(No Model.)

R. P. ROTHWELL.

APPARATUS FOR SINKING SHAFTS.

No. 428,021. Patented May 13, 1890.

FIG. 1.

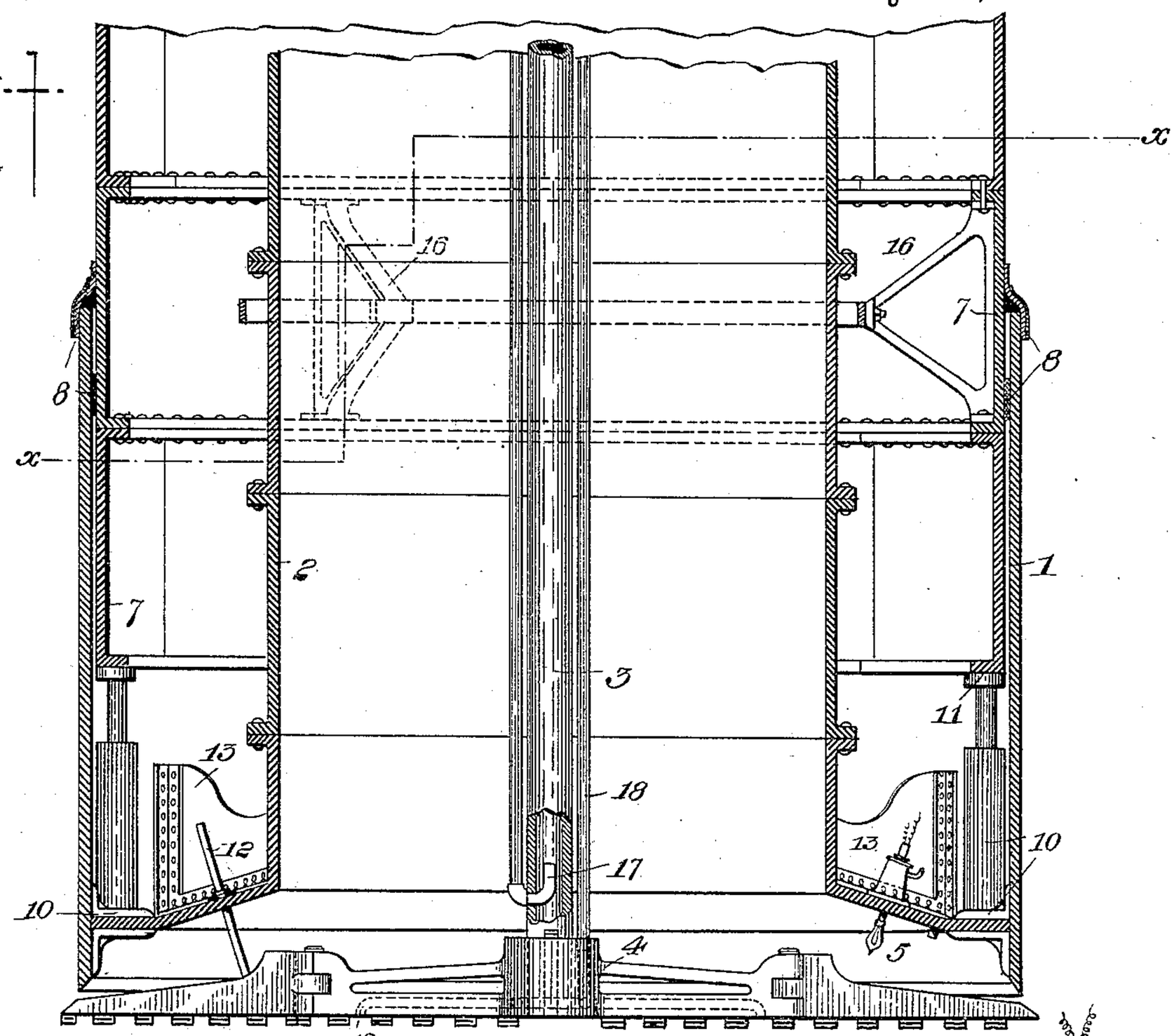


FIG. 2.

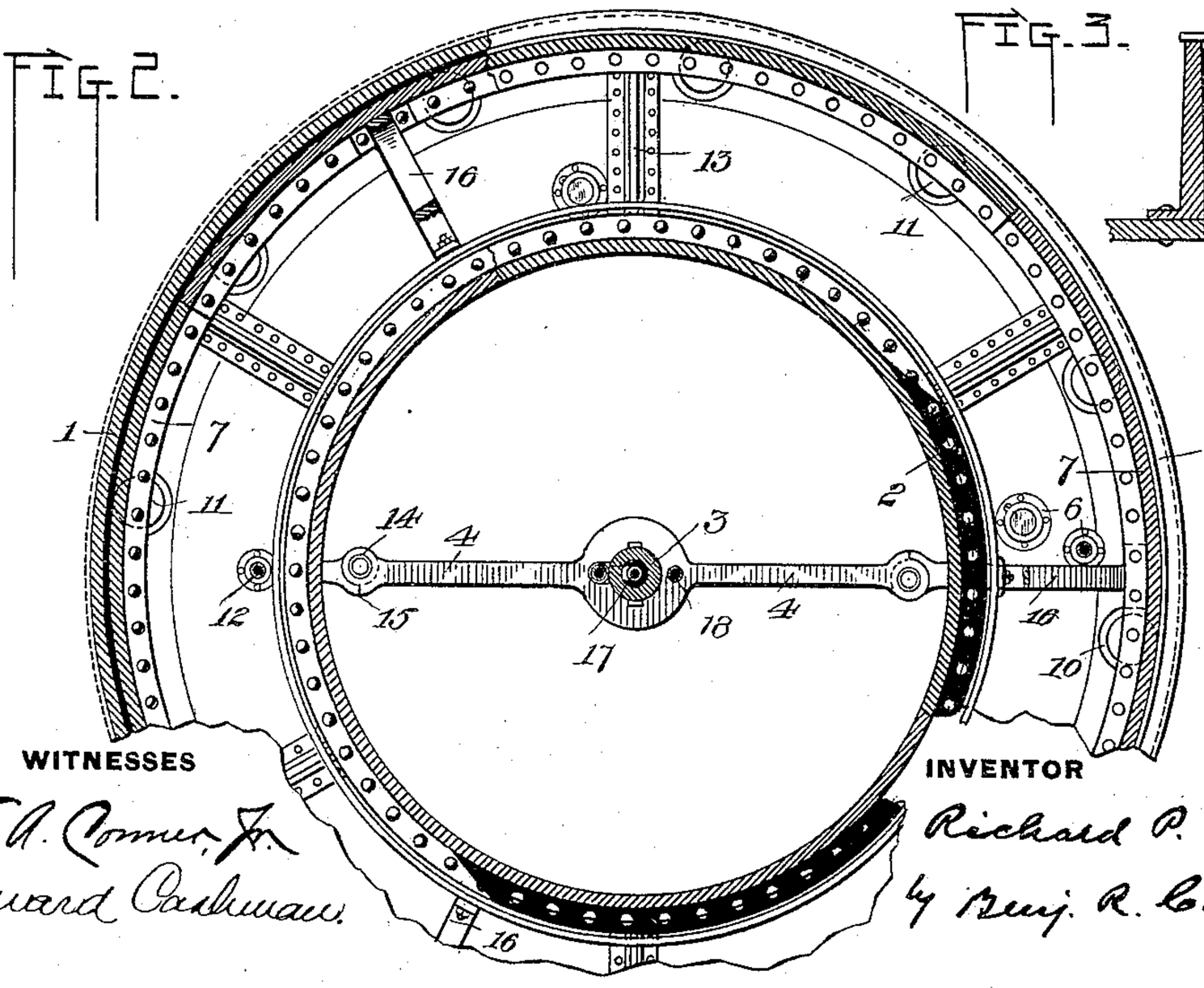
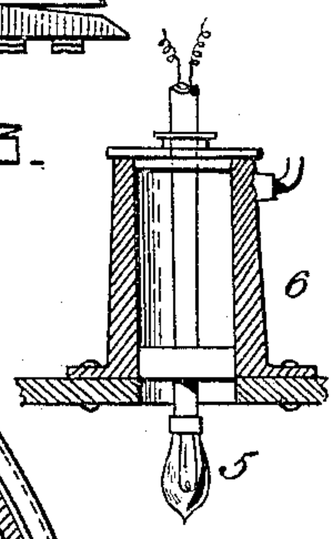


FIG. 3.



WITNESSES

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APPARATUS FOR SINKING SHAFTS.

SPECIFICATION forming part of Letters Patent No. 428,021, dated May 13, 1890.

Application filed December 28, 1889. Serial No. 334,775. (No model.)

To all whom it may concern:

Be it known that I, RICHARD P. ROTHWELL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Apparatus for Sinking Shafts; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

In sinking shafts in wet ground or through quicksand or other loose ground, the following methods have been in use: First, the ground is excavated by hand or machine tools, the shaft being kept dry by pumping to allow this work to be done and the lining to be put in, the lining being put in as the work proceeds, either by additions at the bottom or by allowing the lining, which is suspended, to be lowered as the excavation is made. This is called "sinking dry." In recent years the artificial production of a ring of ice around the shaft has been adopted, the shaft being sunk dry inside the ring wall of ice. Rows of piles have also been driven to form a wall, inside of which the shaft can be sunk dry. I have also used a movable caisson as a "sinking-frame," which was jacked down from the permanent lining or tubing by means of hydraulic or other jacks, the tubing being put in at the bottom as the sinking-frame was pushed down, the material, water, &c., being removed from the shaft as in ordinary well-sinking.

The disadvantages of sinking dry are, the great expense of pumping and the slow progress of the work where there is much water, and the danger of losing the shaft by the running of the quicksand or loose material which sometimes comes in in such quantity as to make it impossible to continue the work, and which may even twist and break the shaft lining or tubing. To overcome these difficulties, M. Chaudron, a Belgian engineer, M. Kindt, M. Lippmann, and others have used the wet-sinking method in which the shaft is drilled or bored from the surface and a tube or tubing pushed down as the drilling progresses. If the pressure on the tube should become so great that this cannot be pushed down, a smaller tube has to be put down inside the first, and this is carried down until rock is reached or until a still smaller tube is required, the size of the shaft diminishing at each operation. The water in the tube being always at its natural level, the pressure on the side of the hole is not disturbed, and the ground has little tendency to "run." When the wet ground has been passed and hard rock reached, a seat is cut in it and the lining is allowed to settle down on a moss-box or other device on this seat, thus making a water-tight joint, and the water in the shaft can then be pumped out and sinking dry continued or mine work commenced.

My invention consists in the apparatus, hereinafter described and pointed out, which combines the advantages of sinking wet with the very great economy and convenience of putting in the lining from the bottom and of allowing access at all times to the bottom of the shaft, and it affords the means of keeping the shaft always vertical and of the same diameter however deep, or in a direct line inclined to the vertical.

In the accompanying drawings, Figure 1 represents a central vertical section of the improved apparatus; Fig. 2, a transverse section, a part being broken away; and Fig. 3 is a vertical section of an electric light and port.

The reference-figure 1 indicates a movable caisson having a water-tight connection with an interior tube 2, in which tube the drill 3 4 is worked. This drill, which may be of any approved form, in the present instance consists in the hollow rod 3, having expanding drills or tools 4 attached thereto in such manner that they can be passed up or down in the tube and expanded when below it to drill or bore the shaft to the necessary size for the caisson to descend. Where rock has to be bored with percussion-drills a free falling device is used to prevent jar. A hollow rod is also used, so that the sand or débris may be forced up through it by means of a water or air jet applied in the usual manner. The great loss of time required for moving the rods and pumping the sand in the usual way

is thus avoided. The tool may be jointed, as at 14, and the joints provided with stops 15, to prevent their closing in one direction. The invention, however, is independent of the form of the drill.

7 indicates the shaft lining or tubing, which may be put in at the bottom, as the shaft is sunk, in any suitable manner. In the drawings it is represented as formed of sections bolted together by means of flanges. A water-tight connection between the caisson and the lining is maintained by means of suitable packing or other device, (indicated at 8,) retained in position by appropriate means.

The caisson is pushed down as the lining of the shaft requires by any suitable means. Hydraulic jacks are indicated in the drawings, which stand upon suitable seats 10, and push against the bottom of the lower section of the tubing or lining, as at 11. The lower part of the caisson is strengthened by the radial steel plates 13, of which there may be any suitable number, bolted to the floor and vertical walls of the caisson and inner tube 2. At intervals between the tubing 7 and tube 2 braces or fenders 16 are interposed as guides to hold the central tube in place as it descends with the caisson.

12 indicates a well-known arrangement of a hand-tool having a water-tight ball-and-socket connection with the ports of the caisson. A suitable number of these ports 6 are arranged in the bottom of the caisson for the admission of bars or tools or nozzles with which the ground can be loosened either by jets of water with heavy pressure or by tools or drills, and through which electric lights 5 may be inserted for the purpose of examining obstructions or ascertaining the nature of difficulties met with in sinking. By means of a port having an upward extension 6, an electric-lighting device provided with suitable packing can be pushed down through the caisson-floor or withdrawn as required, adequate power being applied in any known way to the light or globe holder, said holder or an extension thereof filling the port-extension 5′.

Inspection-ports and man-holes can be provided in the central tube and in the bottom of the caisson.

18 indicates a pipe with branches for introducing a fluid under pressure. This pipe may pass through the drill and be arranged substantially as illustrated. Well-known hydraulic valves may be employed in directing jets through the floor of the caisson.

Workmen can descend between tube 2 and the tubing and caisson, water being excluded by the water-tight connections above described. Water rises in the central tube to the water-level in the soil, thus equalizing the pressure on the water, sand, &c., outside the caisson and preventing the sand from running as would be the case were the water pumped out of the center tube, and the water in this tube does not interfere with the operation of the drill nor with the workmen.

The fine material loosened or triturated by the drilling is to be removed by pumping from the bottom of the inner tube as in the Chaudron system or by jets, as indicated at 17, forcing the débris to pass up through the hollow rod or tube (that also may act as the rod for the drill or boring tool) or from below the caisson. Bowlders or coarse material can also be removed through the central tube, as will be readily understood.

The tubing and the caisson can be made of any suitable material. The former is, however, preferably made of cast-metal sections having inner flanges for bolting together, whereby its exterior is free from projections and its passage through the stuffing-box of the caisson facilitated.

From the foregoing description it will be understood that I use a caisson or sinking-frame, which is made practically water-tight, and that the lining of the shaft enters the caisson through a stuffing-box arrangement, which may be of any suitable construction—such, for example, as that described in connection with a caisson in patents, Nos. 311,656 and 346,543, granted to Hall and to Hall and Bull, which apparatus, however, can only be used for tunneling, the ground being removed by dredging or washing. My construction embraces the central tube before described, and provides an annular space inside the lining or tubing of the shaft wide enough to allow a workman to bolt up the segments of the tubing. I make the center portion of the shaft a tube connected with and, in fact, a part of the sinking-caisson. Water stands at its natural level in this tube, and the tools for drilling or boring the shaft are lowered and worked through it, as in the Kindt-Chaudron method.

The movable caisson is pushed down by jacks from the permanent lining or tubing, and its movement is therefore under complete control, while the tubing can be added to as the caisson descends. Any water that may enter through the caisson stuffing-box can be readily pumped up. The movable caisson has a series of ports, through which jets of water or bars or electric lights may be passed by the use of suitable hydraulic universal joints or other appropriate devices, which will allow them to be operated to loosen the ground to be drilled and aid in sinking. When the caisson has reached an impervious bed, a seat and water-tight joint may be made, as in the Chaudron wet-sinking method and the caisson be let down in it, or by forcing cement through ports in the side of the caisson the foot of the shaft may be made water-tight. The lining or tubing being connected with it, the caisson is thereupon abandoned and the water pumped out of the central tube, and that and the bottom of the caisson removed, so that the shaft may be continued by the dry-sinking method, if desired.

By the use of the above-described apparatus, shafts can be sunk to great depths in wet soils and quicksands with safety and ease. and at a much less expense than by any means heretofore known.

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

1. For use in shaft-sinking, the movable caisson having a water-tight connection with the shaft-tubing, and provided with the interior tube rigidly connected to and movable with said caisson, said tube being in free communication with the open air, substantially as set forth, whereby workmen can safely descend in wet situations to great depths, and the lining or tubing be built on at the bottom.

2. For use in shaft-sinking, the combination of the caisson having water-tight connection with the tube rigidly connected thereto and extending upwardly, said tube being in free communication with the open air, and a drill or boring tool, substantially as set forth, whereby a shaft can be sunk below water-level and water excluded from the space between the tube and tubing while standing at the same level within the tube and outside the caisson and tubing, and the drill operated and mud, sand, or rock removed while the hydrostatic pressure on the outside of the caisson and shaft-lining is undisturbed, and objectionable movement of the sand or soil prevented.

3. For use in sinking shafts, a caisson provided with a tube extending upwardly and in free communication with the open air and forming a rigid continuation of the wall of the caisson, the latter having a water-tight connection with the tubing of the shaft, whereby water will stand at the same level in the tube and outside the caisson and tubing, in combination with jacks or other means of pushing down the caisson and tube, substantially as set forth, whereby water can be excluded from the caisson, a hydrostatic column maintained, a drill or other tool be used, and the caisson lowered.

4. In apparatus for sinking shafts, a water-tight caisson having a water-tight connection with the shaft-tubing, and having its floor continuous with an interior tube open to the air, said floor being provided with ports through which jets of water may be forced under heavy pressure to cut away the material through which the shaft is being sunk and through which bars or other tools or electric lights may be passed to facilitate the work, substantially as set forth.

5. In an apparatus for sinking shafts, a water-tight caisson provided with a port and with an electric light located in or below said port, substantially as set forth.

6. In an apparatus for sinking shafts, a water-tight caisson provided with an inner tube, in combination with a boring-tool secured to the foot of a hollow rod, substantially as set forth.

7. In an apparatus for sinking shafts, a water-tight caisson provided with an inner water-tight tube and an interior hollow tool-rod provided with means for producing an upward current through said hollow rod, substantially as set forth.

8. In an apparatus for sinking shafts, a water-tight caisson provided with an inner tube, a tool-rod located in said tube and a pipe for introducing a fluid under pressure immediately below the tool, substantially as set forth.

9. In an apparatus for sinking shafts, a water-tight caisson provided with an inner tube, and strengthening-plates bolted to the caisson and tube, substantially as set forth.

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

RICHARD P. ROTHWELL.

Witnesses:

EDW. S. HOLMES,

JOHN H. PYPER.