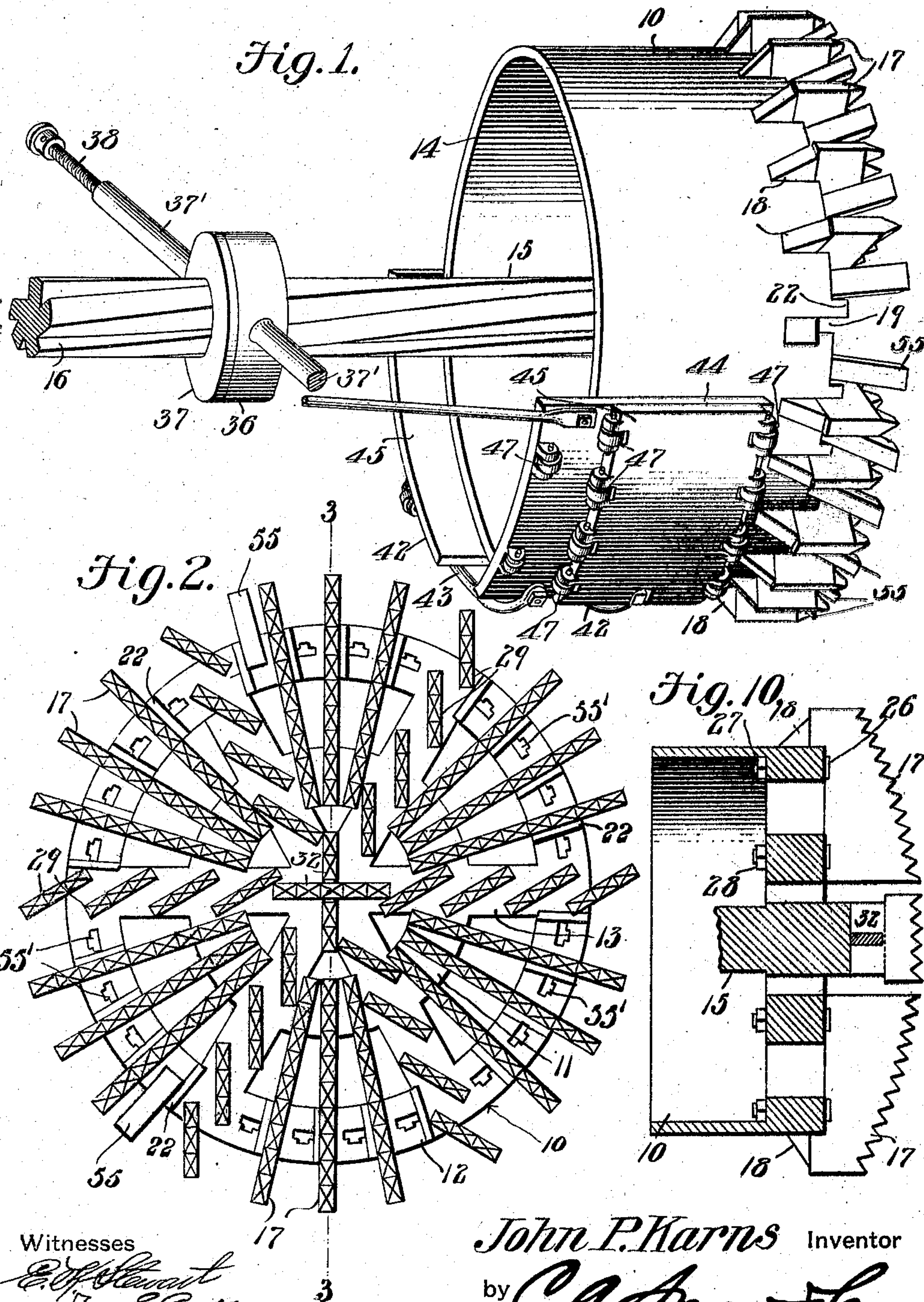


No. 848,107.

PATENTED MAR. 26, 1907.

J. P. KARNs.  
TUNNELING MACHINE.  
APPLICATION FILED NOV. 29, 1905.

2 SHEETS—SHEET 1.



Witnesses

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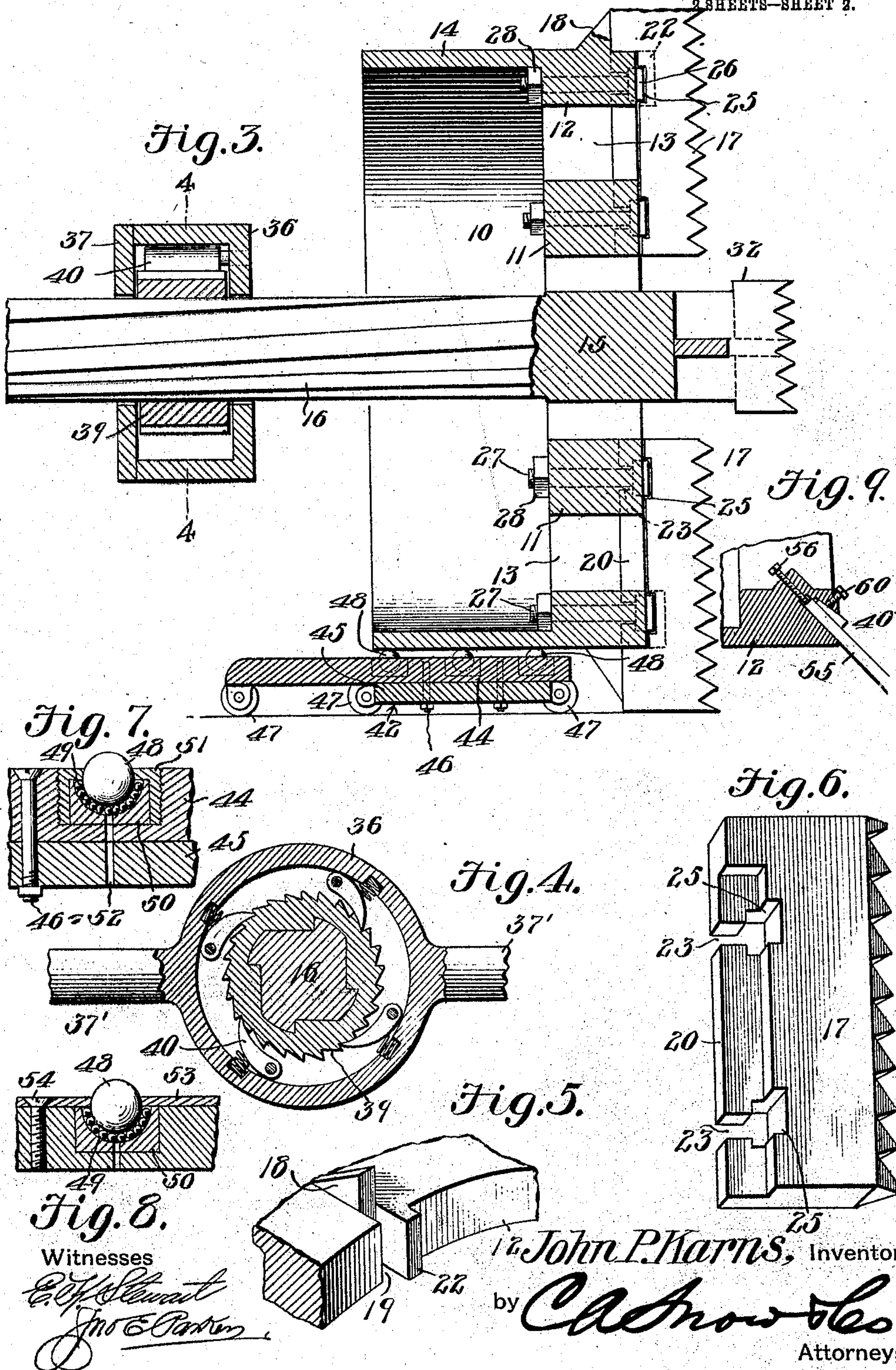


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3 SHEETS—SHEET 2.



Witnesses

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# UNITED STATES PATENT OFFICE.

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## TUNNELING-MACHINE.

No. 848,107.

Specification of Letters Patent.

Patented March 26, 1907.

Application filed November 29, 1905. Serial No. 289,688.

*To all whom it may concern:*

Be it known that I, JOHN PRUE KARNS, a citizen of the United States, residing at Boulder, in the county of Boulder and State of Colorado, have invented a new and useful Tunneling-Machine, of which the following is a specification.

This invention relates to tunneling-machines, and especially to apparatus of that class employed for driving tunnels, drifts, air-courses, and the like for mining and other purposes.

The principal object of the invention is to provide a device of this class which may be operated to rapidly cut a passage sufficiently large to permit the driving mechanism to follow and which may be subsequently used as a tunnel or air-course.

A further object of the invention is to construct a drilling-head of large diameter carrying bits or cutters and to so construct and mount the same that it may be manipulated in the same manner as an ordinary small drill.

A further object of the invention is to provide a device of this class in which the mechanism for revolving the drill-carrying head is arranged close to said head for the purpose of reducing strain on the shaft and, further, to provide a turning means which may be adjusted as the head advances independently of the drill-actuating mechanism.

A further object of the invention is to provide a device of this type in which the drill-head is mounted on a shoe or shield of simple construction and so arranged as to permit free rotation and reciprocating movement of the head.

A still further object of the invention is to provide an improved means for supporting and securing the cutters or bits in place.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size, and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings, Figure 1 is a perspective view of a tunneling machine constructed in accordance with the invention. Fig. 2 is a face view of the same. Fig. 3 is a longitudinal sectional elevation of the machine on the line 3 3 of Fig. 2. Fig. 4 is a transverse sectional view of a portion of the drill-head-turning mechanism on the line 4 4 of Fig. 3. Fig. 5 is a detail perspective view of a portion of the periphery of the main drill-head detached. Fig. 6 is a detail perspective view of one of the bits or cutters of the main head. Fig. 7 is a detail sectional view of a portion of the adjustable drill-carrying shoe, showing one of the antifriction-balls and the manner in which the same is mounted. Fig. 8 is a similar view illustrating a slight modification of the structure. Fig. 9 is a detail sectional view of a portion of the rim of the bit-carrying head, showing the manner in which the diagonally-disposed bits or cutters are mounted. Fig. 10 is a sectional view corresponding to Fig. 3 and illustrating the employment of bits of modified construction.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The main drill-head 10 is circular in form and includes a pair of concentric rings 11 and 12, united by radially-disposed arms or spokes 13, and an inwardly-extending marginal flange 14, all of which are preferably formed integral, and at the central portion of the head is arranged a shaft or hub member 15, which preferably is formed of a separate piece of metal firmly secured to the head, its forward end projecting some distance beyond the forward face of the head and its rear end being provided with helically-disposed grooves 16 of the character commonly employed in power-drills.

The forward face of the main head is provided with a plurality of grooves for the reception of bits or cutters, the main cutters 17 being of the type shown in Fig. 6 and extending from the inner edge of the inner ring 11 to a point beyond the periphery of the ring 12 and flange 14, the outer ends of said bits or cutters being backed by small tapered flanges or lugs 18, that are formed integral with the head and project from the periphery of the ring 12. Each of the bits



or cutters 17 is arranged within a radial groove 19, formed in the forward face of the head, and the rear edge of the bit or cutter is reduced in thickness for the greater portion of its length, forming a flange 20, that fits within the groove, while that portion of the bit which extends beyond the periphery of the ring 12 is of the full thickness of the bit and is supported by the flange or lug 18.

The forward face of the drill-head is further provided with lugs 22, which fit snugly against one side of each of the bits or cutters and serve to reinforce the same during the revoluble movement of the head.

In the rear portion of each of the bits or cutters 17 is arranged a pair of slots 23, at the inner ends of which are enlarged pockets 25, the latter being designed for the reception of the rectangular heads 26 of securing-bolts 27, that pass through suitable openings formed in the head and at their rear threaded ends are enlarged by nuts 28, which are within convenient reach of the operator. The bits or cutters are so supported that comparatively little strain will be exerted on the bolts, and the latter are not subjected to wear nor danger of breakage, so that they are ready for use when it becomes necessary to replace worn or broken bits.

The radial bits are arranged in groups, and between these are disposed groups of inclined bits or cutters 29, the rear faces of which are fitted in suitable grooves formed in both the ring and spokes of the head.

The forward end of the shaft or hub 15 is provided with intersecting grooves at its inner end, and in said grooves are arranged central bits or cutters 32, the cutters being of a length greater than the diameter of the shaft or hub and being arranged to cut their way into the rock or other material in advance of the remaining bits or cutters of the head, so that a circular pocket is formed in the rock or other material, and such pockets serve to some extent as advanced bearings for the shaft or hub and permits relatively free rotative movement of the main head. These bits may be of any suitable construction and held in place in any manner commonly employed in the art.

The outer end of the shaft 15 is connected in any suitable manner to an operating mechanism, by which reciprocatory movement may be imparted to said shaft and head.

Extending around the grooved or rifled portion 16 of the shaft, at a point adjacent to the drill-head, is a cylindrical casing 36, having a removable head 37, secured in place in any suitable manner. From this casing extend arms 37', that are provided at their outer ends with jack-screws 38, which may be turned to engage against the tunnel-wall, and thus hold the casing from movement.

This casing contains a ratchet-wheel 39, hav-

ing a rifled opening for the passage of the rifled portion 16 of the shaft, and engaging the teeth of the ratchet-wheel is a series of spring-pressed pawls 40, which permit free rotative movement of the ratchet-wheel during forward or active movement of the shaft 15 and the drill-head. During the return movement of the shaft and drill-head the pawls 40 hold the ratchet-wheel from movement, and the shaft is therefore compelled to rotate to a slight extent, turning the drill-head the proper distance in readiness for a fresh forward stroke.

By arranging the rotating mechanism close to the drill-head the shaft is relieved of strain to some extent, and the turning mechanism acts also as a partial support for the shaft and the drill-head, so that the latter may turn more freely than where the rotating mechanism is contained within or is adjacent to the engine. The casing further serves as a guide for the shaft and drill-head and prevents lateral play in case the character of the material being drilled changes during the drilling operation.

In order to provide for the free turning movement of the drill-head and at the same time permit its reciprocatory movement, a pair of supporting-shoes 42 are employed, said shoes being arcuate in form and being connected by a bar 43, as shown in Fig. 1. Each of the shoes comprises a pair of curved plates 44 and 45, which are secured together by bolts 46, and both plates are provided with small rollers 47 to permit the moving forward of the shoes as the drilling operation progresses. The uppermost shoe 44 carries a large number of antifriction-balls 48, on which the drill-head is free to revolve and to reciprocate. These balls are preferably supported in the manner shown in Fig. 7, each ball being placed on a number of smaller balls 49 in a curved recess formed in a hardened plate 50, that is seated in a suitable threaded opening formed in the plate 44, and into said threaded opening is screwed an inverted cup 51, which confines the balls and their supports in place without interfering with free rotative movement of the main antifriction-ball. Leading from the bottom of the cup-shaped depression in which the smaller balls are arranged is an opening 52 to permit the passage of dirt or moisture.

In Fig. 8 is illustrated a slightly-modified construction, in which the supporting-block 50 is confined in place by a cap 53, which is secured to the shoe 44 by bolts 54.

It will be observed that the outer ends of the bits or cutters 17 extend somewhat beyond the peripheral line of the flange 14, this being for the purpose of cutting an opening somewhat larger than the drill-head to permit the ready rotation of the head without frictional contact with the side walls of the



tunnel. In order to assist the outer cutters, a number of diagonally-disposed bits or cutters 55 are employed, these bits or cutters being adapted to suitable guiding-openings 55' in the outer ring 12 and being adjustable longitudinally by means of set-screws 56, so that the bit may be gradually forced out as it becomes worn. To assist in holding the bits in place, wedges 40' are employed, these being driven into portions of the bit-receiving openings and locked in position by set-screws 60.

In operating the device the drill-head is mounted on the shoes and reciprocated at any desired speed, the material detached by the bits being removed by a stream of water directed through the open spaces between the rings and the spokes of the cutter-head. At each rearward movement the drill-head is rotated to some extent in order that the bits may attack successively fresh portions of the rock or other material. The shoes may be adjusted from time to time during the progress of the drilling operation in order to support the head.

In Fig. 10 is illustrated a slight modification of the invention, wherein the bits are arranged on curved or inclined lines extending across the main head, those portions of the bits nearer the center of the head being in advance in order to facilitate the cutting operation.

Having thus described the invention, what is claimed is—

1. In a tunneling-machine, the combination with a revoluble bit-carrying head, of a rifled shaft connected thereto, a casing surrounding the shaft at a point adjacent to the head and having diametrically-opposed projecting arms, jack-screws arranged in the arms and designed for engagement with the

tunnel-wall, a ratchet-wheel arranged within the casing and having an opening for the passage of the rifled shaft, and a pawl carried by the casing and engaging the ratchet-wheel.

2. In a tunneling-machine, a revoluble head having radial slots in its forward face, and cutting-bits having their rear edges fitted within the slots, the forward face of the head having shoulders bearing against the sides of the bits.

3. In a tunneling-machine, a revoluble head having radial slots, cutting-bits having flanged rear edges fitting within said slots, the flanges being provided with recessed bolts extending through the head, and entering the slots of the flanges, and means for locking said bolts in position.

4. In a tunneling-machine, the combination with a revoluble head having bit-receiving slots, of cutting-bits, the rear edges of which are disposed within the slots, said bits having pocketed recesses, bolts extending through the head and having rectangular head members entered in said pocketed recesses, and clamping-nuts on said bolts.

5. In a tunneling-machine, a revoluble head having bit-receiving slots, cutting-bits disposed within the slots and extending beyond the peripheral line of the head, and radial flanges or lugs carried by the head and serving to reinforce or back the projecting portions of the bits.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JOHN P. KARNS.

Witnesses:

C. E. DOYLE,

FRANK S. APPLEMAN.