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Schmidt

[11] **3,891,036**

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[54] **CONTROL ARRANGEMENT FOR THE FORWARD AND BACKWARD MOVEMENT OF PERCUSSIVE BORING RAMS**

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[52] **U.S. Cl.** **173/91;** 173/137

[51] **Int. Cl.** **B25d 9/00;** E21b 1/00

[58] **Field of Search** 173/91, 135, 137, 138; 91/154, 462

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2,157,259	11/1971	Germany	173/91

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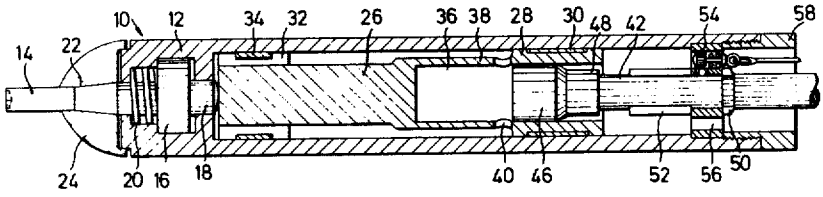
Attorney, Agent, or Firm—Toren, McGeady and Stanger

[57] **ABSTRACT**

In a self-propelled pneumatically operated percussive boring ram of the kind comprising a chisel mounted at the boring end of a hollow housing, a percussion piston which is reciprocal in the housing between the chisel and a back stop in the housing under the action of compressed air which, in use, is admitted through a tubular valve member which has a piston head acting in a cylindrical chamber in the percussion piston and which determines whether the percussion piston acts to drive the boring ram forwards or backwards depending on which of two operative positions the valve member occupies relative to the housing, the tubular member extends through a guide member attached to the housing and can be locked in one or other of its two operative positions during operation of the ram by stops on the valve member and on the guide member and a releasable catch which, when engaged, prevents rotation of the valve member relative to the guide member, the stops being arranged so that, on release of the catch, the valve member can be rotated into a position in which the stops are misaligned and allow the valve member to be moved axially from one operative position to the other.

17 Claims, 5 Drawing Figures



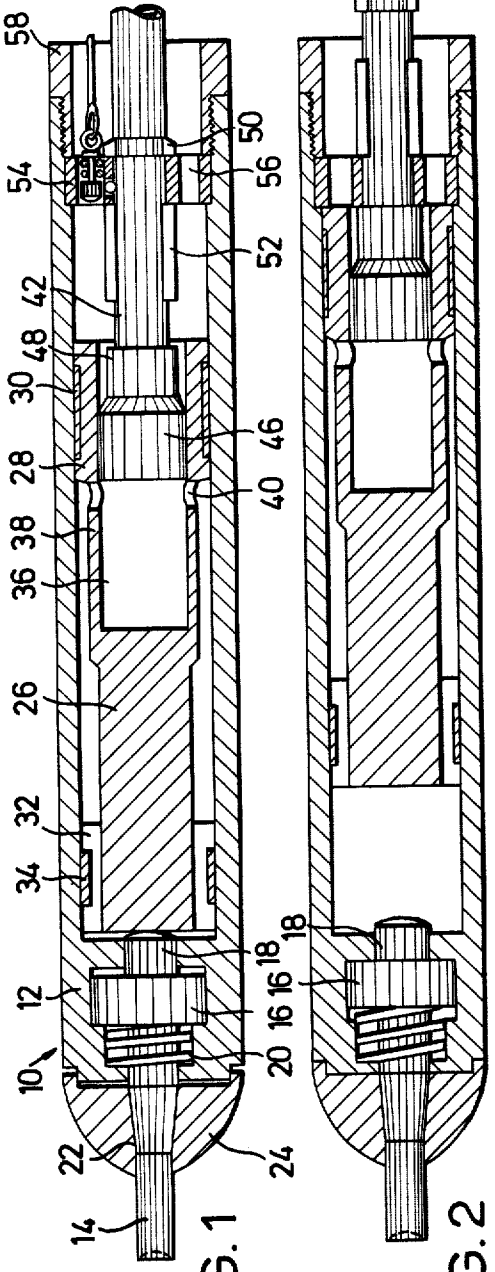


FIG. 1

FIG. 2

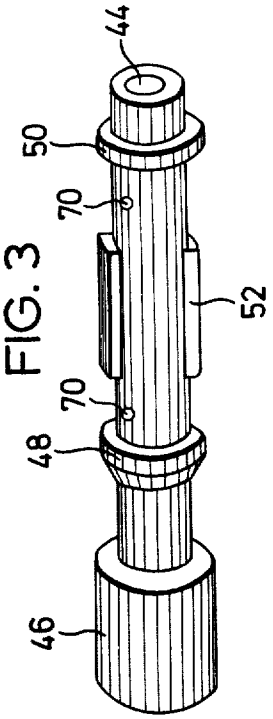


FIG. 3

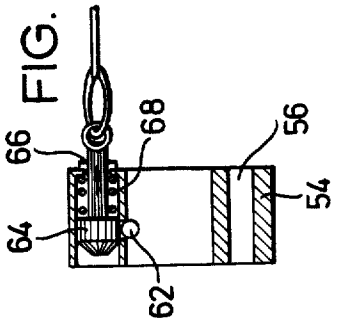


FIG. 5

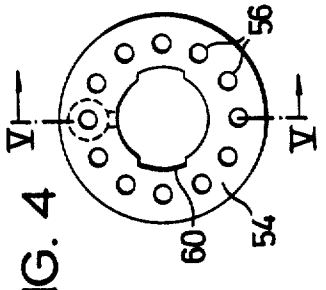


FIG. 4

CONTROL ARRANGEMENT FOR THE FORWARD AND BACKWARD MOVEMENT OF PERCUSSIVE BORING RAMS

This invention relates to self-propelled, pneumatically operated, percussive boring rams of the kind comprising a chisel mounted at the boring end of a hollow housing, a percussion piston which is reciprocable in the housing between the chisel and a back stop in the housing under the action of compressed air which, in use, is admitted through a tubular valve member which has a piston head acting in a cylindrical chamber in the percussion piston and which determines whether the percussion piston acts to drive the boring ram forwards or backwards depending on which of two operative positions the valve member occupies relative to the housing.

The German Auslegeschrift No. **2,157,259** describes a boring ram of this general kind, intended for use as a percussion mole, impact hammer or percussion drill. The known device is used mainly for making tubular holes or channels through the ground under roadways, footwalks or the like, for example before laying cables. When the boring ram is operating forwards it bores and advances through the ground, forcing ground materials out of the way sideways, producing a tubular hole with compacted walls. The ram is driven forwards by the percussion piston being accelerated forwards by compressed air until it impacts against the chisel, which may be spring-mounted to protect the housing of the ram from the full force of the impact. During the forward movement of the percussion piston some of the air situated in front of it is at first allowed to escape into the atmosphere, for example through ports in the wall of the cylindrical chamber in the percussion piston. These ports are closed by the piston head of the tubular valve member shortly before the percussion piston strikes the rear end of the chisel. A cushion of highly compressed air is therefore formed in front of the forward face of the percussion piston, which causes the latter to rebound after transmitting its kinetic energy to the chisel. The resulting backwards movement of the percussion piston is accelerated in that the ports, which originally allowed compressed air to pass outwards into the atmosphere and were then closed by the piston head of the valve member during the forward stroke, in the early stages of the backward stroke allow compressed air to pass from the cylindrical chamber into the space forward of the percussion piston. The pneumatic working face of the cylindrical chamber is smaller than the pneumatic working face of the percussion piston, and the compressed air therefore drives the percussion piston backwards.

As the percussion piston travels backwards, the ports are again closed by the piston head of the tubular valve member, and the compressed air in the cylindrical chamber, which cannot then escape, decelerates the percussion piston, the pressure in the air cushion forward of the piston decreasing. As the percussion piston reaches the end of its rearward motion the ports once more communicate with the atmosphere and thereby release the pressure entirely from the forward air cushion which brings the piston to a stop, and immediately the working cycle begins again.

When the boring ram encounters an immovable obstruction its forward movement ceases. The boring ram must then be switched over to reversed operation, that

is to say so that it travels backwards. The kinetic energy of the percussion piston is then used for propelling the ram backwards, the piston impacting against the back stop which is fixed in the rear part of the housing. For this purpose the position of the tubular valve member is shifted axially backwards in the housing by the operator of the boring ram. Under these circumstances when the percussion piston is travelling forwards, compressed air passes earlier through the ports into the space forward of the percussion piston so that the braking air cushion builds up earlier. If the boring ram is suitably dimensioned it is even possible to prevent the percussion piston from striking the chisel at all, the piston simply rebounding backwards without making contact with the chisel. During backward travel of the percussion piston the ports in the wall of the cylindrical chamber are closed later by the piston head of the valve member and also communicate later with the atmosphere. Consequently, the percussion piston, travelling backwards, now strikes the back-stop of the housing with full force, propelling the boring ram backwards along the tunnel it has previously bored and out of the ground.

In one form of such a boring ram the switching over between forward and reverse drive is accomplished as follows. The tubular valve member is held in a forward position in the housing by a strong spring, and the ram operator must pull the valve member backwards in the housing by means of a cable, against the influence of the spring. This is difficult, particularly in the operation of large boring rams, due to the strength of the spring, which has to be sufficiently great to withstand the thrust of the compressed air acting on the piston head. To pull the valve member backwards into its reverse drive position the operator has to compress this spring, and the spring has to be held compressed all the time during backwards movement of the ram.

In another form of the boring ram, the spring is arranged in such a way that the compressed air would shift the valve member automatically backwards into its reverse drive position if this was not prevented. When the tubular valve member is in its forward drive position it is held there by a catch, and in order to switch the ram to reverse drive the operator, without interrupting the supply of compressed air, pulls on a cable to release the catch and allow the valve member to shift backwards into its reverse drive position. In order to return the ram to forward drive the operator has to interrupt the supply of compressed air briefly, whereupon the valve member shifts forwards under the action of the spring until the catch engages again. The catch is a ball catch. A spring-loaded sliding sleeve, to which the cable is attached, thrusts the balls radially into an annular groove, to engage the catch. The arrangement has several disadvantages. In the first place the ball catch is subjected to high point loads; secondly, the presence of dirt produces a high risk of malfunction; and finally, unintentional switching over, which can be a serious matter, can easily occur for example by a fall of earth onto the cable.

In yet another form of the boring ram the tubular valve member extends backwards through an impact disc which has ports for the passage of air. The valve member has an external thread, and to switch over between forward drive and reverse drive the operator has to uncouple the compressed air hose and rotate the valve member, screwing it in or out with respect to the

housing to change its axial position. The operation is awkward and time consuming, and it is difficult to switch over a ram which is in an inaccessible position in the ground. Dirt can also cause difficulty by jamming the valve member so that it cannot be rotated.

The aim of the present invention is to provide a self-propelled, pneumatically operated, percussive boring ram of the kind described in which the switching between forward and reverse drives can be done in a simple but yet effective way without involving the disadvantages mentioned above.

According to the invention, in such a boring ram the tubular valve member extends through a guide member attached to the housing and can be locked in one or other of its two operative positions during operation of the ram by stops on the valve member and on the guide member and a releasable catch which, when engaged, prevents rotation of the valve member relative to the guide member, the stops being arranged so that, on release of the catch, the valve member can be rotated into a position in which the stops are misaligned and allow the valve member to be moved axially from one operative position to the other.

This arrangement provides the important advantage that the hollow valve is retained reliably in the desired operative position, during operation of the ram, by positive mechanical stops. Although rotation of the valve member in the housing into a certain position renders the mechanical stops inoperative, this kind of rotation is prevented, during operation of the ram, by the catch. In order to switch the ram drive direction, the operator first has to release the catch, for example by pulling on a cable, after which he can rotate the valve member relative to the housing, and the guide member. He rotates the valve member into a position in which the mechanical stops are completely misaligned and therefore inoperative, shifts the valve member axially into its other operative position, and finally rotates it until the catch engages once more. It should be observed that if the catch is inadvertently released, for example because the cable has become jammed in the ground, this does not automatically cause the ram drive to be switched, the valve member still being retained in its desired axial position by the mechanical stops. The valve member has to be rotated into exactly the right position before the mechanical stops preventing axial shifting become inoperative. In the boring ram in accordance with the invention there is no spring acting axially on the valve member, so that with a few movements of his hand to rotate the tubular valve member through a small angle and then shift the member axially, for example by means of the compressed air hose leading to the valve member, the operator can switch the ram reliably and without difficulty between the two modes of operation. When the boring ram is in operation no torque is applied to the tubular valve member and no axial thrust is applied to the catch, which can therefore be made of simple parts sufficient only for retaining the valve member in its desired angular position in the housing. The switching arrangement of the boring ram in accordance with the invention is therefore very robust and insensitive to dirt, which makes it very reliable. The ram can therefore be operated simply and safely under very rough conditions.

The guide member is preferably axially confined, during operation of the ram, between stops on the tubular valve member. In principle, the valve member could have a stop confined between two stops on the guide member, but it is desirable to construct the guide member in the simplest possible way, because it is either an integral part of the housing or is attached firmly to it. The tubular valve member, on the other hand, is a separate and axially movable member and consequently it is a simple matter to give it stops which engage opposite sides of the guide member.

It is a feature of the invention that the tubular valve member is arranged so that it can be locked into either of the two axially spaced operative positions, one for forward and the other for reverse operation of the ram. Although it would be possible to arrange to give the valve member more than two operating positions, in practice only two are necessary, the one giving the best operating conditions for forward drive and the other the best operating conditions for reverse drive of the ram. Doing without any intermediate position for the valve member simplifies construction.

Preferably the tubular valve member has, axially spaced apart, a front stop, a back stop, and between them a middle stop, and when the valve member is locked in one or other of its two operative positions the guide member is confined between the middle stop and either the front or the back stop. Apart from the guide member itself all the stops are on the tubular valve member, and consequently all that is necessary, in order to switch over between forward and reverse drives, is to shift the valve member axially between the limits set by its front and back stops once the valve member is correctly oriented to the guide member. The middle stop may be formed by longitudinal keys which can be brought into line, by rotating the valve member, with internal longitudinal grooves in the guide member. This construction is very convenient, because suitable keys of this kind are readily obtainable and need merely be joined to the tubular valve member or inserted into it. The longitudinal grooves can be arranged as key guides, giving a reliable action because the valve member can be shifted axially relative to the guide member, after releasing the catch, only if the valve member has been rotated into precisely the correct position.

The front and back stops may be provided by collars on the tubular valve member, the collars either being integral with the member or attached to it, for example, by screws. The front stop collar may be an extension of reduced diameter of the piston head. This arrangement is particularly convenient because it makes it unnecessary to manufacture a stop separately.

Preferably, the guide member forms the back stop of the housing. The guide member can be positioned anywhere near the rear end of the housing, and by using it as the back stop of the housing the entire boring ram can be made shorter or, to put the matter in a different way, the percussion piston can occupy a greater fraction of the length of the housing. This not only saves costs but also makes the boring ram more effective.

The guide member can take the form of a perforated ring containing one or more axially extending ports through which air can pass from one side of the ring to the other. The perforated ring is clamped in the rear part of the housing against an internal shoulder by means of a screwed-in retainer. The axial ports allow compressed air to escape unimpeded to atmosphere when the percussion piston is in a suitable axial position relative to the valve member. Because the guide mem-

ber is clamped in place in the housing by means of a threaded retainer it can easily be removed when maintenance or replacement is required.

Preferably the releasable catch comprises a radially displaceable member which acts between the guide member and the valve member, engaging in a recess in the valve member or in the guide member, to lock the two angularly together under the action of an actuator. The catch can be located anywhere desired, but a particularly simple construction is obtained by positioning the parts of the catch between the guide member and the valve member, because in this region an axially sliding and rotating part is in contact with a stationary part of the boring ram. Consequently, the releasable catch needs to move only a short distance and can be rapidly engaged and disengaged.

A particularly advantageous construction is obtained if a ball is used as the radially displaceable member, the ball being housed in the guide member. When the boring ram is in operation, driving either forwards or backwards, the ball is held in engagement in a recess in the tubular valve member. A ball catch of this kind is already known and is very simple in construction. It should be observed that a ball catch can be used safely in the ram in accordance with the invention because the valve member is not subjected, during operation of the ram, to any axial or rotary stresses. The ball catch serves merely to prevent the valve member from rotating in the housing, even in the presence of vibration.

Preferably the actuator is a pin which slides axially in the guide member between a locking position in which it exerts a radially inward thrust on the ball to hold it in engagement with the recess and a release position in which the ball is allowed to disengage from the recess. Axial movement of the actuator pin from its locking position allows the locking ball to escape radially outwards, releasing the lock. The lock can therefore be arranged to be released simply by pulling axially on the actuator pin, for example from a remote location by means of a cable. Once the catch has been released the valve member can be rotated, for example by rotating the compressed air supply hose, whereupon the valve member can be shifted in position axially by a pull or push depending on which operative position it is to be moved into.

The actuator pin may have a tapered front end for camming the ball into the recess on moving into the locking position, and the pin is arranged to be retracted into its release position by means of a rearward extension. Preferably the actuator pin is biassed towards its locking position by a spring, and the catch can be released by a pull on a cable attached to the rearward extension and projecting backwards from the boring ram. This construction allows the drive of the boring ram to be switched in a simple and convenient manner. The operator merely pulls on the cable so as to release the catch, the actuator pin moving axially backwards against the influence of its spring to relax radially inward pressure on the ball, whereupon the operator can rotate the tubular valve member until he is able to shift it axially into its other operative axial position, the operator at the same time releasing the cable. The valve member is then rotated and the ball, which is acted on by the tapered nose of the actuator, rolls on the surface of the valve member until it moves into the other recess in the valve member and the catch automatically engages under the action of the actuator spring. The operator needs to pull on the cable only at the beginning of the switching operation, and the mechanism is so simple that it can be operated even under rough conditions by an operator possessing little special skill.

All the parts of the boring ram are designed and arranged to ensure that when the ram is driving forwards the percussion piston impacts with full force against an impact pin projecting backwards into the housing from the chisel, whereas when the ram is set to travel backwards the percussion piston strikes with full force the guide member fixed to the housing. The full energy given to the percussion piston is therefore utilized for propelling the boring ram both forwards and backwards. In order to protect the housing from the full force of the impact when the boring ram is driving itself forwards against the resistance of the ground, the chisel is preferably axially spring mounted in the housing. The energy in the percussion piston is therefore transmitted directly to the ground, rather than to the housing of the boring ram. On the other hand when the boring ram is being driven backwards the severity of the impact is less and consequently the impact of the percussion piston can be applied directly to the housing, through the guide member. This provides an effective backwards drive for extracting the boring ram from the ground.

An example of a boring ram in accordance with the invention will now be described with reference to the accompanying drawings, in which:

FIG. **1** is a partial axial section through the boring ram showing the parts in the positions they occupy when the ram is ready for driving forwards;

FIG. **2** is a view similar to FIG. **1**, but showing the parts in position when the ram is ready for driving backwards;

FIG. **3** is a perspective view of a slightly modified version of the tubular valve member incorporated in the ram of FIGS. **1** and **2**;

FIG. **4** is a front view of the guide member of the ram shown in FIGS. **1** and **2**; and,

FIG. **5** is an axial section through the guide member taken in the plane V — V in FIG. **4**.

The boring ram **10** has a tubular housing **12** carrying in its front end an axially movable chisel **14**. The rear end of the chisel terminates in an impact pin **18**, and the chisel has a collar **16** which is located in a chamber in the housing and which serves to retain the chisel. A spring **20** acts between the housing and the collar **16** to bias the chisel backwards in the housing into a rearward position determined by the collar **16** in its chamber.

The front part of the chisel **14** projects forwards beyond the front end of the housing **12** and has a conical part **22** on which sits tightly a thrust-nose **24**. These parts are arranged so that when the chisel **14** is driven forwards in the housing by an impact applied to the impact pin **18**, the entire nose part of the boring ram, comprising the impact pin **18**, the collar **16**, the chisel **14** and the thrust-nose **24**, all move forwards together. The chisel **14** itself splits stones and the like. The thrust-nose **24**, on the other hand, forces the ground or rock out sideways, forming a cylindrical hole through the ground, with compacted walls.

The tubular housing **12** contains an axially movable percussion piston **26** which slides backwards and forwards in the housing on guide rings **28** and **32** which are equipped with sliding pads **30** and **34** respectively at opposite ends of the percussion piston. The rear

guide ring **28**, with its sliding pad **30**, forms a seal between the percussion piston and the housing. The front guide ring **32**, with its sliding pads **34**, has axially extending grooves allowing air to flow into and out of the forward part of the housing, in front of the forward face of the percussion piston **26**. The rear part of the percussion piston has an axial bore forming a cylindrical chamber **36**. The wall **38** of the cylindrical chamber **36** has ports **40**, approximately half way along the length of the chamber. In one phase of operation of the ram the ports **40** allow air to flow from the cylindrical chamber **36** into the annular space between the percussion piston **26** and the housing **12**. In another phase of operation, the ports **40** allow air to escape from this annular space into the surrounding atmosphere, as will be described later.

The cylindrical chamber **36** contains a tubular valve member **42** which has an axial through-bore **44**. The rear end of the tubular valve member **42** projects backwards out of the housing **12** and is connected to a source of compressed air through a hose which is not shown in the drawing. The front end of the tubular valve member **42** is in the form of a piston head **46** working in the cylindrical chamber **36**. It should be observed that when the boring ram is in operation, the tubular valve member **42** remains stationary with respect to the housing **12**. The valve member **42** can however be shifted axially in position, relative to the housing, by the operator of the boring ram, between an operative position for causing the ram to be driven forwards and a different operative position for causing the ram to be driven backwards.

In FIG. **1** the valve member **42** is in its forward-drive position. The percussion piston **26**, after travelling forwards, has just impacted against the pin **18** of the chisel. The cylindrical chamber **36** is in communication, through the ports **40**, with the annular space between the piston **26** and the housing **12** and, through the grooves in the guide ring **32**, with the interior of the housing **12** forward of the front face of the piston **26**. A point to observe is that the pneumatic thrust area, that is to say the working area of the cylindrical chamber **36** is smaller than the total working area thrusting the percussion piston backwards, and, in the position of FIG. **1**, a cushion of highly compressed air acts on the forward face of the percussion piston. Consequently, the percussion piston is caused to rebound backwards, whereupon the ports **40** become closed by the pison head **46**. On further backward movement of the percussion piston **26**, the backwards thrust applied by the pressure cushion acting on the forward face of the piston **26** rapidly decreases, with the result that the percussion piston **26** is rapidly decelerated by the compressed air in the cylindrical chamber **36**. As the percussion piston **26** moves backwards to bring the ports **40** beyond the piston head **46**, the ports are opened and release air from the forward annular space into the atmosphere. Shortly thereafter the compressed air in the cylindrical chamber **36** becomes effective to drive the percussion piston **26** forwards again towards the impact pin **18** of the chisel **14**. In the last phase of the forward movement, the ports **40** open forwards of the piston head **46** and a pressure cushion builds up on the forward face of the percussion piston shortly before it strikes the impact pin **18**. The percussion piston then rebounds as already described.

In FIG. **2**, the tubular valve member **42** has been shifted, by the operator of the boring ram, axially backwards into its reverse-drive position. In these circumstances the ports **40** open earlier during the forward movement of the percussion piston **26**, admitting air earlier to the space in front of the percussion piston. The air cushion, which is thus built up earlier, prevents it from impacting forcefully against the pin **18**. The percussion piston **26** bounces back rapidly under the action of the air cushion, finally impacting with considerable force against a stop which is formed by a guide member **54** which is fixed relative to the housing **12** and through which the valve member **42** extends. The impact drives the boring ram backwards through the ground. If the tubular valve member **42** is positioned a little further forwards compared to what is shown in FIG. **2**, the ports **40** will be closed by the piston head **46** before the percussion piston impacts against the guide member **54**, and consequently the boring ram **10** will be driven backwards progressively, the percussion piston **26** travelling forwards again after each impact with the guide member **54**.

In the example shown in FIGS. **1** and **2**, the tubular valve member **42** has a front collar **48** in the form of a backwards extension of reduced diameter of the piston head **46**. The valve member **42** also has a back collar **50** which can, for example, be screwed to the valve member. Projecting radially outwards from the shaft of the tubular valve member **42**, between the two collars **48** and **50**, there are keys **52** positioned diametrically opposite each other. The keys **52** terminate at their forward ends a certain distance short of the rear face of the front collar **48**, this distance being equal to the axial length of the guide member **54**. There is a similar gap between the rear ends of the keys **52** and the forward face of the back collar **50**. When the valve member **42** is in its forward-drive position, as represented in FIG. **1**, the guide member **54** is positioned between the rear collar **50** and the keys **52**. On the other hand, when the valve member **42** is in its reverse-drive position (FIG. **2**), the guide member **54** is situated between the keys **52** and the front collar **48**.

As shown in FIG. **4**, the guide member **54** is a ring having a series of spaced axially extending ports **56** which allow compressed air to flow outwards from the interior of the boring ram out into the atmosphere via the rear end of the ram. The guide member **54** is retained in place by a screwed-in retainer **58** which thrusts the guide member against an internal shoulder in the housing, the guide member **54** being clamped firmly in place so that it cannot rotate relative to the housing.

The guide member **54** has, as shown in FIG. **4**, not only a central hole for the tubular valve member **42**, but also key guides **60** for allowing the keys **52** to pass through. Starting, for example, from the position shown in FIG. **1**, the operator can rotate the valve member **42** until the keys **52** are aligned with the key guides **60**, whereupon he can shift the valve member **42** backwards, the keys sliding through the key guides **60** until the front stop **48** engages the guide member **54**.

With reference to FIGS. **3** and **5**, when the boring ram is in operation a locking ball **62** engages in a recess **70** in the valve member **42** to prevent rotation of the latter in the housing **12**. An actuator pin **64** sliding axially in the guide member **54** holds the ball **62** in engagement with the recess **70**. The actuator pin **64** has a ta-

pering front end. When the actuator pin is pulled axially backwards by the operator of the boring ram, against the influence of a spring **68**, this allows the ball **62** to disengage from the recess **70** so that the operator can rotate the valve member **42** in the housing **12**, the ball moving radially outwards from the recess **70** into the interior of the guide member **54**. As soon as the operator has rotated the valve member **42** far enough to allow the keys **52** to enter the key guides **60** he can pull the valve member **42** backwards from its forward-drive position into its reverse-drive position. The operator then rotates the valve member **42** until the ball **62** engages in a second recess **70** in the hollow valve **42**, the ball being driven into the recess by the tapering head of the spring-loaded actuator pin **64**. The operator is able to retract the actuator pin **64** by means of an extension **66** of the pin, to which a cable is attached. The extension **66**, or its attached cable, projects backwards out of the boring ram, for remote operation.

With reference to FIG. **3**, in this modified form of the tubular valve member the front collar **48'** is spaced axially away from the piston head **46'** instead of being an extension of the piston head. Both the front collar **48'** and the back collar **50'** are annular and are fixed to the valve member or are formed integrally with it.

I claim:

1. In a self-propelled, pneumatically operated, percussive boring ram of the kind comprising a hollow housing, a chisel mounted at the boring end of said hollow housing, a percussion piston reciprocably mounted in said hollow housing, a back stop in said housing for limiting rearward movement of said percussion piston in said housing, said chisel forming a front stop for limiting forward movement of said percussion piston in said housing, means defining a cylindrical chamber in said percussion piston, a tubular valve member having a piston head and located in said housing with said piston head received in said cylindrical chamber, said tubular valve member being adapted to admit compressed air into said cylindrical chamber for reciprocating said percussion piston and thereby driving said boring ram, and means whereby said tubular valve member can be adjusted between two operative axial positions relative to said housing to determine whether said percussion piston acts to drive said boring ram forwards or backwards, the improvement wherein said boring ram includes a guide member attached in said housing and said tubular valve member extends through said guide member, and means for locking said tubular valve member in either of said two operative positions during operation of said boring ram, said locking means comprising axially inter-engaging stops on said tubular valve member and on said guide member, and a releasable catch which, when engaged, prevents rotation of said tubular valve member relative to said guide member, said stops being arranged whereby, on release of said catch, said tubular valve member can be rotated into a position in which said stops are misaligned and allow said tubular valve member to be moved axially from one of said operative positions to the other.

2. A boring ram as claimed in claim **1**, wherein said stops on said guide member are confined axially between said stops on said tubular valve member when said valve member is in either of said two operative positions and said catch is engaged.

3. A boring ram as claimed in claim **2**, wherein said stops on said tubular valve member comprise, axially spaced apart, a front stop, a back stop, and between them a middle stop, and when said tubular valve member is locked in one or other of said two operative positions said guide member is confined between said middle stop and either said front or said back stop.

4. A boring ram as claimed in claim **3**, wherein said middle stop comprises longitudinally extending keys on said tubular valve member, and said guide member is provided with means defining corresponding internal longitudinal grooves for the passage of said keys when said tubular valve member is moved between said two operative positions.

5. A boring ram as claimed in claim **3**, wherein said front stops and said back stops are provided by collars on said tubular valve member.

6. A boring ram as claimed in claim **5**, wherein said collars are integral parts of said tubular valve member.

7. A boring ram as claimed in claim **6**, wherein said front stop collar is an extension of reduced diameter of said piston head.

8. A boring ram as claimed in claim **1**, wherein said guide member forms said back stop in said housing limiting rearward motion of said percussion piston.

9. A boring ram as claimed in claim **8**, wherein said guide member is an impact ring having means defining at least one axially extending port therethrough for permitting the passage of air from one side thereof to the other.

10. A boring ram as claimed in claim **9**, including means removably attaching said impact ring in said housing and comprising an abutment shoulder in said housing and a screwed-in retainer clamping said impact ring against said shoulder.

11. A boring ram as claimed in claim **1**, wherein said releasable catch comprises a radially displaceable member mounted for action between said guide member and said tubular valve member, and an actuator for co-operation with said radially displaceable member to lock said guide member and said tubular valve member angularly together.

12. A boring ram as claimed in claim **11**, wherein said radially displaceable member is a ball, said guide member includes means housing said ball, and said tubular valve member has means defining a recess for engagement by said ball to lock said guide member and said tubular valve member angularly together.

13. A boring ram as claimed in claim **12**, wherein said actuator is a pin and said guide member includes means mounting said actuator pin for axial sliding movement between a locking position wherein said pin exerts a radially inward thrust on said ball to hold said ball in engagement with said recess and a release position wherein said ball is permitted to disengage from said recess.

14. A boring ram as claimed in claim **13**, wherein said actuator pin has a tapered front end for camming said ball into said recess on movement of said pin into said locking position, and said releasable catch includes a rearward extension of said pin whereby said pin can be retracted into said release position.

15. A boring ram as claimed in claim **14**, including spring means biassing said actuator pin towards said locking position.

16. A boring ram as claimed in claim **14**, including a cable attached to said rearward extension of said actuator pin and projecting backwards out of the rear end of said housing.

17. A boring ram as claimed in claim **14**, wherein said locking ball is permanently in contact with said actuator pin.

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