Jan. 27, 1953 E. D. BUIE 2,626,602

DIVING SUIT

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FIG. 1.

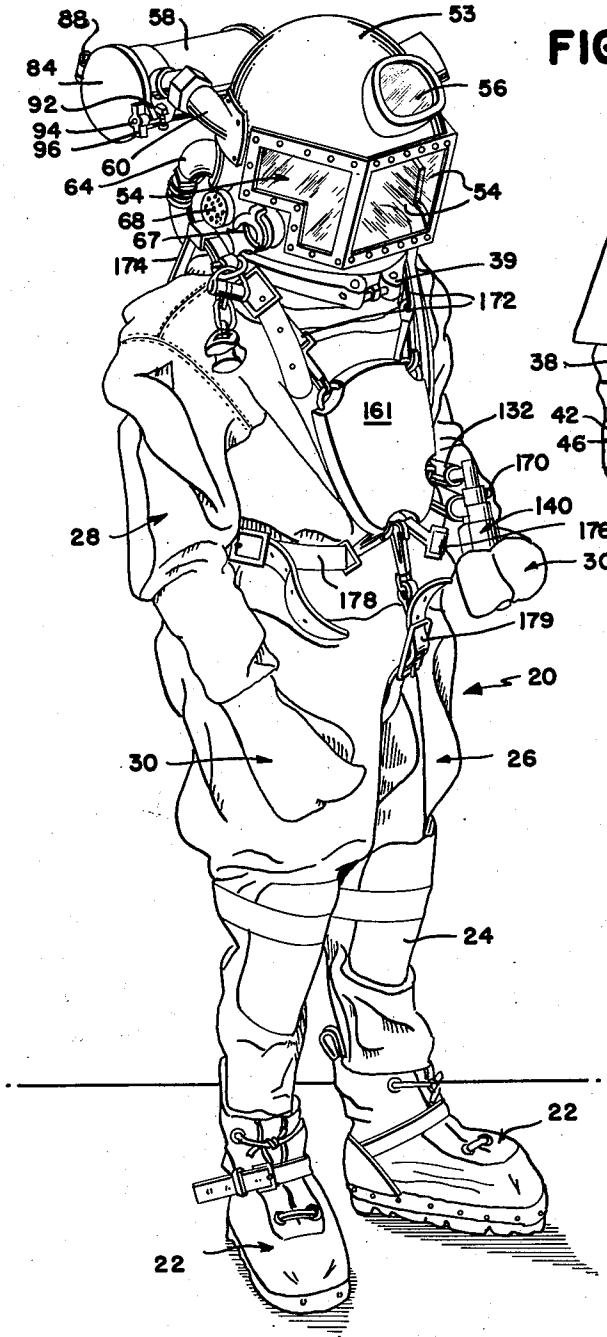

FIG. 4.

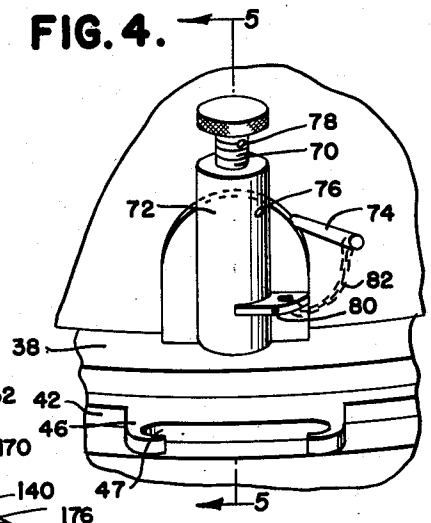

FIG. 5.

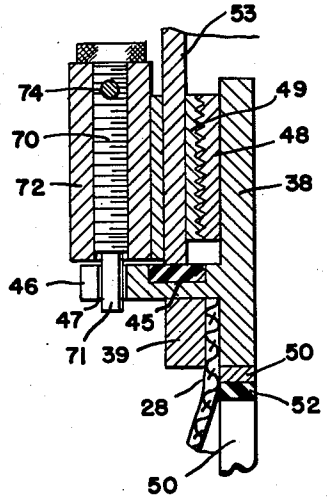

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FIG. 2.

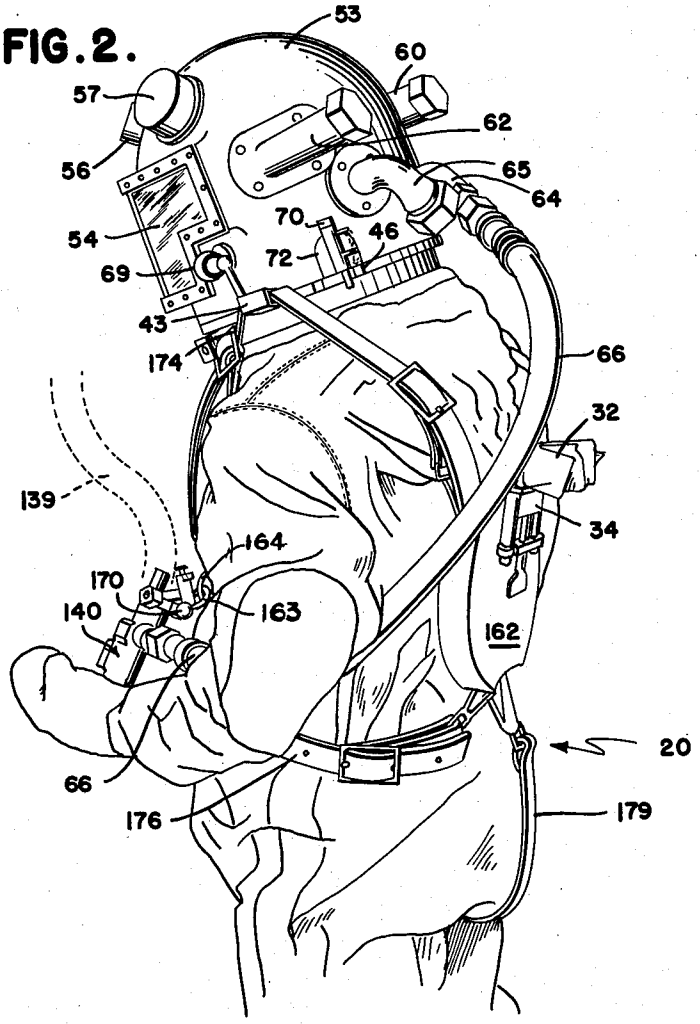
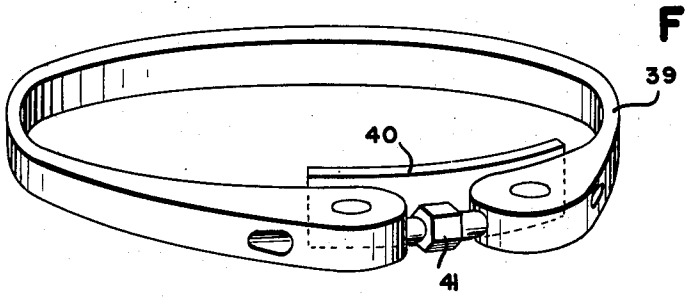


FIG. 3.



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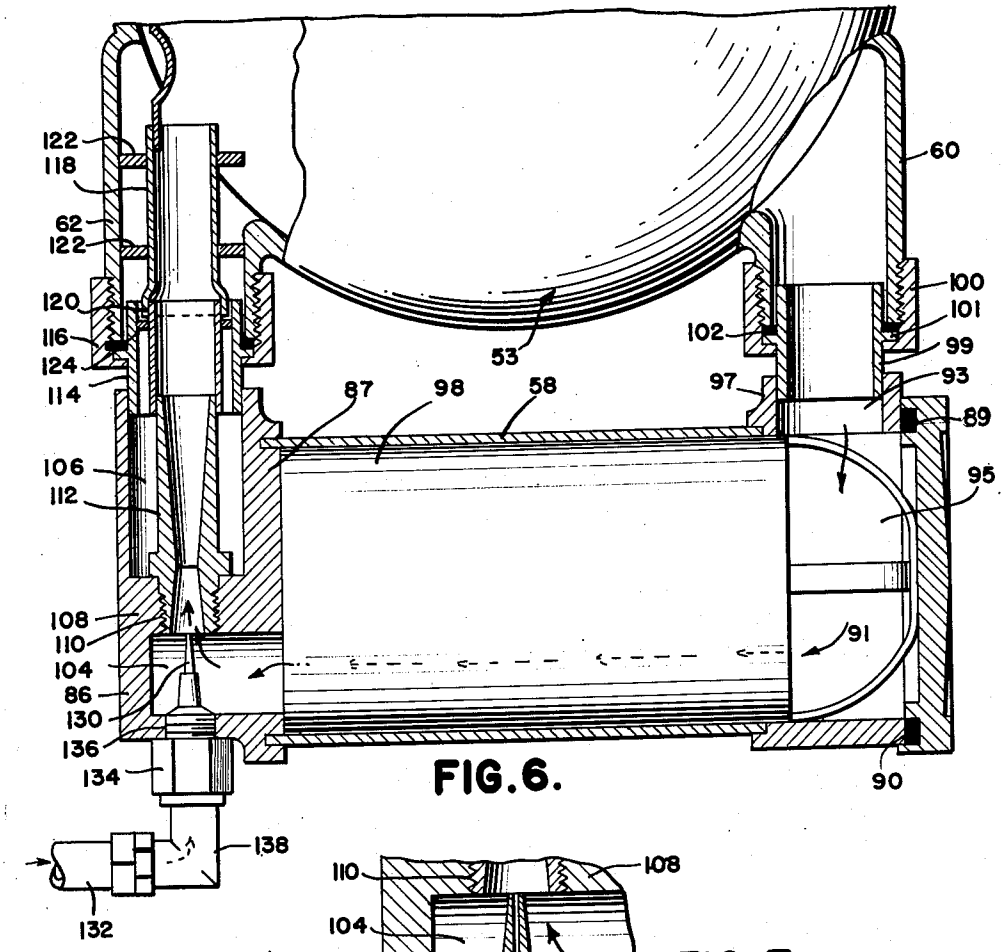

FIG. 6.

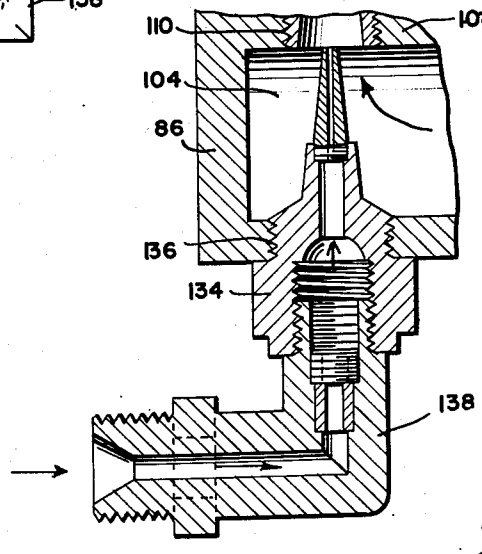

FIG. 7.

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FIG.8.

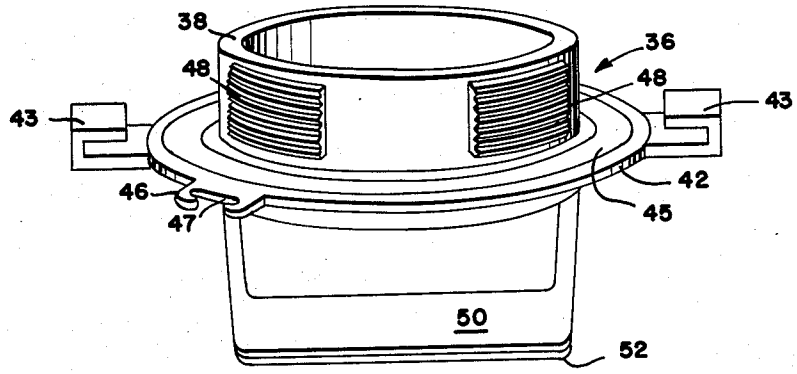

FIG.9.

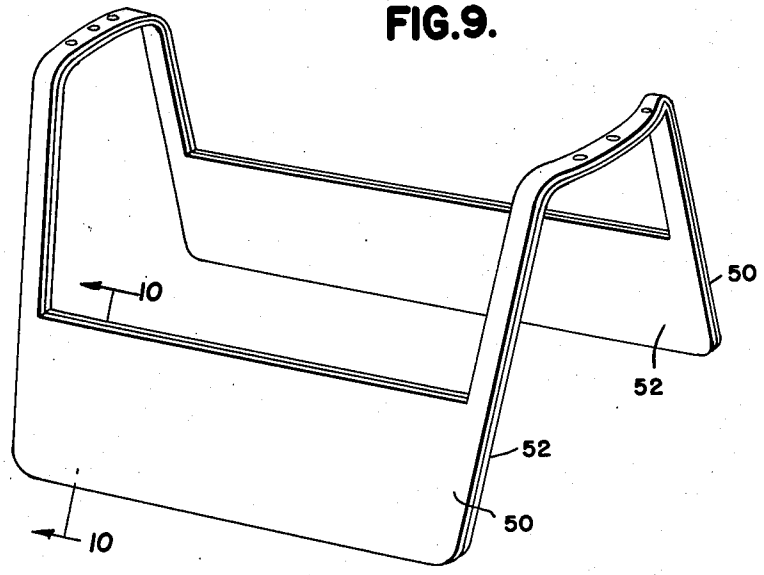

FIG.10.

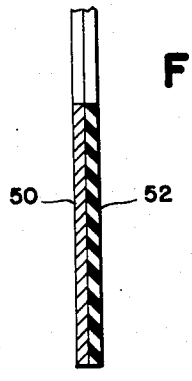

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FIG. 11.

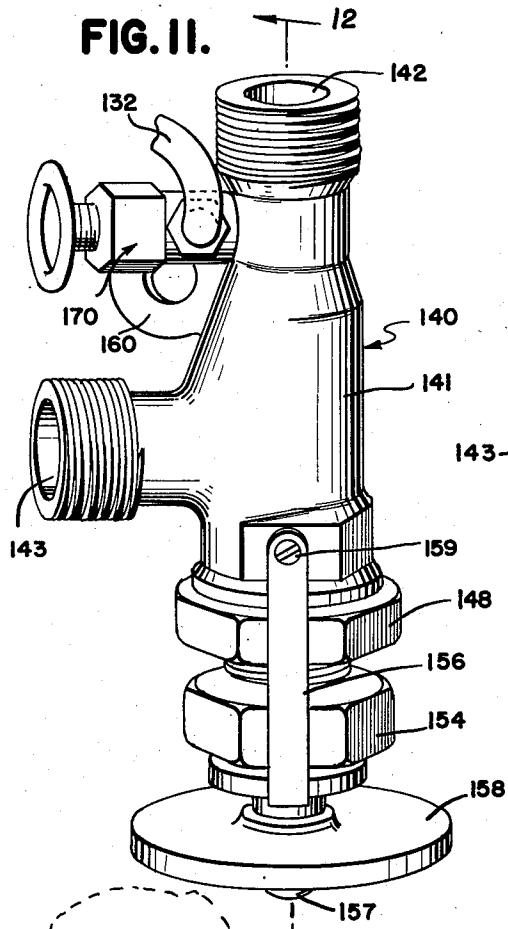


FIG. 12.

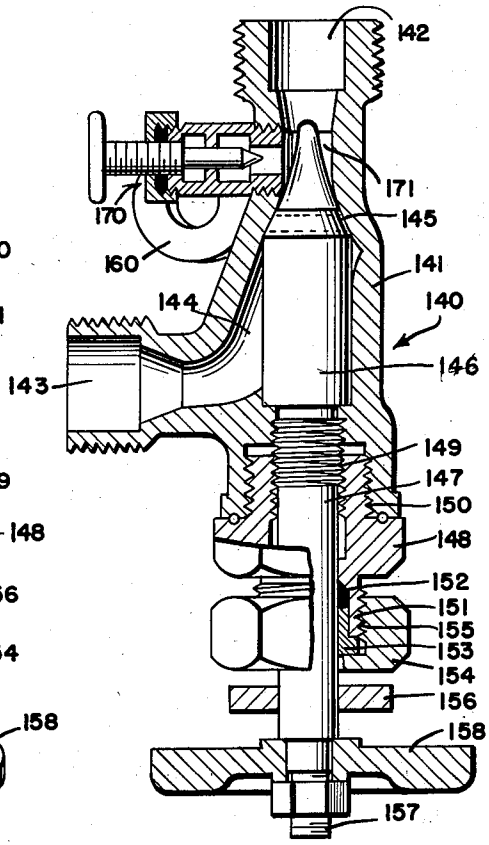


FIG. 13.

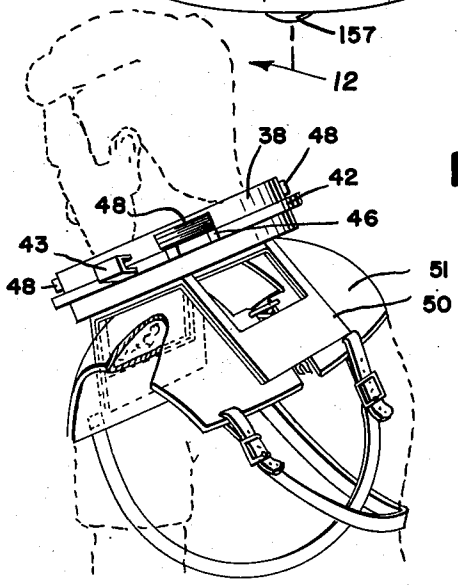
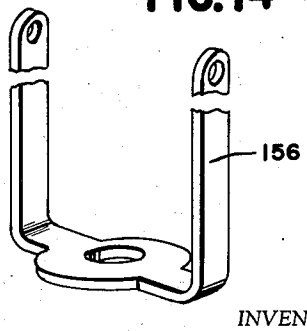


FIG. 14



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ATTORN

Patented Jan. 27, 1953 2,626,602

UNITED STATES PATENT OFFICE

2,626,602

DIVING SUIT

Emerson D. Buie, Washington, D. C.

Application July 20, 1950, Serial No. 174,982

5 Claims. (Cl. 128—144)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to diving suits in general and in particular to a diving suit of the circulating or recirculating type which is of relatively light weight and which may be advantageously used in underwater mine disposal and demolition work.

Conventional diving suits as presently used for relatively deep diving have an overall weight of from 190 to 200 pounds. This is an onerous load and is particularly uncomfortable for the diver while waiting to make a dive. Furthermore, because of the relatively large and rigid breast plate of these diving suits, the diver does not have the freedom of movement of shoulders and arms which is required for mine disposal and demolition work; nor does he have the wide angle of vision which is advantageous in this work.

This inventor has overcome the limitations and disadvantages of the conventional diving suit by producing light weight diving gear consisting essentially of a relatively light weight dress, shoes (weighing approximately 16 pounds each), an open structure breast plate and associated helmet ring, a helmet in which a larger part of the area thereof is taken up by plastic windows for both forward and upward vision, whereby the weight of the helmet is reduced. Further reduction in weight has also been accomplished by elimination of parts in the modified construction of the control valve in which the "Hoke" or oxygen controlling valve is directly connected to the high pressure side of the main needle valve thereby eliminating an adapter as used in the conventional combination of air control and "Hoke" valves. Also the exhaust valve structure has been modified to compensate for the lighter weight of the diving suit by reduction of the length of the coiled spring employed therein.

It is, therefore, the general object of the invention to provide a relatively light weight diving suit which may be used in underwater mine disposal and demolition work.

It is also an object of the invention to provide a relatively light weight diving suit of the portable or self-contained type.

It is a further object of the invention to provide such type of light weight diving suit which may be operated "circulating" as in the manner of operation of conventional types of diving suits and in which air is supplied under pressure to

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the diver from an outside source, or "recirculating" as the particular circumstances attending the operation may require.

It is another object of the invention to provide a diving suit, of relatively light weight, which affords the diver greater freedom of movement than that which is obtained in the conventional diving suits.

It is still another object of the invention to provide a relatively light weight suit in which the diver has a range of vision through the helmet of approximately one hundred and eighty degrees looking forward and also an additional range of vision through the forward top of said helmet.

With these and other objects in view, as will hereinafter more fully appear, and which will be more particularly pointed out in the appended claims, reference is now made to the following description taken in connection with the accompanying drawings which are merely illustrative of a preferred embodiment of the invention and in which:

Fig. 1 is a perspective view of the diving suit of this invention showing the recirculating canister attached to the helmet;

Fig. 2 is a partial perspective view of the diving suit when equipped for circulating operation, i. e. without the canister attached to the helmet;

Fig. 3 is a perspective view of the clamping ring and wear preventing shim of this invention as used for clamping the diving dress to the helmet ring to make a water-tight seal therewith;

Fig. 4 is an exploded perspective view of the safety latching means used to allow for wear on the rubber gasket inserted in the helmet ring and to prevent accidental loosening of the helmet from the helmet ring;

Fig. 5 is a vertical section taken on line 5—5 of Fig. 4 showing the latching means locked with respect to the helmet and the helmet ring;

Fig. 6 is a top plan view partially broken away of the recirculating canister and means for attaching said canister to the rear portion of the helmet;

Fig. 7 is an enlarged sectional view illustrating the jet principled recirculating arrangement;

Fig. 8 is a perspective view of the helmet ring and breastplate assembly;

Fig. 9 is a perspective view of the breastplate;

Fig. 10 is a sectional view of the breastplate taken on line 10—10 of Fig. 9;

Fig. 11 is a perspective view of the Control and "Hoke" valve assembly;

Fig. 12 is a sectional view taken along line 12—12 of Fig. 11;

Fig. 13 is a perspective view showing the arrangement of the shoulder pad harness and its relationship to the helmet ring and breastplate; and

Fig. 14 is a perspective elevational view of the safety ring clamp, partly shown in Fig. 11.

Referring to the drawings the complete diving gear of this invention is shown generally at 20 in Fig. 1. This gear comprises a pair of light weight diving shoes 22 which may weigh around sixteen pounds each. Knee or shin guards are shown at 24. The diving dress is of light weight and comprises trousers 26, jacket 28 and gloves 30. The trousers and jacket may compose a unitary garment. When the dress is of this unitary structure the opening through which the diver puts on or takes off the dress is enlarged. This opening is closed water-tight by a plurality of flaps 32 which are folded, gathered and sealed by clamp 34. Helmet ring 36 (Fig. 8) comprises a neck flange 38, the lower part of which fits snugly within the neckband of jacket 28 and forms a water-tight seal therewith in cooperation with neck ring clamp 39 which, in conjunction with shim 40 and by means of turn-buckle screw 41, bears uniformly on the neck band of the diving dress immediately below horizonal flange 42 of the helmet ring. (See Fig. 5.) Extending laterally from flange 42 are hooked lugs 43 which function to support and hold weight straps 172 and 174. Seating gasket 45 is inserted in a groove in the top face of flange 42 and forms a water-tight seal when helmet 53 is placed thereon. An arcuately notched locking lug 46 extends laterally from flange 42 in alignment with one of the threaded segmental lugs 48 which are positioned around the exterior surface of neck flange 38. Breastplate 50 which constitutes one of the features of this invention, as shown in Fig. 8 and Fig. 9 may consist essentially of a rectangular brass plate of which a large part has been removed to form an opening therein. This breastplate as shown in Fig. 9 is substantially of U shape configuration to conform to the shoulders of the diver. It is securely attached to the underside of flange 38 and serves to orient the helmet ring on and to transmit the weight of the assembled helmet and ring to the shoulders of the diver through shoulder pads 51 as shown in Fig. 13. The underside of breastplate 50 may be lined with a resilient material, such as sponge rubber, as shown at 52.

Helmet 53 which is adapted to fit on helmet ring 36 and to form a water-tight seal therewith is provided with windows 54 for forward vision. These windows afford a range of vision of about one hundred and eighty degrees. A window for upward vision is provided in the forward top of the helmet at 56. At 57 is shown the telephone recess. A canister for recirculating operation is shown at 58 attached to the rear of the helmet. There are a plurality of gooseneck connections on the rear of the helmet. These are 60 for the exhaust of air from the helmet to the canister, 62 for the inlet of oxygenated air from the canister into the helmet, 64 for the inlet of air under pressure into the helmet for "circulating" operation and 65 for the introduction of telephone lines. At 66 is shown the pressure air feed line from control valve 140. Helmet 53 is also provided with an air exhaust port which is fitted with a non-return valve as shown at 67 and 68 and with spit cock 69 for the exhaust condensate. 68 is the discharge port for exhaust valve 67. When operating "circulating" air, under pressure, enters helmet 53 from line 66 through gooseneck 64 and is exhausted from the helmet through valve 67 and port 68.

On the interior surface of and around the lower part of helmet 53 there is provided a plurality of segmental lugs 49 which are exteriorly threaded and are adapted to engage similar lugs 48 positioned on the exterior surface of neck flange 38 of helmet ring 36. Helmet 53 is placed in water-tight relationship with respect to gasket 45 on helmet ring 36 by setting the helmet with its lower edge resting on the gasket. The helmet is readily set on the gasket by turning it through such an angle that segmental lugs 48 and 49 are clear of each other. The helmet is then rotated through an angle to bring the front window into proper alignment with the line of vision thereby causing the threads on lugs 48 and 49 to engage and to drive the lower edge of the helmet into water-tight contact with gasket 45.

Means for prevention of the accidental disengagement of threaded lugs 48 and 49 is provided. This means comprises a threaded screw 70 which engages interiorly threaded lug 72 which is securely attached to the exterior surface of helmet 53 and extends over arcuate notch 47 in lug 46. Screw 70 is provided with a shank 71 which, when the helmet is rotated in sealed relationship, extends into arcuate notch 47. This projecting shank is movable within the limits of this arcuate notch to compensate for the wearing away of gasket 45, but because of the terminal limits of notch 47 prevents the accidental disengagement of lugs 48 and 49.

A device for locking screw 70 in extended position is provided. This device comprises a lock pin 74 which when hole 76 in lug 72 is in alignment with hole 78 in screw 70 is adapted to enter therein thereby preventing accidental rotation of screw 70. Pin 74 may be secured to ear 80 on lug 72 by any flexible means such as chain 82.

Canister 58, shown in section in Fig. 6, comprises a hollow cylindrical body provided with end caps 84 and 86. Cap 84 is hingedly mounted on canister body 58 as at 88 and is held in water-tight contact of gasket 89 with the bearing edge 90 by means of the coaction of bifurcated lug 92 with pivoted threaded bolt 94 and wing nut 96 as shown in Fig. 1. Within canister 58 air purifier unit 98 is positioned in sealed relationship with respect to end wall 87 of end cap 86 by means of the bearing of end cap 84 on resilient handles 91 which are securely attached to the side walls of the unit 98. A port 93, communicating with space 95 in the head end of the canister, is provided in boss 97. This boss is connected to gooseneck 60 by means of flanged bushing 99 which fits telescopically within port 93 and is firmly attached to boss 97 as by welding or otherwise. Bushing 99 in cooperation with flanged interiorly threaded nut 100 constitutes a coupling means for attachment of canister 58 to gooseneck 60. An air-tight seal is formed in this attachment by the bearing of bushing flange 101 on sealing gasket 102. A substantially unobstructed passageway for the flow of air from the interior of the helmet into the canister is thereby provided. At the other end of canister 58, cap 86 is provided with chambers 104 and 106. Partition wall 108 separates chambers 104 and 106. Interiorly threaded port 110 in wall 108 extends between chambers 104 and 106. Chamber 104 communicates with the interior of canister 58 and, when purifier unit 98 is in place,

is adapted to receive air from the interior of helmet 53 purified and dried by passage through the purifier unit. Venturi tube 112 is firmly mounted within chamber 106 by threaded engagement with interiorly threaded port 110. This Venturi tube 112 discharges into flanged bushing 114 which in combination with flanged coupling nut 116 constitutes a coupling to gooseneck 62. Bushing 114 is connected to tubular bushing 118 making a lap joint therewith as shown at 120. There is thus provided a path of gas flow from chamber 104 and purifier unit 98 to the interior of helmet 53. Bushing 118 is provided with a plurality of flanges 122 which serve to position bushing 118 within gooseneck 62.

As shown in Figs. 6 and 7, nozzle 130 is mounted in the wall of end cap 108 to discharge into the throat of Venturi tube 112. When this nozzle discharges into the throat of the venturi, a suction is created in chamber 104 thereby causing a flow of gas through purifier unit 98 and back into helmet 53. Nozzle 130 is connected to gas supply line 132, in which the gas flow is under the control of "Hoke" valve 170. The gas supplied may be oxygen. Nozzle 130 is mounted on base plug 134 which threadedly engages the end wall of cap 86 as at 136. Plug 134 may be connected to gas line 132 by adapter 138.

As shown in Figs. 11 and 12, the control valve shown generally at 140 comprises valve body 141 which is provided with inlet port 142 and outlet port 143 both of which communicate with valve chamber 144. This chamber is provided with a valve seat 145 which coacts with valve head 146 mounted on valve stem 147 to open and close the valve to the flow of gas under pressure therethrough. Valve stem 147 threadedly engages cap nut 148 as at 149 which in turn threadedly engages valve body 141 as at 150. Valve stem 147 extends through packing gland 151 which comprises the usual packing 152, compression ring 153 and compression nut 154 which is adapted to engage threads 155 on the exterior surface of gland 151. Valve stem 147 extends through compression nut 154 through safety stirrup clamp 156 and on its reduced end 157 is provided with hand wheel 158. A source of air or other gas under pressure is fed into port 142 from line 139 as indicated in Fig. 2. This gas may be fed from valve 140 through port 143 to line 66. Safety stirrup clamp 156 is adapted to be fastened to valve body 141 by screw means such as 159. When in position shown in Fig. 11, it prevents rotation of both cap nut 148 and compression nut 154 thereby preventing the accidential disassembling of the valve structure. Eye lug 160 is rigidly attached to the body of valve 140 and is freely attached to chest weight 161 by means of snap link 163 and loop 164 which is firmly attached to weight 161 (see Fig. 2). Control valve 140 is thus movably supported by the weight harness and can be readily operated by the diver.

Hoke valve 170 is tapped into throat 171 of valve body 141 on the pressure side of valve seat 145 and its discharge port is in communication with line 132 to the inlet of base plug 134 and nozzle 130. As shown in Figs. 11 and 12, Hoke valve 170 is a needle valve which is capable of regulating the amount and rate of flow of gas therethrough.

The diving gear includes chest and back weights 161 and 162 which are of such weight as to give the diver a negative buoyancy so that he may readily move around when submerged. These weights are interconnected by shoulder straps 172, 174 which pass through and are held by hooked lugs 43, straps 176, 178 which pass around the waist and by strap 179 passing through the crotch of the diver. The weights are thus held relatively fixed with respect to vertical movement, but can move laterally to some degree.

In the usual recirculating operation of the diving gear, valve 146 is seated on seat 145 and Hoke valve 170 is opened to permit and regulate the flow of gas, such as oxygen, through the Venturi nozzle and tube to be admixed with the air withdrawn from the interior of helmet 53 after said air has been passed through purifier unit 98. When operating "recirculating" as above described, feed line 139 is connected to a source of oxygen or other gas under pressure.

When operating "circulating," "Hoke" valve 170 may be closed, valve 146 is moved from seat 145 and air or other gas passed through port 143, through line 66 and gooseneck 64 into the interior of helmet 53. In this type of operation air is exhausted from the interior of the helmet through exhaust valve 67.

The method of operation of the diving gear is believed to be apparent from the above description. This suit is capable of operation on a pressure bottle source of gas or on the conventional compressor pressurized air system. If the operation is "recirculating" as above described, the Hoke valve is opened all the way and circulation through the helmet is maintained by the injection principle of the jet. Pressure at the jet is maintained at 50 pounds per square inch over that of the surrounding water. This pressure is controlled by the surface crew, the rate of flow into the helmet being dependent upon the size of the orifice in the jet. If the operation is "circulating" pressure on the feeding air is maintained at about 30 lbs. per square inch over that of the surrounding water, by the surface crew. The rate of flow into the helmet is under the control of the diver by means of the control valve. In either case the pressure in the suit should be approximately 2 pounds per square inch over that of the surrounding water. The pressure in the suit is maintained by the tension of the exhaust valve spring.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. Diving gear for use in underwater mine disposal, demolition work and the like comprising a light weight diving dress provided with a neck opening, a helmet ring positioned in the neck of said diving dress, adjustable clamp means for sealing the neck of said dress to said helmet ring, a light weight breastplate extending fore and aft securely attached to said helmet ring, shoulder pads in said gear for supporting said breastplate, a helmet adapted to be removably attached to said helmet ring in water-tight sealed relationship therewith, said helmet and dress being in internal communication with each other so that admission of air into said helmet will inflate said dress, wide angle vision windows in said helmet for forward vision and a top window in said helmet for upward vision, said helmet provided with a plurality of ports for the admission of air under pressure for circulatory opera-

tion, for the admission of air admixed with oxygen for recirculating operation, for the exhaust of air in circulating operation, for the exhaust of air in recirculating operation, for the admission of telephone cables, and for the exhaust of moisture condensate and water, a canister provided with an air purifier unit removably mounted on the rear of said helmet in communication at one end with the port for the exhaust of air in recirculating operation and at the other end with the throat of a Venturi tube connected to the port for the admission of air admixed with oxygen whereby the flow of gas through the Venturi tube withdraws air from said helmet, through the said purifier unit in the canister and reintroduces the residual withdrawn air into said helmet, a control valve in communication on its inlet side with a source of air or oxygen under pressure and connected on the discharge side with the port in said helmet for the admission of air thereinto, a needle valve in communication with the high pressure side of said control valve and with the feed end of said Venturi tube whereby, in recirculating operation, the rate of flow of oxygen to said helmet is controlled.

2. In diving gear for use in underwater mine disposal, demolition work and the like, a light weight diving dress provided with a neck opening and band therearound, a helmet ring positioned within said neck opening and band, said ring comprising an annular ring of T shape cross-section, the cross bar of the T constituting a vertically extending annular flange and the stem of said T constituting a supporting and sealing surface, two upturned ears diametrically opposed on said stem and adapted to carry weight straps, the upper surface of said stem provided with an annular groove with a gasket therein, a plurality of exteriorly threaded segmental lugs spaced around the exterior surface of said flange integral therewith and positioned above said stem, a helmet adapted to fit around said flange, to rest on said gasket and provided with a plurality of exteriorly threaded segmental lugs on its inner surface adapted to threadedly engage and interfit with the lugs on said flange whereby as said helmet is placed on said ring and rotated into position, a water-tight seal is formed with said gasket, an arcuately slotted lug positioned on said stem to extend said slot beyond and parallel to the exterior surface of said helmet, an interiorly threaded tubular lug securely attached to the exterior surface of said helmet and projected over the arcuate slot in said lug and a screw adapted to threadedly engage said tubular lug on said helmet and to project into said arcuate slot in said lug, a transverse hole in said tubular lug, a transverse hole in said screw, a pin adapted to pass through both said holes

to lock said screw in position within said arcuate slot to thereby permit limited rotation of said helmet with respect to said helmet ring and to prevent disengagement of the threaded lugs on said helmet with those on said flange.

3. The combination set forth in claim 1 but further characterized by said breast plate comprising a rectangular plate provided with a centrally located opening therein, a layer of resilient material on the underside of said plate, said plate bent into an approximate U shape to fit over the shoulders of the wearer of said diving gear, to rest on the shoulder pads of said wearer, said plate securely attached to the underside of said helmet ring and adapted to extend downwardly, fore and aft, to thereby comfortably orient and transmit the weight of said helmet, helmet ring and breastplate to the shoulders of the wearer of said diving gear.

4. The diving gear set forth in claim 1, including a single body member carrying both the control and needle valves in parallel arrangement whereby either valve may independently open or close off gas flow.

5. Diving gear comprising: a helmet provided with a main inlet port and a main outlet port through which air is passed in circulatory operation, an air hose connected to said main inlet, a main control valve connected to said hose, a second inlet and a second outlet, an air purifying unit removably connected between said second inlet and outlet so that impure air drawn from the helmet may be purified and returned to the helmet, an oxygen introduction nozzle within said purifying unit, an oxygen carrying tube connected to said nozzle, a secondary valve connected to said tube, a single body member located off the helmet and integrally carrying both valves in parallel arrangement whereby either valve may independently open or close off gas flow.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
484,885	Stove	Oct. 25, 1892
1,162,525	Stelzner	Nov. 30, 1915
1,843,032	Koch	Jan. 26, 1932
2,238,759	Vestrem	Apr. 15, 1941
2,388,674	Browne	Nov. 13, 1945
2,417,177	Richon	Mar. 11, 1947

FOREIGN PATENTS

Number	Country	Date
895,719	France	Apr. 11, 1947