NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

November 6, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for
Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,502,074

Government or
Corporate Employee : U.S. Government

Supplementary Corporate
Source (if applicable) : NA

NASA Patent Case No. : XMS-04935

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐ No ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

Elizabeth A. Carter

Enclosure
Copy of Patent cited above

N71-11190

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N71-11190

March 24, 1970 R. L. JONES ET AL 3,502,074

HELMET ASSEMBLY AND LATCH MEANS THEREFOR

Filed Jan. 3, 1966 6 Sheets-Sheet 1

Fig. 1

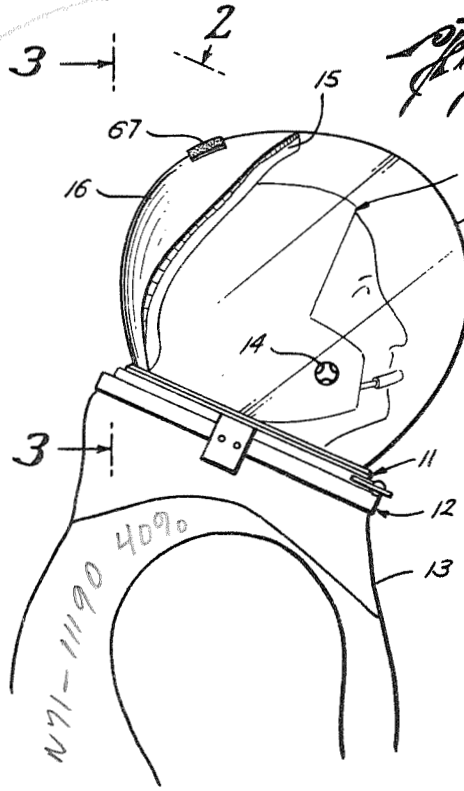

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Fig. 2

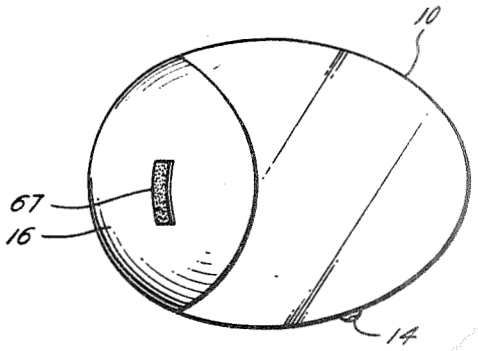


Fig. 3

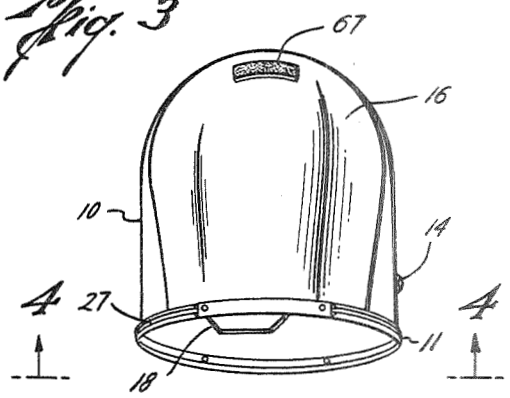
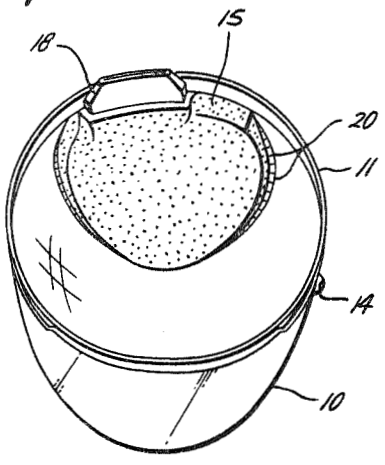


Fig. 4



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HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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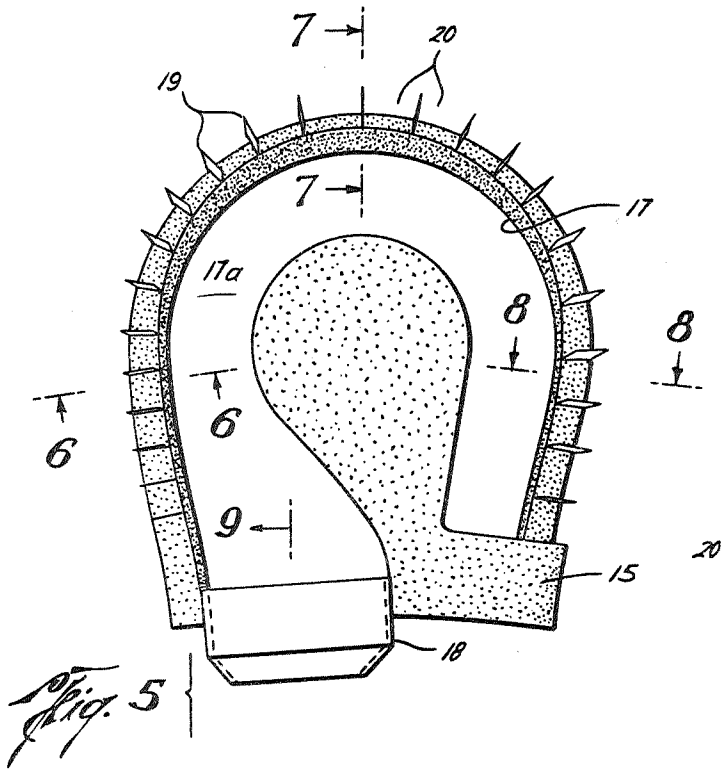


Fig. 5

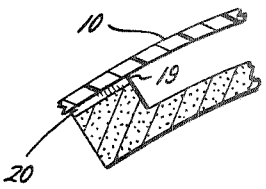


Fig. 6

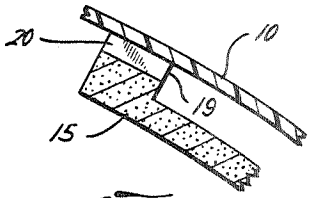
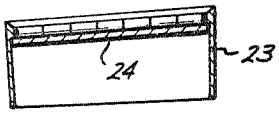


Fig. 7



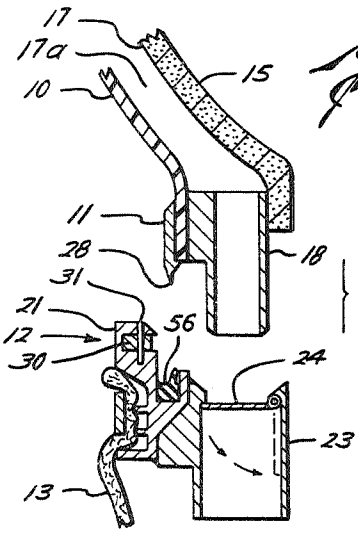


Fig. 9

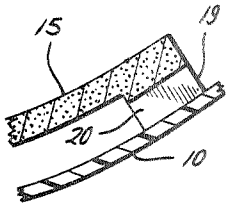


Fig. 8

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HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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Fig. 10

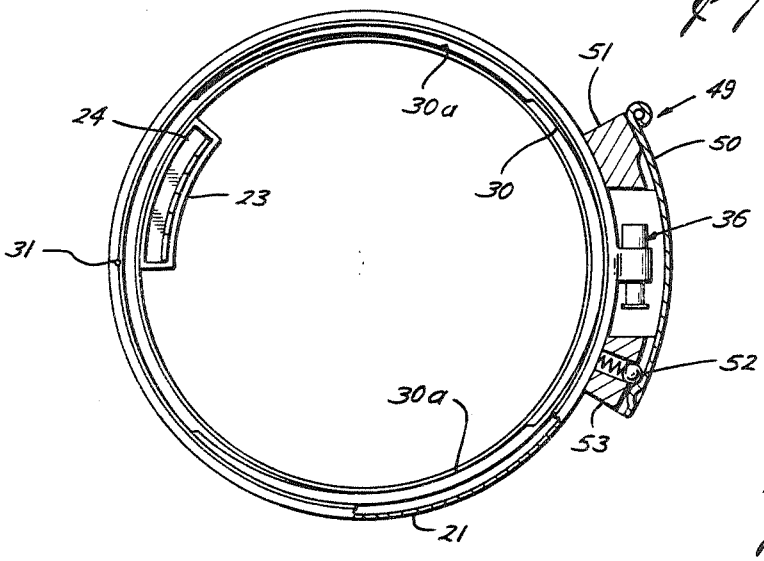


Fig. 11

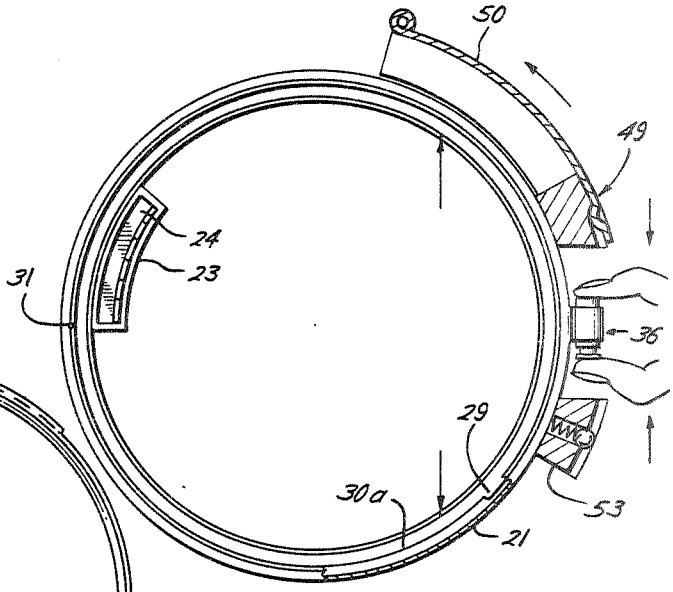
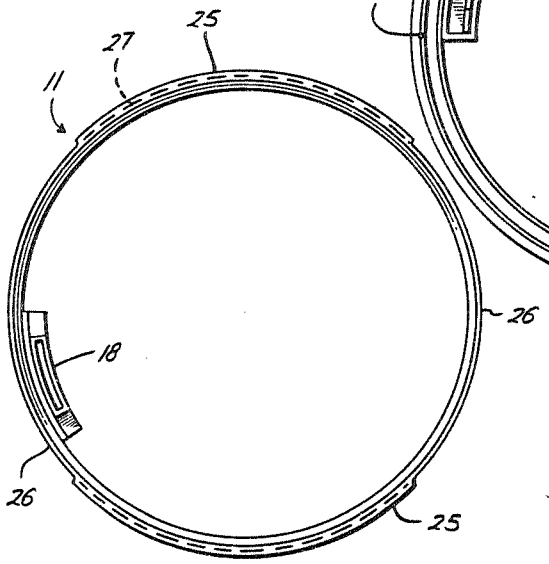


Fig. 12



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HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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Fig. 13

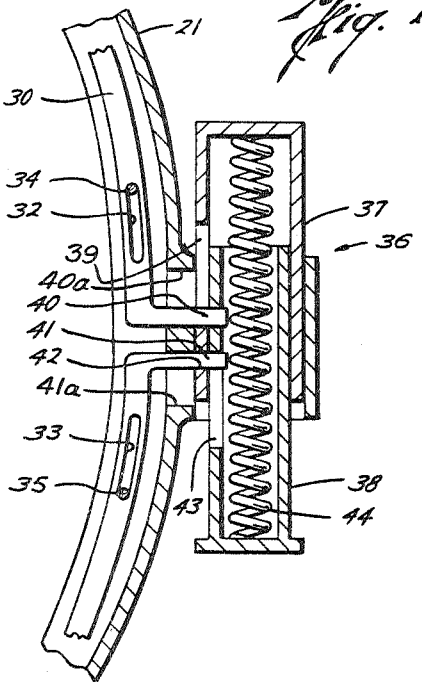


Fig. 14

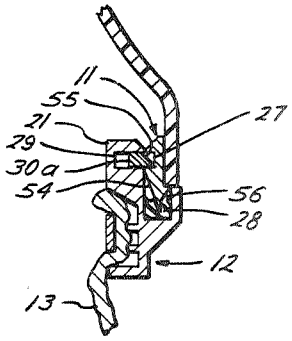


Fig. 18

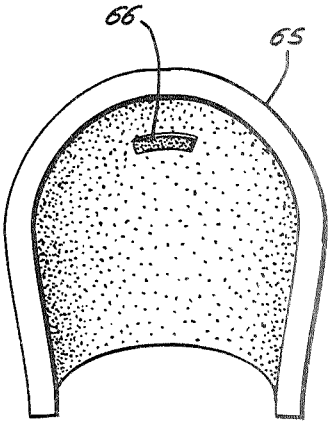
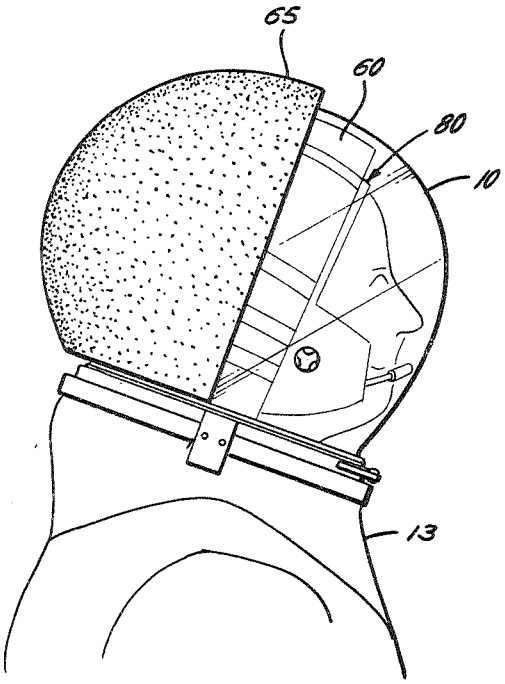


Fig. 19



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HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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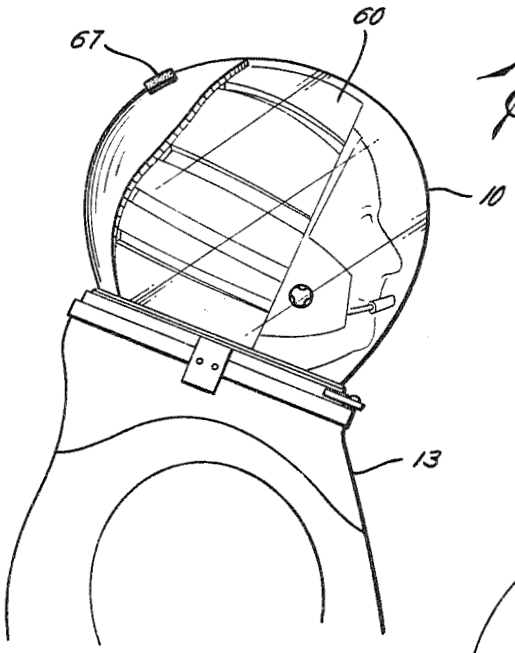


Fig. 17

Fig. 15

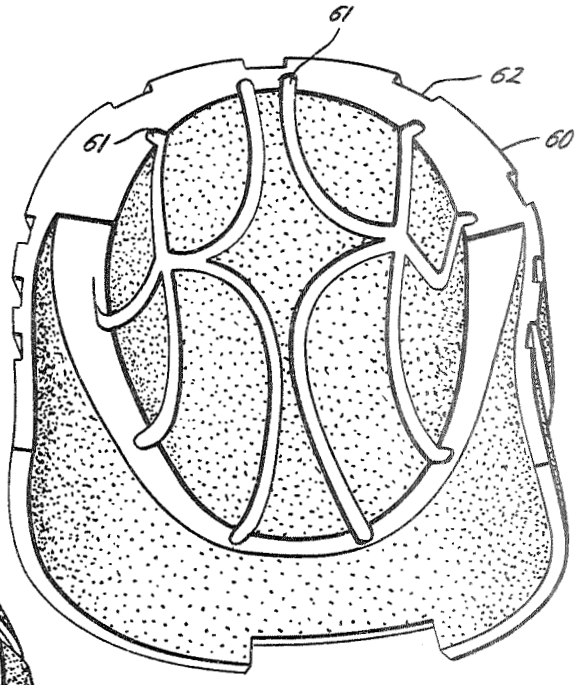
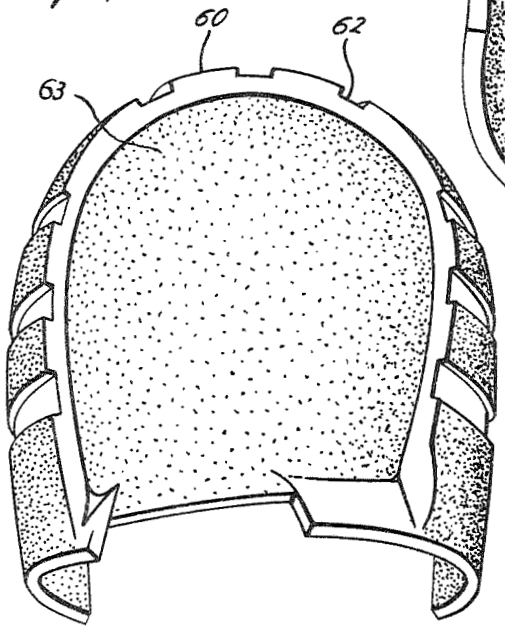


Fig. 16



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HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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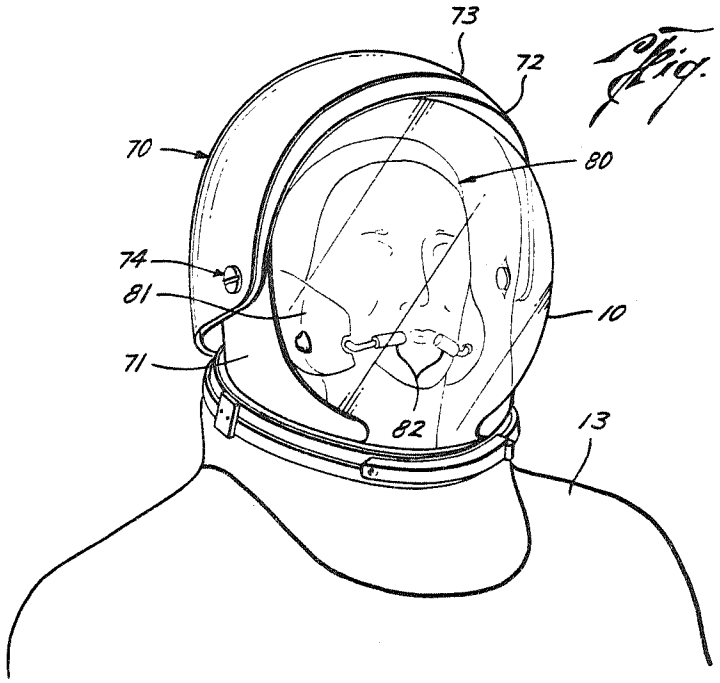

Fig. 23

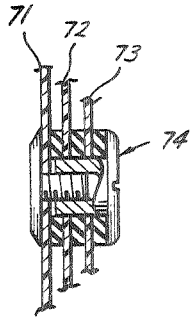

Fig. 22

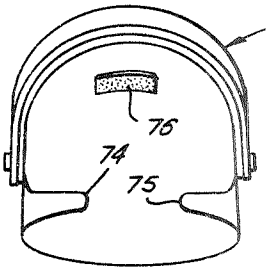

Fig. 20

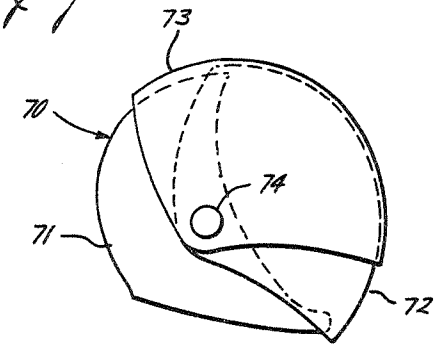

Fig. 21

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3,502,074

HELMET ASSEMBLY AND LATCH MEANS THEREFOR

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Filed Jan. 3. 1966, Ser. No. 518,487
Int. Cl. A62b 7/00; A42b 3/00
U.S. Cl. 128—142.5 15 Claims

ABSTRACT OF THE DISCLOSURE

A helmet assembly formed of a transparent shell of polycarbonate resin of single unit construction. The shell is shaped so as to allow complete freedom of normal head movement, and at the same time be of as small volume as possible. An air distributing and shock absorbing pad is secured in the rear of shell and cooperates with an air valve in the suit for supplying air for breathing, cooling, and defogging. To secure the shell to the suit an automatic latching means allows the wearer to merely position shell over his head and push downward to securely latch the shell. A push button mechanism releases the shell. Impact protection for severe impact periods, e.g., launch, reentry, etc., is provided through the use of a removable internal bump cap and an external pad. The communications are carried on a skull cap which can be worn with or without the shell. An extravehicular, snap-on visor assembly is provided to protect the wearer against glare and radiation.

This invention relates to a helmet assembly and more particularly to a lightweight, protective helmet assembly of the type normally worn with a pressurized flight suit.

Pressure suits which are worn by personnel aboard high altitude aircraft and manned spacecraft include as a part thereof a helmet which completely encloses the head of the wearer. Such helmets must be constructed to provide maximum visibility for wearer and at the same time must also provide adequate impact protection, operational simplicity and reliability, proper breathing atmosphere, anti-fogging of the visor area, quick don/doff capability, adequate cooling and ventilation, and a high degree of comfort for the wearer. Also, since the cabin of the craft in which such helmets are normally worn is small and congested, it is extremely important to make the helmet as small and as lightweight as possible without seriously affecting the comfort or visual range of the wearer. Still further, where the wearer engages in extravehicular activity, i.e., leaving a spacecraft while in orbit, the helmet must protect wearer from the intense glare of the sun and from any harmful radiation that may be present.

Heretofore, flight suit helmets have been of two basic types, i.e., fitted helmets and "fishbowl" helmets. A typical fitted helmet consists of a large, bulky shell of relatively heavy, non-transparent material having a face opening therethrough to which a transparent visor is fitted. This visor may either be permanently fixed or, as is more often the case, may be movably mounted on a shell so that the visor can be opened when desired. Either way, there is always a problem of properly sealing the visor on the shell so that there will be no leak when the helmet is pressurized. The interior of the helmet is individually contoured to snugly fit the head of the wearer, and has communications means for the wearer built therein. Fitted helmets have restricted peripheral visibility and therefore must be rotatably and pivotally mounted on the flight suit

in order to provide an acceptable range of vision. However, by requiring wearer to move the entire helmet every time he moves his head, pressure points are set up on his head and neck which can lead to severe discomfort whenever the helmet is worn for long periods of time. Also, the rotatable connections required for a fitted helmet present problems both in properly sealing the helmet to the suit, and in providing quick don/doff capability for the helmet. The donning and doffing of a fitted helmet is further complicated by the fact that the necessary connections for the built-in communications system must be disconnected each time the helmet is removed.

A typical fishbowl helmet (a helmet which resembles a fishbowl inverted over the head of the wearer) is comprised of a transparent globular shell, and is attached to the suit so that it will not rotate or pivot with respect thereto. Due to the fact that wearer has complete freedom of head movement within the shell, such a helmet not only allows maximum visibility, but is also considerably more comfortable than a fitted helmet. However, prior art fishbowl helmets have not proven satisfactory for actual use with flight suits for a number of reasons. First, these helmets fail to provide the necessary impact protection during those periods in which severe impacts might be encountered, e.g., landings, take-offs, etc. The wearer's head, which is free to move within the fishbowl shell, has no support within the shell and may be whipped against the back of the shell whenever a severe impact occurs. Also, prior art fishbowl helmets require wearer to don a separate mask for breathing, which adds both to his discomfort and to the time required to don/doff the helmet. Further, previous helmets of this type require sophisticated neck closures between the shell and the suit through which wearer must insert his head in order to provide the proper atmosphere within the helmet. This closure forms a seal about wearer's neck which makes donning a suit and helmet using such a closure very difficult, and almost impossible to do without assistance. This neck seal further adds to the discomfort of the wearer, especially where the suit and helmet have to be worn for long periods of time. The donning and doffing of prior fishbowl helmets has also required considerable effort on the part of wearer since the previous means for securing the helmets to the suits have been difficult to operate, especially when wearer is wearing bulky flight gloves.

Heretofore, all of the helmets used in actual space applications have been of the fitted type. These helmets, as described above, are interiorly contoured to fit the head of each individual wearer, and are rotatably and pivotally mounted on the flight suit. Besides being very heavy, such helmets are almost impossible for wearer to don without assistance; have a relatively low visibility range; and are uncomfortable when worn for prolonged periods. Fishbowl helmets have received consideration in the past, but have been rejected because of the serious deficiency in impact protection, and for other reasons set forth above. Extensive research and development programs have merely resulted in more sophisticated and refined fitted helmets which still have the deficiencies inherent in this design.

The present invention, which has been adopted by the United States for its future space programs, constitutes a major breakthrough in the aerospace helmet art in that it provides a helmet assembly which has the advantages of both a fishbowl helmet and a fitted helmet, but one which overcomes the disadvantages previously associated with each of these type helmets. The present helmet assembly has as its basic unit a clear, transparent, specially-shaped shell of extra strong and heat resistive material which can be quickly and easily donned and doffed by the wearer without assistance of any kind. The shell is specifically designed to allow complete freedom of head movement

in the least possible volume, thereby allowing maximum visibility and comfort for the wearer, while at the same time substantially reducing the overall size of the assembly. Cooperating latch means on the neck opening of the flight suit and the helmet shell allow the shell to be quickly and automatically snapped into place on the suit without requiring any additional effort on the part of wearer. The shell is easily released for removal by a push button mechanism on the latch means which can be reliably operated by the wearer even while he is wearing the bulkiest of flight gloves.

Permanently positioned in the rear of the shell is a gas distributing pad of shock-resistive material, the inlet of which cooperates with a valve in the flight suit to distribute gas for breathing and for defogging throughout the shell. Due to the construction of this pad, the need for special breathing masks and seal around the neck of the wearer is eliminated. This pad also serves to provide impact protection for wearer during portions of the flight where only slight impacts are encountered. For severe impact periods, a preformed, slightly resilient internal bump cap is inserted into the shell to hold the head of wearer in a relative stationary position with respect to the shell. Also, to give even further impact protection to wearer, an external impact pad is provided that can be removably secured on the rear exterior of the shell during severe impact periods. The reason for placing this pad externally on the shell is that it substantially increases the impact protection for wearer without increasing the size of the basic helmet shell, as will be more fully explained below.

The present helmet assembly also includes a visor assembly which can be positioned over the shell to protect wearer from glare and radiation during any extravehicular activity. In the present invention, the communication means for wearer are on a lightweight skull cap which is continuously worn by wearer so that the connections for these means need not be disconnected every time the shell is removed. This greatly decreases the time required for wearer to don and doff the present helmet assembly.

The above mentioned and other advantages of the invention will be more readily appreciated as the invention becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a side view of the helmet shell in accordance with the present invention in an assembled position on a flight suit;

FIG. 2 is a top view of the helmet shell taken along section 2—2 of FIG. 1;

FIG. 3 is a back view of the helmet shell apart from the flight suit taken along section 3—3 of FIG. 1;

FIG. 4 is a bottom view of the helmet shell of FIG. 1;

FIG. 5 is an exploded view, partly in section, of the back side of the distributor pad within the helmet of FIG. 1 and the gas outlet valve within the suit;

FIG. 6 is a cross sectional view taken along section 6—6, FIG. 5, partly broken away;

FIG. 7 is a cross sectional view taken along section 7—7, FIG. 5, partly broken away;

FIG. 8 is a cross sectional view taken along section 8—8, FIG. 5, partly broken away;

FIG. 9 is a cross sectional view taken along section 9—9, FIG. 5, partly broken away;

FIG. 10 is a top view, partly in section, of the connecting mechanism mounted in the neck ring of the suit of FIG. 1;

FIG. 11 is a top view, partly in section, of the mechanism shown in FIG. 10 when it is in a released position;

FIG. 12 is a bottom view of the assembly ring affixed to the opening in the helmet shell of FIG. 1;

FIG. 13 is a cross sectional view of the release mechanism for the connecting mechanism of FIG. 10;

FIG. 14 is a cross sectional view, partly broken away, of the helmet assembly ring and the suit neck ring when in assembled position;

FIG. 15 is a perspective view of the internal surfaces of an internal bump pad which is to be used with the helmet shell of FIG. 1;

FIG. 16 is a perspective view of the external surface of the internal bump pad shown in FIG. 15;

FIG. 17 is a side view of the helmet with the bump pad of FIG. 15 inserted therein;

FIG. 18 is a front view of an external protective pad which is to be used with the helmet shell of FIG. 1;

FIG. 19 is a side view of the helmet assembly with both the internal pad of FIG. 15 and the external pad of FIG. 18 in position on the helmet shell;

FIG. 20 is a front view of an extravehicular visor assembly to be used with the helmet shell of FIG. 1;

FIG. 21 is a side view of the visor assembly of FIG. 20 with the visors slightly rotated;

FIG. 22 is a cross sectional view of one of the rotatable joints of the visor assembly of FIG. 20; and

FIG. 23 is a front view of the visor assembly of FIG. 20 in position on the helmet of FIG. 1.

Referring more specifically to FIG. 1, helmet shell **10** having attachment ring **11** secured thereto is shown connected to neck ring assembly **12** of pressure suit **13**. Shell **10**, which constitutes the basic unit of the present helmet assembly, is comprised of an extra strong impact resistance, transparent material capable of maintaining both visual and structural integrity while operating at temperatures ranging from −250° C. to 250° C. One such material is a thermoplastic polycarbonate resin commercially available under the trade name Lexan. A sheet of such lightweight material, approximately 3/16 of an inch, can be shaped into the desired configuration by deep-draw molding processes well known in the molding art. It is pointed out that the entire shell **10** is of one-piece construction with no seams, or the like, to distort visibility. Also, shell **10** has only one penetration therethrough beside the neck opening at its lower end, that being feed port **14**. Port **14**, which allows wearer to eat while wearing shell **10**, is located at the side of shell **10** to prevent it from interfering with the vision of the wearer. The actual construction of this feed port forms no part of the present invention, and could be any of a variety of well known types such as the feed port disclosed in U.S. Patent No. 3,067,425. By so limiting the penetrations, not only is the reliability of shell **10** as a pressure vessel increased, but also the number of openings that must be sealed is reduced to a minimum.

The actual ovoid-like configuration of shell **10**, as shown in FIGS. 1 to 4 inclusive, is determined from actual measurements of wearer's head. For example, by use of multi-exposed photographs the exact dimensions required for full movement of wearer's head in both the horizontal and vertical directions can be accurately determined, and shell **10** can accordingly be designed to allow such movement in the least amount of volume possible. Where the shell is to be used in small congested areas such as spacecrafts, this significant reduction in size is of extreme importance.

Referring now to FIGS. 1 and 5, shell **10** has a gas distributing pad **15** permanently secured (as by bonding or the like) inside the rear of shell **10**. As shown in FIG. 5, pad **15**, which is comprised of a foam material such as polyurethane, and is contoured to the same basic configuration of the rear internal surface of shell **10**, has a C-shaped recess **17** in its rear face so that when pad **15** is in place within shell **10**, recess **17** cooperates with shell **10** to form a passage **17***a* about the rear of shell **10** (see FIG. 9). One end of recess **17** extends to the lower edge of pad **15**, and is fluidly connected to a male inlet fitting **18** which in turn is fixedly attached to shell **10**. The other end of recess **17** terminates above the lower edge of pad **15**, as clearly shown in FIG. 5. Em-

bedded in pad 15 are fin-like elements 19 which contact the internal surface of shell 10 to form openings 20 which are in fluid communication with recess 17. Fins 19 are of progressively larger width, beginning with those nearest the male member 18 and progressing towards the closed end of recess 17 (see FIGS. 6, 7, and 8). By progressively enlarging each fin, the areas of openings 20 are also progressively enlarged which allow gas entering recess 17 through member 18 to be proportionately distributed throughout shell 10, i.e., the small openings 20 near inlet 18 will restrict the flow of gas to insure that some gas will reach the large openings 20 at the other end of passage 17*a*. The exterior surface of the area of shell 10 which overlies pad 15 is painted with heat reflective paint 16 to aid in keeping the circulating gas cool as it passes through shell 10.

Mounted within suit 13 at the rear of neck ring assembly 12, is gas inlet valve 23 (see FIGS. 5 and 9). The valve 23 comprises a spring loaded flapper valve 24 which is normally in the closed position shown in FIG. 9. When the helmet is in place, male member 18 contacts flapper valve 24 to move it to an open position shown by the dotted lines in FIG. 9, and allows gas from the suit to enter passage 17*a* of the distributor pad. This gas, which is normally oxygen, provides the proper atmosphere for breathing, and since the gas is directed against the walls of the helmet, it also serves to keep the helmet in a defogged condition at all times. As there is a steady flow of gas downward around the head, the CO_2 exhaled by wearer is carried into the suit and exhausted therefrom by valves mounted in the suit (not shown), this exhaust procedure within the suit being well known in the art. This eliminates the need for a separate breathing mask and the bulky connections therefor. Also, there is no need for a bulky diaphragm around the neck of wearer to seal the neck opening of shell 10 from suit 13, as is normally done in the prior art helmets of this type.

The helmet shell 10 has attachment ring 11 concentric to the neck opening therein and is fixedly secured thereto by means of bonding, or the like. Ring 11 is divided into four quadrants (FIG. 12), two raised 25 and two recessed 26, the reason for which will be explained below. Raised quadrants 25 have groove 27 (see FIGS. 3 and 14) extending around their circumference to provide a means for attaching shell 10 to suit 13, as will be more fully explained below. The lower edge 28 of ring 11 is tapered to a fine edge, as shown in FIGS. 9 and 14.

Mounted on suit 13 is neck ring assembly 12 which comprises annular housing 21 having groove 29 extending around the inner circumference thereof. Split ring 30 is positioned in groove 29 and is secured its rear portion to housing 21 by means of pin 31 (see FIG. 9). Ring 30 also has two elongated slots 32, 33, one on either side of the split in the front portion of the ring, said slots 32, 33 cooperative with fixed pins 34, 35, respectively, to allow limited movement of ring 30 within groove 29. Ring 30 has two diametrically opposed raised portions 30*a* which extend outside of groove 29, as shown in FIG. 10, when ring 30 is in its normal or contracted position. Each end of ring 30 terminates with a radially extending ear 40, 41, which pass through elongated opening 40*a*, 41*a*, respectively, in housing 21.

To expand ring 30 to a released position (FIG. 11), push button mechanism 36 (FIG. 13) is used. Mechanism 36, which is mounted on housing 21, comprises cylinder 38 telescopically received in cylinder 37. Ear 40 of split ring 30 passes through elongated slot 39 on cylinder 37, and is affixed to cylinder 37. Ear 41 of ring 30 passes through opening 42 in cylinder 37 which is approximately the same size as end 41, and passes into elongated slot 43 in cylinder 38. Spring 44 is positioned between the ends of cylinders 37 and 38 to normally hold them in an expanded position. It can be seen from FIG. 13 that if cylinders 37 and 38 are pressed toward each other, ears 40 and 41 will be moved away from each other to expand ring 30. This moves raised portions 30*a* into groove 29 to allow release of the helmet, as will be more fully explained below.

Protective means 49 is provided on housing 21 to insure against accidental release of ring 30. Means 49 comprise cover 50 slidably mounted on fixed member 51. When cover 50 is in its closed position (FIG. 10), it is held in a place by a spring-biased friction detent 52 which is provided in fixed member 53. Cover 50 can be easily moved to an open position by merely pushing it in the direction shown in FIG. 11.

Little effort is requirely by the wearer to assembly shell 10 on suit 13. He merely positions shell 10 over his head, aligns inlet 18 (which is canted on its sides to aid in alignment—see FIGS. 3 and 4) with gas outlet 23 and pushes shell 10 downward into neck ring assembly 12. Downward movement of shell 11 allows cam surface 54 (FIG. 14) on attachment ring 11 to cooperate with cam surface 55 on split ring 30 to cam ring 30*a* into groove 29. When shell 10 is firmly seated in neck assembly 12, groove 27 in attachment ring 11 will be vertically aligned with raised portions 30*a* which in turn allows 30*a* to expand into groove 27 to lock helmet shell 10 to suit 13. Sealing means 56 is provided in the neck ring assembly 12 which cooperates with edge 28 of ring 11 to form an airtight seal between the suit and the shell. Inlet 18, as briefly discussed above, opens flapper 24 so that a steady supply of gas is circulated through pad 15 to establish the proper atmosphere within shell 10. To remove the shell, wearer merely opens cover 50, presses cylinders 37 and 38 together (FIG. 11) to expand portions 30*a* of ring 30 out of groove 27, and lifts it off his head. This can be done quickly and easily by wearer, even while wearing bulky gloves.

Also, during assembly of the shell on the suit, the recessed quadrants 26 or rings 11 perform an important function. Under normal operating procedures, gas under pressure is admitted into suit 13 during the time wearer is donning helmet shell 10. A portion of this gas continuously escapes from the neck opening of the suit. Without recessed quadrants 26, ring 11 would form a premature seal as soon as it moved into neck ring housing 21, whereby the escaping gas would collect in shell 10. This gas in turn would build up pressure and would work against the wearer's efforts to securely seat shell 10. However, in the present invention the recessed quadrants 26 provide a means for venting the gas which allows wearer to easily lock shell 10 on suit 13. These vents formed by quadrants 26 are completely closed, however, when edge 28 of ring 11 seats on sealing means 47, so that an airtight seal exists between the shell and the suit when in a locked position.

Although distributor pad 15 at the rear of shell 10 provides protection against slight impacts which may be encountered during a normal flight, this pad is insufficient to properly cushion the head during take-offs, landings, and other periods in which severe impacts may occur. To provide the necessary impact protection for such periods, the present helmet assembly includes internal bump cap 60, comprised of any shock-resistant, lightweight material such as polyurethane foam. Cap 60, which is formed to snugly fit the head of the wearer, has a series of passages 61, 62 along its internal and external surfaces, respectively. External passages 62 communicate with openings 19 in distributor pad 15 so that proper ventilation, cooling, and defogging can be maintained while cap 60 is in shell 10. Also, internal passages 61 allow gas within shell 10 to circulate over the head of wearer to aid in cooling. Cap 60, which is of resilient material, can be slightly folded to compress same for insertion and removal, with the natural resiliency holding it in place within shell 10 once it has been positioned. Recess 63 is provided in the rear surface of the cap which

receives distributor pad 15 when the cap is in shell 10. While cap 60 is in place, movement of wearer's head will be restricted, but it is pointed out that cap 60 is only in shell 10 during those periods when wearer's movements are otherwise normally restricted, i.e., strapped in seat for take-off, landing, launch, reentry, etc. By being able to easily remove cap 60 while in flight, a great psychological advantage is imparted to wearer, since during such periods wearer has complete freedom of head movement and substantially unrestricted visibility. Also, by allowing freedom of head movement within shell 10, as opposed to having the head fixed within a fitted helmet, all pressure points on the neck and head of wearer are eliminated, thereby providing considerably increased comfort for the wearer.

To give additional impact protection to wearer during severe impact periods, external bump pad 65 is provided (FIGS. 18 and 19) which is contoured to snugly fit over the rear half of shell 10. This pad 65, which is of shock-resistant, light-weight material such as polyurethane foam, can easily be positioned and removed by wearer without assistance. The natural resiliency of pad 65 will normally hold the pad on shell 10, but to insure the securement of pad 65 on shell 10, a strip of hook tape 66, such as Velcro tape, is secured to the inside of pad 65 which cooperates with a complementary strip of hook tape 67 on shell 10. By providing the additional impact protection through an external bump pad, as opposed to increasing the size of the internal bump cap, the volume of shell 10 can be held to a minimum. This is an important consideration since the periods during which severe impacts are encountered constitute but a small part of the overall flight time. It would be impractical and undesirable to increase the overall volume of the shell which is utilized throughout the flight, just for the small period of time this additional impact protection is needed.

Further, it is recognized that there will be times during space flight when personnel will leave their spacecraft to operate in the hostile environment of space. During this time the possibility exists that such personnel will be exposed to extreme radiation and glare from the sun. To protect against such glare and radiation, the present helmet assembly includes an extravehicular visor assembly 70 (FIGS. 20 to 23) which securely "snaps" over shell 10. Visor assembly 70 is comprised of an open-faced support member 71 having substantially the same shape as the rear half of shell 10, but being slightly larger than said shell. Visors 72, 73 which are mounted on support 71 by means of rotatable connections 74 (FIG. 22), are rotatable with respect to each other, and also with respect to support 71. Both visors are comprised of high impact and temperature resistant material such as thermoplastic polycarbonate resin, and are of transparent quality. Each of the two visors is tinted on a shade density continuum so that when the two visors are moved relative to eash other they will provide varying degrees of light transmission. For example, with the visors in the position shown in FIG. 2, the darkest shade in the continuum of visor 72 would begin at the lower edge thereof and progress to the lightest shade at its upper edge. The reverse is true of visor 72, with the darkest and lightest shades lying at its upper and lower ends, respectively. It can easily be seen that by independently rotating visor 72 with respect to visor 73, or vice versa, 72 and 73 will overlap each other in different relationships and varying degrees of shading, ranging from 1 to nearly 100 percent light transmission will result therefrom. Support 71, which is of resilient material such as thin polycarbonate resin, has tabs 74 and 75 extending around the lower front portion thereof to aid in maintaining assembly 70 on shell 10. Due to the resiliency of support 71 it can easily be slipped over shell 10 and maintained thereon, as shown in FIG. 23. To insure that the visor is maintained in place, a piece of hook tape 76 is mounted in the rear of the internal surface of support 71 which cooperates with a complementary piece of hook tape 67 on shell 10.

The means of communications for the present helmet assembly are carried by lightweight skull cap 80 which is made of silk, linen, cotton, or the like. Cap 80 has earphones 81 and microphones 82 thereon which move with the head of wearer and never change their relative position with relation to wearer, regardless of his head movement within shell 10. All connections (not shown) for the earphones and microphones are connected through suit 13, and need not be disconnected when helmet shell 10 is removed. Cap 80 is easily removable, but, due to its lightweight construction, it can be worn continuously during flight without any discomfort to the wearer, and offers no obstruction to the easy don/doff capability of shell 10 with or without bump cap 60.

The present helmet assembly as described above constitutes a substantial advance in the flight suit helmet art. This is easily recognized when the present helmet is compared with a representative helmet of the type actually used in present aerospace applications. The most commonly used helmet at present is of the fitted type (as defined above), having a movable face visor, and is one that is rotatably and pivotally mounted on the flight suit. The following chart clearly points up the advantages of the present invention over such prior art helmets.

	Typical helmet assembly of the present invention	Typical representative helment of the type most commonly used in present aerospace applications
Weight	6¾ pounds	13 to 15 pounds.
Volume occupied by shell.	Approx. 12,200 cc	Approx. 14,620 cc.
Vision compared to that with helmet off.	92.5%	41.6%.
Time required to don helmet.	3 to 4 seconds (no assistance needed).	1 to 2 minutes (almost impossible to don without assistance).
Time required to doff helmet.	1 to 2 seconds	20 seconds.
Comfort	Maximum possible for head enclosures.	Possible physiological damage under prolonged wear conditions due to head restraint within helmet and limited peripheral visibility.
Impact protection	Withstands 48 ft.-lbs. before cracking.	Withstands 13 ft.-lbs. before cracking.

Although the present invention has been described as being used primarily for aerospace applications, it should be understood that the helmet disclosed could be used equally as well in other environments, e.g., underwater exploration, escape units for submarines and the like, protective units for personnel working in contaminated atmospheres, and many others.

While a particular embodiment of the helmet assembly has been illustrated and described, it will be obvious that changes and modifications can be made without departing from the spirit of the invention and the scope of the appended claims.

What is claimed and desired to be secured by Letters Patent is:

1. In combination with a pressurized protective suit having a neck ring assembly mounted about a neck opening therein and having means for supplying gas thereto, a helmet assembly comprising:

a one-piece, transparent shell having an open end generally conforming to the configuration of the neck ring assembly, said open end adapted to receive the head of the wearer, said shell being sized to allow normal movement of the head in all directions within said shell;

means permanently secured to the rear, internal surface of said shell releasably coupled to said gas supply means within said suit to distribute gas for breathing, cooling, and defogging throughout the shell and provide impact protection to the wearer;

an attachment ring secured to the shell about the exterior surface of the open end thereof;

releasable latch means cooperating with said attachment ring and said neck ring assembly for automatically latching said shell to said suit; and

means for sealing said shell to said suit when said shell is in a latched position on said suit.

2. The combination as set forth in claim 1 wherein said transparent shell is of avoid-like configuration determined by the actual dimensions required for an individual wearer to achieve maximum head movement within the shell in both horizontal and vertical directions, thereby providing the smallest possible shell which allows maximum head movement.

3. The combination as set forth in claim 2 wherein said transparent shell is comprised of thermoplastic, polycarbonate resin.

4. The combination as set forth in claim 1 wherein said means for distributing gas in said shell comprises:

a pad of lightweight, shock-resistant material permanently secured to the rear internal surface of said shell, said pad having a recess therein which cooperates with the internal surface of said shell to define a passageway about the rear portion of said shell, said pad having openings about the periphery thereof which fluidly connect said passageway with the interior of said shell;

inlet means secured to said pad in fluid communication with said passageway, said inlet means releasably coupled to said gas supply means within said suit whereby gas delivered to said inlet means from said gas supply means will pass through said passageway and out said openings in said pad into the interior of said shell to provide a proper atmosphere for wearer.

5. The combination as set forth in claim 4 wherein said gas supply means includes:

a valve means mounted on said neck ring assembly and releasably coupled to said inlet means, said valve means including means to automatically shut off the supply of gas when said inlet means is uncoupled from said valve means.

6. The combination as set forth in claim 4 wherein each successive opening about the periphery of said pad is larger than the previous one, beginning with the opening nearest said inlet means.

7. The combination set forth in claim 1 wherein said neck ring assembly includes an annular housing mounted concentrically about the neck opening in said suit, and wherein said cooperative releasable latch means comprises:

an attachment ring concentrically mounted about said opening in said shell, said attachment ring having a circumferentially extending groove around the outer surface thereof;

said annular neck ring housing having an internal circumferentially extending groove therein;

a resilient split ring mounted for limited expansible movement within the groove in said housing, said split ring having substantially diametrically opposed raised portions on its inner circumference sized to extend out of the groove in said housing when said split ring is in its normal or contracted position, whereby said attachment ring on said shell contacts said raised portions when said shell is positioned on said neck ring assembly;

said attachment ring and said split ring having cooperating cam surfaces thereon so that downward movement of said shell into said housing will expand said split ring into the groove of said housing to allow said attachment ring to move into the housing until the groove in said attachment ring is aligned with said split ring, whereby said split ring will contract into the groove in said attachment ring to latch said shell to said suit; and

means attached to said split ring for expanding said split ring to release said shell from said neck ring assembly.

8. The combination set forth in claim 7 wherein said split ring includes a radially extending ear on each end thereof, each of which passes through a respective elongated opening in said housing and wherein said means for expanding said split ring comprises:

a first and second cylinder mounted for limited tangential movement on said housing, said second cylinder telescopically received for slidable movement within said first cylinder;

said ear on one end of said split ring extending through an elongated slot on said first cylinder and secured to said second cylinder;

said ear on the other end of said split ring secured to said first cylinder; and

means positioned between the ends of said first and second cylinders to normally bias said cylinders away from each other.

9. The combination as set forth in claim 1 wherein said helmet assembly includes:

means removably positionable in the internal rear half of said shell between the head of the wearer and the gas distributing and impact means for protecting the head of the wearer against severe impacts.

10. The combination as set forth in claim 9 wherein said internal severe impact protection means comprises:

a bump cap of lightweight, shock-resistant material removably secured in the internal rear half of said shell, said cap having an external surface conforming substantially to the basic configuration of the rear internal surface of said shell with a recess therein to receive the gas distributing means, said cap having an internal surface conforming to the shape of wearer's head, and said cap having passageways in both the internal and external surfaces thereof in fluid communication with said gas distributing means to provide proper atmosphere within the shell when said cap is in place.

11. The combination as set forth in claim 1 wherein said helmet assembly includes:

means removably secured on the external rear half of said shell for protecting the head of the wearer against severe impacts.

12. The combination as set forth in claim 11 wherein said external impact protection means comprises:

an external impact pad of lightweight, shock-resistant material having an internal surface conforming substantially to the external surface of said shell, positioned on the external, rear half of said shell; and

means for releasably securing said pad to said shell.

13. The combination as set forth in claim 1 wherein said helmet assembly includes:

a visor assembly removably positioned on said shell, said visor assembly comprising:

an open-face support having the same basic configuration as said shell, said support being comprised of resilient material whereby it can be removably positioned on said shell;

first and second visors comprised of transparent material;

said first visor being tinted on a shade density continuum ranging from the darkest shade at its lower end to the lightest shade at its upper end;

said second visor being tinted on a shade density continuum ranging from the lightest shade at its lower end to the darkest shade at its upper ends;

means for mounting said first and second visors to said support for independent relative movement between each visor and between each visor and said support.

14. A latching mechanism for releasably latching a helmet assembly to a pressurized suit comprising:

an attachment ring adapted to be concentrically

mounted about the opening in a helmet which receives the head of wearer, diametrically opposed outwardly extending flange portions, said attachment ring having a groove extending around the external circumference of said diametrically opposed flanges;

a neck ring assembly adapted to be secured about a neck opening in a suit, said neck ring assembly comprising:

an annular housing adapted to be mounted concentrically about the neck opening in the suit, said housing having an internal circumferentially extending groove therein;

a split ring mounted for limited expansible movement within the groove in said housing, said split ring having diametrically opposed raised portions on its inner circumference sized to extend out of the groove in said housing when said split ring is in its normal or contracted position, whereby the diametrically opposed flanges of said attachment ring contact said raised portions when said attachment ring is placed in said housing; said diametrically opposed flanges of the attachment ring and said split ring having cooperating cam surfaces thereon so that downward movement of the attachment ring into said housing will expand said split ring to allow said attachment ring to move into the housing until the groove in the attachment ring is aligned with said split ring whereby the split ring will contract into the groove on said attachment ring to latch said attachment ring to said neck ring assembly;

means attached to said split ring for expanding said split ring to release said attachment ring from said neck ring assembly.

15. The latching mechanism set forth in claim 14 wherein said split ring includes a radially extending ear on each end thereof, each of which passes through a respective elongated opening in said housing and wherein said means for expanding said split ring comprises:

a first and second cylinder mounted for limited tangential movement on said housing, said second cylinder telescopically received for slidable movement within said first cylinder;

said ear on one end of said split ring extending through an elongated slot on said first cylinder and secured to said second cylinder;

said ear on the other end of said split ring secured to said first cylinder; and

means positioned between the ends of said first and second cylinders to normally bias said cylinders away from each other.

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