

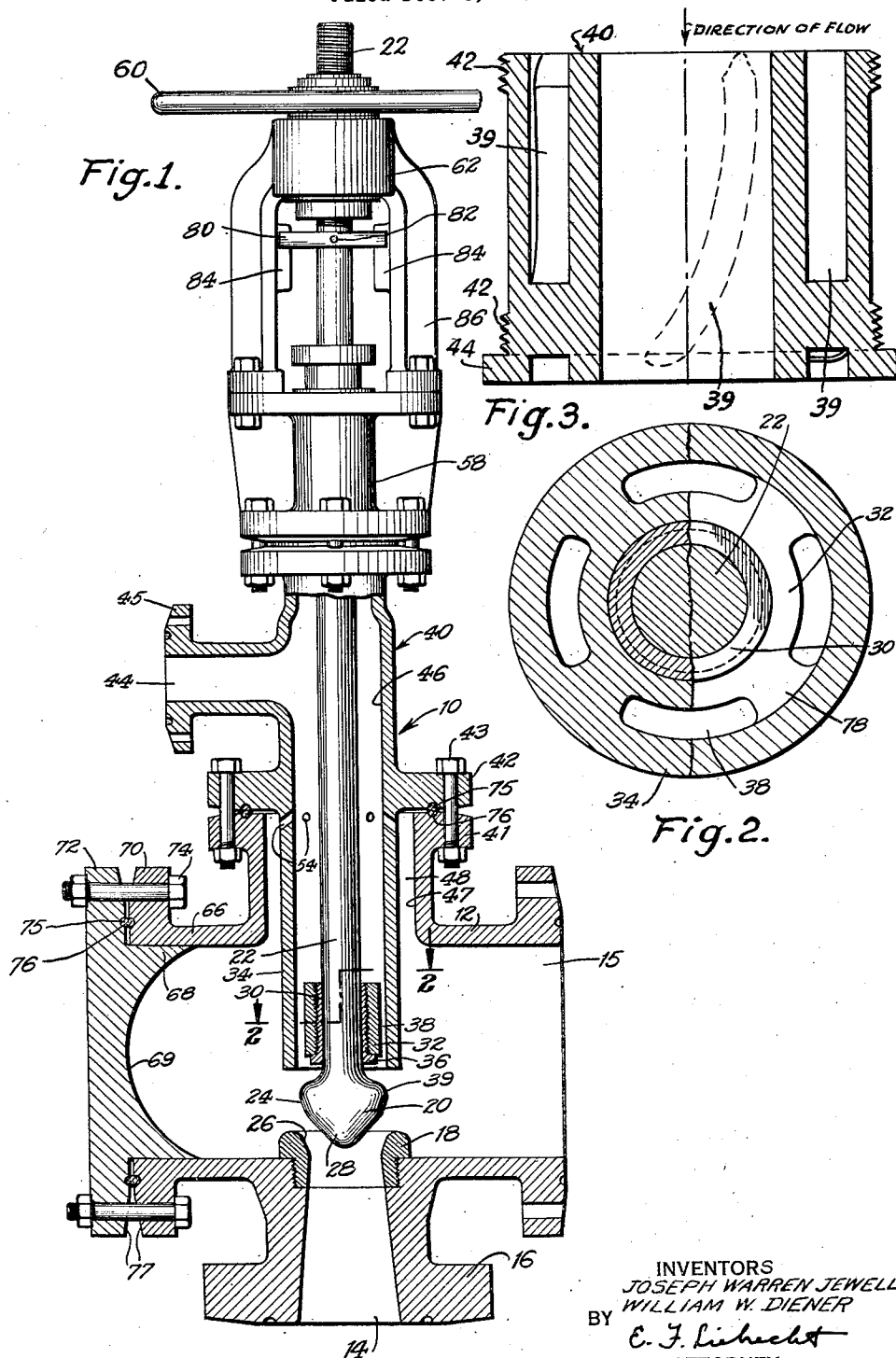
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VALVE CONSTRUCTION

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VALVE CONSTRUCTION

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This invention relates to improvements in pressure control valves especially adapted for use in connection with hydrocarbon cracking apparatus.

5 Modern cracking furnaces are usually operated to maintain hydrocarbon fluids under relatively high pressure and at an elevated temperature to effect the desired extent of conversion of the hydrocarbon fluids being heated in the furnace. 10 It is necessary to reduce both the temperature and pressure of the converted hydrocarbon products before introducing them into the fractionating equipment. The pressure on the hot products of conversion is reduced by passing them 15 through a pressure reducing valve. Heretofore it has been the practice to reduce the temperature of the converted products with quench oil introduced on the high pressure side of the valve. It was found that introducing residual quench oil on 20 the low pressure side of the valve usually resulted in excessive coke formation in the valve immediately after expansion of the conversion products.

A valve construction embodying our invention permits the use of a cooling medium, such as quench oil on the low pressure side of the valve and at the same time coke formation is prevented. With the use of a quench oil on the low pressure side, it is possible to use a relatively 30 heavy oil such as black oil or a bottoms product instead of the conventional distillate gas oil.

In a valve constructed according to our invention, the transfer line and the valve up to the point of pressure reduction are designed to give 35 smooth flow of the fluid materials so that no obstruction is present to act as a nucleus for a coke formation. The valve is provided with an inlet for quench oil and the quench oil flows around the valve stem and around the plug valve 40 where it meets the products of conversion after the pressure drop so as to quench the products of conversion and prevent coke formation.

The valve further includes a bonnet having a sleeve which surrounds a portion of the valve stem and which is spaced from the body of the 45 valve to provide a space between the upper portion of the sleeve and the valve housing. The sleeve is provided with a series of openings near its upper portion to permit the quench oil to pass from the sleeve and through the space between the sleeve and the valve housing to cool the outside of the sleeve and to mix with the products of conversion introduced into the valve housing. The valve may be placed at any point 50 in the transfer line from the furnace outlet on

one end to a position within the tower on the other end.

The lower portion of the sleeve is provided with a bearing to afford support for the valve stem. The bearing is provided with slots to 5 permit passage therethrough of the quench oil from the interior of the sleeve into the valve housing to mix with the hot products of conversion and to cool the plug valve and associated parts. 10

The internal parts of the valve subjected to the high temperature of the products of conversion are cooled by the streams of quench oil and the quench oil is introduced so as to obtain effective mixing of the hot products of conversion with 15 the cooling oil. The complete mixing so obtained materially reduces the temperature of the conversion products and inhibits coke formation, especially when using heavy residual oil as the cooling medium. By preventing the formation of 20 coke, the valve mechanism has a longer life and may be reliably used for a longer period of time than the valves now in use.

In the drawing:

Fig. 1 represents a vertical section taken 25 through a valve constructed to embody our invention;

Fig. 2 represents an enlarged horizontal cross section taken substantially on line 2—2 of Fig. 1; and 30

Fig. 3 represents an enlarged vertical section showing a bearing and sleeve in a one piece construction.

Referring now to the drawing, the reference character 10 designates one form of a valve embodying our invention and which includes a valve housing or casing 12 provided with an inlet 14 35 and an outlet 15. The inlet 14 is adapted to convey or transfer hot products of conversion under pressure resulting from a hydrocarbon conversion operation and pass them through the valve to reduce the pressure thereon. The inlet 40 end of the valve housing may be provided with suitable connecting means such as a flange 16 whereby the valve housing may be attached to a transfer line. From the drawing it will be seen that the outlet 15 has a much larger diameter than the inlet 14 so as to provide space for carrying away the expanded products of conversion after the reduction in pressure and the added 45 amounts of quench oil which are introduced into the valve housing as will be later pointed out in greater detail. 50

The inlet is provided with a valve seat 18 which may be provided at the inner end of the 55

inlet 14 in any suitable manner. In the drawing the valve seat 18 extends into the interior of the valve housing and is screw threaded in place. A plug valve 20 is secured to the lower end of an elongated valve stem 22, the plug valve co-operating with the valve seat 18 to control the size of the opening for conducting products of conversion into the valve housing and to control the degree of pressure reduction desired. The valve stem 22 extends longitudinally of the valve.

The plug valve 20 is of general rounded shape and is provided with a beveled annular surface 24 which cooperates with a similar beveled surface 26 on the valve seat 18 for providing a close fit when the plug valve is closed on the valve seat 18. The plug valve 20 has a conical lower portion 28 which permits smooth flow of the conversion products into the valve housing 12 and at the same time subdivides the stream and directs the subdivided stream in annular form into the valve housing where it is intimately mixed with a cooling medium as will be hereinafter described. Other forms of plug valves may be used.

A bearing 30 is provided for the lower portion of valve stem 22 in order to guide the valve stem and to prevent vibration or chatter of the valve plug during the operation. The bearing is suitably secured, as by screw threads, to a sleeve member 32 mounted within the lower end of a sleeve 34 which will be presently described in greater detail. The lower end of the bearing member 30 is provided with a flange 36 which abuts a portion of the lower end of the sleeve member 32.

The sleeve member 32 is secured to the internal wall of sleeve 34 in any suitable manner and it may be made integral therewith. The sleeve member 32 is provided with a plurality of arcuate slots 38 which lead from the interior of the sleeve 34 to the valve housing 12 adjacent the upper portion 39 of the plug valve 20. The sleeve 34 provides means whereby quench oil is passed around the valve stem 22 and through slots 38 into the housing 12 for admixture with the cracked hydrocarbons which are introduced into the valve housing 12 through inlet 14. The upper portion 39 of the plug valve 20 is curved to assist in the smooth flow of cooling medium into the valve housing 12. In some valves the bearing 30 and sleeve member 32 may be omitted or placed in other parts of the valve.

A bonnet 40 is secured to a flange 41 on housing 12 by any suitable means such as flange 42 and bolts 43. The bonnet is provided with a secondary inlet 44 for the introduction of quench oil or a cooling medium into the valve housing 12. The bonnet 40 may be provided with any suitable means such as flange 45 for connecting the inlet 44 with any suitable source of quench oil. The inlet 44 communicates with the interior of the bonnet 40 and the quench oil is directed toward the valve stem 22.

The bonnet 40 is provided on its lower portion with the sleeve 34 above referred to. The sleeve 34 extends downwardly into the valve housing 12 and conducts the cooling medium through slots 38 to a point close to the valve seat 18. The interior of the bonnet is of a smaller diameter than the valve housing 12 and the interior wall 46 thereof forms a continuation of the sleeve 34. The valve housing 12 is provided with a vertically arranged annular wall 47 which is of a larger diameter than sleeve 34 and which is spaced from the sleeve 34 to form an annular space 48.

The sleeve 34 at its upper portion adjacent the flange 42 of the bonnet 40 is provided with a plurality of openings 54 which are preferably inclined to the vertical. The openings are spaced around the sleeve and afford communication between the interior of the sleeve 34 and the space 48 between the exterior of the sleeve 34 and the wall 47 of the valve housing 12 to conduct a portion of the cooling medium into the valve housing 12. In some instances the openings 54 may be omitted but the preferred construction includes them.

The valve stem 22 extends upwardly through a flanged member 58 which contains packing material for the upper portion of the valve stem 22. Any suitable packing gland or packing material may be used and a specific showing thereof has been omitted from the drawing. The upper end of the valve stem 22 is screw threaded to cooperate with a hand operated member 60 for changing the position of the valve plug 20 with respect to the valve seat 18. If desired, suitable roller bearing constructions (not shown) may be provided in the member 62 of the valve adjacent the hand operating member 60 in order to facilitate the operation of the valve.

If desired, the valve housing 12 may be provided with a removable closure to afford easy access to the interior of the valve housing 12 for repair or emergency purposes. The valve housing may be provided with a collar or sleeve 66 for receiving a closure member 68 having a curved internal face 69 which eliminates dead spaces where coke might form. The collar or sleeve 66 may be provided with a flange 70 for cooperating with the flange 72 on the closure 68 to provide a tight fit. Any suitable means for connecting the flanges may be used such as bolts 74, for example.

Gaskets 75 in grooves 76 are preferably provided between the flanges of the valve. The flanges of the valve as shown for example at 77 on flanges 70 and 72 are cut away at an angle to provide space for a tool to facilitate removal of the closure member 68 or facilitate disassembly of the other parts of the valve.

In the operation of the device, the plug valve 20 is positioned with respect to the valve seat 18 in order to obtain the desired pressure drop in the hot products of conversion passing from the transfer line through inlet 14. The conical lower portion 28 on plug valve 20 subdivides the incoming stream of hot conversion products and the subdivided stream passes through the annular space between the bottom of plug valve 20 and the top of the valve seat 18.

Quench or cooling oil, such as relatively heavy residual oil, is introduced through the secondary inlet 44 and passes into bonnet 40 around the valve stem 22. The introduced quench oil cools the bonnet and valve stem and then a portion of the oil passes downwardly through the sleeve 34 and slots 38 in the bearing 30 into the valve housing 12 where the quench oil is mixed with the subdivided stream of hot conversion products passing into the valve housing 12 at the immediate point of expansion. If desired, the connecting portions 78 between slots 38 in sleeve 34 may be tapered toward a point at their upper portions to facilitate passing of the cooling oil into the slots 38. Another portion of the quench oil passes through openings 54 in the sleeve 34 and passes downwardly through space 48 and then is introduced into the valve housing 12 where it is also mixed with the hot products of conversion introduced into the valve housing 12.

The oil in passing through the sleeve and space or passageway 48 cools the sleeve and the upper portion of the valve housing 12.

In passing through the opening between the plug valve 20 and the valve seat 18, the pressure on the products of conversion is reduced and there is some expansion and cooling of the products of conversion. As soon as this expansion takes place, the products of conversion are intimately mixed with the quench oil passing through the slots 38 in the bearing 30 and the products of conversion are then further intimately mixed with the other portion of the quench oil which is introduced into the valve housing 12 on the exterior of the sleeve 34 by means of openings 54 and passageway 48.

The inlet 14 and the valve up to the point of pressure reduction are designed to give a smooth flow to the products of conversion so that no obstruction is present to act as a nucleus for coke formation. By means of sleeve 34, the quench oil is introduced into the valve housing 12 adjacent the valve seat 20 and plug valve 18 and in this way intimate mixing of the cooling medium and hot conversion products is obtained and coking is inhibited. The expanded and cooled products of conversion leave the valve through enlarged outlet 15.

From the above description it will be seen that the inlet 14 is the only portion of the valve which is subjected to severe temperature and pressure conditions and that the rest of the plug valve is uniformly cooled by streams of cooling oil so introduced as to obtain effective and intimate mixing of the hot products of conversion with the cooling oil. The complete mixing obtained in this manner materially reduces the liability to coke formation especially when using a heavy residual oil as the cooling medium.

As the quench oil is introduced into the valve housing 12 from a point above the valve housing it will be seen that the packing and all bearings and threads in the operating mechanism of the valve which are positioned above the point of introduction of the cooling medium are protected against relatively high temperatures. Also, there is no possibility of products of conversion reaching the operating parts of operating mechanism of the valve and in this way the formation of any coke in the operating mechanism is avoided.

A spindle guide 80 is secured to valve stem 22 by drive pin 82 for preventing rotation of the valve stem 22 during the manipulation of the valve. The guide 80 has forked ends (not shown) which embrace the guide members 84 projecting from the upper frame 86 of the valve so that the guide 80 slides on and follows the guide members 84 during the manipulation of the valve.

While the bearing 30 and sleeve member 32 have been shown in the drawing as separate pieces, with bearing 30 screw threaded into the sleeve member 32, it is to be understood that other constructions may be used. For example, bearing 30 and sleeve member 32 may be made of one piece provided with slots 38 and the one piece construction may be provided with external threads whereby it may be detachably secured in the lower end of sleeve 34 such as shown in Fig. 3, for example. With this construction the unit assembly comprising bearing 30 and sleeve member 32 may be removed as a unit and another unit assembly substituted for it.

The slots 38 in sleeve member 32 are shown in the drawing as vertical and rectilinear. How-

ever, these slots 38 may be curved as shown at 39 in Fig. 3 to provide a curvilinear path so as to impart a whirling motion to the quench oil as it passes downwardly through the slots to obtain better mixing with the conversion products to be quenched. The integral units comprising a bearing and sleeve member as described in the previous paragraph may be provided with slots 38 having different curvatures so that different whirling motions may be given to the quench oil by using different unit assemblies. That is, each unit may have slots which differ from the slots of other units in curvature. By making such a unit assembly, it may be easily removed. The portions between the slots 38 may be considered as vanes.

In Fig. 3 we have shown a one piece bearing and sleeve member 40 provided with external threads 42 for threading into the lower portion of sleeve 34. An abutment 44 is provided for abutting the lower end of sleeve 34. As shown in Fig. 3 the slots 39 are curved and parallel but other arrangements may be used.

Our invention provides direct and controllable means of cooling the valve plug which will help to prevent coke formation in the release orifice and on that part of the valve plug exposed to transfer line temperature. The flow through the valve is arranged to get intimate mixing at the actual point of pressure release. The operating mechanism for the valve is protected from coke formation.

The use of a quench oil or cooling medium at low pressure saves money in initial cost of pumps and lines. If the quench oil is one which will remain in the liquid phase in the evaporator tower, there is a saving in the required size of the evaporator tower.

While one form of valve has been shown it is to be understood that this is by way of example only and that various changes and modifications may be made without departing from the spirit of our invention.

We claim:

1. A pressure control valve of the character described adapted for use with transfer lines containing hot hydrocarbon cracked products under superatmospheric pressure including, in combination, a housing having an inlet opening and an outlet opening, a valve seat in said housing for said inlet opening, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the size of the inlet opening, a sleeve extending into said housing and surrounding a portion of said valve stem, said sleeve being smaller than said housing to form a space between said sleeve and said housing, and a bearing for said valve stem at one end of said sleeve, the sleeve adjacent its other end being provided with an opening, said bearing being provided with a slot, said housing being provided with a secondary inlet opening for admitting quench oil around said valve stem and into said sleeve, the quench oil being adapted to pass through said sleeve opening into said space between said sleeve and said housing and through said bearing slot into said housing to quench the hot hydrocarbon cracked products as they are admitted to said housing through said inlet opening and also to cool said valve member and associated parts to inhibit the formation of coke.

2. A pressure release valve of the character described adapted for use with transfer lines containing hot hydrocarbon cracked products under superatmospheric pressure including, in combina-

tion, a housing provided with an inlet opening for the fluid under pressure and an outlet opening for the fluid under lower pressure, a valve seat in said housing for said inlet opening, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the size of the inlet opening, said valve stem extending longitudinally of said housing, means including a sleeve surrounding the lower portion of said valve stem, and a bearing for said valve stem at one end of said sleeve, said bearing being provided with slots, said means being provided with a secondary inlet for admitting quench oil into said housing around said valve stem and into said sleeve, the quench oil being adapted to pass through said bearing slots into said housing to quench the hot hydrocarbon cracked products admitted to said housing through said inlet opening and also to cool said valve member and associated parts to inhibit the formation of coke.

3. A control valve of the character described adapted for use with transfer lines containing hot hydrocarbon cracked products under pressure including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the opening of said inlet, and means associated with said housing and including a sleeve surrounding a portion of said valve stem, said sleeve extending into said housing and being spaced from said housing, one end of said sleeve being adjacent said valve member, said sleeve being provided with an outlet opening, said means being provided with a secondary inlet for admitting a cooling medium around said valve stem and into said sleeve, the cooling medium being adapted to pass through said sleeve and sleeve outlet opening into said housing to cool the hydrocarbon cracked products admitted to said housing through said inlet and also to cool said valve member and associated parts to inhibit the formation of coke.

4. A valve of the character described adapted for use with transfer lines containing hydrocarbon cracked products including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the opening of said inlet, a bonnet secured to said valve housing and including a sleeve surrounding a portion of said valve stem, said sleeve extending into said housing, and a bearing for said valve stem adjacent one end of said sleeve, said bearing being provided with slots and said sleeve adjacent its other end being provided with a plurality of openings, said bonnet being provided with a secondary inlet for admitting a cooling medium around said valve stem and into said sleeve, the cooling medium being adapted to pass through said sleeve openings and bearing slots into different parts of said housing to quench the hydrocarbon cracked products admitted to said housing through said inlet and also to cool said valve member and associated parts to inhibit the formation of coke.

5. A valve of the character described adapted for use with transfer lines containing hot hydrocarbon fluid including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for opening and closing said inlet, a bonnet provided with

a sleeve extending into said housing and surrounding a portion of said valve stem, said sleeve being provided with an outlet opening, and means whereby a cooling medium is introduced into said sleeve around said valve stem, the cooling medium being adapted to pass through said sleeve and sleeve outlet opening into said housing to cool said valve member and associated parts.

6. A valve of the character described adapted for use with transfer lines containing hydrocarbon cracked products including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the opening of said inlet, a sleeve surrounding a portion of said valve stem, said sleeve extending into said housing, one end of said sleeve being adjacent said valve member, said sleeve being provided with a plurality of openings, and means whereby a cooling medium is admitted around said valve stem and into said sleeve, the cooling medium being adapted to pass through said sleeve and sleeve openings into different parts of said housing to cool the hydrocarbon cracked products admitted to said housing through said inlet and also to cool said valve member and other valve parts to inhibit the formation of coke.

7. A valve of the character described adapted for use with transfer lines containing hot hydrocarbon fluids, including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the opening of said inlet, a sleeve surrounding a portion of said valve stem and extending into said housing, one end of said sleeve being adjacent said valve member, said sleeve being spaced from the interior wall of said housing, said sleeve being provided with openings adjacent said valve member and adjacent said space between said interior wall of said housing and said sleeve and means whereby a cooling medium is admitted around said valve stem and into said sleeve, the cooling medium being adapted to pass through said sleeve and a portion thereof is adapted to pass through said sleeve openings adjacent said valve member and another portion is adapted to pass through said sleeve openings adjacent said space between said interior wall of said housing and said sleeve to cool the hydrocarbon fluids admitted to said housing through said inlet and also to cool said valve member and other valve parts.

8. A valve of the character described adapted for use with transfer lines containing hot hydrocarbon fluids, including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for controlling the opening of said inlet, said valve member having a tapered end portion to change the incoming stream of hydrocarbon fluids into an annular stream, a sleeve surrounding a portion of said valve stem and extending into said housing, one end of said sleeve being adjacent said valve member, said sleeve being spaced from the interior wall of said housing, said sleeve being provided with openings adjacent said valve member and adjacent said space between said interior wall of said housing and said sleeve and means whereby a cooling medium is admitted

around said valve stem and into said sleeve, the cooling medium being adapted to pass through said sleeve and a portion thereof is adapted to pass through said sleeve openings adjacent said valve member to cool the valve member and be intimately mixed with said annular stream and another portion is adapted to pass through said sleeve openings adjacent said space between said interior wall of said housing and said sleeve to be mixed with the partially cooled hydrocarbon fluids in said housing to further cool them and also cool other valve parts.

9. A valve of the character described adapted for use with transfer lines containing hot hydrocarbon fluid including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for opening and closing said inlet, a bonnet provided with a sleeve extending into said housing and surrounding a portion of said valve stem, said sleeve being spaced from said housing, a bearing member for said valve stem adjacent one end of said sleeve, said bearing member being provided with slots, said sleeve adjacent its other end being provided with an outlet opening, said bonnet being provided with a secondary inlet for admitting a cooling medium into said sleeve around said valve stem, the cooling medium being adapted to pass through said sleeve opening and bearing member slots into said housing to cool said valve member and associated parts, said slots being arranged to give the cooling medium a whirling motion as it passes therethrough.

10. A valve of the character described adapted for use with transfer lines containing hydrocarbon cracked products at elevated temperature and pressure including, in combination, a hous-

ing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, means including a plug valve adapted to cooperate with said valve seat for controlling the volume of cracked products introduced into said valve housing, means including a sleeve extending into said housing, said sleeve being provided with an opening, said last mentioned means being provided with a secondary inlet for admitting a cooling medium into said sleeve, the cooling medium being adapted to pass through said sleeve opening into said housing to cool the hydrocarbon cracked products admitted to said housing through said inlet and also to cool said plug valve and associated parts to inhibit the formation of coke.

11. A valve of the character described adapted for use with transfer lines containing hot hydrocarbon fluid including, in combination, a housing provided with an inlet and an outlet, a valve seat in said housing associated with said inlet, a valve stem provided with a valve member adapted to cooperate with said valve seat for opening and closing said inlet, a bonnet provided with a sleeve extending into said housing and surrounding a portion of said valve stem, said sleeve being provided with an outlet opening, and means whereby a cooling medium is introduced into said sleeve around said valve stem, the cooling medium being adapted to pass through said sleeve and sleeve outlet opening into said housing to cool said valve member and associated parts, and a closure mounted on said housing and forming a wall thereof, said closure being removably mounted to afford access to the interior of said housing.

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