C. A. CASE.

ROTARY TUNNELING MACHINE.

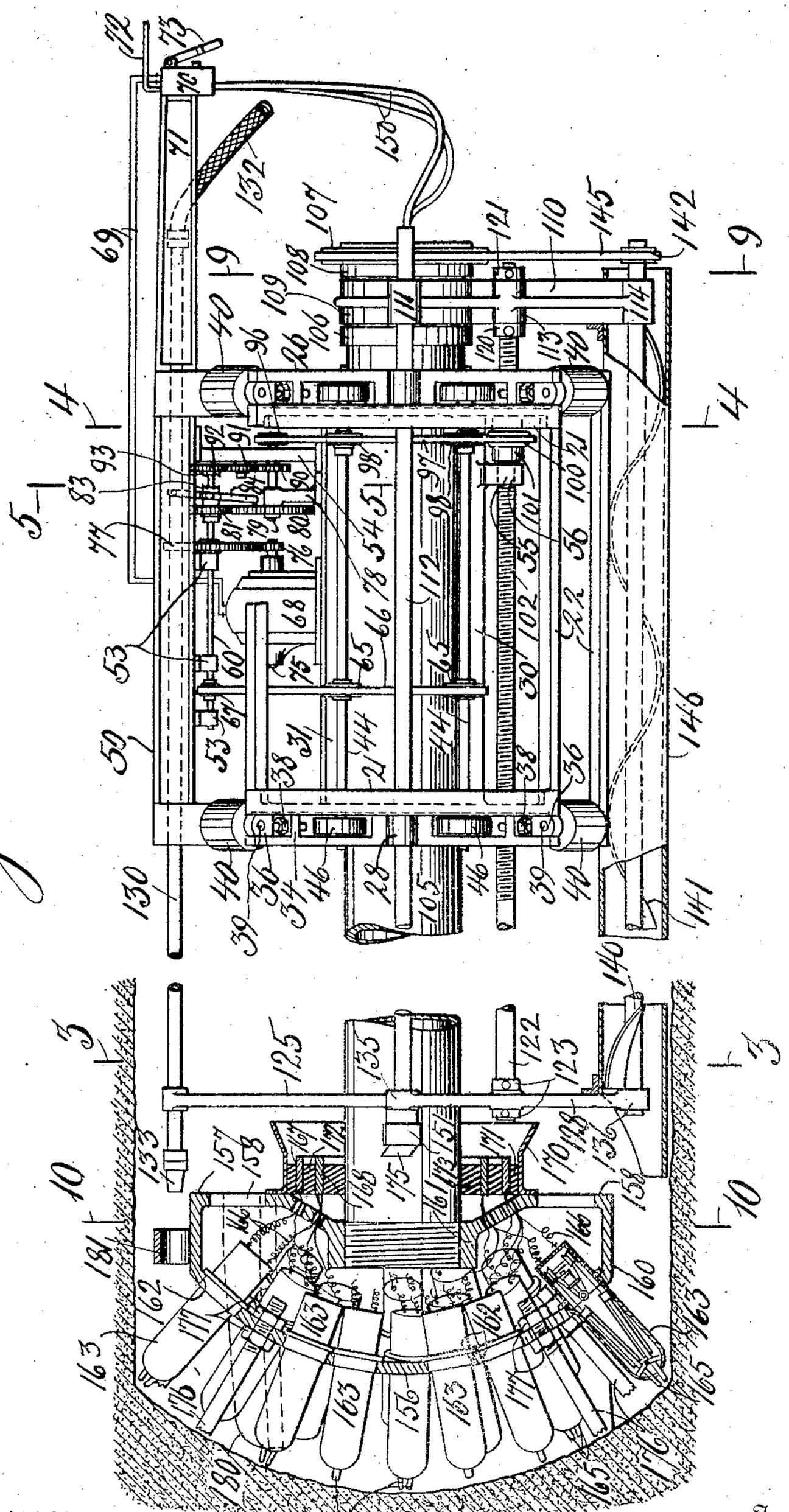
APPLICATION FILED APR. 20, 1908.

914,636.

Patented Mar. 9, 1909.

5 SHEETS—SHEET 1.

Fig 1



Witnesses

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5 SHEETS—SHEET 2.

Fig 2

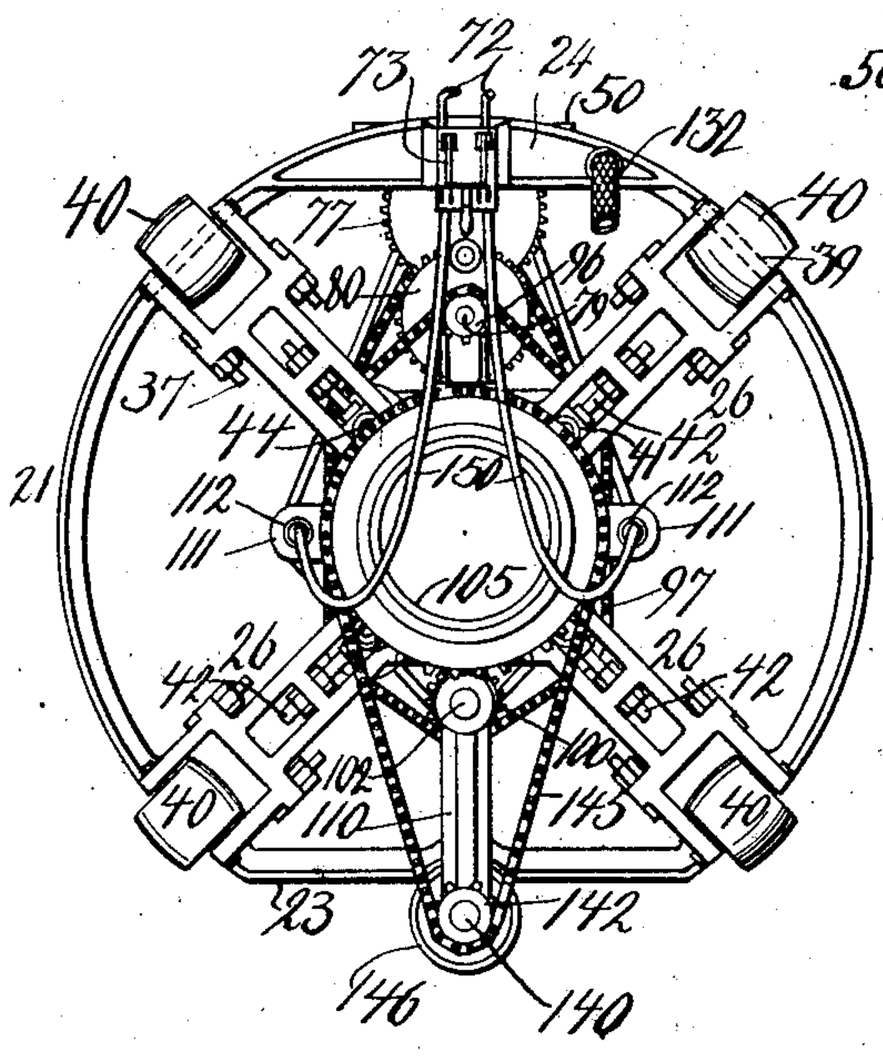


Fig 5

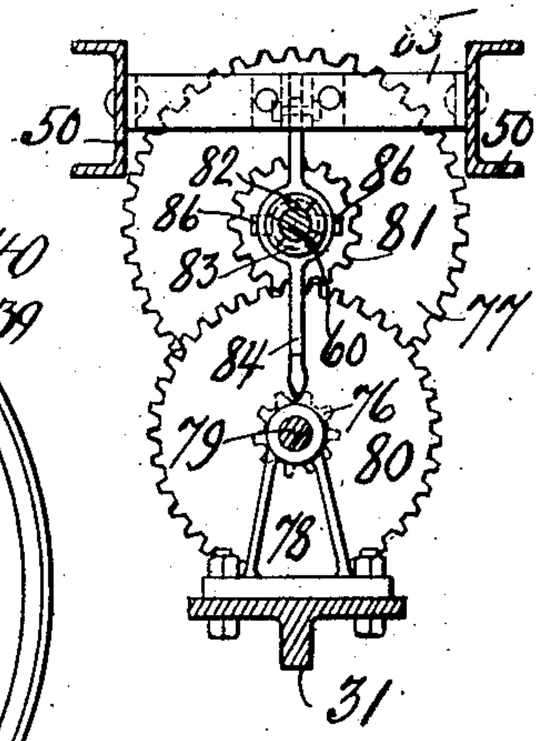


Fig 3

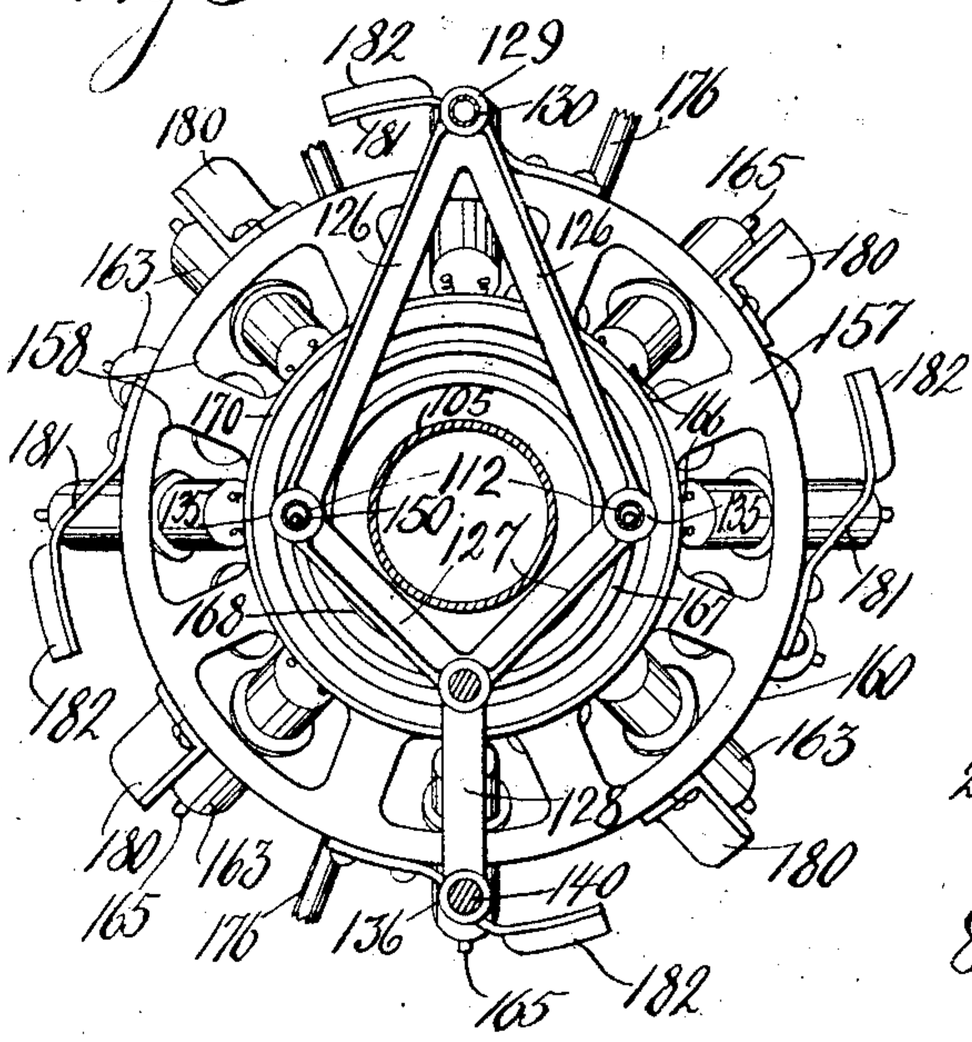
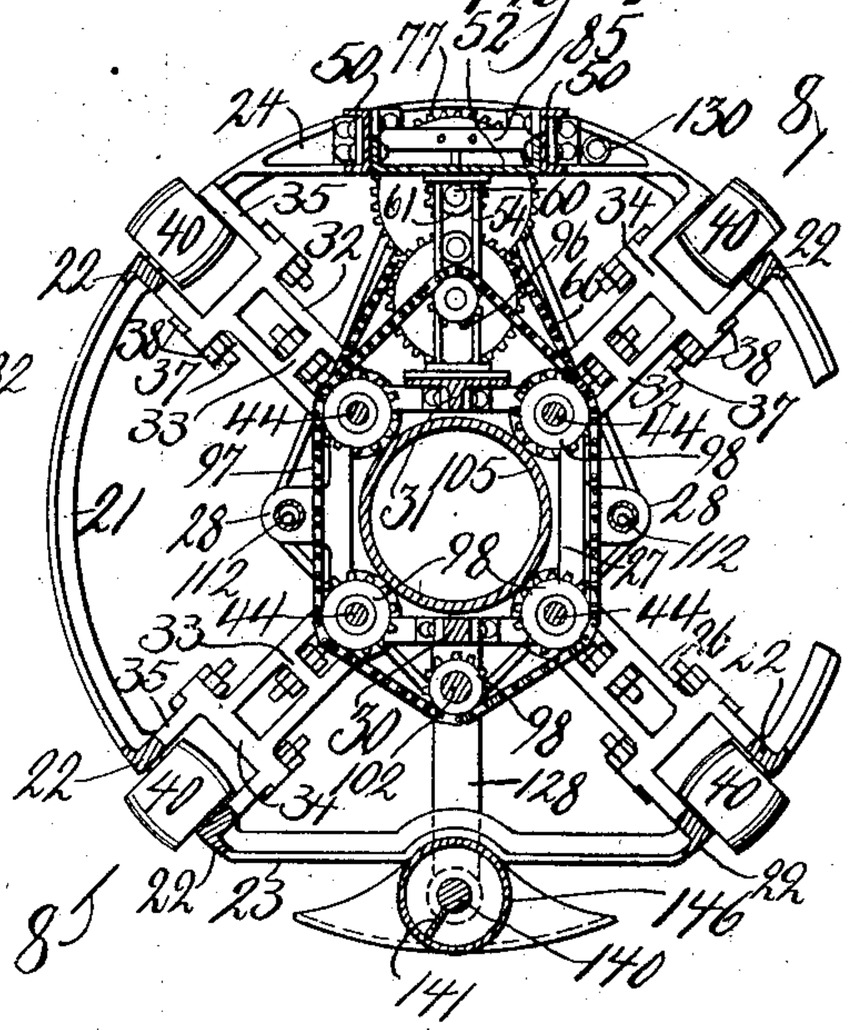


Fig 4



Witnesses

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5 SHEETS—SHEET 3.

Fig 6

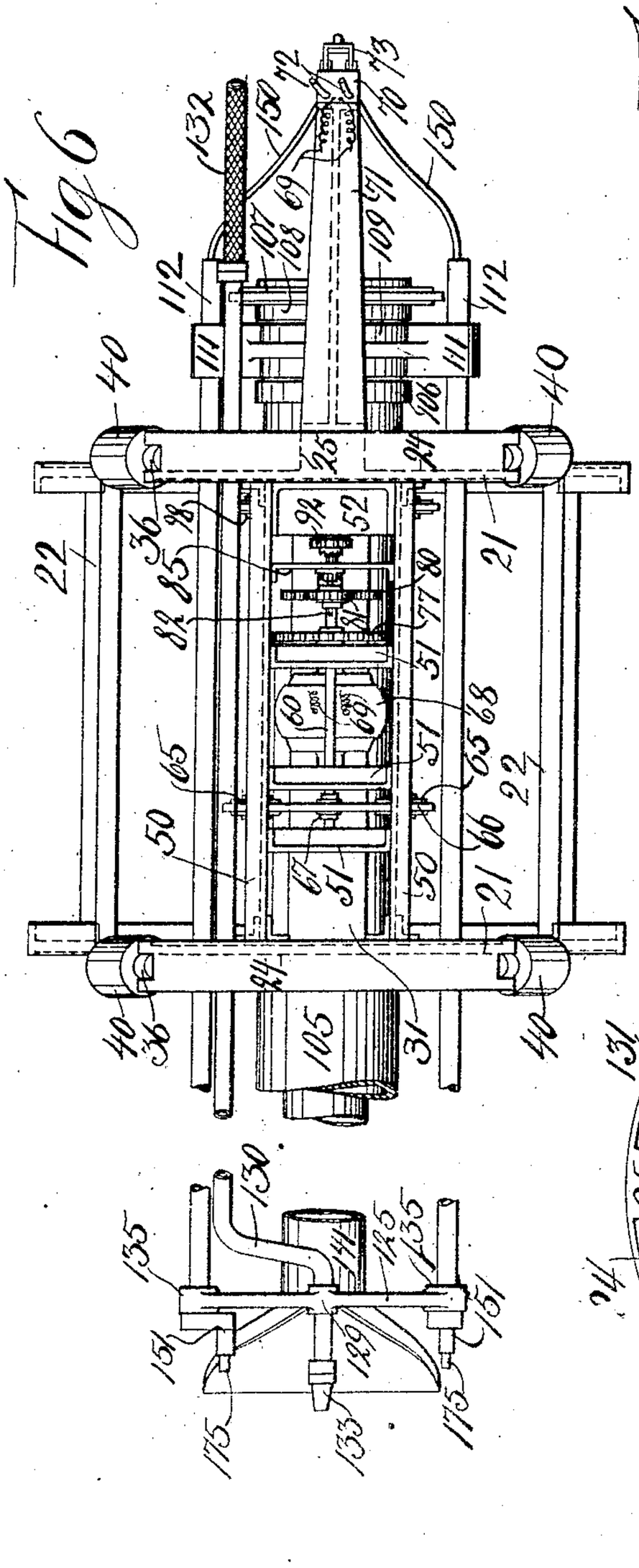


Fig 9

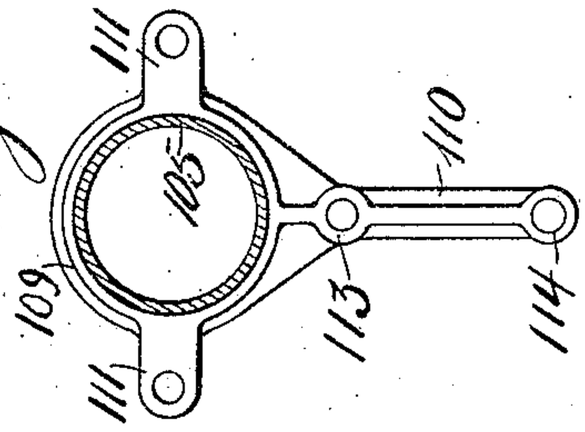


Fig 8

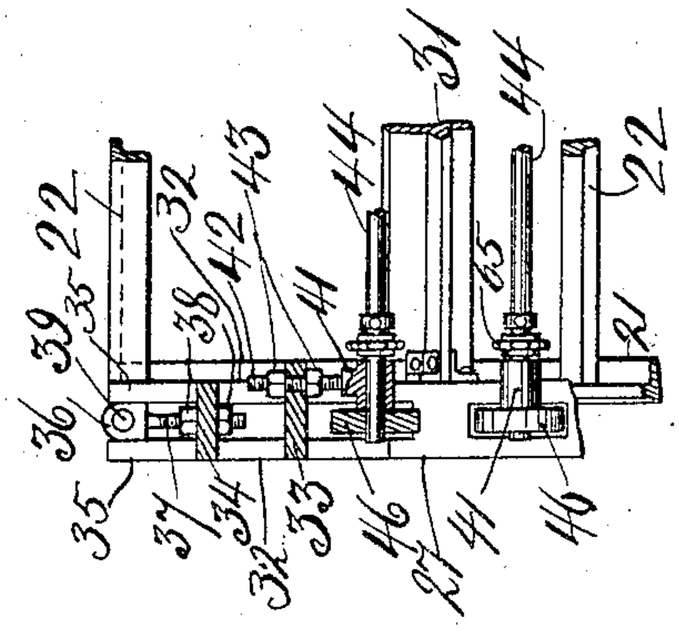
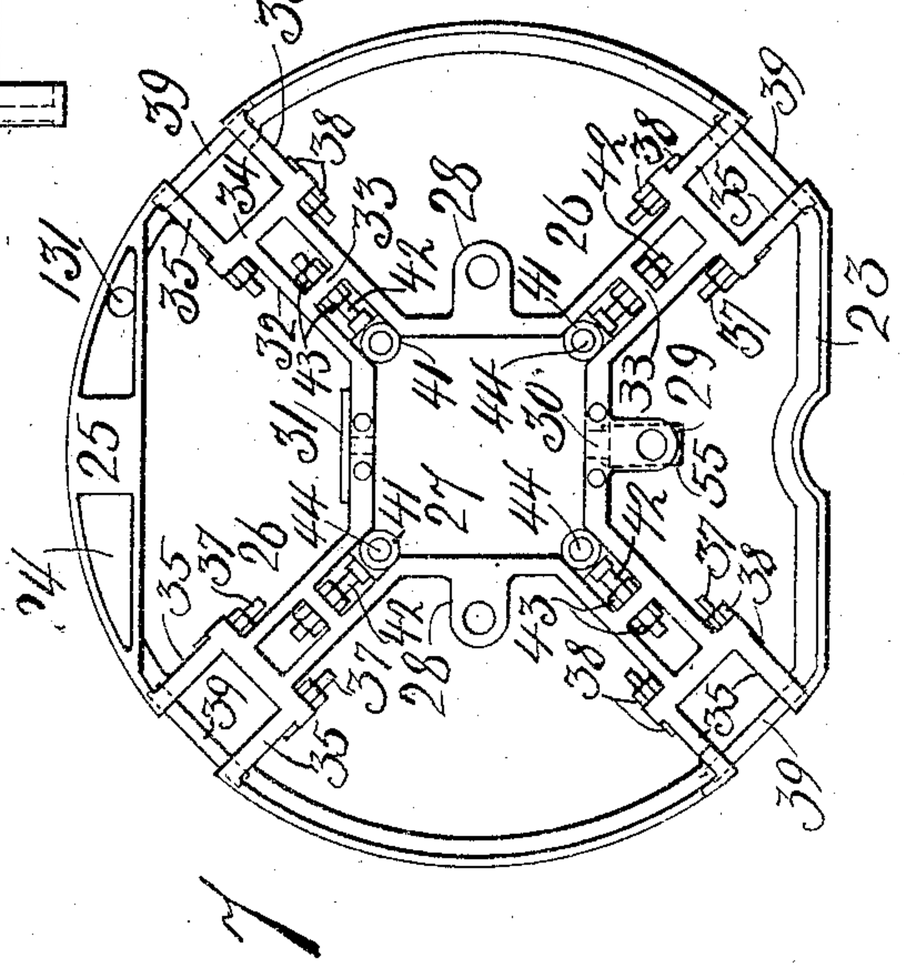


Fig 7



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5 SHEETS—SHEET 4.

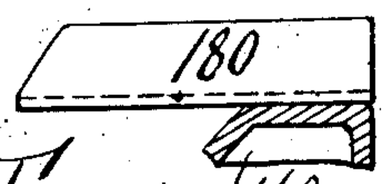

Fig 11

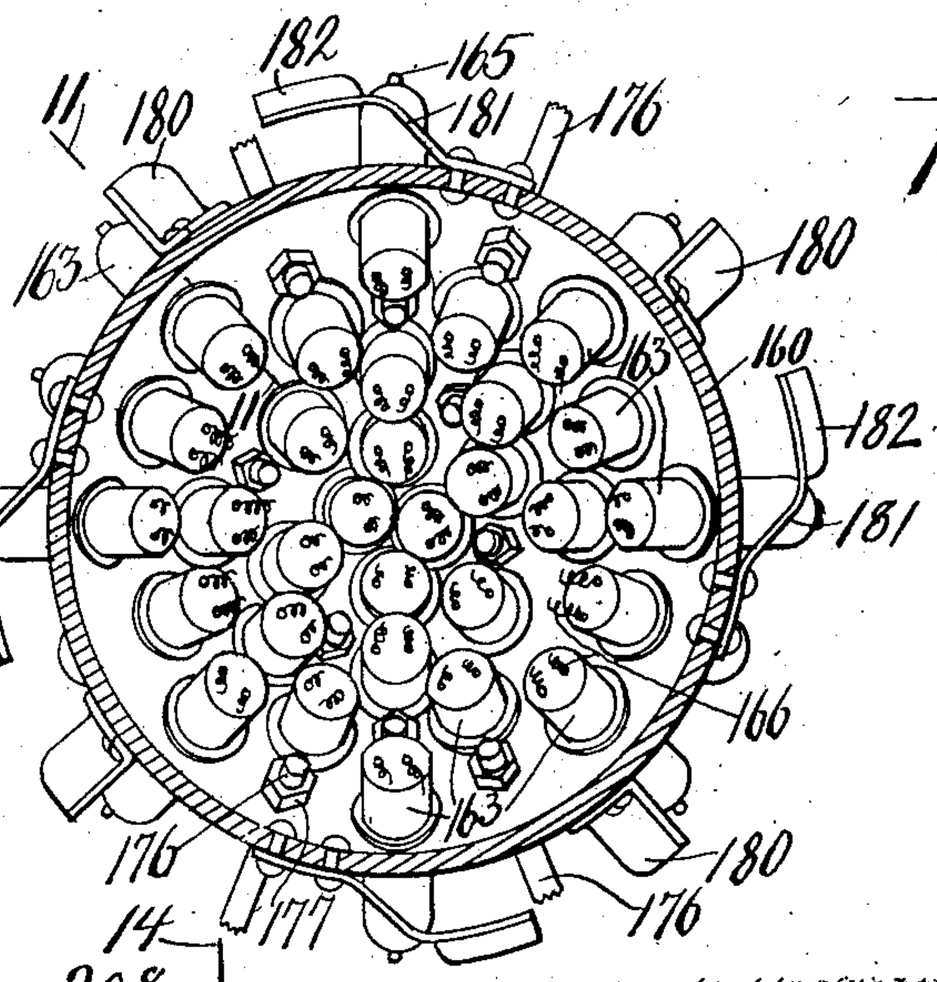

Fig 10

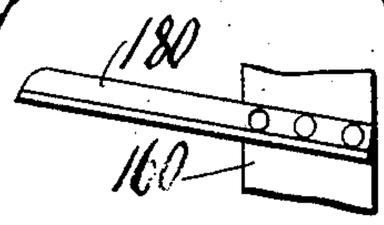

Fig 12

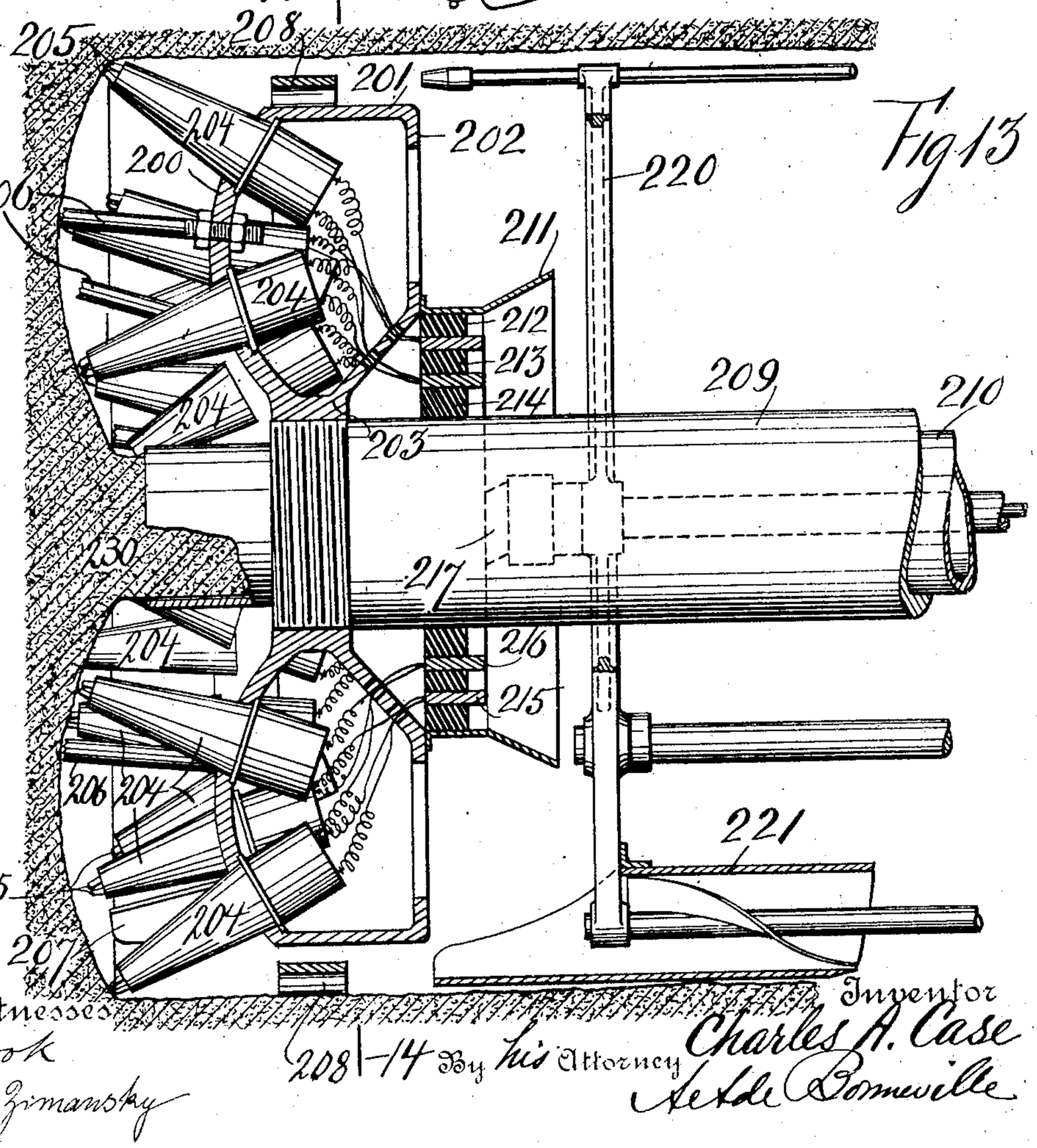

Fig 13

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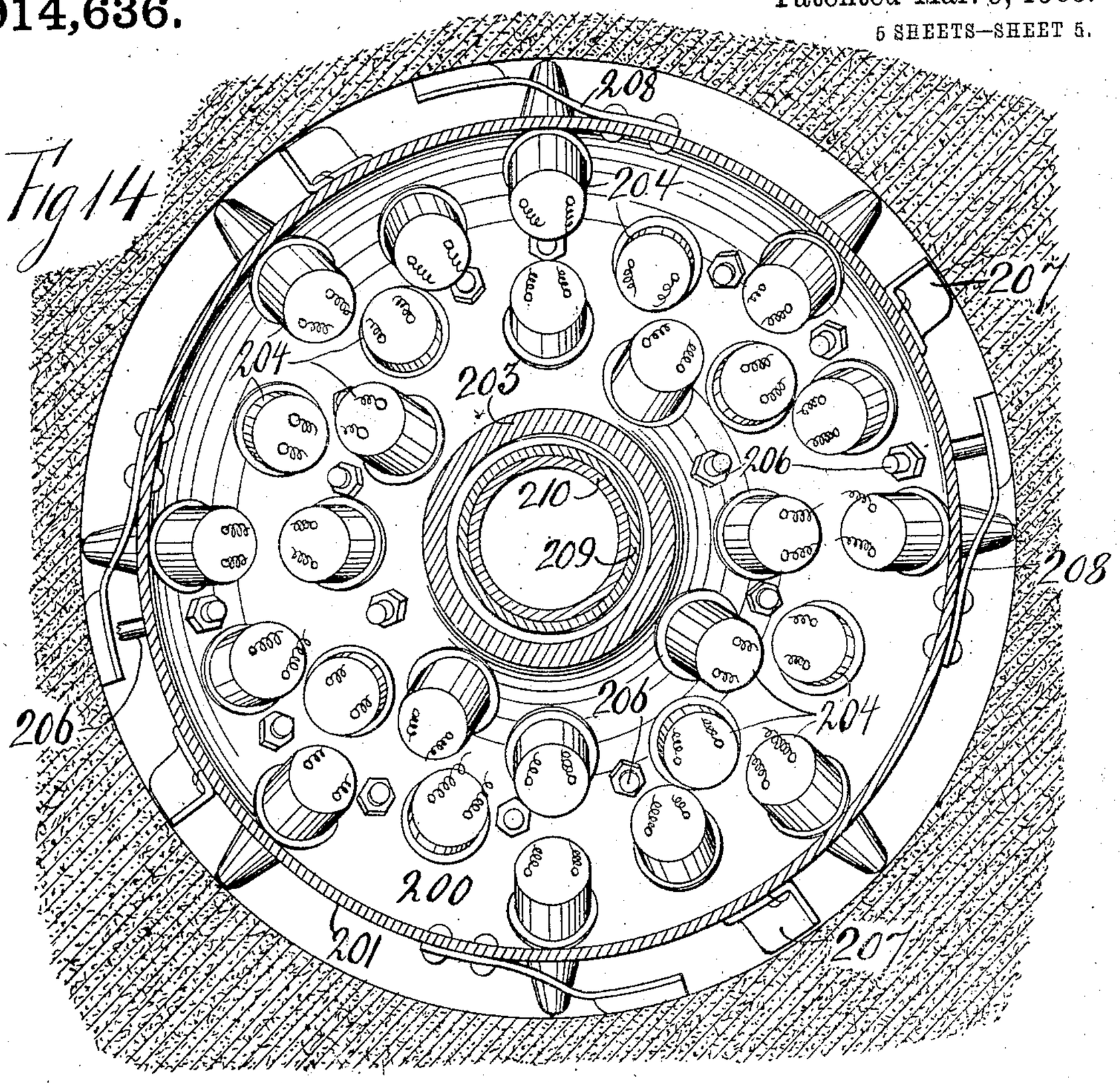
5 SHEETS—SHEET 5.

Fig 14



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UNITED STATES PATENT OFFICE.

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ROTARY TUNNELING-MACHINE.

No. 914,636. Specification of Letters Patent. Patented March 9, 1909.

Application filed April 20, 1908. Serial No. 427,986.

To all whom it may concern:

Be it known that I, CHARLES A. CASE, a citizen of the United States, and a resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Rotary Tunneling-Machines, of which the following is a specification.

This invention relates to a rotary tunneling machine, and its object is the production of an apparatus by means of which rock or other materials are disintegrated, by suddenly changing their temperatures and thereby blistering them on their surfaces, and then scraping off such portions of the materials that are not detached from the main portions thereof.

The invention is particularly adapted for digging round tunnels.

The invention is exemplified in this application in a machine which comprises essentially a rotating head, carrying torches for heating the surface of the material to be treated, and scrapers connected with the head. Means are also provided to axially advance the head of the machine while rotating, and other means to conduct a stream of water or other cooled fluid or air against the surface of the material, and appurtenances to remove the disintegrated material.

Figure 1 represents a partial side view and axial section of a tunneling machine exemplifying the invention in a tunnel, Fig. 2 shows a right hand end view of the machine shown in Fig. 1, Fig. 3 is a section of Fig. 1 on the line 3, 3, Fig. 4 shows a section of Fig. 1 on the line 4, 4, Fig. 5 represents an enlarged partial section of Fig. 1 on the line 5, 5, Fig. 6 shows a partial top plan view of Fig. 1, Fig. 7 represents an end view of the frame of the machine, Fig. 8 is a partial section of Fig. 4 as on the line 8, 8, Fig. 9 shows a partial section of Fig. 1 on the line 9, 9, Fig. 10 represents a partial section of Fig. 1 on the line 10, 10, Fig. 11 is a partial section of Fig. 10 on the line 11, 11, Fig. 12 shows a top plan view of Fig. 11, Fig. 13 represents a partial axial section of a modification of the invention in a tunnel, and Fig. 14 shows a partial section of Fig. 13 on the line 14, 14.

The invention comprises a supporting frame with ring ends 21 connected by the longitudinal ties 22. Each ring end is flattened at its lower portion 23 and has a flanged rib 24 at its upper portion. From one of the ribs 24 extends the lug 25. Radial arms 26 extend inwardly from the circumferential portions of the ring ends, and join with the inner secondary rectangular frame 27. Lugs 28 extend from the vertical members of the frame 27 and the lug 29 extends from the lower horizontal member thereof. A rectangular tie 30 with the guide lug 55 having the opening 56 connects the lower horizontal members of the said frame 27, and the tee shaped tie 31 connects the upper horizontal members thereof.

The radial arms 26 each comprise the four members 32 that are joined by the shelf 33 and by the shelf 34. From each of the latter extend two pairs of posts 35, the upper ends of which directly connect with circumferential portions of the ring ends 21. Each pair of posts 35 constitute guides for brackets 36 that have threaded stems 37 with the nuts 38, by means of which they are clamped to the shelves 34. A pivot 39 is supported in each pair of brackets 36 and on each of which is journaled a guide roller 40. Journal brackets 41 are guided between the lower portions of the members 32 and have each extending from them threaded spindles 42 with nuts 43, by means of which they are adjustably secured to the shelves, 33. In the journal brackets 41 are journaled the driving shafts 44 that have connected thereto the driving rollers 46. Between the ring ends 21 extend the channel ties 50, and between the latter are interposed the supports 51 and 52. From the supports 51 extend the journal brackets 53, and a channel bracket 54 extends between the support 52 and the tie 31. A counter shaft 60 is journaled in the brackets 53 and in a bearing 61 formed with the channel bracket 54.

On each of the shafts 44 is fastened a sprocket chain wheel 65. A sprocket chain 66 engages each of the wheels 65 and with a sprocket chain wheel 67 on the shaft 60.

On the teé shaped tie 31 is located an electric motor 68 having the electric conductors 69 leading from the fuse box 70 supported on the arm 71 extending from the lug 25 of one of the end rings 21. Electric feed wires 72 lead to the fuse box 70 to which is connected the switch 73. On the armature shaft 75 of the motor 68 is fastened the pinion 76, the teeth of which mesh with the teeth of the spur gear 77 secured to the counter-shaft 60.

A journal bracket 78 is supported on the

tee shaped tie 31, and in which is journaled a spindle 79 that is also supported in a bearing of the channel bracket 54. A gear 80 is fastened to the spindle 79 and the teeth thereof mesh with the teeth of the pinion 81 on the counter shaft 60, with which latter it is engaged by means of a spline 82. One member 83 of a clutch extends from the pinion 81. A shifting lever 84 is fulcrumed from a cross tie 85 fastened to the channel ties 50. A pair of pins 86 of the lever 84 engage a groove of the member 83 of the clutch. On the spindle 79 is fastened a gear 90 the teeth of which mesh with the teeth of a gear 91 journaled on a pin extending from the channel bracket 54. The teeth of the latter gear mesh with the teeth of the gear 92 journaled on the counter shaft 60, from which latter extends the clutch member 93 that engages with the clutch member 83.

On the spindle 79 is fastened a sprocket chain wheel 96, with which is engaged a sprocket chain 97 that is led over guide sheaves 98 journaled on the four shafts 44, and said chain at its lower end engages with the sprocket chain wheel 100, extending from the threaded sleeve 101 on the driving screw 102.

A driving drum 105 is supported on the rollers 46 and at its rear end has fastened thereto the collar 106, and a sprocket chain wheel 107 with the sleeve 108 extending from the latter. Between the collar 106 and the sleeve 108 is interposed on the drum 105 the ring bracket 109 with the arm 110. The latter bracket has the side lugs 111 for conduits 112, which are also supported in the lugs 28. The bracket 109 has the central boss 113 and the lower boss 114 in its arm 110.

The back end of the driving screw 102 is fastened to the boss 113 by means of the collars 120 and 121, and the shank 122 of said screw is fastened to the frame 125 by means of the collars 123. The frame 125 comprises the two upper converging members 126, the central converging members 127 and the lower arm 128. At the junction of the members 126 is formed a boss 129 with an opening which supports one end of the water pipe 130, and the other end of the said pipe passes through openings 131 in the flanged ribs 24 formed with the end rings 21. A rubber tube 132 is coupled to one end of the pipe 130, and a nozzle 131 extends from the other end of said pipe. Bosses 135 with openings are formed at the junctions of the members 126 and 127 of the frame 125 and in which are fastened the forward ends of the conduits 112. A boss 136 with an opening extends from the lower arm 128. One end of the conveyer shaft 140 having the spiral conveyer 141 is journaled in the boss 136 and the other end thereof is journaled in the boss 114 of the arm 110.

On the shaft 140 is fastened the sprocket chain wheel 142, and a sprocket chain 145 connects the latter wheel with the sprocket chain wheel 107. A conveyer conduit 146 for the conveyer 141 is fastened at one end of the arm 110, and at the other end to the arm 128 of the frame 125. In the conduits 112 are located electric conductors 150, that extend from the fuse box 70 to brush holders 151 supported on the ends of the said conduits 112.

A hollow rotating head with spherical crown 156, rear wall 157 having openings 158, cylindrical wall, 160 and sleeve 161 is fastened to the driving drum 105. In the crown 156 are formed openings 162 in which are supported the receptacles 163 of electric torches, that comprise a pair of carbons 165 and their usual appurtenances. Feed wires 166 bring current to said carbons and extend to metallic conductor rings 167 and 168. A hood 170 extends from the wall 157 and insulated material 171 is interposed between the metallic ring 167 and the inner surface of the hood 170. Insulating material 172 is interposed between the rings 167, 168, and insulating material 173 is interposed between the drum 105 and the ring 168. Brushes 175 extend from the brush holders 151 and one thereof bears on the ring 167 and the other bears on the ring 168.

Regulating scrapers 176 extend from the crown 156 and prevent the ends of the carbons from scraping on the face of the material being treated and scraping off portions thereof. They are held in place by the lock nuts 177. On the cylindrical portion 160 of the head are fastened the collecting scrapers 180 which collect the blistered material and bring it in the path of the conveyer casing 146. Springs 181 with the shoes 182 extend from the cylindrical surface 160 of the head to locate it centrally in the tunnel that is being dug.

Referring to Figs. 13 and 14, the invention is shown with a modified head comprising an annular crown 200, a cylindrical wall 201, rear wall 202 and a sleeve 203. In the crown 200 are secured the receptacles 204 of the electric torches with carbons 205. Scrapers 206 and 207 similar to 176 and 180 extend from the crown 200, and springs 208 similar to 181 extend from the cylindrical surface 201 of the head. The sleeve 203 is fastened to the driving drum 209 that contains the detachable core pipe 210. From the rear wall 202 extends the hood 211 similar to 170, and between the latter and the said drum are located the insulating rings 212, 213 and 214. Metallic rings 215 and 216 are located between the insulating rings 212, 214 and have between them insulating rings 213. The said metallic rings are engaged with brushes 217 similar to 175. A frame 220 similar to 125 is represented with this modification, as well as the conveyer casing 221 with its appurtenances, similar to 146.

To operate the invention and referring specially to Figs. 1 to 12, the machine is located to bring the carbon points of the torches, in close proximity to the surface of the material or tunnel to be operated upon the frame with the ring ends 21 being adjacent to the frame 125 and consequently to the rotating head having the crown 156. The frame 21 is tightly held in position and prevented from turning by causing the rollers 40 to bear with sufficient pressure against the sides of the tunnel. This is accomplished by locating the threaded stems 37 in the shelves 34 so that the said rollers 40 will tightly hug the sides of the tunnel. The switch 73 is closed to feed current to the motor 68, which drives the counter shaft 60. The latter through the sprocket chain wheel 67, chain 66 and the four sprocket chain wheels 65 rotates the shafts 44, and thereby the driving rollers 46, which latter rotate the driving drum 105 and thereby the rotating head. The countershaft 60 by means of the pinion 81, gear 80 on the spindle 79, sprocket wheel 96 with sprocket chain 97, rotates the sprocket wheel 100. The latter by means of the threaded sleeve 101 axially moves the driving screw 102. The screw 102 being connected with the arm 110 of the ring bracket 109 extending from the driving drum 105 axially moves the latter and the rotating head. With the axial movement of the said driving drum 105, the conveyer casing 146 with its conveyer, the frame 125 with the brush holders 151, pipe 130 and other immediate appurtenances are also axially moved. If the rotating head is to be backed the clutch with the members 83 and 93 are locked, which separates the pinion 81 from the gear 80, and by means of the gears 90, 91 and 92, the rotations of the spindle 79 are reversed, which reverses the axial movement of the driving screw 102 and will consequently reverse the axial movement of the said rotating head. During the rotations of the rotating head, a stream of water or other cooled fluid is forced through the pipe 130. During the rotation of the said rotating head the insulated metallic rings 167, 168 are in contact with the brushes 175 and thereby electric current is brought through the conductors 150 to the wires 166 of the electric torches having the receptacles 163, by virtue of which electric flames are produced between the points of the said carbons 165, which will heat the material acted upon. This heating with the cooling, blisters the said material, and portions which are not disintegrated are scraped off with the scrapers 176 and 180. The disintegrated material is carried away by the conveyer in the casing 146. The frame of the machine is held tightly against the walls of the tunnel that is being dug, by means of the adjustable rollers 40 which bear against said walls by locating the spindles 37 of the brackets 36 in proper operative positions.

Referring particularly to Figs. 13 and 14 of the modification of the invention the rotating head with the annular crown 200 blisters a ring in the head of the tunnel, and leaves a core of the material 230, which enters the core pipe 210, and from the latter the core can easily be removed, the said pipe 210 being detachable from the driving drum 209.

It will be noted that other heating means may be substituted for the electric torches and that various types of motors may be used in place of the electric motor.

Having described my invention I claim:

1. In a machine the combination of means to heat a material, means to chill said material, the resulting heating and chilling alternating with each other and means to rasp and scrape said material.

2. In a machine the combination of rotatory means to heat a material, means to chill said material, the resulting heating and chilling alternating with each other to blister and disintegrate said material.

3. In a machine the combination of rotatory means to heat a material, means to chill said material, the resulting heating and chilling alternating with each other, and rotatory scrapers to bear on said material.

4. In a machine the combination of a rotating head, heating means carried on the head, scrapers on said head and cooling means adjacent to the head.

5. In a machine the combination of a rotating head, heating means carried on the head, scrapers on said head, cooling means adjacent to the head, and means to axially move said head.

6. In a machine the combination of a rotating head, electric torches carried on the head, scrapers on said head, cooling means adjacent to the head, means to axially move said head during its rotations, and means to feed the electric torches with current.

7. In a machine the combination of a rotating head, torches on said head to heat a material operated upon, scrapers on the head, springs extending from said head to maintain it in proper position with said material, cooling means adjacent to said head and means to axially move said head with its appurtenances during the rotations thereof.

8. In a machine the combination of a head, electric torches on said head to heat a material operated upon, scrapers on the head, cooling means adjacent to the head, a driving drum supporting the head, means to rotate the driving drum, a frame extending from the drum, a second frame in connection with the first frame, metallic conductor rings carried on the drum and insulated therefrom, wires connecting the rings with the torches, electric conductors carried on the frames and

brushes in circuit with the latter conductors bearing on the metallic conductor rings.

9. In a tunneling machine the combination of a head, torches on said head to heat the material operated upon, scrapers on the head, cooling means adjacent to the head, a driving drum supporting the head, a frame encircling the drum, driving shafts journaled in the frame, rollers on said shafts supporting and bearing against the driving drum, means to rotate the latter shafts and thereby the drum with its appurtenances, a driving screw in the frames, a frame in connection with each end of the driving screw, one of the latter frames connected with the driving drum, a threaded sleeve on the driving screw and axially bearing against the frame encircling the driving drum, and means to rotate the sleeve and thereby axially drive the screw with the driving drum.

10. In a tunneling machine the combination of a head, electric torches on said head to heat the material operated upon, scrapers on the head, cooling means adjacent to the head, a driving drum supporting the head, a frame encircling the drum, guide rollers adjustably supported on the frame, driving shafts journaled in the frame, rollers on said shafts supporting and bearing against the driving drum, a motor supported on the frame, means between the motor and the driving shafts to rotate the latter, a ring frame supported on the driving drum, a second frame in connection with the ring frame, a driving screw with its ends fastened to the latter two frames, a threaded sleeve engaging said screw and axially bearing against the frame encircling the driving drum, means between the motor and the sleeve to rotate the latter and also to reverse the said rotation, a pair of electric conduits carried on the ring frame and its accompanying frame, a pair of electric conductors in each conduit, a brush at one end of each pair of electric conductors, insulated conductor rings connected up with the head, carbons in the torches and electric conductors between the carbons and the said rings.

11. In a tunneling machine the combination of a head with a spherical crown, torches extending from the crown of the head to heat the material operated upon, regulating scrapers extending from said crown to protect the ends of the torches, a pipe to conduct a cooling fluid against the said material, a driving drum supporting the head, means to rotate the drum, means to axially move the drum, and a conveyer adjacent to the head.

12. In a tunneling machine the combination of a head, torches extending from the head to heat the material operated upon, regulating scrapers extending from the head, a pipe to conduct a cooling fluid against the said material, a driving drum supporting the head, a supporting frame for the said drum, ring ends in said frame, radial arms in the ring ends, an inner frame formed with the arms, guide rollers adjustably pivoted in the upper ends of the arms to bear against the sides of the tunnel that is being dug, driving shafts adjustably journaled at the inner ends of the arms, driving rollers on the latter shafts bearing against the driving drum to rotate the same and means to axially move the driving drum.

13. In a tunneling machine the combination of a head, torches extending from the head to heat the material operated upon, scrapers extending from the head, a pipe to conduct a cooling fluid against the said material, a driving drum supporting the head, a supporting frame for the drum, guide rollers pivoted in the frame to bear against the sides of the tunnel that is being dug, driving shafts journaled in the supporting frame, rollers on the latter shafts bearing against the driving drum, a counter-shaft journaled in the supporting frame, means to rotate the counter-shaft, sprocket chain wheels on each of the driving shafts, a sprocket chain wheel on the counter-shaft, a sprocket chain connecting the latter chain wheel with the chain wheels on the driving shafts, and means to axially move the driving drum in two directions from the rotations of the counter shaft.

14. In a tunneling machine the combination of a head, torches extending from the head, scrapers extending from the head, a pipe for a cooling fluid adjacent to the head, a driving drum supporting the head, a supporting frame for the drum, a motor supported in the frame, a counter-shaft journaled in the frame, connections between the motor and counter-shaft, driving rollers in the supporting frame bearing against the driving drum and driven by the counter-shaft, a driving screw connected up with the driving drum, a threaded sleeve engaging with the driving screw, the ends of the sleev bearing against the supporting frame, and connections between the countershaft and the sleeve, to rotate the latter in two directions and thereby axially move the driving screw.

15. In a tunneling machine the combination of a head, torches extending from the head, scrapers extending from the head, a pipe for a cooling fluid adjacent to the head, a driving drum supporting the head, a supporting frame for the drum, a motor supported in the frame, a counter-shaft journaled in the frame, connections between the motor and counter shaft, a spindle pivoted on the supporting frame, gearing between the spindle and counter-shaft to rotate the former from the rotations of the latter, means to reverse the rotations of the spindle, a driving screw connected up with driving drum, a sleeve on the screw with its end faces bearing against the supporting frame, a sprocket chain wheel

on the sleeve, a sprocket chain wheel on the spindle, and a sprocket chain connecting the two sprocket chain wheels.

16. In a tunneling machine the combination of a head, torches on the head, scrapers on the head, cooling means adjacent to the head, a driving drum supporting the head, a supporting frame for the drum, a ring bracket supported on the drum and extending below the same, a conveyer conduit supported by the bracket, a conveyer in said conduit, a shaft for the conveyer, a sprocket wheel on the shaft, a sprocket wheel on the driving drum, a sprocket chain connecting the sprocket chain wheels, means to rotate the driving drum and means to axially move the said drum.

17. In a tunneling machine the combination of an annular head, torches extending from the head, scrapers extending from the head, cooling means adjacent to the head, a driving drum supporting the head, a supporting frame for the drum, means to rotate the drum with its head and means to axially move the drum.

18. In a tunneling machine the combination of an annular head, torches extending from the head, scrapers extending from the head, cooling means adjacent to the head, a driving drum supporting the head, a core pipe for a core of the material operated upon in the drum, means to rotate the drum, and means to axially move the drum.

Signed at the borough of Manhattan in the county of New York and State of New York this 15th day of April A. D. 1908.

CHARLES A. CASE.

Witnesses:
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MARTIN ZIMANSKY.