

Sept. 23, 1969

A. G. BODINE

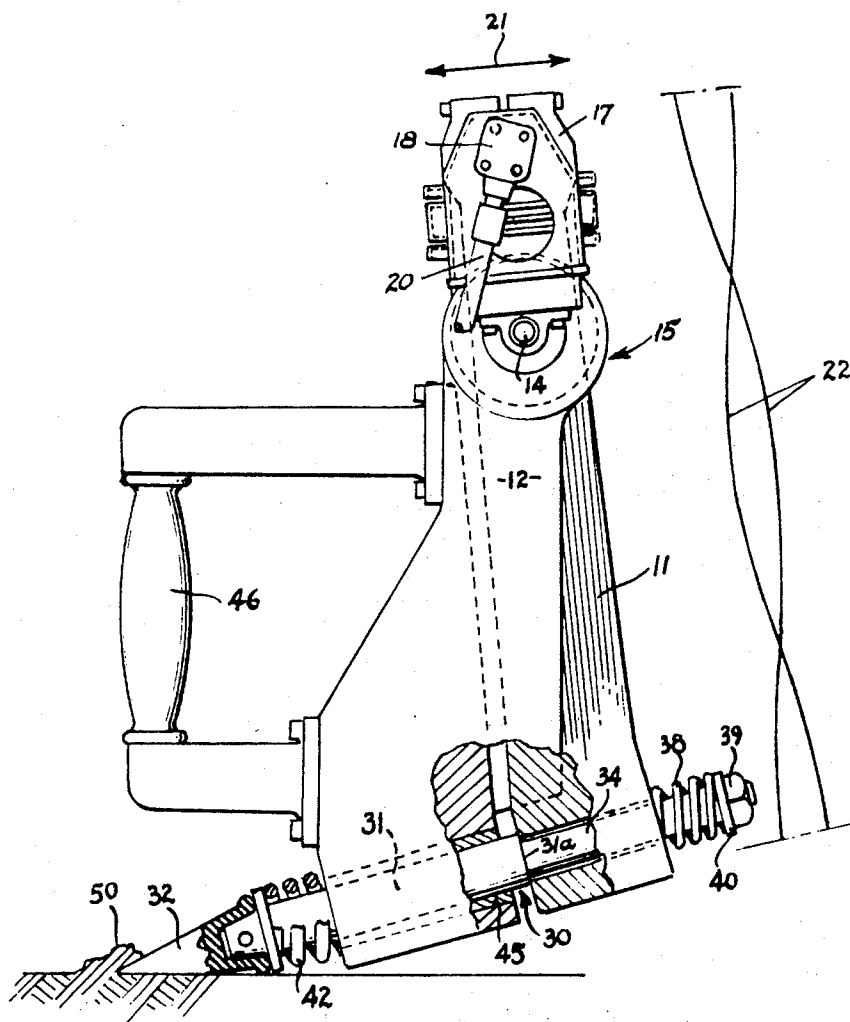
3,468,384

SONIC HAND CUTTING TOOL UTILIZING SONIC RECTIFICATION IN
CONJUNCTION WITH DOUBLE ACTING SPRING BIASING

Filed Feb. 5, 1968

2 Sheets-Sheet 1

Fig. 1



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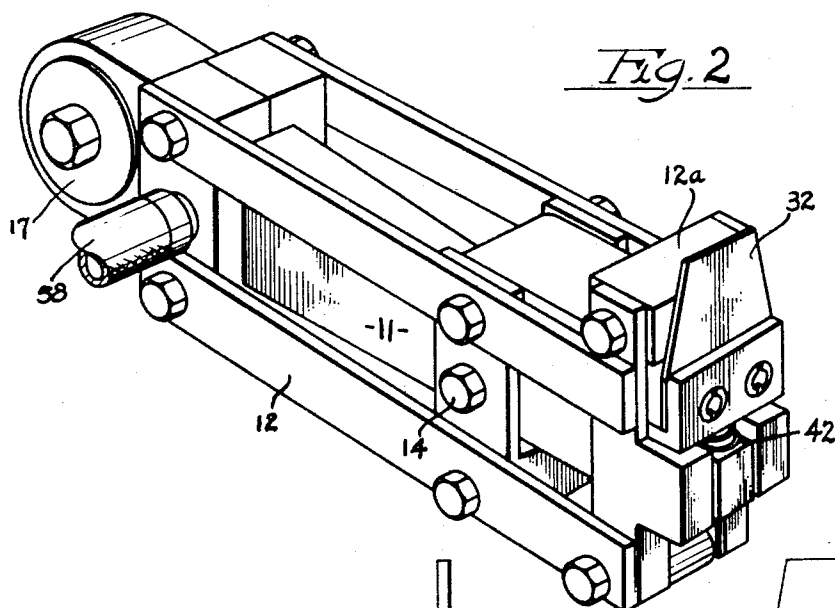


Fig. 2

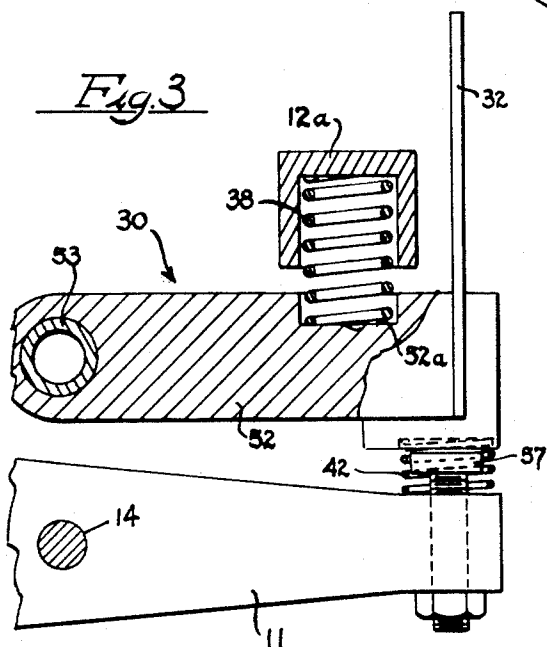


Fig. 3

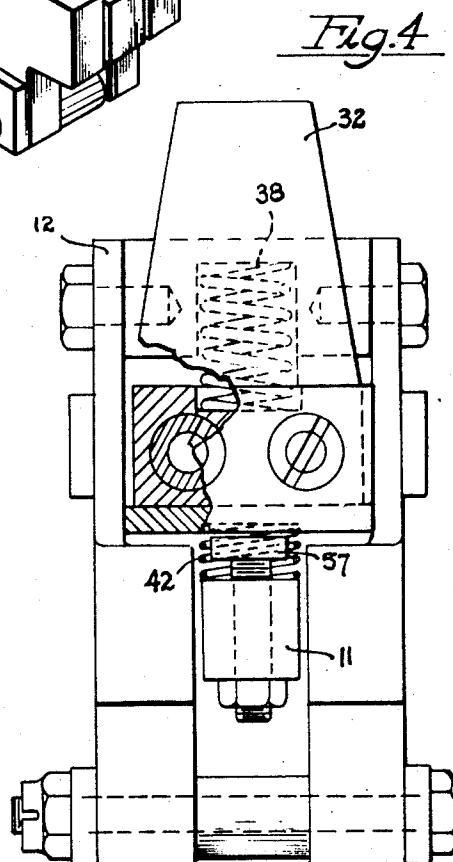


Fig.4

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SONIC HAND CUTTING TOOL UTILIZING SONIC RECTIFICATION IN CONJUNCTION WITH DOUBLE ACTING SPRING BIASING

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Continuation-in-part of application Ser. No. 627,390,
Mar. 31, 1967. This application Feb. 5, 1968, Ser.
No. 703,178

Int. Cl. B26b 7/00

U.S. Cl. 173—49

4 Claims

ABSTRACT OF THE DISCLOSURE

A hand operated cutting tool has a cutter member which is driven by unidirectional pulses of sonic energy. These unidirectional sonic pulses are provided from a resonant vibration system which is coupled through a sonic rectifier device to the cutter member. Double acting spring means is utilized to resiliently urge the resonant vibration system against the cutter member and to simultaneously provide a resilient force against the cutter member acting in a direction away from the resonant vibration system, thereby providing optimum coupling between the vibration system and the cutter member under various cutter member load conditions and enabling high Q operation of the vibration system.

This application is a continuation-in-part of my application Ser. No. 627,390 filed Mar. 31, 1967 and now Patent No. 3,367,716, for sonic rectifier coupling for rock cutting apparatus.

This invention relates to hand operated apparatus using sonic energy for cutting and chipping operations and more particularly to such apparatus suitable for use in chiseling hard material, scraping surfaces, various manufacturing and processing operations and the like.

In the aforementioned patent application of which this application is a continuation-in-part, the utilization of unidirectional pulses of sonic energy for rock cutting operations is described, this unidirectional sonic energy being developed by means of an acoustic rectifier.

In connection with FIG. 13 of this prior application, a tractor driven rock ripping apparatus is described in which double acting spring biasing is provided, one of the spring members operating to resiliently urge the resonantly vibrating bar against the cutter member, the other of the spring members operating to urge the cutter member away from the resonant bar member. It has been found that the use of such double acting spring biasing is particularly useful in hand operated tools utilizing the principles of sonic rectification to provide optimum operation, and it is this particular feature as adapted to sonic hand tools that the instant application is directed.

The double acting spring mechanism of this invention is particularly applicable to hand tools in view of the fact that in the use of such tools, the load on the cutter varies considerably, depending upon the application of hand pressure, this load dropping off to close to zero when the tool while still operating is removed from the workpiece. Under such low load conditions, the double acting spring operates to provide a damper for the high level vibratory energy to prevent overstressing for the components of the two thereby preventing the tool from damaging itself. Such damping functions in a similar manner when the tool is operated under light load conditions, i.e. where a small amount of pressure is being applied against the workpiece. Further, the use of the double acting spring member enables the adjustment of the coupling between

the resonant system and the cutter member to provide an optimum Q in the resonant vibration system and an optimum work cycle for the particular operation requirements and load conditions.

The primary object of this invention, therefore, is to provide double acting spring means for optimizing the operation of a hand operated cutter tool which is driven by unidirectional pulses of sonic energy coupled thereto through an acoustic rectifier from a resonant vibration system.

The operation of the device of the invention will now be described in conjunction with the drawings of which,

FIG. 1 is an elevation view partially in cross-section of a first embodiment of the invention suitable for chipping operations,

FIG. 2 is a perspective view of a second embodiment of the device of the invention suitable for operations such as scraping paint;

FIG. 3 is an elevation view partially in cross-section of a portion of the embodiment of FIG. 2, and

FIG. 4 is a bottom plan view of the embodiment of FIG. 2.

Briefly the apparatus of the invention comprises a resonant vibration system which is excited by means of an orbiting mass oscillator. The resonant vibration systems includes a resonant bar member which is pivotally supported upon the frame of the device. The output of an orbiting mass oscillator is coupled to the bar member to cause resonant elastic vibration thereof. The resonant bar member is coupled to a cutter member by means of double acting spring means which simultaneously provides a first bias force urging the resonant bar member against the cutter member and a second bias force urging the resonant bar member and the cutter member away from each other.

Referring now to FIG. 1, a first embodiment of the device of the invention is illustrated. Resonant bar member 11 which is fabricated of an elastic material such as steel, is pivotally supported on frame member 12 by means of pin member 14 which is contained within pivotal support 15. An orbiting mass oscillator unit 17 which may be one of the types described in my Patent Nos. 2,960,314 or 3,217,551, is driven by means of hydraulic motor 18 which receives its drive power through hydraulic line 20. The rotor of oscillator 17 is orbitally driven and by virtue of its eccentricity sets up vibrations in its housing in the directions indicated by arrow 21.

The housing of oscillator 17 is coupled to resonant bar 11. The rotor of oscillator 17 is driven at a speed such as to cause resonant elastic vibration of bar member 11 so as to set up a standing wave vibration pattern therein as indicated by graph lines 22. Cutter member 30 includes a larger diameter shaft portion 31 to which cutter bit 32 is attached and a smaller diameter shaft portion 34 which extends from shaft portion 31 and which extends through resonant bar member 11. A shoulder portion 31a is formed on the end of shaft portion 31, this shoulder portion forming a coupling interface between bar member 11 and cutter member 30. A first spring member 38 is retained on the end of shaft portion 34 by means of screw 39 and washer 40. Spring member 38 provides a bias force urging resonant bar member 11 against shoulder portion 31a, thereby providing a coupling force between the resonant bar and the cutter member. Shaft portion 31 is slidably mounted in frame 12 in sleeve bearing 45. Spring 42 is retained on shaft portion 31 between cutter bit 32 and frame 12 and provides a bias force tending to urge cutter bit 32 away from the frame, this force thus opposing that of spring 38 and tending to reduce the coupling force at the interface of resonant bar 11 and shoulder portion 31a. The springs 38 and 42 thus provide

opposing biasing forces which affect the coupling between the resonant bar 11 and cutter member 30.

Handle 46 is provided to enable the operator to grasp the tool.

In operation the operator draws the cutter bit 32 against the workpiece 50 to be cut. The bias force provided by the operator's hand action causes shoulder 31a to be driven against bar member 11, a resilient biasing force being provided at the interface between the cutter member and the bar member by spring 38. The resonant bar thus in its vibratory excursions towards bit 32 provides unidirectional pulses of energy thereto while in its vibratory excursions in the reverse direction is effectively uncoupled from the cutter member. Under light load conditions or with the cutter bit 32 disengaged from the workload the vibratory energy is effectively dampened by springs 38 and 42 so that it does not reach high enough proportions to engender self destruction of the tool. It can also be seen that by means of these two springs the effective coupling between resonant bar 11 and cutter member 30 can be made to provide the desired work cycle for optimum operation of the tool in accordance with the particular operation conditions. Further this resilient biasing is designed to provide optimum Q of the resonant vibration system.

Referring now to FIGS. 2-4 a second embodiment of the device of the invention is illustrated. The second embodiment is particularly suitable for use as a paint scraper and operates similarly to the first embodiment in conjunction with oppositely directed resilient bias forces to provide unidirectional sonic energy pulses to the scraper blade. Resonant bar 11 is pivotally supported in frame 12 on pivot pin 14. Scraper assembly 30 has a scraper blade 32 extending therefrom and a blade support portion 52 which is pivotally mounted on frame 12 by means of pin 53. Spring 38 is retained in retainer box 12a of the frame and in recess 52a formed in scraper blade support 52. Spring 38 thus provides a resilient bias force urging the scraper assembly towards resonant bar 11. Spring 42 is retained in a groove formed in the rear portion of scraper blade support 52 and abuts against resonant bar 11 to provide a resilient bias force tending to separate the resonant bar and the scraper assembly. An adjustment screw 57 is provided on resonant bar 11 and can be adjusted to provide the desired degree of coupling between the resonant bar and the scraper assembly.

Sonic energy is provided to cause resonant elastic vibration of bar member 11 in the same general fashion as described in connection with the first embodiment, in this instance orbiting mass oscillator 17 being pneumatically driven by compressed air fed thereto by means of pneumatic line 58. Orbiting mass oscillator may be of the type described in my Patent No. 2,960,314.

As for the first embodiment, with the resonant vibration

of bar 11, unidirectional pulses of energy are fed to the scraper assembly, springs 38 and 42 providing opposite biasing forces which act to optimize the operation of the tool and to dampen the vibratory energy under light and no load conditions.

It is to be noted that in both of the embodiments described the resonant bar 11 is supported on the frame at the standing wave vibration nodes so as to minimize dissipation of energy in the frame and to avoid discomfort to the operator.

I claim:

1. A cutting apparatus comprising
a resonant vibration system;
sonic oscillator means coupled to said resonant vibration system to cause resonant elastic vibration thereof,
a cutter member, and
acoustic rectifier means for coupling only unidirectional pulses of sonic energy from said vibration system to said cutter member,
2. The device of claim 1 wherein said apparatus includes a frame member, said resonant vibration system comprising an elastic bar pivotally supported on said frame member for interconnecting said rectifier means and said sonic oscillator means.
3. The device of claim 2 wherein said double acting spring means comprises a first spring urging said cutter member and said elastic bar apart and a second spring urging said elastic bar and said cutter member together.
4. The device as recited in claim 2 wherein said double acting spring means includes a first spring interposed between said frame member and said cutter member for urging said cutter member toward said elastic bar and a second spring interposed between said cutter member and said elastic bar urging said member and said elastic bar apart.

References Cited

UNITED STATES PATENTS

545,149	8/1895	Carpenter	175—56 X
3,151,912	10/1964	Herrmann	173—49 X
3,367,716	2/1968	Bodine	299—14
3,394,766	7/1968	Lebelle	173—49

ERNEST R. PURSER, Primary Examiner

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15—93; 30—272; 299—14