Jan. 15, 1935. C. E. RHEIN ET AL 1,987,972

DECOKING LANCE

Filed Jan. 7, 1933 3 Sheets-Sheet 1

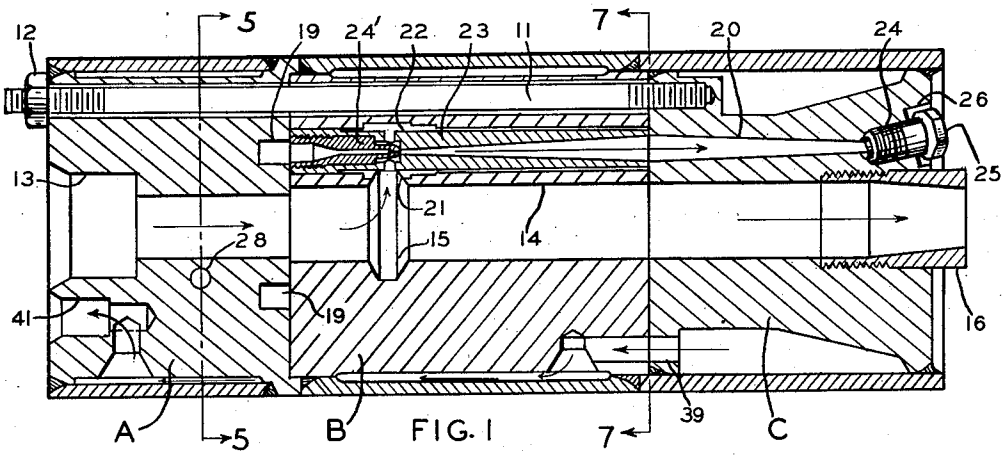


FIG. 1

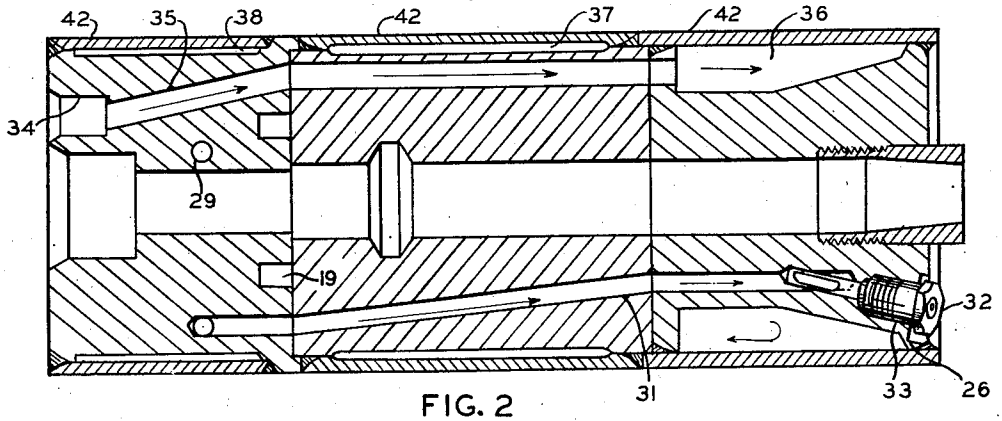


FIG. 2

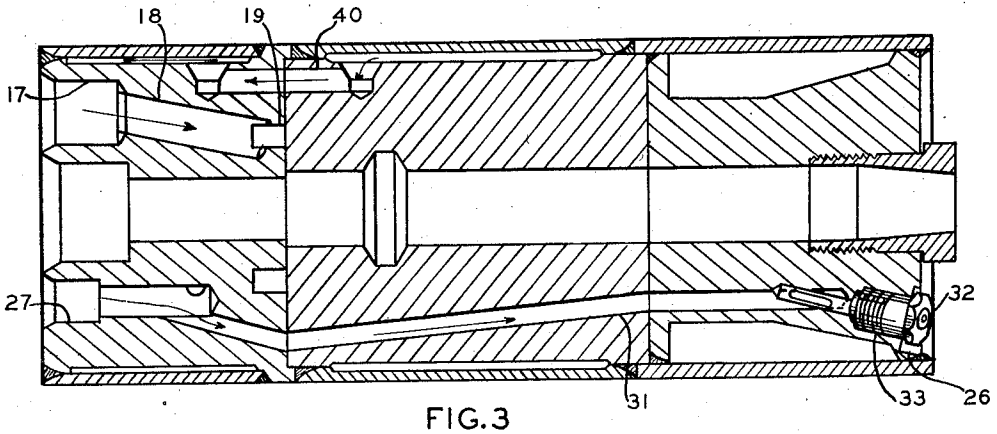


FIG. 3

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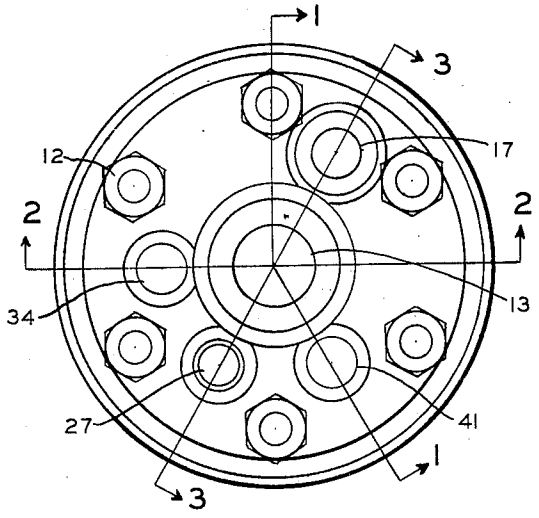


FIG. 4

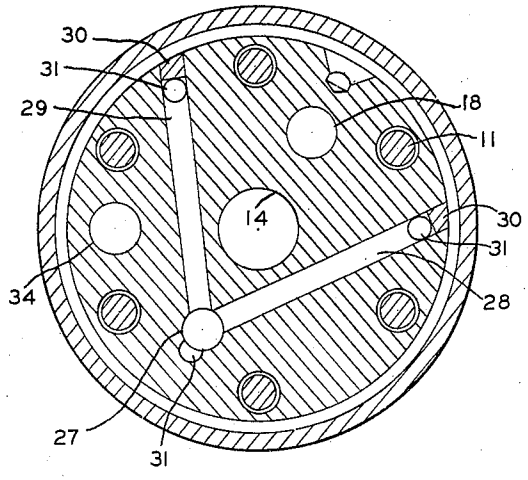


FIG. 5

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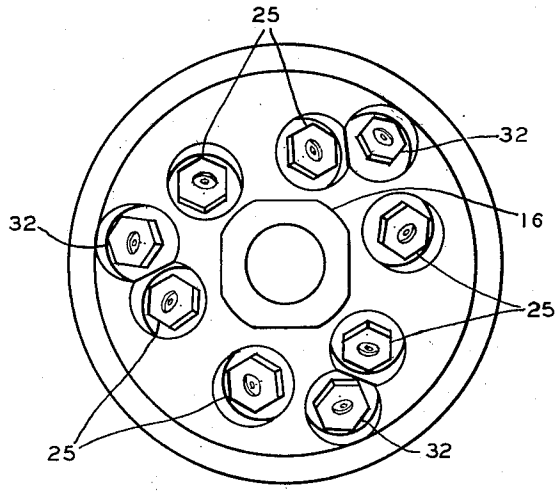


FIG. 6

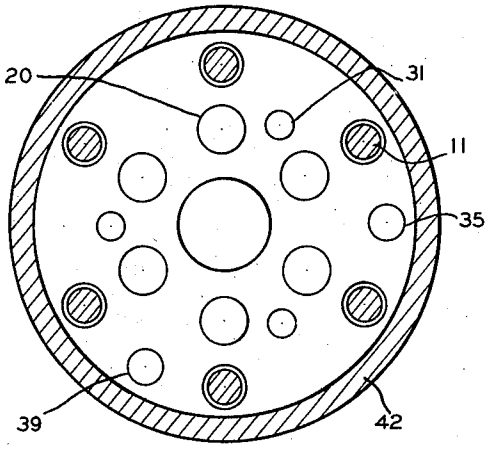


FIG. 7

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UNITED STATES PATENT OFFICE

1,987,972

DECOKING LANCE

Charles E. Rhein and James J. Bruton, Los Angeles, Calif., assignors to The Linde Air Products Company, a corporation of Ohio

Application January 7, 1933, Serial No. 650,726

9 Claims. (Cl. 158—27.4)

This invention relates to apparatus for removing carbon and other combustible deposits from tubes. More particularly the invention is applicable for use in removing the deposit of carbon from oil cracking stills and is of a character similar to and an improvement upon decoking apparatus disclosed in the copending application of C. E. Rhein and J. J. Bruton, Serial No. 631,167, filed August 31, 1932.

Apparatus of this character has heretofore been known as a lance and comprises broadly; an assembly of blow-pipes arranged in a circular manner about a central air passage, some for delivering jets of oxygen and others for delivering jets of a combustible fuel; a casing enclosing the assembly of blowpipes and provided with a water jacket for cooling the blowpipe nozzles; and a number of pipe lines connecting with the blowpipes and the central air passage and serving as a handle for guiding the lance. This type of lance is relatively heavy, especially in the head portion, and consequently does not lend itself to easy manipulation in the interior of tubes as readily as does our improved construction. The large number of parts within the casing also make the lance costly to construct and difficult to repair.

An object of this invention therefore is to provide a substantially unitary head for a decoking lance having a minimum number of parts. Another object of this invention is to provide an economically and lightly constructed apparatus for removing combustible deposits from the interior of tubes. A further object of this invention is to provide a complete cooling means for lowering the temperature of the entire head of the apparatus and for preventing the possibility of burning out the walls of the lance. Yet another object is to provide means for directing jets of oxygen and fuel to impinge at an angle against deposits within still tubes and also means for maintaining this angle. Further objects of this invention are to provide a simple apparatus and a novel arrangement of burner tips so that the parts may be easily disassembled and replaced. These and other objects of this invention will be evident from the following description and the accompanying drawings, of which

Figure 1 is a cross section of an apparatus illustrating one embodiment of this invention, the section being taken on the line 1—1 in Figure 4;

Figure 2 is a cross section taken on the line 2—2 in Figure 4;

Figure 3 is a cross section taken on the line 3—3 in Figure 4;

Figure 4 is a view of the rear end of the apparatus with the handle removed;

Figure 5 is a section on the line 5—5 in Figure 1;

Figure 6 is a view of the front of the apparatus showing the location of the burner tips; and

Figure 7 is a section on the line 7—7 in Figure 1.

The apparatus of the form illustrated in the drawings may comprise a lance head constructed of a number of relatively light blocks of metal drilled to form passages for delivering air, oxygen and a combustible fuel and recessed on the outer surface to form spaces for circulating a cooling fluid. As a material for the cylindrical blocks it is preferred to employ copper toward the front end of the lance head in order to secure adequate cooling where the heat is most intense, a bronze composition in the center of the head which is most suitable for handling oxygen, and steel in the rear of the head for ruggedness and strength. When the blocks are secured together, previously drilled passages are brought into alinement, so that the various gases may be delivered to the end of the lance without leakage or undue restriction.

It is preferred to employ three cylindrical blocks of metal in making up the head of the lance. A rear block A may serve to form a means of connection with the pipe lines or handle of the lance and to distribute the incoming gas to a number of symmetrically arranged passages. The passages are drilled through a central block B in which a mixing of air with oxygen takes place, and a front block C is provided for adapting the passages to direct the gas outwardly to inclined nozzles in the face of block C. In order to secure the separate blocks together and to make a substantially unitary head, a number of stud bolts 11 are inserted through holes in the blocks A and B and screwed into short threaded holes in the bock C. The blocks are tightly joined when cooperating nuts 12 are drawn up on the stud bolts.

The block A has an inlet 13 for admitting air or other diluting fluid to a passage 14 which extends longitudinally and centrally through the head. Within the block A the passage is made relatively small in diameter so as to leave sufficient space for the numerous other passages which supply oxygen, fuel gas and water to the lance head. The passage 14 may be counterbored, as at 15, a short distance from the rear of the block B, forming an enlarged area in the passage. A nozzle 16 is provided in the forward end of the passage and may have a bore which converges toward the end for increasing the velocity of the blast of air issuing into the interior of the tube to be cleaned.

The block A is further provided with an inlet 17 for admitting oxygen and an inclined passage 18 terminating in an annular space 19, which serves as an oxygen distributing chamber. It is preferred to have six equally spaced oxygen passages 20 leading from the space 19 to the front end of the block C. These passages 20 intersect the counterbore 15 leaving openings 21 through which air from the passage 14 may join the oxygen, and at the points of intersection en-

larged areas 22 are bored within the oxygen passages to enable the air to flow more readily into the passages 20. So as to insure a comparatively great dilution of the oxygen, injectors 23 may be employed in the passages 20, having nozzles 24' adjacent the openings 21 for drawing air through the areas 22. In the block C the oxygen passages taper to a smaller diameter near the outlet where outwardly inclined drillings 24 are made to connect with the passages 20. The drillings 24 are also inclined at an acute angle with the radial planes of the passages 20 in order to impart a swirling motion to the jets of oxygen. The jets are formed by nozzles 25 which may be threadedly secured in the drillings 24 so as to protrude but slightly beyond the surface of the block C. The end of the block is countersunk, as at 26, to provide recesses for receiving the heads of the nozzles and for protecting the angular setting of the tips against bending and distortion from contact with the walls of tubes.

In order to admit a fuel gas to the lance head, an inlet 27 may be drilled in the rear of the block A. As shown in Fig. 5, two transverse drillings 28 and 29 are made from the outer edge of the block to terminate in the forward end of the inlet 27. The outer ends of these drillings may be closed off with suitable plugs 30. Arranged symmetrically and relatively close to the outer margin of the lance head are three passages 31 for conducting the fuel gas to nozzles 32 at the forward end of the block C. The passages 31 are inclined toward the center axis of the head in the block B so as to proceed through the block C inside of the outer recessed area. The nozzles 32 are inclined outwardly toward the rim of the lance head in drillings 33 in a manner similar to the oxygen nozzles 25. However the fuel nozzles are further inclined at an acute angle with the radial planes of the passages 31 so as to tilt toward adjacent oxygen nozzles. With this arrangement of tips the fuel gas jets unite with jets from the adjacent oxygen nozzles at points substantially close to the outer margin of the lance head. When operating within tubes of a slightly greater diameter than that of the lance, the fuel jets will ignite close to the inner surface of the carbon or other combustible deposit in the tube and direct the most intensely hot areas of their flames against the surface of the deposit. The three fuel nozzles will thus be paired with three of the oxygen nozzles, while the remaining oxygen nozzles will direct independent, single jets against the deposited material and tend to spawl off the heated and burning pieces of carbon or other combustible material.

An inlet 34 for a cooling medium may be made in the rear of the block A so as to join with a passage 35 leading through the lance head to the forward block C. The passage 35 opens into a space 36 which is formed by removing the surface of the block C to a comparatively great depth, leaving only thin walls of metal surrounding the passages. Spaces 37 and 38 may also be removed from the surfaces of the blocks B and A respectively to provide further means for cooling the lance head. These latter spaces are shallow, because the temperature of the two rear blocks does not become so high as that of the block C. A short passage 39 through the outer margin of the head connects the cooling spaces 36 and 37, and a similar passage 40, at a point preferably more than 90° from the passage 39, may be provided to connect the cooling spaces 37 and 38. An outlet 41 is provided, leading from the space 38 to the rear of the block A In order to enclose the cooling spaces, the lance head may have a jacket comprising cylindrical sleeves 42 which are slipped over each of the blocks and welded or soldered to the outer edges thereof. With this arrangement of jacketed cooling spaces and interconnecting passages, water or any other suitable cooling medium may be circulated through the passage 35 to the space surrounding the block C and passed back around the blocks B and A to the outlet 41, lowering the temperature of the entire lance head.

The inlet and outlet passages in the rear of the block A may be tapped and countersunk for receiving the various gas and cooling medium supply pipes. The compact arrangement of the passages in the lance head will permit these supply pipes to be closely arranged so as to serve as a suitable handle for guiding the lance.

In operation, fuel such as illuminating gas or acetylene is turned on at the rear of the lance head and the fuel nozzles are ignited. When the lance is inserted into the interior of the tube to be cleaned, the air and oxygen are turned on, producing an area of highly concentrated heat where the whirling jets impinge on the surface of the deposit in the tube. The blast of air through the central duct ejects the material from the tube as it is burned and spawled off by the high temperature flames. In order to prevent or substantially to eliminate the effect of the oxygen in tending to cut the steel walls of the tubes, the concentration of oxygen is reduced. The injectors in the oxygen passages draw in enough air from the central duct to lower the concentration of oxygen below what is normally a cutting mixture. Water may be continuously passed through the cooling jacket to protect the lance head and nozzles and also to indicate roughly the temperature within the tube. When steam appears at the water outlet, the carbon or combustible deposit is burning but at the same time adhering to the tube so that the lance cannot be advanced, indicating unsatisfactory operating conditions.

While we have disclosed a preferred embodiment of this invention it will be understood that changes may be made in the form as described without departing from the scope of this invention.

We claim:

1. In an apparatus for removing deposits from the interior of tubes, a head consisting of a plurality of blocks arranged in end to end relation, each of said blocks being provided with a plurality of passages, the passages in the blocks being aligned with the passages in adjacent blocks; a plurality of oxygen nozzles operatively connected with said passages to receive oxygen therefrom; at least one fuel nozzle; means for supplying fuel to the fuel nozzle; and means for diluting the oxygen supplied to the oxygen nozzles and for producing an air jet at the forward end of the head.

2. Apparatus for removing deposits from the interior of tubes comprising a head consisting of a plurality of blocks, each block having a plurality of passages, the passages of adjacent blocks being aligned; means operatively connected to certain of said passages for forming jets of oxygen, said means being so positioned as to direct the jets outwardly and circumferentially; at least one fuel nozzle operatively connected to another of said passages, said fuel nozzle being inclined outwardly and at an angle opposed to the direc-

tion of the oxygen jet forming means; and means for supplying a blast of air longitudinally of the head.

3. In apparatus for removing deposits from the interior of tubes, the combination of a plurality of blocks arranged in end to end relation, each block being provided with a plurality of passages extending longitudinally therein, the passages of adjacent blocks being aligned and arranged in a circular manner about the central axis; a plurality of oxygen nozzles secured in certain of the passages of one of the blocks and directed in such a direction as to impart a swirling motion to the oxygen jets delivered therefrom; a plurality of fuel nozzles arranged in other of the passages of the block supporting the oxygen nozzles; an air nozzle for directing a blast of air centrally of the oxygen jets; and means including said passages for supplying oxygen, fuel and air to the respective nozzles.

4. In an apparatus for removing deposits from the interior of tubes, the combination with a head consisting of a plurality of blocks, each of said blocks being provided with a plurality of passages therein and the passages of adjacent blocks being in alignment, of a number of spaced oxygen nozzles, said nozzles being affixed in the ends of certain of the passages in one of the blocks and disposed at an angle with said passages, said nozzles being inclined outwardly toward the outer margin of the head, and substantially half as many fuel nozzles arranged at an angle opposed to the oxygen nozzles in order to form composite fuel and oxygen jets, said fuel nozzles being spaced substantially equi-distant circumferentially.

5. An apparatus for removing deposits from the interior of tubes comprising a head composed of three blocks, each block having a plurality of passages therein, the passages of adjacent blocks being aligned, said blocks being securely held together; means for directing a blast of diluting fluid longitudinally of the head; means including injectors within certain of the passages for delivering oxygen and for receiving a portion of the diluting fluid and mixing it with said oxygen; nozzles operatively connected with said last mentioned passages for directing diluted oxygen against the deposits in the tubes; at least one fuel nozzle; and means for supplying fuel to said nozzle.

6. In a device of the class described the combination of a distribution block, an intermediate block and a delivery block, said distribution block being provided with an annular passage on one face thereof and a conduit extending from said annular passage to the other face of said block, said intermediate block being provided with a plurality of passages extending therethrough; a plurality of injectors secured within certain of the passages of the intermediate block, said injectors being in operative connection with said annular passage and one of the other passages in said intermediate block, said delivery block being provided with a plurality of passages, certain of said passages being in communication with the injectors in said intermediate block; and nozzles supported by said delivery block at the end of the passages in communication with said injectors.

7. An apparatus for removing deposits from the interior of tubes comprising a cylindrical head made up of blocks of metal arranged in end to end relation, each of said blocks having a plurality of passages, the passages of adjacent blocks being in alignment; means operatively connected to one of the terminal blocks and extending through the remaining blocks for clamping said blocks together; jet forming means mounted in some of the passages of one of the terminal blocks for forming jets of oxygen impinging on the deposit to be removed, at least one fuel nozzle for igniting the deposit; means comprising at least one of the passages in each of the blocks for supplying fuel to said nozzle; means including the central passage in each of the blocks for directing a blast of air longitudinally of the head; a sleeve surrounding each of said blocks and forming spaces for a circulating medium to cool said blocks; and means for connecting the spaces about adjacent blocks, said connecting means not being in alignment.

8. In apparatus of the class described the combination of a plurality of blocks having passages therein, the blocks being arranged in end to end relation with the passages of adjacent blocks in alignment; nozzles secured to one of said blocks at the extremity of said passages, said blocks being provided with annular depressions at the exterior thereof; sleeve members surrounding said blocks cooperating with said annular depressions to form cooling liquid chambers; and passages connecting said annular depressions of the respective blocks, said passages not being in alignment whereby the cooling liquid is caused to flow circumferentially about said blocks.

9. A decoking lance comprising a body member provided with a central aperture and a plurality of longitudinally extending passages surrounding said central aperture, nozzles at one end of said passages, said nozzles being directed outwardly and at an angle to radial planes passing through the center of the body member, each of said passages having an injector mounted therein; means providing a gas passage from said central aperture to said longitudinal passages adjacent said injectors; and means independent of said central aperture for supplying oxygen to said passages.

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