

Aug. 11, 1953

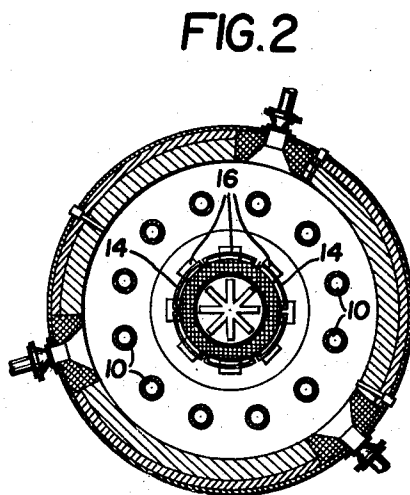
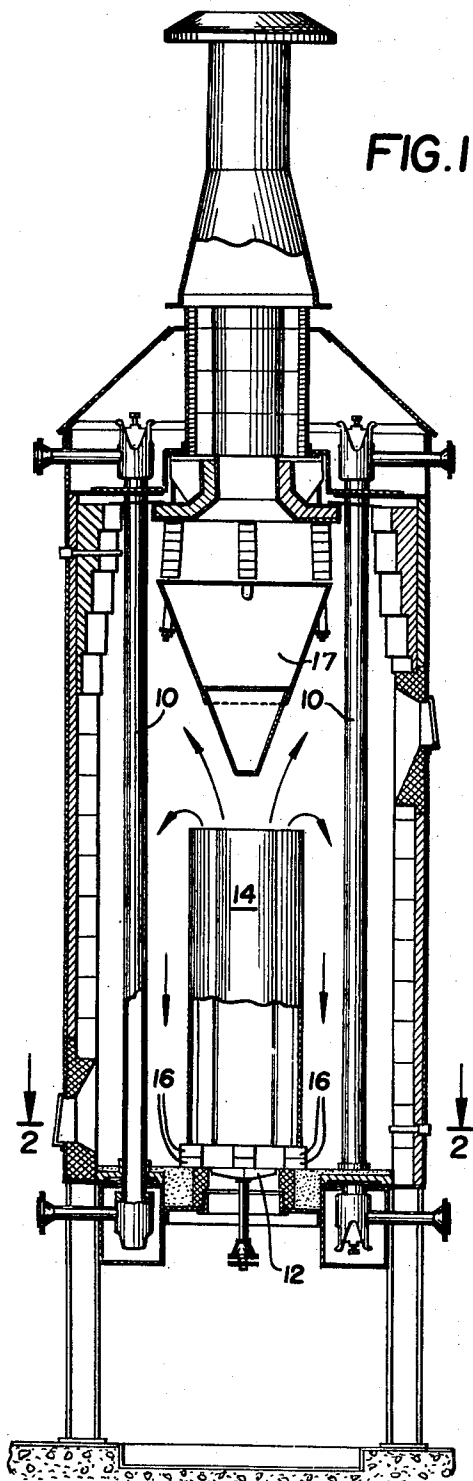
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HEAT CONTROL IN VERTICAL FURNACE BY FLUE GAS RECIRCULATION

Filed March 22, 1949

2 Sheets-Sheet 1



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FIG. 3

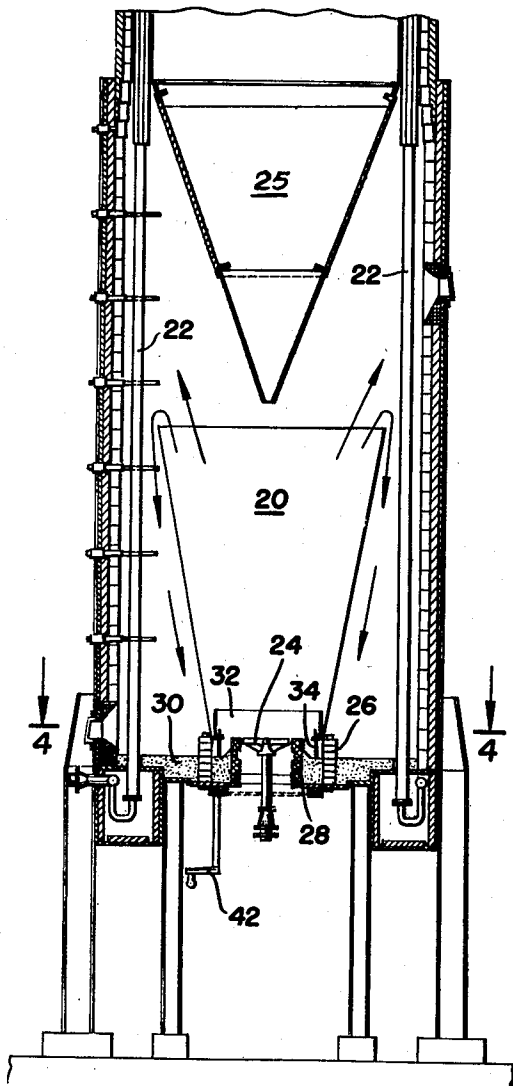


FIG. 4

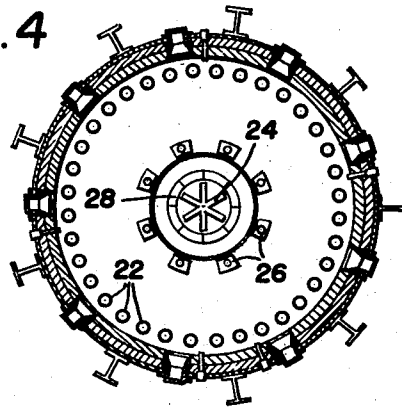
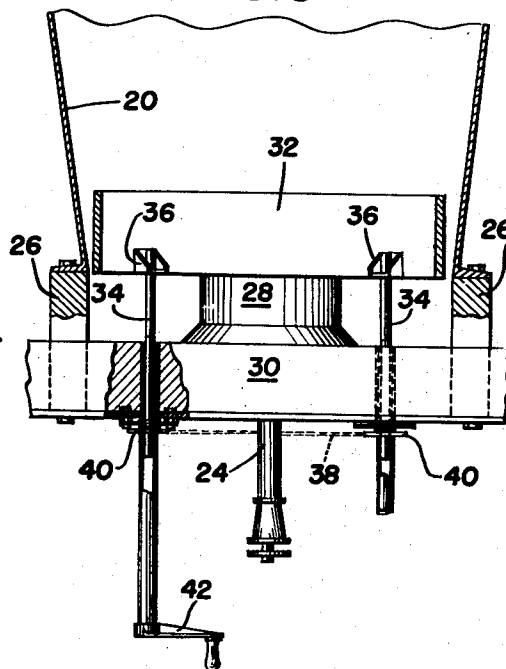


FIG. 5



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UNITED STATES PATENT OFFICE

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HEAT CONTROL IN VERTICAL FURNACE BY
FLUE GAS RECIRCULATION

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2 Claims. (Cl. 23—277)

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This invention pertains to an upright furnace having vertical tubes forming a radiant section above the heat source, and an object of the invention is to provide means and method for controlling the heat in that radiant section.

In certain operations the tubes are filled with a catalyst so that the chemical reactions take place within the heating elements of a direct-fired furnace.

Temperature control within the radiant section for this operation is usually critical for various reasons:

(a) The operating temperatures may range from 700° F. to 1800° F. and in many cases the permissible temperature of the metal tubes becomes a limitation in the design of the furnace.

(b) The reaction through the catalyst beds in the tubes is of a variable nature, depending upon the charging stock, the type of catalyst used, and the end-products desired. For example, it may be advisable to bring the charge up to temperature as rapidly as possible, and as the reaction progresses, to reduce the heat intensity to a fraction of the average rate of heat absorption.

(c) As the catalyst becomes poisoned, or less effective, at the end of the run, it may be desirable to change the heat intensity at different elevations in the furnace in order to have the least possible variation in the end-products of reaction.

The present invention meets the above critical conditions by recirculating the products of combustion within the radiant zone of the furnace.

Further and other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate what is now considered to be a preferred embodiment of the invention.

In the drawings:

Fig. 1 illustrates a sleeve, or hollow cylinder, above the burner;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Fig. 3 illustrates a modification of the invention in which the sleeve above the burner is tapered in order to produce a Venturi effect. If desired, the angle of sleeve taper may be modified to vary the heat intensity on the tubes. A damper for controlling the rate of recirculation is provided;

Fig. 4 is a cross-section on line 4—4 of Fig. 3; and

Fig. 5 is an enlarged view, partly in section, showing the damper adjusting mechanism.

Figs. 1 and 2 illustrate a furnace having vertical tubes 10 filled with a catalyst, and a burner 12 in the middle of the furnace floor.

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Supported directly above the burner is a tubular metal sleeve 14 which, as illustrated, is made in longitudinal sections for ease of replacement. The sleeve is supported above the floor by spaced apart fire bricks 16 resting on the floor. Above the sleeve 14 is a well-known inverted conical baffle 17. The radiant section of the furnace comprises substantially the entire interior of the furnace below a horizontal plane passing through and approximately half way up the cone 17.

As a result of this construction, the hot gases from the burner rise through tube 14 into the radiant portion of the furnace while the burner, acting as an inspirator, recirculates some of the products of combustion downwardly outside tube 14, past the brick supports 16 into the bottom of the tube and then upwardly and outwardly again through the tube. The tube 14 itself becomes heated and radiates heat to the tubes 10 at a temperature which is modified and controlled to the desired degree by the gas recirculation described.

The embodiment of Figs. 3, 4 and 5 also operates in the manner above described except that the cylindrical tube 14 is replaced by a conical tube 20 which tapers upwardly and outwardly, thus producing a Venturi effect which accelerates the recirculation of the gases. Above the tube 20 is an inverted conical baffle 25 similar to the baffle 17. The radiant section of the furnace comprises substantially the entire interior of the furnace below a horizontal plane passing through and approximately half way up the cone 25.

In this modification the heat-absorbing tubes of the furnace are designated 22, the burner is 24, the support for tube 20 is fire bricks 26, the vertical tube around the burner is 28 and the furnace floor is 30.

In the throat of tube 20 is an annular band forming a damper 32 supported by threaded vertical rods 34 attached by brackets 36 to the lower rim of the damper (Fig. 5).

Rods 34 are geared together by chain 38 and sprockets 40; therefore, when hand crank 42 is turned by the operator, the damper will move vertically to control the rate of recirculation of flue gases into and through tube 20.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

What is claimed is:

1. A vertical furnace comprising a radiant section having a hollow cylindrical bank of radiant heat absorbing tubes defining a vertical axis, a

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burner at the bottom of said radiant section for discharging combustion products upwardly along said axis, said radiant section having a floor at the bottom thereof, an open ended recirculating tube located with its axis vertical and with its lower end spaced above said floor and adjacent to said burner, and a recirculation damper located at the lower end of said recirculating tube, said damper comprising an annular band movably supported adjacent the lower end of said recirculating tube, said band having a width at least equal to the space between said floor and the lower end of said recirculating tube, and means for moving said band vertically to regulate the size of the recirculation opening at the lower end of said recirculating tube in order to control the amount of recirculation which takes place.

2. A vertical furnace comprising a radiant section having a hollow cylindrical bank of radiant heat absorbing tubes defining a vertical axis, a burner at the bottom of said radiant section for discharging combustion products upwardly along said axis, said radiant section having a floor at the bottom thereof, a frusto-conical open ended recirculating tube located with its axis vertical and its small end down but spaced above said floor and adjacent said burner, and a recirculation damper located at the small end of said

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tube, said damper comprising an annular band movably supported within the small end of said recirculation tube, said band having a width at least equal to the space between the small end of said recirculating tube and said floor, and means for moving said band vertically to regulate the size of the recirculation opening at the small end of said tube in order to control and regulate the amount of recirculation which takes place.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
486,990	Tallmadge -----	Nov. 29, 1892
700,664	Bryan -----	May 20, 1902
1,546,038	Smith -----	July 14, 1925
1,671,448	Plassmann -----	May 29, 1928
1,729,763	De Florez -----	Oct. 1, 1929
2,028,326	Hanks et al. -----	Jan. 21, 1936
2,174,663	Keller -----	Oct. 3, 1939
2,276,527	Throckmorton et al. -	Mar. 17, 1942
2,294,254	Throckmorton et al. -	Aug. 25, 1942
2,424,765	McCollum -----	July 29, 1947
2,430,344	Kemp -----	Nov. 4, 1947
2,455,201	Wallis et al. -----	Nov. 30, 1948
2,500,499	Schuurman -----	Mar. 14, 1950