

March 10, 1964

R. D. WELLS ETAL
DEPLOYABLE FACE MASK

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2 Sheets-Sheet 1

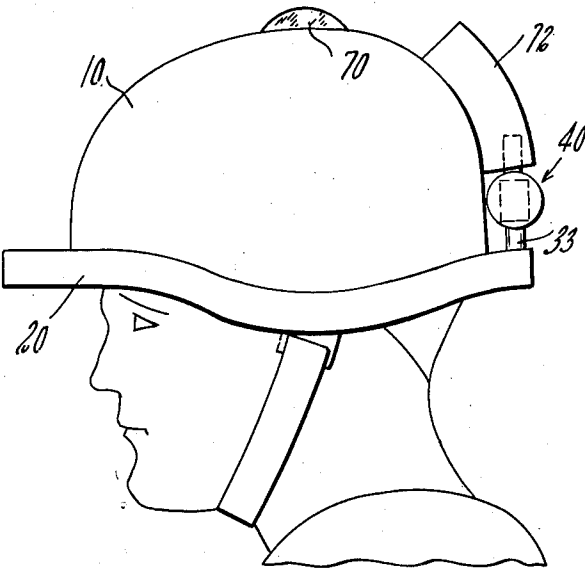


Fig. 1.

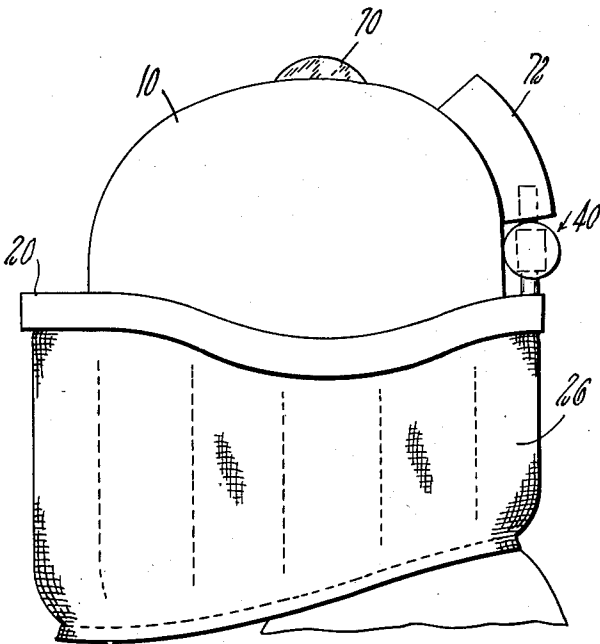


Fig. 2.

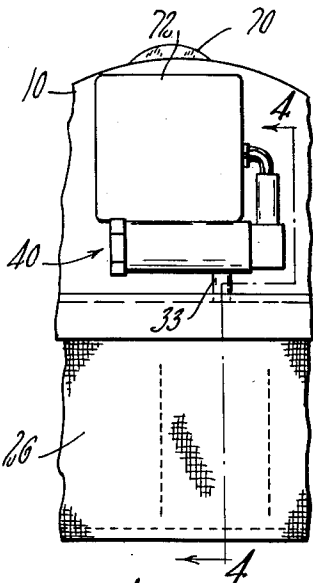


Fig. 3.

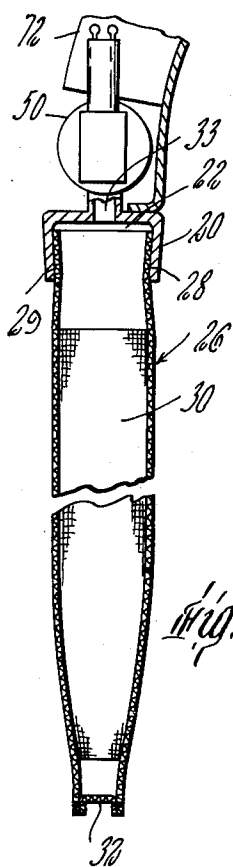
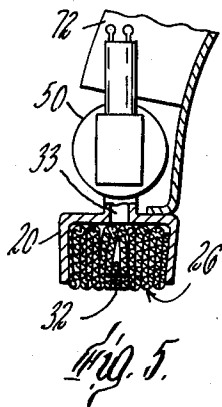
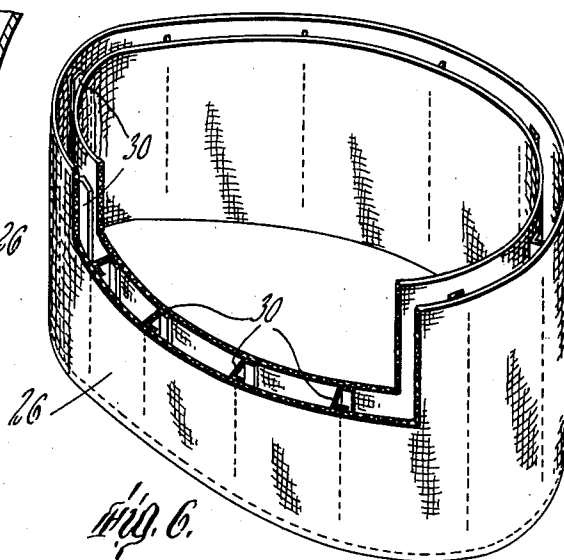
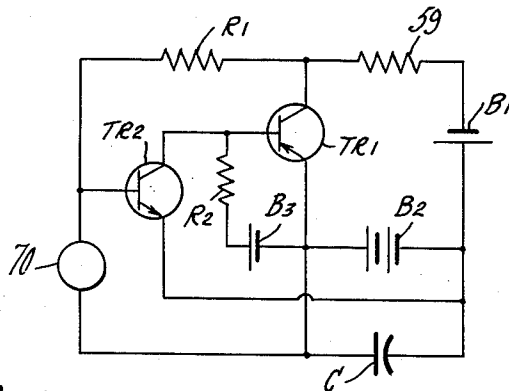
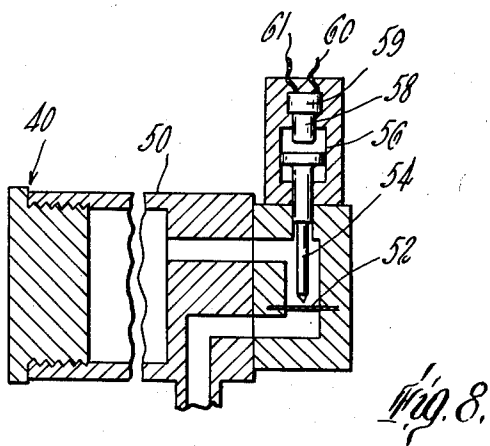
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DEPLOYABLE FACE MASK

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10 Claims. (Cl. 2-2)

This invention relates to a protective face mask, and more particularly to a mask or canopy designed to provide protection to the eyes and exposed facial and neck skin areas of a wearer from high intensity thermal radiation such as emanates from nuclear or similar intense blasts.

It is an object of the invention to provide a mobile face mask which is positioned for protective action only after subjection of the facial areas to such thermal radiation has become imminent. Until such time the face and neck of the wearer can remain unobstructed.

To this end the mask is movable from a storage position, as in a head covering or headdress which provides a storage area for the mask when not in use, to a protective position overlying the exposed facial and neck areas of the wearer.

Because the mask is not normally in a protective position, it is a further object of the invention to provide mechanism for insuring deployment of the face mask to a protective position within a matter of a small fraction of a second after the occurrence of any nuclear blast at a distance from the wearer less than the maximum travel distance of harmful thermal radiation.

Because of the time lag in brain controlled human muscular activity, deployment of the face mask to protective position within any such short period of time has to be independent of any manual action of the wearer and accordingly it is a further object of the invention to provide a mechanism which will cause proper deployment of the face mask when needed without manual manipulation or actuation.

The invention is based upon observation of the characteristics of the time-intensity curve of thermal blast radiation and relies upon recognition of the fact that radiation intensity from nuclear blasts increases on a time curve and that the slope of the curve is such that there is a certain time interval sufficient to permit deployment of a protective mask, if properly designed, through actuation of deployment mechanism at the beginning of the time interval before the radiation exposure endures for a sufficient length of time at any of the increasing levels of intensity to cause severe skin burns.

It is accordingly another object of the invention to provide a mechanism for positively deploying a protective face mask into protecting position within a very short time interval after arrival of radiation.

In general then it is an object of this invention to provide an actuating mechanism triggered by the radiation and which is sufficiently rapid in operation so that the mask will be substantially completely deployed within a matter of, in its preferred form, less than 100 milliseconds and anyway less than about 200 milliseconds after the arrival of sufficient radiation to trigger the mechanism. The rapidity of these action makes it necessary to provide a positive motor action for deploying the mask together with a triggering mechanism which is promptly actuated upon arrival of nuclear blast radiation.

In its preferred form then the device of this invention includes a collapsible or foldable mask constituted preferably of opaque cloth which may have a heat-reflecting outer surface or coating, a head covering or other headdress having a storage area for storing the mask in a collapsed position retracted away from the face, eyes and

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neck of the wearer together with positively acting means, preferably gaseous, for deploying the mask and means, preferably also mounted on the headdress, for actuating the deploying means responsive to radiation emanating from a nuclear blast at a distance from the wearer within the maximum travel distance of harmful thermal radiation from the source.

Where a gas is used as the deploying power, the gas is confined under pressure within a container which is provided with a fast release mechanism such as will be hereinafter described and normally including an explosive.

The above and other objects of the invention will be more fully understood when considered in connection with the following description of a typical device embodying the invention as shown in the accompanying drawings wherein:

FIG. 1 is an elevational view of a combatant or other subject wearing a device in accordance with this invention showing the headdress—a helmet in this case—with the accompanying protective mask in normal inoperative retracted non-protecting position;

FIG. 2 is a view similar to that shown in FIG. 1 but with the protective face mask deployed in protective position;

FIG. 3 is a rear elevational detail view showing a portion of the mechanism shown in FIGS. 1 and 2;

FIG. 4 is an enlarged detail view, partly in cross-section, taken along the line 4-4 of FIG. 3;

FIG. 5 is a view similar to that of FIG. 4 but showing the protective face mask retracted in its storage receptacle in the helmet;

FIG. 6 is a perspective view broken away to show the construction of the protective face mask;

FIG. 7 is a circuit diagram for the device; and

FIG. 8 is a detail view of certain of the parts shown in FIGS. 1, 2 and 3.

As shown in FIG. 1 a helmet 10 of any normal design is provided with a slightly enlarged brim 20, which may be formed integral with the helmet or otherwise attached to the rim, forming a downwardly open peripheral channel 22 (FIG. 4) for the reception of the protective face mask and acting as a storage receptacle for the face mask.

Firmly attached, as by adhesive or other substantially air-tight affixing means within the channel is a downwardly depending cylindrical double-walled bag 26 which is formed of flexible opaque impermeable or low permeable material, e.g., a fine count cloth coated with an appropriate plastic, the external wall of which can and preferably does have an aluminum or other heat-reflecting surface in the form of a metallized coating or other deposition. As shown, the upper marginal edge 28 of the internal wall of bag 26 is attached to the inner flange of brim 20 and the upper marginal edge 29 of bag 26 is attached to the outer flange of brim 20. Thus the bag may be stuffed into the receptacle 22 as shown in FIG. 5. As shown, the opposed walls of the channel are slightly converging to provide a means for preventing inadvertent deployment of the mask from the receptacle, though other equivalent restraining means may be provided. For reasons which shall be later understood, the bag or sack-like element 26 is provided around its circumference with spaced partition elements 30 (FIG. 6) which retain the cylindrical spaced relation of the two walls of the sack when it is inflated and the sack has a bottom wall 32 to aid in maintaining the bottom of the sack when inflated so that the walls are spaced in proper relation to each other.

The partitions 30 terminate below the tops of the walls of the cloth of the mask 26 as shown in FIG. 4 so that free circulation of gas may occur around the top of the mask.

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The bottom of the mask as shown in FIG. 2 can have a proper contour so as to extend further over the chin of the wearer than the bottom of the mask at the back of the neck, thus to cover exposed portions of the upper part of the chest.

The sack-like element 26 is thus adapted to be blown out of the position shown in FIG. 5 into the position shown in FIG. 4 and FIG. 2 by the application of a gas which is released under pressure into the storage receptacle. For this purpose, at the rear of the helmet there is an upstanding pipe 33 which pierces the brim as shown in FIG. 4 and this pipe is connected to a gaseous storage receptacle generally indicated at 40 in FIG. 1 and shown more in detail in FIG. 8. This includes a storage unit 50 adapted to retain a gas under pressure, liquefied or not, e.g., CO₂, and which communicates with the pipe 33 through a valve mechanism shown in FIG. 8 which includes a diaphragm of metal or the like 52 which retains the gas until it is pierced by a ram die 54 mounted for motion in the cylinder 56. An explosive charge 58 with an associated detonator 59 is provided within the cylinder to actuate the ram die 54. Leads from the detonator 60, 61 are connected to radiation detector 70 having a substantially 360° exposure and being shown as a dome-like element disposed on the tip of the helmet. However, a plurality of individual cells distributed around the helmet may be substituted. A suitable gas source may be a cartridge containing about 20 grams of CO₂.

In FIG. 7 is shown a circuit for actuating the detonator 59 in response to the photocell 70 which is seen to make use of a two-stage transistor amplifier featuring an NPN transistor TR1 and a PNP transistor TR2. The detonator 59, whose resistance may be in the order of five ohms for example, and the photocell are connected in a voltage dividing circuit including a resistor R1 through which is passed current from a pair of batteries B1 and B2, the batteries likewise being disposed in series to aid one another. By means of a variation in the resistance of the photocell with radiation intensity, the voltage dividing circuit is adapted to control the operation of transistor TR1 which in turn controls transistor TR2 and the detonator. To this end transistor TR1 has its base connected to the junction of the resistor R1 with the photocell while its emitter is connected to the junction of batteries B1 and B2. Connected to the collector of transistor TR1 is the base of transistor TR2 which has its emitter connected to the positive terminal of battery B2 and its collector connected to the junction of resistor R1 and the detonator 59. Bias for transistor TR2 is supplied by a battery B3 connected in series with a load resistor R2 for transistor TR1 between the collector of transistor TR1 and the emitter of transistor TR2. Completing the arrangement is a capacitor C disposed across the battery B2 to decrease the response time of the circuit.

That is to say, in operation under normal conditions, both transistors are biased to cutoff so that virtually no current flows through the detonator 59. When the photoconductive element detects an increase in radiation intensity, however, its resistance decreases with the result that the potential of the base of transistor TR1 is raised, causing it to become conductive. In consequence, the potential of the base of transistor TR2 is decreased causing it to conduct also and to increase the voltage across the detonator. This voltage increase has the effect of raising the potential of the base of transistor TR1 still further so that it inducts still more strongly. By means of this regenerative action, the detonator is energized with a correspondingly increasing amount of output current from transistor TR2 until it explodes and opens the valve.

72 represents a housing of the back of the helmet for accommodating the circuit elements of FIG. 7.

As thus can be seen the device provides a very fast acting triggering mechanism for deploying a stored protective face mask into a position extending downwardly

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from the specially designed brim of a headdress and the mechanism is such that the entire action can take place in a matter of not more than 200 milliseconds because of the use of the explosive for releasing the gas. In fact, a device that has been constructed has operated in a matter of less than 25 milliseconds.

If desired, the face mask portion 26 may be provided with bleed holes in its bottom wall 32 or elsewhere to lessen danger of rupture of the face mask material during or after deployment, all depending upon the amount of gas which is compressed in the gas tank 50.

The double wall construction of the protective face mask in addition to providing for the gaseous inflating action, provides additional protection by way of insulation between the thermal radiation and the face of the wearer and where CO₂ is used an additional cooling effect is obtained as a result of the expansion of the gas.

A suitable cloth for the mask may be a nylon fabric having 171 warp threads per inch $\times$ 115 filling threads per inch, coated with polyurethane to provide a coated fabric weight of 2.0 oz./sq. yd., but other resin coated opaque non-permeable or low permeable clothes may equally well be used.

What is claimed is:

1. A mobile protective face mask comprising a headdress having a rigid brim, a storage receptacle extending around at least the front of said brim, a face mask constituted of flexible material collapsed and stored in said receptacle, said mask being in the form of a bag having an inner and outer wall and having its upper edges attached to said brim, said mask being adapted in deployed position to extend downwardly over the face of the wearer of the headdress, with the inner and outer walls of the bag defining an insulating space between said walls, and automatic means for propelling the unattached portion of said mask out of said receptacle into deployed position.

2. A mobile protective face mask as claimed in claim 1 wherein the automatic means includes means for inflating the bag as it is moved into deployed position to maintain said walls in spaced relation.

3. A mobile protective face mask as claimed in claim 1 wherein the automatic means includes a photosensitive detector for driving said mask into deployed position responsive to the impingement on the headdress of nuclear blast radiation.

4. A mobile protective face mask comprising a headdress having a brim, a storage receptacle in said brim for a face mask, a bag-like inflatable face mask attached to said brim and adapted in deployed position to extend downwardly over the face of the wearer of the headdress, said mask being constituted of flexible material adapted to be collapsed and stored in said receptacle, means for inflating said mask to blow said flexible material out of said receptacle into deployed position covering the face of a wearer of said headdress and means including a photosensitive detector for actuating said inflating means to deploy said facemask, responsive to the impingement of nuclear blast radiation.

5. A mobile protective face mask as claimed in claim 4 wherein the outer wall of said face mask has a heat-reflecting surface.

6. A mobile protective face mask comprising a headdress having a brim, a storage receptacle in said brim for a face mask, a bag-like inflatable face mask attached to said brim and adapted in deployed position to extend downwardly over the face of the wearer of the headdress, said mask being constituted of flexible material adapted to be collapsed and stored in said receptacle, storage means for gas under pressure, conduit means leading from said gas storage means to said mask receptacle, means for releasing said gas to inflate said mask and blow it out of said receptacle into deployed position covering the face of a wearer of said headdress and means including a photosensitive detector for actuating said gas in-

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flating means to deploy said face mask responsive to the impingement of nuclear blast radiation.

7. A mobile protective face mask as claimed in claim 6, wherein said gas storage means includes a diaphragm for retaining said gas under pressure, and said gas releasing means includes a ram die for puncturing said diaphragm, an explosive for imparting a diaphragm-puncturing impact to said ram die, a detonator for said explosive, and an electrical circuit connecting said detector to said detonator.

8. A mobile protective face mask as claimed in claim 6, including means for retaining said mask against inadvertent displacement from said storage receptacle.

9. A mobile protective face mask comprising a head-dress, a brim-like overhang on said head-dress, a storage receptacle for a face mask, said receptacle extending along at least a front portion of said overhang, a face mask having an upper edge thereof attached to said overhang and adapted in deployed position to extend downwardly over the face of the wearer of the head-dress, said mask being constituted of flexible material adapted to be collapsed and stored in said receptacle, storage means for gas

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under pressure, conduit means leading from said gas storage means to said mask receptacle, means for releasing said gas to blow said flexible material out of said receptacle into deployed position covering the face of a wearer of said head-dress and photo-sensitive means, responsive to the impingement of nuclear blast radiation, electrically connected to and adapted to actuate said gas releasing means to release said gas and deploy said face mask.

10. A mobile protective face mask as claimed in claim 9 wherein said gas is carbon dioxide, whereby said material is cooled by said gas when said gas is released from said storage means.

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