

PATENT SPECIFICATION (11)

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(54) ROTARY SHEAR

(71) I, FRANCIS JOSEPH FUCHS, JR., a citizen of the United States of America, of 9 University Way, Princeton Junction, State of New Jersey, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates, broadly speaking, to an improved rotary shear. More specifically, this invention relates to an improved rotary shear having drive means and means for feeding material to be cut into the shear.

2. Description of the Prior Art:

Rotary cutting devices of various designs and for various purposes are known. Prior art devices have lacked maneuverability, particularly desirable for cutting cloth in intricate patterns, have been bulky, have lacked means for effectively feeding material to be cut into the device and, where these devices were driven by power, the power drive had left considerable room for improvement. Examples of rotary cutting devices hereinabove mentioned and exemplifying the prior art are found in U.S. Patent 666,513 (1901), U.S. Patent 2,042,097 (1936), U.S. Patent 2,276,365 (1942), U.S. Patent 2,570,195 (1951), U.S. Patent 3,364,710 (1968) and U.S. Patent 3,710,444 (1973).

SUMMARY OF THE INVENTION

One of the objects of this invention is to provide an improved rotary shear.

Another object of this invention is to provide a rotary shear which is highly maneuverable in use so as to be capable of cutting intricate patterns and which is characterized by relatively low bulk and mass so as to permit extended use without fatiguing the operator.

A further object of this invention is to provide a rotary shear which affords the operator a full field of view in advance of

the shear thereby permitting the operator to accurately follow the lines of the pattern to be cut.

Still another object of this invention is to provide a rotary shear having an improved power drive.

Yet another object of this invention is to provide a rotary shear having improved means to feed material to be cut into the shear.

Still other and further objects of this invention will become apparent during the course of the following description and by reference to the accompanying drawings and the appended claims.

Briefly, the invention comprises a rotary shear having a pair of shear wheels, one driving and the other driven, the driving shear wheel may, in one embodiment, be parallel to the driving shear wheel and, in another embodiment, may be placed at an angle to the driving shear wheel. The rear periphery of the driving shear wheel may, in yet another embodiment, be provided with serrations or teeth to engage cloth to be cut thereby to more positively feed the cloth into the shear wheels for cutting therebetween. A spring-loaded feeding wheel may be placed adjacent to the front of the driven shear wheel, cooperating if desired with serrations or teeth on the rear of the driving shear wheel to pinch cloth to be cut and thereby to more positively feed the cloth between the shear wheels for cutting therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like numerals represent like parts in the several views:

FIG. 1 represents a view in side elevation of the rotary shear, the power handle being shown in partial medial longitudinal section, the cutting head being partially broken away to show certain details of the worm drive.

FIG. 2 represents a section of the cutting head, taken along the line 2—2 of FIG. 1.

FIG. 3 represents a view in end elevation of the cutting head, taken from the line 3—3

of FIG. 1, showing further the outline of the power handle.

FIG. 4 represents a section of a modified cutting head, generally similar to FIG. 2, the driven shear wheel being shown as disposed perpendicularly to the driving shear wheel.

FIG. 5 represents a view in side elevation of a modified cutting head showing the driven shear wheel having a smaller diameter than the driving shear wheel for less material elevation above the table top, also indicating diagrammatically the angle of approach of the material into the cutting head.

FIG. 6 represents a view in side elevation of the cutting head in an alternative embodiment in which the rear peripheral edge of the driving shear wheel has serrations or teeth to engage the surface of the material being cut thereby to more positively feed the material into the cutting head.

FIG. 7 represents an enlarged section of a portion of the driving shear wheel of FIG. 6, showing a serration or tooth at the rear peripheral edge thereof, the section being taken along the line 7—7 of Fig. 6.

FIG. 8 represents diagrammatically a view in side elevation of a further modification of the cutting head, showing the resiliently mounted feeding wheel associated with the driven shear wheel, and serrations or teeth on the rear peripheral edge of the driving shear wheel in the manner of FIG. 6.

FIG. 9 represents a section taken along the line 9—9 of FIG. 8, showing the driven shear wheel together with the feeding wheel adjacent the front face of the driven shear wheel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Rotary shear 1 comprises a power handle 2 housing an electric motor 3 which may be driven by suitable connection through a power cord (not shown) to an electric main. Alternatively, the electric motor 3 may be driven by batteries (not shown) enclosed within the said power handle 2, the batteries being rechargeable or not as desired. A trigger switch 4, mounted in power handle 2, controls switch points 5 thereby to start or to stop the electric motor 3.

A rotatable shaft 6 having a coupling 7 at one end and a worm gear 8 at the opposite end, extends through one end of the power handle 2. Coupling 7 receives one end of the armature 9 of the electric motor 3, set screw 10 securing the coupling to the armature 9 as shown in FIG. 1.

Power handle 1 is contoured on its exterior surfaces to provide a comfortable and secure manual grip for the operator of the rotary shear 1.

Cutting head 11 comprises driving shear wheel 12 and driven shear wheel 13 rotat-

ably mounted in a frame 14 having a bracket extension 15 secured to power handle 2 by means of screws 16 as shown.

With particular reference to FIG. 2, driving shear wheel 12 is seen as being coaxially mounted on screw 17 with backing wheel 18, nut 19 threaded on the said screw 17 firmly pressing together the driving shear wheel 12 and backing wheel 18 thereby to prevent relative rotation therebetween. Driving shear wheel 12 and backing wheel 18 have diverging portions 20 and 21, respectively, which define an inner race for ball bearings 22 positioned around the entire periphery of the inner race. The frame 14 comprises two portions 23 and 24 cooperating to define an outer race for the said ball bearings 22. It will be seen, therefore, that the driving shear wheel 12 and associated backing wheel 18 are peripherally supported in frame 14 for rotation about the axis of screw 17. Backing wheel 18 includes a tooth-carrying projection 25 around the entire periphery thereof meshing with worm gear 8 on shaft 6. Operation of electric motor 3 will therefore produce rotation of driving shear wheel 12 within frame 14.

Drive shear wheel 13 is coaxially mounted on screw 26 with backing wheel 27, nut 28 threaded on the said screw 26 firmly pressing together the driven shear wheel 13 and backing wheel 27 thereby to prevent relative motion therebetween. Driven shear wheel 13 and backing wheel 27 have diverging portions 29 and 30, respectively, which define an inner race for ball bearings 31 positioned around the entire periphery of the inner race. The frame 14 comprises two portions 32 and 33 cooperating to define an outer race for the said ball bearings 31. It will be seen, therefore, that the driven shear wheel 13 and associated backing wheel 27 are peripherally supported for rotation within frame 14 about the axis of screw 26.

Driving shear wheel 12 and driven shear wheel 13 are mounted within the frame 14 in such manner that their peripheral cutting edges 34 and 35, respectively contact each other with a slight overlap as clearly shown in FIGS. 1—3.

Frame 14 includes a cover 36 protecting worm gear 8 and backing wheel 18.

The operation of the rotary shear 1 shown in FIGS. 1—3 will now be described.

The operator holds power handle 1 with trigger switch 4 depressed, thereby driving electric motor 3 and rotating driving shear wheel 12 within frame 14 of cutting head 11. The operator advances rotary shear 1 into the material 37 to be cut, generally along the outline of a pattern on the said material 37. Driving shear wheel 12, rotating as indicated by the arrow in FIG. 1, draws in the said material 37 between the driving shear wheel 12 and the driven shear

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wheel 13, whereby the driven shear wheel 13 is caused to rotate as indicated by the arrow in FIG. 1, and the material 37 is sheared between the two shear wheels 12 and 13.

The particular drive arrangement connecting the power handle 2 and the cutting head 11 permits an in-line arrangement of the said cutting head 11 relative to the said power handle 2, thereby affording the operator of the rotary shear 1 a clear line of sight along the material 37 being cut. This fact, coupled with the generally compact arrangement of the parts of rotary shear 1, permits great maneuverability and accurate cutting along intricate patterns laid out on the said material 37.

In the embodiment of cutting head 11 shown in FIG. 4, frame 14 is bent so as to dispose driven shear wheel 13 perpendicularly to driving shear wheel 12, the peripheral cutting edges 34 and 35 meeting at a common tangent. This embodiment of cutting head 11, which is connected to and driven by power handle 2 in the same manner as hereinbefore described for the embodiment of cutting head 11 shown in FIGS. 1-3, is particularly useful when cutting material which is lying on a table or the like, in which event the driven shear wheel 13, which will underlie the material being cut, will be advanced under the material generally parallel to the table, thereby permitting the said material to be cut without being elevated greatly off the table, which will reduce operator fatigue in cutting the material and which may promote accuracy in following a pattern on the material.

In FIG. 5, a modified cutting head 11 is shown with a driven shear wheel 13 of smaller diameter than the driving shear wheel 12 in order to reduce the elevation of the material 37 being cut over the table top. In order to minimize slippage of material 37 relative to the cutting head 11 when rotary shear 1 is in operation, the minimum diameter of driven shear wheel 13 is selected relative to the diameter of driving shear wheel 12 so that, at maximum material thickness, the tangent of the angle of approach α , the sides of which angle α are the tangents to the shear wheels 12 and 13 at the initial points of contact with the entering material 37, is equal to or less than the minimum coefficient of friction between the shear wheels 12 and 13 and the material 37. Typically, for cutting cloth of commonly encountered thicknesses, the angle α will advantageously lie in the approximate range of 25° - 40° .

In that embodiment of cutting head 11 shown in FIGS. 6 and 7, the peripheral cutting edge 34 of driving shear wheel 12 has on its rear (i.e., on that portion thereof which does not face the driven shear wheel 13)

teeth or serrations 38 extending around the entire periphery thereof. When cutting materials like cloth, the teeth or serrations 38 positively engage or catch the surface of the said material to promote a more positive feed of the material into the cutting head 11.

In that embodiment of cutting head 11 in FIGS. 8 and 9, showing the driving shear wheel 12 and the driven shear wheel 13, and omitting the frame, backing wheels, cover and other non-relevant parts of the cutting head 11 to avoid obfuscating the figures, resilient means are mounted coaxially with the driven shear wheel 13, which resilient means are adapted to bear against the material 37 being cut and to pinch the said material against the driving shear wheel 12 so as to more positively feed the material 37 into the cutting head 11. Such resilient means is seen as comprising a central hub 39 mounted on screw 26 against the front of driven shear wheel 13, a feeding wheel 40 having an outer diameter slightly larger than the outer diameter of the driven shear wheel 13, and a plurality of springs 41 interposed between the inner diameter 42 of the feeding wheel 40 and the outer diameter of the central hub 39, counterbores being provided in the feeding wheel 40 and the central hub 39 to receive and retain in position the springs 41. The feeding wheel 40 is free to slide along the driven shear wheel 13 and is centered about the central hub 39 by the springs 41 in the absence of forces tending to slide the feeding wheel 40 relative to the driven shear wheel 13. When such a force is applied to the feeding wheel 40, at the periphery thereof directed radially inwardly, the springs 41 will be distorted as shown in FIG. 8. In operation, the rotary shear 1 is advanced into the material 37 being cut. Because the outer diameter of the feeding wheel 40 is greater than the outer diameter of the driven shear wheel 13, the material 37 will depress the feeding wheel 40 against the force of the springs 41, and the reaction of the springs 41 will maintain the feeding wheel 40 in engagement with the material 37, to pinch the material 37 between the feeding wheel 40 and the driving shear wheel 12, thereby producing a more positive feed of the material 37 into the cutting head 11. The rotatable mounting of the feeding wheel 40 ensures the maintenance of engagement with the material 37 throughout the entire cutting operation. Advantageously, and particularly where material 37 is cloth, the driving shear wheel 12 will have on its peripheral rear edge serrations or teeth 38 in the same manner as shown in FIGS. 6 and 7.

WHAT I CLAIM IS:—

1. A rotary shear for cutting material, said rotary shear comprising:



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wheel 13, whereby the driven shear wheel 13 is caused to rotate as indicated by the arrow in FIG. 1, and the material 37 is sheared between the two shear wheels 12 and 13.

The particular drive arrangement connecting the power handle 2 and the cutting head 11 permits an in-line arrangement of the said cutting head 11 relative to the said power handle 2, thereby affording the operator of the rotary shear 1 a clear line of sight along the material 37 being cut. This fact, coupled with the generally compact arrangement of the parts of rotary shear 1, permits great maneuverability and accurate cutting along intricate patterns laid out on the said material 37.

In the embodiment of cutting head 11 shown in FIG. 4, frame 14 is bent so as to dispose driven shear wheel 13 perpendicularly to driving shear wheel 12, the peripheral cutting edges 34 and 35 meeting at a common tangent. This embodiment of cutting head 11, which is connected to and driven by power handle 2 in the same manner as hereinbefore described for the embodiment of cutting head 11 shown in FIGS. 1-3, is particularly useful when cutting material which is lying on a table or the like, in which event the driven shear wheel 13, which will underlie the material being cut, will be advanced under the material generally parallel to the table, thereby permitting the said material to be cut without being elevated greatly off the table, which will reduce operator fatigue in cutting the material and which may promote accuracy in following a pattern on the material.

In FIG. 5, a modified cutting head 11 is shown with a driven shear wheel 13 of smaller diameter than the driving shear wheel 12 in order to reduce the elevation of the material 37 being cut over the table top. In order to minimize slippage of material 37 relative to the cutting head 11 when rotary shear 1 is in operation, the minimum diameter of driven shear wheel 13 is selected relative to the diameter of driving shear wheel 12 so that, at maximum material thickness, the tangent of the angle of approach α , the sides of which angle α are the tangents to the shear wheels 12 and 13 at the initial points of contact with the entering material 37, is equal to or less than the minimum coefficient of friction between the shear wheels 12 and 13 and the material 37. Typically, for cutting cloth of commonly encountered thicknesses, the angle α will advantageously lie in the approximate range of 25°-40°.

In that embodiment of cutting head 11 shown in FIGS. 6 and 7, the peripheral cutting edge 34 of driving shear wheel 12 has on its rear (i.e., on that portion thereof which does not face the driven shear wheel 13)

teeth or serrations 38 extending around the entire periphery thereof. When cutting materials like cloth, the teeth or serrations 38 positively engage or catch the surface of the said material to promote a more positive feed of the material into the cutting head 11.

In that embodiment of cutting head 11 in FIGS. 8 and 9, showing the driving shear wheel 12 and the driven shear wheel 13, and omitting the frame, backing wheels, cover and other non-relevant parts of the cutting head 11 to avoid obfuscating the figures, resilient means are mounted coaxially with the driven shear wheel 13, which resilient means are adapted to bear against the material 37 being cut and to pinch the said material against the driving shear wheel 12 so as to more positively feed the material 37 into the cutting head 11. Such resilient means is seen as comprising a central hub 39 mounted on screw 26 against the front of driven shear wheel 13, a feeding wheel 40 having an outer diameter slightly larger than the outer diameter of the driven shear wheel 13, and a plurality of springs 41 interposed between the inner diameter 42 of the feeding wheel 40 and the outer diameter of the central hub 39, counterbores being provided in the feeding wheel 40 and the central hub 39 to receive and retain in position the springs 41. The feeding wheel 40 is free to slide along the driven shear wheel 13 and is centered about the central hub 39 by the springs 41 in the absence of forces tending to slide the feeding wheel 40 relative to the driven shear wheel 13. When such a force is applied to the feeding wheel 40, at the periphery thereof directed radially inwardly, the springs 41 will be distorted as shown in FIG. 8. In operation, the rotary shear 1 is advanced into the material 37 being cut. Because the outer diameter of the feeding wheel 40 is greater than the outer diameter of the driven shear wheel 13, the material 37 will depress the feeding wheel 40 against the force of the springs 41, and the reaction of the springs 41 will maintain the feeding wheel 40 in engagement with the material 37, to pinch the material 37 between the feeding wheel 40 and the driving shear wheel 12, thereby producing a more positive feed of the material 37 into the cutting head 11. The rotatable mounting of the feeding wheel 40 ensures the maintenance of engagement with the material 37 throughout the entire cutting operation. Advantageously, and particularly where material 37 is cloth, the driving shear wheel 12 will have on its peripheral rear edge serrations or teeth 38 in the same manner as shown in FIGS. 6 and 7.

WHAT I CLAIM IS:—

1. A rotary shear for cutting material, said rotary shear comprising:

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- (a) a handle,
 (b) a motor means mounted within said handle,
 (c) a shaft connected to said motor means and adapted to be rotated thereby, said shaft extending through an end of said handle,
 (d) a worm gear mounted to that end of said shaft extending outside of said handle,
 (e) a cutting head mounted to said handle adjacent said shaft,
 (f) a first shear wheel rotatably mounted within said cutting head and having a peripheral cutting edge,
 (g) the longitudinal axis of said shaft extending parallel to said first shear wheel,
 (h) a second shear wheel rotatably mounted within said cutting head and having a peripheral cutting edge,
 (i) the peripheral cutting edges of said first and second shear wheels being adapted to cooperate to cut material fed into said cutting head between the said first and second shear wheels,
 (j) gear means mounted to said first shear wheel and meshing with said worm gear on said shaft,
 (k) whereby rotation of said shaft by said motor means will rotate said first shear wheel in said cutting head.
2. A rotary shear as in claim 1, wherein:
 (l) said second shear wheel is parallel to said first shear wheel.
3. A rotary shear as in claim 1, wherein:
 (l) said second shear wheel is disposed perpendicularly to said first shear wheel.
4. A rotary shear as in claim 1, further comprising:
 (l) teeth spaced around the periphery of said first shear wheel and adapted to engage said material.
5. A rotary shear as in claim 1, further comprising:
 (l) resilient means mounted to said second shear wheel and adapted to bear against said material and pinch said material against said first shear wheel.
6. A rotary shear as in claim 5, wherein:
 (m) said resilient means comprises:
 (i) a hub coaxially mounted to said second shear wheel,
 (ii) a feeding wheel positioned around said hub, the outer diameter of said feeding wheel being larger than the outer diameter of said second shear wheel, the inner diameter of said feeding wheel being spaced from the outer diameter of said hub,
 (iii) spring means operatively positioned between the outer diameter of said hub and the inner diameter of said feeding wheel whereby to resiliently center said feeding wheel around said hub.
7. A rotary shear as in claim 6, further comprising:
 (n) teeth spaced around the periphery of said first shear wheel and adapted to engage said material.
8. A rotary shear as in claim 1, wherein:
 (l) the outer diameter of said second shear wheel is less than the outer diameter of said first shear wheel.
9. A rotary shear as in claim 8, wherein:
 (m) said first and second shear wheels are adapted to define with said material an angle of approach α (as hereinbefore defined) lying in the approximate range $25^\circ - 40^\circ$.
10. A rotary shear as in claim 1, further comprising:
 (l) a first set of ball bearings positioned in said cutting head and peripherally rotatably mounting said first shear wheel in said cutting head,
 (m) a second set of ball bearings positioned in said cutting head and peripherally rotatably mounting said second shear wheel in said cutting head.
11. A rotary shear for cutting material substantially as described with reference to the accompanying drawings.

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