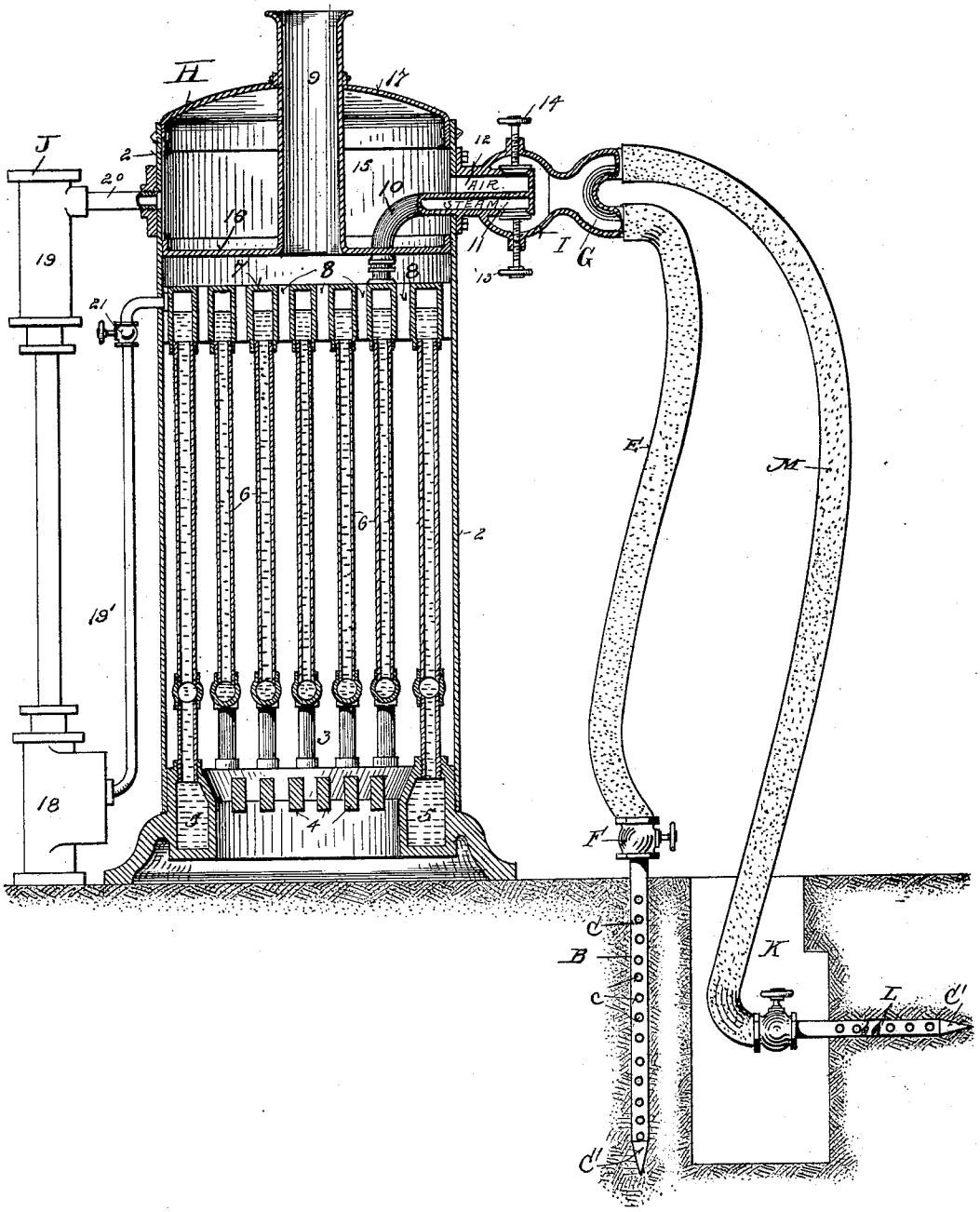
No. 632,388. Patented Sept. 5, 1899.

# J. WHITEHEAD.

## APPARATUS FOR THAWING FROZEN GROUND.

(Application filed Sept. 25, 1897.)

(No Model.)

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## APPARATUS FOR THAWING FROZEN GROUND.

SPECIFICATION forming part of Letters Patent No. 632,388, dated September 5, 1899.

Application filed September 25, 1897. Serial No. 652,952. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN WHITEHEAD, a citizen of the United States, residing at Urbana, in the county of Champaign and State of Ohio, have invented certain new and useful Improvements in Apparatus for Thawing Frozen Ground, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to certain new and useful improvements in an apparatus for thawing frozen ground.

The object of my invention is to provide a suitable apparatus whereby the heat-containing medium may be introduced into frozen ground under pressure, thereby being forced through the interstices in the earthy substance for the purpose of thawing the ground to make the subsequent work of shoveling or otherwise excavating easy and rapid, such medium preferably consisting of steam, hot water, or hot air.

The general object of this invention is to enable practical mining operations, ditch-digging, and tunnel-making to be carried on irrespective of the fact that the earth or ground is frozen, whereby the barrier of severe climatic conditions to the prosecution of such work shall be effectively removed and these important pursuits of industry be made possible of practice as well in winter, however severe, as in the milder seasons. This object I carry out in practice in a satisfactory and economical way by the use of my apparatus.

In the accompanying drawing, on which like reference-letters indicate corresponding parts, the figure represents a vertical sectional view of my combined water and air heater and discharge-valve, also showing the manner of conducting the steam or hot water to the ground.

It will be understood that a hole has been drilled in the ground and that the drill has been removed and the heat-pipe C inserted therein. Connection is now made with the said pipe and the apparatus which supplies the heat-containing medium, as steam, or hot water, or hot air. Such connection I illustrate by means of the flexible pipe E, attached to the heat-pipe by a device F, constituting a coupling and a cock, and the other end of the flexible pipe is attached to one end of a supply-pipe G, extending from an apparatus H, a cock I being interposed to control the heat-carrying medium. This apparatus H is shown as in the nature of a boiler for generating steam or for heating water, and it will also be understood that it constitutes a hot-air apparatus, when considered in connection with the pump J, designed to inject air into the apparatus H, that the same may be heated instead of water. This combined water and air heater is composed of an outer shell 2, having a fire-box 3 with grate-bars 4 and a water-chamber 5, connected with water-tubes 6, joined to a water and steam head 7, with passages or spaces 8, through which the smoke and products of combustion pass to the stack 9. A steam-space of the head 7 has connected to it a pipe 10, which conveys steam to and through the cock I, having a steam-passage 11 and an air-passage 12, controlled by hand-valves 13 and 14, respectively. This cock connects with the pipes E and M. When steam is to be the heating medium, the valve 14 is closed and the valve 13 opened. When hot air is to be the heating medium, the valve 13 is closed and the valve 14 is opened. The air-passage 12 of the cock leads into the air-chamber 15, formed by the casing 2 and sheet 16 and the cover 17. A steam-pump 18 receives steam through a pipe 19′ from the steam-supply apparatus and its pump-cylinder proper, 19, to force air into the air-chamber 15 through a pipe 20. The heat striking the plate 16 and passing through the stack with the general heat of the apparatus heats the air in this air-chamber to the desired extent. When steam is to be used instead of air, the pump is not operated, the cock 21 being used to cut off the steam. Now, then, either of these heat-containing mediums is introduced into the pipe and is directed against the surrounding frozen earth by passing out of the perforations *c*. The latent heat contained in these mediums, say in the case of steam to raise water from a freezing to a boiling point, is about nine times greater than the heat necessary to generate it and it at once attacks the frozen earth and melts the frozen particles contained therein, and thus loosens and softens the earth so that it can be excavated, say, by the use of a pick and shovel. The heat rises through the interstices in the

soil as well as radiates by the action of the pressure, and thus a considerable area around the pipe is melted down. It will be understood also that when the heat-pipe is introduced into the drill-hole after the drill is removed or is driven into the earth without previously drilling, as hereinafter referred to, still it fits closely and tightly in the earth, so as to form a tight joint that will prevent the steam or hot air or other medium from escaping or working out around the sides of the pipe. It will be understood that the pipe is placed deep enough into the earth to take the upper or outer perforations far enough from the surface to leave sufficient earth to make this joint or packing. Sufficient pressure for effective work cannot be obtained in the absence of this packing or tight-joint feature. With it, however, the medium is held from escaping, and such pressure can be applied, while there is the essential element of economy resulting from preventing the medium from escaping, and the digging can be commenced either after withdrawing the pipe or by allowing the same to remain in the ground and by digging around it. After having excavated, as suggested at K, lateral holes may be drilled by the use of drilling apparatus and then the heat medium introduced into such lateral holes, as shown at L, through the branch flexible pipe M. Thus it will be seen that I introduce into the frozen ground heat-containing mediums in a manner which is simple and effective and by a form of apparatus easily carried about for use in remote places, as in mining regions, in many localities of which the important industry of mining is brought to a standstill by the condition of the soil during the winter season and indeed for weeks and even months after that season is over, being until the soil partially thaws.

My apparatus is also useful in preparing the soil for ditch-digging during the winter season and in the matter of building tunnels in a severe climate during said season.

It should be observed that while I have mentioned a drilling-machine as one means for drilling into the soil in order to form the holes and prefer to use it still the heat-pipe C with its point $c'$ may be driven into the ground where it is not too hard, and then the other operations are performed.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a mechanical equipment for thawing the earth the following apparatus: a heat-pipe perforated a part of its length and pointed to adapt it to be inserted in the earth and make tight contact therewith, the insertible part including the perforated portion and a part of the imperforated portion, and an apparatus for charging such heat-pipe either with steam or hot air, and consisting, substantially, of combined steam-generating devices and air-heating devices, a steam-operated pump for charging the air-heating devices with air, a steam connection between said steam-pump and steam-generating devices, a suitable cock connected with the steam-generating and air-heating devices, a flexible pipe connecting said cock with said perforated pipe, the cock being adapted to alternately admit air or steam.

2. In a mechanical equipment for thawing frozen earth the following apparatus: a steam-generator and an air-heater consisting of a shell with a fire-box near one end, and a water and steam head, an air-chamber above said head, a steam and air cock connected with said head and said air-chamber, a steam-pump with its operating-cylinder connected with said head and its pumping-cylinder connected with said air-chamber, a flexible pipe connected with said cock adapted to receive steam or air according to the adjustment of the cock, a heating-pipe connected at one end with said flexible pipe and pointed at the other and having perforations through a portion of its length and insertible in the earth throughout the perforated portion and a part of the imperforated portion, whereby a special apparatus is formed for alternately applying steam and air, and an effective distribution of such medium against the frozen earth is effected without leakage of the medium between the earth and heating-pipe, substantially as shown and described.

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

JOHN WHITEHEAD.

Witnesses:
R. C. HORR,
COLIN MCDONALD.