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DE-SANDING OF HEAVY OILS ON HIGH PRESSURE HYDROGENATION

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NOTE: This report, written by Dr. W.A.O. Herrmann after his retirement, is reproduced in unedited form as submitted. The opinions expressed by the author are not necessarily those held by the Energy Research Laboratories.

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by

W.A.O. Herrmann

Heavy, asphaltic oils contain varying amounts of mineral matter and, if obtained from tar sands or oil shale, sand. Especially the sand is disturbing in the hydrogenation as on heating and reacting with hydrogen the viscosity and specific gravity of the oil decreases so much that the sand and other mineral matter settle towards the bottom part of the reaction vessel. Here their concentration increases and the reaction volume decreases correspondingly. This mineral matter is not very active as hydrogenating catalyst and its surface becomes covered with coke which in commercial practices has led to the formation of "caviar", i.e., the coke layer on the mineral particles grew up to 1/8" in size.

Coal contains much more inorganic mineral matter than heavy oils and the asphalt content in the sludge is much higher. Therefore, its viscosity, specific gravity and with this its capacity for carrying mineral matter, is much higher and normally no desanding is required. Only one case (Rheinbraun) is known in which the first vessel, when liquifying a sand containing lignite, which hydrogenates faster and further, had to be desanded intermittently.

The intermittent desanding of the first vessel requires an additional group of carbide tipped valves which can not be shut off completely (the valve seat breaks). Also the sand concentration varies with the prominence of the coal and with the operation of the system.

If oil is to be processed, the amount of sand to be withdrawn is much smaller. Part of the mineral matter settles out and part of it is carried out of the reaction space at the top. The quantity of sludge to be

discharged from a hydrogenation system is therefore much smaller than with coal.

In order to operate the discharge of sand in very small quantities more or less continuously, it can be combined with the discharge of sludge from the hot separator approximately as depicted in Fig. 2. The feed oil plus cold recycle and a portion of the total hydrogen, sufficient to prevent coking in the preheating system, is introduced into the first reactor at a certain level (about 2 to 3 feet) above the entrance of the hot recycle and the balance of the hydrogen. Heavier mineral particles can therefore settle downward while the fresh feed oil is carried upward by the heavier recycle oil. The hot recycle oil entrance is advantageous by arranged concentrically around the feed oil entrance. The sludge to be discharged leaves the system from the bottom of the first vessel through a pipe advantageously arranged concentrically around the hot recycle entrance. In this way the mineral particles too heavy to be carried out of the top of the vessels and therefore settling towards the bottom, are carried out together with that portion of the sludge which is discharged in the course of the normal operation and does not require additional facilities.

When hydrogenating oil the portion not converted to lower molecular weight and therefore vaporized compounds is much smaller than with coal. In order to maintain a sufficient upward streaming velocity of liquid material for proper mixing with hydrogen and catalyst or minerals distribution, a large quantity of sludge must be recycled, mostly with and cooling it (hot recycle) and only a smaller portion is discharged as is depicted in Fig. 1.

Figure 1.

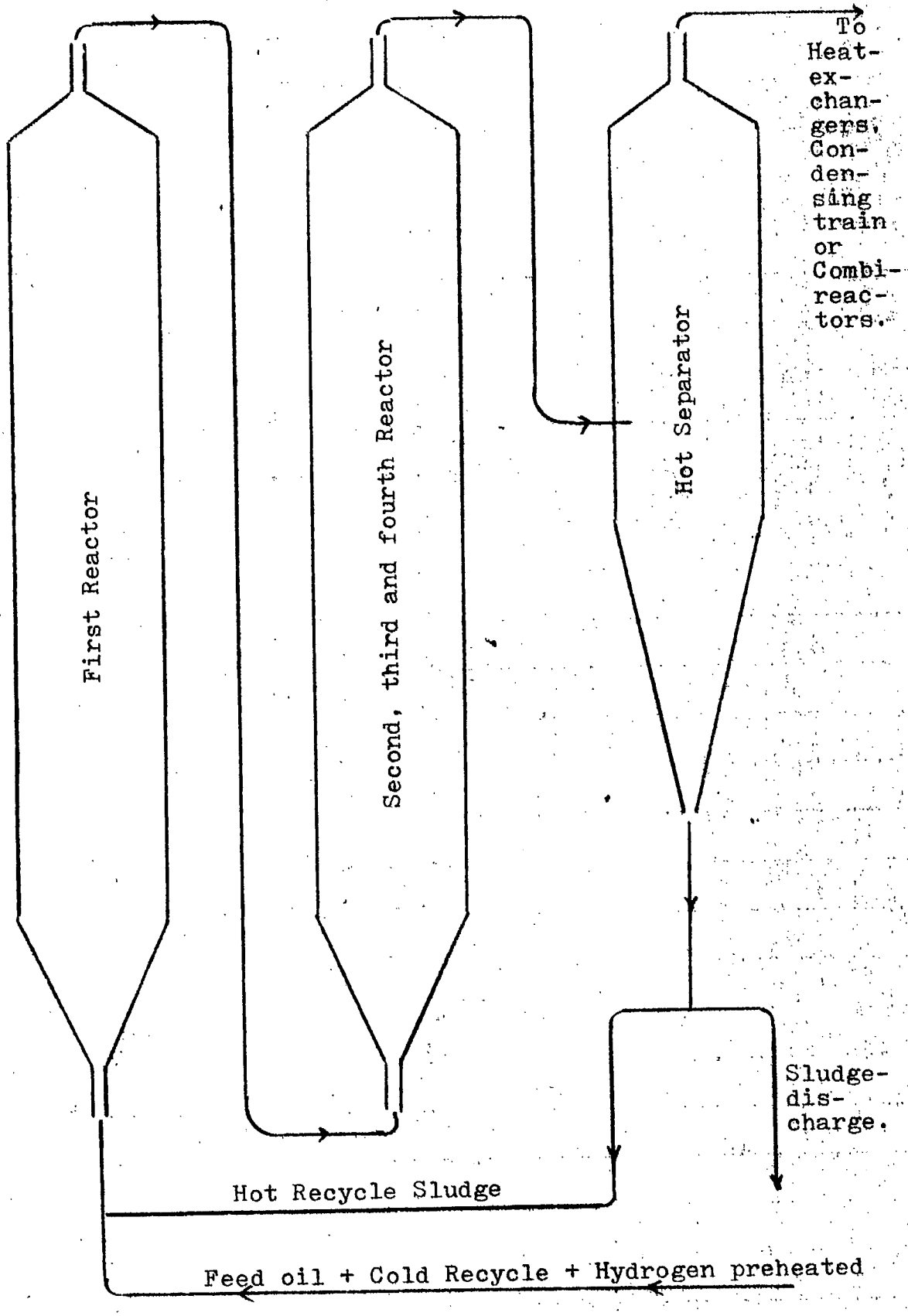
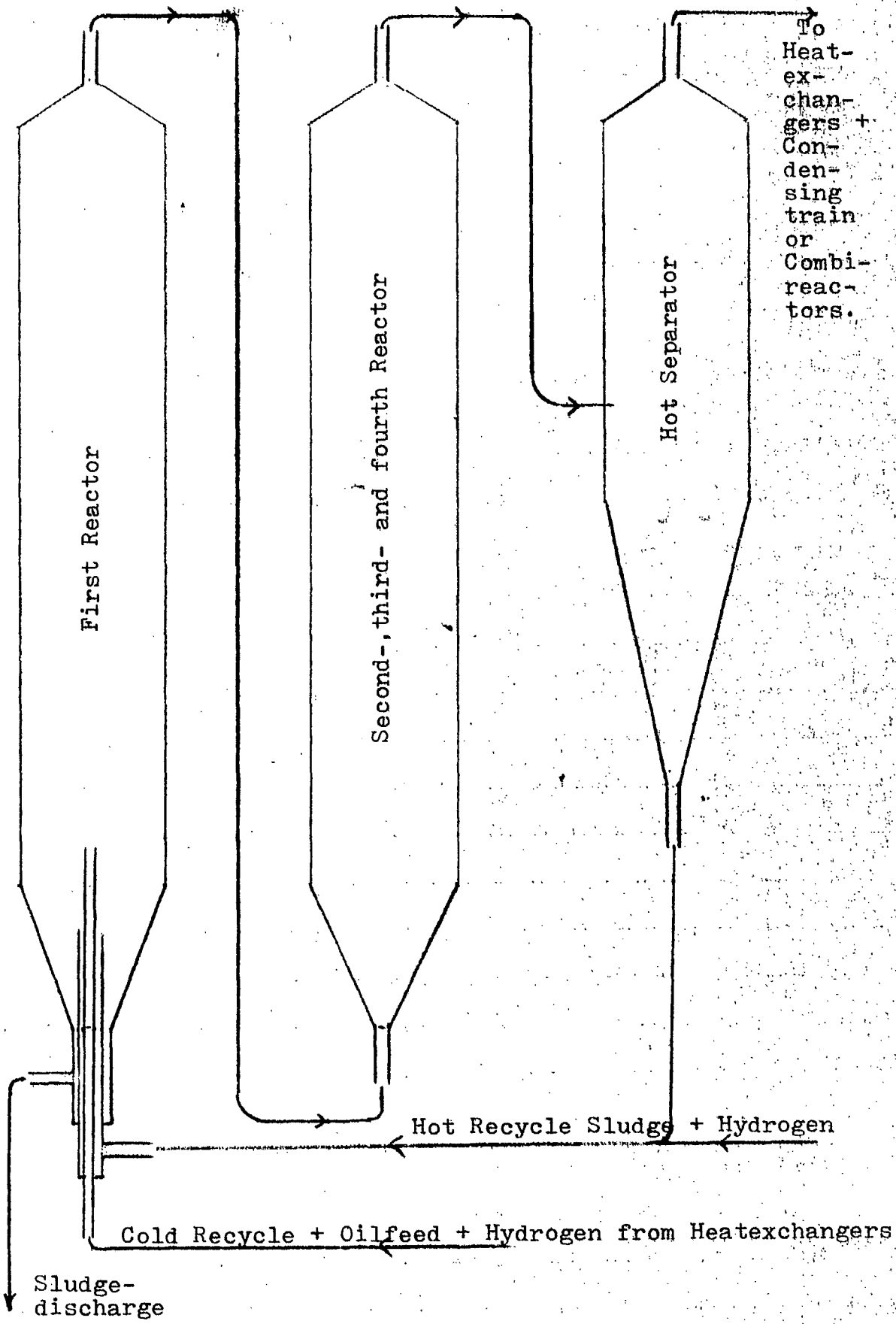

First Reactor
Second, third and fourth Reactor
Hot Separator
To Heat-exchangers, Condensing train or Combi-reactors.
Sludge-discharge.
Hot Recycle Sludge
Feed oil + Cold Recycle + Hydrogen preheated

Figure 2.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Cold Recycle + Oilfeed + Hydrogen from Heatexchangers
Sludge-discharge