March 1, 1949. L. E. SIMMONS 2,462,910

SET SCREW

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Fig. 1.

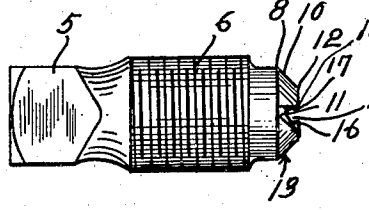


Fig. 3.

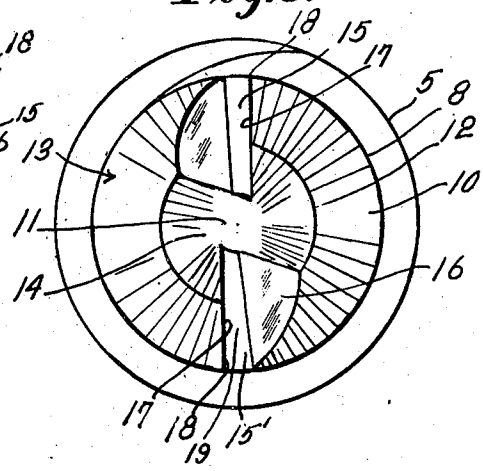


Fig. 2.

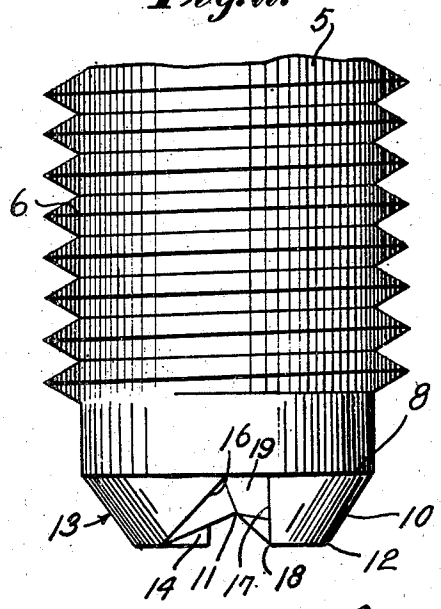


Fig. 4.

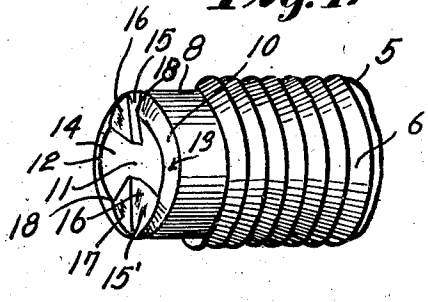
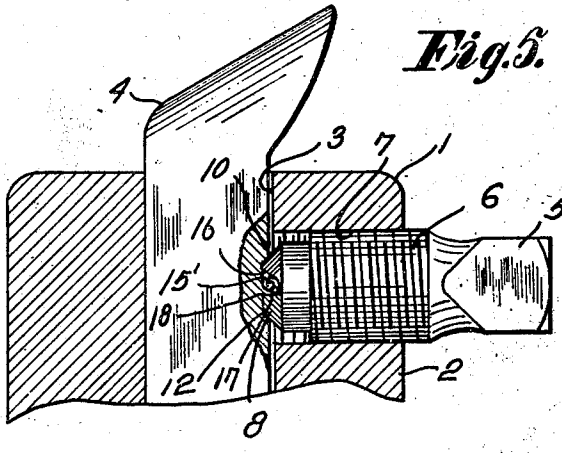


Fig. 5.



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SETSCREW

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7 Claims. (Cl. 151—32)

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My invention relates to set screws and more particularly to set screws for securing cutter bits or cutter bit holders in the chain blocks of the cutter chains of coal cutting machines.

Coal cutting machines, in this country, are practically universally equipped with circulating (orbitally moving) cutter chains made up generally of bit-carrying blocks and connecting links. The bit-carrying blocks have sockets in which the shanks of resharpenable bits, or the holders of so-called throw-away type bits, are adapted to be received; and set screws are provided to engage the shanks of the bits or bit holders and clamp them in these sockets. The cutting instrumentalities are subjected to very powerful forces tending to cause their loss, and there is, of course, much vibration which tends to loosen the set screws.

Conventional set screws are formed with their bit- or bit holder-engaging ends frusto-conically shaped externally, and countersunk so that an annular work-engaging portion generally V-shaped in radial section is provided. Tightening of the set screws results in advance of the screws at a rate determined by the lead of the screw threads, and the pressure exerted by the screw action forces the sharpened annular portions at the front end of the screws into the metal of the bit or of the holder shank. There is no mechanical interlock, as distinguished from a frictional holding effect, tending to prevent the backing out of the screw. Of course, direct withdrawal of the bit or holder until the screw has been slightly loosened will be prevented by the embedding of the forward end of the annular formation at the work-engaging end of the screw; but, aside from the friction action—the binding between the surfaces of the threads and the threaded bore in which they are arranged and the binding action of the surfaces at the inside and outside of the foremost annular edge of the screw—there is nothing to keep the bit from being loosened by reason of vibration.

According to my invention, there is secured a large part of the frictional binding action of conventional set screws, but there is added to this the necessity of detaching or rolling down a chip formed as the set screw is turned "home," and getting this chip out of the way as the set screw is backed out, takes substantial force. In a preferred embodiment, I accomplish these results by retaining the externally frusto-conical, internally countersunk forward portion of the set screw throughout the greater part of the circumference, and by providing, preferably at substantial

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diametrically opposite points, notches in this foremost portion of the screw, in such manner that the leading edge or wall of each notch, in terms of the direction of rotation of the set screw during tightening, slopes rearwardly, while the rearward wall, in terms of the direction of tightening rotation, is desirably relatively nearly parallel to the axis of rotation of the screw. The circumferential dimension of the notch is determined with two considerations in mind:

1. The desire to maintain at least the major part of the foremost end of the bit intact, and

2. The desire to provide for the formation of a chip or chips of the necessary thickness.

It will be understood that, since the forward end of the set screw advances as it rotates, the thickness of the chip raised as the screw is turned "home" depends on the circumferential dimension of these notches. The greater the circumferential dimension of the notch, the thicker the chip. Desirably, the width of the notch will be made sufficient to form a chip of sufficient strength to effect the desired resistance to loosening of the screw, but only of sufficient thickness for that purpose, whereby the set screw will not needlessly cut up the metal of the shank which it engages, and whereby a considerable part of the frictional holding of the conventional set screw will be retained, and whereby there may be a necessity for the leading, sloping wall of the notches to override the chips formed as far as possible instead of simply detaching them. The absence of relief behind the chip raising surfaces will provide for maximum frictional holding of the screw and also result in chips of maximum strength and in maximum fixity, so to speak, of the chips to the body with which they are attached.

The depth of the notches will be determined by the size of the chip to be formed, and its probable ultimate volume.

From the foregoing, it will be appreciated that it is an object of my invention to provide an improved set screw. It is another object of my invention to provide an improved set screw requiring, as far as possible, no large increase in the force required to set it tight, but which will require a definitely increased amount of force initially to loosen it. It is a further object of my invention to provide an improved set screw which, through the formation of a chip which must be disposed of in order to loosen the screw, and through the concurrent retention of the frictional locking of conventional screws in as large a measure as possible, will serve the conjoint ends

of requiring maximum forces to loosen it while maintaining at the practicable minimum damage to the surface to be engaged by the screw or increased danger of breakages. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings, in which one illustrative embodiment of the invention is shown for purposes of illustration:

Fig. 1 is a side view of a set screw embodying the invention in its illustrative form.

Fig. 2 is an enlarged fragmentary view showing the work engaging end of the set screw in side elevation.

Fig. 3 is a front end view of the set screw, also on an enlarged scale.

Fig. 4 is a perspective view of the front end of the set screw.

Fig. 5 is a central longitudinal sectional view of a bit-carrying chain block, showing the set screw in a substantially, but not completely, tightened condition.

Referring to the drawings, and first to Fig. 5, it will be observed that the lug portion 1 of a chain block 2, which is shown only in part, is provided with a socket 3 in which a resharpenable type cutter bit 4 is shown in cutting position. An illustrative embodiment of my improved set screw is shown at 5 threadedly engaged, by means of its own threaded portion 6, with an internally threaded bore 7 in the block, and with the forwardmost work-engaging portion 8 thereof in contact with the adjacent side of the bit 4.

It will be observed that the forward end of the set screw is provided with an externally frusto-conical portion 10 and that this portion is centrally countersunk as at 11 with the result that, before the formation of the notches later described, there exists an annular portion whose foremost edge or narrow surface, as may be desired (herein shown as an edge 12), lies throughout its circumference in a plane to which the axis of the screw is perpendicular. The surface of the frusto-conical portion 10 designated at 13 is adapted to have frictional engagement with the seat which the set screw forms for itself in the work when tightened; and this is also true of the surface 14 which bounds the depression formed by countersinking at 11.

The forward end of the portion of the screw is provided with, herein, a pair of chip-forming, receiving and flattening portions or notches, generally designated 15 and 15'. The number of these may be varied, depending upon the desired results, but it is my opinion, although it is to be understood that the invention is not to be limited to this, that to have two of these notches in diametrically spaced relation is the most desirable arrangement. Each of these notches has two walls in addition, in some forms, to a bottom wall. These notches may be formed desirably by milling; and the forward wall, in terms of rotation in a tightening direction of the screw, is sloping as at 16, the slope being so arranged that the notch is widest at its mouth and the slope being further arranged desirably to cooperate in rolling down or rolling over the chip formed as later described. The rearward wall of these notches shown at 17 is desirably substantially parallel to the axis of the screw. It will be observed, in view of the width or space between the forwardmost portions of the walls 16 and 17, that as the set screw is screwed inwardly there is what might be called an "equivalent projection" of the forwardmost portion of the wall 17 equal to the ratio of

the annular extent of the mouth of the notch to 360°, multiplied by the lead in linear measure of the screw. In other words, there is at 18 an edge having an effective projection, so far as the metal in advance of it, in terms of its rotation in a screwing-in direction is concerned, sufficient to raise a chip of a desired thickness. The width of this chip may be increased by changing from a line at 12 to a surface. The thickness of the chip may be changed by varying the distance between the forwardmost points in the walls 16 and 17. The angle of the surface 17 with respect to a plane including the axis of the screw may be varied, but satisfactory results are secured with the arrangement illustrated, namely, with the surface 17 parallel to a plane including the axis of rotation of the screw. The depth of the notch may be varied, depending upon the amount of chip which it is intended to form; and the angle of the surface 16 will be determined so as to roll down, rather than to break off the chip, if possible. There is no relief behind the surfaces 17, and hence a frictional binding effect between the surfaces 13 and 14 and the surfaces they engage will be provided, and the chips formed will be of maximum strength and tenacity of connection with the body of the metal from which they are being raised.

It will be observed that the surfaces 16 and 17 are, in the illustrative embodiment of the invention shown, separated at their innermost portions by a surface 19, which is generally outwardly facing with respect to the notches, and forwardly facing with respect to the set screw itself, and slopes generally outwardly in a direction from the axis of the screw towards its periphery. This surface, when engaged by a chip, will deflect the chip forwardly and cause it to roll, instead of resulting in jamming as would occur in a sharp-cornered pocket. Ultimately, if and when the notch is filled with a chip, it will act to limit further movement of the set screw inwardly.

From the description which has been given, the mode of operation of the invention will readily be seen. When the set screw is tightened, it forms a groove in the face of the piece to be gripped, most portions of the bottom wall of which lie in a single plane, but which has constantly turned up two chips, with the illustrative construction, these chips being received in the notches 15, 15' and rolled up in these notches and compacted therein. When the screw has been tightened to the desired degree, it will be held against release by the combination of two actions. It cannot be released without getting the chips out of the way—either through breaking them off, or, as more ordinarily will occur, rolling them down. The other action is the same action which is present with all conventional set screws of this type: a strong frictional engagement between the surfaces 13 and 14 and the sloping side walls of the annular recess formed in the work.

I have found that to release my improved set screw to a point where it can be freely unscrewed, many more foot pounds of force are required than are necessary to release the conventional set screw, there being a prolonged resistance to unscrewing lasting through an angle of wrench movement of many degrees, whereas, when the conventional set screw is once "started" the resistance falls off immediately to practically nothing. It will be observed that, by reason of the nature of my invention, damage (scoring) of the faces of the shanks of the bits or holders is minimized while yet, through the formation of

the chips, a definitely positive type of lock is provided. It will further be noted that save for the relatively small arcuate gaps in the circular edge 12 and faces 13 and 14 the frictional holding which is secured with a so-called standard type set screw is maintained. This is due in large part to the absence of relief behind the surfaces 17 and portions 18.

Actual tests in use show that the danger of accidental loosening of my improved set screw is far less than with a set screw not formed with the notches 15, 15', since displacement of the chip in some manner is essential and since the forces tending to hold the set screw against release are not immediately lost upon a very small angle of outward turning of the screw.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A set screw having at its end a projecting annular portion substantially V-shaped on radial planes and cut away at at least one point to provide a notch having a forward bounding wall, in terms of tightening rotation of the screw, sloping inwardly and rearwardly, and having an opposite wall having the elements of the surface thereof more nearly parallel to the axis of the screw, said projecting portion, where not cut away as above mentioned, having the foremost points therein lying substantially in a single plane perpendicular to the axis of the screw.

2. A set screw having at the forward end thereof projecting arcuate portions adapted to be forced into the work to be held, upon tightening of the screw, said arcuate portions each exceeding 90° in arcuate extent and being spaced by chip receiving notches having relatively straight surfaces for raising as the screw is turned in a chip and having relatively sloping surfaces for displacing the chip as the screw is turned out, the parts of said projecting portions supporting said chip-raising surfaces formed without relief.

3. A set screw having at the forward end thereof an annular portion adapted to be forced into the work to be held, upon tightening of the screw, said annular portion having at least two relatively small sections thereof cut away to form chip receiving notches bounded at their forward sides, in terms of inward rotation of said set screw, by surfaces whose outermost portions are the most advanced, and at their rearward sides having surfaces at least substantially parallel to each other and to a single diametric plane, said annular portion presenting at least one forwardly facing surface adapted to engage with the work with a binding frictional action on tightening of the set screw and said set screw having at least one other forwardly facing surface disposed outwardly of said first mentioned forwardly facing surface and adapted through the compacting of a chip between it and the surface from which said chip is raised to limit advance of said set screw.

4. A set screw having at its end a projecting annular portion substantially V-shaped on radial planes and cut away at substantially opposite points therein to provide notches having forward bounding walls, in terms of tightening rotation

of the screw, sloping inwardly and rearwardly, and having opposite walls having the elements of the surfaces thereof substantially parallel to the axis of the screw, said projecting portion, where not cut away as above mentioned, having the foremost points therein lying substantially in a single plane perpendicular to the axis of the screw, the portion of said projecting portion not cut away substantially exceeding the cut away part thereof.

5. A set screw having at its work-engaging end an annular portion adapted to be forced into the work to be held upon tightening of the screw, said annular portion having at least one relatively small section thereof cut away to form a chip-receiving notch bounded at its forward side, in terms of screw rotation in tightening direction, by a surface whose outermost portion is the most advanced, and at its rearward side having a surface at least substantially parallel to a diametric plane, said notch also having a bottom surface arranged between said surfaces and lying substantially in a plane and facing towards the work-engaging end of the set screw and at all points therein separated from the extreme forward end of said work-engaging end by a distance less than the width of said chip-receiving notch at its mouth, for limiting the depth of penetration of said annular portion into the work to be held.

6. A set screw having at its work-engaging end an annular portion V-shaped in cross-section and adapted to be forced into the work to be held upon tightening of the screw, said annular portion having at least one relatively small section thereof cut away to form a chip-receiving notch bounded at its forward side, in terms of screw rotation in tightening direction, by a surface whose outermost portion is the most advanced, and at its rearward side having a surface at least substantially parallel to a diametric plane, said rearward surface providing a cutting edge terminating in a point which is at the leading end of an arcuate edge which at all points arcuate to the rear of said point lies forwardly of a line of like radial disposition but of the helix angle of the set screw, said cutting edge operative as the screw is rotated in a tightening direction to raise a chip on the screw-engaging face of the work and the chip so raised being received in the space provided by the notch, said notch also having a bottom surface arranged between said surfaces and facing towards the work-engaging end of the set screw for coacting with a chip for limiting the depth of penetration of said annular portion into the work to be held, said bottom surface separated at all points therein from the forward end of said portion by a distance less than the distance between the most widely separated points in said first and second mentioned surfaces.

7. A set screw having at its work-engaging end a projecting annular portion substantially V-shaped in section on a radial plane and adapted to be forced into the work to be held upon tightening of the screw, said annular portion being cut away at at least one point to provide a notch having a forward bounding wall, in terms of tightening rotation of the screw, sloping inwardly and rearwardly, and having an opposite rear wall the elements of the surface of which are more nearly parallel to the axis of the screw, and further having a bottom wall between said walls facing towards the work-engaging end of the set screw, said rear wall serving as the screw is

rotated in tightening direction to raise a chip on the face of the work and said bottom wall being so disposed as to deflect the chip so raised toward said forward sloping wall so that the chip is caused to coil in the space provided by said notch and to fill the notch from top to bottom whereby the chip limits the degree of penetration of said set screw, and said sloping wall serving to displace the chip as the screw is turned out and such displacing of the chip tending to resist loosening of the screw.

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