Sept. 27, 1966 C. J. McMANUS ET AL 3,274,745

PROCESS FOR CONSTRUCTING A PETROLEUM REFINERY

Filed July 2, 1962 3 Sheets-Sheet 1

FIGURE I

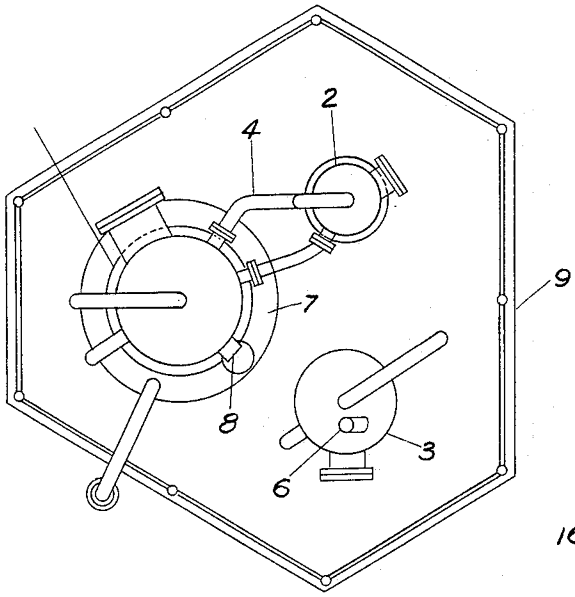
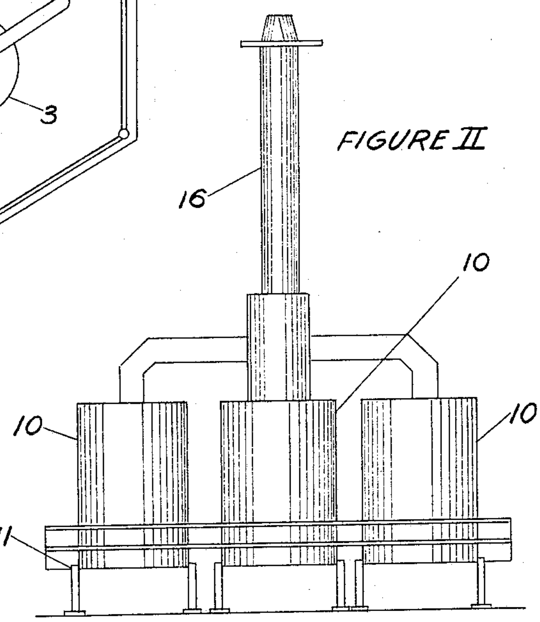


FIGURE II



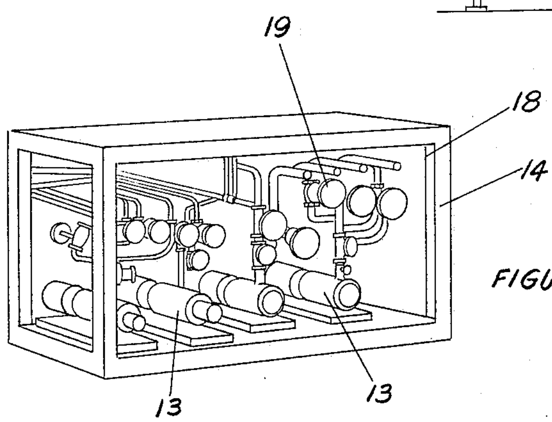


FIGURE III

CALVIN J. McMANUS
FRANCIS J. UPTON
INVENTORS

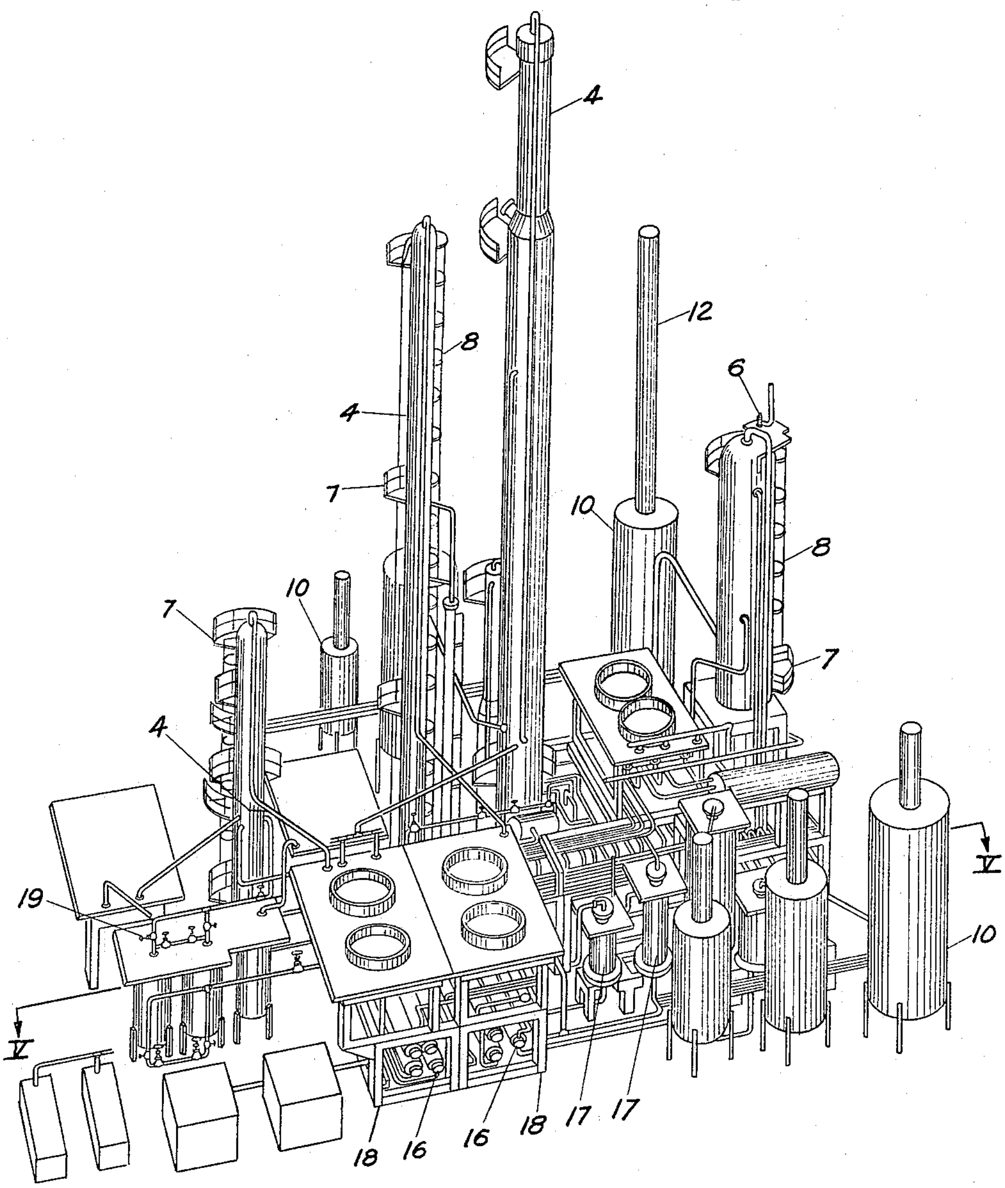
BY

ATTORNEY

PROCESS FOR CONSTRUCTING A PETROLEUM REFINERY

Filed July 2, 1962 3 Sheets-Sheet 2

FIGURE IV



CALVIN J. McMANUS
FRANCIS J. UPTON
INVENTORS

BY [signature]
ATTORNEY

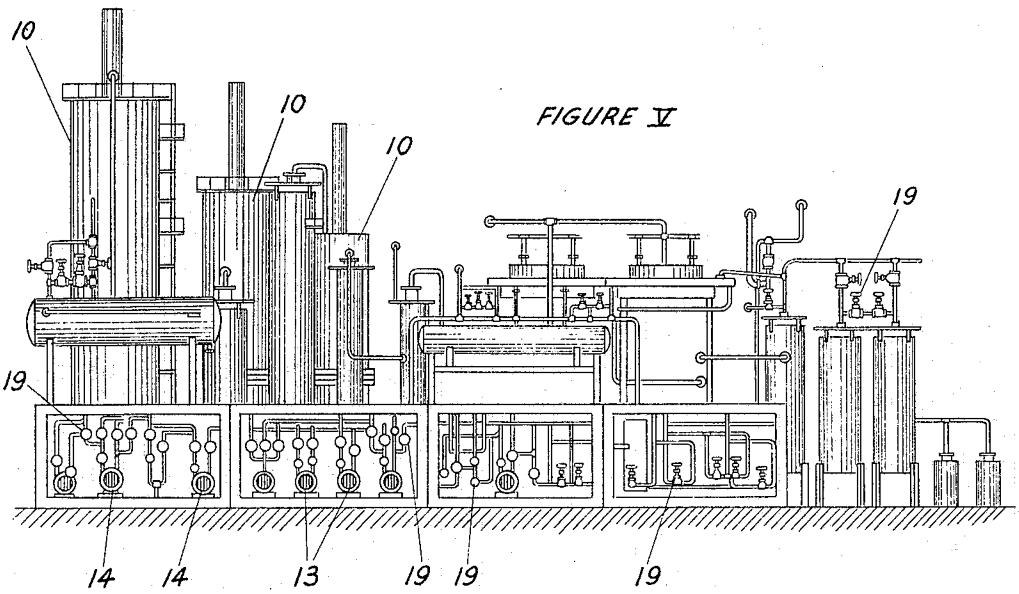


FIGURE V

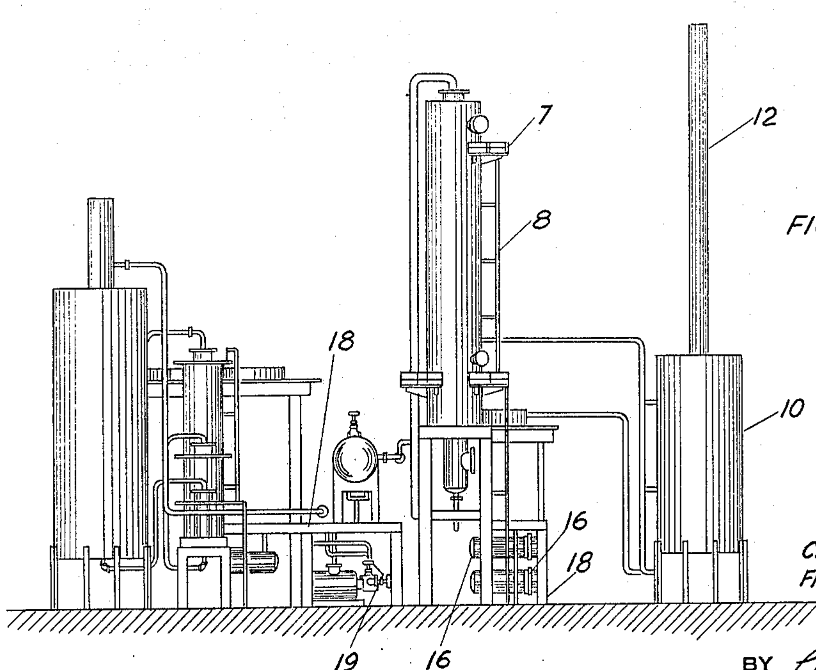


FIGURE VI

CALVIN J. McMANUS
FRANCIS J. UPTON
INVENTORS

BY [signature]
ATTORNEY

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PROCESS FOR CONSTRUCTING A PETROLEUM REFINERY

Calvin J. McManus, Forest Hills, and Francis J. Upton, Little Neck, N.Y., assignors to Foster Wheeler Corporation, New York, N.Y., a corporation of New York

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2 Claims. (Cl. 52—745)

This invention relates to the construction of petroleum refineries. It is a process whereby elements of equipment are subassembled in advance of field erection.

A refinery includes pumps, compressors, heaters, heat exchangers, towers and coolers as well as allied piping, valves, controls and accessories. Subassembling portions of refinery processes at shop locations has been employed to take advantage of fabrication facilities which would be unavailable at a construction site. This practice also minimizes field labor requirements and reduces the risk of adverse weather conditions on construction schedules.

Approaching subassembly from the traditional flow diagram viewpoint, series portions of systems have been collected in subassemblies. Such collections have included, for example, a pump in series with a heater and one or more process elements together with associated feed and product line connections. The present invention approaches subassembly by beginning with the refinery itself as a structure. Construction and maintenance of the resulting structure were looked to in grouping elements for the various packages. By this process subassemblies are each limited to a species of elements such as heaters or towers grouped in separate structures modules for field erection. Exchangers, pumps, compressors and associated piping are also packaged together in at least one structural module. The modules are later assembled at the job site. Necessary process interconnections are made and the modules are structurally integrated.

Basically this advance offers improved layout of process elements. Common species have similar foundation demands; as well as similar access, control, insulation and maintenance requirements. The present arrangement of elements focuses these problems for convenient solution. Further, since common species of elements often originate from the same source, using the present technique, it is frequently convenient to subassemble the various modules at different origins.

These and other advantages will be seen more fully from the accompanying drawings wherein:

FIGURE I is a plan view which depicts a plurality of towers preassembled as a module.

FIGURE II ideally illustrates a heater package suitable for this invention.

FIGURE III represents a typical subassembly of pumps in a structural frame module. The pumps are complete with associated piping and valves.

FIGURE IV is an idealized representation of various modules after field assembly to form the process portion of a petroleum refinery.

FIGURE V is an idealized elevation view taken along line V—V of FIGURE IV.

FIGURE VI is a partial side view of the assembly of FIGURE IV.

In the drawings, FIGURES I to III teach the technique of subassembling refinery equipment according to species. FIGURES IV through VI illustrate the field assembly and structural integration of modules.

All modules are designed to meet size and weight limitations imposed by transportation and erection facilities. It is generally desirable to shop test all components to

minimize field testing. In this regard the economics gained by such expedients as shop instrumentation must be weighed against the risk of injury in transit.

Tower module

Towers are shown in FIGURE I as crude tower **1**, stripper **2** and a caustic wash tower **3**, pressembled in a single module. In this ratio, each tower is rigidly connected to the others for shipment. But when erected connections are severed so that the towers are fixedly connected at their bases only. Upper extremities are free to move vertically relative each other. Thus, differential vertical expansion can be accommodated while foundation costs are minimized. It will be understood that a plurality of tower modules could also be employed.

All towers can be shipped with trays. Such accounterments as piping **4**, instruments (not shown), relief valve **6**, platforms **7**, ladders **8**, electrical conduits, lighting and insulation may be shop installed. Deck **9** depends from caustic wash tower **3**. When shop insulation is resorted to, an adequate number of lifting lugs must be provided to avoid use of slings which might result in insulation damage.

Heater module

Heaters **10** assembled in the module depicted in FIGURE II can be shipped complete with shop installed platform **11**, burners, refractory, tubing, instruments, insulation, electrical conduits and cable. In the case of catalytic reforming heaters, the reforming reactors can be supported off the heater shell and can be shop assembled with the heater. Fired heaters with catalyst in the tubes are susceptible of similar treatment. In any event, with shop installed insulation it is desirable to provide an adequate number of lifting lugs to avoid use of slings. For a heater module, in addition to field erection it is also necessary to weld stack **12** at the construction site.

Exchanger and pump modules

A typical collection of pumps **13** is shown in the pump module **14** of FIGURE III. As shown in FIGURES IV, V and VI, compressor **14**, heat exchangers **16** and drums **17** are afforded substantially similar fare. In this embodiment most of the structural modules are designed to fit into 10 foot by 12 foot by 50 foot spaces. All equipment is connected to its module which generally comprises a structural steel frame **18**. Shell and tube exchangers **16** are generally short and straight. Provision may be made for tube bundle removal. Associated valves **19** and piping are shop assembled.

Field erection

To the extent that shop fabrication is employed, field work can be reduced to the following:

Setting up the modules on anchor bolts fixed in suitable foundations.

Tieing-in piping and electrical lines.

Calibrating instruments.

Setting relief valves.

Field testing.

It will be understood by those skilled in construction and petroleum engineering that wide changes may be made in the details of this technique without departing from the main theme of invention as defined by the claims.

What is claimed is:

1. A process for constructing a petroleum refinery which has species of equipment elements, pumps and heaters and towers each defining a species, the process comprising the steps of preassembling a plurality of the elements of at least two of the species with each species in at least one separate structural module and with the size and weight of each module determined by handling and shipping limitations, transporting the modules to a desired site, erecting the modules on suitable foundations, operatively interconnecting the equipment elements, structurally integrating the modules.

2. A process for the construction of a petroleum refiinery which has species of equipment elements, pumps and heaters and towers each defining a species, the process comprising the steps of preassembling a plurality of the elements of at least two of the species with each species in at least one separate structural module and with the size and weight of each module determined by handling and shipping limitations, connecting suitable electrical apparati and instrumentation and piping and valves to the preassembled elements, transporting the modules to a desired refinery site, erecting the modules

on suitable foundations, operatively interconnecting the electrical apparati and instrumentation and piping, and structurally integrating the modules.

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CHARLIE T. MOON, *Primary Examiner.*

WHITMORE, A. WILTZ, *Examiner.*