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J. H. HOWARD

1,978,084

WELL DRILLING BIT

Filed Feb. 5, 1932

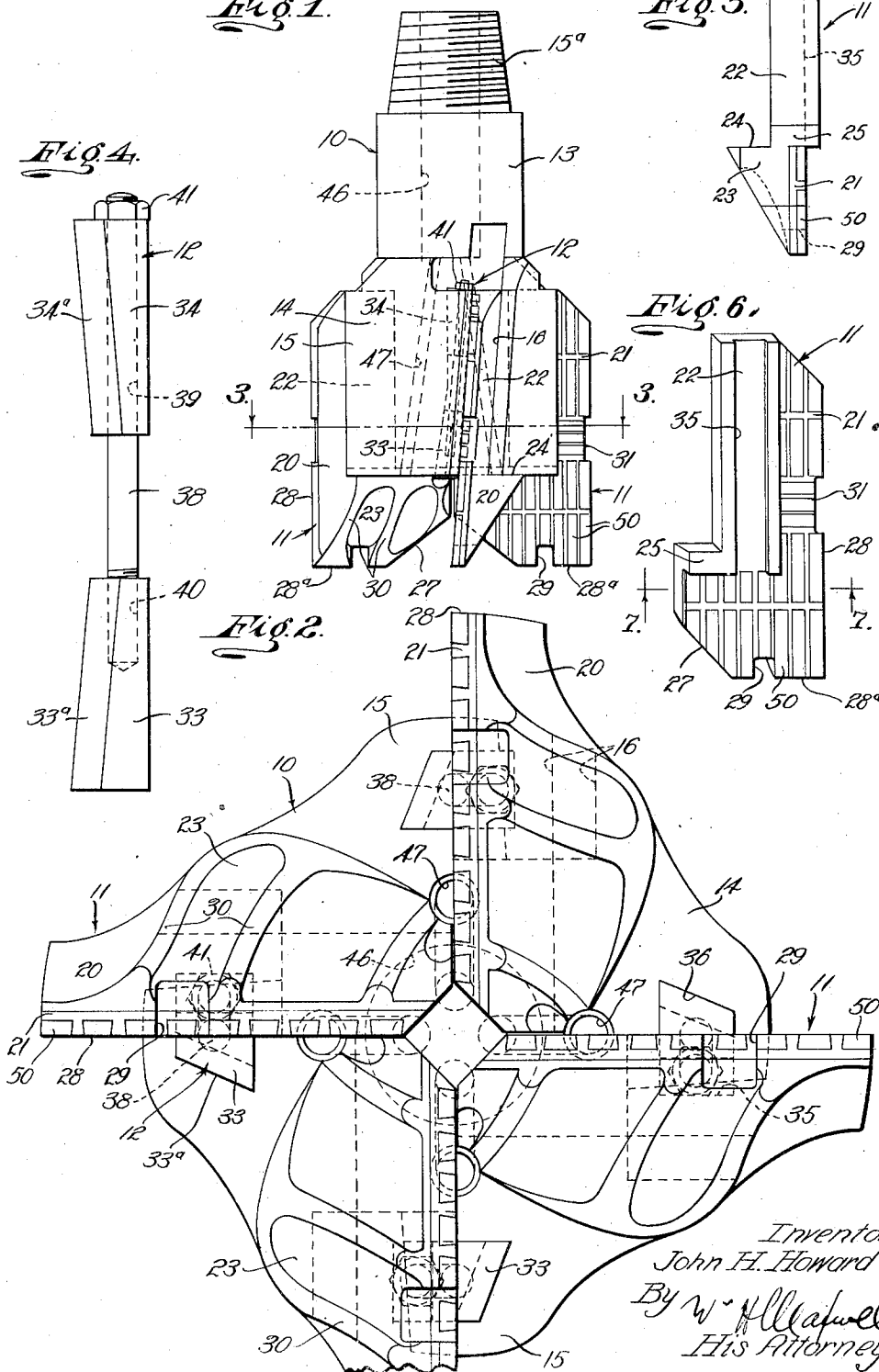
2 Sheets-Sheet 1

Fig. 1.

Fig. 5.

Fig. 4.

Fig. 6.



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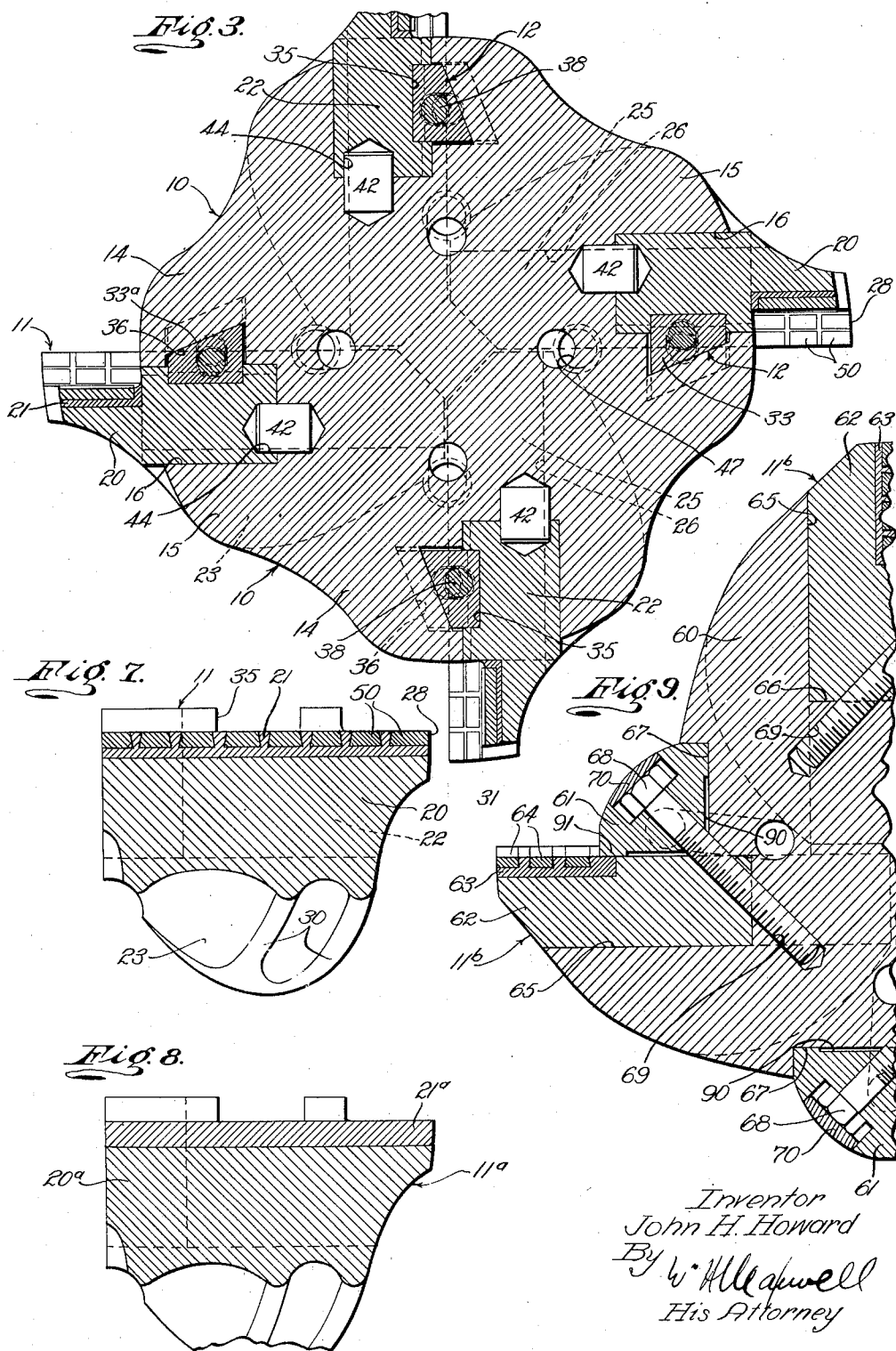
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

1,978,084

WELL DRILLING BIT

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8 Claims. (Cl. 255—61)

This invention has to do with a well drilling tool and has particular reference to a well drilling bit. A general object of the present invention is to provide a simple, practical and effective well bit having improved detachable cutting parts.

An object of the invention is to provide a well drilling bit in which the cutting parts are removably or detachably mounted on the body in a novel, practical and dependable manner, and so that they may be readily replaced.

Another object of the invention is to provide a simplified and commercially practical means for detachably mounting a cutting blade or cutting unit on the body of a bit. In accordance with the invention, the cutting blades or units are securely fixed to the body so that they will not become displaced or separated from the body when subjected to severe working conditions or when greatly worn, and yet may be quickly detached from the body for replacement, etc.

Another object of the invention is to provide a detachable cutting unit for use on a well drilling tool that is particularly effective in acting on the formation and that is self-sharpening through use.

Another object of the invention is to provide a detachable cutting unit or blade for a well drilling tool that has a cutting face or plate that may be provided with diamonds or hard metal inserts, and a comparatively heavy backing for the cutting face or plate that has a relatively low resistance to abrasion.

Another object of the invention is to provide a well bit involving or including a cutting unit of the character just referred to, in which the cutting unit is removably carried by the body of the bit in an effective manner so that it is not liable or subject to breakage, failure or distortion.

A further object of the invention is to provide a bit of the character mentioned that is simple and inexpensive of manufacture and that is economical in operation, as the cutting parts may be easily replaced when worn.

Further objects and features of the invention will be best and more fully understood from the following detailed description of typical forms and applications of the device, throughout which description reference will be had to the accompanying drawings, in which:

Fig. 1 is a side elevation of one embodiment of the present invention. Fig. 2 is an enlarged elevation of the lower end of the tool illustrated in Fig. 1. Fig. 3 is an enlarged transverse de-

tailed sectional view taken substantially as indicated by line 3—3 on Fig. 1. Fig. 4 is an enlarged side elevation of one of the wedge assemblies for attaching a cutting unit to the body. Fig. 5 is a side or edge view of one of the cutting units. Fig. 6 is a perspective view of one of the cutting units or blades included in the bit. Fig. 7 is an enlarged transverse detailed sectional view taken as indicated by line 7—7 on Fig. 6. Fig. 8 is a transverse detailed sectional view similar to Fig. 7, illustrating another form of cutting unit. Fig. 9 is a transverse fragmentary sectional view of another embodiment of the invention.

The form of my present invention illustrated in Figs. 1 to 7 inclusive of the drawings includes, generally, a body 10, a plurality of cutting blades or cutting units 11, and means 12 for detachably securing the units 11 to the body.

The body 10 of the bit includes a shank 13 for connecting with an operating string and an enlarged head or lower portion 14 for carrying the cutting units 11. The shank 13 may be of round cross section and is provided at its upper end with suitable means for connection with an operating string of drill pipe, or the like. In the particular case illustrated in the drawings, a tapered screw-threaded pin 15^a is provided on the upper end of the shank 13. The lower portion 14 of the body is preferably of greater diameter or cross sectional area than the shank 13. The shape or configuration of the lower portion 14 may be varied considerably without departing from the broader spirit of the invention and depends to a certain extent upon the number and character of the cutting units 11.

The embodiment of the invention disclosed in the drawings includes four cutting units 11, and the head or lower portion 14 of the body has four equally spaced, laterally projecting and longitudinally extending projections or wings 15. The outer ends of the wings 15 may be rounded as illustrated in the drawings. A longitudinal opening or slot 16 is provided in each of the wings 15. The slots 16 preferably extend from the lower end of the body 10 to the upper ends of the wings 15. The slots 16 are open at the outer ends of the wings 15 and in the preferred construction, have flat side walls and inner ends. In the specific construction illustrated, the slots 16 are substantially rectangular in horizontal cross section, having flat parallel side walls and a normal flat inner end. The slots 16 are provided to receive the inner ends of the cutting units 11 as will be hereinafter described, and may be disposed to

carry the cutting units in any desired position. In the case illustrated in the drawings, the slots 16 are inclined downwardly and forwardly relative to the direction of rotation of the tool when in operation. The lower end of the body 10 is flat and normal to the longitudinal axis of the tool.

The cutting blades or cutting units 11 are provided to act on or destroy the formation in the well bore and are detachably connected to the body 10 by the means 12. In the typical construction illustrated in the drawings, there are four like cutting units 11, it being understood that there may be any desired number of cutting units and that the units may be varied somewhat in shape if desired, or found practical. Each of the cutting units 11 includes a body or backing 20 of a material having a relatively low resistance to abrasion, and a face plate 21.

The invention contemplates the forming of the backing 20 of bronze, brass, aluminum, or other material having a relatively low resistance to abrasion. Each of the bodies or backings 20 includes an upwardly projecting stem 22 to extend into and fit a slot 16, and an enlarged lower end portion 23 for seating against the lower end of the body 10. The stems 22 of the backings are of rectangular cross-sectional configuration and are adapted to effectively fit the slots 16. In accordance with the invention, the stems 22 project laterally outward from the slots 16 throughout the lengths of the slots. In the embodiment of the invention being described, the outer edges of the stems are straight and substantially vertical, while the upper outer corners of the stems are bevelled.

The lower end portion or enlarged portion 23 of each backing 20 extends rearwardly from the forward face of the stem 22 and inwardly toward the center of the body 10. The upper ends or shoulders 24 of the backing portions 23 are flat to seat against the lower end of the body 10. An upwardly projecting key 25 is provided on each shoulder 24 to extend into or cooperate with a key-way 26 in the lower end of the body 10. The keys 25 extend inwardly from the bases of the stems 22. The slots 16 and key-ways 26 are in alignment, and the several key-ways 26 are tangential to a circle concentric with the central longitudinal axis of the body. In this manner, the keys 25 extend inwardly to approximately the center of the body. The inner lower corner 27 of each backing is bevelled or inclined downwardly and outwardly. The lower ends of the several backing portions 23 are inclined or rounded upwardly and rearwardly from the forward faces of the cutting units and are shaped as will be hereinafter described. Each of the backings 20 of relatively soft material may be integral members, and, as will be seen from an inspection of Fig. 5, are substantially L shaped in front elevation.

The plates 21 of the cutting units are provided to carry diamond substitutes or inserts 50 of cutting material or abrasion resisting material such as tungsten carbide, or the like. A face plate 21 is provided on the forward face of each body of backing 20. In the preferred construction, the cutting plates 21 completely cover the forward faces of the exposed or projecting portions of the backings 21. The plates 21 may extend into the slots 16 to lend strength and rigidity to the cutting units 11. In accordance with the invention, the plates 21 may be attached to the backings 20 in any suitable manner, for example, they may be molded or cast directly on to the backings, It

has been found practical to make the plates 21 of mild steel, however, the invention contemplates the formation of the plates of hard bronze or the like.

The diamond substitutes or inserts 50 of hard cutting material are cast directly in the plates 21. There may be any desired number of abrasion resisting and hard cutting inserts 50 provided in each plate 21 and they may be arranged or positioned as desired. In the case illustrated in the drawings, the inserts 50 have their faces flush with the forward faces of the plates and are spaced apart vertically and horizontally. The sides of the inserts 50 may be inwardly divergent so that the inserts are effectively locked in the plates 21. The plates 21 extend to the outer and lower edges of the backings 20 and together with the inserts 50 form side and lower cutting edges 28 and 28^a. A notch 29 may be provided in the lower end of each cutting unit 11 to decrease the length of the lower cutting edge 28^a and to make the cutting edge discontinuous. Reinforcing ribs 30 are provided on the rear sides of the backings 20 and extend upwardly and rearwardly at opposite sides of the notches 29. Notches 31 may be provided in the outer vertical edges of the several cutting units 11.

The means 12 for detachably securing the cutting units 11 to the body 10 operates to releasably or removably retain the stems 22 in the slots 16. The means 12 is in the nature of an independent wedge means for individually retaining each stem 22 in a slot 16. Each unit or independent element of the retaining means 12 includes two wedges 33 and 34 cooperating with registering grooves or key-ways 35 and 36 in a stem 22 and the walls of a slot 16. The key-ways 35 are provided in the forward faces of the stems 21 and are polygonal, being of uniform configuration and size throughout their lengths. The key-ways 35 extend the entire lengths of the stems 22 and their inner walls may be substantially flush with the forward faces of the plates 21. The key-ways 36 in the body 10 have flat walls and directly register with the key-ways 35 to form vertical or longitudinal openings for receiving the wedges 33 and 34.

In accordance with the invention either the inner walls of the key-ways 35 or the inner walls of the key-ways 36 or both are inclined to cooperate with the wedges 33 and 34. In the particular case illustrated in the drawings the end or inner walls of the key-ways 36 have upper portions inclined downwardly and inwardly to receive or cooperate with the upper wedges 34 and have lower portions inclined downwardly and outwardly to cooperate with the lower wedges 33. The wedges 33 and 34 are shaped to effectively fit the openings formed by the key-ways 35 and 36. The wedges 33 and 34 have inclined sides 33^a and 34^a to slidably cooperate with the inclined wall portions of the key-ways 36.

The invention provides means for actuating or urging the wedges 33 and 34 toward one another when in the key-ways 35 and 36. Bolts 38 slidably pass through openings 39 in the upper wedges 34 and have their lower ends threaded into openings 40 in the lower wedges 33. Nuts 41 are threaded on the upper ends of the bolts 38 to react against the upper ends of the wedges 34. The wedges 33 and 34 and the key-ways 35 and 26 are shaped and related to cause the cutting blades 11 to be urged inwardly toward the center of the bit. In the particular case illustrated in the drawings the inclined sides

33^a and 34^a of the wedges and the inclined walls of the key-ways 36 are pitched rearwardly and inwardly as clearly illustrated in Fig. 3 of the drawings. This sloping or pitching of the inclined sides of the wedges and walls of the key-ways causes the wedges to force or urge the cutting units 11 inwardly toward the center of the tool.

In assembling the tool, the cutting units 11 are slid or moved horizontally inward into positions where the stems 22 are seated in the slots 16, and the keys 25 occupy the key-ways 26. The lower wedges 33 carrying the bolts 38 may then be passed upwardly into the lower ends of the key-ways 35 and 36, and the upper wedges 34 slid downwardly on the bolts 38 to cooperate with the upper end portions of the key-ways. The nuts 41 are then threaded on to the bolts 38 to move or urge the wedges 33 and 34 toward one another and thus tightly hold the cutting units 11 in the slots 16. The inclined sides of the wedges and walls of the key-ways, in sloping or tapering forwardly and inwardly, cooperate to force the cutting units inwardly against the inner walls of the slots 16 and to securely hold the cutting units against outward movement or displacement.

The invention includes means for properly positioning the units 11 and for holding the cutting units against longitudinal movement. Dowels 42 are arranged in sockets in the inner walls of the slots 16 and cooperate with or project into sockets 44 in the cutting units 11. When the cutting units 11 are assembled or positioned in the slots 16, the dowels 42 extend into the sockets 44 and hold the cutting units against longitudinal movement in positions where their shoulders 24 seat against the lower end of the body. Further, the dowels 42 positively prevent longitudinal movement of the cutting units 11 at all times. It is to be understood that the wedges 33 and 34 cooperate with the key-ways 36 in a manner to urge the cutting units 11 inwardly so that they are maintained in locking engagement with the dowels 42. In this manner the loss or displacement of a lower wedge 33 may not cause displacement of the cutting unit from the body 10, as the upper wedge 34 and the dowel 42 would effectively hold the cutting unit against disengagement from the body.

The tool is provided with means for handling circulation fluid and for washing or flushing the forward active faces of the cutting units 11. A central longitudinal fluid passage 46 is provided in the shank 13. Branch passages 47 extend downwardly from the lower portion of the passage 46 to discharge at the lower end of the body. Notches or openings may be provided in the backing 20 at the lower ends of the passages 47 to permit the downward discharge of fluid. The branch passages 47 discharge downwardly in front of the downwardly projecting cutting units 11 so as to effectively flush the cutting faces of the blades or units.

Fig. 8 of the drawings illustrates a type of improved cutting unit 11^a that may be mounted on or embodied in the form of the invention just described. The cutting unit 11^a includes a body or backing 20^a of a material having a relatively low resistance to abrasion, and a plate 21^a formed of a relatively hard material mounted on the forward face of the backing 20^a. The backing 20^a may be formed of bronze, brass, aluminum or the like, and may be constructed in the same manner as the backing 20 described above. The plate 21^a on the forward face of the cutting unit 11^a is hard having a high resistance to abrasion and

may be formed of steel, tungsten carbide, or the like. The plate 21^a may completely cover the exposed forward end of the backing 20^a and may be attached to the backing in any suitable manner, for example, it may be cast directly on to the backing. The hard plate 21^a extends to the side and lower edges of the backing 20^a to provide effective side and bottom cutting edges.

A plurality of the cutting units 11^a of the character just described may be removably attached to the body 10 of the bit by the means 12, in the same manner as the cutting units 11. A bit constructed in this manner has the cutting plate 21^a formed of a relatively hard abrasion resisting material providing effective cutting edges, and supported by and backed up by the backing 20^a of relatively soft material. With this construction the backing 20^a effectively supports the plate 21^a, but is sufficiently soft to be worn away with the cutting edges so as to not interfere with the effective cutting action. In this manner the cutting unit is self-sharpening through use.

In Fig. 9 of the drawings, I have illustrated a modified manner of removably attaching a cutting unit 11^b to the body 60 of the bit. The construction illustrated in Fig. 9 of the drawings includes the bit body 60, the cutting unit 11^b, a block or insert 61 arranged against the forward face of the cutting unit 11^b and bolts retaining the cutting unit 11^b and the inserts 61 in position.

The cutting unit 11^b may be similar in construction to the cutting unit 11 described above. In the case illustrated, the cutting blade or cutting unit 11^b includes backing 62 of bronze or other material having a relatively low resistance to abrasion, and a plate 63 mounted on the forward face of the backing 62 and carrying a plurality of inserts 64 having a high resistance to abrasion. The plate 63 may carry any desired number of spaced hard cutting inserts or diamond inserts 64. The rear face of the cutting unit abuts or seats against a shoulder 65 on the steel body 60. The inner edge of the cutting unit 11^b abuts an outwardly facing shoulder 66 on the body. The insert 61 is in the nature of a comparatively large body of relatively hard material such as steel, arranged against the forward face of the cutting unit 11^b. The inner end portion of the insert block 61 is arranged between the cutting unit 11^b and a shoulder 67 on the body. These faces of the block 61 are relieved as at 90 to provide comparatively narrow rims 91 at the edges of the block 61 that act as pivot rims as will be subsequently described. The outer end portion of the block 61 may be rounded as illustrated in the drawings. The outer portion of the cutting unit 11^b and the lower end portion of the cutting unit 11^b (not shown), are exposed, that is, they project beyond the body 60 and the insert block 61. Bolts 68 are arranged through openings in the block 61 and the cutting blade 11^b. The inner ends of the bolts 68 are threaded into openings 69 in the body. The bolts 68 are disposed at about 45° to the inner sides of the block 61 so that the block is adapted to act as a lever and pivot on the edges 91 and pull or force the blade 11^b inward. The bolts 68 operate to clamp the cutting unit 11^b against the shoulder 65 and to clamp the block 61 against the forward face of the cutting unit. The heads of the bolts 68 may be covered by welding, or a strip 70 welded over them. The strip or welding 70 may be ground off to render the bolts 68 accessible when it is desired to detach the cutting unit.

In the embodiment of the invention disclosed in 150

Fig. 9 of the drawings, the plate 63 carrying the cutting inserts 64 is supported by material having a relatively low resistance to abrasion and is thus exposed for cutting action at all times. The backing 62 having a relatively low resistance to abrasion is worn away together with the plate 63 and inserts 64 so that it does not interfere with the cutting action of the plate 63 and the inserts 64.

The present invention provides a well drilling tool in which the self-sharpening cutting units are detachably mounted on the body so that they may be easily replaced. In the embodiments of the invention illustrated in Figs. 1 to 7 inclusive of the drawings, the wedge means 12 removably attaches the cutting units to the body 10 so that they are effectively supported to transmit the working or cutting thrusts directly to the body, and so that they are dependably held against separation or displacement from the body. The cutting units in having comparatively large portions in the slots 16 are not liable to breakage or distortion. The wedges 33 and 34 securely retain the inner portions of the cutting units in the slots 16 and continually urge the cutting units inward against the inner ends of the slots. The lower end of the body 10 forms a large shoulder or abutment against which the cutting units bear so that the upward thrusts are directly transmitted to the body 10 and do not affect the retaining means 12. The cutting units are easily and quickly removed from the body by unthreading the bolts 38 and driving or removing the wedges from the key-ways 35 and 36. The cutting parts or plates 21 and 21^a are backed up by the backing of relatively soft material so that they will always have proper working clearance. As the backing 11 is worn away together with the cutting edges of the plate it does not interfere with the effective cutting action of the bit, and provides for proper cutting clearance.

The cutting units may be quickly replaced when worn or when it is desired to change the size or type of the cutting units or blades.

Having described only typical preferred forms and applications of my invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims:

50 Having described my invention, I claim:

1. A well drilling tool including an elongate body having a longitudinal slot, a cutting unit extending into the slot, and means for removably attaching the cutting unit to the body including wedges fitting registering key-ways in the unit and the walls of the slot, each wedge having a longitudinally inclined and transversely pitched face cooperating with a correspondingly inclined and pitched wall of a keyway, and means for operating the wedges toward one another to hold the unit in the slot and urge it toward the center of the body.

2. A well drilling tool including a body having a slot, a cutting unit extending into the slot, and means for removably attaching the cutting unit to the body including wedges fitting registering key-ways in the unit and the walls of the slot, each wedge having a longitudinally inclined and transversely pitched face cooperating with a correspondingly inclined and pitched wall of a key-

way, and a single member for forcing the wedges toward one another to hold the unit in the slot and urge it toward the center of the body.

3. A well drilling tool including, a body having a slot, a cutting unit extending into the slot, and means for removably attaching the cutting unit to the body including wedges fitting registering key-ways in the unit and the walls of the slot, each wedge having a longitudinally inclined and transversely pitched face cooperating with a correspondingly inclined and pitched wall of a keyway, and screw means for operating the wedges toward one another.

4. A well drilling tool including, a body having a slot, a cutting unit extending into the slot there being a key-way in a wall of the slot and a key-way in the cutting unit registering with the first mentioned key-way, the keyway in the wall of the slot having oppositely pitched inclined walls at its opposite ends, and wedges fitting the opposite ends of the key-ways and cooperating with said inclined walls.

5. A well drilling tool including, a body having a slot, a cutting unit extending into the slot there being a key-way in a wall of the slot and a key-way in the cutting unit registering with the first mentioned key-way, the keyway in the wall of the slot having oppositely pitched inclined walls at its opposite ends, wedges for fitting the opposite ends of the key-ways and cooperating with said inclined walls, and a single screw threaded member for actuating the wedges.

6. A well drilling tool including, a body having a slot, a cutting unit extending into the slot there being a key-way in the wall of the slot and a key-way in the cutting unit registering with the first mentioned key-way, the keyway in the wall of the slot having oppositely pitched inclined walls at its opposite ends, wedges for fitting the opposite ends of the key-ways and cooperating with said inclined walls, and a bolt for actuating the wedges.

7. A well bit including an elongate body having a longitudinal slot in its exterior, there being a longitudinal key-way in a side wall of the slot, a cutting unit extending into the slot and having a key-way registering with the key-way in the slot, and means removably attaching the unit to the body including wedges fitting the registering key-ways, means urging the wedges toward one another, and a dowel projecting from the inner wall of the slot and extending into a socket in the cutting unit to prevent longitudinal movement of the unit.

8. A well drilling tool including, a body having a longitudinal slot, a cutting unit extending into the slot, there being registering longitudinal keyways in the unit and a wall of the slot, a dowel projecting from the inner wall of the slot and cooperating with a socket in the inner end of the unit, a wedge fitting the keyways, the wedge having a longitudinally inclined and a transversely pitched surface cooperating with a correspondingly inclined and pitched wall of a keyway to hold the unit in the slot and to urge the unit inwardly whereby the dowel and socket are maintained in cooperation, and means for actuating the wedge.

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