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APPARATUS FOR COKING SOLID CARBONIZABLE MATERIALS

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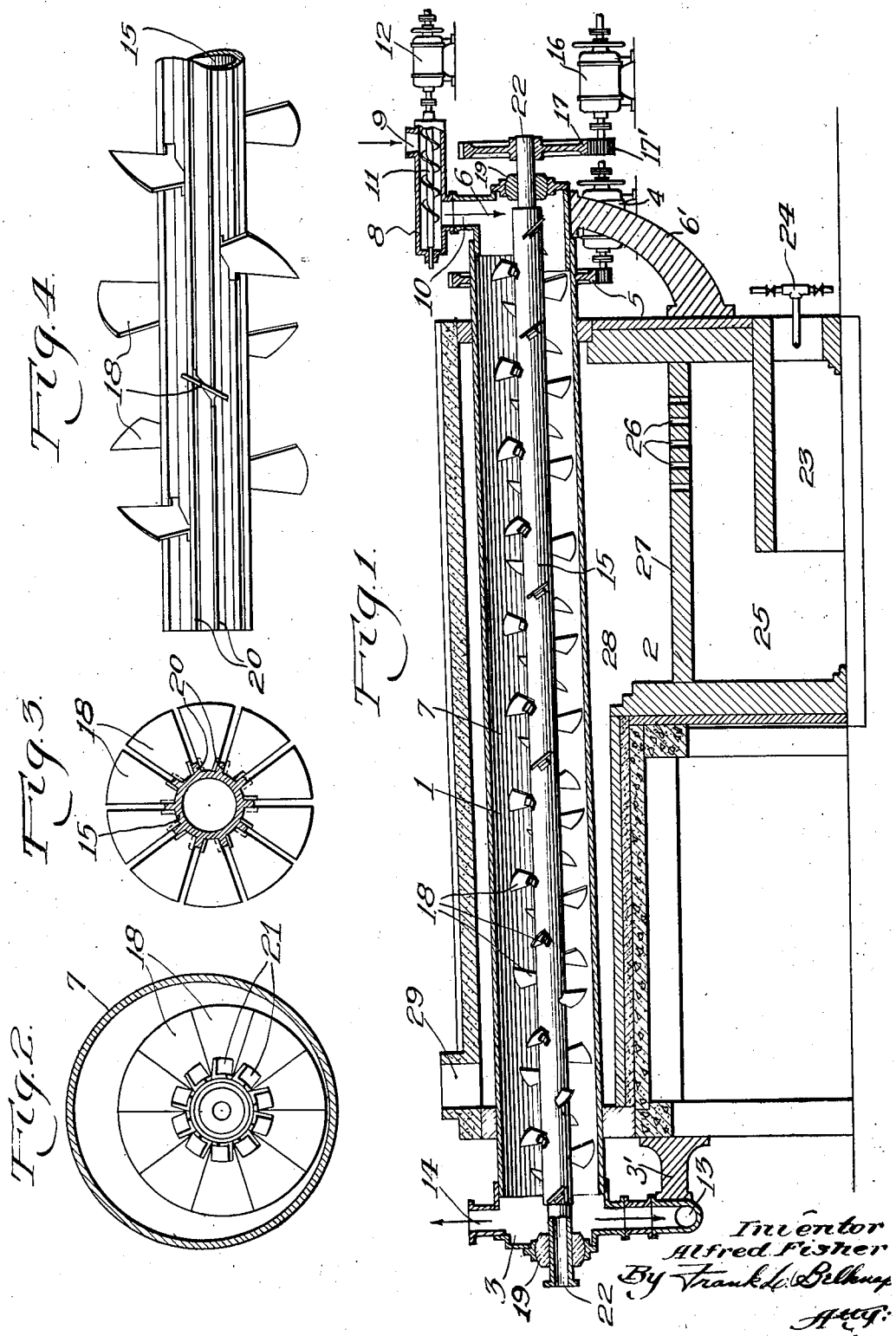

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APPARATUS FOR COKING SOLID CARBONIZABLE MATERIALS

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This invention relates to the treatment of carbonaceous materials and refers particularly to an improved apparatus for the devolatilization and coking of carbonaceous materials.

The features of the present invention render it particularly applicable for the treatment of carbonaceous materials such as mixtures of coal and petroleum coke. The invention is adaptable to the treatment of either of these materials alone, or to the treatment of any other suitable carbonaceous material. The invention is not limited to the treatment of any one or any particular group of materials or to any exact conditions of treatment but is directed rather to an improved method and means of subjecting any suitable material to any conditions of treatment permitted by an apparatus embodying the features hereinafter described.

The utility, objects and advantages of my invention will be apparent from the accompanying diagrammatic drawing and following detail description.

In the drawing, Fig. 1 is a sectional elevational view of a device comprising one embodiment of my invention.

Fig. 2 is a transverse sectional view of the retort and shaft.

Fig. 3 is a transverse sectional view of a slightly modified form of shaft.

Fig. 4 is a fragmentary side elevational view of the shaft shown in Fig. 3.

Retort 1 is substantially horizontally disposed within furnace 2, being slightly inclined toward the discharge end 3 of the retort to permit continuous travel of the material undergoing treatment through the retort as the latter is rotated by any suitable means such as an electric motor or other suitable mover, not shown, through variable speed reducer 4 and gears 5. The inlet end 6 and the discharge end 3 of the retort are preferably held stationary by the brackets 6' and 3' but the central portion 7 of the retort, passing through furnace 2 may be rotated at any desired speed. Material to be treated may be introduced to the stationary inlet end 6 of the retort through screw conveyor 8, having supply port 9 and discharge port 10. The screw or helical conveyor 11 may be driven at any desired rate through speed reducer 12 by means of an electric motor or other prime mover, not shown. A seal may be maintained upon the inlet end of the retort to prevent escape of gases or ingress of air to the zone of treatment by means of the material retained in conveyor 8 as it passes through said conveyor to the retort. Similarly a seal may be maintained at the discharge end of the retort by means of a similar conveyor 13 which retains a body of solid carbonized material discharged from retort 1. Vapors evolved by the treatment of carbonaceous material may be removed through port 14 at the discharge end 3 of the retort and liquid seals may be provided within suitable condensing, cooling and collecting equipment, not shown, through which the vapors may pass after they are released through port 14.

Shaft 15 may be rotated at any desired speed in either direction by any suitable motivating means, not shown, through variable speed reducer and reversing mechanism 16 and gears 17 and 17'. Shaft 15 is provided with breaker blades 18, preferably disposed along the shaft in the form of a single or multiple broken helix, and extending throughout the entire or any portion of the length of the retort. Breaker blades 18 preferably do not actually touch or scape the inner surface of the retort but are preferably of such length that relatively small clearance is provided between the blades and one or more points around the inner circumference of the retort and the spacing and shape of the blades upon shaft 15 is such that upon rotation of the retort the entire inner surface of the rotatable shell 7 is exposed to the action of the blades, that is, no gaps are permitted in the continuity of the line of breaker blades as the shaft 15 is rotated. The ends of the shaft passing through the stationary inlets 6 and discharge end 3 of the apparatus are preferably mounted in self-aligning bearings 19, of any well known construction, to accommodate deflection of the shaft, due to the relatively long span ordinarily required between bearings.

As a feature of the invention the breaker blade shaft 15 may preferably be mounted eccentric with respect to the rotatable portion 7 of the retort and preferably the shaft is mounted so that the minimum clearance between the breaker blades and the inside surface of the rotatable shell 7 is adjacent the hottest portion of the heated shell, in this case its lower surface. These features are more clearly illustrated in Fig. 2 of the drawing.

Another feature of the invention provides for the use of slightly shorter breaker blades at substantially the mid-section of shaft 15 or blades of graduated and progressively shorter length from each end toward the center of the shaft, thus providing a means for compensating for the deflection in shaft 15 and maintaining a substantially uniform clearance between the breaker blades and the bottom of shell 7.

Any of the well known methods of joining metals may be employed to fasten breaker blades 18 to shaft 15; for example, they may be welded or may be riveted or bolted to the shaft by means of clip angles 21, as illustrated in Fig. 2 of the drawing. However, as a special feature of the invention, the shaft 15 may have longitudinal stiffening or strengthening ribs 20 to minimize or prevent deflection of the shaft and thus avoid any lateral deflection thereof, and said ribs may serve as members to which breaker blades 18 are bolted or otherwise attached, as illustrated in Figs. 3 and 4 of the drawing. It will be understood, of course, that the reinforcing ribs 20 may be straight or helical in form and may or may not be utilized as a means of attaching the breaker blades.

As a feature of the invention, shaft 15 may be hollow and any suitable cooling medium may be circulated through the hollow portion provided to cool the shaft and prevent excessive expansion and deflection of this member. In case the shaft is not cooled in this manner, it is preferably constructed of suitable metals or metallic alloys capable of withstanding high temperatures without distortion or weakening such as, for example, tungsten, nickel-chromium-steel, silichrome-steel, chrom-iron or the like, and in such cases the shaft preferably assumes the form illustrated in Figs. 3 and 4. However, when the entire breaker blade shaft is not cooled, it is ordinarily desirable to cool at least that portion of the shaft adjacent to bearings 19 for obvious reasons, and as a feature of the invention hollow bearing ends 22, separated from the remainder of the hollow shaft in any suitable manner, are provided and may be cooled by circulating fluid through these portions of the shaft only. In this case the remainder of the hollow shaft is vented to prevent excessive pressure within the shaft due to heating.

It is within the concepts of the invention to cool the entire shaft 15 or any portion thereof with fluid such as, for example, hydrocarbon oil and to utilize the heat imparted to the oil by incorporating this step with any oil treating process such as distillation or cracking. Similarly water may be used as the cooling medium and the heat thus utilized for such purposes as preheating the feed water to a boiler or generating steam, or steam may be employed as the cooling medium and may be superheated in passing through shaft 15.

Furnace 2, surrounding the retort, supplies the heat required for coking and devolatilization of the carbonaceous material as it passes through the rotatable shell 7 of the retort. Combustible materials such as, for example, fuel oil and air are supplied to the firing compartment or tunnel 23 of the furnace through burner 24, discharging into combustion zone 25 of the furnace at a point beyond the perforations 26 in arch 27. By means of this construction the shell 7 of the retort is protected against direct impingement of the flame and consequent overheating. Combustion products are discharged from the heating zone 28 of the furnace, surrounding the rotatable shell 7, through flue 29 to a stack, not shown.

As an example of the utility of some of the major features of the present invention, by regulation of the speed of rotation of shell 7 and the speed and direction of rotation of shaft 15, the progress of the carbonaceous material undergoing treatment through the heated zone may be assisted or retarded to any desired degree, thus affording means of controlling the time to which the material is exposed to heating. By the rotation of both shaft 15 and shell 7 of the retort, the material undergoing treatment is agitated, the inner surface of shell 7 is kept substantially free of adhering coke deposits which might cause early destruction of the shell due to overheating. By rotation of shell 7 of the retort, a constantly changing portion of the shell is exposed to the most severe temperature in the heating zone of the furnace permitting the utilization of higher temperatures than otherwise possible without damaging the shell of the retort by distortion. By a combination of the inclined position of the retort and rotation of the shell the progress of carbonaceous material undergoing treatment through the heated zone is insured, regardless of whether shaft 15 is utilized or not, and by the use of these two features in the treatment of materials of low coking index such as, for example, many petroleum cokes resulting from the destructive distillation or cracking of oil, the shaft and breaker blades may be eliminated.

I claim as my invention:

1. In combination, a furnace, an elongated retort disposed within said furnace, an elongated shaft eccentrically disposed within said retort and supported at each end thereof, separate means for establishing independent relative motion of rotation of both said shaft and of said retort, means for introducing solid carbonaceous material to said retort at one end thereof, means for removing carbonized residue from the opposite end of said retort, and means longitudinally mounted upon said shaft for preventing lateral deflection thereof.

2. In combination, a furnace, a retort disposed in said furnace, means for revolving said retort, a shaft disposed within said retort, separate means for rotating said shaft, means for introducing solid carbonaceous material into said retort, means connected to said shaft for passing said carbonaceous material through said retort upon relative movement of said retort and said shaft comprising a plurality of paddles disposed upon said shaft in the form of a broken helix, and means for removing carbonized residue from said retort.

3. In combination, a furnace, a retort disposed in said furnace, means for revolving said retort, a shaft eccentrically disposed within said retort, separate means for rotating said shaft, means for introducing solid carbonaceous material into said retort, a plurality of paddles disposed on said shaft in the form of a broken helix to effect passage of carbonaceous material through said retort, stiffening ribs on said shaft to retain said paddles thereon and simultaneously prevent lateral deflection of said shaft, and means for removing solid carbonized material from said retort after its passage therethrough.

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