

No. 612,919.

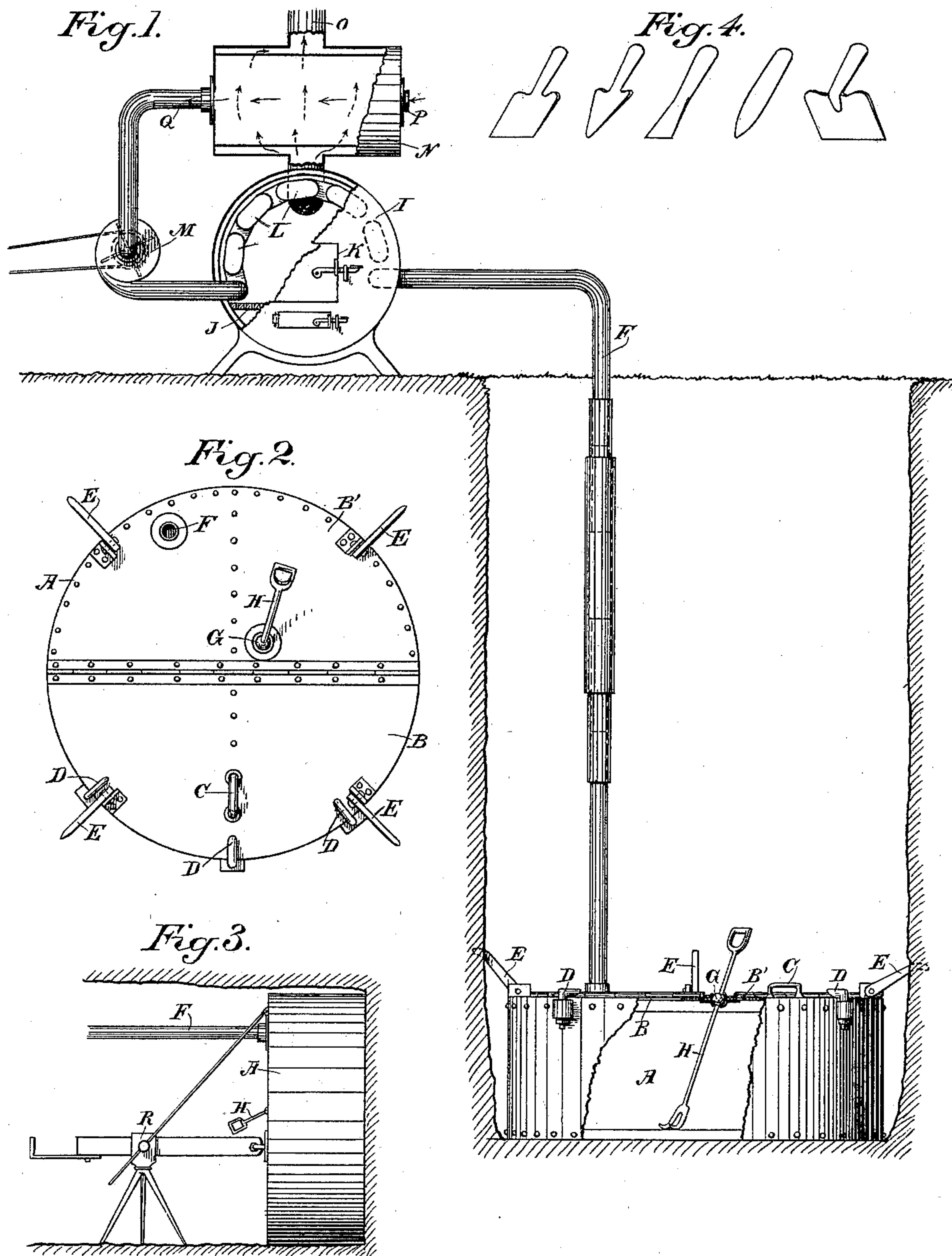
Patented Oct. 25, 1898.

J. H. L. TUCK.

APPARATUS FOR SOFTENING AND EXCAVATING FROZEN EARTH.

(Application filed Oct. 1, 1897.)

(No Model.)



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JOSIAH H. L. TUCK, OF SAN FRANCISCO, CALIFORNIA.

APPARATUS FOR SOFTENING AND EXCAVATING FROZEN EARTH.

SPECIFICATION forming part of Letters Patent No. 612,919, dated October 25, 1898.

Application filed October 1, 1897. Serial No. 653,682. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH H. L. TUCK, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Apparatus for Softening and Excavating Frozen Earth; and I hereby declare the following to be a full, clear, and exact description of the same.

10 My invention relates to an apparatus which is especially designed for softening and excavating frozen earth.

It consists of a closed caisson, means for fitting and holding it against the surface to be acted on, means for supplying heated air to the space within the caisson, and means for excavating the softened material without opening the entire caisson, and in details of construction which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a general view of my apparatus. Fig. 2 is a top view of the caisson. Fig. 3 shows its use for tunneling. Fig. 4 represents the different tools to be used in connection with the apparatus.

The object of my invention is to provide an apparatus by which frozen earth containing valuable precious metals may be continuously softened and excavated.

It is especially applicable to mining in high latitudes where the earth remains frozen to a great depth throughout the year.

A is a caisson, which may be made, preferably, of sheet-steel or other metal riveted up into a cylindrical form having a diameter approximately as great as that of the desired shaft-tunnel or other excavation. The end of the caisson which is designed to fit against the surface to be operated on is left open. The other end is closed either by an entirely-removable cover or preferably, as here shown, by a cover made in two parts B and B', one part being permanently secured to the caisson and the other having a central line of hinges, whereby it may be opened to obtain access to the interior of the caisson for the purpose of removing the softened and loosened material from time to time.

50 C is a suitable handle by which the cover can be opened when desired.

D represents hinged clamping arms or le-

vers which are adapted to close upon the cover B and hold it firmly in position.

E E are arms hinged around the periphery of the caisson, projecting outwardly therefrom. These arms serve as braces, the outer ends resting against notches in the excavation as the latter proceeds and serving to hold the caisson against the face of the shaft or tunnel in which it is working to prevent unnecessary escape of the heated air.

F is an opening and suitable connection for a tube through which hot air is introduced to the caisson.

G is a ball-joint suitably fitted into a corresponding socket in the fixed part of the cover of the caisson, and through this ball a shaft or handle H is slidable and also turnable in any direction by reason of the ball or universal joint through which it passes. This joint, while allowing perfect freedom of movement of the handle, prevents any escape of heated air through the joint.

The lower end of the shaft is adapted to receive various forms of excavating-tools, such as are illustrated in the present case in Fig. 4. Any one of these tools may be fixed to the end of the shaft while the cover is open and employed after the cover has been closed and heat applied to excavate and loosen the soil within the caisson as fast as it is sufficiently softened by the heat. In this manner the operation may proceed until so much material has been loosened as to fill the caisson. The heat can then be temporarily shut off, the hinged cover B released and opened, and the loosened material removed, after which the cover is closed and the process continued.

In order to supply heated air with the greatest facility, I have shown a furnace I, having within it a grate J, with suitable fuel-door at K, and an ash-pit below the grate. Within this furnace and surrounding the fuel-space I have shown a series of returning bent pipes L, through which the air to be heated is caused to pass from the inlet to the exit end. The exit end of the pipe is connected with the passage F of the caisson by a telescopic or other suitable connection which will allow the caisson to be gradually moved forward without interfering with the connection between itself and the furnace.

M is a fan or other blower which is adapted

to deliver the air into the heating-pipes L of the furnace.

In order to economize fuel and to gradually raise the temperature of the air, which is intensely cold in these regions, I have shown a heating-drum N, which is suitably fixed in the smoke-stack O, through which products of combustion leave the furnace. This preliminary heater has a suction or inlet valve, as shown at P, and the pipe Q connects the opposite end with the suction fan and blower M.

The operation will then be as follows: When the fan-blower is set in operation, it draws the air through the suction-valve P, through the chamber N, where it is exposed to the escaping products of combustion from the furnace. The temperature will thus be raised to a considerable degree before the air enters the casing of the fan-blower. From this blower the air is forced into the heating-pipes L of the furnace, where its temperature may be raised to any desired degree. The pressure from the fan-blower causes the air to traverse these pipes, and, passing through the telescopic connecting-pipe, it enters the caisson A at a high temperature and acts constantly upon the frozen surface of soil against which the open end of the caisson is pressed. This continued heat will soften the soil, and by means heretofore described it can be loosened and excavated and removed from the caisson from time to time as soon as a sufficient amount has been loosened up. The work can thus be continued with considerable rapidity.

When the apparatus is to be used in a tunnel, it is placed with the open end against the face which is to be worked, and it is retained in contact with this face by means of any suitable mechanism which will produce the requisite pressure against the back or end of the caisson. Such a device I have here shown at R; but it will be manifest that various devices may be used for the purpose, according to convenience and location of the work.

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

1. An apparatus for softening frozen ground consisting of a caisson having an open front adapted to contact with the surface to be softened, the opposite end being closed and provided with a cover, means for locking said cover when closed, means for introducing heated air within the caisson, and a handle passing through the closed cover and provided with an excavating-tool, said handle adapted to be moved for the purpose of excavating and loosening the soil within the caisson.

2. An apparatus for softening and excavat-

ing frozen soil consisting of a caisson having an open front, a closed rear end, a cover and means for locking said cover when closed, a pipe and connections through which heated air is introduced into the caisson, a handle extending through the fixed portion of the cover and adapted to have excavating-tools fixed to its inner end, a ball fitted and turnable in the opening of the cover and having a hole made through it through which the handle is slidable whereby change of direction and distance may be effected.

3. An apparatus for softening and excavating frozen ground consisting of a caisson having an open front and a closed rear with a cover, locking-clamps by which the cover is retained in a closed position, a pipe through which heated air is introduced to the interior, a handled shaft, a universal ball-joint fixed in the cover through which the handle is slidable, the inner end of said handle being constructed to receive excavating-tools which can be operated from the outside of the caisson and holding devices surrounding the caisson adapted to be locked against the sides of the excavation so as to hold it in contact with the surface to be excavated as it is advanced.

4. A device for softening and excavating frozen earth consisting of an open-front caisson having a closed rear end and a cover, means for holding the caisson in contact with the surface to be excavated, a universal joint and a movable tool passing through said joint adapted to loosen and excavate the material within the caisson, a pipe extending outwardly from the cover of the caisson, a heating-furnace, the discharge end of said pipe connecting with the caisson, a fan-blower by which air is forced into said pipe and a preliminary heater fixed in the smoke-stack of the furnace having an inlet-valve at one end and a pipe connecting the opposite end with the fan-blower.

5. An apparatus for softening frozen earth consisting of a closed and movable caisson having an open front adapted to contact with the surface to be acted upon, an air-heating furnace, extensible pipes connecting said furnace with the caisson, whereby the latter may be moved to different positions independently of the furnace, and an air-forcing apparatus to propel the heated air from the furnace to the caisson.

In witness whereof I have hereunto set my hand.

JOSIAH H. L. TUCK.

Witnesses:

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J. C. BRODIE.