

March 17, 1942.

E. SCHÖN ET AL

2,276,883

APPARATUS FOR PREHEATING LIQUID CARBONACEOUS MATERIAL

Filed Feb. 11, 1939

FIG.-1

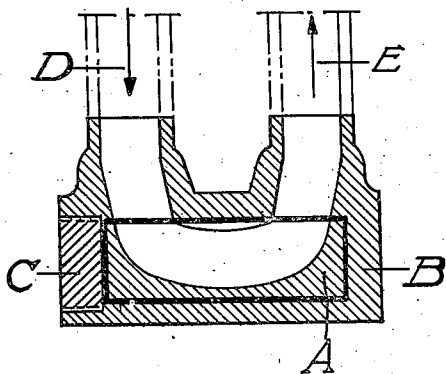


FIG.-2

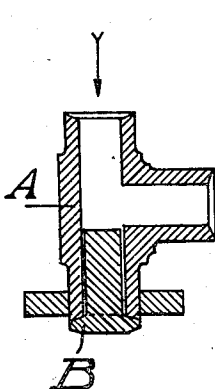
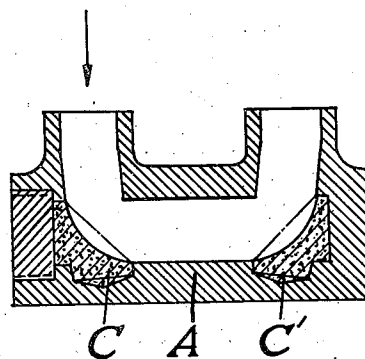


FIG.-3

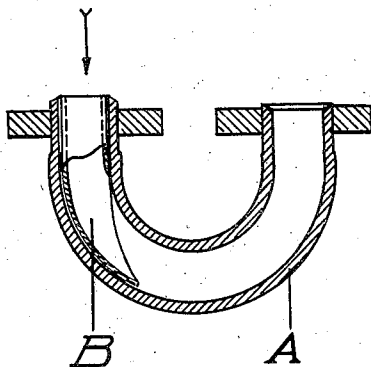


FIG.-4

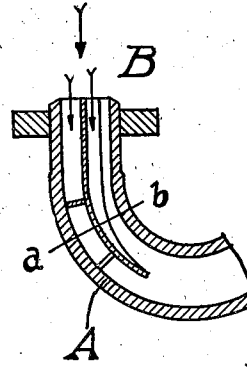


FIG.-5

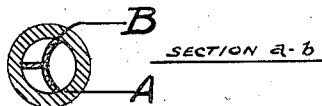


FIG.-6

Ewald Schoen
Alfred Schiwy Inventors
Ewald Woehner
By P. A. Young Attorney

UNITED STATES PATENT OFFICE

2,276,883

APPARATUS FOR PREHEATING LIQUID
CARBONACEOUS MATERIAL

Ewald Schön and Alfred Schiwy, Buer, and Ewald
Woehner, Ludwigshafen-on-the-Rhine, Ger-
many, assignors to Standard Catalytic Com-
pany, a corporation of Delaware

Application February 11, 1939, Serial No. 256,002
In Germany May 18, 1937

1 Claim. (Cl. 196—133)

The present invention relates to the treatment of liquid distillable carbonaceous materials containing solid matter in dispersion with hydrogen or gases containing free hydrogen under high pressures of at least 50 atmospheres, preferably at least 100 atmospheres and at high temperatures above 300° C., usually between 400° and 550° C. and more particularly to improvements in tube preheaters to be used in the said treatment.

The present invention is of particular importance for the destructive hydrogenation of bituminous coal in which the coal is made into a paste with oil, and preheated in a tube preheater. Further, the present invention may be applied with advantage in the destructive hydrogenation of liquid initial materials, in which solid catalysts or other solid materials are suspended.

The tube preheaters as hitherto used for the preheating of coal-oil pastes usually consisted of a long passageway composed of vertical tubes which at their upper and lower ends were connected with each other by return bends. Through the passageway thus made the material to be preheated was pumped and indirectly heated during its passage by heating gases.

In practical operation in tube preheaters of this type failures occurred, mainly consisting in failures of the return bends at the lower ends of the vertical tubes, due to damages done to the construction material which was partly worn away.

We have after intensive investigation of all of the phenomena which occur and of possible measures to avoid the damages to the preheater quite unexpectedly found that the damages to the preheater can be counteracted in an effective way by the application of return bends protected by a material having a Brinell hardness of more than 400 from attacks by the fluid substances. This protection may be effected by the application of corrosion resistant materials having a Brinell hardness of more than 400 for the construction, coating or lining of the return bends or of internal parts protecting the bends against damages, or by providing at the endangered parts of the return bends buffers formed by a construction material of the said hardness.

In the preheating of bituminous coal pastes, return bends in accordance with the present invention have, in particular, to be applied in the temperature zone of 200 to 375° C. (the temperature being measured in the material to be heated), and outside this temperature zone other bends may be employed, if desired. More particularly, the temperature zone of 250° to 350° C.,

has been found as a dangerous zone in respect of the damages, when treating bituminous coal. In the case of preheating coal-oil pastes the return bends should be preferably protected by a material having a Brinell hardness of between 400 and 600, say about 550.

The return bends in accordance with the present invention may be protected in various ways.

The return bends of the ordinary type may be constructed of, coated, or lined with a material having a Brinell hardness above 400.

The return bends may be provided with interchangeable tube-like pieces to be inserted in the return bend, constructed of, coated or lined with materials having a Brinell hardness above 400.

A bend of this type is illustrated in Figure 1 of the accompanying drawing. The cast piece (A), in which the return of the direction of flow takes place, is fixed in a piece (B), into which it can be introduced from the side through an opening which can be closed by a closure (C). The curvature of the passageway in the return bend may be flatter than in usual return bends for constructional reasons. The mixture of liquid and gas flows out from tube (D), through the return bend into the tube (E).

The return bends may also be so constructed, that, for example, the passageway for the carbonaceous material is provided with buckets, for example, one opposite each of the tubes connected by the return bend. In these buckets oil is collected which forms a buffer against which the material passing through the preheater bumps. The oil collected in the bucket may also be converted into a coke-like mass which is very resistant against erosion, and protects the underlying wall of the return bend which in this case may be constructed of a material of less hardness.

An example of this type of return bend is illustrated in Figure 2 of the accompanying drawing. In the return bend (A) made in one piece, the passageway for the carbonaceous material is provided with two buckets (C) and (C'). The bend is provided with a closure (D). The space indicated with dots, is filled with coke, in case the liquids to be heated have a tendency to cokify. The coke then acts as a protective layer.

This type of return bend may also be constructed in a different way by providing only one bucket opposite the tube through which the material flows in the direction of the bend or by providing the second bucket at the side of the bend where the material coming out of the curve

of the bend bumps against the wall, or by providing buckets at the sides and at the ends.

Another form of bend in accordance with the present invention is illustrated in Figure 3. The left half of the bend has the form of an ordinary T-piece. The lengthening piece at the lower side contains an easily interchangeable part of great thickness (B) made of iron or resistant material.

The return bends may also be provided with one or more internal constructions of material having a Brinell hardness of more than 400, which protect the inner wall of the return bend by catching the fluid coming into the bend.

Examples of such constructions are illustrated in Figures 4 and 5. According to Figure 4 the return bend is provided with an internal interchangeable part in the form of a scoop (B). Figure 5 shows this scoop (B) constructed in the middle of the passageway. Figure 6 is a section along the line *a-b* of Figure 5.

The same constructions which here have been shown for the lower return bends may of course also be applied at the upper bends.

The expression "materials having a Brinell hardness of more than 400" when used in this application means metallic substances of the said hardness and also non-metallic materials the hardness of which while usually determined in another way is as high as that of a metallic substance having a Brinell hardness of more than 400.

As examples of materials having a Brinell hardness of more than 400 may be mentioned special cast alloys with a high content of chromium and a small content of silicon, molybdenum or cobalt. The Brinell hardness values of these materials are between 500 and 600 degrees, the tensile strength is between 55 and 90 kilograms per square millimetre. The base material may be ferritic with intercalated carbides or material similar to ledeburite.

The cast pieces are of such hardness that their surfaces can practically not be machined or otherwise worked.

The carbon content of the alloys should be low and preferably below 1 per cent.

Typical examples of alloys employed according to the present invention have the following composition:

	C	Si	Mn	Ni	Cr	W	Mo
A.....	0.6	1.8	0.7	13.0	15.0	2.0	-----
B.....	0.3-0.4	0.3-0.6	0.3-0.5	0.5-0.6	13-14.5	-----	-----
C.....	1.5	-----	-----	-----	13.5	1.0	1.0

Also alloys with a still higher content of chromium, for example, of 20 to 30 per cent of chromium together with, for example, molybdenum and, if desired, cobalt may advantageously be employed. The said alloys are usually hardened to attain the desired Brinell hardness.

These materials are of particular advantage for the construction of the said interchangeable tube-like pieces. Suitable materials for this purpose are also ceramic masses, for instance fire proof stone ware or porcelain, or materials

having as a main constituent aluminium oxide or silicon oxide, for example corundum or hard glass as quartz glass.

Using these substances as construction materials for the tube-like pieces to be inserted in the return bends these pieces can be more easily interchanged if it is necessary. The space between the preheater tube and the inserted tubular piece is ordinarily filled with coke, in case the liquids to be heated have a tendency to cokify, and the tubular piece may be merely removed by dashing it. But this dashing can be more easily carried out if the piece is made of the said non-metallic material.

As example of coating materials having said Brinell hardness may be mentioned special hard high melting enamels.

That the enamels in many cases must be high melting is a special condition caused by the fact that the steels, usually special steels on which the coating is made require a heat treatment in order to obtain the desired properties. The enamel can be brought on to the parts of the apparatus prior to, during or after the said heat treatment. Since the coating with enamel also is done at elevated temperature, the heating of the apparatus thereby occurring can form a part of the heating reaction giving the steel the desired properties.

In any case the melting point of the enamel should be some hundred degrees higher than the temperature to which the apparatus is exposed in its use.

Although the present invention is of particular importance for preheaters constructed of vertical tubes, it may also be applied with advantage for preheaters partly or wholly constructed of horizontal or inclined tubes, since the return bends will always be most exposed to damages, and more particularly those parts of the bend where the impact of the material treated is strongest must be constructed in accordance with the present invention.

The rest of the preheater may be constructed of a less resistant material than the return bends.

The process is of particular advantage in the treatment of initial materials containing chlorine or when applying catalysts or additions having a corrosive action such as hydrogen chloride, ammonium chloride and the like.

What we claim is:

An apparatus for preheating liquid distillable carbonaceous materials containing solid matter in dispersion with gases selected from the group consisting of hydrogen and gases containing free hydrogen, before treating them under high pressure of at least 50 atmospheres and at high temperatures above 300° C., which consists in a tube preheater provided with return bends furnished with interchangeable tube-shaped pieces fixed therein and made of a ceramic material as hard as substances having a Brinell hardness of more than 400.

EWALD SCHÖN.
ALFRED SCHIWY.
EWALD WOEHNER.