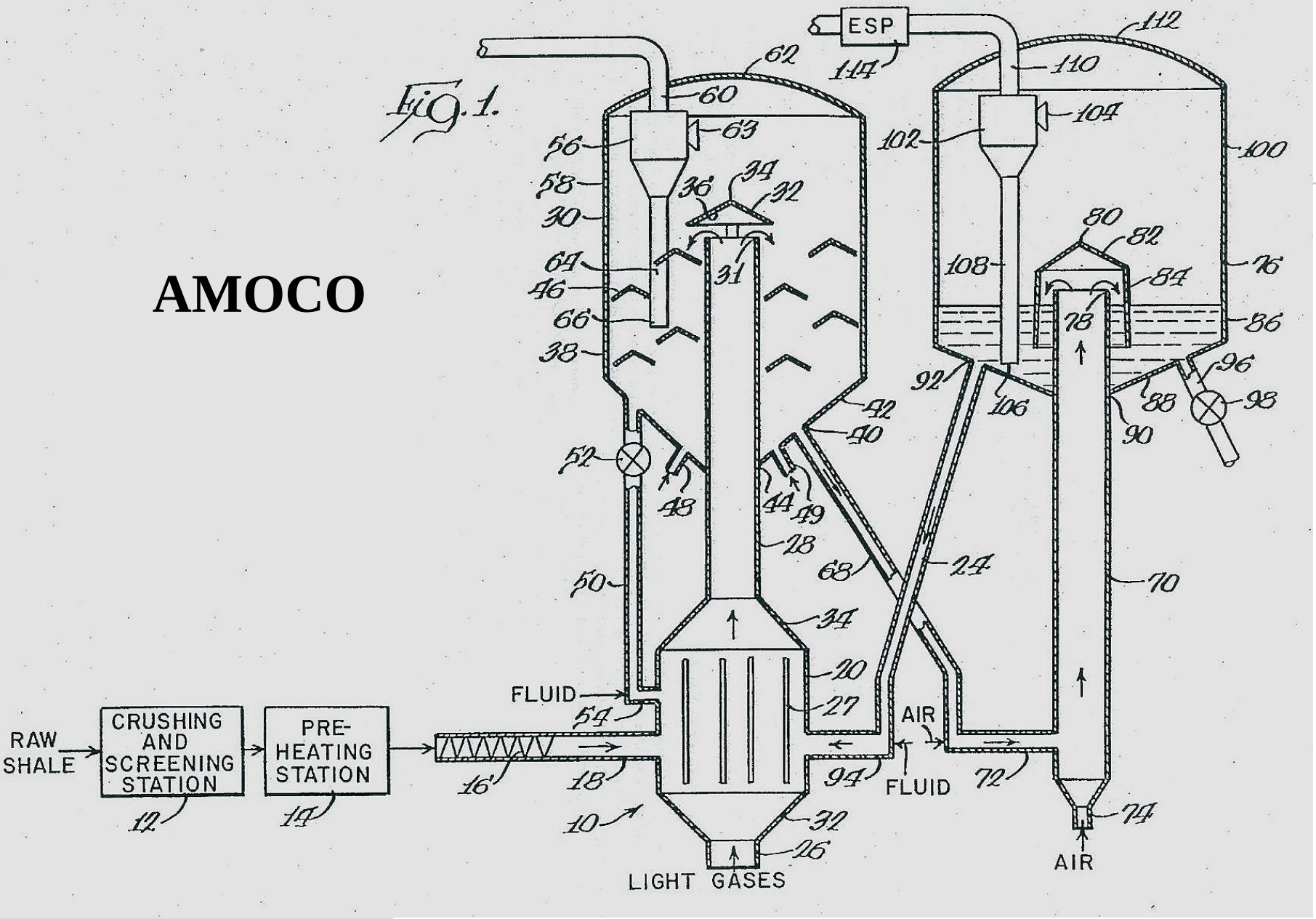


Fig. 1.
ESP
RAW SHALE
CRUSHING AND SCREENING STATION
PRE-HEATING STATION
FLUID
AIR
FLUID
AIR
LIGHT GASES

Design Resolution

- Inert carrier
  - No spent shale in retort - better yield
  - No dusts into oil - better quality oils
- Fluid bed design
  - Like Amoco
  - Do not allow carrier/shale separation
  - Remove dust from carrier after heating
  - Obtain basic data: temp., particle data, fluidization characteristics (species, psd)
  - Need pilot testing

Conclusions

- High oil prices will not make small scale units magically become economical
- Too much iron, steel and concrete
- Need to find a larger capacity alternative
- FCCU holds considerable promise
- Think beyond Big Oil's dead ends
  - FCCU benefited from years of improvements
- Investigate beneficiation - fines not an issue if Fl. Bed
- Oil sands has done it, oil shale can too!