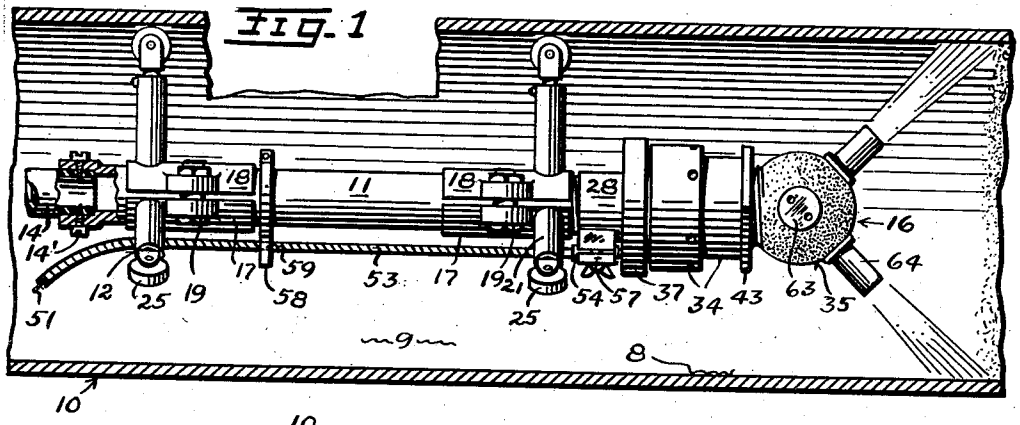
Sept. 19, 1944. J. G. BOYD ET AL 2,358,557

BLAST CLEANING DEVICE

Filed June 26, 1942 2 Sheets-Sheet 1

Fig. 1



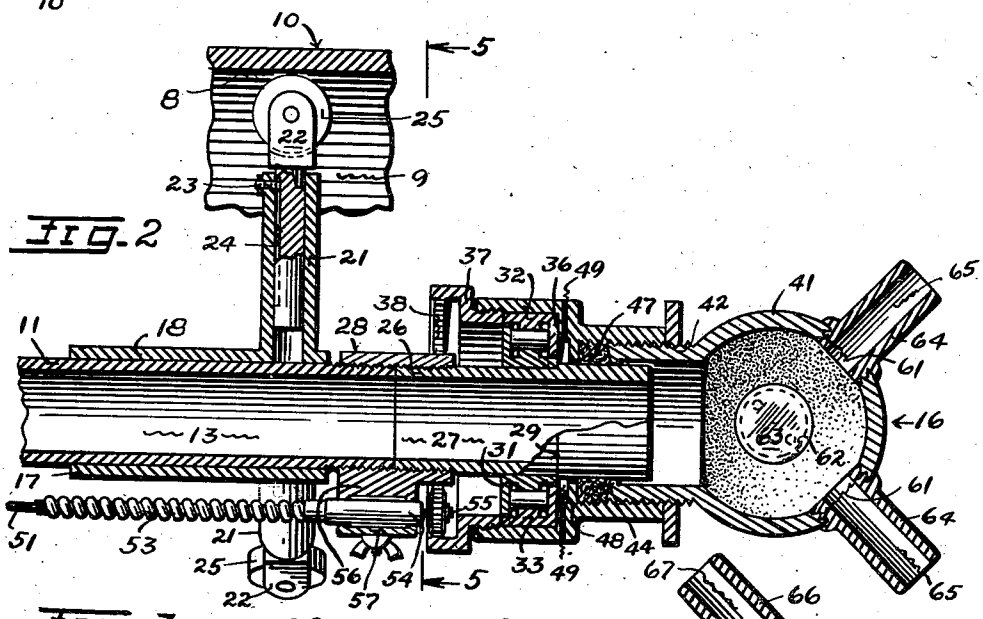


Fig. 2

Fig. 3

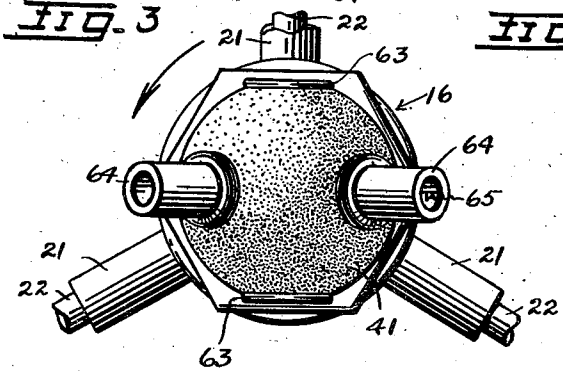
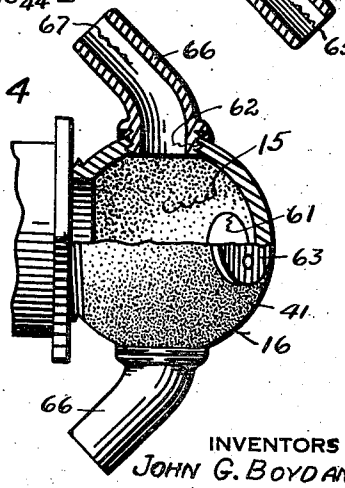


Fig. 4



INVENTORS
JOHN G. BOYD AND
CLAYTON M. HANE
BY Henry N. Young
ATTORNEY

Sept. 19, 1944. J. G. BOYD ET AL 2,358,557

BLAST CLEANING DEVICE

Filed June 26, 1942 2 Sheets-Sheet 2

Fig. 5

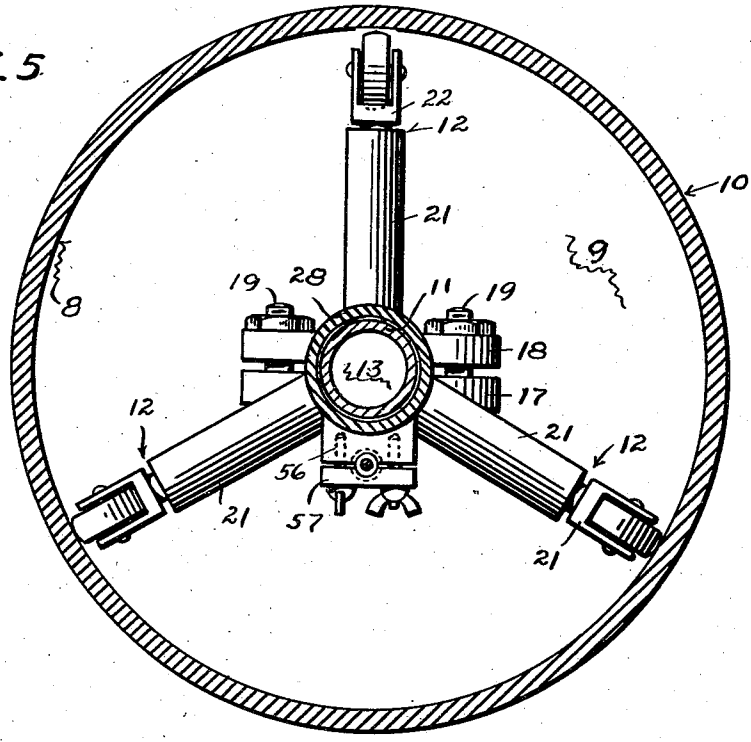


Fig. 6

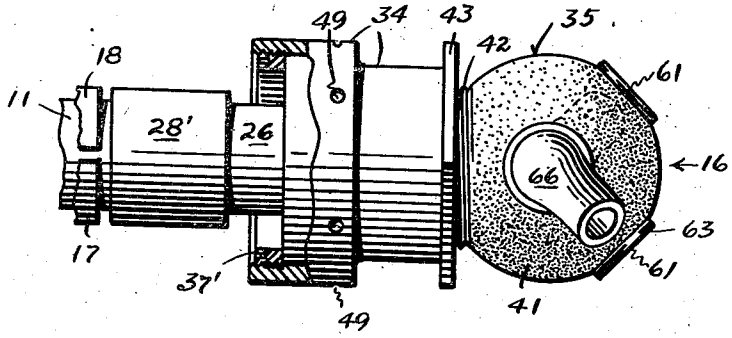
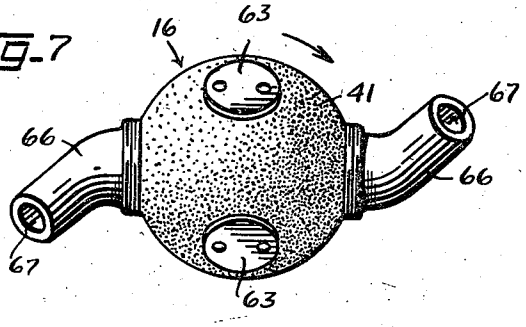


Fig. 7



INVENTORS
JOHN G. BOYD AND
CLAYTON M. HANE
BY Henry N. Young
ATTORNEY

Patented Sept. 19, 1944 2,358,557

UNITED STATES PATENT OFFICE

2,358,557

BLAST CLEANING DEVICE

John G. Boyd, Oakland, and Clayton M. Hane,
Contra Costa County, Calif.

Application June 26, 1942, Serial No. 448,580

6 Claims. (Cl. 51—8)

The invention relates to a device for progressively cleaning the sides of a cylindric bore by the forcible application of a fluid against them.

A general object of the invention is to provide a particularly effective device for the cleaning of bore walls by the application of a blast of cleansing material in and along the bore.

A more specific object is to provide an improved travelling sand blast unit having a rotary head for forcibly delivering air-borne sand and similar abradants in and along the surface of a bore.

Another object is to provide a particularly simple dynamically balanced blast unit of the type described.

A further object is to provide a particularly effective seal between the rotary head and the unit element which carries it.

An added object is to provide an improved and simple means for effecting the rotation of the rotary head.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent from a consideration of the following description of typical embodiments thereof and of the accompanying drawings, in which,

Figure 1 is a side view of a unit embodying the features of invention and operatively installed within a fragmentarily shown pipe.

Figure 2 is an enlarged axial section of the head end portion of the unit of Figure 1.

Figure 3 is a fragmentary head end view of the unit.

Figure 4 is a partly sectional axial elevation showing alternative nozzle members installed on the rotary head of the unit.

Figure 5 is a sectional view taken at 5—5 in Figure 2.

Figure 6 is a fragmentary side view of a modification utilizing nozzles shown in Figure 4 for a further purpose.

Figure 7 is a front end view of the head of Figure 6.

In its present embodiments, the device of our invention is shown as embodied in a blasting unit for use to progressively clean the surface 8 bounding the uniform cylindric bore 9 of a pipe 10 by effecting the forcible application of a cleaning blast to remove scale or other unwanted coatings from the bore side 8. The disclosed structure has been particularly designed for the cleaning application under pressure of a continuous blast of air-borne particles which may comprise abradants such as sand, emery or carborundum particles and/or particles of chemically active materials, as may be desirable for a bore to be cleaned.

As particularly illustrated, a unit embodying the structural features of our invention essentially comprises a tubular body member 11 having sets of supporting and positioning legs 12 extending radially from it adjacent its ends and having the rear and front ends of its passage 13 respectively connected with the passage of a supply hose 14 and with a nozzle-supplying manifold space 15 provided within a head 16 rotatably mounted on the body. The hose 14 is preferably flexible, is shown as secured by screws 14' in a counterbore portion of the passage 13 at the rear end of the body 11, and provides a passage which is preferably of no greater diameter than the body passage whereby to avoid any constriction of the stream at the hose connection. The hose 14 comprises the source of the pressure stream containing air-borne cleaning particles for blasting projection from the unit, and is supplied with said stream from a suitable pumping and mixing device not shown, such devices being well known in the art.

Split sleeves having complementary sections 17 and 18 mount the legs 12 and are removably mounted on the body 11 for adjusted positioning therealong, bolts 19 being cooperative between complementary sections 17 and 18 to clampingly fix them to the body. Preferably, and as shown, the legs 12 radiate in symmetrically spaced relation from the body axis, with the sleeve section 17 providing two legs 12 while the section 18 provides but one leg 12. Each leg 12 comprises a tubular section 21 extending integrally from a sleeve section 17 or 18, and an outer section 22 telescopically adjustable in the bore of the section 21 for its fixing in adjusted position by a set screw 23 mounted in the outer end of the section 21 and engageable with the bottom of a kerf 24 extending in and along the section 22.

The outer end of each leg section 22 is arranged to engage the bounding surface of a bore to be cleaned, as the surface 8 of the pipe bore 9, for movement axially therealong without undue friction, and a suitable anti-friction means is preferably provided thereat; for the latter purpose, the outer portion of the section 22 may mount a roller or wheel 25 which has its plane constantly including the unit axis to thereby minimize tread friction for a wheel engaging the surface 8. When, as is shown, the portion of the section 22 which engages within the section 23 is cylindric, the engagement of the inner end of the set screw 23 in the kerf 24 prevents a misalignment

of the wheel during a length adjustment of a leg.

In practice, the effective lengths of the legs 12 are adjusted to substantial equality for the axially centered disposal of the unit in the pipe passage 9. When the pipe is in the prone position shown, two of the legs of each leg assembly may support the unit on wheels 24 from lower side points of the inside pipe surface 8 while the wheels of the third legs are slightly spaced from upper points of said surface as a means to prevent an appreciable tilting of the unit in the pipe passage. For the use of the unit in straight bores, the two leg assemblies are preferably positioned adjacent the opposite ends of the tubular body 11, while the use of the unit in and along curved bores may be facilitated by decreasing the mutual spacing of the leg assemblies as permitted by the present leg-mounting device.

It will now be noted that the head 16 is rotatably mounted on a tubular member 26 comprising an extension of the body 11 unitarily fixed thereto and coaxially abutting the latter with its passage 27 registering with the body passage 13 as a continuation thereof. As particularly shown in Figures 1 and 2 and 5, the body extension member 26 is secured to the body member 11 by means of a coupling sleeve 28 threadedly engaging the members, while a coupling sleeve 28' functions as the sleeve 28 for fixing the members 11 and 26 of the embodiment of Figure 6 together as a structural element. The sectional structure thus provided for the head-mounting body of the unit is designed to facilitate the assembly of the unit elements, and comprises the immediate support for the rotary head 16.

Intermediately thereof the body member 26 is internally stepped to provide a shoulder 29 facing rearwardly and against which the inner race ring 31 of a suitable roller bearing assembly 32 engages, said race being fixedly held in its place as by its driven fit upon the member. The outer race ring 33 of the bearing assembly mounts a tubular member 34 which comprises a rear portion of the head 16 and carries a forward head member 35 providing the manifold cavity 15 which supplies the nozzles of the head with the cleaning material. As shown, the bore of the member 34 is intermediately stepped to provide a rearwardly facing shoulder 36, and its larger bore portion is arranged to closely and removably receive the race 33 in engagement with the shoulder 36 as a stop.

Rearwardly of the portion thereof which receives the race 33, the member 34 threadedly mounts within it a suitable keeper ring for releasably fixing the race 33 in place in the member and so secures the member against movement axially of the supporting body while the head rotates about the body axis. A radially stepped keeper ring 37 is shown in Figures 1 and 2 and provides an internal gear 38 at its rearward end portion for use in a manner to be hereinafter described, while the keeper ring 37' shown in Figure 6 lacks any gear.

Preferably, and as shown, the head member 35 includes a globate forward part 41 providing the space 15 from which the blast is discharged through suitable nozzles, and a tubular stem-like part 42 which is arranged for fixed engagement with the forward portion of the head member 34. As shown, the cylindrical part 42 is of somewhat less diameter than the globate part 41, threadedly engages with and within the forward portion of the member 34 while freely receiving the forward end of the body member 26, and is arranged for fixing in its mounted position by means of a lock nut 43 mounted on its threaded exterior and arranged for jambing engagement with the annular forward end of the head member 34.

Noting that the manifold cavity 15 comprises the interior space of the head member 35 provided jointly within its parts 41 and 42, and that the working pressure in said cavity is appreciably in excess of atmospheric, means are provided for preventing the pressure-forcing of the air-borne abradant into and through the bearing assembly 32. As particularly illustrated, the rearward extremity of the head member 35 is provided with an inturned flange 44 having its bore closely receiving the cylindrical exterior of the body member 26 for the rotation of the head about the member, while the portion of the head member 34 forwardly of its shoulder 36 is provided with an internal annular flange 45 having its bore receiving the body member 26 as does the flange 44. The space defined by and between the slightly beveled face at the inner end of the member 42 at its flange 44 and the flange 45, and between the exterior of the body member 26 and the interior face of the head member 34 between said flanges, comprises a stuffing box which is arranged to contain a suitable soft packing 47, with the permitted adjusted setting of the head stem 42 in the member 34 determining the degree of seal provided by the packing.

To further protect the head-carrying bearings 32 from the possible movement of the abradant material thereinto by pressure, the flange 45 of the member 34 is preferably provided at a point forwardly of the shoulder 36 of the member to thereby define an annular cavity 48 between the flange and the bearing assembly, with passages 49 extending radially through the member from the cavity. The passages 49 are constantly open and serve as relief or bleeder ducts for the space 48 to prevent the pressure circulation through the bearings of any air which may pass the packing 47. It will thus be understood that the cleaning material to be delivered in the blast from the head 16 is kept out of the support bearings for the head without interference with the rotation of the head.

In the embodiment of Figures 1 to 5 inclusive, the rotation of the head 16 is arranged to be positively effected by driving it with a flexible shaft 51 which is actuated by a suitable motor means (not shown) and carries a pinion 52 engaging the gear 38 of the keeper 37 for rotating the head at the desired rotary speed. In the present instance, the motor means for actuating the shaft 51 would be independent of the blast unit, and the shaft is carried in a usual flexible sheath 53 providing a head portion 54 in which a rigid shaft 55 carrying the pinion 52 and comprising the terminal portion of the shaft 51 is journalled. The appropriate positioning of the pinion 52 for engaging the gear 38 is effected by mounting the sheath head 54 on a radial extension 56 of the coupling member 28 to which it is removably secured by a bolted-on cap 57. A hanger member 58 providing an eye 59 for freely receiving the sheath 53 therethrough may be mounted at a rearward point of the body for maintaining the forward sheath and shaft portions in parallel relation to the unit axis and so prevent kinking of the sheath and shaft adjacent the shaft-mounting extension 56 of the sleeve 28.

The globate part 41 of the rotary head 16 is provided with one or more sets of discharge openings at which suitable jet nozzles may be provided. As particularly shown, a set of openings 61 is provided in the part 41 forwardly of the spherical center thereof, the lines of said openings radiate from said center as comprising a point in the unit axis, and said lines make angles of about forty five degrees with said axis and lie in a common plane including the axis whereby they are symmetrically related to the head member. A further set of two threaded openings 62 is provided in the part 41 at opposite sides thereof and in mutually coaxial relation, with their line intersecting the unit axis at or adjacent the spherical center of the part 41, whereby they are also symmetrically related to the head. The openings 61 and 62 are preferably of like size and threading, and screw-plugs 63 are provided for application to close those openings 61 and/or 62 not used for mounting nozzles on the head.

By particular reference to Figures 1 to 3 inclusive, it will be seen that nozzles 64 are threadedly mounted in the forward head openings 61, said nozzles providing straight discharge passages 65 whereby these forwardly-directed passages are arranged to deliver the air-borne abradant from the head 16 in lines which intersect the axis of rotation of the head at a common point and make angles of substantially forty-five degrees with said axis. With the head 16 rotating, as by the action of the drive shaft 51 through the disclosed gear connections, while the unit is advanced through the bore to be cleaned, the jets discharged from the two nozzles 64 will operate in helical lines along the bore surface for cleaning the latter. Although the arrangement is not shown, it will be understood that nozzles 64 might be mounted at the rearward openings 62, with the forward openings 61 closed by screw-plugs 63 or also having nozzles 64 mounted thereat.

It may sometimes be desirable to direct the discharged jets of cleaning material rearwardly with respect to the head part 41, and to that end appropriately formed nozzles 66 are provided for mounting at the radial head openings 62 to provide rearwardly directed jets of cleaning material against the surface being cleaned. As particularly brought out in Figure 4, the nozzles 66 provide curved discharge passages 67 which have their inlet and discharge ends making an angle of substantially forty-five degrees with each other. The present nozzles 64 and 66 are provided with external flanges at the bases of their threaded parts whereby they may be fixedly set against the head in operative position thereon.

With the nozzles 66 mounted to discharge rearwardly, and with the planes of their discharge passages including the head axis as in Figure 4, the flexible shaft 51 would be utilized to rotate the head 16 as before. With this nozzle arrangement, the feeding motion of the present unit in a bore to be cleaned may be one of retraction rather than of advancement with respect to the bore end from which the unit is inserted. While the nozzles 66 might be directed forwardly in coplanar relation with the unit axis, such a use thereof at the openings 62 in lieu of the straight nozzles 64 at the openings 61 is not generally desirable because of the added wear of an abrasive on the walls of a curved passage.

It will now be particularly noted that if the plane of the passage 67 of a mounted nozzle 66 is disposed in intersecting relation to the axis of rotation of the head 16, the line of the discharged jet does not intersect the unit axis and the reaction of discharge therefore produces a turning moment upon the head as a possible head-rotating means. Such a functioning of jets from nozzles is provided for in the assembly of Figures 6 and 7 wherein nozzles 66 mounted at the rear openings 62 of the head 16 are disposed in symmetrical arrangement to discharge their jets obliquely forwardly for simultaneously providing the described bore-cleaning and head-rotating actions; a similar action may, of course, be produced if the nozzles 66 are directed obliquely rearwardly with their planes intersecting the unit axis. With the head 16 thus arranged for rotation by the jet reaction as comprising a fluid-motor drive for the head, no other head-rotating means may be needed; accordingly, the gearless keeper ring 37' is shown as installed on the rear head member 34 in lieu of the ring 37, while the body-coupling sleeve 28' lacking a drive shaft mounting is also used in the assembly.

While the present structures have been particularly described as for use in providing a sand blast, it will be understood that a blast of air alone may be provided by the unit, or that a liquid cleaning or coating fluid might be discharged therefrom for direction against the sides of a bore as the unit and bore are moved relatively in the axial line of the bore; for descriptive convenience, a fluid containing an abradant may be referred to as an abradant fluid.

In the present application of the unit it is assumed that the supply hose 14 is utilized as a handle for appropriately shifting the unit in and along a bore being treated with fluid discharged from the unit in the manners shown and described. Furthermore, the rotary head arrangements of Figures 1 to 3 or of Figures 6 and 7 might be used to direct a blast against flat surfaces in front of them and transverse to the unit axis, as well as radially within a bore.

From the foregoing description of our invention, taken in connection with the accompanying drawings, the advantages of the construction and operation will be readily understood by those skilled in the art to which the invention appertains. While we have described the features and use of assemblies which we now consider to be preferred embodiments of our invention, we desire to have it understood that the showings are primarily illustrative, and that such changes may be made, when desired, as fall within the scope of the following claims.

We claim:

1. In an abradant blast unit, a rigid tubular body arranged to receive an abradant fluid under pressure, a hollow head providing a discharge nozzle and having a tubular intake portion receiving an end of the body, a ring bearing means operative between the exterior of the body and the interior of the tubular head portion for rotatably mounting the head on the body for its rotation about the axis of the body portion enclosed by it, means providing a fluid-tight seal between the body and the intake portion of the head at a point between the cavity of the head and the bearing means to prevent the escape of the fluid from the head through the bearing means, and means operative to rotate the head during the discharge of fluid from the nozzle.

2. In an abradant blast unit, a tubular body arranged to receive an abradant fluid under pressure, a hollow head providing a discharge nozzle

and having a tubular intake portion freely receiving an end of the body, a ring bearing means operative between the exterior of the body and the interior of the tubular head portion for rotatably mounting the head on the body for rotation about the axis of the body portion enclosed by it, means providing a sealing ring between the body and the intake portion of the head at a point between the cavity of the head and the bearing means, said sealing ring and bearing ring being axially spaced to define an annular cavity between them and said tubular head portion being radially perforated for venting said cavity, and means to rotate the head during the discharge of fluid from the nozzle.

3. In a blast unit, a tubular body arranged to receive an abradant fluid under pressure, a hollow head rotatably mounted upon the body in sealed relation thereto for receiving the fluid therefrom and provided with a discharge opening having its line intersecting the axis of rotation of the head, a nozzle having a passage with angularly related intake and discharge portions lying in a common plane, and means adjustably mounting the nozzle at said opening for its disposition to discharge the abradant fluid in a line which is oblique to said axis of rotation in either intersecting or non-intersecting relation thereto.

4. In a blast unit, a tubular body arranged to receive an abradant fluid under pressure, a globate head rotatably mounted upon the body in sealed relation thereto for receiving the fluid therefrom and provided with a plurality of discharge openings about it in symmetrical relation to the axis of rotation of the body and having their lines meeting at a common point of the said axis, like nozzles having curved passages and mounted at said openings in position to discharge jets of the fluid in lines which are similarly oblique to said axis in such non-intersecting relation thereto that the reactions of the discharged jets are operative to urge a rotation of the head about said axis.

5. In a blast unit, a hollow body arranged to supply a blasting fluid under pressure, a hollow head mounted upon the body in sealed relation thereto for receiving the fluid from the body and for its rotation about a fixed axis with respect to the body and provided with a discharge opening having its line intersecting the axis or rotation of the head, a nozzle having a passage with angularly related intake and discharge portions, and means mounting the nozzle at said opening for its adjusted disposition to discharge the fluid from the head in a line which is oblique to said axis of rotation in either intersecting or non-intersecting relation thereto.

6. In a blast unit for progressive operation in and along a uniform bore to project a blasting fluid against the bore-defining surface, a tubular body arranged to axially receive a blasting fluid under pressure at an end thereof constituting its rear end, a hollow head swivelled upon the front body end in sealed relation thereto for receiving the fluid from the body and for its rotation about the body axis and provided with a discharge opening having its line intersecting the axis of rotation of the head, a nozzle having a passage with angularly related intake and discharge portions, means mounting the nozzle at said opening for its adjusted disposition to discharge the fluid from the head and against said bore-defining surface in a line which is oblique to said axis of rotation in either intersecting or non-intersecting relation thereto and is directed either forwardly or rearwardly from the head, and means on the body engageable with the bore-defining surface for axially centering the body in the bore for its axial movement therealong.

JOHN G. BOYD.
CLAYTON M. HANE.