Nov. 3, 1942. H. M. DODGE ET AL 2,300,912

RESPIRATORY DEVICE

Filed Dec. 5, 1938 4 Sheets-Sheet 1

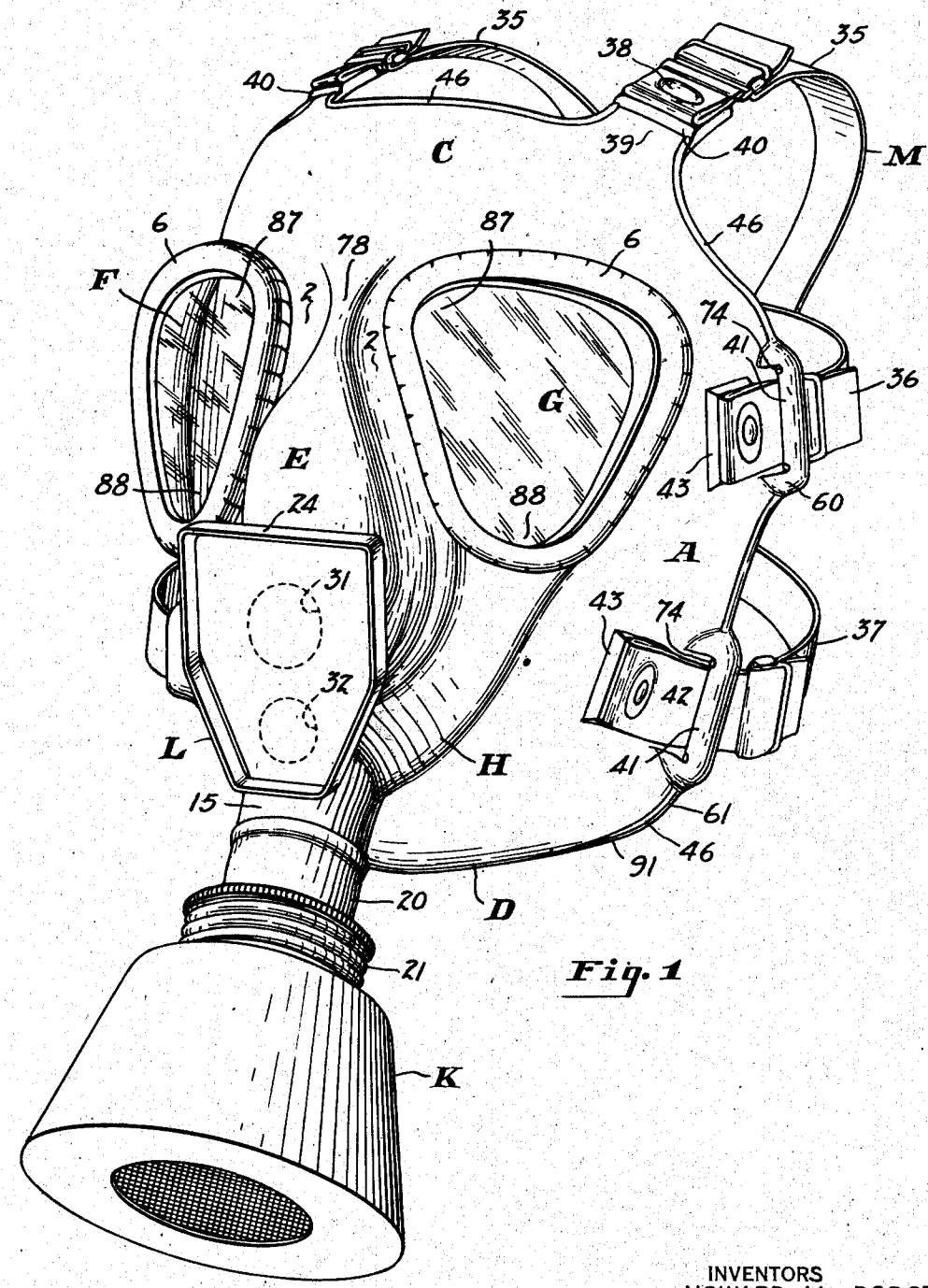

Fig. 1

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RESPIRATORY DEVICE

Filed Dec. 5, 1938 4 Sheets-Sheet 2

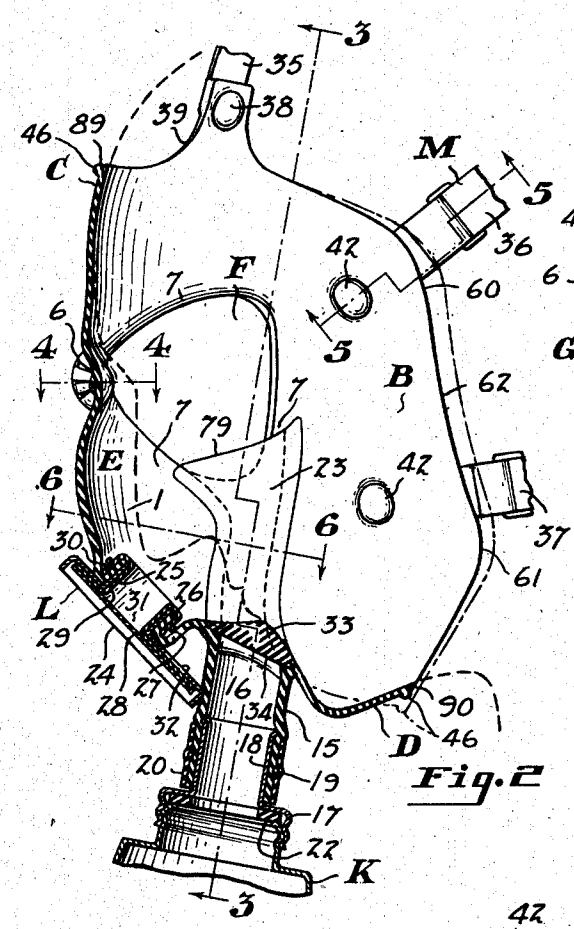

Fig. 2

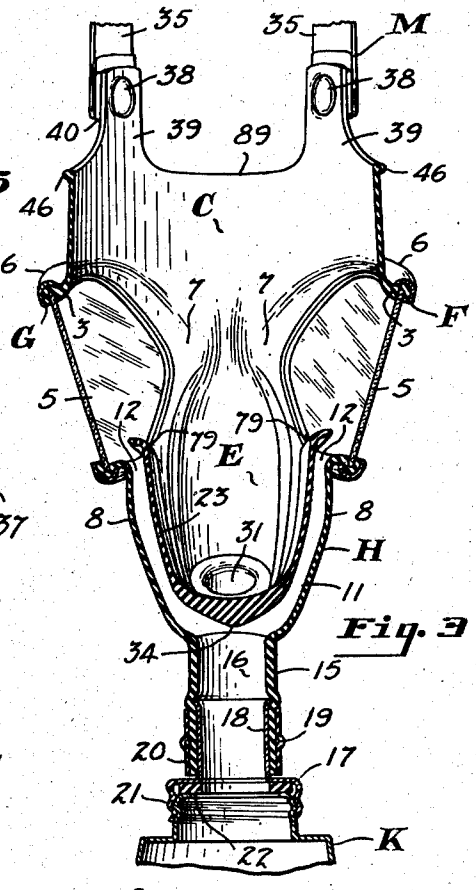

Fig. 3

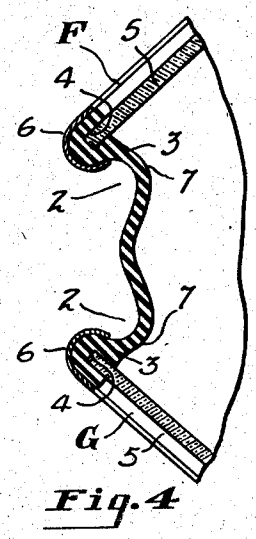

Fig. 4

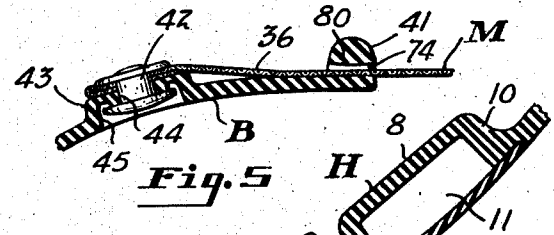

Fig. 5

Fig. 6

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RESPIRATORY DEVICE

Filed Dec. 5, 1938 4 Sheets-Sheet 3

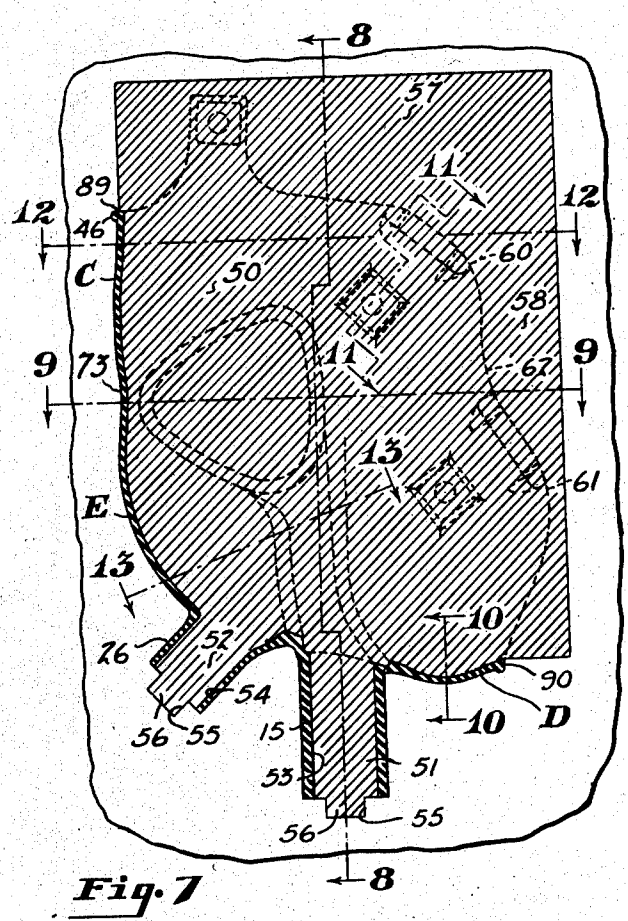

Fig. 7

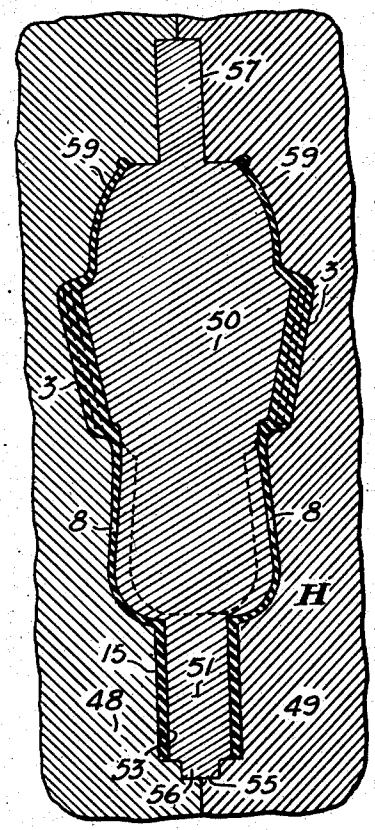

Fig. 8

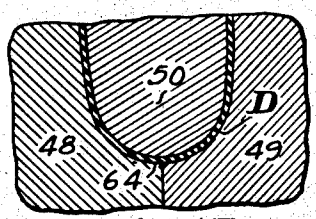

Fig. 10

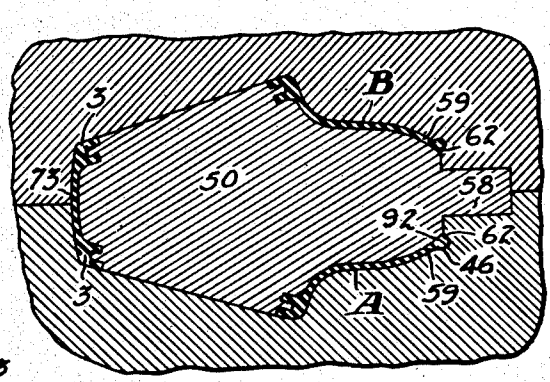

Fig. 9

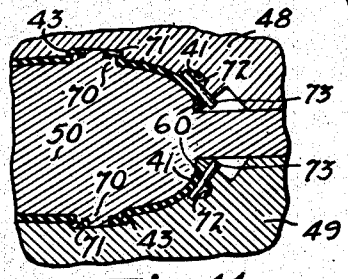

Fig. 11

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RESPIRATORY DEVICE

Filed Dec. 5, 1938 4 Sheets-Sheet 4

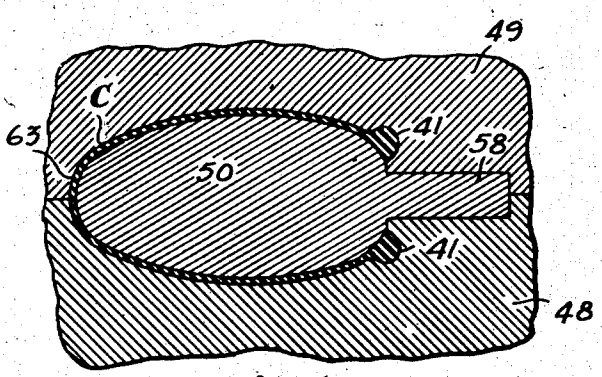

Fig.12

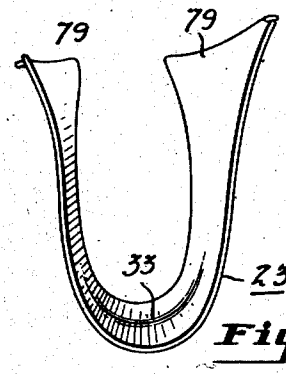

Fig.16

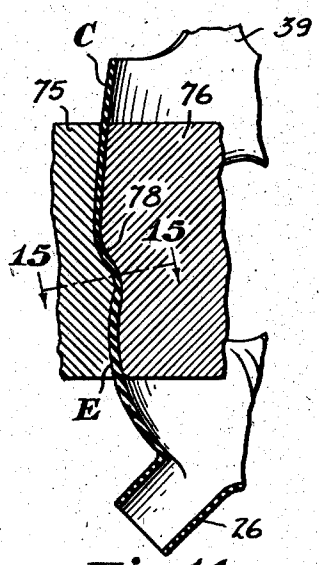

Fig.14

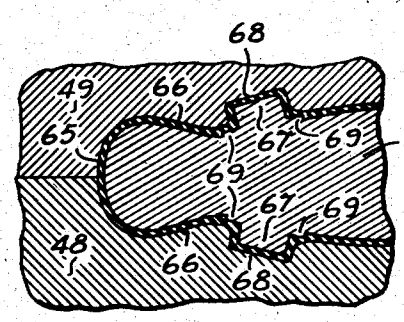

Fig.13

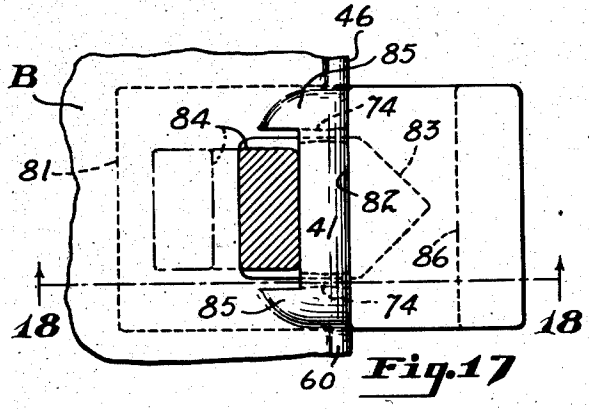

Fig.17

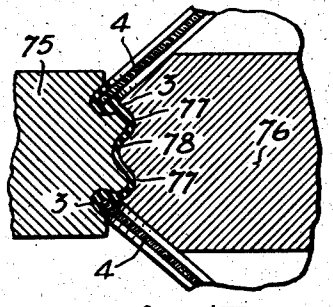

Fig.15

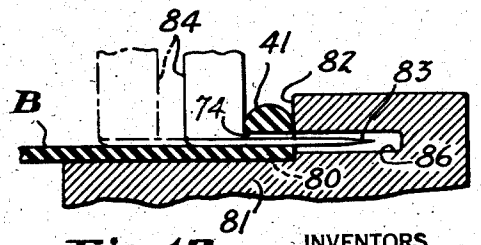

Fig.18

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Patented Nov. 3, 1942 2,300,912

UNITED STATES PATENT OFFICE

2,300,912

RESPIRATORY DEVICE

Howard M. Dodge, Wabash, Ind., and Herman T. Kraft, Akron, Ohio, assignors to The General Tire & Rubber Company, Akron, Ohio, a corporation of Ohio

Application December 5, 1938, Serial No. 243,974
In France October 7, 1938

17 Claims. (Cl. 128—141)

This invention relates to respiratory devices, and more particularly to face masks for protecting a wearer of the same against noxious gases and the like such as are used in warfare and certain industries, and the method of their manufacture.

It has been customary to make gas masks and other respiratory devices out of flexible material which is placed over the face of a wearer and held by a suitable harness, the device being provided with sight lenses or windows and an opening or openings for breathing. Preferably, an air inlet opening in the device is connected to a suitable filtering device, usually carried externally of the mask. It is considered desirable to have the masks integrally formed of rubber or the like in a single molding operation, and, for reasons of economy, without the use of an elaborate multi-part mold.

An object of the invention is, therefore, to provide an improved method of making gas masks or similar respiratory devices by means of a relatively simple and inexpensive mold, so as to materially reduce the time and expense incident to the manufacture of such devices.

A gas mask for use in military and industrial operations should fit the face of a wearer with a relatively high degree of accuracy and substantially conform thereto so as to afford maximum range of vision and permit free movement by the wearer without danger of shifting or dislodging the mask. While it would be relatively simple to shape a mask to conform accurately to the facial contours of a single person, it is desirable, in order to permit manufacture of respiratory devices of the character contemplated on a commercial scale, that a single mold form masks which substantially conform to the different physiognomies of many people.

Another object is, therefore, to provide a respirator or mask which is adapted to conform itself with a high degree of accuracy to the different facial contours of a number of people while permitting to each person a wide range of vision and increased freedom of movement.

Another object is to provide a respirator of flexible material which, although molded substantially flat or with the sides or cheek portions in substantially parallel relation, and which normally assumes its flat molded shape, is adapted, upon being held in the hand or hands with the front or nasal portion lowermost, to fall open naturally to substantially face shape with the cheek portions diverging from one another.

Another object is to provide a respiratory device of molded rubber composition which has relatively thin cheek, chin, nose, and forehead portions and relatively thick reinforcing portions to retain the several portions of the device in their proper relative positions and to support the air filter or supply tube so as to minimize distortion of the mask.

Another object is to provide a mask having improved discharge means for readily releasing from the interior thereof moisture and liquid discharges of the wearer.

Another object is to provide a gas mask having a relatively smooth inside surface for engagement with the face of the wearer and which is provided with improved means for attachment of the harness straps to the face covering portions.

A further object is to provide an improved gas mask or respiratory device, which is simple in design and construction and relatively inexpensive to manufacture. Other objects and advantages of the invention will become apparent from the following detailed description of a gas mask embodying the invention, and the novel method of producing the same, which is made in connection with the accompanying drawings, in which:

Figure 1 is a front perspective view showing our improved mask;

Fig. 2 is a median sectional view, with parts removed, taken substantially through the forehead, nose, and chin portions of the mask;

Fig. 3 is a sectional view of the mask, with parts removed, taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a sectional detail taken substantially on the line 4—4 of Fig. 2 and enlarged with respect thereto;

Fig. 5 is a sectional detail, showing the harness fastening means, taken substantially on the line 5—5 of Fig. 2 and enlarged with respect thereto;

Fig. 6 is a sectional detail, through the nasal portion, taken substantially on the line 6—6 of Fig. 2 and enlarged with respect thereto;

Fig. 7 is a diagrammatic view, partly in section and with parts broken away, of a mold and core for making the gas mask of the present invention;

Fig. 8 is a diagrammatic sectional view, with parts broken away, of the mold used in carrying out the method of the present invention to make the gas mask described, and is taken substantially on the line 8—8 of Fig. 7;

Fig. 9 is a diagrammatic sectional view, with parts broken away, taken substantially on the line 9—9 of Fig. 7;

Fig. 10 is a diagrammatic sectional detail taken

substantially on the line 10—10 of Fig. 7 and enlarged with respect thereto;

Fig. 11 is a diagrammatic detail in section taken substantially on the line 11—11 of Fig. 7;

Fig. 12 is a diagrammatic sectional view, with parts broken away, taken substantially on the line 12—12 of Fig. 7;

Fig. 13 is a diagrammatic sectional detail taken substantially on the line 13—13 of Fig. 7;

Fig. 14 is a diagrammatic view, in section, showing the operation of reshaping a part of the front portion of the mask after the first molding operation;

Fig. 15 is a sectional detail, with parts broken away, taken substantially on the line 15—15 of Fig. 14;

Fig. 16 is a perspective view of a covering strip employed in forming the air intake passage;

Fig. 17 is a diagrammatic view, partly in section, showing the method and apparatus for forming the harness strap guides in the mask; and

Fig. 18 is a detail view, partly in section and with parts removed, taken substantially on the line 18—18 of Fig. 17.

In the drawings, like parts throughout the several views are indicated by the same letters and numerals of reference. The mask, Fig. 1, comprises cheek portions A and B for overlying the cheeks of the wearer, a forehead portion C extending between the cheek portions and for overlying the forehead of the wearer, a chin portion D in the form of a cup to receive the chin of the wearer, and a nasal portion E for the nose of the wearer. On opposite sides of the nasal portion are sight windows F and G for the right and left hand eyes, respectively, of the wearer. A reinforcing wishbone H extends between the sights F and G and beneath the nasal portion E to provide a passage for fresh air drawn through a filter or canister K suspended therefrom. If desired, a flexible conduit may be interposed between the wishbone and the canister so that the latter may be carried in a suitable pocket or pouch. An expiration device L is attached to the front of the mask at the nasal portion and a harness M secures the device in place over the face of the wearer.

The cheek portions A and B and the forehead and chin portions C and D are arranged to closely overlie the corresponding face portions of the wearer and to effect a substantially airtight seal therewith so as to prevent the passage of gas or the like into and out of a breathing chamber 1 between the front of the mask and the face of the wearer, during inhalation by the wearer. When the mask is opened to substantially face shape, as will be later described, relatively deep grooves 2 or furrows are formed on opposite sides of the nasal portion E and extend upwardly to substantially the top of the sight windows F and G.

The sight windows protrude somewhat from the normal surface of the mask and comprise relatively thick frame portions 3, Fig. 4, formed with internal annular channels 4 which receive glass lights 5. A relatively rigid sheath 6 formed of suitable strong material such as sheet metal circumferentially embraces each of the window frames 3 about the channels 4 so as to secure the glass lights 5, in place. Thus, the window frames, which are preferably integral with the relatively thin material of the cheek portions A and B of the mask, form a hermetic seal with the glass lights 5 to prevent the passage of gas or the like through or around the windows of the mask. The juncture 7 of the periphery of the window frame 3 with the material of the mask, forms an annular resilient cushion which bears against the forehead, cheeks and nose of the wearer around the wearer's eyes to hold the glass lights 5 away from the wearer's face, thus permitting the use of glasses or spectacles underneath the mask.

The wishbone or fresh air conduit H has an outer wall 8 offset or in relief with respect to the surface of the mask, being connected thereto by side walls 9 and 10, respectively. As previously mentioned, the wishbone H forms a channel or passage 11 which extends from the right sight window F to the left sight window G and underneath the nasal portion E. This channel opens into the breathing chamber 1 adjacent the bottom of each of the sight windows through openings 12 formed in the bottoms of the frame portions 3.

The central part of the wishbone H is provided with a downwardly extending inhalation tube 15 which is formed integral with the outer wall 8 thereof and provides a fresh air intake passage 16 continuous with the passage or channel 11. A fitting 17 is provided with a tubular extension 18 which is received within the end of the elastic or stretchable tube 15. Preferably, the extension 18 is of slightly larger diameter than the inhalation tube so that the latter is slightly distended by the fitting extension to insure an airtight seal. If desired, one or more turns of a suitable binding element 19, such as wire, may be wrapped about the tube 15 to secure the latter in place over the extension 18 and an elastic band 20 applied thereover to improve the appearance of the joint and to prevent the clothing or apparel of the wearer from catching or snagging on the binding 19. The fitting 17 has threads 21 by means of which it is attached to the top of the canister K and is provided with a rubber gasket 22 for effecting a tight seal with the canister.

Along the edges of the channel 11 the inside surfaces of the mask are relieved or cut away to receive a substantially U-shaped cover strip 23 of suitable flexible material such as rubber which is formed to substantially the shape shown in perspective in Fig. 16. This strip extends substantially from the right sight window F to the left sight window G, overlying the channel 11 throughout substantially its entire length. It is substantially flush with the inside surface of the mask so that the interior of the mask, particularly in the region of the wearer's cheeks, nose, and mouth, is smooth and unbroken by protruding seams, thus avoiding chaffing and irritation of the user while being worn. The cover strip 23 and the wishbone H thus cooperatively define the enclosed fresh air intake conduit or passage which carries air being drawn into the breathing chamber 1 into the window frames 3 at the bottoms of the latter. Accordingly, the formation of moisture on the inside of the glasses 5 is minimized since the incoming air sweeps over the inside surfaces of the glasses to maintain the latter clear and free from moisture. Preferably, lateral flanges 79 are formed on the ends of the cover strip and project toward the glass windows 5 so as to direct incoming air toward and over the inside surfaces of the windows. As appears in Fig. 3, the air directing flanges 79 are above the bottoms of the windows when the mask or respirator is being worn. However, being spaced inwardly from the glasses 5, and relatively close to the wearer's cheeks, the flanges do not objectionably interfere with the vision of the wearer.

The only openings into the breathing chamber 1 of the mask from the inhalation passage 16 are the openings 12 in the window frames 3. Thus, moisture or the like in the lower part of the breathing chamber in the mask is prevented from running into canister K. The portion of the cover strip 23 which is disposed above the inhalation passage 16 is centrally thickened as indicated at 33 to fit between the chin and lower lip of the wearer. This thickened portion is in the form of an elongated ridge having a length about equal to the width of a wearer's chin and having its ends tapered toward the normally relatively flat surface of the strip 23. A transverse thickening of the underside of the strip 23 beneath the ridge 33 forms an air directing wedge 34 which extends toward the inhalation passage 16. This wedge divides the incoming air so that part thereof flows up the right hand channel 11 of the wishbone H to the sight window F and part flows up the left hand channel 11 of the wishbone H to the sight window G.

A reinforcing and shape-retaining means is provided for the mask by the structural combination of the window frames 3 and wishbone H which are integrally joined together. These parts serve to prevent collapse of the mask and thus facilitate the attachment of the mask to the face of the wearer. The reinforcing wishbone and window frames serve to support the weight of the canister K substantially uniformly from all parts of the mask. In this manner localization of stress is avoided, which minimizes rupture or tearing of the material of the mask and reduces the tendency for a part of the mask to shift on the wearer's face. The relatively heavy or thick sectioned construction of the wishbone H, particularly with respect to the walls 9 and 10 thereof, resists collapse and thus avoids the possibility of shutting off the air.

Preferably, the rubber walls of the inhalation tube 15 are materially thicker than the material of the rubber cheek portions A and B and the forehead and chin portions C and D respectively, so as to carry the canister K relatively rigidly and prevent as much as possible the dangling or swinging of the canister like a pendulum when the wearer turns his head, or while the wearer is marching or moving about. Although no specific thickness of the inhalation tube walls is necessary, it has been found satisfactory to make the walls about twice as thick as the average thickness of the cheek, chin and forehead portions. The thickening of the walls 9 and 10 of the wishbone is more pronounced adjacent the inhalation tube 15 and the thickening of the cover strip 23 effected by the ridge 33 and wedge 34 imparts increased rigidity to the wishbone structure.

If desired, the walls of the nasal portion E may be somewhat thicker than the walls of the cheek, chin and forehead portions, particularly the marginal portions of the latter, which should be of the utmost flexibility so as to closely fit the face of a wearer. Around the edge of the mask is an integral reinforcing bead 46 which is continuous about the marginal edges of the cheek, chin and forehead portions.

The expiration device L comprises a housing 24 formed of metal or the like, and provided with a tubular extension 25 frictionally received within an inturned tubular member 26 formed in the lower part of the nasal portion E. A flutter valve 28 of conventional construction is disposed in the housing 24 and has formed thereon a tubular rubber passage member 29 which is disposed through the inturned tube of the extension 25. End 30 of the flutter valve tube 29 is then reversely folded over the inside end of the extension 25 and tubular portion 26. A wire binding 27 may be tensioned around the assembly to secure the parts together.

As appears in Figs. 1 and 2, the axis of exhalation passage 31 through the expiration device L is inclined downwardly from the breathing chamber 1 substantially at the bottom of the nasal portion E so as to permit drainage from the breathing chamber. Preferably, the rear of the flutter valve housing 24 is provided with an aperture 32 to permit the wearer of the device to insert a finger therethrough to free the flutter valve in case the latter becomes stuck or closed by the formation of ice or the like.

The harness M comprises top straps 35 and side straps 36 and 37. The top straps are secured by any suitable means such as rivets 38 to integral extensions 39 of the forehead portion C. Preferably, the ends of the extensions 39 are thickened, as indicated at 40, and the heads of the rivets are countersunk on the inside thereof to avoid contact with the forehead of the wearer.

Side straps 36 and 37 are passed through slits 80 (formed as later described) in elongated bosses 41 molded integrally with the relatively thin cheek portions A and B of the mask at the marginal edges of the latter. As shown in Fig. 5, the slit 80 through each boss 41 is formed between the material of the boss and the material of the cheek portion of the mask so that the strap is held flatwise against the outside surface of the mask. The ends of the straps 36 and 37 are secured to the mask by fastening means such as rivets 42 which extend through apertures 44 formed in thickened reinforcements 43 formed integrally with the cheek portions A and B of the mask and at portions of the latter removed from the bosses 41. Preferably, the apertures 44 are recessed, as indicated at 45, to receive the heads of the rivets 42 so that the latter are maintained out of contact with the face of the wearer or at least do not protrude beyond the inside surfaces of the cheek portions of the mask.

In manufacturing a gas mask of the character described in accordance with the method of the present invention, a pair of separable mold parts 48 and 49 and a core 50, Figs. 7, 8, and 9, are employed. The mold parts are arranged for movement toward and away from one another by means of any suitable apparatus or arrangement well known in the molding art and define a mold cavity having the contours of the mask previously described when the latter is in a substantially flattened position. The core 50 is removably carried between the mold sections 48 and 49, being separated therefrom by spaces corresponding to the desired thicknesses of the several parts of the mask. Extensions 51 and 52 of the core are disposed axially through cylindrical chambers 53 and 54, respectively, of the mold cavity and form the inhalation and exhalation conduit passages respectively. Sockets 55 are provided in the mold sections to receive reduced diameter portions 56 of the extensions 51 and 52 to center the latter and insure proper positioning of the core 50 in the mold cavity. The core 50 extends above and rearwardly, relatively speaking, of the marginal portions of the mask, as indicated at 57 and 58, respectively, these extended portions being secured between the mold sec-

tions 48 and 49. The mold cavity is arranged so that the cheek portions A and B of the mask are formed in spaced substantially parallel relation with respect to one another as contradistinguished from the divergent shape which they will take when applied to the face of the wearer. The cheek portions have rear marginal portions 59 which are molded so as to be normally curved or directed towards one another. Corresponding regions of the marginal edges of the cheek portions A and B are molded so as to normally be disposed relatively close together and closer than other corresponding regions of the cheek portions which are removed from the said marginal edges thereof. This particular arrangement of parts gives the mask advantageous face conforming characteristics which materially assist in imparting to the mask the property of effectively preventing the passage of gas into the breathing chamber 1 from around the marginal edges of the mask, and also makes the mask more comfortable to wear. Preferably, the outline contour of the cheek portions is in the form of a double ogee curve, having upper and lower protruding edge portions 60 and 61 in the region of the bosses for the harness straps 36 and 37, respectively, and a recessed or inwardly curved edge portion 62. When worn, the mask is disposed on the face of the wearer so that the edge portions 60 are at or directed toward the temples of the user, while the edge portions 61 overlie the rear portions of the wearer's jawbone and the recessed edge portions 62 prevent interference, by the mask, with the ears of the wearer.

The core 50 and mold sections 48 and 49 are formed so that front part 63 of the forehead portion C of the mask is molded with a material radius of curvature, as shown in Fig. 12, and so as to provide a material radius of curvature for the central part 64 of the chin portion D during the molding and vulcanizing operation, as shown in Fig. 10.

The parts of the mold sections and core which form the nasal portion E of the mask are shaped as indicated in Fig. 13, providing a material radius of curvature for front central part 65. Toward the cheek portions of the mask from the central part 65 of the nasal portion, the latter has side parts 66 which curve inwardly toward one another and are molded and vulcanized so as to normally lie closer together than parts of the nasal portion which are towards the central part 65 thereof. This feature of construction is advantageous in providing a mask which more accurately conforms to the contours of the human face and at the same time permits the mask to be used by persons having different facial characteristics, particularly with regard to the nose.

The core 50 is formed with projecting portions 67 which form the channel 11, and the mold parts 48 and 49 have recesses mating therewith, as indicated at 68, to form the walls 8, 9, and 10 of the wishbone H. Preferably, the core 50 is provided with relatively low raised portions 69 adjacent the raised portion 67, for forming the recesses which receive the marginal edges of the cover strip 23, although, if desired, such recesses can be formed in the cover strip by cutting or burning after the molding and vulcanizing of the integral portions of the mask have been completed.

Projecting portions 70 on the sides or lateral faces of the core 50 and corresponding or mating recesses 71 in the mold sections 48 and 49, Fig. 11, form the external bosses 43 and internal recesses 45, respectively, for attaching the ends of the harness straps. The mold sections are provided with recesses 72, adjacent the marginal edges of the mold cavity, which form the elongated bosses 41 of the harness-attaching means. The ends of the recesses 72 are somewhat wider and more shallow than the central portions thereof to shape the bosses 41 with broad fan-shaped ends 35 which taper toward and blend into the outer surface of the cheek portions of the mask. Desirably, core pins 73 which taper to a relatively thin section at their centers, are received in the mold sections and disposed in spaced parallel relation across the recesses 72 adjacent the ends of the latter to form spaced holes 74 in the elongated harness-holding bosses 41.

About the entire periphery of the mold cavity, except as interrupted by the harness-attaching bosses, the mold sections 48 and 49 are formed with a substantially continuous recess 92 which shapes the bead 46 on the edges of the mask. This bead is thus integral with the relatively thick sectioned bosses 40 and 41 which retain the harness straps.

To mold a mask, raw rubber compound or similar material in the form of relatively thin sheets or strips is placed about the core 50 or in the mold cavity so as to be substantially continuous over the entire surface thereof which is utilized in forming the mask. The core is then disposed between the mold sections 48 and 49 and the assembly is heated under pressure in accordance with conventional rubber molding practice for a suitable length of time to cure or vulcanize the rubber. During the molding operation the rubber material is distributed and homogenized throughout the mold cavity so as to fill all the interstices thereof. The mold halves 48 and 49 are then separated and the mask stripped from the mandrel or core 50 and trimmed.

As shown in Fig. 7, the tubular portion 26 of the nasal part E, which forms the exhalation passage, is molded in protruding relation with respect to the mask. After the vulcanizing or curing is completed the tubular member 26 is reversed or turned outside in so as to project inwardly into the breathing chamber 1. The flutter valve housing 24 is then attached in accordance with the manner previously described.

To facilitate the molding of the mask by a single pair of mold sections, it is preferable that the portions of the mold cavity which form the front surface of the mask be slightly curved or outwardly bowed, as indicated at 73 Fig. 9. This portion of the mask extends between the frames 3 of the sight windows F and G and is molded with the outward curve or bow so as to provide sufficient draft for lateral withdrawal of the mold section from the core. Preferably, after the first molding and vulcanizing operation around the core 50 and in the first pair of mold sections 48 and 49, the front portion 73 of the mask is reshaped between a second pair of mold sections 75 and 76, Figs. 14 and 15. In this reshaping operation the front portion of the mask between the sight window frames has imparted thereto a triple bend which, in cross section, is in the form of a double ogee curve, shown in Fig. 15. Undercut or inwardly bent concave portions 77 are thus provided adjacent the window frames 3 and form the grooves or furrows 2. A central protruding or convex portion 78 is also formed in this manner to normally overlie the bridge of the nose of the wearer. Al-

though this reshaping operation is preferably carried on in a second mold from that which initially forms the mask, the mold section 75 can be set in a recess formed between the mold sections 48 and 49 and the core 50 may be formed in the shape of the mold section 76 so as to form the recessed portions 77 and protruding portion 78 of the nasal portion E simultaneously with the molding of the remainder of the mask in the initial molding operation.

The cover strip 23, previously mentioned and which may also be in the form of a flat strip of flexible material such as sheet rubber, is fastened on the inside of the mask over the channel 11 by any suitable means such as vulcanization or an adhesion agent like rubber cement. The recesses formed by the raised portions 69 of the mold core are of a depth substantially equal to the thickness of the marginal portions of the strip 23 so that the exposed surfaces of such margins of the strip are substantially flush with the inside surface of the mask. When in place within the mask, the strip 23 is substantially U-shaped as indicated in Fig. 16.

As previously mentioned and shown in Figs. 11 and 12, the elongated bosses 41 are molded and vulcanized integrally with marginal portions of the cheek portions of the mask. In order to form the elongated slits 80 therein to receive the harness straps, the edge of the vulcanized mask is placed on an anvil 81, Figs. 17 and 18, with one of the bosses 41 against an abutment 82. A pointed, double-edged knife 83, carried by a suitably mounted and actuated arm 84, is forced to the right, as viewed in Fig. 18, from substantially the broken line position to the full line position indicated. During this movement the knife 83 severs the central part only of the boss 41 between the tapering holes 74 formed therein during the molding operation, from the relatively thin material of the mask, leaving the tapering, fan-shaped end portions 85 beyond the holes 74 integrally connected to the mask. Recess 86 is formed in the abutment 82 to accommodate the projecting pointed end of the knife 83.

The construction of the present mask and the manner in which it is attached to the head of the wearer by the improved harness insures a more effective gastight seal with the wearer's face. The fit of the bosses 41 over the harness straps permits the marginal edge portions of the mask to accommodate themselves to the particular facial contours of the wearer.

The relatively heavy sectioned nasal portion E, which protrudes from the front of the mask, permits the remaining portions of the device to be disposed in closely overlying relation with respect to the wearer's face so that the sight windows F and G permit a relatively wide range of vision. Preferably, the windows, which may be made curved if desired, are of substantially triangular shape with rounded corners. The wide ends of the windows are uppermost and have corner portions 87 directed toward one another over the bridge of the wearer's nose in the region of the protruding part 78 of the nasal portion E. From the corners 87 the windows diverge downwardly on opposite sides of the nasal portion E to relatively narrow bottom portions 88 of the windows which are at the upper ends or openings 12 of the air inhalation channel 11 and in front of the air-directing flanges 79 of the cover strip 23.

Normally the mask assumes the substantially flat shape in which it is molded, thus facilitating its being packed in a relatively small container for ease in transportation. When held in the hand or hands with the front portion of the mask lowermost, the cheek portions A and B normally fall or bow outwardly away from one another and the mask assumes a substantially face shape. This movement involves a hinging or bending action at the central portions of the mask through the central part 63 of the forehead portion C, central part 64 of the chin portion D, and central portions 65 and 78 of the nasal portion E. Furthermore, the outward movement of the side or cheek portions of the mask draws marginal edge portion 89 of the forehead portion C and edge portion 90 of the chin portion D inwardly from the molded shape indicated by the broken lines of Fig. 2 to substantially the full line position of that figure. This inward drawing of the edge of the chin portion produces a cup-like formation which receives the chin of the wearer and effects a snug, gas-tight fit therewith. The outwardly bowed or convex portions of the lower part of each of the cheek portions A and B, formed therein during the molding operation and indicated at 91, Fig. 1, effect a continuation of the chin cup around the sides of the wearer's jaw to substantially the base of the latter in the region of the protruding edges 61 of the cheek portions of the mask. Thus, a snug fit all around the wearer's jaw is provided which is comfortable and gas tight. The inwardly curling or curved edge portions 59 of the cheek portions A and B are pressed against the cheeks of the wearer by the elasticity of the mask and because of the tension induced therein effect a positive inward drawing action on the edges 89 and 90 of the forehead and chin portions respectively, so that all of the edge portions of the mask around substantially the entire periphery of the face opening are held snugly against the flesh of the wearer to effect a substantially gas-tight seal therewith.

Other modes of utilizing the principles of the present invention may be resorted to, change being made in the particular procedure and details of construction set forth, numerous modifications thereof, alterations, and substitution of parts being contemplated, it being understood that the embodiment set forth above and shown in the drawings is given for purposes of explanation and illustration.

What we claim is:

1. A respirator device comprising an integral mask of relatively thin flexible rubber to cover the face of a wearer, a strap harness for holding the mask in place, an integral rubber boss protruding outwardly from the mask adjacent a marginal edge thereof, a slit through the boss between the material of the boss and the material of the mask, one of the harness straps being disposed in the slit, and means securing said harness strap to a portion of the mask removed from said boss.

2. A respirator device comprising an integral mask of relatively thin flexible rubber to cover the face of a wearer, a strap harness for holding the mask in place, an integral rubber boss protruding outwardly from the mask, an aperture through said boss, a counterbore in the aperture on the inside of the mask, and a fastening element extending through the aperture and connected to one of the straps of the harness, the fastening element having a head disposed in the

counterbore and substantially wholly below the inside surface of the mask.

3. A respirator device comprising a mask of flexible material having cheek, chin, and nose portions to overlie the corresponding parts of the wearer's face, eyepieces on opposite sides of the nose portion, and a tubular air channel extending substantially between the eyepieces and passing beneath the nose portion and above the bottom of the chin portion, said tubular channel having an inner wall normally disposed to lie against the bottom lip of the wearer and above the wearer's chin, said inner wall having a ridge extending in a direction longitudinally of the channel and disposed adjacent the lower lip of the wearer.

4. A respirator device comprising a mask of flexible material having cheek, chin, and nose portions to overlie the corresponding parts of the wearer's face, eyepieces on opposite sides of the nose portion, and a tubular air channel extending substantially between the eyepieces and passing beneath the nose portion and above the bottom of the chin portion, said tubular channel having an inner wall normally disposed to lie against the bottom lip of the wearer and above the wearer's chin, said inner wall being thickened in the form of a wedge extending transversely of the wall at the portion thereof beneath the nose portion of the mask.

5. A respirator device comprising a mask of flexible material having cheek, chin, and nose portions to overlie the corresponding parts of the wearer's face, eyepieces on opposite sides of the nose portion, and a tubular air channel extending substantially between the eyepieces and passing beneath the nose portion and above the bottom of the chin portion, said tubular channel having an inner wall centrally thickened at the portion thereof below the nose portion of the mask, said thickened portion being in the form of a ridge the sides of which are angularly disposed with respect to one another.

6. A respirator device comprising a mask of flexible material having cheek, chin, and nose portions to overlie the corresponding parts of the wearer's face, eyepieces on opposite sides of the nose portion, and a tubular air channel extending substantially between the eyepieces and passing beneath the nose portion and above the bottom of the chin portion, said tubular channel having an inner wall continuous from one eyepiece to the other, said inner wall being centrally thickened at the portion thereof below the nose portion of the mask, the thickened portion being in the form of a ridge the sides of which are angularly disposed with respect to one another and are substantially flush with the adjacent surfaces of the mask.

7. A respirator device comprising a mask of thin flexible rubber to cover the face of the wearer, a strap harness for holding the mask in place, an integral rubber boss formed along one marginal edge of the mask and protruding outwardly therefrom, an integral reinforcing bead formed along the edge of the mask and connected to the boss at one end thereof, an elongated slit in the boss, one of the harness straps being disposed in the slit, and means securing said strap to the mask.

8. A respirator device comprising an integral mask of relatively thin flexible rubber to cover the face of a wearer, a strap harness for holding the mask in place, an integral rubber boss protruding outwardly from the mask, an aperture through said boss, a recess inside the mask opposite the boss and aligned with the aperture, an annular channel in the bottom of the recess around the aperture, and a fastening element extending through the aperture and connected to one of the harness straps, the element having a head disposed in the recess substantially wholly below the inside surface of the mask and against the bottom of the recess inside the channel.

9. A respirator device comprising an integral mask of relatively thin flexible rubber to cover the face of a wearer, a strap harness for holding the mask in place, an integral rubber boss protruding outwardly from the mask adjacent a marginal edge thereof, said boss being of elongated character and having enlarged ends which are connected to the mask over areas wider than the boss, a slit through the boss between the material of the boss and the material of the mask, one of the harness straps being disposed in the slit, and means securing said harness strap to a portion of the mask removed from said boss.

10. A respirator comprising a mask of relatively soft flexible rubber material having integral cheek, chin, nose and forehead portions for overlying the corresponding parts of the wearer's face, a pair of spaced rubber eyepiece frames integral with the cheek portions, portions of said mask being formed to provide a tubular passage extending between the frames and having the central portion of said passage disposed under the nose portion, the walls of said passage being integral with the frames and including an inner wall which is flush with the inside surfaces of the mask adjacent thereto, a rubber air tube integral with the passage walls for conducting air to the passage, the ends of the passage being disposed so that air discharged therefrom is directed onto eyepieces in the frames, the cheek portions being normally disposed in approximate parallelism so that the mask normally assumes a substantially flat shape, said cheek portions having margins which are curved toward one another a greater amount than the natural curvature of a wearer's face so that in conforming the mask to the face of a wearer said margins are moved outwardly a relatively greater amount than the cheek portions adjacent thereto to draw the edge of the chin portion upwardly so that the latter is tensioned against the underside of the wearer's chin to form an air-tight seal therewith, and an attaching harness for holding the mask to the wearer's head, said harness including strap portions having ends which are secured to the cheek portions of the mask inwardly of said curved edges so that said curved edges are freely movable to conform themselves to the facial contour of the wearer.

11. A face mask for a respirator comprising integral cheek, nose and chin portions of resilient flexible material for overlying corresponding parts of a wearer's face, eyepieces on opposite sides of the nose portion, means providing an air passage extending substantially between the eyepieces and passing above the bottom of the chin portion and below the nose portion, said means including an inner wall formed with a ridge inside the mask and extending longitudinally of the passage to be received between the chin and the lower lip of the wearer, and said inner wall being formed with a transversely extending wedge on the passage side thereof and intermediate the ends of the passage, and means for supplying air to the passage in the region of the wedge.

12. A face mask for a respirator comprising integral cheek, nose and chin portions of resilient flexible material for overlying corresponding parts of a wearer's face, eyepieces on opposite sides of the nose portion, means providing an air passage extending substantially between the eyepieces and passing above the bottom of the chin portion and below the nose portion, said means including an inner wall substantially flush with the inside surfaces of the mask, said wall being thickened intermediate the ends of the passage to fit between the chin and the lower lip of the wearer and to resist collapsing of the passage wall upon movement of the wearer's chin, and means for supplying air to the passage in the region of the thickening.

13. A molded face mask for a respirator comprising integral cheek, chin, nose and forehead portions of relatively thin resilient and flexible material, a pair of eyepiece frames of relatively thick resilient and flexible material disposed on opposite sides of the nose portion and integral therewith and with the cheek and forehead portions, means defining a substantially U shaped tubular air passage extending across the front of the mask above the chin portion and below the nose portion and having side portions the upper ends of which terminate in the eyepiece frames, said means including relatively thick walls of resilient and deformable material integral with the adjacent portions of the mask and with the eyepiece frames, the inside wall of the passage being relatively thicker along the bottom portion thereof beneath the nose portion than along the side portions to strengthen the walls of said bottom portion and thereby resist spreading apart of the side portions, whereby the thick walls of the tubular air passage and the eyepiece frames constitute integral stiffening means to retain the molded shape of the front of the mask, and means having connection with said passage to supply air thereto.

14. A molded face mask for a respirator comprising integral cheek, chin and forehead portions of resilient flexible material for overlying corresponding regions of the face of a wearer, the cheek portions being outwardly convex and having interior surfaces in confronting relation to one another, said mask having margins that along the cheek portions only are curved inwardly a greater amount than normal face conforming curvature whereby in applying the mask to the face of the wearer said cheek margins are bent outwardly relative to the other portions of the mask and thereby draw the margins of the forehead and chin portions inwardly.

15. A molded face mask for a respirator comprising integral cheek, chin and forehead portions of resilient flexible material for overlying corresponding regions of the face of a wearer, the cheek portions being outwardly convex and having interior surfaces in confronting relation to one another, said mask having margins that along the cheek portions only are curved inwardly a greater amount than normal face conforming curvature, the margins of the chin and forehead portions being of less than normal face conforming curvature, whereby in applying the mask to the face of the wearer said cheek margins are bent outwardly relative to the other portions of the mask and thereby draw the margins of the forehead and chin portions inwardly.

16. A molded face mask for a respirator comprising integral cheek, chin, nose and forehead portions of resilient flexible material for overlying corresponding regions of a wearer's face, said portions being generally curved with less than face conforming curvature in a vertical plane through the forehead, nose and chin portions and more than face conforming curvature in a horizontal plane through the cheek and nose portions whereby in applying the mask to the face of a wearer the cheek portions are bent outwardly to reduce the curvature thereof and of the mask through the cheek and the nose portions in said horizontal plane and the forehead and chin portions are drawn together to increase the curvature of the mask through the forehead, nose and chin portions in said vertical plane.

17. A molded face mask for a respirator comprising integral cheek, chin, nose and forehead portions of resilient flexible material for overlying the corresponding parts of a wearer's face, said cheek portions including central parts in spaced confronting relating to one another when the mask is in normal unstressed condition, the margins of the cheek portions being curved toward one another so that in said condition the edges of the cheek portions are closer together than the central parts of the cheek portions, the normal curvature of said margins being greater than face conforming curvature while the margin of the chin portion is normally of no greater curvature than face conforming curvature, whereby in applying the mask to the face of the wearer the cheek portions are spread apart and the margins thereof are bent outwardly from their normal positions relative to the central parts to reduce the curvature thereof and the margin of the chin portion is bent inwardly from normal unstressed condition to increase the curvature thereof.

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