United States Patent

Yant

[15] **3,652,447**

[45] **Mar. 28, 1972**

[54] PROCESS FOR EXTRACTING OIL FROM OIL SHALE

[72] Inventor: **Milfred R. Yant,** Laredo, Tex.

[73] Assignees: **Samuel S. Williams,** Laredo; **Samuel Herrmann; Cleo Herrmann,** El Paso, Tex. , part interest to each

[22] Filed: **Apr. 18, 1969**

[21] Appl. No.: **817,418**

[52] **U.S. Cl.**.....**208/11,** 201/19, 201/35, 201/37, 202/134

[51] **Int. Cl.**.....**C10g 1/02,** C10b 53/06

[58] **Field of Search**.....208/11; 204/DIG. 11; 201/19, 201/35, 36, 37; 202/134, 135; 203/100

[56] **References Cited**

UNITED STATES PATENTS

3,449,213	6/1969	Knapp et al	201/19
3,227,642	1/1966	Lemelson	204/168
3,464,892	9/1969	Bennett	208/11

OTHER PUBLICATIONS

Gould, The Washington Post, May 31, 1966

Sharkey et al., Nature, Vol. 202, No. 4936, June 6, 1964, pages 988 & 989

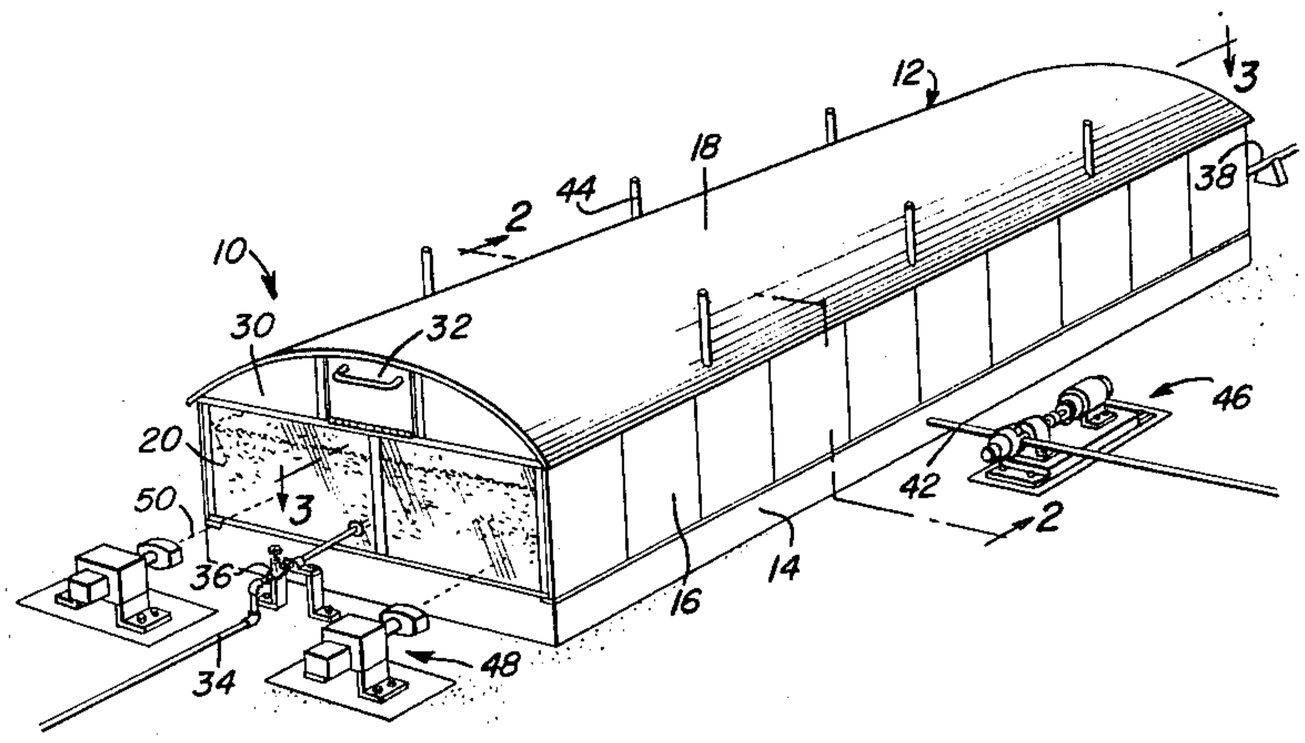
Primary Examiner—Curtis R. Davis

Attorney—Clarence A. O'Brien and Harvey B. Jacobson

[57] **ABSTRACT**

Pyrolytic recovery of shale oil by passage of pulsed, laser beams through a body of crushed shale housed in an enclosure from which gaseous products are withdrawn by a vacuum pump. Operation of the vacuum pump is synchronized with the laser generators to generate negative pressure pulses between the energy pulsations of the laser beams.

11 Claims, 4 Drawing Figures

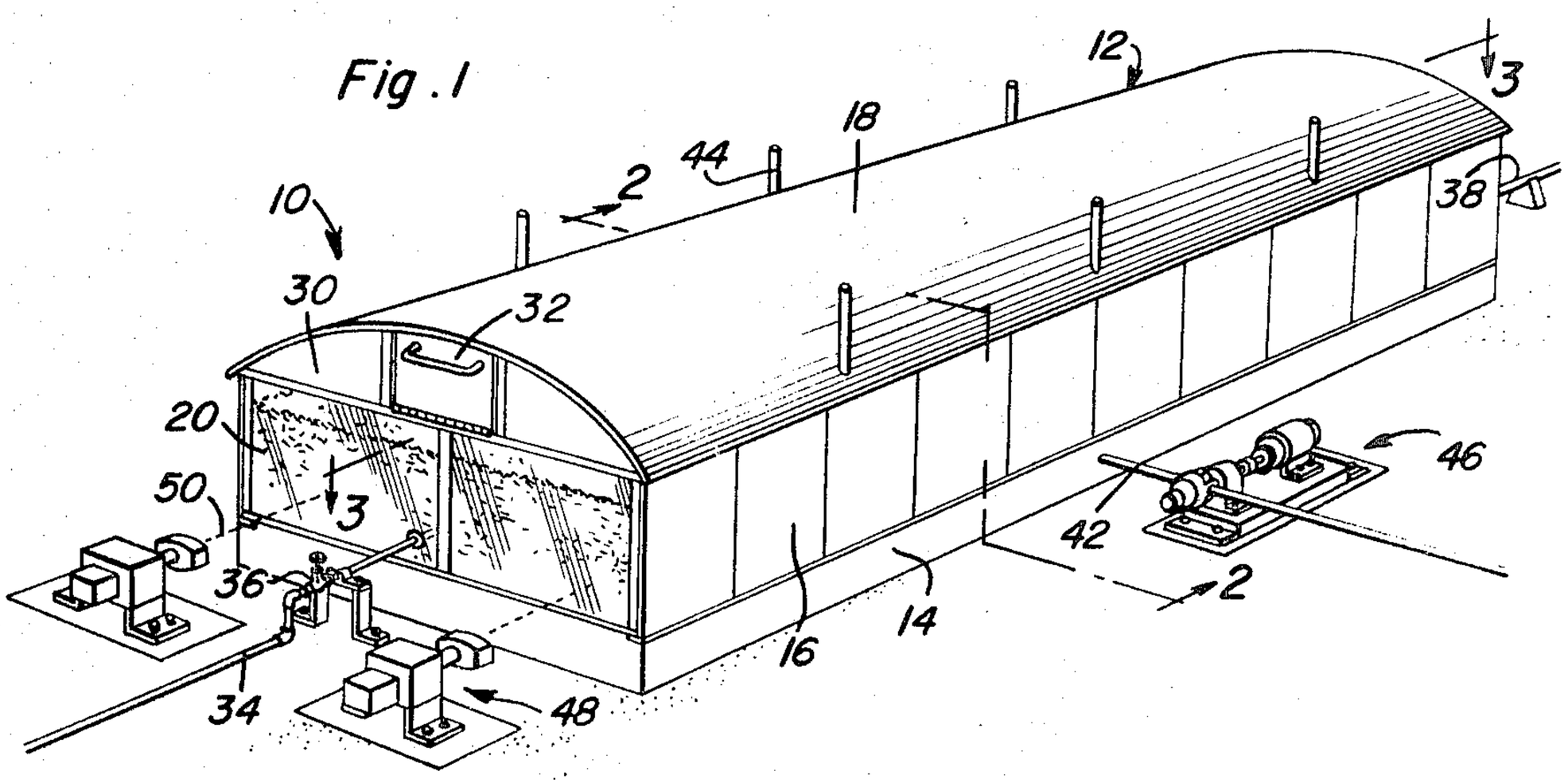


PATENTED MAR 28 1972

3,652,447

SHEET 1 OF 2

Fig. 1



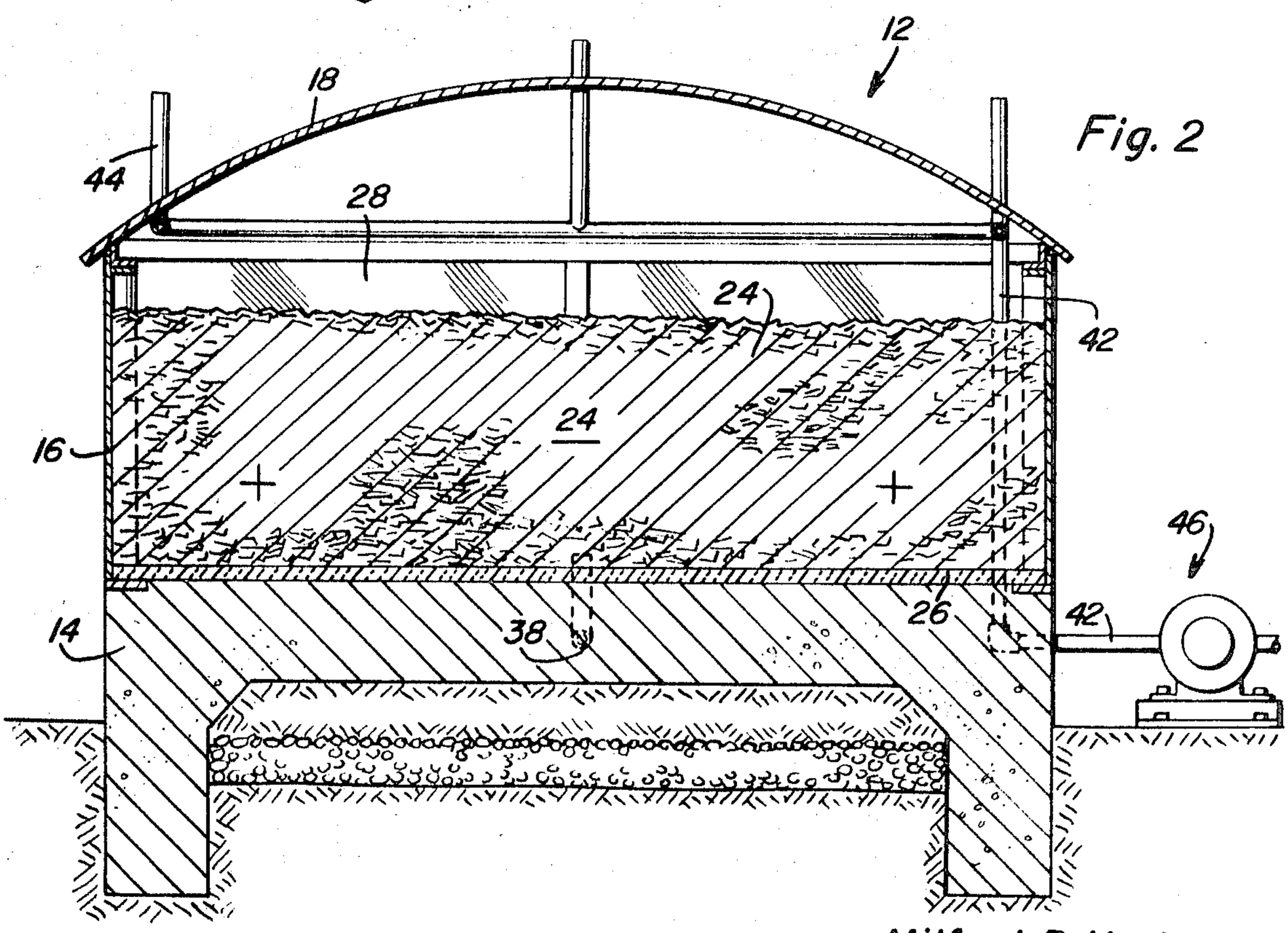


Fig. 2

Milfred R. Yont
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

PATENTED MAR 28 1972

3,652,447

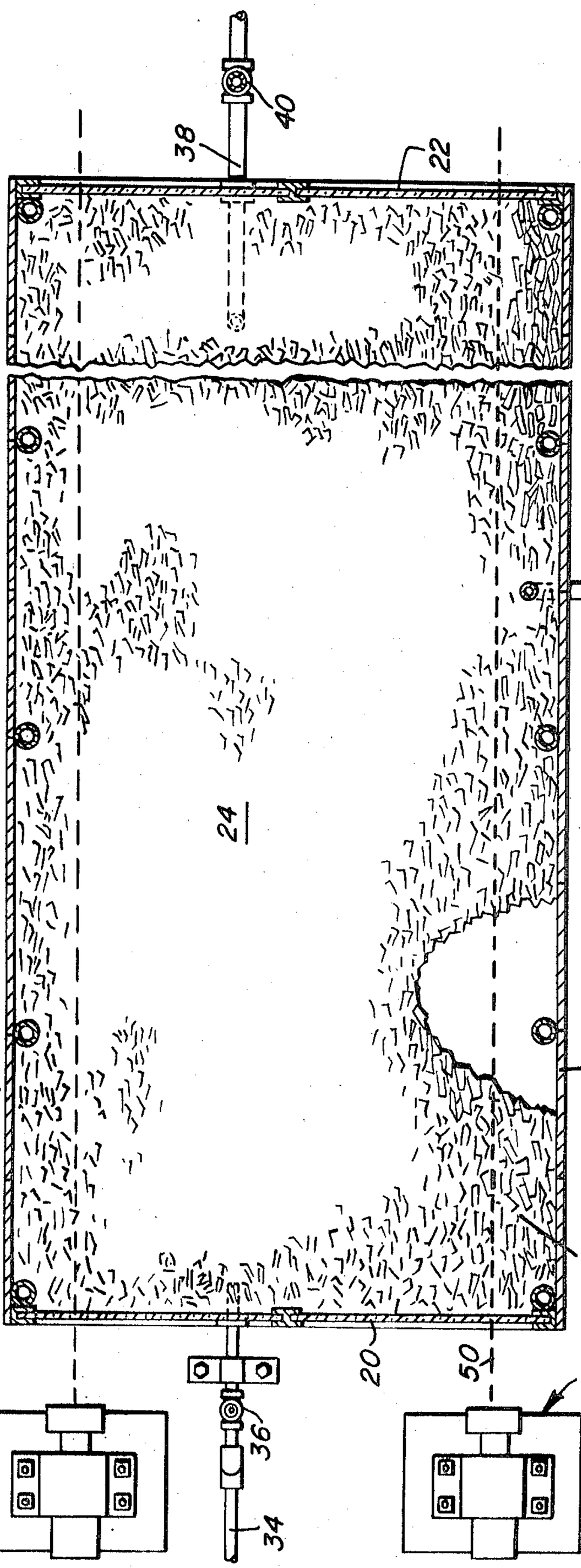


Fig. 3

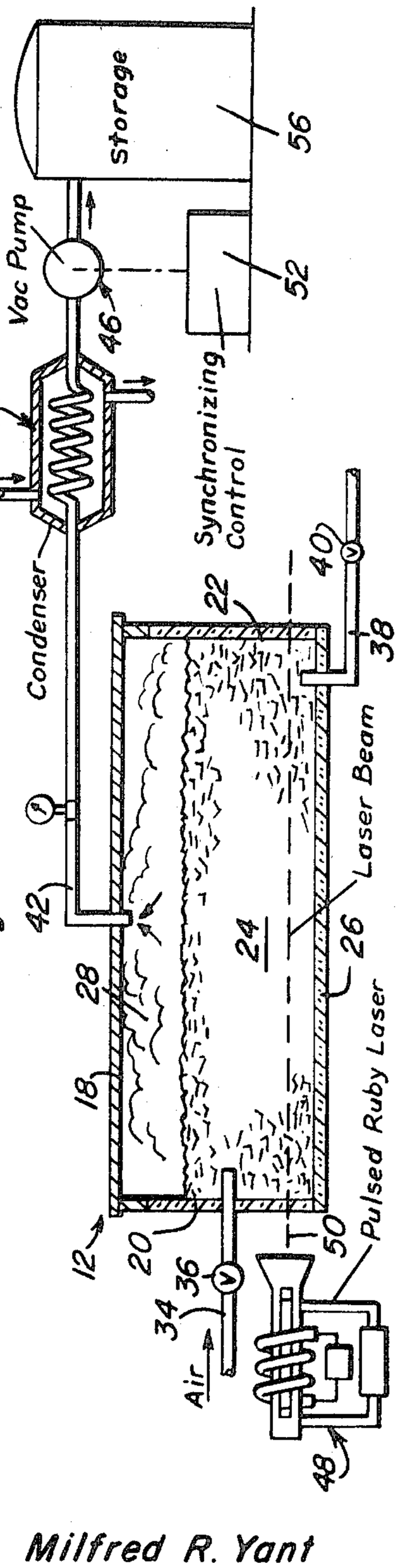


Fig. 4

Milfred R. Yant
INVENTOR.
BY Shannon O'Brien and Harvey B. Jacobson
Attorneys

PROCESS FOR EXTRACTING OIL FROM OIL SHALE

This invention relates to the recovery of valuable hydrocarbons from hydrocarbonaceous solids such as oil shales and the like. More particularly, the present invention is concerned with an economic and efficient method and retort apparatus for recovering shale oil.

Various processes and apparatus have been devised for use in the pyrolysis of shale rocks in order to decompose the organic material and recover shale oil therefrom. Apparatus for accomplishing shale oil recovery has however been quite expensive in view of the material handling problems and the quantity of shale oil recovered for the amount of raw material that is retorted since too large a body of solid material could not be fully retorted in one operation. This problem is overcome, for example, in one type of known apparatus by carrying smaller quantities of the material to be retorted on vehicles passing through a retorting zone having liquid seals. Also, in this type of apparatus, the combustion supporting gas must be separately heated before injection into the retorting zone to react with the solid material. Although the use of laser beam radiation as a source of energy for rapid heating of coal has been investigated, the continued transmissivity of a large body of shale rock relative to a laser beam as combustion progresses does not persist and the distribution of heat energy throughout the body of material of material presents a formidable problem that has not been heretofore overcome. Accordingly, an important object of the present invention is to provide a novel and improved method and means for recovering shale oil by use of the energy of laser beams to initiate and effectively maintain combustion within a relatively large body of crushed oil shale.

In accordance with the present invention, the bottom layers of a large body of oil shale are heated by pulsed laser beams. The heated shale when contacted by air drawn in to an enclosure, causes eduction of gaseous hydrocarbons that rise upwardly through the shale to a gas collection space. The rising gas and air heat the upper layers of the crushed shale in order to retort the entire body of shale. Liquid products gravitate downwardly to the bottom and are drawn off while the gas is drawn upwardly by vacuum pressure pulses synchronized to occur between the pulsations of the laser beams. Because of the synchronized vacuum pressure pulses, voids are intermittently produced in the body of crushed shale to maintain its transmissivity with respect to the laser beams which would otherwise decrease as the shale is retorted under the heat produced. The heat generated by the laser beams is also thereby distributed throughout to cause retorting of all portions of the crushed shale body.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. **1** is a perspective view illustrating the apparatus of the present invention.

FIG. **2** is an enlarged transverse sectional view taken substantially through a plane indicated by section line **2—2** in FIG. **1**.

FIG. **3** is an enlarged partial sectional view taken substantially through a plane indicated by section line **3—3** in FIG. **1**.

FIG. **4** is a simplified schematic sectional view of the apparatus.

Referring now to the drawings in detail, FIG. **1** illustrates the apparatus of the present invention generally referred to by reference numeral **10** designed to carry out the oil shale recovery process. The apparatus includes a relatively large, elongated enclosure generally referred to by reference numeral **12** which has a base or foundation **14** on which sidewall sections **16** are mounted to form wall assemblies on opposite longitudinal sides of the foundation. The sidewall sections are interconnected by a roof portion **18**. The roof portion as well as the sidewall sections **16** are made of a suitable, opaque material such as steel plate. The sidewall assemblies formed by

the sidewall sections **16** are interconnected at the opposite ends by radiation transmissive, end wall portions which are made of a material such as glass including an entry end wall portion **20** at one longitudinal end and an exit wall portion **22** at the opposite longitudinal end as shown in FIG. **3**.

The enclosure **12** is filled up to a predetermined height with a large body of hydrocarbonaceous solids such as crushed oil shale **24** as more clearly seen in FIGS. **2** and **3** supported on top of the foundation **14** by a fire clay floor **26**. A gas collection space **28** is formed above the body of crushed oil shale. As shown in FIG. **1**, the roof portion **18** at the ends, are supported on opaque end wall sections **30** above the glass wall portions **20** and **22**, said end wall sections having openings mounting hinged access doors **32** through which the oil shale is loaded into the enclosure.

Combustion supporting fluid such as air is supplied to the body of oil shale from any suitable source through an air intake conduit **34** which mounts a control valve **36** to regulate the quantity of air drawn in. Liquid hydrocarbon products or shale oils are withdrawn from the body of crushed solids **24** through a conduit **38** which extends upwardly through the floor **26** into the enclosure. A cutoff valve **40** is mounted in the conduit **38** in order to control the outflow of the liquid. A suction conduit **42** is interconnected with a plurality of exhaust pipes **44** that extend upwardly from the roof portion. Thus, gaseous products within the gas collection space **28** at various locations above the body of solids **24** are withdrawn from the enclosure through the conduit **42** to which a vacuum pump assembly **46** is connected.

As shown in FIGS. **1** and **3**, a pair of laser beam generators **48** are mounted externally of the enclosure **12** adjacent one longitudinal end. The laser beam generators are of the pulsed ruby type arranged to direct a pair of pulsed laser beams **50** through the bottom layer of the body of solids **24**. The beams thus enter the enclosure through one end wall portion **20** in horizontally spaced relation to each other, exiting from the other horizontally spaced end wall portion **22**. The beams while passing through the body of solids generate the requisite amount of heat for retorting purposes.

Referring now to FIG. **4**, it will be observed that each of the laser beams **50** is emitted from a conventional type of pulsed ruby laser generator **48**. In order to obtain efficient and thorough retorting of the entire body of solids, the operation of the vacuum pump **46** is controlled by the synchronizing control **52** so as to time the negative pressure pulses applied to the gas collection space **28** between the pulsations of the laser beams **50** being pulsed at a predetermined rate. In this manner, the transmissivity of the body of solids **24** with respect to the laser beams are maintained as the gaseous products rise upwardly into the space **28** and the liquid products are drawn off through the conduit **38**. The negative pressure pulses also draw in a regulated quantity of air through conduit **34** necessary to support the retorting process. Also, the gaseous products may be conducted through a condenser **54** as shown in FIG. **4** and then delivered by the vacuum pump **46** to a storage container **56**.

By way of example only, the capacity of the retort enclosure **12** when the body of solids is filled to the top of the plate glass wall portions **20** and **22** will be 480 cubic feet leaving the gas collection space **28** which will be filled with gas from the pyrolytic action of the laser beams. The gas is drawn to the condenser **54** by a vacuum pump of 3 horsepower capacity with a 30 to 35 c.f.m. rating. The negative pressure pulses of the vacuum pump will be synchronized in continuous out-of-phase relation to the pulsations of the laser beams of 5 pulses per minute. A commercially available ruby laser generator of well-known construction and operation may be utilized. The glass end wall portions **20** and **22** will not only transmit the laser beams but will also permit visual inspection of the interior of the enclosure.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is

not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In a method of recovering hydrocarbons from a body of crushed, hydrocarbonaceous solids within an enclosure comprising the steps of: passing radiant energy having a predetermined rate of pulsations through the body of crushed solids; and withdrawing gaseous products from said enclosure by pressure pulses continuously out of phase with said pulsations of the radiant energy.

2. The method of claim 1 wherein said pressure pulses are negative in value to simultaneously draw into the body of crushed solids combustion supporting fluid.

3. The method of claim 2 including the step of conducting liquid products from the body of crushed solids.

4. The method of claim 3 wherein said solids are oil shale and said liquid products are shale oil.

5. The method of claim 1 wherein said solids are oil shale.

6. The method of claim 5 wherein said pressure pulses are negative in value to simultaneously draw into the body of crushed solids combustion supporting air.

7. In an apparatus for retorting a body of solids, an enclosure, means generating pulsating radiant energy passing through said enclosure for heating said solid material therewithin, and means connected to said enclosure for inducing flow of reaction gas through the solid material at a rate maintaining the transmissivity of the solid material with respect to the radiant energy.

8. The combination of claim 7, wherein said means for inducing flow of reaction gas includes a vacuum pump and control means connected to the pump for producing suction pulses synchronized in continuous out of phase relation to the pulsating radiant energy.

9. The combination of claim 8, wherein the radiant energy is a laser beam passed through a bottom layer of the body of solids.

10. The combination of claim 7, wherein the radiant energy is a laser beam passed through a bottom layer of the body of solids.

11. The method of claim 1, wherein the radiant energy is a laser beam passed through a bottom layer of the body of solids.

* * * * *