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Pneumatic self-propelled impact rock breaking device with the assistance of ultra-high-pressure pulsed jet flow

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(71) Applicant(s)
China University of Mining and Technology

(72) Inventor(s)
Jiang, Hongxiang;Du, Changlong;Liu, Songyong;Liu, Zenghui;Li, Hongsheng;Yang, Daolong;Gao, Kuidong

(74) Agent / Attorney
Madderns Pty Ltd, GPO Box 2752, Adelaide, SA, 5001, AU

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KR 20110073802 A
CN 2047717 U

ABSTRACT

The present invention discloses a pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow. A front end of a front pressurized water chamber is provided with an end cover, a tail end of the front pressurized water chamber is connected to a front end of a middle piston chamber, a tail end of the middle piston chamber is connected to a front end of an impact piston acceleration chamber, and a tail end of the impact piston acceleration chamber is provided with a water-air inlet connector. The end cover is provided with detritus filter notches, alloy nozzle ball teeth, and alloy ball teeth. The front pressurized water chamber is provided with an impact drill bit and a spring. The middle piston chamber is provided with a middle piston. The impact piston acceleration chamber is provided with an impact piston. The end cover, the front pressurized water chamber, the middle piston chamber, the impact piston acceleration chamber are successively communicated with water channels inside a water-air inlet connector. The water-air inlet connector is connected to an air compressor and a low-pressure water-feeding pump via a water-air combined pipe. The present invention integrates an ultra-high-pressure pulsed jet flow into a rock breaking process depending on a mechanical impact, thus solving the difficulty of drilling and breaking rock with a high Platts hardness coefficient.

PNEUMATIC SELF-PROPELLED IMPACT ROCK BREAKING DEVICE WITH THE ASSISTANCE OF ULTRA-HIGH-PRESSURE PULSED JET FLOW

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates to a pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow, which particularly applies to drilling or breaking rock with a high Platts hardness coefficient.

Background

In 2015, the *BP Statistical Yearbook of World Energy* pointed out that China is still the world's largest energy consumer, which accounts for 23% of global consumption and 61% of global net growth. Coal resource consumption accounts for 66.03% of total consumption. In the future for a long period of time, coal will have an irreplaceable position as China's primary energy source. *Outline of China's National Plan for Medium- and Long-term Scientific and Technological Development (2006 to 2020)* clearly points out that, there is an urgent need to strengthen the research on safe and efficient mining and utilization of coal resources, and it is explicitly required to focus on ore mining technologies for deep and complex strata.

At present, coal mining for deep and complex strata has gradually carried out. Therefore, safe and efficient coal resource mining technology and equipment for the deep and complex strata are faced with high requirements and new challenges. As the ground stress increases, the elastic modulus, hardness and breaking strength of coal-bearing rock in the deep and complex strata also increase, and the uniaxial compressive strength reaches up to 150 MPa or above in most cases. Drilling of the coal-bearing rock is a prerequisite for efficient implementation of ore blasting, mining under pressure relief, roadway support, and other like projects. Problems such as low efficiency in drilling of a hard coal-bearing rock and a large amount of dust directly constrain efficient development of ore resources such as coal in the deep and complex strata. Underground drilling of the coal-bearing rock mainly adopts two manners:

mechanical cutting and a mechanical impact. During rock breaking in the mechanical cutting manner, the wear of a cutting tool is serious and the consumption is high, and this manner is usually used to cut and break a coal-bearing rock with the Platts hardness coefficient $f \leq 8$. Most of the coal-bearing rock can be broken in the mechanical impact manner, but this manner has such problems as severe wear and shedding of ball teeth, low efficiency in rock breaking, and a large amount of dust during operation in hard coal-bearing rock ($f > 15$), greatly reducing rock breaking ability and efficiency of the mechanical impact manner, and service life and reliability of the equipment. How to safely and efficiently break the hard coal-bearing rock has become the key issue and difficulty in the efficient development of ore resources such as coal in the deep and complex strata.

It has been proved that, the rock breaking ability of the cutting tool can be enhanced and its service life can be prolonged with the assistance of a high-pressure water jet. However, continuous high-pressure water jet consumes a lot of water, and a large area of stagnant water is produced in the workplace for mechanical breaking of the coal-bearing rock, making it difficult for the device to work normally. In the common rock breaking manner with the assistance of a continuous water jet, only a "water hammer pressure" is produced, which has a limited ability to impact on and break the rock. The subsequent "stagnation pressure" is low, such that it is difficult to aggravate internal damage and crack growth in the hard coal-bearing rock. Thus, the continuous water jet fails to be widely applied in breaking equipment for the hard coal-bearing rock. A pulsed jet flow has higher ability to impact on and break the coal-bearing rock than the continuous water jet. Due to a low-temperature impact and low water consumption of the pulsed jet flow, the wear rate and consumption of the ball teeth can be reduced, the service life thereof can be prolonged, and the working conditions of rock breaking depending on the mechanical impact can be improved.

SUMMARY OF THE INVENTION

Invention objective: An objective of the present invention is to overcome the shortcomings in the prior art, and provide a pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow. The device fundamentally integrates an ultra-high-pressure pulsed jet flow into a rock breaking process depending on a mechanical impact, thus solving the difficulty of

drilling and breaking rock with a high Platts hardness coefficient.

To achieve the foregoing objective, the present invention adopts the following technical solutions: A pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow includes an air compressor, an air tank, a low-pressure water-feeding pump, an overflow valve, a pulsed solenoid valve, a ball valve, a water-air combined pipe, a water-air inlet connector, an impact piston acceleration chamber, a middle piston chamber, a front pressurized water chamber, a one-way valve, an impact drill bit, a spring, a stop collar, a middle piston, an impact piston, and an impact piston cushion, where

a front end of the front pressurized water chamber is provided with an end cover, a tail end of the front pressurized water chamber is connected to a front end of the middle piston chamber, a tail end of the middle piston chamber is connected to a front end of the impact piston acceleration chamber, and a tail end of the impact piston acceleration chamber is provided with the water-air inlet connector; a drill bit pilot hole is opened in the center of the end cover, several detritus filter notches are evenly distributed around the rim of the end cover, several alloy nozzle ball teeth and alloy ball teeth are alternately arranged on an external end face of the end cover, a pressurized water notch is opened on an internal end face of the end cover, and ultra-high pressure water channels are opened on the bottom of the pressurized water notch; the ultra-high pressure water channel is communicated with the alloy nozzle ball teeth, a connected water channel is opened on a side wall of the pressurized water notch, and an impact drill bit and a spring are provided in an inner cavity of the front pressurized water chamber; the head of the impact drill bit is fitted into the drill bit pilot hole, a middle portion of the impact drill bit is fitted into the inner cavity of the front pressurized water chamber, and the spring is disposed on a tail portion of the impact drill bit; a water channel IV is opened on the front pressurized water chamber, and is communicated with the connected water channel via the one-way valve; a groove I is provided on a front end of an inner cavity of the middle piston chamber, and the stop collar is inserted into the groove I; the middle piston is provided at the middle portion of the inner cavity of the middle piston chamber, and a front end of the middle piston passes through the stop collar and contacts the spring; the stop collar prevents the middle piston from coming out of the middle piston chamber; a water channel III is opened on the middle piston chamber, and is communicated with the

water channel IV; the impact piston is provided in an inner cavity of the impact piston acceleration chamber, and a water channel II is opened on the impact piston acceleration chamber and is communicated with the water channel III; a water inlet and an air inlet are provided on an external end face of the water-air inlet connector, a groove II is provided on an internal end face of the water-air inlet connector, and the impact piston cushion is inserted into the groove II; and a water channel I and an air channel are opened on the water-air inlet connector, wherein the water channel I is respectively communicated with the water channel II and the water inlet, and the air channel is respectively communicated with the inner cavity of the impact piston acceleration chamber and the air inlet; and

the water-air combined pipe comprises a high-pressure water pipe and an air pipe; the high-pressure water pipe is respectively communicated with the water inlet and the ball valve, and the ball valve is connected to the low-pressure water-feeding pump via the overflow valve; and the air pipe is communicated with the air inlet and the pulsed solenoid valve, and the pulsed solenoid valve is connected to the air compressor via the air tank.

Further, an alloy tip body is mounted on a front end of the head of the impact drill bit.

Further, a seal ring groove IV is opened on the periphery of the head of the impact drill bit, and a seal ring groove V is opened on the periphery of the middle portion of the impact drill bit.

Further, the end cover and the front pressurized water chamber are fixed through welding; and the front pressurized water chamber, the middle piston chamber, the impact piston acceleration chamber, and the water-air inlet connector are connected with magnetic bolts.

Further, an end face of the tail end of the impact piston acceleration chamber is provided with a seal ring groove I, an end face of the tail end of the middle piston chamber is provided with a seal ring groove II, and an end face of the tail end of the front pressurized water chamber is provided with a seal ring groove III.

Further, a deep hole is provided in the impact piston, so as to reduce the weight of the impact piston, and the impact piston is made from aluminum alloy or copper.

Further, a steel wire pipe is used as the air pipe, and the number of steel wire

layers of the air pipe is not less than 2; and elastic rubber sleeves are wrapped around the high-pressure water pipe and the air pipe.

Beneficial effects: The present invention adopts a pneumatic driving manner; has a small overall size and a simple and compact structure; can be easily assembled or disassembled; produces large power; and achieves simple and reliable high-pressure water sealing. A mechanical impact with the assistance of an ultra-high-pressure pulsed jet flow can implement drilling or breaking of rock with a high Platts hardness coefficient. The ultra-high-pressure pulsed jet flow can greatly damage rock in advance, reduce the rock strength, and minimize the crush resistance of hard rock, thus reducing the degree of difficulty in breaking hard rock through a mechanical impact, and improving the ability and efficiency of the impact rock breaking device in drilling hard rock. The ultra-high-pressure pulsed jet flow not only can suppress generation of dust during rock breaking, but also can enable mechanical ball teeth to break hard rock, prolonging the service life of the mechanical ball teeth and improving safe and efficient development of energy resources. Thus, the present invention has important social significance for the sustainable development of mines in China.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to the present invention;

FIG. 2 is a front view of a front pressurized water chamber according to the present invention;

FIG. 3 is a left view of the front pressurized water chamber according to the present invention;

FIG. 4 is a cross-sectional view of an impact drill bit according to the present invention;

FIG. 5 is a cross-sectional view of a middle piston chamber according to the present invention;

FIG. 6 is a cross-sectional view of an impact piston acceleration chamber according to the present invention;

FIG. 7 is a cross-sectional view of a water-air inlet connector according to the present invention; and

FIG. 8 is a front view of a water-air combined pipe according to the present invention.

Description of reference numerals in the drawings: 1. Air compressor, 2. Air tank, 3. Low-pressure water-feeding pump, 4. Overflow valve, 5. Pulsed solenoid valve, 6. Ball valve, 7. Water-air combined pipe, 8. Water-air inlet connector, 9. Impact piston acceleration chamber, 10. Middle piston chamber, 11. Front pressurized water chamber, 12. One-way valve, 13. Impact drill bit, 14. Spring, 15. Stop collar, 16. Middle piston, 17. Magnetic bolt, 18. Impact piston, 19. Impact piston cushion, 7-1. High-pressure water pipe, 7-2. Elastic rubber sleeve, 7-3. Air pipe, 8-1. Water inlet, 8-2. Air inlet, 8-3. Water channel I, 8-4. Groove II, 8-5. Air channel, 8-6. Threaded hole I, 9-1. Seal ring groove I, 9-2. Water channel II, 9-3. Threaded hole II, 10-1. Seal ring groove II, 10-2. Water channel III, 10-3. Groove I, 10-4. Threaded hole III, 11-1. Seal ring groove III, 11-2. Water channel IV, 11-3. Hole slot, 11-4. Connected water channel, 11-5. Threaded hole IV, 11-6. Ultra-high pressure water channel, 11-7. Alloy nozzle ball teeth, 11-8. Alloy ball teeth, 11-9. Detritus filter notch, 11-10. End cover, 11-11. Pressurized water notch, 11-12. Drill bit pilot hole, 13-1. Alloy tip body, 13-2. Drill bar, 13-3. Seal ring groove IV, 13-4. Seal ring groove V, and 18-1. Deep hole

DETAILED DESCRIPTION OF THE INVENTION

The present invention is further explained below with reference to the accompanying drawings.

As shown in FIG. 1, a pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow of the present invention includes: an air compressor 1, an air tank 2, a low-pressure water-feeding pump 3, an overflow valve 4, a pulsed solenoid valve 5, a ball valve 6, a water-air combined pipe 7, a water-air inlet connector 8, an impact piston acceleration chamber 9, a middle piston chamber 10, a front pressurized water chamber 11, a one-way valve 12, an impact drill bit 13, a spring 14, a stop collar 15, a middle piston 16, an impact piston 18, and an impact piston cushion 19. A front end of the front pressurized water chamber 11 is provided with an end cover 11-10, a tail end of the front pressurized

water chamber 11 is connected to a front end of the middle piston chamber 10, a tail end of the middle piston chamber 10 is connected to a front end of the impact piston acceleration chamber 9, and a tail end of the impact piston acceleration chamber 9 is provided with the water-air inlet connector 8.

As shown in FIGs. 1, 2, 5, 6, and 7, the end cover 11-10 and the front pressurized water chamber 11 are fixed through welding. A threaded hole IV 11-5 is opened on an end face of the tail end of the front pressurized water chamber 11, threaded holes III 10-4 are opened respectively on end faces of the front end and the tail end of the middle piston chamber 10, threaded holes II 9-3 are opened respectively on end faces of the front end and the tail end of the impact piston acceleration chamber 9, and a threaded hole I 8-6 is opened on an end face of the front end of the water-air inlet connector 8, to fixedly connect the front pressurized water chamber 11, the middle piston chamber 10, the impact piston acceleration chamber 9, and the water-air inlet connector 8 with magnetic bolts 17. To ensure the impermeability at joints between the front pressurized water chamber 11, the middle piston chamber 10, the impact piston acceleration chamber 9, and the water-air inlet connector 8, the end face of the tail end of the impact piston acceleration chamber 9 is provided with a seal ring groove I 9-1, the end face of the tail end of the middle piston chamber 10 is provided with a seal ring groove II 10-1, and the end face of the tail end of the front pressurized water chamber 11 is provided with a seal ring groove III 11-1. Seal rings are mounted in the foregoing seal ring grooves respectively.

As shown in FIG. 1 to FIG. 4, a drill bit pilot hole 11-12 is opened in the center of the end cover 11-10, several detritus filter notches 11-9 are evenly distributed around the rim of the end cover 11-10, several alloy nozzle ball teeth 11-7 and alloy ball teeth 11-8 are alternately arranged on an external end face of the end cover 11-10, a pressurized water notch 11-11 is opened on an internal end face of the end cover 11-10, and ultra-high pressure water channels 11-6 are opened on the bottom of the pressurized water notch 11-11. The ultra-high pressure water channel 11-6 is communicated with the alloy nozzle ball teeth 11-7. A connected water channel 11-4 is opened on a side wall of the pressurized water notch 11-11, and an impact drill bit 13 and a spring 14 are provided in an inner cavity of the front pressurized water chamber 11. The head of the impact drill bit 13 is fitted into the drill bit pilot hole 11-12. An alloy tip body 13-1 is mounted on a front end of the head of the impact drill

bit 13, a middle portion of the impact drill bit 13 is fitted into the inner cavity of the front pressurized water chamber 11, and the spring 14 is disposed on a tail portion of the impact drill bit 13. To ensure the impermeability at joints between the impact drill bit 13, the end cover 11-10, and the front pressurized water chamber 11, a seal ring groove IV 13-3 is opened on the periphery of the head of the impact drill bit 13, a seal ring groove V 13-4 is opened on the periphery of the middle portion of the impact drill bit 13, and seal rings are mounted in the foregoing seal ring grooves respectively. A water channel IV 11-2 is opened on the front pressurized water chamber 11, and is communicated with the connected water channel 11-4 via the one-way valve 12. The one-way valve 12 is mounted in a hole slot 11-3 on the terminal of the water channel IV 11-2, and is used to prevent backflow of water in the front pressurized water chamber 11.

As shown in FIG. 1 and FIG. 5, a groove I 10-3 is provided on a front end of an inner cavity of the middle piston chamber 10, and the stop collar 15 is inserted into the groove I 10-3. The middle piston 16 is provided at a middle portion of the inner cavity of the middle piston chamber 10, and a front end of the middle piston 16 passes through the stop collar 15 and contacts the spring 14. The stop collar 15 prevents the middle piston 16 from coming out of the middle piston chamber 10. A water channel III 10-2 is opened on the middle piston chamber 10, and is communicated with the water channel IV 11-2. In this embodiment, the section of the groove I 10-3 is a non-circular shape. In this way, interference between the stop collar 15 and the water channel III 10-2 can be prevented, the stop collar 15 can be easily mounted, and the number of water channel sealing elements can be decreased.

As shown in FIG. 1 and FIG. 6, the impact piston 18 is provided in an inner cavity of the impact piston acceleration chamber 9. A deep hole 18-1 is provided in the impact piston 18, so as to reduce the weight of the impact piston 18. The impact piston 18 is made from aluminum alloy or copper. A water channel II 9-2 is opened on the impact piston acceleration chamber 9, and is respectively communicated with the water channel III 10-2 and water channel I 8-3.

As shown in FIG. 1 and FIG. 7, a water inlet 8-1 and an air inlet 8-2 are provided on an external end face of the water-air inlet connector 8, a groove II 8-4 is provided on an internal end face of the water-air inlet connector 8, and the impact piston cushion 19 is inserted into the groove II 8-4. A water channel I 8-3 and an air channel

8-5 are opened on the water-air inlet connector 8, where the water channel I 8-3 is respectively communicated with the water channel II 9-2 and the water inlet 8-1, and the air channel 8-5 is respectively communicated with the inner cavity of the impact piston acceleration chamber 9 and the air inlet 8-2.

As shown in FIG. 1 and FIG. 8, the water-air combined pipe 7 includes a high-pressure water pipe 7-1 and an air pipe 7-3. The high-pressure water pipe 7-1 is respectively communicated with the water inlet 8-1 and the ball valve 6. The ball valve 6 is connected to the low-pressure water-feeding pump 3 via the overflow valve 4. The air pipe 7-3 is communicated with the air inlet 8-2 and the pulsed solenoid valve 5, and the pulsed solenoid valve 5 is connected to the air compressor 1 via the air tank 2. In this embodiment, a steel wire pipe is used as the air pipe 7-3, where the number of steel wire layers of the air pipe 7-3 is not less than 2. An elastic rubber sleeve 7-2 is wrapped around the high-pressure water pipe 7-1 and the air pipe 7-3.

During operation of the air compressor 1, the air compressor 1 produces compressed air and injects the compressed air into the air tank 2 to form stable-pressure compressed air. The stable-pressure compressed air is turned into intermittent compressed air through the pulsed solenoid valve 5; and the intermittent compressed air is introduced into the air pipe 7-3 of the water-air combined pipe 7 and the air channel 8-5 of the water-air inlet connector 8, and then injected into the impact piston acceleration chamber 9 to act upon the impact piston 18. The impact piston 18 is driven by the compressed air to impact on the middle piston 16. The middle piston 16 impacts on the spring 14 and the impact drill bit 13, to propel the impact drill bit 13 to break rock. During operation of the low-pressure water-feeding pump 3, water with a certain pressure is introduced into the overflow valve 4, the ball valve 6, the high-pressure water pipe 7-1 of the water-air combined pipe 7, the water channel I 8-3 of the water-air inlet connector 8, the water channel II 9-2 of the impact piston acceleration chamber 9, the water channel III 10-2 of the middle piston chamber 10, the water channel IV 11-2 of the front pressurized water chamber 11, the one-way valve 12, and the connected water channel 11-4 successively, and then enters the pressurized water notch 11-11 of the end cover 11-10. When the air compressor 1 and the low-pressure water-feeding pump 3 operate at the same time, under the impact, the impact drill bit 13 instantaneously increases the pressure of the water in the pressurized water notch 11-11, and an ultra-high-pressure pulsed jet flow is then

formed via the alloy nozzle ball teeth 11-7 to impact on and break the rock. While the pressure of the water in the pressurized water notch 11-11 is instantaneously increased, the mutually connected end cover 11-10, front pressurized water chamber 11, middle piston chamber 10, and impact piston acceleration chamber 9 are subjected to a forward force to produce a feed speed, to propel the alloy nozzle ball teeth 11-7 and the alloy ball teeth 11-8 that are mounted on the end cover 11-10 to impact on and break the rock.

During rock drilling by use of the pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow of the present invention, the impact piston 18 instantaneously accelerates under the effect of the compressed air to produce a linear speed, and then impacts on the middle piston 16 to endow the middle piston with the impact and speed of certain magnitude. The middle piston 16 impacts on the spring 14 and the impact drill bit 13, to propel the impact drill bit 13 to break the rock. The low-pressure water-feeding pump 3 produces water with a certain pressure. The water is then introduced into the pressurized water notch 11-11 of the end cover 11-10 through the high-pressure water pipe 7-1 of the water-air combined pipe 7, the water channel I 8-3 of the water-air inlet connector 8, the water channel II 9-2 of the impact piston acceleration chamber 9, the water channel III 10-2 of the middle piston chamber 10, the water channel IV 11-2 of the front pressurized water chamber 11, and the one-way valve 12. During rock breaking by means of a mechanical impact, while the middle piston 16 impacts on the spring 14 and the impact drill bit 13, the impact drill bit 13 instantaneously increases the pressure of the water in the pressurized water notch 11-11 under the impact, and then the water is urged to pass through the ultra-high pressure water channel 11-6, to form an instantaneous ultra-high-pressure pulsed jet flow via the alloy nozzle ball teeth 11-7. The ultra-high-pressure pulsed jet flow can break in advance the rock beyond an action range of the impact drill bit 13. While the impact drill bit 13 instantaneously increases the pressure of the water which is in the pressurized water notch 11-11, the mutually connected end cover 11-10, front pressurized water chamber 11, middle piston chamber 10, and impact piston acceleration chamber 9 are subjected to a forward force, to propel the alloy nozzle ball teeth 11-7 and the alloy ball teeth 11-8 to impact on and break the rock.

The spring 14 is used to release a compressed elastic potential to reversely act on

the middle piston 16 and the impact piston 18. After the pulsed solenoid valve 5 cuts off supply of the compressed air, the impact piston 18 moves in a reverse direction. When the pulsed solenoid valve 5 recovers the supply of the compressed air, the impact piston 18 makes a forward impact motion again, that to implement impact rock breaking by the impact drill bit 13, the alloy nozzle ball teeth 11-7, and the alloy ball teeth 11-8 with the assistance of a continuous ultra-high-pressure pulsed jet flow.

The above merely describes preferred embodiments of the present invention. It should be noted that, several improvements and modifications may be made by persons of ordinary skill in the art without departing from the principle of the present invention, and these improvements and modifications should also be considered within the protection scope of the present invention.

CLAIMS

What is claimed is:

1. A pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow, comprising: an air compressor (1), an air tank (2), a low-pressure water-feeding pump (3), an overflow valve (4), a pulsed solenoid valve (5), a ball valve (6), a water-air combined pipe (7), a water-air inlet connector (8), an impact piston acceleration chamber (9), a middle piston chamber (10), a front pressurized water chamber (11), a one-way valve (12), an impact drill bit (13), a spring (14), a stop collar (15), a middle piston (16), an impact piston (18), and an impact piston cushion (19), wherein

a front end of the front pressurized water chamber (11) is provided with an end cover (11-10), a tail end of the front pressurized water chamber (11) is connected to a front end of the middle piston chamber (10), a tail end of the middle piston chamber (10) is connected to a front end of the impact piston acceleration chamber (9), and a tail end of the impact piston acceleration chamber (9) is provided with the water-air inlet connector (8); a drill bit pilot hole (11-12) is opened in the center of the end cover (11-10), several detritus filter notches (11-9) are evenly distributed around the rim of the end cover (11-10), several alloy nozzle ball teeth (11-7) and alloy ball teeth (11-8) are alternately arranged on an external end face of the end cover (11-10), a pressurized water notch (11-11) is opened on an internal end face of the end cover (11-10), and ultra-high pressure water channels (11-6) are opened on the bottom of the pressurized water notch (11-11); the ultra-high pressure water channel (11-6) is communicated with the alloy nozzle ball teeth (11-7), a connected water channel (11-4) is opened on a side wall of the pressurized water notch (11-11), and an impact drill bit (13) and a spring (14) are provided in an inner cavity of the front pressurized water chamber (11); the head of the impact drill bit (13) is fitted into the drill bit pilot hole (11-12), a middle portion of the impact drill bit (13) is fitted into the inner cavity of the front pressurized water chamber (11), and the spring (14) is disposed on a tail portion of the impact drill bit (13); a water channel IV (11-2) is opened on the front

pressurized water chamber (11), and is communicated with the connected water channel (11-4) via the one-way valve (12); a groove I (10-3) is provided on a front end of an inner cavity of the middle piston chamber (10), and the stop collar (15) is inserted into the groove I (10-3); the middle piston (16) is provided at the middle portion of the inner cavity of the middle piston chamber (10), and a front end of the middle piston (16) passes through the stop collar (15) and contacts the spring (14); the stop collar (15) prevents the middle piston (16) from coming out of the middle piston chamber (10); a water channel III (10-2) is opened on the middle piston chamber (10), and is communicated with the water channel IV (11-2); the impact piston (18) is provided in an inner cavity of the impact piston acceleration chamber (9), and a water channel II (9-2) is opened on the impact piston acceleration chamber (9) and is communicated with the water channel III (10-2); a water inlet (8-1) and an air inlet (8-2) are provided on an external end face of the water-air inlet connector (8), a groove II (8-4) is provided on an internal end face of the water-air inlet connector (8), and the impact piston cushion (19) is inserted into the groove II (8-4); and a water channel I (8-3) and an air channel (8-5) are opened on the water-air inlet connector (8), wherein the water channel I (8-3) is respectively communicated with the water channel II (9-2) and the water inlet (8-1), and the air channel (8-5) is respectively communicated with the inner cavity of the impact piston acceleration chamber (9) and the air inlet (8-2); and

the water-air combined pipe (7) comprises a high-pressure water pipe (7-1) and an air pipe (7-3); the high-pressure water pipe (7-1) is respectively communicated with the water inlet (8-1) and the ball valve (6), and the ball valve (6) is connected to the low-pressure water-feeding pump (3) via the overflow valve (4); and the air pipe (7-3) is communicated with the air inlet (8-2) and the pulsed solenoid valve (5), and the pulsed solenoid valve (5) is connected to the air compressor (1) via the air tank (2).

2. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 1, wherein an alloy tip body (13-1) is mounted on a front end of the head of the impact drill bit (13).

3. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 2, wherein a seal ring groove IV (13-3) is opened on the periphery of the head of the impact drill bit (13), and a seal ring groove V (13-4) is opened on the periphery of the middle portion of the impact drill bit (13).

4. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 2, wherein the end cover (11-10) and the front pressurized water chamber (11) are fixed through welding; and the front pressurized water chamber (11), the middle piston chamber (10), the impact piston acceleration chamber (9), and the water-air inlet connector (8) are connected with magnetic bolts (17).

5. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 4, wherein an end face of the tail end of the impact piston acceleration chamber (9) is provided with a seal ring groove I (9-1), an end face of the tail end of the middle piston chamber (10) is provided with a seal ring groove II (10-1), and an end face of the tail end of the front pressurized water chamber (11) is provided with a seal ring groove III (11-1).

6. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 1, wherein a deep hole (18-1) is provided in the impact piston (18), so as to reduce the weight of the impact piston (18), and the impact piston (18) is made from aluminum alloy or copper.

7. The pneumatic self-propelled impact rock breaking device with the assistance of an ultra-high-pressure pulsed jet flow according to claim 1, wherein a steel wire pipe is used as the air pipe (7-3), and the number of steel wire layers of the air pipe (7-3) is not less than 2; and elastic rubber sleeves (7-2) are wrapped around the high-pressure water pipe (7-1) and the air pipe (7-3).

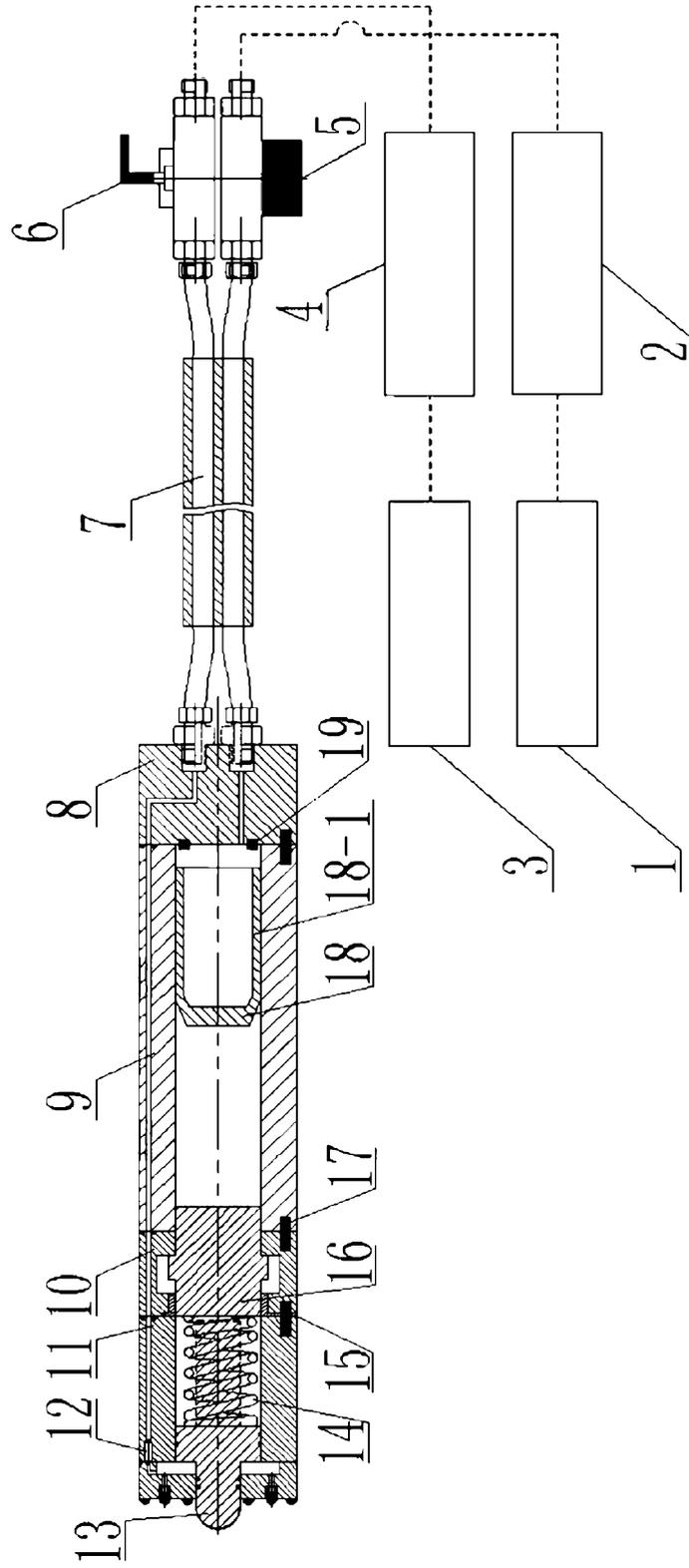


FIG.1

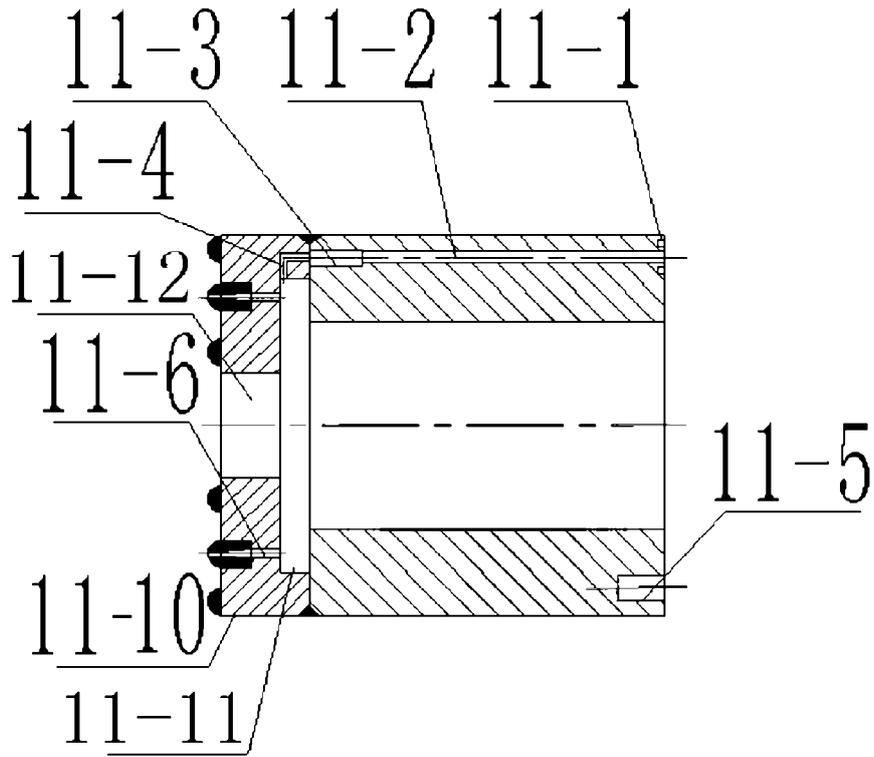


FIG. 2

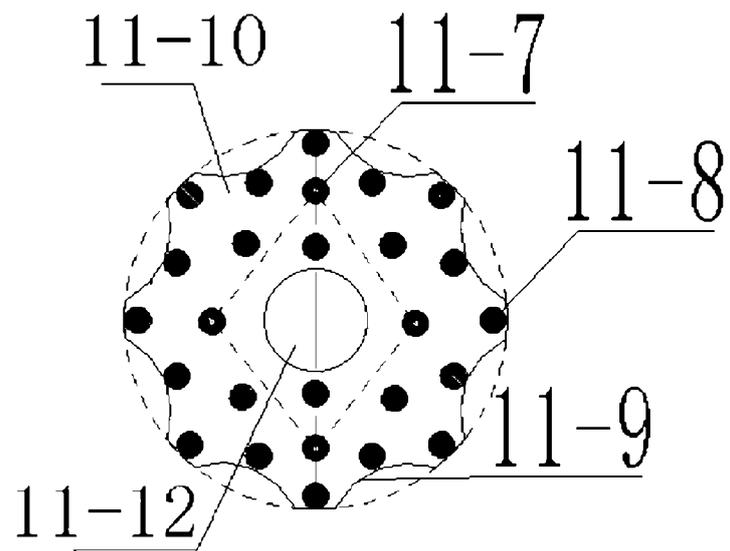


FIG. 3

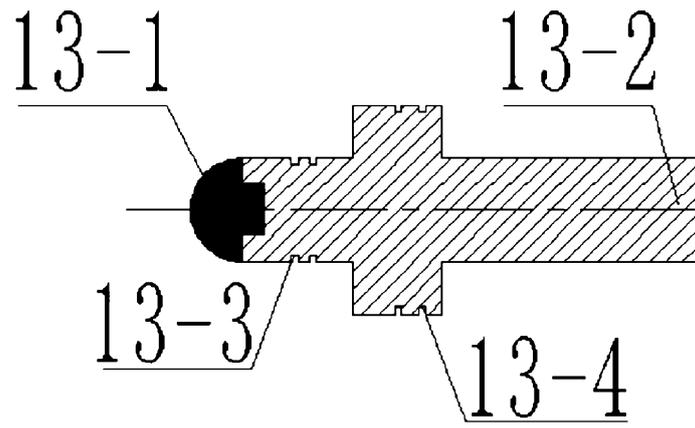


FIG.4

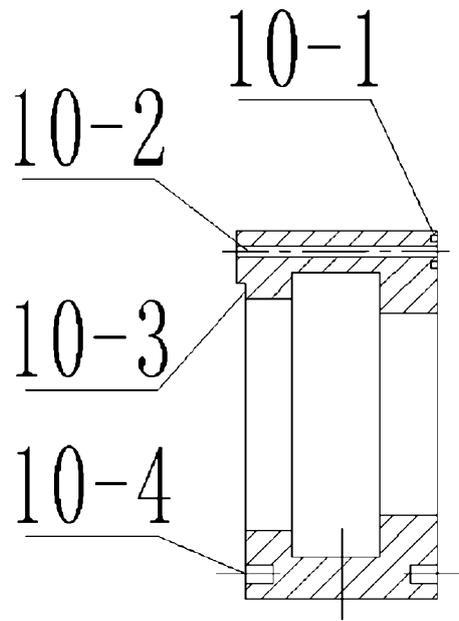


FIG.5

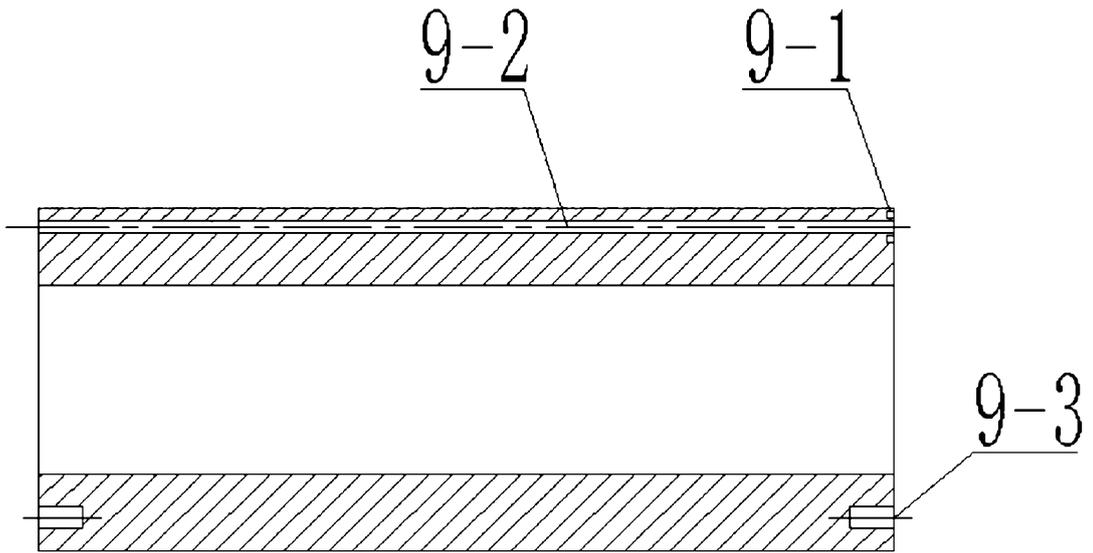


FIG.6

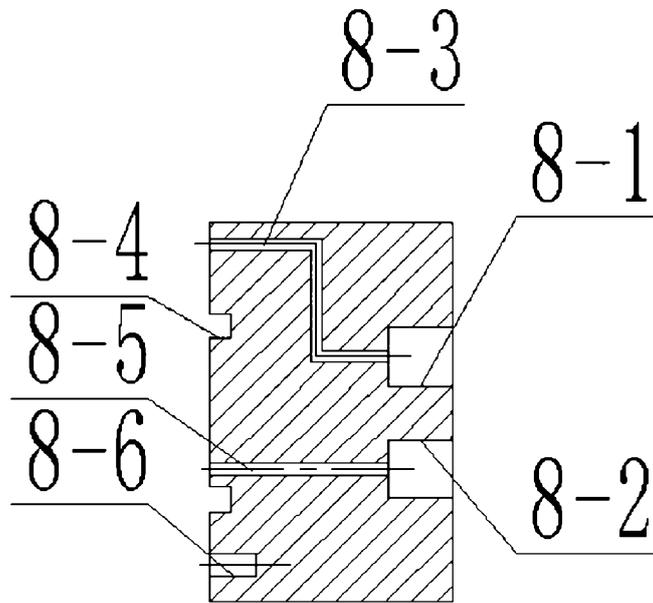


FIG.7

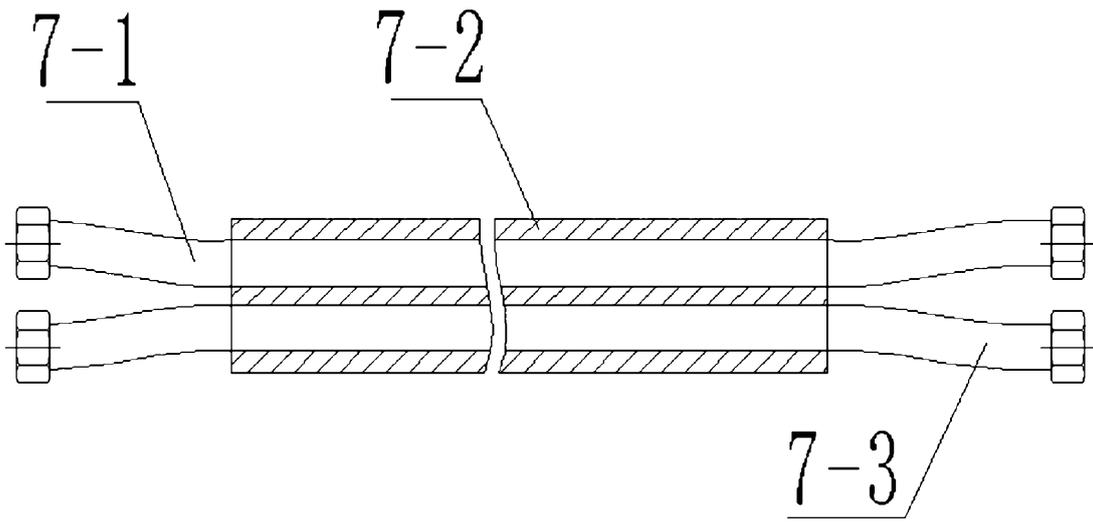


FIG. 8