July 10, 1962 G. A. COOLEY 3,043,288

WORK MEMBER FOR A PERCUSSIVE TOOL

Filed June 15, 1960 3 Sheets-Sheet 1

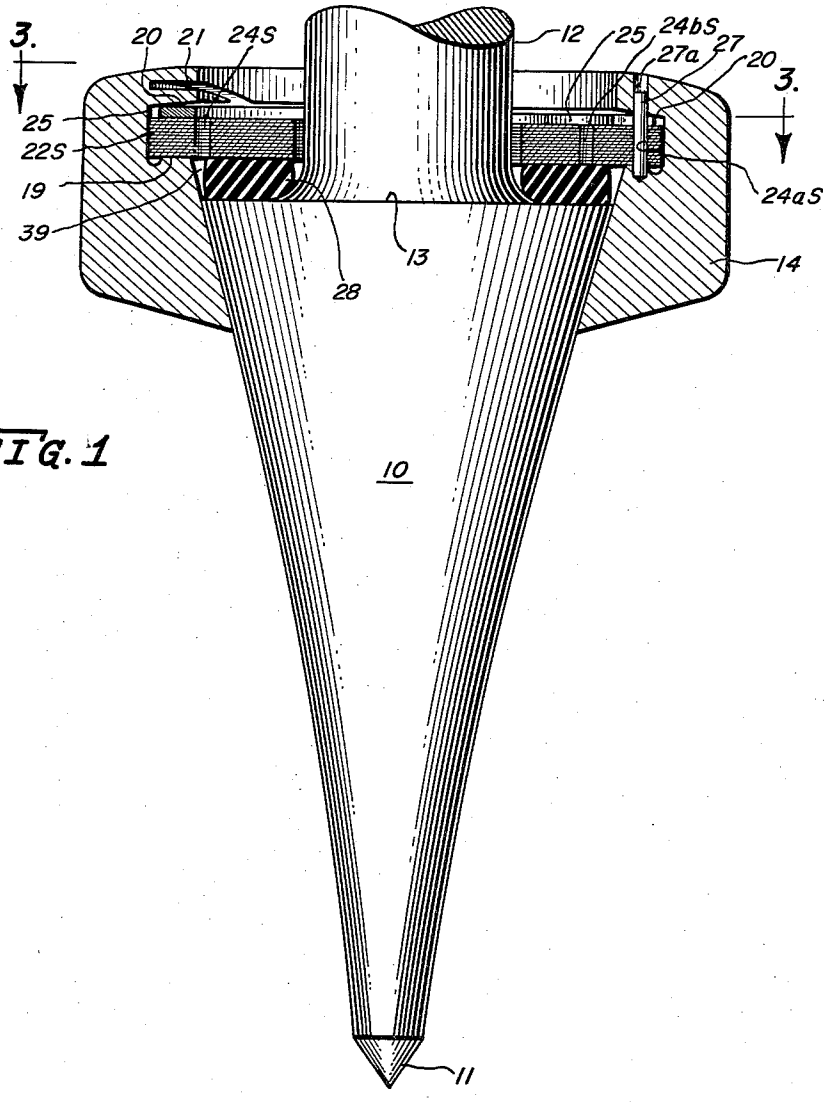
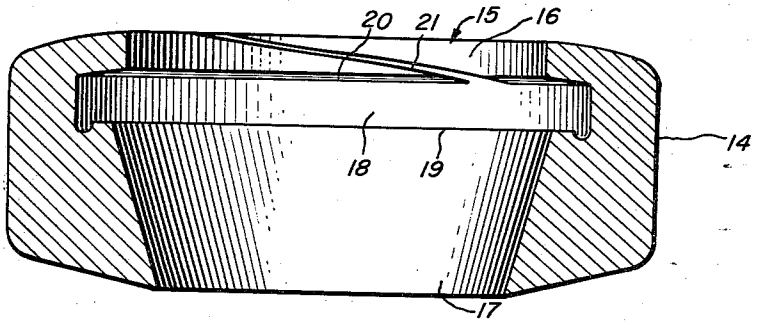


FIG. 1

FIG. 2



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FIG. 3

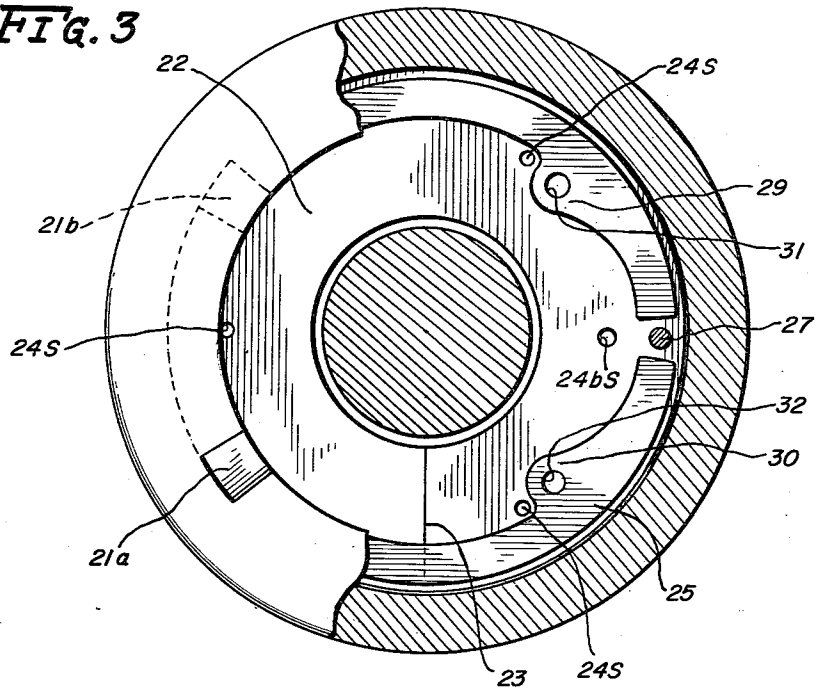
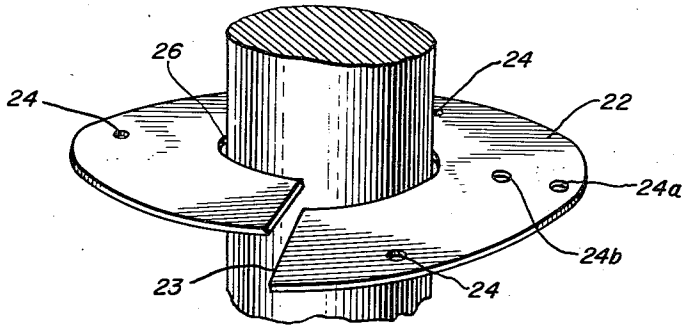


FIG. 4



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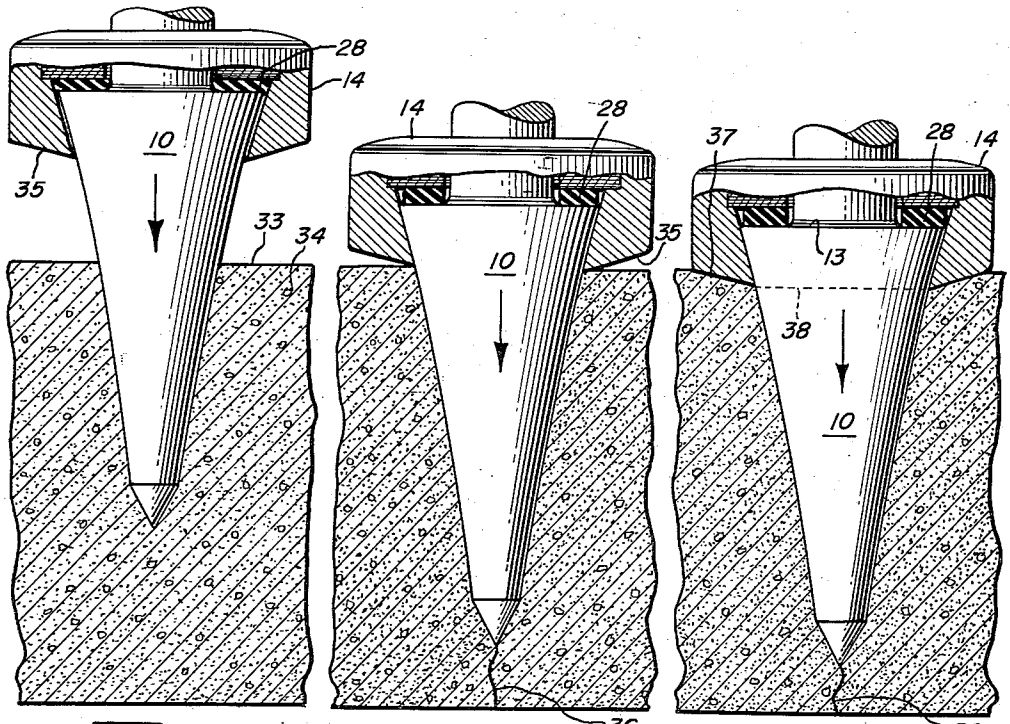


FIG. 5a FIG. 5b FIG. 5c

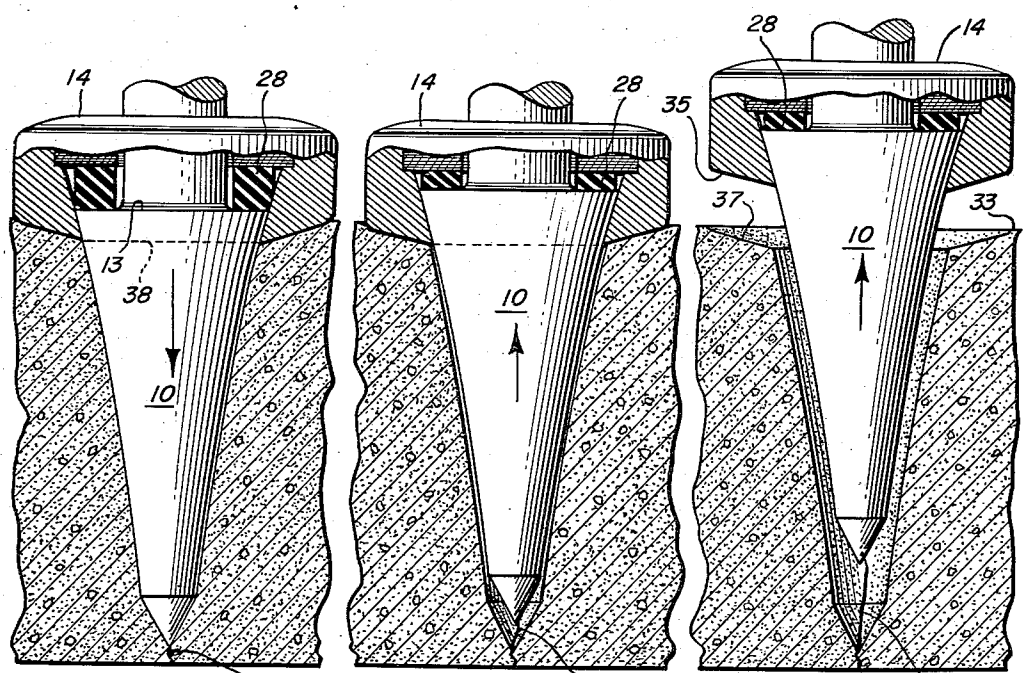


FIG. 5d FIG. 5e FIG. 5f

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WORK MEMBER FOR A PERCUSSIVE TOOL

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Filed June 15, 1960, Ser. No. 36,302
13 Claims. (Cl. 125—36)

This invention relates to a work member or spike for a percussive tool, and more especially to a self-extracting spike particularly suited for use as the concrete-penetrating work member of a paving breaker.

The conventional paving breaker structure includes a casing providing a cylinder having a piston reciprocable therein, and such piston serves as a hammer element which in the course of its reciprocatory movement transmits high-valued impact forces to a spike or work member supported by the casing for limited axial movements relative thereto. The spike extends outwardly from the tool casing and is provided with a pointed end that is placed in abutment with a concrete slab or other material to be broken by operation of the tool. The spike is caused to penetrate the concrete slab by the high-valued impact forces transmitted to the spike by the reciprocating piston or hammer.

A problem of considerable significance which is encountered in the use of a paving breaker in the demolition of concrete slab is that the spike element thereof frequently becomes embedded in the concrete mass penetrated thereby and remains gripped therein by a frictional force of large magnitude (normally in the range of from 5,000 to 20,000 pounds) which is exerted on the spike by the surrounding material, and as a consequence, the spike cannot be withdrawn manually or by ordinary mechanical techniques. In such event, the workman detaches the casing from the embedded spike, inserts another spike into the casing, and then cracks or breaks the material surrounding the embedded spike so as to free the same and permit extraction thereof.

It will be apparent that such extraction operations are not only an annoyance but are also time consuming and require the availability of a plurality of spikes. It should also be mentioned in particular reference to the use of paving breakers of the ordinary type having violently vibrating casings, that a frictionally embedded spike causes substantially and often costly workman fatigue inasmuch as in attempting to release and extract such spike, the initial procedure is for the workman to manually lift the violently vibrating tool upwardly (the weight thereof being in the order of one hundred pounds) so as to develop upwardly-active vibratory impact forces between the vibrating casing thereof and the spike element in an effort to drive the spike element upwardly and out of its embedded condition, which effort as has already been indicated is by no means consistently successful.

The problem of spike extraction has been considered in Leavell Patent No. 2,752,889, which discloses an arrangement for extracting spikes which selectively utilizes the upwardly-directed movements of the vibratory tool casing to accomplish the desired spike extraction without the necessity of any manual lifting action by the worker. The present invention differs from the principles set forth in such prior Leavell patent in that the extraction operation is accomplished through structure comprised entirely by the spike element and is independent of the movements

of the tool casing. Therefore, the present invention is useful not only with vibratory tools but also with vibrationless tools, as for example the vibrationless percussive tool disclosed in Leavell Patent No. 2,679,826, without entailing structural complications in either type of tool.

In view of the foregoing, an object of the present invention is to provide a self-extracting work member or spike for paving breakers, and like percussive tools having a problem of work member extraction, which will be useful with both vibratory and vibrationless tools without entailing structural complications therein.

Another object of the invention is in the provision of a self-extracting spike for paving breakers or the like which is characterized by developing between the embedded spike and material frictionally gripping the same a force acting upwardly on the spike and having sufficient magnitude to consistently withdraw the same from the frictional grip of the penetrated material.

Still another object is that of providing a spike equipped with elastic energy-storage structure operative to store energy imparted thereto by the downwardly-directed impacts received by the spike from the reciprocating hammer and then operative to apply the stored energy in reverse direction to the spike to withdraw the same from the frictional grip of the concrete or other penetrated material.

Yet another object is to provide a conical or generally coniform or otherwise contoured spike having the characteristic of tapering toward the apex or point thereof with sufficient acuteness so that a very short axial withdrawing movement of only a small fraction of an inch will suffice to entirely free the same from the frictional grip of the penetrated material; and which tapered spike is equipped with elastic energy-storage structure operative to store energy imparted thereto by the downwardly-directed impacts received by the spike from the reciprocating hammer and then operative to apply such energy between the penetrated material and the spike as a reversely directed force acting upwardly on the spike to move it upwardly through such short distance adequate to release it from the grip of the penetrated material.

Yet another object of this invention is in the provision of such a tapered spike having an elastic energy-storage structure for accomplishing the purpose described which includes an elastic ring circumjacent the spike and providing an interior surface engageable with the tapered surface of the spike surrounded thereby, such circumjacent ring being adapted to be brought by the downward movement of the tapered spike into a state of abutment as between the lower surface of the ring and the upper surface of a concrete slab or other work material being penetrated by the spike, which upper surface of such work material then resists further downward movement of the circumjacent ring so that the continued impact-impelled downward movement of the tapered spike results in strongly-forced downward movement thereof relative to and producing an energy-storing radial and consequent circumferential stretching of the circumjacent ring; the taper of the inclined area of contact between the spike and circumjacent ring being greater than the minimum self-releasing taper for the materials respectively comprising the spike and ring, wherefore such strongly-forced energy-storing radial and consequent circumferential stretching of the circumjacent ring then reactively results in an energy-yielding circumferential and consequent radial contraction thereof strongly forcing an upward move-

ment of the tapered spike through the short distance adequate to release it from its embedded condition in the work material.

Still a further object is that of providing a tapered spike and elastic energy-storage ring as heretofore described, which ring is resiliently related to the spike for limited axial movement with respect thereto, such resilience being effective to protect the ring and means attaching the same to the spike from damage that could otherwise result from axial impact forces arising from the sudden arrestment of the downwardly moving spike by the concrete or other work material penetrated thereby.

Yet a further object is to provide a unique arrangement for positively and strongly attaching the energy-storage ring to the spike, which arrangement effects the aforementioned axially resilient relationship of the spike and ring. Additional objects and advantages will become apparent as the specification develops.

An embodiment of the invention is illustrated in the accompanying drawings, in which—

FIGURE 1 is a broken side view in elevation of a spike and energy-storage ring combination embodying the invention, and in which such energy-storage ring structure is shown in section;

FIGURE 2 is a longitudinal sectional view of the energy-storage ring;

FIGURE 3 is a horizontal sectional view taken along the plane 3—3 of FIGURE 1;

FIGURE 4 is a broken perspective view of the shank portion of the spike and one of the annular wafers or disks used in resiliently relating the spike and ring; and

FIGURES 5*a* through 5*f* inclusive are side views, primarily in elevation but partly in section, of the spike and ring structure shown in relation to a work material, and respectively illustrate successive stages in a cycle of penetration-and-extraction operation.

Description of Structure

The structural exemplification of the invention illustrated in the drawings includes a spike element or work member **10** of tapered configuration which at its outer or lower end terminates in a sharpened point **11**, and at its upper end is equipped with an axially extending shank **12**. The shank **12** is generally cylindrical and has a diameter that is substantially less than the enlarged upper end portion of the tapered spike, and an annular surface or shoulder **13** is defined by such enlarged upper end portion along the plane of its mergence with the shank **12**. The surface of the spike **10** is generally conical and, as is most evident in FIGURE 1, the taper is not linear from the annular shoulder **13** to the point **11** but instead is somewhat arcuate and slightly concave outwardly, with the angle of inclination of the surface with respect to the vertical axis being less adjacent the point **11**. While this concave configuration is not essential to the present invention, it is useful in facilitating initial penetration of the spike into a concrete slab or other work material.

The spike element **10**, and particularly the shank **12** thereof, will extend into the casing of a paving breaker (not shown) and at its upper end is adapted to receive repetitive impacts transmitted thereto by a piston or hammer element in its reciprocatory movement. A heavy, approximately conical spike of the type shown is particularly suited for use with a tool capable of developing and transmitting very heavy blows thereto, such as the percussive tool disclosed in the aforementioned Leavell Patent No. 2,679,826.

Circumjacent the upper enlarged end portion of the spike **10** and lower end portion of the shank **12** is an elastic energy-storage structure **14** in the form of an annular collar or ring comprised of a material, such as a properly tempered steel, having the characteristics of high strength and a degree of elasticity. In the preferred form shown, the energy-storage ring **14** is uninterrupted circumferentially about its entire 360° arc and has a central passage **15** extending axially therethrough. The upper end portion **16** of this passage is substantially cylindrical while the lower portion **17** thereof is generally frustoconical and tapers inwardly and downwardly with substantially the same taper as that of the enlarged upper end portion of the spike **10**. As is clear from FIGURE 1, the ring **14** surrounds such upper end portion of the spike so that these correspondingly tapered surfaces are oriented in adjacency.

The included angle defined by these adjacent frustoconical areas should be equal to or greater than that defined by the minimum self-releasing taper for the unlubricated sliding abutment of the materials respectively comprising the spike and ring components, which taper in the case of steel is 16°35′. In the specific structural embodiment under consideration, the included angle shown as approximately 30° is more than adequate to establish a positive self-releasing relationship between the spike and ring components, both being made of steel, with or without the application of a lubricant to the adjacent surfaces thereof.

Intermediate the upper and lower ends thereof, the axial passage **15** has a section of enlarged diameter forming an annular channel **18** connecting with the tapered lower passage portion **17** at a horizontally disposed annular support surface **19** and with the upper cylindrical passage portion **16** through an upwardly and inwardly inclined annular preloading surface **20**. As will be brought out in greater detail hereinafter, the angular inclination of the surface **20** provides a preloading function, and the angle formed by this surface with a horizontal plane is termed the preloading angle and in this specific structure is approximately 7°.

Communicating with the annular channel **18** through the inclined annular surface **20**, and extending downwardly and clockwisely thereto from the upper surface of the energy-storage ring **14**, is a groove **21** of generally helical configuration cut into the cylindrical wall defining the passage portion **16** to a radial depth approximately equal to that of the annular channel **18**, as will be understood from inspection of FIGURES 1, 2, and 3. The arcuate length of the helical groove **21** is not critical, and in the present structure is approximately 75°.

Mounted in the channel **18** is a stack of annular wafers or disks **22**, each of which is severed or slit along a radial line **23** as is shown most clearly in FIGURES 4 and 3, and such annular stack is denoted **22S** and is seen most clearly in FIGURE 1. Each of the disks **22** has a plurality of small angularly-spaced lubrication openings or apertures **24** located adjacent and distributed entirely around the outer edge portion thereof (there being three apertures separated by angles of 120° in the illustrated structure).

Each disk is angularly locked relative to the others in the stack thereof, so that (*a*) the apertures **24** of the respective disks are aligned and produce a plurality of angularly-spaced lubrication "bores" **24S** extending vertically entirely through and distributed entirely around such stack, as will be understood from FIGURES 1 and 3, and so that (*b*) the radial slits **23** are distributed in equally angularly-spaced relation entirely around such annular stack. The consistency of these conditions (*a*) and (*b*) is prearranged during fabrication of such disks **22** by appropriately locating the radial slit **23** relative to the angularly-spaced apertures **24** in each of the individual disks.

These disks, considered separately, are thin resilient elements which may be formed of spring steel, and the relatively thick stack thereof shown in FIGURE 1 might, for example, have a thickness of one-third of an inch, being comprised of about thirty such disks each having a thickness of approximately 0.010 inch. It will be seen that this stack of disks is peripherally seated upon the annular support surface **19** which forms the bottom wall of the annular channel **18**, and the stack is held down-

wardly upon such support surface **19** by a standard radially-expansive split lock ring **25**, as is made evident in FIGURE 3. The inherent resilience of the lock ring **25** causes it after installation to expand outwardly and beneath the inclined annular preload surface **20**, thereby camming itself downwardly and forcing the disks **22** into tight peripheral engagement one with another and with the support surface **19**. Thus, a vertically active preload is enforced on the stack of disks through the cooperative relationship of the inclined annular surface **20** and the radially-expansive lock ring **25**.

Each of the annular disks **22** defines a centrally located opening **26** of somewhat greater diameter than the spike shank **12** which, as seen in FIGURES 1 and 3, is coaxially disposed therein so as to afford an annular clearance between the disks and the shank. Each of the disks **22** is angularly locked relative to the other disks in the stack thereof by a pin **27** which prevents rotation of such stack about the spike shank **12** within the annular channel **18** defined in the energy-storage ring **14**. The pin **27** is inserted in a vertical bore **27***a* provided in the upper peripheral portion of the ring **14**, and lockingly extends through the apertures **24***a* provided in the respective disks to receive such pin, as is best seen in FIGURE 1. The pin **27** may be somewhat flexible and slightly bent to fixedly retain the same in its inserted position, and is preferably hollow or provided with a thread-equipped opening in the upper end thereof to facilitate its removal for disassembly of the spike-and-ring structure. Each of the disks **22** also comprises an indexing aperture **24***b* to facilitate assembly of the structure as hereinafter set forth.

The angularly-locking apertures **24***a* and the indexing apertures **24***b* are so located during fabrication of the individual disks that vertical alignment of the indexing apertures **24***b* after the disks have been aggregated to form the stack **22S** will at the same time establish the aforementioned arrangement of the slits **23** and vertically align the angularly-locking apertures **24***a* to permit reception of such pin **27**. The vertical alignments of the apertures **24***a* and of the apertures **24***b* will be regarded as respectively comprising an angularly-locking "bore" **24***a*S extending entirely through the stack of disks, and an indexing "bore" **24***b*S likewise extending entirely therethrough.

Interposed between the lowermost disk in the assembled stack **22S** and the upwardly-facing annular surface **13** is a resilient doughnut-shaped element **28** that may be formed of polyurethane, or other suitably selected rubber-like material. The doughnut **28** augments the axial resiliency between the spike **10** and the energy-storage ring **14** as provided by the stack **22S** of thin flexible disks which is employed as a positive holding means for properly and permanently securing the ring to the spike; but the disk system may be designed to entirely provide the required resiliency, in which case the doughnut **28** may be replaced by a likewise separable but rigid element, or by a rigid element formed as an integral part of the spike **10** or its shank **12**.

Assembly

The peripheral helical groove **21** in the energy-storage ring **14** and the radial slit **23** in each of the flexible disks **22** are cooperatively employed in assembling the spike-and-ring structure. More specifically, considering the ring **14** in the unassembled condition thereof illustrated in FIGURE 2, the spike **10** is moved downwardly through the central axial passage **15** provided therethrough until further downward movement of the spike relative to the ring is prevented by engagement of the correspondingly tapering surfaces of the spike and of the lower portion **17** of such passage, when the spike and ring will have the positional relationship shown in FIGURE 1. Next the doughnut **28**, if it is employed, will be installed circumjacent the shank **12** of the spike element and upon the upwardly-facing annular surface **13** defined thereon.

Following this, each one of the plurality of annular and normally planar flexible disks **22** is installed by first inserting the shank **12** through the central opening **26** of such disk and then temporarily deforming the disk by axially separating the two radial edges thereof as shown in FIGURE 4, so as to permit the peripheral portion of the lowermost edge, now considering FIGURES 4 and 3, to be rotated clockwisely into the open upper end **21***a* of the clockwisely descending helical groove **21** defined in the ring **14**; and then the disk is clockwisely rotated relative to the ring **14** by an additional amount equal to the arcuate length of the groove **21** or about 75°, whereupon the aforesaid peripheral portion of such lowermost radial edge of the temporarily deformed disk will begin to emerge from the open lower end **21***b* of the helical groove **21** and enter the annular channel **18**, so that a further additional clockwise rotation of the disk relative to the ring **14** through an arc of 360° will "thread" or "screw" the entire helical peripheral portion of the disk downwardly and into the annular channel **18**. As soon as the entire 360° of its periphery has thus been delivered within the annular channel, the disk will reassume its normal planar form and fall into the place it is to occupy in the stack **22S**. In this manner, all of the disks **22** to be employed in aggregating the installed stack **22S** thereof are successively "screwed" into their respective final axially related positions in the assembly as shown in FIGURE 1.

A stylus point, nail, or other similar instrument is then inserted in the indexing aperture **24***b* in the uppermost disk of the thus completed stack **22S** thereof, and by this means such uppermost disk is rotated about the axis of the spike element **10** and relative to the next underlying disk **22** in the stack until the stylus point engages and descends into the indexing aperture **24***b* in such immediately underlying disk; and this process of circular or arcuate and descending movements with the stylus point is continued until it has successively descended into and vertically aligned all such apertures **24***b*, at which time (1) all of the corresponding angularly-spaced lubrication apertures **24** plurally provided in the respective disks **22** will have been vertically aligned to produce a plurality of lubrication "bores" **24S** which extend entirely through the stack **22S** of such disks **22**, (2) all of the radial slits singly provided in the respective disks will have been relatively positioned in angularly-spaced relation about the entire circumference of the stack, and (3) all of the angularly-locking apertures **24***a* singly provided in the respective disks will have been vertically aligned to produce the angularly-locking "bore" **24***a*S which extends entirely through the stack. Continued circular or arcuate movement of the stylus point still fully inserted in the indexing "bore" **24***b*S will then align such angularly-locking "bore" **24***a*S with the therewith cooperative angularly-locking bore **27***a* provided in the peripheral portion of energy-storage ring **14**, whereupon all of the disks **22** making up the stack **22S** thereof are locked in their respective final angularly related positions in the assembly by the full insertion of the pin **27** through such bore **27***a* and such "bore" **24***a*S as in their state of alignment.

The assembly is finally completed by radially compressing the split lock ring **25** sufficiently, after locating the same about the shank **12** of the spike element, to permit the lock ring **25** to be moved downwardly through the cylindrical portion **16** of the central axial passage provided in the energy-storage ring **14**. The compressed lock ring **25** is then released so that it springs outwardly beneath the inclined preload surface **20** to forcibly press the sack of disks together and downwardly upon the annular support surface **19** of the ring **14** in the firmly preloaded relationship hereinbefore described. It will be noted in FIGURE 3 that the split lock ring **25** has inwardly turned end portions **29** and **30** respectively provided with openings **31** and **32** therein for cooperation with a tool of standard character that may be used in radially compressing the lock ring. The structure can be disassembled by

reversing the steps set forth, but it is believed that disassembly will be infrequent if it is ever required, especially because the spike can be sharpened when necessary without removing the ring **14** and associated structure.

Penetration and Extraction Cycle

In the most frequent type of use of the assembled self-extracting spike structure, assuming it to be properly mounted in a paving breaker, the point **11** of the spike will be placed upon the upper surface **33** of a concrete slab **34**, and the reciprocatory movement of the tool hammer will drive the spike downwardly and into the slab **34** as shown in FIGURE *5a*.

As operation of the tool is continued, the tapered spike will continue to penetrate and descend into the slab until the frustoconical bottom surface **35** of the energy-storage ring **14** is brought into initial contact with the upper surface of the slab, as shown in FIGURE *5b*. In most cases the high-valued lateral forces developed within the slab by the wedging action of the downwardly-moving tapered spike will cause the slab to fracture along a generally vertical interface, and in FIGURES *5b* through *5f* such fracture is indicated by the line **36**. It should be mentioned, however, that the fractural separation produced by this powerful wedging action often becomes substantially wider than a merely detectable crack, and in such cases removal of the concrete fragment which has been separated from the main mass of the slab is materially facilitated.

As operation of the tool is further continued, the high-valued downwardly-acting forces developed by the impacts delivered to the spike will impel its further descent into the concrete slab **34**, so that the ring **14** carried downwardly therewith will forcibly and progressively impress its frustoconical bottom surface **35** into the upper surface **33** of the slab, forming therein a generally mating seat **37** for such bottom surface **35** of the ring, as shown in FIGURES *5c* through *5f*. The purpose of the frustoconical contour of this bottom surface **35** of the ring is to minimize the lateral or radial thrust which would otherwise develop to undesirably high values between portions of the upper end of the spike element **10** or of its shank **12** and therewith slidably cooperative surfaces internally comprised by the tool, in case such bottom surface of the ring were, for example, planar and if the longitudinal axis of the spike **10** should not be perpendicular to the upper surface **33** of the slab at the time of the initial encounter of the downwardly moving ring with such surface **33** of the slab.

When, during the evidently radially progressive development of such mating surface **37** in the upper surface of the concrete slab, the progressively increasing area thereof becomes sufficiently great, the upwardly-directed reactive compressive forces produced in the concrete will cease to be exceeded by the downwardly-directed impact forces applied thereagainst through and by the energy-storage ring **14**. As a consequent of the occurrence of this condition, downward movement of the energy-storage ring **14** terminates, but the spike element **10** continues to be driven deeper into the concrete by the high-valued impact forces developed in the tool, and progressively moves downwardly relative to the ring **14** and into the configuration therewith which is illustrated in FIGURE *5d*. The extent of the downward movement of the spike relative to the ring is exaggerated in FIGURE *5d* for purposes of graphic illustration; and the extent of such movement is readily apparent by noting, as between FIGURES *5c* and *5d*, the variation of the distance between the broken lines **38**, indicating the lowermost plane of the frustoconical bottom surface **35** of the ring, and the annular surface **13** defined on the spike element **10**.

Quite evidently this strongly-forced progressive downward axial movement of the tapered spike **10** deeper into the concrete and relative to the closely circumjacent energy-storage ring **14** can only occur coincidently with a thereby produced progressive radial and consequent circumferential stretching of the ring, necessarily in association with a progressive elastic storage therein of potential mechanical energy which, because of the self-releasing taper of the contiguous surfaces of the spike and ring and because of the reactive operation of the progressively stretching and progressively resisting ring, applies to the spike a continuous and progressively increasing upward axial force, which, when it has developed to equality with or to slightly exceed the less rapidly increasing frictionally established axial force theretofore retaining the tapered spike in its embedded condition in the concrete, triggers the discharge of such elastically-stored potential mechanical energy, whereupon, through the agency of the circumferential and consequent radial contraction of the ring, this reversely-acting energy forcibly impels the tapered spike **10** through the short upward axial movement adequate to free it from the frictional grip of the concrete, as shown in FIGURE *5e*.

Since the quantity of such discharging mechanical energy which thus impels the spike through the short upward axial movement adequate to free it from its embedded condition in the concrete mass ordinarily substantially exceeds the quantity of energy actually utilized in effecting this short movement of the spike against the frictional force tending to retain it in the concrete mass, it follows that a considerable part of such discharging energy becomes invested in imparting a not inconsiderable upward velocity to the self-extracting spike structure, so that the ring **14** normally jumps entirely clear of the upper surface of the concrete slab by a readily appreciable or conspicuous amount, as shown in FIGURE *5f*, thus signalling the operator that the cycle of penetration-and-extraction operation has been completed, and that the spike point may be relocated for commencement of a subsequent penetration.

In the event that the self-extracting spike is to be used with a percussive tool capable of developing only relatively light or low-valued repetitive impact forces for transmission to the spike, it may be desirable to reduce the friction developed between the contiguous self-releasing taper surfaces of the spike and ring beyond the reduction in friction which can be accomplished by lubricating such surfaces as by filling the space **39** by introducing thereinto a dry lubricant through one or more of the bores **24S**. Such additional reduction in the friction between the contiguous surfaces can be provided by lining the tapered surface of the ring with a material having a relatively low coefficient of friction as, for example, with a synthetic resin plastic such as nylon or a synthetic rubber such as polyurethane. In either event, the preferable condition is to impregnate the linear with a dry lubricant such as, for example, graphite or molybdenum disulfide. Lubricants of this same type may be used for directly lubricating the unlined contiguous surfaces of the spike and ring. It may be noted that while from the point of view of friction reduction either or both of the contiguous surfaces of the spike and ring could be equipped with a friction-reducing liner, practicably it is difficult to maintain a bond between the spike and such liner therefor because of the repetitive impact forces transmitted to the spike.

While I have in this specification, for purposes of illustration, described in considerable detail one specific embodiment of my invention, it will be understood that many changes in details can be made by those skilled in the art without departing from the spirit of my invention.

I claim:

1. A self-extracting work member structure for use with a percussive tool operative to transmit repetitive high-valued impact forces thereto, comprising a work member element for penetrating concrete slabs and the like in response to such impact forces transmitted thereto and having a tapered slab-penetrating portion that may become frictionally gripped by such penetrated slab, the taper of

said slab-penetrating portion being acute so as to cause release thereof from any such frictional grip of the penetrated slab in consequence of a limited axial withdrawing movement of said work member element from its position of deepest penetration into such slab, and an elastic energy-storage structure disposed adjacent the upper end of said slab-penerating portion so as to be brought into abutment with such penetrated slab upon penetration thereof to a predetermined depth by said slab-penetrating portion, said energy-storage structure as a result of such abutment being operative to develop between said work member element and penetrated slab an axial force displacing said work member element through such limited axial withdrawing movement and thereby releasing the same from the frictional grip of such penetrated slab.

2. The self-extracting work member structure according to claim 1 in which the acute angle of said taper is selected to restrict said limited axial withdrawing movement to a value not exceeding one-half of an inch.

3. A self-extracting work member structure for use with a percussive tool operative to transmit repetitive high-valued impact forces thereto, comprising a work member element for penetrating concrete slabs and the like in response to such impact forces transmitted thereto and having a tapered slab-penetrating portion that may become frictionally gripped by such penetrated slab, the taper of such slab-penetrating portion being acute so as to cause release thereof from any such frictional grip of the penetrated slab in conseqeunce of a limited axial withdrawing movement of said work member element from its position of deepest penetration into such slab, and an elastic energy-storage structure carried by said work member element so as to be brought into abutment with such penetrated slab upon penetration thereof to a predetermined depth by said slab-penetrating portion, said energy-storage structure being operative as a consequence of and subsequent to such abutment to develop between said work member element and such penetrated slab an axial force displacing said work member element through such limited axial withdrawing movement and thereby releasing the same from the frictional grip of such penetrated slab.

4. The self-extracting work member structure according to claim 3 in which said elastic energy-storage structure comprises an annular element circumjacent said tapered slab-penetrating portion adjacent the maximum diameter thereof, said annular element being circumferentially stretched by the continued slab-penetrating displacements of said work member element following abutment of said annular element with such penetrated slab to develop the aforesaid axial withdrawing force.

5. The self-extracting work member structure of claim 3 in which said annular element is provided with a tapered passage therethrough matingly receiving said slab-penetrating portion of said work member element therein, the mating tapered surfaces of said annular element and work member element defining a self-releasing taper therebetween.

6. The self-extracting work member structure of claim 5 in which said annular element is a continuous ring.

7. A self-extracting work member structure for use with a percussive tool operative to transmit repetitive high-valued impact forces thereto, comprising a work member element for penetrating concrete slabs and the like in response to such impact forces transmitted thereto and having a tapered slab-penetrating portion that may become frictionally gripped by such penetrated slab, the taper of said slab-penetrating portion being acute so as to cause release thereof from any such frictional grip of the penetrated slab in consequence of a limited axial withdrawing movement of said work member element from its position of deepest penetration into such slab, and an elastic energy-storage structure carried adjacent the upper end of said slab-penetrating portion so as to be brought into abutment with such penetrated slab upon penetration thereof to a predetermined depth by said slab-penetrating portion, said energy-storage structure subsequent to such abutment being engaged by said work member structure and having force imparted thereto during the continued slab-penetrating displacements of said work member element, said energy-storage structure being operative to store such force as potential mechanical energy until the value thereof exceeds the value of the frictional grip of such penetrated slab and to then develop between said work member element and penetrated slab an axial force displacing said work member element through such limited axial withdrawing movement to thereby release the same from the frictional grip of such penetrated slab.

8. The self-extracting work member structure according to claim 7 in which said elastic energy-storage structure comprises an annular element circumjacent said tapered slab-penetrating portion adjacent the maximum diameter thereof, said annular element being circumferentially stretched by the continued slab-penetrating displacements of said work member element following abutment of said annular element with such penetrated slab to develop the aforesaid axial withdrawing force.

9. The self-extracting work member structure of claim 8 in which the annular element is provided with a tapered passage therethrough matingly receiving said slab-penetrating portion of said work member element therein, the mating tapered surfaces of said annular element and work member element defining a self-releasing taper therebetween.

10. The self-extracting work member structure of claim 9 in which said annular element is a continuous ring.

11. The self-extracting work member structure according to claim 7, and further comprising a resilient mounting structure securing said elastic energy-storage structure to said work member element and affording limited axial movements therebetween to prevent damage to said elastic energy-storage structure that could otherwise result from axial impact forces imparted thereto by the sudden arrestment of the slab-penetrating motions of said work member element.

12. The self-extracting work member structure of claim 11 in which said mounting structure includes a plurality of flexible disks oriented one upon another to define a stack thereof, said stack being fixedly secured to said elastic energy-storage structure and related to said work member element through the resilience of said stack.

13. A self-extracting work member structure for use with a percussive tool adapted to transmit repetitive high-valued impact forces thereto, comprising a work member element adapted to penetrate concrete slabs and the like in response to such impact forces transmitted thereto and having a tapered slab-penetrating portion sometimes frictionally gripped by such penetrated slab, the taper of said slab-penetrating portion being sufficiently acute to cause release thereof from the frictional grip of such penetrated slab in consequence of a limited axial withdrawing movement of said work member element from its position of deepest penetration into such slab, an elastic energy-storage structure adapted to be brought into abutment with such penetrated slab by the slab-penetrating displacements of said work member element for developing between said work member element and penetrated slab an axial force of sufficient magnitude to move said work member element through such limited axial withdrawing movement and thereby release the same from the frictional grip of such penetrated slab, and resilient mounting structure securing said elastic energy-storage structure to said work member element and affording limited axial movements therebetween to prevent damage to said elastic energy-storage structure that could otherwise result from axial impact forces imparted thereto from the sudden arrestment of the slab-penetrating motions of said work member element by the slab being penetrated thereby, said mounting structure including a plurality of flexible disks oriented one upon another to define a stack thereof fixedly

secured to said elastic energy-storage structure and related to said work member element through the resilience of said stack, each of said flexible disks being a generally annular ring having a radially extending slit therethrough, said elastic energy-storage structure including an annular element having a passage extending therethrough receiving said work member element therein, said passage being provided intermediate the ends thereof with an enlarged annular channel having a diameter approximately equal to the outer diameter of each of said disks for the circumjacent and axial enclosure of the peripheral portions thereof, said passage also being provided with a helical groove connecting said channel and screwingly providing axial access to said channel for effecting such enclosure therein of each of said disks.

References Cited in the file of this patent

UNITED STATES PATENTS

1,784,012 Jowett ---------- Dec. 9, 1930