ABSTRACT
A portable cutter unit is operated by fluid pressure from a pump, such as the water pump on a fire engine. An intensifier unit is connected between the pump and the cutter unit, and functions to generate relatively high operating fluid pressure from the relatively low fluid pressure produced by the pump to operate the cutter unit, the intensifier unit including a pilot valve operable from the portable cutter unit. The cutter unit includes interchangeable scissors-type and anvil and blade-type heads, for use in cutting light and heavier materials, respectively.

15 Claims, 24 Drawing Figures
POWER OPERATED PORTABLE SHEAR DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates generally to portable cutter or shear devices for use in the field. More particularly, it relates to a power operated portable shear device especially adapted for use by fire and rescue personnel at the scene of an accident or disaster, and which is capable of generating relatively high cutting forces from the relatively low water pressure produced by the water pump of a fire engine.

2. Description of the Prior Art
There is frequent need at the scene of automobile accidents and other disasters for a rescue worker to cut through metal and other materials, to reach trapped victims or simply to gain access to an area. When saws, axes and other manual tools are used for this purpose, not only can the task take an inordinate amount of time, but further injury to a trapped victim can occur. In some instances, acetylene torches are used to cut through metal, but again such must be used with care to avoid injury to a victim. In addition, a torch cannot be employed where the danger of fire or explosion exists.

The use of tools powered by electric motors, while feasible in some instances, is not a fully acceptable alternative to manual tools and acetylene torches, for two principal reasons. First, there may or may not be sufficient electric power available at the accident or disaster scene; the uncertainty as to adequate electric power renders such electric motor-driven tools unreliable, and thus not fully acceptable for rescue work. Secondly, as with acetylene torches, the use of electric motors in an environment where explosive or flammable vapors are present is dangerous, and, therefore, unacceptable.

For all of these reasons, there is need for a portable, power driven cutting or shear device capable of quickly cutting through metal and other materials, one which will not cause injury to trapped victims, and which offers no hazard when working in an explosive or flammable environment. The present invention is intended to satisfy that need.

SUMMARY OF THE INVENTION

The portable rescue shear device of the present invention includes a cutter unit that is connected through an intensifier unit to a fluid pump, such as the pump carried by a fire engine for pumping water through a hose line. The cutter unit is compact and relatively light in weight so that it can be easily manipulated by a rescue worker, and includes a housing equipped with a handle, and to which a selected cutter head is detachably connected. The invention includes cutter heads of the scissors type and the anvil and blade type, and such are easily interchanged. The scissors type cutter head is intended for use on thin sheet metal and like material, while the anvil and blade type cutter head is effective on bar stock and other relatively thick materials.

The cutter unit housing contains a power cylinder housing a power piston, to which one end of a power shaft or ram is connected. The other end of the ram is detachably connectible to the cutter head, for operating the same in response to movement of the piston.

The power piston is operated by fluid pressure conducted to and from the cutter unit by flexible pressure supply lines.

While the cutter unit must be ruggedly constructed to withstand the forces placed thereon during use, it must also be compact in size for ease of handling. Thus, the size of the power piston is limited. This size limitation on the power piston is of importance because the fluid pressure generated by the usual fire engine pump, while more than adequate for fighting fire, is relatively low for operating a shear cutting unit. Normally, this relatively low pressure could be accommodated in a shear cutter unit by the use of a relatively large piston, taking advantage of the known pressure times area relationship for force generation. But, because the need for a compact cutter unit in the present invention dictates a relatively small power piston, this cannot be done. This is why the intensifier unit is provided between the pump and the cutter unit.

The intensifier unit includes a main housing containing a relatively large main cylinder within which a main piston is slidably received. In the preferred embodiment of the invention the main housing has two confronting power chambers of relatively small diameter, and the main piston carries two oppositely directed small diameter plungers, one being received in each power chamber. A main valve mounted on the main housing is operated by a pilot valve to admit fluid from the pump to one side or the other of the main piston.

The power chambers are connected in a closed loop with the power cylinder containing the power piston of the cutter unit, which loop is filled with a suitable hydraulic fluid. Thus, when the relatively low fluid pressure from the pump acts on the relatively large main piston to move one of the small diameter plungers into its power chamber, the other plunger is simultaneously moved outwardly within its chamber, and hydraulic fluid under a relatively high pressure is supplied to the power piston of the cutter unit for operating the cutter head. In this way the relatively low fluid pressure from the fire engine or other pump is intensified, and used to generate a relatively large force at the cutter head. In the preferred embodiment of the invention the pilot valve is hydraulically operated from a control valve mounted on the cutter unit, so that the rescue worker has full control over the operation of the power operated shear device. The control valve is supplied pressure from the same fire engine or other pump, and is manipulated to supply operating fluid to the pilot valve, which in turn activates the main valve of the intensifier unit. The pilot valve is also equipped with a handle for manual operation, which handle can be locked in a neutral position to thereby immobilize the rescue shear device.

The intensifier unit is equipped with pressure relief valves to guard against excessive pressures, and a pressure test unit is mounted on the inlet side of the main valve for determining and adjusting the fluid pressure supplied from the pump. In addition, the fluid supply lines are fitted with fuse elements that will rupture if excessive line pressure should occur. These fluid pressure fuses provide backup to the pressure relief valves, in case the latter should become corroded or damaged.

The power piston of the preferred embodiment is double acting, to provide positive and forceful action on both the forward and the withdrawal strokes of the ram. In one modification of the invention, however, a
single action power piston is employed. In this instance, the power piston is retracted by a spring, and the intensifier unit is supplied with only one power chamber and plunger. In another embodiment of the invention, the hydraulically operated pilot valve is replaced by an electrical activator, which arrangement may be preferable in some instances.

It is also to be understood that while the invention will be described primarily as a rescue shear device for use by fire and rescue workers, it can also be used in other situations. For example, the present portable power shears would be well-suited for use in a scrap metal reclamation yard. When used for such other purposes, it is understood that fluid operating pressure would be supplied by some suitable pump arrangement.

It is the principle object of the present invention to provide a powerful portable rescue shear device that can be easily used by rescue workers and others wherever desired, one which is capable of quickly cutting or shearing metal or other wreckage away from trapped victims at the scene of automobile, airplane, train, boat and other accidents or disasters, and which is safe to use in an explosive or flammable environment.

Another object is to provide a portable, power operated shear device that can be easily manipulated and controlled by one operator.

A further object is to provide a power shear device equipped with two types of easily interchanged cutter heads, a scissors type head for cutting sheet metal and other light materials, and an anvil and blade type head for cutting or shearing heavy materials.

Yet another object is to provide a portable power shear device which is powered by a pump such as is used by firemen for the purpose of pumping water through hose lines, and which can be used simultaneously with the supplying of water to such hose lines.

Still another object is to provide a portable shear device that requires a minimum of instruction and physical ability to use, and which can be used to advantage in situations apart from rescue work.

Other objects and many of the attendant advantages of the invention will become readily apparent from the following description of the Preferred Embodiments, when taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view illustrating one embodiment of the power shear device of the present invention as such might be used by a rescue worker at an accident scene, the device being operated by fluid pressure from a pump carried on rescue vehicle;

FIG. 2 is an enlarged plan view of the cutter unit of the shear device of FIG. 1, the unit being fitted with a scissors-type cutter head;

FIGS. 3A and 3B are enlarged fragmentary transverse sectional views taken on the lines 3A—3A and 3B—3B, respectively, of FIG. 2; and show the construction of the control valve;

FIG. 4 is a fragmentary side elevational view, partly in section, taken on the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary bottom view of the cutter head of FIG. 4, showing how such is detachably mounted;

FIG. 6 is a fragmentary top plan view of the cutter unit of FIG. 1, equipped with a modified form of cutter head of the anvil and blade type;

FIG. 7 is a fragmentary side elevational view of the cutter head of FIG. 6;

FIG. 8 is a vertical sectional view, taken on the line 8—8 of FIG. 7;

FIG. 9 is an enlarged plan view of the intensifier unit of FIG. 1;

FIG. 10 is an elevational view, partly in section, of the intensifier unit of FIG. 9;

FIG. 11 is a fragmentary horizontal sectional view through the pilot valve of the intensifier unit, taken on the line 11—11 of FIG. 10, and showing the valve in its closed or "OFF" position;

FIG. 12 is a fragmentary horizontal sectional view, similar to FIG. 11, but showing the pilot valve in its open or "ON" position;

FIG. 13 is an enlarged fragmentary, horizontal sectional view through the main valve of the intensifier unit, taken on the line 13—13 of FIG. 10;

FIG. 14 is an enlarged, fragmentary, horizontal sectional view taken on the line 14—14 of FIG. 10, further showing construction of the main valve;

FIG. 15 is a fragmentary, vertical sectional view taken on the line 15—15 of FIG. 10, through the pilot valve and the main valve;

FIG. 16 is a perspective view of the valve core of the main valve;

FIG. 17 is a schematic view of the hydraulic control circuit for the portable power shear device of FIG. 1;

FIG. 18 is a schematic view of a modified form of control circuit for the power shear device, wherein an electric actuator is substituted for the pilot valve;

FIG. 19 is a schematic view of a modified power shear device, utilizing a single action power piston in the cutter unit;

FIG. 20 is an enlarged fragmentary side elevational view, partly in section, of the cutter unit of the embodiment of FIG. 19;

FIG. 21 is an enlarged, fragmentary elevational view of a second embodiment of the main valve, which may be preferred in some uses;

FIG. 22 is a horizontal sectional view taken on line 22—22 of FIG. 21; and

FIG. 23 is a perspective view of the valve element of the main valve of FIGS. 21 and 22.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings, a rescue worker 2 is shown carrying the preferred embodiment 4 of the cutter unit of the present invention, preparatory to working on a wrecked vehicle 6. The cutter unit 4 is supplied with operating fluid under pressure through a combined hose line 8, the inlet end of which is connected to an intensifier unit 10. The intensifier unit 10 is connected to pump apparatus 12 mounted on a rescue vehicle 14.

The cutter unit 4 is shown in detail in FIGS. 2-5, and includes an elongated housing 16 terminating at the forward end in a generally cubical mounting head 18, and which contains a cylindrical bore 20. The cylindrical bore 20 is divided by a wall 22 into a forward power cylinder 24 and an aft cylindrical valve chamber 26, the latter being open at its outer end. A power piston 28 is
slidably received within the power cylinder 24, and carries a sealing ring 30 in an annular groove on the cylin-
drical surface thereof. The power cylinder 24 ex-
tends partly into the mounting head 18, and the latter
has a reduced diameter cylindrical bore 32 extending
therethrough aligned on the axis of the power cylinder 24, said bore 32 having an annular groove therein for
reception of an O-ring seal 33. A power shaft or ram 34
is connected at its rear end to the power piston 28 and
extends forwardly through the bore 32, the forward or
outer end of the ram 34 carrying a bifurcated head or
connecting yoke 36 having aligned bores in the legs
thereof for receiving a connecting pin 38.

The power piston 28 is of the double acting type, and
for this purpose the housing 16 has two supply ports 40
and 42, the port 40 being located on the mounting head
18 and opening into the forward section of the power
cylinder 24, and the port 42 opening into the aft section
of the power cylinder. Fluid conduits 44 and 46 are
connected to the supply ports 40 and 42, respectively,
and lead to the intensifier unit 10, the conduits 44 and
46 being embodied in the combined hose line 8.

The cutter unit 4 of FIGS. 1-5 is equipped with a cut-
ter head 48 of the scissors type, for use on sheet metal
and the like. The mounting head 18 is designed so that
the cutter head 48 can be easily and quickly mounted
or dismounted, and for this purpose has a rectangular,
transversely extending recess 50 cut in the flat bottom
face 52 thereof. A rectangular channel 54 extends from
the recess 50 to the vertical flat front face 56 of the
head 18, and the end walls of the recess 50 have cen-
trally disposed, aligned, tapered frusto-conical bores
58 therefor for receiving tapered connecting pins 60.
The channel 54 is offset from the center of the mount-
ing head 18.

The cutter head 48 includes a mounting bracket 62
having a rectangular base portion 64 that is snugly
received in the rectangular recess 50, and a rectangular
arm portion 66 connected with the base portion 64 and
which extends forwardly through the channel 54. The
end walls of the base portion 64 have tapered bores 68
therein for receiving the tapered connecting pins 60 with
a wedge fit, whereby the bracket 62 is rigidly but
detachably secured to the mounting head 18.

The arm 66 has a lateral offset 70 therein, and termi-
nates at its outer end in a pair of upstanding ears 72
having aligned bores therein for receiving a pivot pin
74 that connects the midportions of upper and lower
scissors blades 76 and 78, respectively, thereto. The
forward ends of drive links 80 and 82 are connected by
pivot pins 84 to the rear ends of the upper and lower
scissors blades 76 and 78, respectively, and the rear
ends of the links 80 and 82 are pivotally mounted on
the connecting pin 38. Thus, when the ram 34 is ad-
vanced, the forward cutting edges of the scissors blades
76 and 78 will separate, the forward portion of the arm
56 having a cutout 85 therein to accommodate down-
ward movement of the rear end of the upper blade 76
and its link 80. When the ram 34 is then retracted, the
cutting surfaces of the blades 76 and 78 will move to-
ward each other to effect shear cutting of any material
therebetween.

Referring now to FIGS. 1 and 9-17, the intensifier
unit 10 includes a main housing 86 having a base flange
88 and containing a main cylinder 90, the cylinder 90
including a cylindrical bore 92 extending into the main
housing 86 from one end face 94 thereof, and which
terminates in a reduced diameter manifold chamber
96. The open end of the main housing 86 is closed by
a cover plate 98 secured by bolts 100, an annular gasket
102 being disposed between the cover plate 98 and
the end face 94, and the cover plate 98 carrying an an-
nular boss 104 thereon that forms a manifold chamber
106.

The rear face 108 of the main housing 86 has an axi-
ally extending cylindrical housing 110 thereon, and the
cover plate 98 bears a similar, aligned cylindrical hous-
ing 112. The cylindrical housings 110 and 112 contain
axially aligned, cylindrical power chambers 114 and
116, respectively, that open into the main cylinder 90
and which are threaded internally at their outer ends to
receive fittings 118 and 120, respectively. A main pist-
on 122 carrying a sealing ring 124 in an annular groove
on the cylindrical surface thereof is slidably re-
ceived within the main cylinder 90, and has oppositely
extending, axially aligned plungers 126 and 128 thereon
that are slidingly received in the power cham-
bers 114 and 116, respectively. The plungers 126 and
128 and their power chambers 114 and 116 are of such
length that the main piston 122 can move the length of
the main cylinder 90, with the plungers remaining slid-
ably engaged within their respective power chambers.
O-ring seals 127 and 129 are carried in annular grooves
on the outer ends of the plungers 126 and 128, respec-
tively, to prevent fluid pressure from leaking between
the main cylinder 90 and the outer ends of the power
chambers 114 and 116.

The forward section of the power cylinder 24 of the
cutter unit 4 is connected by the conduit 44 to the fit-
ting 118 on the power chamber 114, and the aft section
of said power cylinder is connected by the conduit 46
to the fitting 120, all in a closed loop system containing
a given volume of hydraulic fluid, the closed loop in-
cluding a reservoir 130 connected with the conduits
44 and 46 through one-way check valves 132 and 134,
respectively (FIG. 17). Thus, when the main piston 122
is driven to move the plunger 126 into the power cham-
ber 114, the check valve 132 remains closed, and hy-
draulic fluid is forced under pressure into the forward
end of the power cylinder 24, thereby urging the ram
34 to retract. Simultaneously, hydraulic fluid from the
decreasing in volume aft end of the power cylinder 24
is transmitted to the expanding power chamber 116
through the conduit 46, the check valve 134 allowing
replacement fluid to be added to the system if needed.
Similar operation in the opposite direction occurs when
the main piston 122 is driven the opposite way, whereby
operation of the shear cutting unit 48 is ob-
tained.

The main piston 122 is operated by fluid pressure ad-
mitted to the manifold chambers 96 and 106 at the op-
posite sides thereof through fittings 136 and 138, and
the transmission of such operating fluid is controlled by
a main valve 140 that in turn is operated by a pilot
valve 142. The main valve 140 includes a cylindrical
body 144 having a cylindrical bore 146 extending
therethrough, and terminating at its lower end in an ex-
ternal flange 148. The flange 148 is secured by bolts
150 to the top surface 152 of the intensifier main hous-
ing 86, an annular gasket 154 being interposed therebe-
tween.

The side wall of the cylindrical body 144 has two axi-
ally spaced, parallel supply and discharge arc chambers
156 and 158 cut or cast in the exterior, said grooves ex-
tending for 90 degrees and being covered by welded in place arcuate strips 160 and 161, respectively. At the ends of the upper or supply arc chamber 156 radial ports 162 and 164 extend into the body 144, and similar ports 166 and 168 are disposed at the opposite ends of the lower or discharge arc chamber 158. Diometrically opposite the vertically aligned ports 162 and 166 the body 144 has a vertical chamber 170 therein, and inwardly directed ports 172 and 174 leading to said chamber 170 are arranged to diametrically confront the ports 162 and 166. Similarly, a vertical chamber 176 is disposed opposite the vertically aligned ports 164 and 168, and connecting ports 178 and 180 confront said ports 164 and 168, respectively. Obviously, all internal passages can either be drilled, or they can be provided during casting.

A rotary valve core 182 is received in the housing 140, and has two vertically spaced diametric bores 186 and 188 extending therethrough which extend at right angles to each other. The upper bore 186 is arranged to connect either the ports 178 and 164 or the ports 162 and 172, depending upon the rotary position of the valve core 182, and the lower bore 188 is arranged to connect either the ports 168 and 180 or the ports 166 and 174. The bores 186 and 188 have O-ring seals 187 and 189, respectively, seated in annular grooves at the opposite ends thereof, to prevent excessive pressure losses.

Referring now to FIG. 17, the intensifier unit 10 is supplied with water pressure from the pump 12, which is connected to a water supply tank 190 carried by the truck 14, and driven by a motor 192, which can be the motor of the truck 14 or a separate unit. The pump 12 also includes an inlet 194 and a discharge 196, the pump inlet 194 being connected by a conduit 198 to the discharge arc chamber 158 of the main valve 140, and the pump outlet being connected to the main valve supply arc chamber 156 by a conduit 200.

The vertical valve chamber 170 is connected by a conduit 202 to the fitting 136 leading to the manifold chamber 96, and similarly a conduit 204 connects the fitting 138 to the valve chamber 176. The conduits 202 and 204 have pressure relief valves 206 and 208, respectively, therein to prevent an excessive pressure build-up in the device. As further insurance against damage from excessive pressure, fragile fuse elements 210 and 212 are disposed in the lines 202 and 204, respectively, and are chosen to fracture at a pressure greater than the setting of the relief valves 206 and 208.

The main valve 140 is operated by the pilot valve 142, the latter including a lower cup-shaped body member 214 having a flange 216 thereon which is secured to the open upper end of valve body 144 by bolts 218, a gasket 220 being interposed therebetween. The lower body member 214 contains a circular working chamber 222, and has an axial bore 224 in the bottom wall 226 thereof. An operating shaft 228 is secured by a key 230 within an axial socket 232 in the valve core 182, and projects upwardly through the bore 224. An O-ring seal 234 is carried within a groove in the wall of the bore 224, and seals the lower end of shaft 228.

An upper body member 236 having an open-ended chamber 238 therein and a projecting flange 240 is secured to the upper surface of the lower member 214 by bolts 242, the top wall 244 of the chamber 238 having a socket 246 therein for seating the upper end of the shaft 228. An O-ring seal 235 is carried in a groove in the wall of chamber 238, to seal the upper end of shaft 228.

The side wall of the body member 236 has a circumferential slot 248 therein, which extends for 90 degrees, and which has an enlarged seat portion 250 positioned centrally thereof. The threaded inner end of a manual operating handle 252 projects through the slot 248 and is threaded into a radial bore 249 in the operating shaft 228, whereby the operating shaft 228 and the valve core 182 can be rotated over the 90° allowed by the length of the slot 248. A lock nut 254 (FIG. 11) is threaded on the operating handle 252, and is receivable within the seat 250 when the handle 252 is midway the slot 248 to lock the operating valve in a neutral position.

The main valve 140 can be operated by the handle 252. When the lock nut 254 is seated in the enlarged seat portion 250, the axial bores 186 and 188 of the valve core 182 are out of communication with all of the ports 174, 180, 166, 168, 172, 162, 178 and 164. After the lock nut 254 has been retracted, when it is desired to retract the ram 34 and thereby operate the cutting shears 48, the handle 252 is moved on the "ON" end of the slot 248, whereby the upper valve core bore 186 is moved to connect the port 164 with the port 178 and fluid under pressure is supplied to the manifold chamber 106 through the conduit 204. Simultaneously, the lower valve core bore 188 connects the ports 174 and 176, whereby the manifold chamber 96 is connected to the discharge chamber 158 by the conduit 202.

The main piston 122 is thereby driven toward the power cylinder 114, whereby high fluid pressure is transmitted to the power chamber 24 by the conduit 44. When the main piston 122 has travelled fully toward the cylinder 114, pressure therebehind is relieved through a bleed port 256 positioned at the center of the main chamber 90. The bleed port 256 connects with a passage 258 in the main valve body 140 and which leads to the discharge chamber 158.

Movement of the cutting head power ram 34 in the opposite direction is achieved by moving the operating handle 252 to the opposite or "OFF" end of the slot 248, as will be obvious. While such manual operation of the shear unit from the location of the intensifier unit 10 is possible and may be desirable in some instances, automatic operation from the shear unit is usually preferable.

To provide such automatic operation, the portion of the operating shaft 228 received in the chamber 222 has a radial vane 260 thereon, the outer surfaces 262 of which carry a seal 263 and engage the three walls of the chamber 222. The cylindrical wall of the chamber 222 has a similar vane 264 affixed thereto by screws 266, although it could be formed integrally if desired, the vane 264 dividing the interior of the chamber 222 into two pressure chambers 268 and 270 (FIG. 12). Fittings 272 and 274 are connected to the chambers 268 and 270, respectively, for operating the vane operating shaft 228. When the lock nut 254 is retracted, the operating shaft 228 can be rotated in either direction to the limits provided by the ends of slot 248 and the handle 252 by alternately connecting one of the fittings 272 or 274 to a supply of fluid pressure while the other is connected to drain, as will be apparent from a study of the drawings.
The flow of fluid pressure to and from the pilot valve chambers 268 and 270 is controlled by a control valve 276 carried by the cutter unit 4. The valve housing of the control valve 276 is the aft portion of the elongated housing 16 containing the cylindrical bore section 26, said housing having forward and aft parallel, axially spaced arcuate passages 278 and 280 cut therein, the passages extending 90° and being covered by welded in place plates 282 and 284, respectively. Radial ports 286 and 288 extend inwardly from the opposite ends of the aft arcuate passage 278, and similarly radial ports 290 and 292 are disposed at the opposite ends of the forward arcuate passage 280.

The body 16 has two axial passages 294 and 296 drilled thereinto from the aft end of said body, and which are then plugged at their outer ends. The passages 294 and 296 are spaced 90 degrees, with the passage 294 diametrically opposite the bores 288 and 292, and with radial ports 298 and 300 being arranged to confront said ports 288 and 282, respectively, the ports 298 and 300 being in communication through the axial passage 294. Similarly, the axial passage 296 is diametrically opposite the ports 286 and 290, and communicates with radial ports 302 and 304 that respectively confront the ports 286 and 290. A fitting 306 carried by the body 16 communicates with the axial passage 294, and a similar fitting 308 connects with the axial passage 296.

A cylindrical valve stem 310 is disposed within the bore 26, and has an enlarged, knurled handle portion 312 on the outer end thereof. The forward end of the stem 310 has an annular groove 314 therein disposed oppositely threaded bores 316 extending through the wall of the chamber 26, and the valve stem is rotatably secured in position by the reduced diameter head portion 318 of screws 320 threaded into the bores 316. The aft or outer end of the bore 26 has a groove therein containing an O-ring seal 322, and rotation of the knurled handle portion 312 is limited at its opposite positions by stop lugs 313 secured in threaded bores in the housing 16, the stop lugs 313 being spaced 90 degrees apart, and the handle portion 312 carrying a finger 315 engageable with said stop lugs.

The valve stem 310 has two diametrically disposed and axially spaced bores 324 and 326 extending therethrough, said bores being rotated 90 degrees relative to each other. The bore 324 is arranged to connect either the ports 286 and 302 or the ports 288 and 298, and the bore 326 is arranged to connect either the ports 290 and 304 or the ports 292 and 300. Between the bore 326 and the O-ring seal 322 the valve stem 310 has an annular groove 328 therein for collecting any leaked fluid, said groove being connected with the bore 324 by a drain passage 330.

The forward arcuate passage 278 is connected by a conduit 332 to the fluid pressure supply conduit 200 (FIG. 17), and the aft passage 280 is connected by a conduit 334 to the drain conduit 198. The fitting 306 leading to the axial passage 294 is connected by a conduit 336 to the fitting 272 of the pilot valve chamber 268, and the fitting 308 of the axial passage 296 is connected with the pilot valve chamber fitting 274 by a conduit 338. The control valve 276 functions like the valve 140 when operated by the handle 312 to drive the operating shaft 228 in either direction, the manner in which this occurs being readily discernible from an examination of the drawings. The operator holds the cutter unit with one hand by a handle 340 mounted on the cubical head 18, grasping the handle 312 with the other hand to remotely operate the pilot valve 142.

Because the fluid pressure from the pump outlet 196 can vary greatly, it is desirable to determine the value thereof before it is used to operate the shear unit. For this reason, and to prevent accidental injury to the shear operator, the main valve 140 is initially placed in a neutral position by threading the lock nut 254 into the locking space 250 midway of the groove 248. The pressure in the line 200 is then passed through a bypass line 342 leading directly to the discharge line 198 (FIG. 17), the supply line 200 having a pressure reducer 344 therein just forward of the bypass line 342.

The bypass line 242 contains a pressure gauge 346 and a shut-off valve 348 connected in series, whereby the supply pressure can be checked and adjusted to a desired setting. The valve 348 must be closed before releasing the lock nut 254 to allow fluid to pass to the main valve 140, or a power loss will occur which will adversely affect the operation of the shear unit. The lock nut 254 is then released, the control valve 276 being first placed in a neutral position. Thereafter, the power ram can be activated in either direction by properly rotating the handle 312 to remotely operate the pilot valve 142, or the main valve 140 can be operated directly by moving the handle 252 by hand. In either case the blades 76 and 78, because of the intensifier unit 10, will be operated with considerable force to cut sheet material placed therebetween.

Before the pilot valve handle 252 is manually operated, pressure must be relieved in the lines 336 and 338. For this purpose, the lines 336 and 338 are respectively provided with bleed valves 337 and 339 (FIG. 17).

Refferring now to FIGS. 6–8, a second embodiment of a cutter head is shown at 400, such being easily interchangeable with the scissors type cutter head 48 merely by pulling the tapered lock pin 60 and the pin 38. The cutter head 400 is of the anvil type, and includes a straight mounting bracket 402 having rectangular base portion 404 identical to the base portion 64 of the bracket 62.

The mounting bracket 402 includes an arm 406 having an upright anvil 408 on the outer end thereof, and upon which a shear blade 410 is slidably mounted by a tapered keeper 412 riding in a tapered track 414 provided in the side of said arm 406. The rear end of the shear blade is connected directly to the yoke 36 by the pin 38, and the front inner edge 416 thereof is arranged to just slide past the front face 418 of the anvil 408 when the ram 34 is fully advanced. The anvil cutter unit 400 is intended for heavy duty use.

Refferring now to FIG. 18, a further embodiment of the invention is shown wherein the fluid operated pilot valve 142 is replaced by a conventional two directional rotary electric solenoid 500, to which energy is supplied from a power source 502. The rotary solenoid 500 is operated by a control switch 504 mounted on the cutter unit 4', modified to replace the control valve 276 with suitable switches 504 mounted near a handle 506. Otherwise, the structure of FIG. 18 corresponds to that of FIG. 17.

A modification of the cutter unit 4 is shown at 600 in FIG. 20, wherein the double-acting power cylinder is replaced by a single acting power piston 602 mounted in a cylinder 604 in the housing 606. A cutter
head 605 is mounted on a mounting bracket 630, the bracket 630 being mounted like the bracket 62. The cutter head 605 includes a pair of cutter blades 607 and 609, each in the form of a bell crank having cutter portions 611 and 613 and link attaching portions 615 and 617, respectively. The blades 607 and 609 are pivotally mounted at the elbow thereof on a pin 619 mounted to extend between upstanding ears 621 on the outer end of the bracket 630, and are pivotally connected through links 623 and 625 to a pin 603 carried by a yoke 601 mounted on the outer end of a power cam 608 that is connected at its other end to the power piston 602.

Power fluid is supplied behind the power piston 602 through a port 610 and conduit 612, the piston being returned by a coil spring 614 disposed in front thereof. A control circuit for the cutter unit 600 is shown in FIG. 19, such being of the electrically operated type shown in FIG. 18.

Referring to FIG. 19, because a single action piston 602 is used in the cutter head 600, an intensifier unit 616 with only one power chamber 618 is required, such being operated by a rotary solenoid pilot valve 620 controlled from a switch unit 622 on the cutter head 600. Otherwise, the operation of the arrangement of FIG. 19 is similar to that of FIGS. 17 and 18, except that the pressure relief valve 624 in the fluid circuit between the main valve 140 and the intensifier unit 616 is arranged to be electrically operable from a switch 626 on the cutter unit 600 to change the relief valve setting so that both heavy-duty and light-duty sheath attachments can be operated safely and effectively, without danger of overload damage and with adequate pressure for maximum effectiveness.

For example, if an operator were using a heavy-duty sheath attachment which requires higher pressure, and he changed to a light-duty attachment which operates at a lower pressure, he would need to change the pressure relief valve setting so that pressure would be relieved before damage could occur to the light-duty attachment. On the other hand, if the operator is using a light-duty attachment, and must change to a heavy-duty attachment, he would need to change the relief valve setting in order to have sufficient pressure for effective use of the heavy-duty attachment. By having the relief valve 624 remotely controlled at the cutter unit 600, time is lost in changing the relief valve setting for either instance, an important factor under emergency conditions.

The sealing in the cutter unit of FIGS. 19 and 20 is assisted by atmospheric pressure in opening the cutter blades of the attachment. It is apparent that the sheath attachment of FIGS. 19 and 20 is designed to close on the forward ram stroke, unlike the shear unit 48.

Referring now to FIGS. 21–23, a modification of the main valve is shown at 700, which main valve 700 may be preferred in some instances because it is simpler and somewhat easier to manufacture than the main valve 140. The main valve 700 is operated by a pilot valve 142 like that shown in FIGS. 1–17, and includes a cylindrical body 702 having a cylindrical bore 704 extending therethrough, the lower end of said body 702 having a flange 706 thereon that is secured by bolts 150 to the intensifier main housing 86. The pilot valve 142 is secured to the top face of the valve body 702 by bolts 218, suitable gaskets 154 and 220 being utilized to seal the joints.

The valve body 702 has four equally spaced, tapped ports 708, 710, 712 and 714 therein. The diametrically opposite ports 708 and 712 are connected by fittings 716 and 718, respectively, to the conduits 202 and 204, whereby to conduct flow to and from the opposite sides of the main piston 122 of the intensifier unit 10. The port 710 is connected by a fitting 720 to the conduit 200 leading from the pump discharge, and the diametrically opposite port 714 is connected by a fitting 722 to the pump return conduit 198. A vertical passage 724 similar to the passage 258 is provided in the valve body 702, and empties into the port 714.

Flow within the cylindrical chamber 704 of the main valve 700 is controlled by a planar, vane-like core or valve element 726. The core or valve element 726 comprises a diametrical axial section through cylinder having nearly identical dimensions to the cylindrical chamber 704 and includes top and bottom faces 728 and 730, parallel flat sides 723 and 734, and arcuate end faces 736 and 728. O-ring type seals 740 are carried in peripheral grooves on the valve element 726 to seal such with the surfaces defining the cylindrical chamber 704, and said element is secured axially thereof to the lower end of the shaft 228 of the pilot valve assembly 142.

The valve element 726 is dimensioned and fixed to the shaft 228 that when the pilot valve handle 252 is locked in its central or neutral position, the valve element 726 will extend diametrically between the ports 710 and 714 and will fully block both thereof. Thus, no flow through the main valve can occur. When the handle 252 is then moved to the left in FIG. 21, the valve element 726 will shift to connect the ports 708 and 710, and the ports 712 and 714. Rotation of the shaft 228 by 90 degrees in the opposite direction will connect the ports 708 and 714, and the ports 710 and 712. It is thus readily seen that the main valve 700 provides the same flow control as the main valve 140, while being of somewhat simpler construction.

Obviously, many modifications and variations of the present invention are possible, without departing from the invention as shown and described.

I claim:

1. A portable power sheave device for forcible entry and rescue work, and used in combination with a fire department pumper truck, said truck including a water pump, said sheare device comprising: a portable cutter unit, said cutter unit including: a cutter head; and piston means connected with said cutter head and arranged to operate the same in response to fluid pressure; fluid pressure intensifier means located remotely from said cutter unit, and connected with said piston means; and means adapted to connect said remotely located intensifier means with said water pump on said truck, said connecting means including valve means operable to actuate said intensifier means for transmitting fluid pressure to said cutter unit piston means, and means for operating said valve means.

2. A portable power sheave device as recited in claim 1, wherein said intensifier means includes: a housing containing a relatively large diameter main cylinder and at least one relatively small diameter power chamber; a main piston slidably received in said main cylinder; and a plunger carried by said main piston and slidably received within said power chamber, said power chamber being connected with said cutter unit piston means by conduit means containing hydraulic fluid,
and said valve means being operable to control the flow of fluid pressure from said source into said main cylinder for operating said main piston.

3. A portable power shear device as recited in claim 2, wherein said cutter unit piston means is single acting, said piston means being movable in one direction by fluid pressure transmitted thereto from said power chamber of said intensifier unit, and including resilient means for returning said piston means in the opposite direction when said fluid pressure transmitted from said power chamber is relieved.

4. A portable power shear device as recited in claim 2, wherein said cutter unit piston means is double acting and said intensifier means includes two power chambers disposed on opposite sides of said main piston, said main piston carrying two plungers, one plunger being slidably received in each power chamber, said power chambers being connected to the opposite sides of said double acting cutter unit piston means.

5. A portable power shear as recited in claim 1, wherein said cutter head piston means includes a power ram, and wherein said cutter head comprises: a mounting bracket; and cutter means mounted on said mounting bracket and connectible with said power ram.

6. A portable power shear as recited in claim 5, wherein said cutter means comprises a scissors unit.

7. A portable power shear as recited in claim 5, wherein said cutter means comprises: an anvil fixed to the outer end of said mounting bracket; and a cutter blade slidably mounted on said mounting bracket, and connectible with said power ram.

8. A portable power shear device as recited in claim 1, wherein said intensifier means includes a housing having a relatively large diameter main cylinder and a main piston slidably received within said main cylinder, and wherein said valve means is arranged to control the flow of fluid pressure into said main cylinder from said source of fluid pressure, said valve means including: a main valve including a housing having port and passage means therein; a main valve core received in said main valve housing; said main valve core being rotatable between at least one position wherein a flow path is established between said source of fluid pressure and said main cylinder; and a neutral position wherein flow through said main valve is blocked; and means operable to rotate said main valve core.

9. A portable power shear device as recited in claim 8, wherein said means operable to rotate said main valve core includes: an operating shaft connected with said valve core; a housing mounted over the upper end of said operating shaft and having an annular slot in the wall thereof; a handle extending through said slot and engaged with said operating shaft; and said operating shaft being arranged so that when said handle is positioned at one end of said slot said main valve is open for flow therethrough, and so that when said handle is positioned medially of said slot said main valve core is in said neutral position; and means operable to releasably secure said handle in said neutral position.

10. A portable power shear device as recited in claim 8, wherein said means operable to rotate said main valve includes: an operating shaft connected with said valve core; a fluid operated pilot valve connected with said operating shaft; and a control circuit connected with said source of fluid pressure, and containing a control valve for operating said pilot valve to rotate said main valve in a desired direction, said control valve being positioned on said cutter unit.

11. A portable power shear device as recited in claim 8, wherein said means operable to rotate said main valve includes: an operating shaft connected with said valve core; electric rotary solenoid means connected with said operating shaft; a power supply; and switch means on said portable cutter unit and connected with said power supply and said rotary solenoid means, operable to selectively actuate said solenoid means.

12. A portable power shear device as recited in claim 1, further including pressure control means connected to prevent damage to said cutter unit in case said cutter unit is overloaded.

13. A portable power shear device as recited in claim 12, wherein said pressure control means comprises a pressure relief valve.

14. A portable power shear device as recited in claim 1, wherein said connecting means further includes flow volume control means to prevent excessive flows from said pump to said intensifier unit.

15. A portable power shear device as recited in claim 1, wherein said connecting means further includes pressure test means.

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