

**Prior Art:**

Multi-Pass (MP) trays were introduced by Union Carbide Corporation in 1964. (U.S. Patent 3,410,540 by Bruckert, granted on 11/12/1968) The concept of the MP tray was to address several inherent disadvantages of conventional multi-pass sieve or valve trays, i.e., a large percentage of the column area required for downcomers and receiving pans, long flow path lengths creating hydraulic gradients on the tray, and high weir loadings resulting in high froth heights. (Delnicki, W. V & Wagner, J. L., *Chem. Eng. Pro.*, 66, 3, March 1970)

As illustrated in Figure 1 (Kiekpatrick, B., *The Oil and Gas Journal*, Apr. 3, 1978), rectangular-shaped downcomers are arranged parallel to each other, while the remaining tower area is perforated active area. Liquid is discharged from the spouts in the bottom of the downcomer, and directed to the active area of the tray below. Successive trays are rotated 90° from each other. The downcomers fabricated as elongated boxes not only collect the liquid and distribute to the next tray, but also provide the primary support for the entire tray.

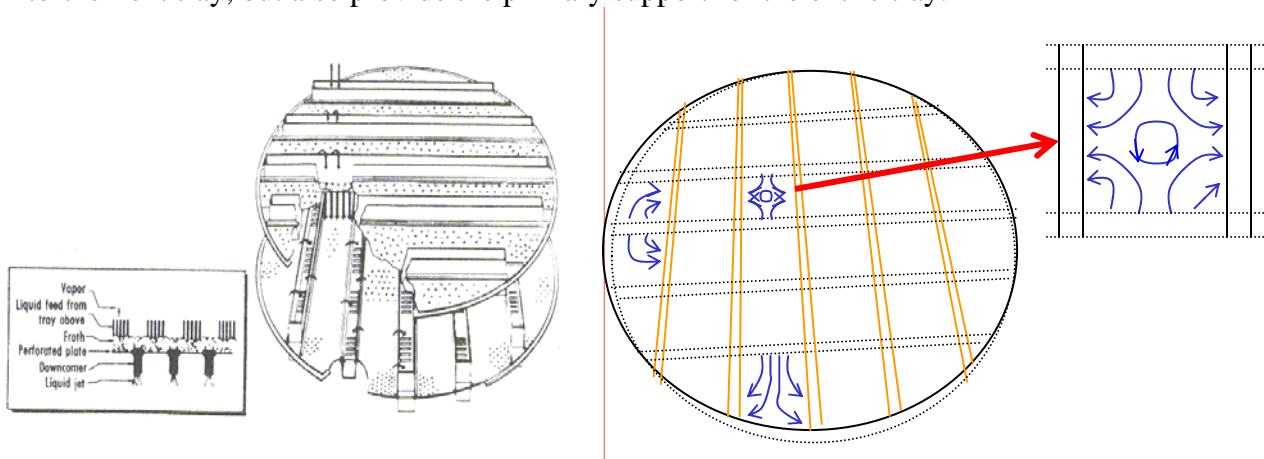


Figure-1

Figure-2

Later Development:

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In an effort to *minimize* the inherent problem of MP Tray, i.e., poor liquid flow distribution and having a stagnant flow area at the center, as shown in Figure 2, UOP developed an Enhanced Capacity Multiple Downcomer (ECMD, Figure 3) Tray based on the patent (#5,382,390) issued on Jan. 17, 1995 by Resetarits; M. R. & Lockett; Michael J. The improvements were described in the Abstract of the patent; “*The vapor capacity of multiple downcomer type fractionation trays is increased by the provision of vapor directing slots in the tray deck, with the slots being oriented toward the closest downcomer to reduce froth height. The slots located in the relatively narrow deck area between downcomers are accordingly divided into two sets which point in opposite directions. Vertical baffles are provided above the downcomer inlets. The baffles preferably extend upward to slightly below the lower surface of the next higher tray, with the upper edge of the baffles being notched to accommodate the downcomers of this next higher tray.*”

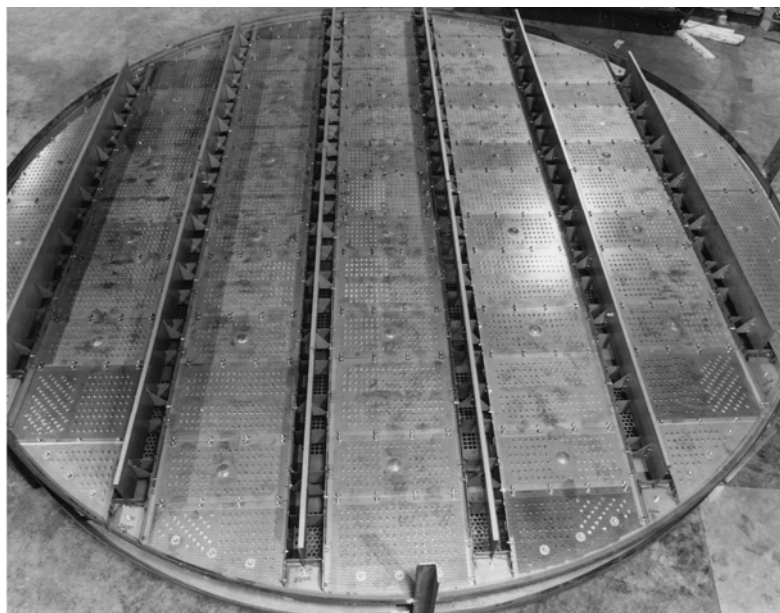


Figure- 3

(AIChE Spring National Meeting, Houston, Texas March 22, 1995)

AMT ADV[®]-MP Tray:

AMT International, Inc. developed a radically different version of multi-pass tray, called ADV[®]-MP Tray in early 2001. The key feature of ADV[®]-MP Tray is its unique way of arranging downcomers, as demonstrated below (Figure 4):

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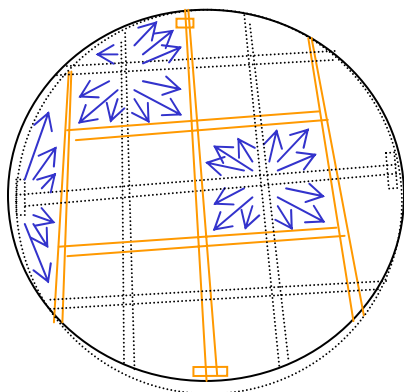


Figure-4

As it can be seen, AMT ADV[®]-MP Tray arranges some of the downcomers 90° from each other to form a connected (grid-like) downcomer assembly. Similar to MP Tray of the prior art, ADV[®]-MP Trays are rotated 90° from the adjacent tray. While having the same total number of downcomer boxes, ADV[®]-MP Tray discharges liquid in the center of the active area of the tray below to facilitate a **radial liquid pattern**. Radial liquid flow pattern enhances liquid flow distribution, while eliminating stagnant liquid flow areas on the active area. Furthermore, liquid flow path length of ADV[®]-MP Tray is much longer than that of the prior art MP tray.

ADV[®]-MP Tray design is further demonstrated in the 3-dimensional pictures shown below (Figure 5).

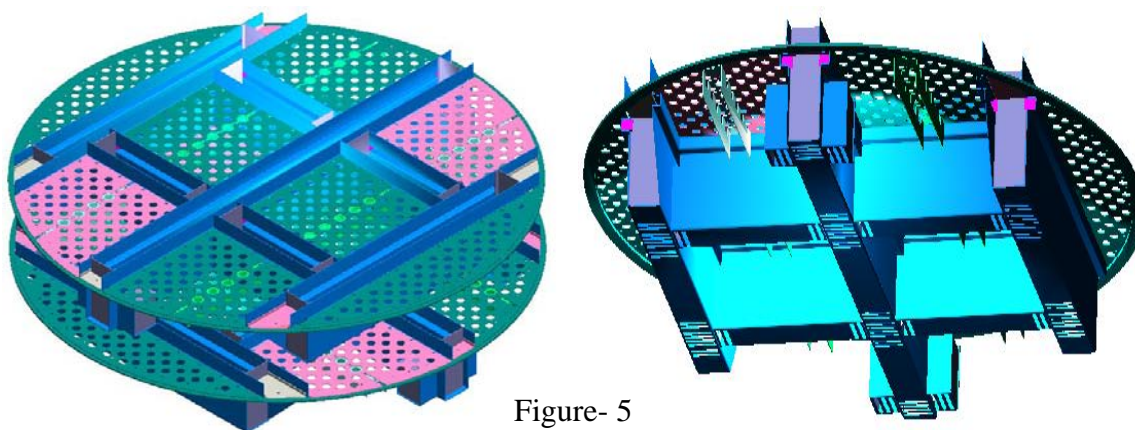


Figure- 5

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The key claim of the ADV[®]-MP development is that multiple (rectangular-shaped) downcomer boxes are arranged in such a way that all downcomers are connected and equalized in a “grid-like” assembly as shown in Figure 5. The advantages of ADV[®]-MP include uniform liquid flow distribution (resulting from perfect radial flow pattern), good liquid mixing from tray to tray, and longer liquid flow path than MP trays of the prior art. The benefits of ADV[®]-MP trays are higher capacity and higher efficiency than MP or ECMD Trays of the prior art.

ADV[®]-MP trays have been adapted in an LPG recovery unit revamp shown in Figure 6 below with excellent results for capacity increase and higher product yield.

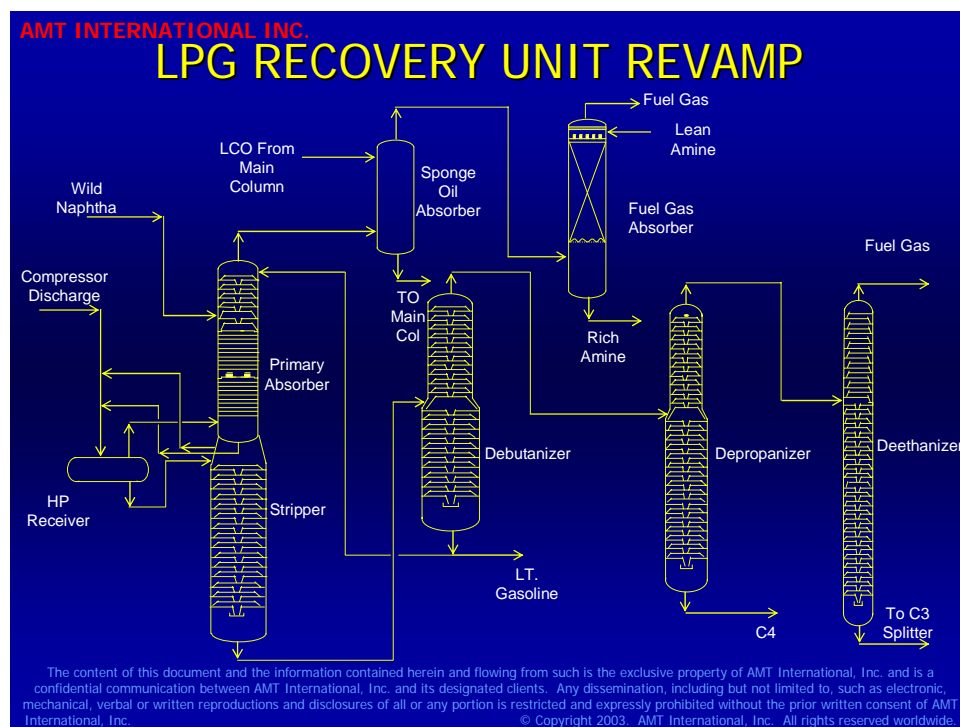


Figure - 6

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Figures -7 & 8 Field Installation of ADV[®]-MP Trays

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