A fissured substra water pumping apparatus and method. The fissured substrata water pumping apparatus comprises a water pumping pipe (5) made of a seamless stainless steel tube which extends into a hole drilled into substrata. An exposed end of the water pumping pipe (5) is connected to an annular drainage siphon (8) and a valve (11) by means of a connector (7). A plurality of water pumping holes (2) is disposed on the pumping pipe (5) at intervals. A one-way water baffle plate (3) is disposed inside the water pumping pipe (5). Rubber water-blocking rings (4) containing an expanding agent are sleeved on the outer wall of the water pumping pipe (5) at intervals. A sealant (6) is disposed between the outer wall of the top end of the water pumping pipe (5) and the inner wall of the drilled hole. An annular drainage siphon (8) connected to the water pumping pipe (5) is externally connected to a servo pump (9) and a water storage tank. The fissured substrata water pumping apparatus pumps water from substrata fissures according to the principle of a sealed fluid siphon, so that substrata water is prevented from softening bottom strata, thereby improving the stability of surrounding rock; in addition, water outflow volume is effectively controlled by means of the disposed valve, thereby ensuring that the drainage siphon (8) is full of water at all times, and air is prevented from entering drilled holes and weathering rock strata.
南京市玄武区太平门街 1 号 304 室，Jiangsu 210016 (CN)。


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一种底板裂缝水抽装置和方法，包括伸入底板钻孔内部由无缝不锈钢管制成的抽水管（5），抽水管（5）外端通过连接接头（7）与环状引流虹吸管（8）和阀门（11）连接。抽水管（5）上间隔分布有若干抽水孔（2），抽水管（5）内设有单向隔水片（3），抽水管（5）外壁间隔套装有内含膨胀剂的橡胶阻水环（4），抽水管（5）末端的外壁与钻孔的内壁之间设有密封胶（6），与抽水管（5）相连的环状引流虹吸管（8）外接伺服泵（9）和储水箱。底板裂缝水抽吸装置通过密封流体虹吸原理，将底板裂缝中的水抽出，阻止底板水软化底板层，增强底板围岩稳定性，同时通过设置的阀门有效控制出水量，保证了引流虹吸管（8）中始终充满水，防止空气进入底板钻孔风化岩层。
Fissured Substrata Water Pumping Apparatus and Method

Field of the Invention

The present invention relates to fissured floor water pumping apparatus and method, which are especially applicable to floor water drainage and pumping from fissure-developed surrounding rocks, soft surrounding rocks, and water-seeping surrounding rocks in mines, tunnels, and underground works.

Background Art

Fissure-developed surrounding rocks, soft surrounding rocks, water-seeping surrounding rocks, or surrounding rocks containing weak intercalations, argillation intercalations, various structural planes, or various composite structures, are often encountered in mines, tunnels, and underground works, wherein, soft surrounding rocks containing mudstone interlayers have high swelling and weathering characteristics; in addition, the mudstone may be argillized easily under the combined action of water and kinetic pressure when it encounters water, which is often accompanied with phenomena such as water seepage from surrounding rock, wetted and softened surrounding rock, and roadway floor heave, etc. When such surrounding rocks are shored by means of floor anchoring, it is difficult to set floor anchor bolts and create strong anchoring force; in addition, usually, after shoring measures are taken, floor heave and roadway floor crack still occur under a water seepage condition, resulting in adverse effects to normal use of the roadway and safe production. In view of above conditions, it is desirable to develop fissured floor water pumping apparatus and method, to drain off floor water and thereby prevent the surrounding rocks from being softened by accumulated water in the area of a floor separation layer, and prevent and reduce floor heave. The apparatus not only has a simple structure and is easy to use, but also can reduce the shoring cost and effectively increase surrounding rock stability.

Contents of the Invention

Technical problem: To overcomes the drawbacks in the prior art, the present invention provides fissured floor water pumping apparatus and method, which are simple in structure, low in cost, easy to use, and can attain a good water pumping effect.

Technical scheme: The fissured floor water pumping apparatus provided in the present invention comprises a water pumping pipe extending into a borehole drilled in the floor, and a servo pump, wherein, several reversed clamps and water pumping holes are arranged on the outer wall of the water pumping pipe at intervals, a rubber water blocking ring containing an expansion agent is fitted over a joint between pipe sections of the water pumping pipe, an unidirectional water baffle plate is disposed in the water pumping pipe, the clearance between the outer wall of the outlet of the water pumping pipe and the inner wall of the borehole port is filled with a sealant, the outlet end of the water pumping pipe is connected via a connector to one end of an annular drainage siphon, the other end of the annular drainage siphon is connected via a valve to the inlet of the servo pump, and the outlet of the servo pump is connected via a hose into a water tank; the water pumping pipe is made of a seamless stainless steel pipe.
The unidirectional water baffle plate has an eccentric pin shaft that can be opened and closed in one way in it; the water pumping holes are perpendicular to the wall of the water pumping pipe, and only one water pumping hole is drilled at each cross section of the pipe wall; the servo pump is a pressure-stabilizing self-regulating pump.

The fissured floor water pumping method provided in the present invention comprises the following steps:

a. mounting a fissured floor water pumping apparatus, and fitting a rubber water blocking ring over a water pumping pipe on which water pumping holes have been drilled, and reversed clamps and unidirectional water baffle plate have been mounted, according to the condition of water content in the fissured floor water;

b. extending the water pumping pipe into the borehole, till the water pumping pipe reaches the bottom of the borehole, pulling the water pumping pipe backwards so that the reversed clamps clamp the inner wall of the borehole firmly; sealing the borehole after the water pumping pipe is fixed, injecting a sealant into the clearance between the outer wall of the outlet of the water pumping pipe and the inner wall of the port of the borehole;

c. connecting the exposed end of the water pumping pipe via a connector to one end of an annular drainage siphon, connecting a servo pump to the other end of the annular drainage siphon, mounting a valve at the inlet of the servo pump to control the water flow, connecting the servo pump via a pipeline to a water tank, and fixing the annular drainage siphon to the sides of the roadway;

d. opening the valve, starting the servo pump to pump out the water in the floor through the annular drainage siphon, and setting a steady pressure for the servo pump with an instrument, so that the servo pump automatically starts and stops according to the pressure of the floor water and thereby controls the water flow.

Beneficial effects: With comprehensive consideration of the overall characteristics of fissure-developed surrounding rocks, soft surrounding rocks, and water-seeping surrounding rocks in mines, tunnels, and underground works, the present invention provides fissured floor water pumping apparatus and method, which utilize a principle of connected vessel and a principle of sealing fluid siphon to pump out the water in the fissures of floor, and thereby prevent hydration failure of a soft rock shoring system; in addition, the present invention utilizes a valve to effectively control the water flow, so as to ensure the reliability, safety, and sustainability of the soft rock shoring system under a fissure water condition. The apparatus is simple in structure, low in cost, easy to use, reliable and effective. Specifically, the advantages include:

1) A water blocking ring containing an expansion agent is fitted over the joint between pipe sections of the water pumping pipe, so as to effectively block the accumulated water according to the condition of water seepage from the rock strata and prevent accumulated water in different rock strata to flow out along the surface of the borehole; in addition, the clearance between the outer wall of the outlet of the water pumping pipe and the inner wall of the borehole port is filled with a sealant to attain a positive effect of water blockage and weathering resistance;

2) The other end of the annular drainage siphon is connected via a valve to the inlet of the servo pump, so as to effectively control the water flow and prevent the rock strata from being weathered owing to intrusion of external air into the borehole;
3) An unidirectional water baffle plate is disposed in the water pumping pipe, to prevent the water collected in the upper part of the pipe from flowing to the lower part, and thereby prevent the lower rock strata from expansion and crack resulted from long-time immersion in accumulated water;

4) The external servo pump connected to the annular drainage siphon is a pressure-stabilizing self-regulating pump, which can automatically regulate its operation (on/off) according to the hydraulic pressure in the water pumping pipe so as to form efficient and power-saving water pumping circulation.

Description of the Drawings

Fig.1 is a schematic structural diagram of the apparatus provided in the present invention.

In the figures: 1 - reversed clamp; 2 - water pumping hole; 3 - unidirectional water baffle plate; 4 - water blocking ring; 5 - water pumping pipe; 6 - sealant; 7 - connector; 8 - annular drainage siphon; 9 - servo pump; 10 - water tank; 11 - valve.

Embodiments

Hereunder the present invention will be further described with reference to the examples shown in the accompanying drawings:

The fissured floor water pumping apparatus provided in the present invention mainly comprises an unidirectional water baffle plate 3, a water blocking ring 4, a water pumping pipe 5, an annular drainage siphon 8, a servo pump 9, and a water tank 10, wherein, the water pumping pipe 5 extends into a borehole in the floor, the end of the water pumping pipe 5 exposed outside of the borehole is connected to the annular drainage siphon 8, and the annular drainage siphon 8 is connected to the servo pump 9; the water pumping pipe 5 is made of a seamless stainless steel pipe, several reversed clamps 1 and water pumping holes 2 are arranged on the outer wall of the water pumping pipe 5 at intervals, the rubber water blocking ring 4 that contains an expansion agent is fitted over the joint between pipe sections of the water pumping pipe 5, and has an eccentric pin shaft that can be opened and closed in one way; when there is no water, the unidirectional water baffle plate 3 falls off freely under gravity and is closed; when water exists, the unidirectional water baffle plate 3 is pushed aside by the upward pressure applied by the lower water flow. The clearance between the outer wall of the outlet of the water pumping pipe 5 and the inner wall of the borehole port is filled with a sealant 6, the outlet end of the water pumping pipe 5 is connected via a connector 7 to one end of the annular drainage siphon 8, the other end of the annular drainage siphon 8 is connected via a valve 11 to the inlet of the servo pump 9, the servo pump 9 is a pressure-stabilizing self-regulating pump, and the outlet of the servo pump 9 is connected via a hose into the water tank 10; the water pumping holes 2 are set perpendicular to the wall of the water pumping pipe 5, and only one hole is drilled at each cross section of pipe wall.

The fissured floor water pumping method provided in the present invention comprises the following steps:

a. mounting a fissured floor water pumping apparatus, and fitting a rubber water blocking ring 4 over a water pumping pipe 5 on which water pumping holes 2 have been drilled and reversed clamps 1 and unidirectional water baffle plate 3
have been mounted, according to the known condition of water content in the fissured floor water;

b. extending the water pumping pipe 5 mounted with fittings into the borehole, till the water pumping pipe 5 reaches the bottom of the borehole, then pulling the water pumping pipe 5 backwards so that the reversed clamps 1 clamp the inner wall of the borehole firmly; sealing the borehole after the water pumping pipe 5 is fixed, injecting a sealant 6 into the clearance between the outer wall of the outlet of the water pumping pipe 5 and the inner wall of the port of the borehole; sealing the space between borehole and the water pumping pipe 5;

c. connecting the exposed end of the water pumping pipe 5 to one end of an annular drainage siphon 8 via a connector 7, connecting a servo pump 9 to the other end of the annular drainage siphon 8, mounting a valve 11 at the inlet of the servo pump 9 to control the water flow, connecting the servo pump 9 via a pipeline to a water tank 10, and fixing the annular drainage siphon 8 to the sides of the roadway;

d. opening the valve 11, starting the servo pump 9 to pump out the water in the floor through the annular drainage siphon 8, and setting a steady pressure for the servo pump 9 with an instrument, so that the servo pump 9 automatically starts and stops according to the pressure of the floor water and thereby controls the water flow.
Claims

1. A fissured floor water pumping apparatus, comprising a water pumping pipe (5) extending into a borehole drilled in the floor, and a servo pump (9), wherein: several reversed clamps (1) and water pumping holes (2) are arranged on the outer wall of the water pumping pipe (5) at intervals, a rubber water blocking ring (4) containing an expansion agent is fitted over a joint between pipe sections of the water pumping pipe (5), an unidirectional water baffle plate (3) is disposed in the water pumping pipe (5), the clearance between the outer wall of the outlet of the water pumping pipe (5) and the inner wall of the borehole port is filled with a sealant (6), the outlet end of the water pumping pipe (5) is connected via a connector (7) to one end of an annular drainage siphon (8), the other end of the annular drainage siphon (8) is connected via a valve (11) to the inlet of the servo pump (9), and the outlet of the servo pump (9) is connected via a hose into a water tank (10); the water pumping pipe (5) is made of a seamless stainless steel pipe.

2. The fissured floor water pumping apparatus according to claim 1, wherein: the unidirectional water baffle plate (3) has an eccentric pin shaft that can be opened and closed in one way in it.

3. The fissured floor water pumping apparatus according to claim 1, wherein: the water pumping holes (2) are perpendicular to the wall of the water pumping pipe (5), and only one hole is drilled at each cross section of the pipe wall.

4. The fissured floor water pumping apparatus according to claim 1, wherein: the servo pump (9) is a pressure-stabilizing self-regulating pump.

5. A fissured floor water pumping method utilizing the apparatus according to any of claims 1-4, comprising the following steps:
   a. mounting the fissured floor water pumping apparatus, and fitting the rubber water blocking ring (4) over the water pumping pipe (5) on which water pumping holes (2) have been drilled and reversed clamps (1) and unidirectional water baffle plate (3) have been mounted, according to the condition of water content of the fissured floor water;
   b. extending the water pumping pipe (5) into the borehole, till the water pumping pipe (5) reaches the bottom of the borehole, then pulling the water pumping pipe (5) backwards so that the reversed clamps (1) clamp the inner wall of the borehole firmly; sealing the borehole after the water pumping pipe (5) is fixed, injecting the sealant (6) into the clearance between the outer wall of the outlet of the water pumping pipe (5) and the inner wall of the port of the borehole;
   c. connecting the exposed end of the water pumping pipe (5) to one end of the annular drainage siphon (8) via the connector (7), connecting the servo pump (9) to the other end of the annular drainage siphon (8), mounting the valve (11) at the inlet of the servo pump (9) to control the water flow, connecting the servo pump (9) via a pipeline to a water tank (10), and fixing the annular drainage siphon (8) to the sides of the roadway;
d. opening the valve (11), starting the servo pump (9) to pump out the water in the floor through the annular drainage siphon (8), and setting a steady pressure for the servo pump (9) with an instrument, so that the servo pump (9) automatically starts and stops according to the pressure of the floor water and thereby controls the water flow.
FIGURE 1.