

No. 864,704.

PATENTED AUG. 27, 1907.

R. B. SIGAFOOS.
TUNNELING MACHINE.
APPLICATION FILED OCT. 17, 1906.

2 SHEETS—SHEET 1.

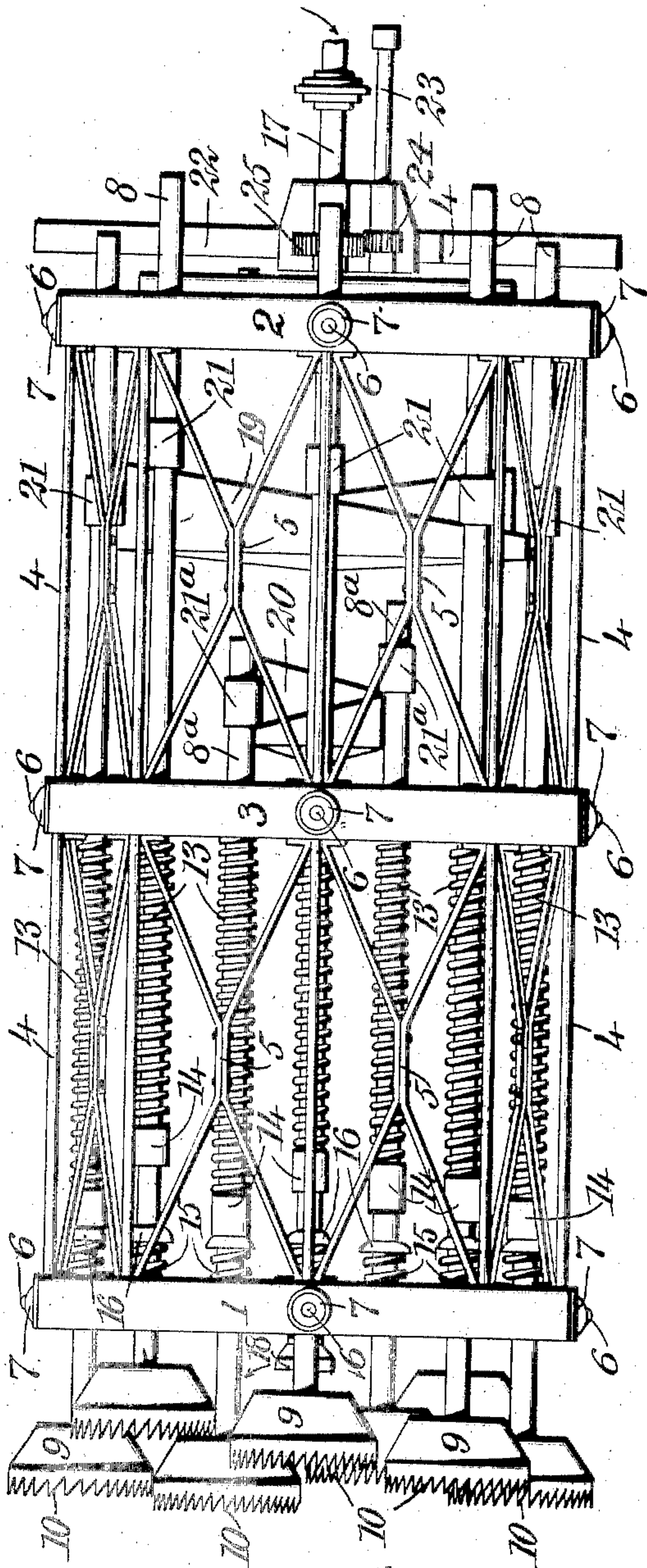


Fig. 1.

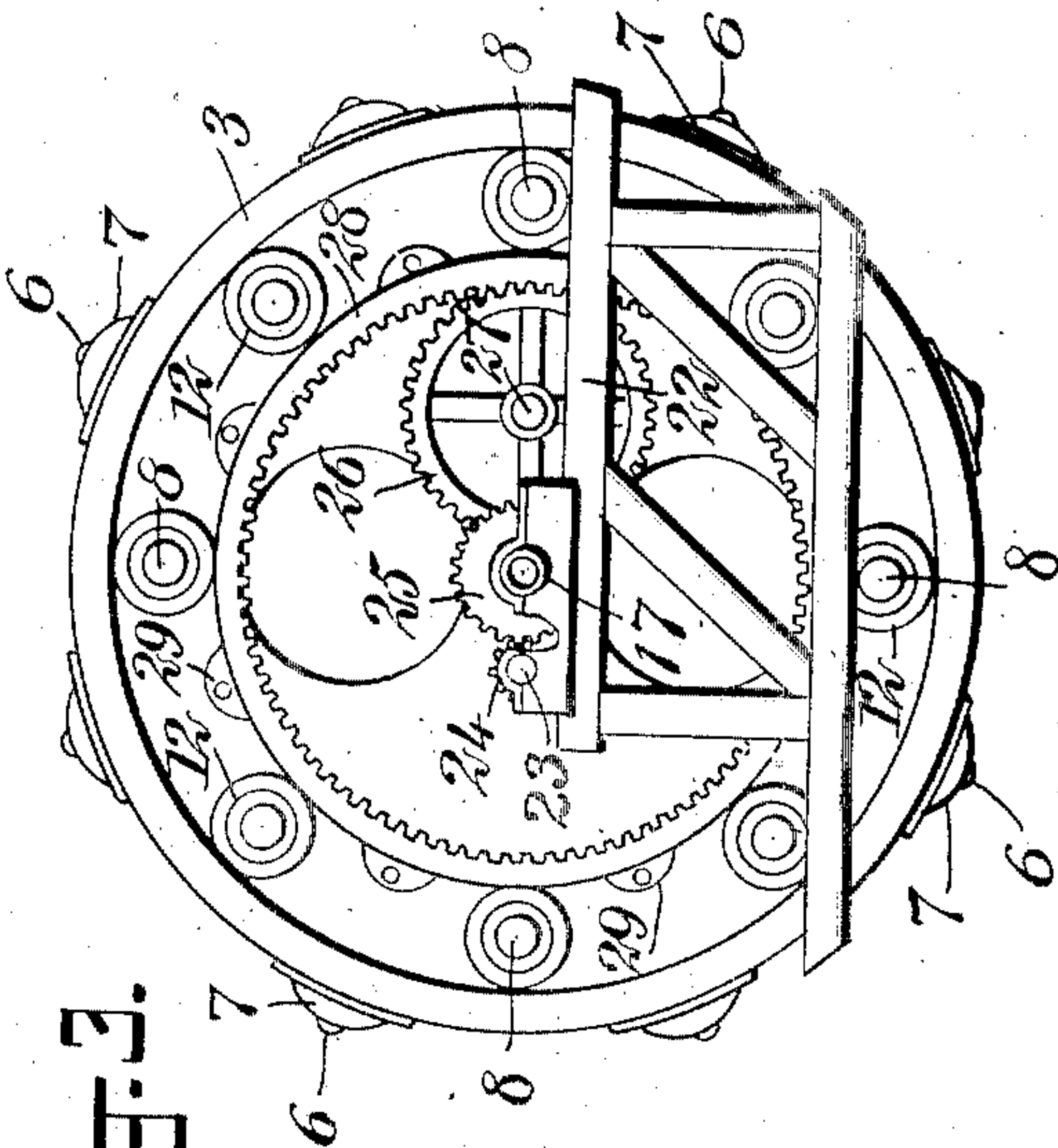


Fig. 2.

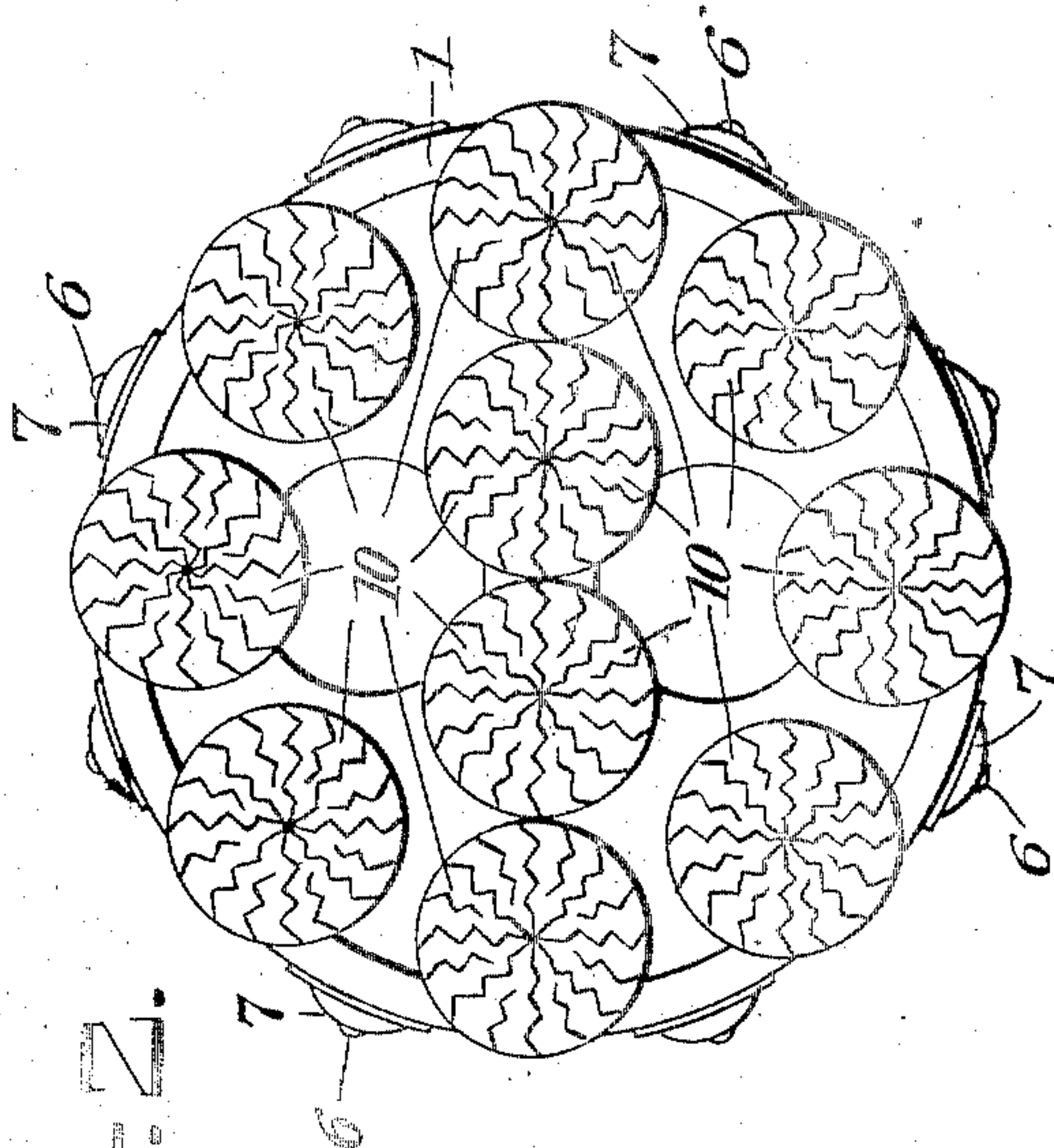


Fig. 3.

WITNESSES

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2 SHEETS—SHEET 2.

Fig. 4.

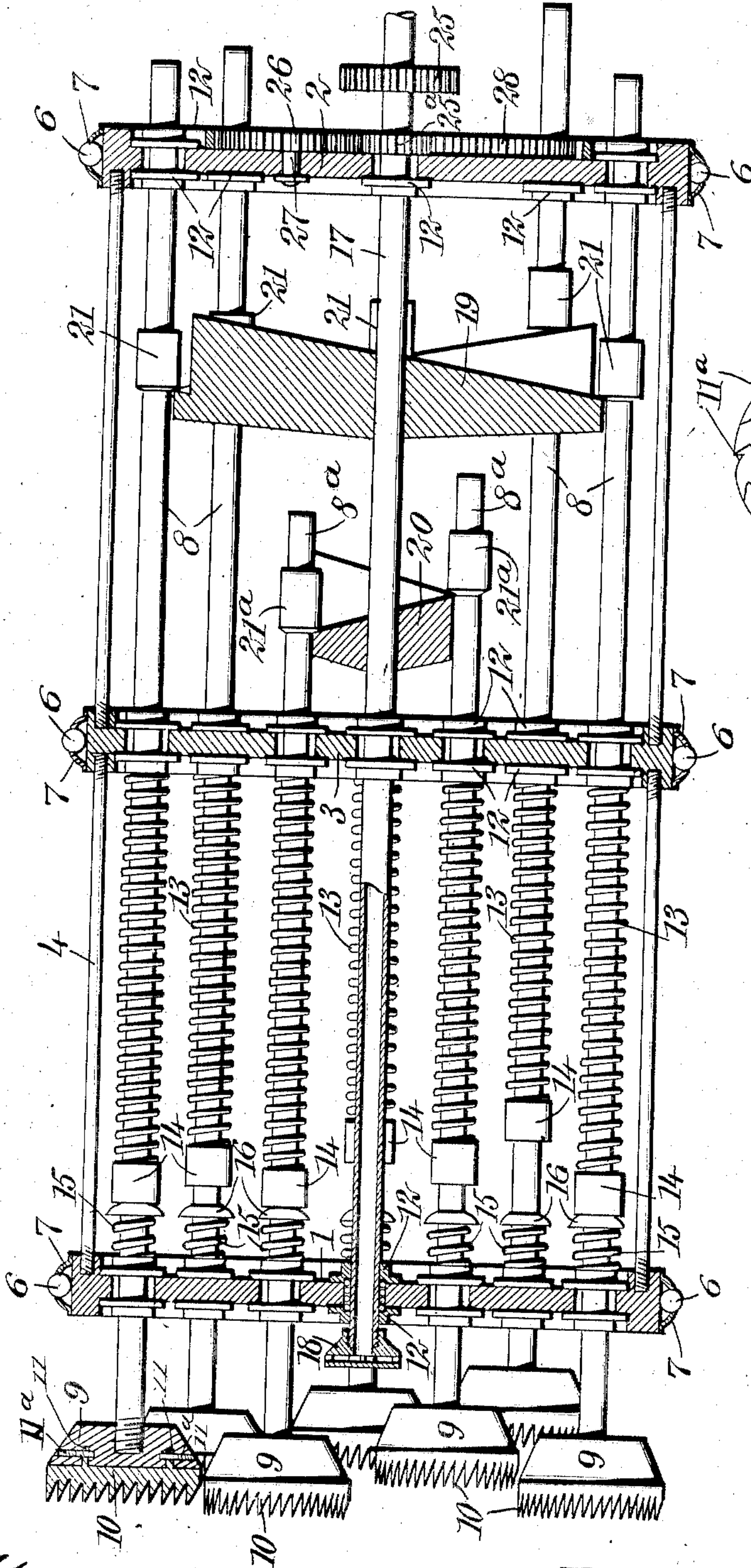
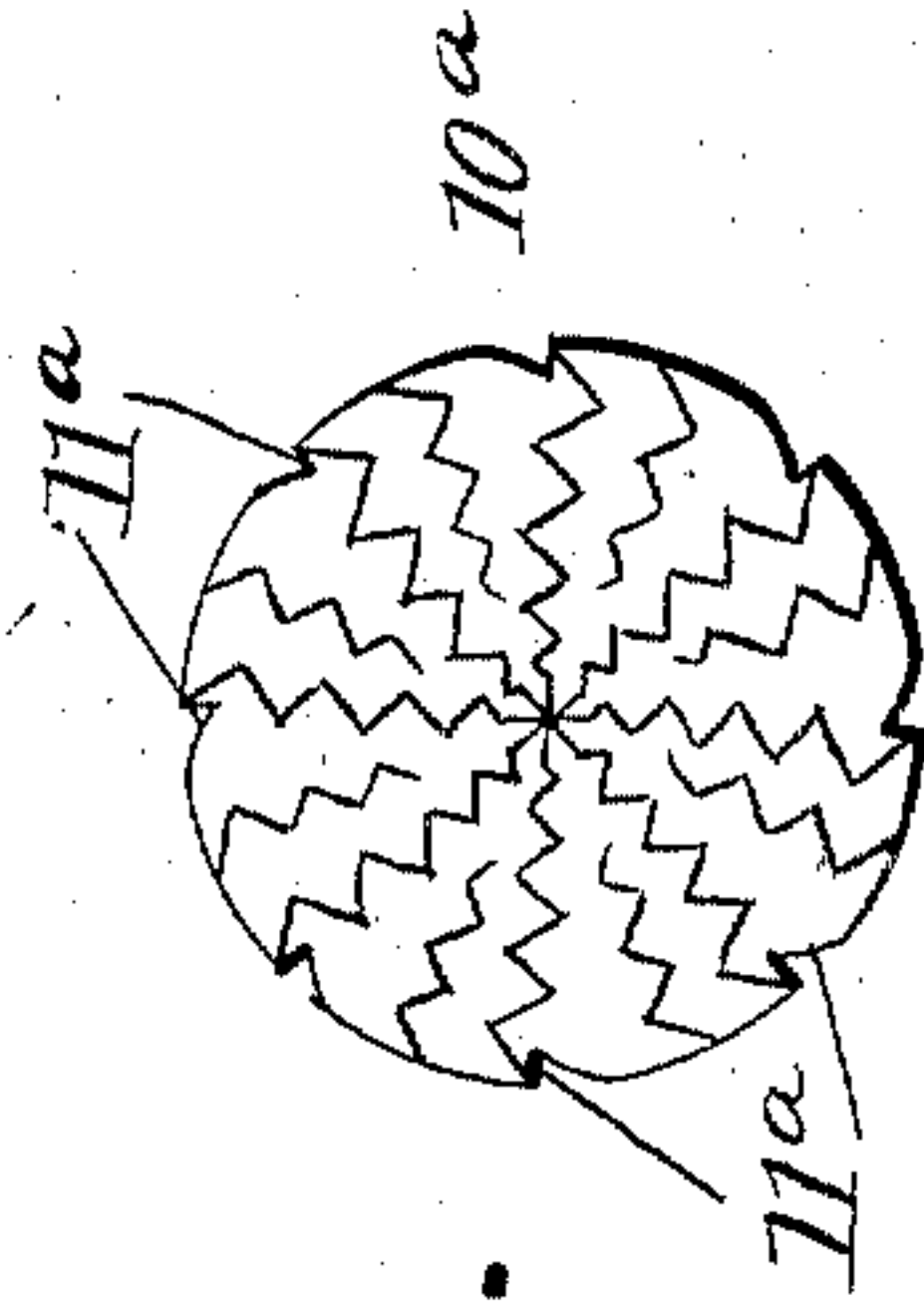


Fig. 5.



WITNESSES

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UNITED STATES PATENT OFFICE.

RUSSEL BIGALOW SIGAFOOS, OF HELENA, MONTANA, ASSIGNOR TO THE AMERICAN ROTARY TUNNEL MACHINE AND DEVELOPMENT COMPANY, OF DENVER, COLORADO, A CORPORATION OF COLORADO.

TUNNELING-MACHINE.

No. 864,704.

Specification of Letters Patent.

Patented Aug. 27, 1907.

Application filed October 17, 1906. Serial No. 339,350.

To all whom it may concern:

Be it known that I, RUSSEL BIGALOW SIGAFOOS, a citizen of the United States, and a resident of Helena, in the county of Lewis and Clark, and State of Montana, have invented a new and Improved Tunneling-Machine, of which the following is a full, clear, and exact description.

This invention is an improved machine for driving tunnels, sinking shafts and the like, having among other objects the provision of a machine for this purpose which will make a uniform, clean bore through rock and other materials with comparative ease and facility, and accomplish this without undue strain on the machine frame even although the material at one side of the bore be harder than that at the other.

The machine is further constructed to eliminate dust and clean the cutters of the borings at they are formed, preferably by streams of water which carry and discharge the muck at the rear of the machine without the need of further mechanism.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a plan view of the preferred form of my invention; Fig. 2 is a front end elevation of the same; Fig. 3 is a rear, end elevation of the machine; Fig. 4 is a central, longitudinal, sectional view of the same on an enlarged scale; and Fig. 5 is a modified form of the cutter disk.

The machine frame is composed of three circular heads 1, 2 and 3, the head 1 being the forward end of the machine frame; the head 2 at the rear thereof and the head 3 occupying an intermediate position. These heads are preferably thickened at their circumference, as best shown in Fig. 4, where they are connected together by a series of rods 4 threaded into them or otherwise affixed. For further strengthening the frame of the machine the heads are connected together by diagonal bracing-bars 5 arranged in the shape of diamonds, as illustrated in Fig. 1, this construction affording a strong, rigid frame capable of withstanding severe strain. On the circumference of each head are carried at equidistant points roller or ball bearings 6 held in containers 7, with a portion of the ball protruding therefrom, adapting the frame to easy, rotary and longitudinal movement when the machine is in operation.

Journaled in each of the heads is a series of circularly-arranged shafts 8, the series being concentric to the heads and carrying at their forward ends cutter-heads 9 to which they are secured in any convenient manner. The cutter-heads 9 in turn, are each provided with a

cutter-disk 10 having radially-arranged zigzag cutting-teeth on their front faces. These disks are preferably secured to the heads 9 by means of annular grooves in the latter into which flanges 11 on the back faces of the cutter disks project. These flanges are engaged by pins 11^a as shown in Fig. 4 or other well-known devices passing through them and the heads which positively connects these parts together.

Journaled in the heads 1 and 3 between the shafts 8 are two somewhat shorter shafts 8^a provided with like cutting means on their forward ends and acting, when the machine is in operation, to remove that material inclosed by the outer ring of cutters; these latter cutters, as best shown in Fig. 2 are of such diameter as to project beyond the frame a sufficient distance to admit of the ball-bearings carried by the heads, to pass into the bore cut. The bearings of all of the shafts in the heads 1, 2 and 3 are frictionless and are preferably each composed of a series of balls held in position by a recessed and flanged collar 12 secured in any suitable manner at each side of the head, this construction adapting the shafts to easily slide and rotate when in operation.

Surrounding the shafts 8 and 8^a are spiral springs 13 interposed between the bearings of the head 3 and collars 14 secured to them near the head 1, said springs normally forcing the shafts in a forwardly direction. These shafts are further surrounded by somewhat shorter springs 15 arranged adjacent to the inner face of the head 1 and provided with sleeves 16, which, in connection with the springs 15, form buffers opposed to the collars 14.

Journaled in the center of the heads 1, 2 and 3 in similar bearings as provided for the shafts 8 and 8^a, is a hollow shaft 17 having fixed at its forward end a water-head 18 constructed with a series of openings on its circumference for directing and distributing water to each of the cutters. This shaft has also fixed to it between the heads 2 and 3, a large cam 19 and a somewhat smaller cam 20, the cam 19 having a double inclined upper face for contacting with tappets 21 fixed to the shafts 8, and the cam 20 having a single inclined face for contacting with tappets 21^a fixed to the shafts 8^a. It is apparent from this construction that as the hollow shaft 17 revolves, the cams 19 and 20 retract the shafts 8 and 8^a, respectively, against the tension of the springs 13, drawing the cutters gradually to an inward position and permitting them to be forcibly thrust forward by the springs 13 as the tappets pass over the abrupt portions of the cams. The cutters are released from overstroke by the buffers composed of the springs 15 and sleeves 16, which act as a cushion on the front head 1.

For positively rotating the central shaft 17 and also the machine frame, is provided adjacent to the head 2, a frame 22 on which is journaled a driving shaft 23, having a gear 24 fixed to its inner end, in mesh with a gear 25 fixed to the shaft 17. The shaft 17 has also fixed to it near the gear 25, a somewhat smaller gear 25^a, in mesh with a gear 26 journaled on a stud 27 projecting from the head 2. The gear 26 meshes with an internal gear 28 concentrically and rigidly attached as by ears 29, to the outer face of the head 2.

In Fig. 5 is shown a modified form of cutter disk 10^a in all respects like the disk 10, but having in its periphery a series of angular notches 11^a which act as reamer edges, giving the bore a smooth surface and preventing it from becoming too small as the cutter wears.

When the machine is in operation, the hollow shaft 19 is connected up with a water supply and the shaft 23 is driven from any suitable source of power. This causes the machine frame to revolve, as also the several cutters carried by it, due to the frictional contact of the tappets with their respective cams, said cams as hereinbefore stated, acting to also draw the cutters rearwardly which are thereafter thrust forward by the springs 13. As the cutters revolve and reciprocate, a stream of water from each of the apertures in the distributing head 18 plays upon them, eliminating the dust of the borings and discharging the muck to the rear of the machine without the need of other mechanism.

I have shown and described the cam 19 as having a double inclined face and two abrupt portions, thereby giving the outer ring of cutters two complete reciprocations on each revolution of the machine frame. It is, however, evident that this portion of the construction, as well as other parts of the machine, might be infinitely varied without departing from the spirit of my invention; and I consider that I am entitled to such modifications as fall within the scope of the appended claims.

Having thus described my invention I claim as new and desire to secure by Letters Patent:

1. In a tunneling machine, in combination, a rotary frame, cutters journaled in said frame, means for rotating the cutters and means for automatically reciprocating said cutters as they rotate.

2. In a tunneling machine, in combination, a rotary frame, a cutter journaled in said frame, means for rotating the cutter means for gradually retracting said cutter, and means for suddenly thrusting it forward.

3. In a tunneling machine, in combination, a rotary frame composed of a plurality of heads having frictionless bearings on their peripheries, means for rigidly connecting the heads of the frame together, a plurality of cutters journaled in the heads, and means for rotating and reciprocating the cutters.

4. In a tunneling machine, in combination, a rotary frame, a cutter journaled in said frame, means for rotating the cutter means for gradually retracting said cutter, means for suddenly thrusting the cutter forward, and buffing means for relieving the cutter of over-stroke.

5. In a tunneling machine, in combination, a rotary frame, a cutter journaled in the frame, means for reciprocating the cutter as the frame is rotated, and means for frictionally rotating said cutter from said reciprocating means.

6. In a tunneling machine, a rotary frame, a series of shafts journaled in the frame and arranged in a circle, cutters carried at the forward ends of the shafts, a second set of shafts journaled in the frame between the first set, and means for reciprocating and rotating each of said sets of shafts.

7. In a tunneling machine, a rotary frame composed of a plurality of circular heads, a series of rods connecting the heads together, and diagonally-arranged bars connecting the heads together between the rods.

8. In a tunneling machine, a frame composed of a series of circular heads spaced apart and connected together by rods, diagonal bars arranged between the rods connecting the heads together, and frictionless bearings carried on the peripheries of the heads.

9. In a tunneling machine, in combination, a frame composed of a plurality of heads rigidly connected together, means for rotating the frame, a plurality of shafts journaled in the heads, each having a cutter head attached to the forward end thereof, a hollow shaft journaled in the center of the heads, means carried by the hollow shaft for directing a stream of water upon each cutter head, means for rotating the hollow shaft, and means for causing the cutter head shafts to reciprocate as said hollow shaft is rotated.

10. In a tunneling machine, in combination, a rotary frame, a series of shafts circularly arranged journaled in the frame, a second set of shafts journaled in the frame intermediate the first set, cutting means carried by said shafts, tappets fixed to said shafts, a hollow shaft journaled in the center of the frame, cams fixed to said hollow shaft coacting with the tappets of the cutter shafts for reciprocating the cutters, means for rotating said hollow shaft, and means carried by said hollow shaft for directing a stream of water to each cutter.

11. In a tunneling machine, a frame, and a series of cutters journaled in the frame comprising cutter heads having cutter disks secured thereto provided with radially-arranged zigzag cutting teeth.

12. In a tunneling machine, a frame, a plurality of cutters journaled in the frame comprising cutter heads having annularly grooved faces and cutter disks provided with flanges on their rear faces fitting in said grooves, and radially-extending zigzag cutting teeth on their front faces.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RUSSEL BIGALOW SIGAFOOS.

Witnesses:

RICHARD LOCKEY,
MOSES MORRIS.