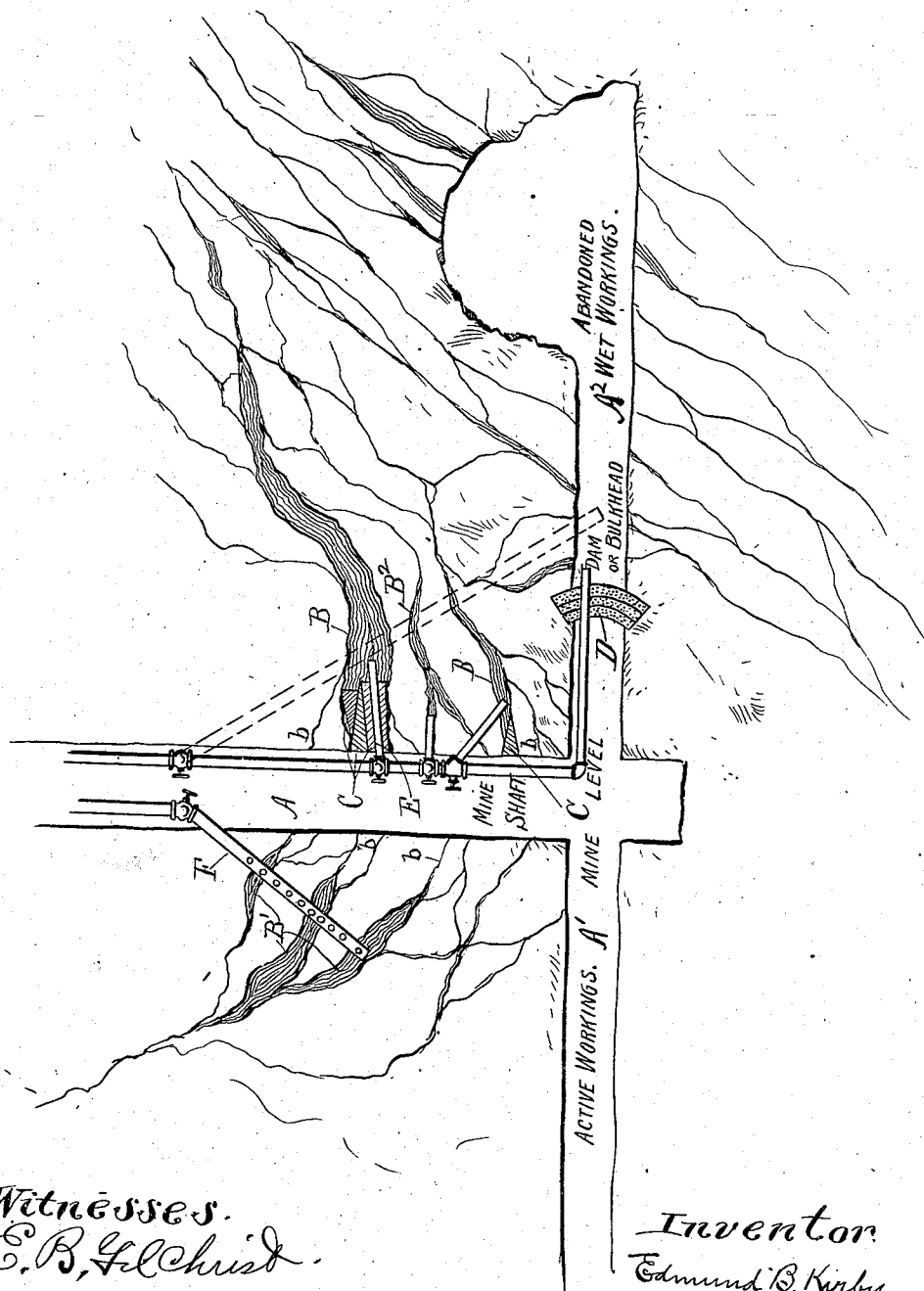


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 PROCESS FOR STOPPING OR SEALING OFF UNDERGROUND FLOWS OF WATER INTO
 MINE WORKINGS, &c.

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900,683.

Patented Oct. 6, 1908.



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UNITED STATES PATENT OFFICE.

EDMUND B. KIRBY, OF FLAT RIVER, MISSOURI.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EDMUND B. KIRBY, a citizen of the United States, residing at Flat River, in the county of St. Francois and State of Missouri, have invented a certain new and useful Improvement in Processes for Stopping or Sealing Off Underground Flows of Water into Mine-Workings or other Excavations, of which the following is a full, clear, and exact description.

It is well known that the earth's crust is irregularly permeated with water; and that when pits or subterranean excavations, for example mines, are made in it this water, when present in the neighborhood, tends to flow under its pressure into these excavations through the fractures and crevices which are generally found throughout said crust. In order to carry on mining operations, it is therefore necessary to pump out all such inflowing water. Since it is the misfortune of most mines to encounter water bearing ground, and since the quantity of water is frequently from several hundred to several thousand gallons per minute with lifts of from several hundred to one or two thousand feet, the expense of mine drainage is generally an important item, and often the most serious one in the business.

In the art of mining, attempts have frequently been made to stop, or seal off, or reduce incoming flows of water. Wedges have been used, together with dams, walls, bulkheads and a variety of constructions in timber, stone, brick, concrete, cement, etc. Massive tubes or linings of metal have been erected to seal off water bearing zones; and there is a well known process of shutting off water by freezing the ground. The known methods, so far as developed, have not found any wide application in mining. They are generally excessive in cost, or they require the expert experience of a specialist, or they are uncertain in result. Moreover rock crevices are so numerous and intricate, and mine water is usually under such high pressure, that it will generally find its way around any stop or barrier and enter the mine by other routes.

My invention consists primarily of the introduction into subterranean flows of water entering a mine, and at any convenient point or points, of any kind of sub-divided solid matter which is capable of being carried by those flows toward their exits and of being

deposited in and choking up the passages leading to said exits.

In most cases I prefer to use for the purpose stated finely sub-divided clay, which will be held in suspension in the flowing water; and in the best practice said material is preliminarily mixed with water, and the water carrying it in suspension is injected by suitable pressure producing means into the moving under-ground currents through pipes placed in holes, drilled for the purpose, leading to the passages through which said currents are flowing toward the exits into the mine. Other materials may be used, as, for example, sand, mill tailings or slimes, cement, saw-dust, horse manure, chopped hay, straw or fiber; or in fact, as above stated, any material capable of being introduced into the flowing currents and of being carried along thereby into passages which will be choked and sealed when said material accumulates therein.

The injection of the water bearing this material in suspension, may be made by any suitable means, as, for example, force pumps or stand pipes extending far enough toward the surface to furnish the necessary pressure.

The suspended particles when introduced into a cavity containing water which is in motion by one or many currents toward exits into the mine, are seized and carried toward these exits, settling and accumulating in and choking, at various points, the passages leading to said exits. The moving currents automatically select those particular passages which require sealing—that is to say, those passages which are discharging into the mine, because it is through them that the water currents flow. It disregards innumerable other passages which do not discharge into the mine because the water is not in motion flowing through said passages. The choking which occurs in the passages through which the out-going currents flow occurs at the most favorable points. These will generally be where the passages are smallest, and the flow most diffused. In fact large passages cannot be choked in the manner stated. The choking of these passages by the deposition therein of the suspended solid material will, of course, be gradual. When the passages are completely choked, the process ceases, although other passages and cavities which do not lead to and discharge into the mine may be and generally are still unfilled

and open. If, by the choking of one or more passages, the current is deflected to another course, the work is automatically resumed in the new passage. At any choked locality
 5 the pressure of the water holds the choking particles firmly in place. This automatic selective action of the out-going currents bearing suspended solid particles may produce a complete and perfect seal, shutting
 10 off all out-going threads of water, and it does this by filling not the main passages only, but those favorable automatically-selected localities where the deposition of the material can be effective. The material in suspen-
 15 sion is often carried for considerable distances to reach the points where the choking is effective. I have in practice sealed water flows issuing at various points along a distance of 240 feet from the point of injection.
 20 The choking in these cases occurred close to the points of exit, and the channels leading thereto remain unfilled.

Where the water passages leading to the mine are so large that they cannot be effectively choked and sealed in the manner specified, various forms of artificial barriers, such, for example, as those before mentioned, which are in common use in this art, may be employed for sealing off or reducing water
 25 flows through such large passages; and, when so used in connection with the injection of the material, as stated, will serve an important function and be a part of the invention herein described and claimed. These artificial constructions are to be so disposed that they will choke up the large passages, either closing them altogether, or so reducing them
 30 in area that the injected material will accumulate therein and ultimately close them up. In case an artificial construction does completely close a large passage through which water is flowing into a mine, as for example when a barrier is erected across the
 35 connection between a wet working and the mine proper the usual result is that the water restrained from flowing through this large passage will seek and find smaller passages and crevices through which it will flow. In fact, the water pressure is so great that it
 40 will not infrequently make such small passages. In any event, when the material stated is introduced into the moving flows behind said barriers, said material will accumulate in these small passages and seal
 45 them. It is obvious therefore that the artificial barriers need not be water tight. Generally speaking, their function is primarily, in so far as their erection is a part of the present invention, to so reduce the size of the
 50 water passages leading to the exits that the solid material will accumulate in them and seal them. Sometimes these artificial constructions are primarily erected for the purpose of supporting weak ground, but even

then they may, and generally will, restrict 65 the size of the water exits.

It is apparent that if the water flows are sealed off in the manner described, the pressure of the imprisoned water is more apt to break the ground than when the water is allowed to flow freely. It may, therefore, be
 70 necessary to use in connection with the described process, more frequently and extensively than under ordinary conditions, any of the well known forms of artificial constructions whose primary purpose is to support
 75 weak ground.

In the drawing, the figure is a necessarily conventional vertical section through a mine and adjacent earth's crust, illustrating the
 80 general disposition of the water passages leading to the mine working. This drawing also shows several forms of artificial barriers for choking large water passages, and it also shows pipes arranged for injecting the material into the flowing streams of water leading
 85 to the exits of the mine.

In this drawing A represents the mine shaft, and A' and A² lateral underground passages leading therefrom, one of these passages or drifts leading to an abandoned wet
 90 working and one to an active working.

B, B', B² represent large cavities through which the water flows. One of these cavities B is a natural cavity which discharges
 95 through a large opening into the mine. Its discharge exit is shown as more or less completely closed by wooden wedges C; and the pipe E through which the material is injected into the cavity passes through or between
 100 these wedges. As before stated, it is not necessary that these wedges should make a water-tight joint between the cavity B and the mine. Small leaks therein will be closed by the injected material.
 105

b represents numerous small water passages through which water may flow into the mine working. The injected material being delivered into the water passages at a greater or less distance behind the small passages to
 110 be choked will be carried along by the water flows into said small passages, in which it will be deposited as stated, and ultimately will completely close them. A masonry bulkhead D may be built across the draft A², but,
 115 as before stated, it need not be a water tight bulkhead or dam because, if it leaked, the solid material introduced behind it will accumulate in the small passages and ultimately seal them up.
 120

In cases where the water enters the mine only through small exits the artificial barriers will be unnecessary. Such a condition, for example, is disclosed on the left side of the
 125 drawing. In this case a pipe F is inserted into a hole drilled so as to cross and intersect various water passages, and this pipe may have numerous perforations through

which the material forced through the pipe may discharge into the water passages. After it is so discharged it will be carried along by the flowing current and automatically enter those small passages through which the water is flowing into the mine and very little of it will enter or accumulate in any other passages because the water is not flowing through them.

10 This invention is based upon the discovery that various forms of solid material if introduced into the water currents will automatically enter the small passages leading to the exits into the mine, and will accumulate there, and ultimately practically seal them. 15 When all of the water enters the mine through such small passages, the mere introduction of the solid material into the flowing currents at some point or points with which all of the 20 exits communicate will be sufficient. If water enters the mine through passages too large to be so sealed, artificial barriers must be placed in such large passages. These barriers will as far as possible close these passages; but if they leak or if because of the 25 barriers the water makes or finds other small passage-ways into the mine, then the solid material introduced into the large cavity behind the barrier, will soon choke and seal said 30 small passages.

Having described my invention, I claim:

1. The described process of sealing off flows of water issuing from the earth's crust into excavations made therein, which consists in the introduction into said flows, at 35 any convenient points prior to their points of exit, of any kind of solid matter, which is capable of being carried by said moving flows toward said exits and of accumulating and choking up the passages leading thereto. 40

2. The described process of sealing off flows of water issuing from the earth's crust into excavations made therein, which consists in the injection into said flows, at any 45 convenient points prior to their points of exit, of water carrying in suspension any kind of solid matter which is capable of being carried by said moving flows towards the said

exits and of accumulating and choking up the passages leading thereto.

3. The described process of sealing off flows of water from the earth's crust into excavations therein, which consists in inserting pipes into holes leading to passages through which said water is flowing toward the exits 50 into said excavations, and in the forcing through said pipes into said flowing water, of water carrying in suspension any kind of solid matter which is capable of being carried by said flowing water toward said exits 55 and of accumulating in and choking the passages leading thereto. 60

4. The herein described process of sealing off flows of water issuing from the earth's crust into excavations therein, which consists in erecting artificial barriers in the 65 larger passages through which the water so flows for the purpose of wholly or partly shutting off said flows or making the passages leading to the exits of so much smaller 70 size that they are capable of being choked in the manner stated, and of then introducing into the water passages behind said barriers any kind of solid material capable of being carried by said moving flows of water toward 75 the exits and of accumulating in and choking up the passages leading thereto.

5. The herein described process of sealing off flows of water issuing from the earth's crust into excavations therein which consists 80 in introducing into said flows at any convenient points prior to their points of exit into the mine of any kind of solid matter which is capable of being carried by said moving flows toward said exit and of accumulating 85 and choking up the passages leading thereto, and in erecting artificial barriers in the passages which are too large to be so closed, and introducing into the water behind said barriers said solid material. 90

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

EDMUND B. KIRBY.

Witnesses:

C. J. ADAINE,
FRANK LALLY.