No. 885,044. PATENTED APR. 21, 1908.

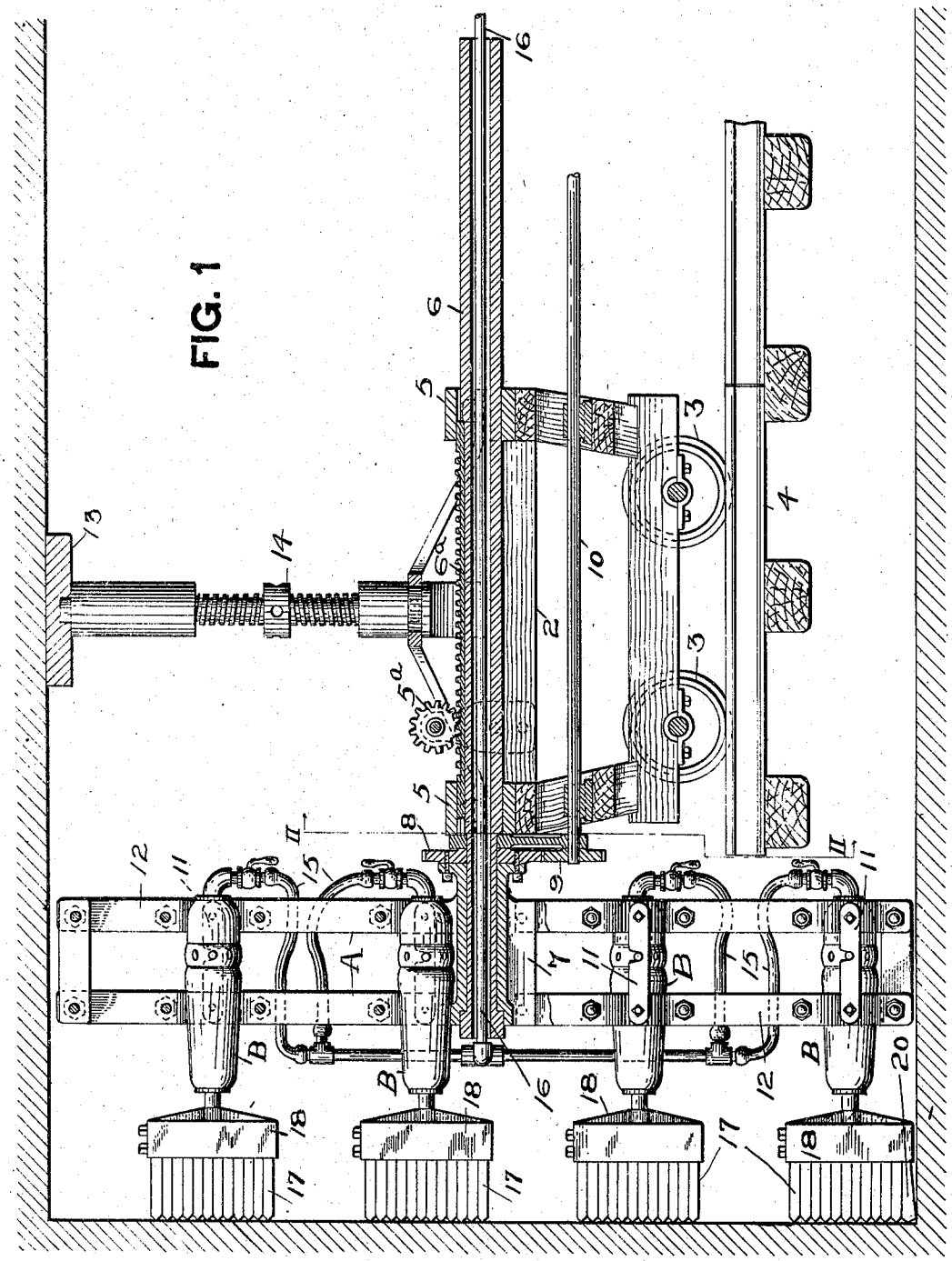
W. J. HAMMOND, Jr.

TUNNELING MACHINE.

APPLICATION FILED NOV. 15, 1906. RENEWED SEPT. 25, 1907.

4 SHEETS—SHEET 1.

FIG. 1



WITNESSES.

W. Arthur Keller

M. L. Barth

INVENTOR.

William J. Hammond Jr.

by James K. Bakewell

his attorney

No. 885,044. PATENTED APR. 21, 1908.

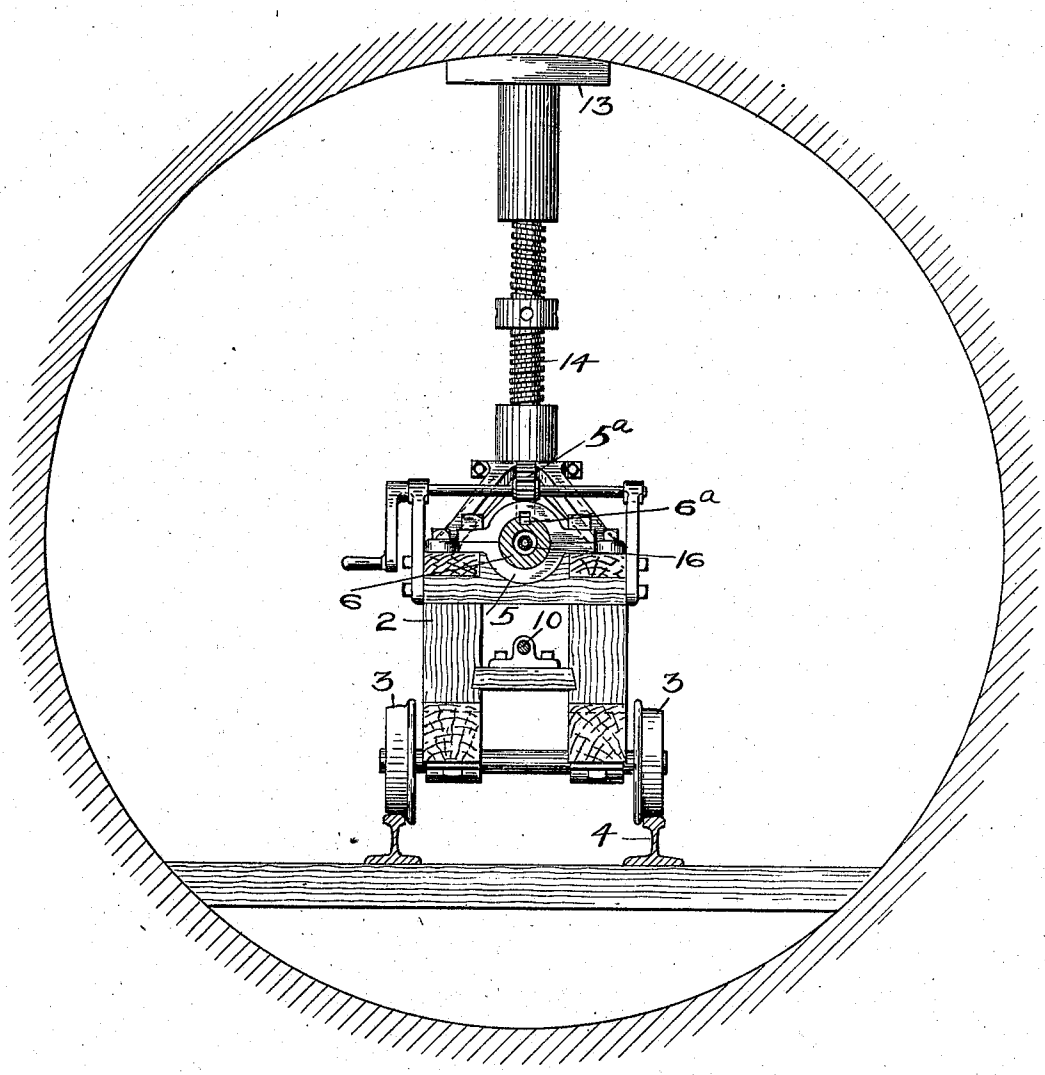
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4 SHEETS—SHEET 2.

FIG. 2



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Mabarth

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No. 885,044. PATENTED APR. 21, 1908.

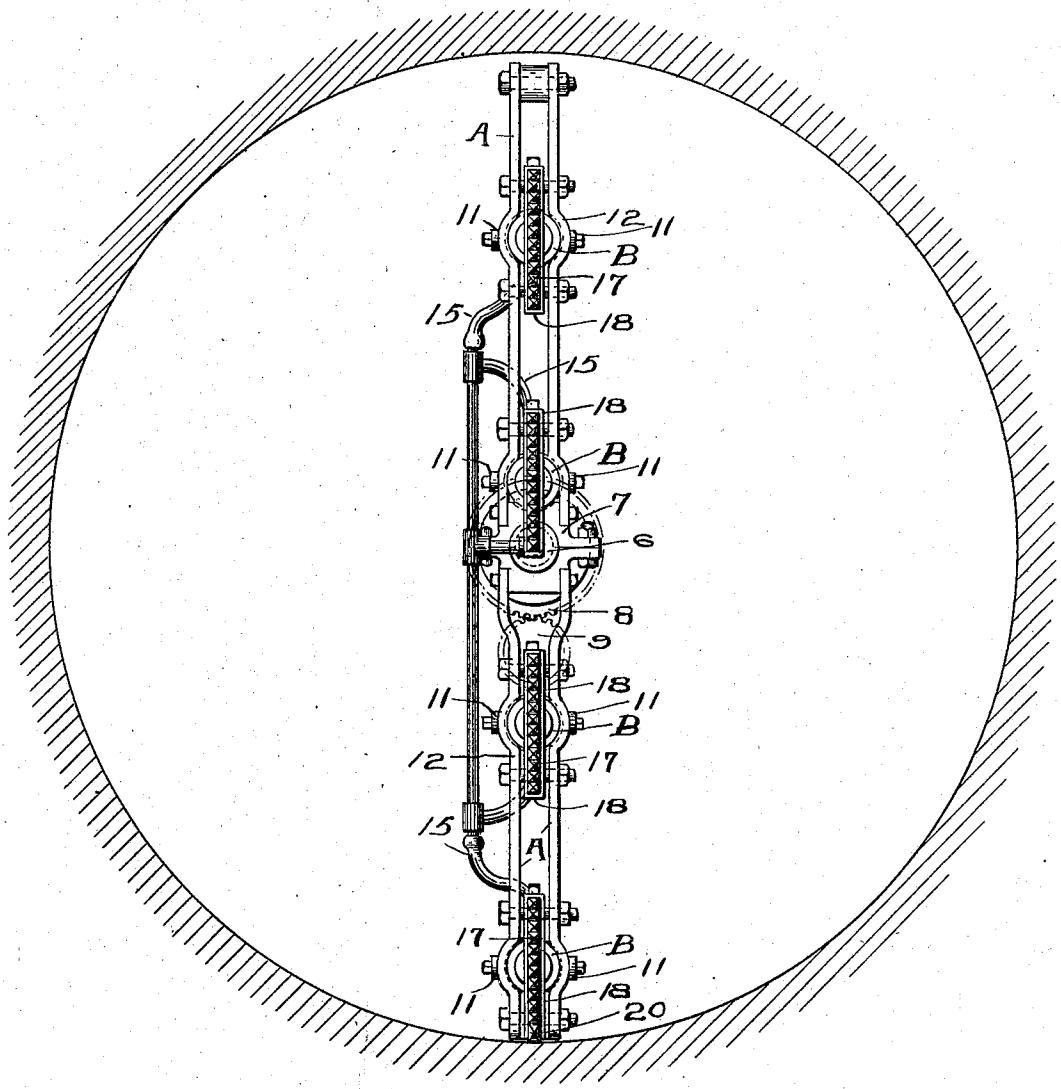
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4 SHEETS—SHEET 3.

FIG. 3



WITNESSES.

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No. 885,044. PATENTED APR. 21, 1908.

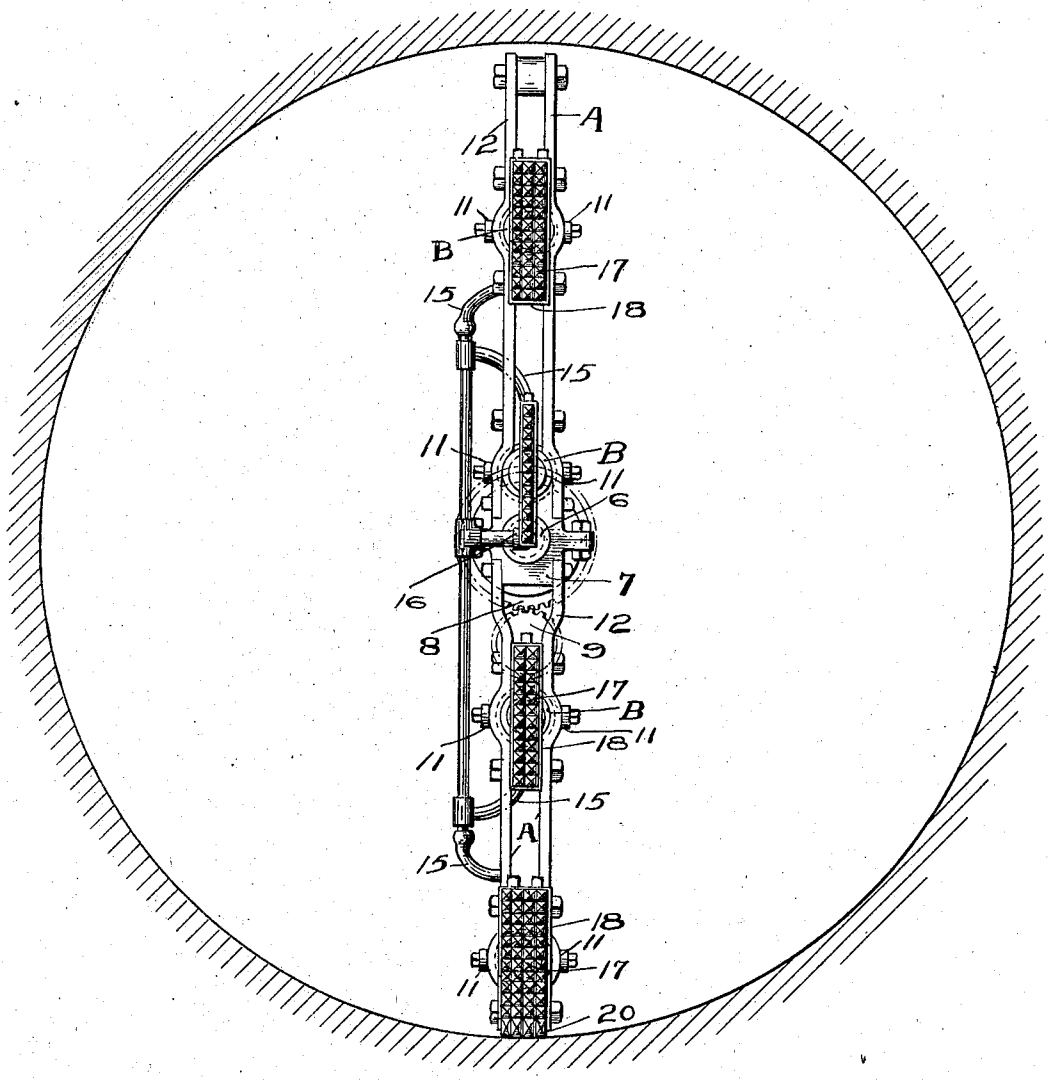
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4 SHEETS—SHEET 4.

FIG. 4



WITNESSES.

W. Arthur Keller

MaBarth

INVENTOR.

William J. Hammond Jr.

by James E. Bakewell

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UNITED STATES PATENT OFFICE.

WILLIAM J. HAMMOND, JR., OF PITTSBURG, PENNSYLVANIA.

TUNNELING-MACHINE.

No. 885,044. Specification of Letters Patent. Patented April 21, 1908.

Application filed November 15, 1906, Serial No. 343,536. Renewed September 25, 1907. Serial No. 394,580.

To all whom it may concern:

Be it known that I, WILLIAM J. HAMMOND, Jr., of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Tunneling-Machine, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal sectional view illustrating my invention, part being in elevation; Fig. 2 is a vertical sectional view on the line II—II of Fig. 1; Fig. 3 is a front elevation of the face of the revolving head carrying the pneumatic hammers, and Fig. 4 is a similar view of the head carrying a series of pneumatic hammers graduated in width.

Like symbols of reference indicate like parts wherever they occur.

My invention relates to an improvement in apparatus for driving tunnels and it consists in a revoluble head having pneumatic hammers arranged thereon in radial lines at such distances from the center that their actions shall overlap on each side of the center to break the rock in concentric overlapping circles, and in devices for carrying and operating the parts as is hereinafter more fully set forth.

I will now describe my invention so that others skilled in the art to which it appertains may manufacture and use the same.

In the drawing 2 represents the carrying-truck which may be of any suitable construction provided with wheels 3 adapted to run on the section of track 4, which may be about five feet in length. Centrally mounted on the truck 2 are the journal heads or boxes 5, and a pinion 5^a the teeth of which are adapted to engage with the rack 6^a mounted on the outer face of the hollow shaft 6, the purpose of which pinion and rack is to feed the shaft 6 forward. Journaled on the forward end of the shaft 6 is the sleeve 7 which at its rear end is provided with the gear-wheel 8 which meshes with the pinion 9 on the end of the power shaft 10. Secured to the forward end of the sleeve 7 is the head A which may be formed of one or more radial arms 12 provided with suitable strengthening braces 11. The arm 12 should be of a length substantially equal to the radius of the tunnel to be driven. Mounted on the truck 2 is a screw-jack 14 having a block 13 adapted to bear against the top of the tunnel to hold the truck 2 stationary. Mounted on the arm or arms 12 of the head A are the hammers B which are provided with conduits 15 which connect with a main conduit 16 within the hollow shaft 6. These conduits serve to convey steam, pneumatic, electric or other power to the hammers B. The hammers B are provided with a series of teeth 17 secured in a head 18 and arranged closely together, forming a rectangular hammer, the greatest length of which extends radially; and these hammers are so arranged on the rotating head A that they shall disintegrate the rock in concentric overlapping circles; that is to say, as shown in Figs. 1 and 3, the hammer at the bottom of the head A is arranged to disintegrate the rock at the extreme lower portion of the tunnel to be driven, the next hammer above the lowest hammer is separated from the lowest hammer at a distance very slightly less than the length of the hammer, and so on to the top hammer above the central shaft or sleeve 7. The effect of this is that as the hammers B are caused to reciprocate, and as the head A rotates, the rock will be disintegrated in concentric overlapping circles. The hammers B are provided with driving mechanism, not shown in the drawings, of such construction as to give to the hammers from four hundred to two thousand strokes per minute.

In Fig. 4 I have shown another form of hammer head, each head from the center being wider than the preceding hammer to compensate for the greater distance it has to travel, each circle being greater than the preceding one.

The head A should be arranged to rotate under the power of the power-shaft 10 at the rate of about one revolution per minute. On ordinary rock the effect of the blows of the hammer and the rotation of the head A will give a disintegration of the entire breast of the tunnel to a depth of from one-eighth of an inch to one-half of an inch, more or less, at each revolution of the head A. As the rock is thus disintegrated the head A is fed forward by the rotation of the pinion 5^a. The rack 6^a may extend on the shaft for any desired practical length. When the limit of the rack has been reached, the jack 14 is loosened and the truck 2 and section of track 4 is moved forward, the head A at the same time being retracted on the truck 2. The lower or outer of the hammers B, at its outer end, is provided with a flaring tooth 20 which gives a disintegrating action beyond

the end of the head A to allow for the clearance of the same. In order to successfully operate this apparatus it is necessary that the hammers B should be given rapid, short, successive strokes and that the head A be rotated at such speed that the disintegration of the rock or earthy material may be complete.

I am aware that it is old to cut the breast of tunnels in eccentric circles and to break the intervening rock. I am also aware that the use of cutters and hammers on rotatory heads is not new, and I do not desire to claim the same broadly.

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

1. In a tunneling machine, a rotatory head having a series of diametrically arranged reciprocating hammers and separated from each other by distances slightly less than the length of the hammers, whereby the entire breast of the tunnel may be disintegrated by the rotation of the head and the reciprocation of the hammers.

2. In a tunneling machine, a rotatory head having a series of diametrically arranged reciprocating hammers and separated from each other by distances slightly less than the length of the hammers, these hammers having separable teeth arranged side by side to form a cutting surface greater in length than in breadth, the greater length extending radially on the rotatory head whereby the entire breast of the tunnel may be disintegrated by the rotation of the head and the reciprocation of the hammers.

3. In a tunneling machine, a rotatory head having a series of diametrically arranged reciprocating hammers and separated from each other by distances slightly less than the length of the hammers, the outer hammers being provided with a flaring tooth, whereby a disintegrating action beyond the end of the head is produced to allow for the clearance of the same.

4. In a tunneling machine, a rotatory head having a series of reciprocating hammers arranged in radial lines and separated from each other by distances slightly less than the length of the hammers, these hammers having separable teeth arranged side by side to form a cutting surface greater in length than in breadth, the greater length extending radially on the rotatory head, and the width of the hammers increasing successively with the distance from the center of the head.

5. In a tunneling machine, a rotatory head having two or more radial arms, and having hammers thereon separated from each other by distances slightly less than the length of the hammers.

In testimony whereof, I have hereunto set my hand.

WILLIAM J. HAMMOND, JR.

Witnesses:

JAMES K. BAKEWELL.

C. E. EGGERS