May 11, 1965 R. W. SCOTT 3,182,734

FUSION PIERCING OR DRILLING MACHINE

Filed Jan. 11, 1963

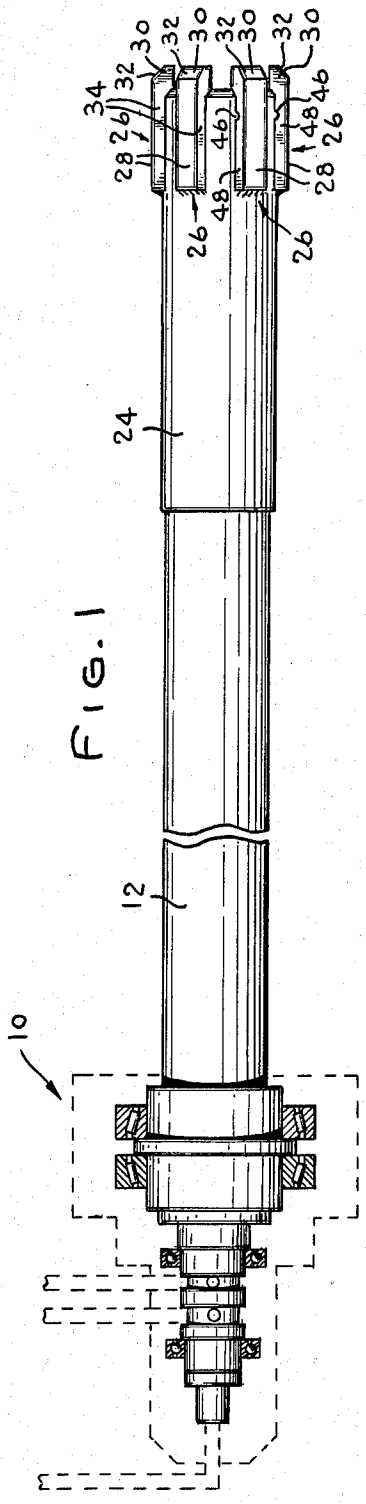


FIG. 1

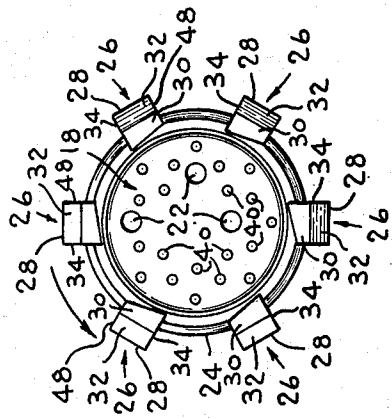


FIG. 3

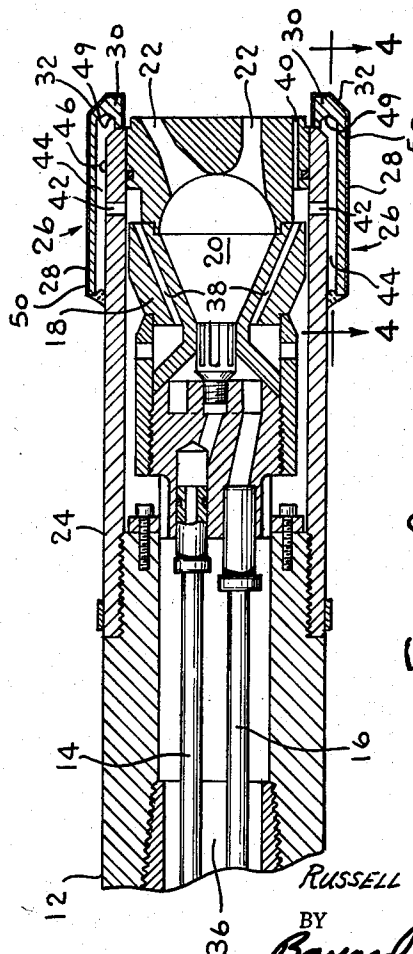


FIG. 2

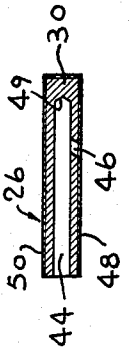


FIG. 4

INVENTOR.
RUSSELL W. SCOTT
BY
Bayard A. Michael
ATTORNEY

United States Patent Office 3,182,734 Patented May 11, 1965

3,182,734

FUSION PIERCING OR DRILLING MACHINE

Russell W. Scott, 1000 Detroit Ave.,
Iron Mountain, Mich.

Filed Jan. 11, 1963, Ser. No. 250,810
5 Claims. (Cl. 175—14)

This invention relates to fusion piercing (drilling) machines which are employed to penetrate extremely hard ores.

Fusion piercing machines employ a set of rotating reamers and high-temperature, high-velocity flames to break down and penetrate ores that are economically unworkable with conventional drilling equipment. Basically, this type of equipment consists of a long, rotatably mounted kelly, or pipe, at one end of which is mounted a combustion head adapted to produce generally axially extending high-velocity flames at its bottom face. The combustion head is enclosed in a cylindrical reamer shell which has a plurality of hard surfaced reamer lugs secured to its periphery and extending slightly further than the shell and the combustion head.

The drilling head is cooled by cooling water which is passed through the kelly and around the combustion chamber and is permitted to escape axially through a plurality of ports in the bottom face of the combustion head. As the cooling water leaves the combustion head, it encounters the extremely high operating temperatures and almost instantaneously bursts into high pressure steam which blows the cut material from underneath the blow pipe and up through the hole produced thereby.

Due to the extremely high operating temperatures of this equipment, the reamer lugs, although being hard surfaced, wear down to an unusable size within approximately thirty feet of drilling (in Taconite ores), where the drill has to be withdrawn and replaced. The worn head may be salvaged by removal and replacement of the worn lugs but the shell must also be replaced about every third time the lugs are replaced. This necessary periodic stoppage of the equipment for repair or replacement constitutes a very significant maintenance and down time expense.

The principal object of this invention is to increase the efficiency of the fusion piercing drilling machines by providing better and longer lasting reamer lugs.

This object is attained by passing a portion of the cooling water through substantially the entire length of each reamer lug and discharging it through upwardly angled ports located on the trailing side of the lug.

This type of water cooling substantially reduces the operating temperature of the reamer lugs and drills embodying this invention are able to drill about twice as far as those used heretofore, and even after such operation only the leading corner of each lug has to be resurfaced as compared to the replacement of the entire lug as required with known equipment. The high pressure steam produced at the side of each lug helps move the cut material upwardly.

Another advantage of this invention is that due to the decreased and more confined wear of the reamer lugs, the entire blow pipe is considerably better guided in the drilled hole, with resulting reduced wear of the reamer shell, the kelly and its bearing support structure. Generally, the new lugs can be reworked five times (compared to three) before the shell needs replacement.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the single embodiment shown in the drawings in which:

FIG. 1 represents the fragmentary side view of the fusion piercing machine and a schematic view of its driving means;

FIG. 2 represents a cross-sectional fragmentary view of the fusion piercing machine and a cross-sectional view of the combustion chamber;

FIG. 3 represents a bottom view of the fusion piercing machine; and

FIG. 4 represents a cross-sectional view of the reamer lug.

Referring to the drawings in detail, FIG. 1 shows the fusion piercing machine assembly which is rotatably mounted in suitable support structure **10**.

Oil and oxygen are conveyed through kelly **12** by conduits **14** and **16** respectively to combustion head **18** where they are mixed in chamber **20** to produce high-temperature and high-velocity flames at orifices **22, 22** in the bottom face of the combustion head. The orifices are so spaced as to produce fairly uniform coverage and heating of the area below the drill head when it is rotated during operation. Reamer shell **24**, having reamer lugs **26, 26** uniformly spaced on its outer periphery is removably attached to the kelly and encloses the combustion head. The lugs have their longitudinal face portion **28** parallel to the axis of the kelly and have their tips **30** extending slightly past the bottom face of combustion head **18** and reamer shell **24** to space the head from the bottom of the hole. Since the severest heat and wear is experienced by the lug tips, they are somewhat thicker than the main body of the lug, and are bevelled longitudinally and transversely to form an angular cutting surface **32** and a heavy leading tip corner **34**.

Cooling water is pressure fed to the combustion head by means of passage **36** in the kelly. A portion of the cooling water flows through passages **38** next to the combustion chamber to escape through ports **40, 40** for conversion to high pressure steam. Another portion of the cooling water flows through inlet ports **42, 42** into longitudinal cavities **44, 44** within lugs **26**, from which it escapes through upwardly angled ports **46** on trailing side **48** of the lugs. The ports are located above the lower extremity **49** of cavity **44** to provide for discharge above the debris to reduce likelihood of fouling the ports. The cooling of the lugs proves quite significant. With the old construction the hard surfaced lugs showed evidence of having reached the plastic state where material was actually wiped off. With the cooling of the lugs the wear is confined to the tips of the lugs with no evidence of having reached the plastic state.

Lugs **26** are welded to the reamer shell and are hard surfaced with a layer **50** of suitable hard surfacing material (an alloy of cobalt, chromium and tungsten), as Stellite 6. The drilling head may easily be reconditioned merely by rebuilding such corners with the hard surfacing material which may be applied to the lugs by arc welding. While the lugs are repaired easily (compared with replacement in the past) it is also important to note the lugs can be reworked five times before the shell needs replacement (three times with the old construction). This indicates the improved guiding afforded by the present rig. On top of all this the drill will pierce about twice as much rock before requiring resurfacing. All told, it appears maintenance costs are reduced by about twenty percent and this is significant since these rigs now run many thousands of dollars per month for maintenance.

Although only a single embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. Fusion piercing apparatus comprising:

a kelly rotatably mounted in a support structure and containing first conduit means for conveying com-

bustible material and second conduit means for conveying a liquid coolant;

a combustion head secured to said kelly and having a mixing chamber and axially outwardly facing orifices in communication with said first conduit means, and coolant passages in communication with said second conduit means and surrounding said mixing chamber, said coolant passages being in communication with axially extending ports for conveying a part of the liquid coolant to the atmosphere;

a plurality of reamers surrounding said combustion head, said combustion head being adapted to produce high temperature flames at said orifices which flames in combination with said reamers are adapted to penetrate hard ores; and

a coolant passage provided within each of said reamers having an inlet port in communication with at least one of said coolant passages of said combustion head and having an outlet port to the atmosphere to thereby convey a part of the liquid coolant directly to the atmosphere through the reamer.

2. Apparatus according to claim 1 wherein said kelly is adapted to operably rotate in one direction, and said exit ports are located in the trailing side of said reamers and are angled away from the flames to discharge the coolant in an upward direction during operation of the fusion piercing apparatus.

3. Apparatus according to claim 2 wherein said reamers extend longitudinally with respect to said kelly and have tips extending beyond said combustion head, each of said tips being heavier on its leading side than on its trailing side.

4. Apparatus according to claim 2 wherein said reamers extend longitudinally with respect to said kelly, each coolant passage extending through substantially the entire length of the reamer, and each exit port being positioned between the longitudinal extremities of said coolant passage.

5. An aperture according to claim 1 wherein said outlet ports of the reamers are located on one side of each reamer.

References Cited by the Examiner

UNITED STATES PATENTS

2,327,499	8/43	Burch	175—15
2,327,508	8/43	Craig	175—15
2,675,994	4/54	Smith et al.	175—15 XR
3,093,197	6/63	Freeman et al.	175—14

CHARLES E. O'CONNELL, *Primary Examiner.*