Feb. 13, 1934. C. E. FRASER 1,947,137

GOGGLES

Filed March 8, 1927

Fig. 1.

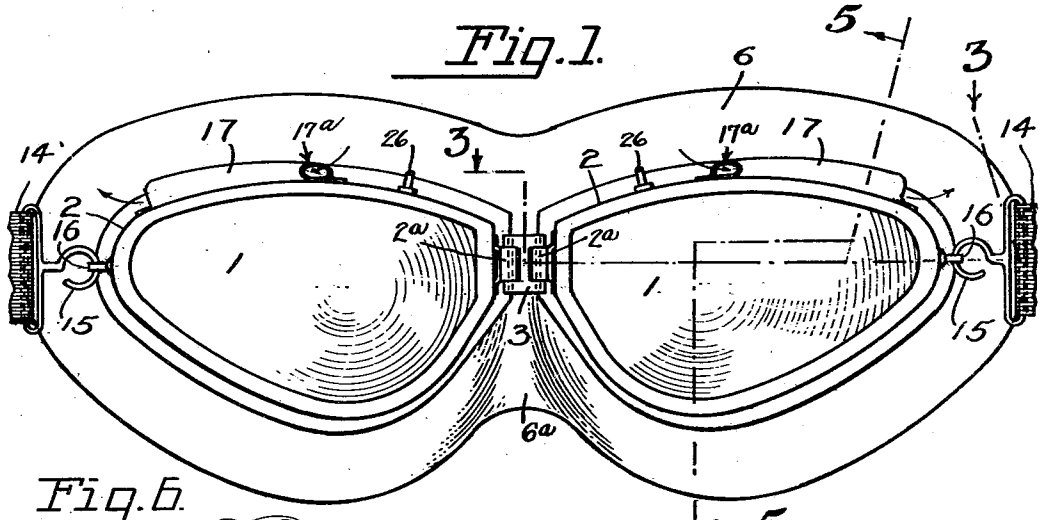


Fig. 6.

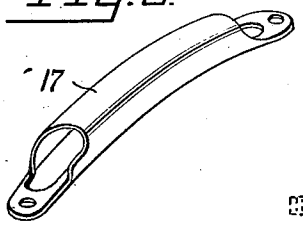


Fig. 5.

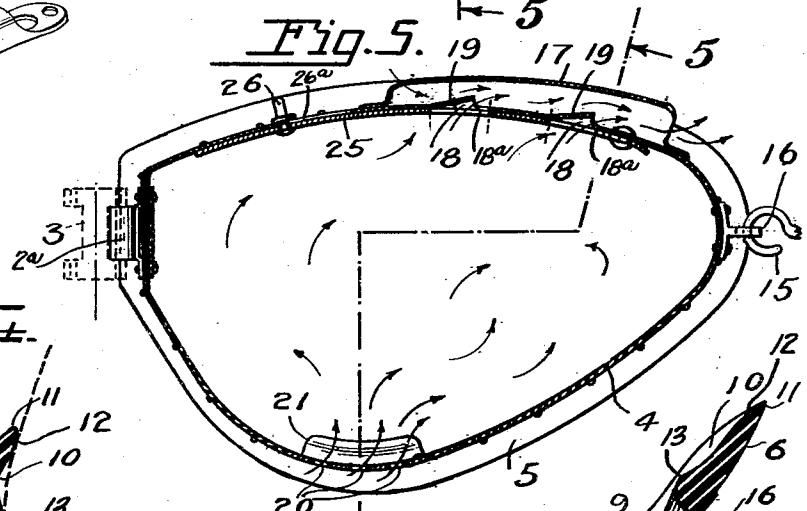


Fig. 4.

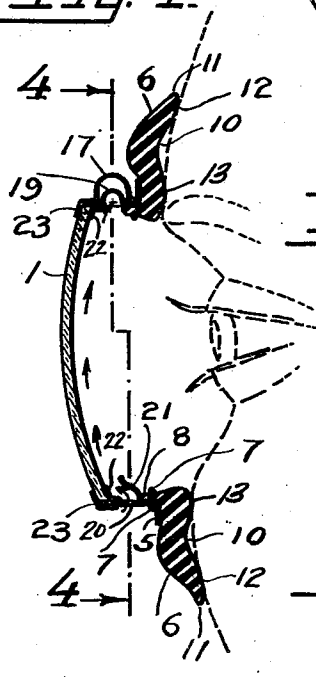


Fig. 3.

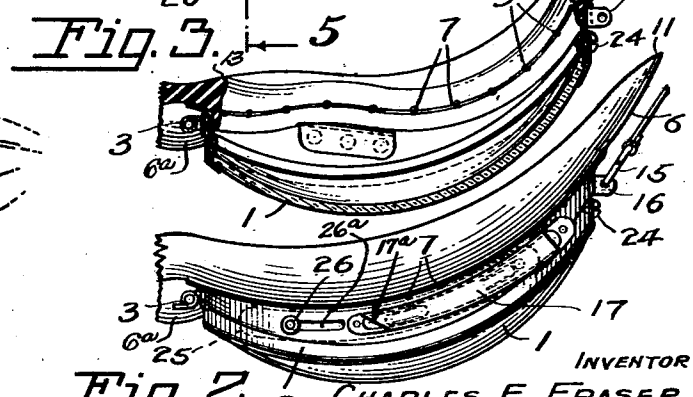
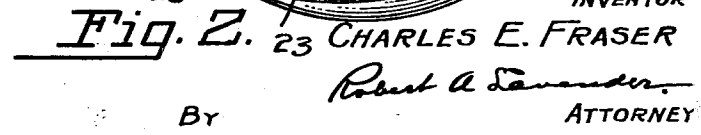


Fig. 2.



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UNITED STATES PATENT OFFICE

1,947,137

GOGGLES

Charles E. Fraser, Brooklyn, N. Y., assignor to Willson Products Inc., Reading Pa.

Application March 8, 1927. Serial No. 173,665

51 Claims. (Cl. 2—14)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

My invention relates broadly to method of and apparatus for goggles and more particularly to such method and apparatus for use by aviators and racing motorists.

My said novel method and means have been devised to demonstrate their highest efficiency under the most adverse and severe conditions, such as endurance, altitude, speed, wide temperature difference and weather conditions for testing planes and personnel as well as racing of motor cars, motor boats, dirigibles, balloons and other devices, where the craft as well as personnel may be most severely tested to develop the limits of their several endurances. In such most severe conditions of altitude and other extreme cold the eyes and their pupils, or either, are likely to become dangerously affected, frosted or frozen; the deficiency of oxygen in the air at high altitudes, and the substantial reduction of the accustomed atmospheric pressure upon the bodies of personnel, tends to reduce the normal physical resistance and efficiency of personnel and render same liable to great physical impairment and discomfort due to weight and stresses upon and about the head, as by undue weight of goggles or tension of band 14, which otherwise would be ineffective.

Previously goggles have had to be made with the lenses so far from the eyes that it has been difficult as well as highly expensive to make the lenses serve also the purpose of correcting defects of vision of the wearer, but my invention also overcomes this condition.

The main object of my invention is to provide such method and apparatus that will be comfortable to the wearer, when compelled to use them for a long period of time, such, for example, as when making endurance tests; essential features thereof relating particularly to means for utilizing the air pressure and flow to which the applied goggles are subjected in service, so as to insure comfortable air-tight contact with the face of the wearer and ventilation of the eye cups, while simultaneously preventing fogging of the lenses.

To overcome said conditions and tendencies and to attain these and other objects, and in accordance with the general features of this unitary and related invention, my improved method contemplates the adjustment and securement to the wearer of goggles by forming a partial vacuum between the edges of said goggles and the face of the wearer and within the area of said edges; the further step of creating within said goggles of a separate and independent partial vacuum, preferably within each eye-cup of the goggles; the further step of varying the degree of vacuum within each of said eye-cups; or of varying the relative rates of inlet and outlet flow of air through the eye-cups; the further step of creating said separate partial vacuum within the eye-cups, or the ventilating flow therein, by relatively moving the goggles and the outer air and confining a portion of said outer air and relatively moving said confined air past ports in said eye-cups, with the further step of increasing the velocity of said confined air in its said movement past said ports, with the further step of Venturi-like restricting the area of said confined air adjacent said ports, with the further step of substantially increasing the normal area of frictional and other driving engagement of said confined column of air and the air coming through each of said outlet ports, with the further step of increasing said last named driving engagement by forming a channel in said confined column of air passing over said port, each of said steps being conjointly employed, and may be severally used, in the accomplishment of the new and useful functions and results of my invention.

The partial vacuum sealing of the edges of each eye-cup to the features of the wearer substantially tends to prevent circulation of air near the eye-balls and tends to prevent frosting or other injury to or impairment of the eyes in the low temperatures prevailing at high altitudes as well as in winter at all altitudes. The same further tends to hold the goggles in position, which function is further contributed to by the separate partial vacuum in each eye-cup, and leaves the head-band 14 without appreciable tension about the head, whose otherwise substantial tension tends in some cases at high altitudes to contribute to a headache or other discomfort. In my invention said band 14 is a safety hold-on. Said edge vacuum seal further eliminates all inflow of air to the eye-cups to that coming through each of their provided inlets and enables a partial vacuum to be formed therein in fact, instead of in theory, and the control of such vacuum to be readily and uniformly accomplishable under like conditions of relative velocity and ratios of areas of inlet to outlet ports.

To demonstrate the practical utility of my method a related, improved and novel apparatus embodying my invention, and which may be used advantageously and economically in practicing said improved method as a unitary invention, is provided to also serve as an example, to those skilled in the art, of the facility with which,

after becoming familiar with my invention, the many forms and kinds of existing apparatus, with or without substantial modification, may be employed in the efficient practice of my said method in like and kindred production.

I have produced a pair of goggles in which there is a wide angle of vision and the lenses of which are cleared of fogging by ventilation produced by a partial evacuation of the eye cup. The goggles are firmly held in place upon the face of the wearer by the partial evacuation of the eye cup and by the use of a pad particularly designed to produce a vacuum between the wearer's face and the pad when placed in its proper position. The head-band functions normally as a safety hold-on. The ventilating draft is confined substantially to a plane adjacent the inner surface of each lens, and is preferably removed from the eyes of the wearer so that the function thereof may not impair vision or affect the eyes.

My invention consists substantially in my method and the construction, combination and arrangement of parts associated therewith or as will be more fully hereinafter set forth as shown by the accompanying drawing and finally pointed out in the appended claims.

I have found that the partial vacuum at 10 in Fig. 4 will not hold protractedly due to leakage normally through slight irregularities in portions of the surface of the skin of the wearer in contact with the points 12, 13 at the borders of the partial vacuum volume 10, but that the force of the pressure and/or velocity of the medium in which the goggle is worn, exerted externally upon the goggle as well as upon the portion of the face-contacting pad 6, which projects substantially beyond the edges of the lens portions of the goggle, smooths the skin at the points of contact with the goggle portions and efficiently maintains the seal of said partial vacuum.

In applying the goggle, the fingers are passed over the outer surface of pad 6, projecting beyond the lens of the goggle. This excludes air from volume 10 and the projection of pad 6, beyond the lens of the goggle, enables the avoidance of finger-smearing the edges of the outer surface of the lens while thus suction sealing the goggle to the wearer.

Said seal substantially contributes to the maintenance of the volume of relatively quiescent air about the eyes of the goggle wearer and between the lens and the eyes. Said quiescent air is in contact with and receives heat and moisture from features of the wearer, the moisture being mainly received from the eyes. This moisture, instead of collecting upon and fogging or frosting the inner surface of the lens as heretofore, is entrained into a limited volume of the external atmosphere flowing across the line of vision and between the lens and the quiescent volume, and which volume is preferably localized across and in contact with the inner surface of the lens. The discharge of the flowing volume with its entrained moisture maintains the inner surface of the lens free from vision obscuring fogging and frosting. The limitation of the volume of inflowing air relative to the discharge so as to afford within the eye cup lesser than external pressure further tends to localize the volume flowing across the eye cup. The relation of the two air volumes to each other and to the eyes, with the substantial area of the contact of the quiescent volume with features of the wearer, the body heat through said contact transmitted to the quiescent volume; the distance from the eye, and the limited volume, of the atmosphere flowing localized over the lens, produces negligible, if any, turbulence of the quiescent volume, and substantially affords a comfortable temperature at the eyes of the wearer when otherwise the eyes may become uncomfortable, frosted or frozen.

I have found that in wearing goggles with air rushing past at substantial velocity, the head, not being an efficient air foil, causes dead air under pressure to be built up in front of the face with its apex in the region of the nose and its base at the sides of the face. Due to this fact, openings through the impervious walls of eye cups, within said pressure area, will occasion a pressure inlet of atmosphere into, and greater pressure within, the goggle eye cup. I have overcome this by leading the discharge from the goggle eye cups to, and exhausting the same at, the temple edges of the goggle by means which is neat in appearance, uncumbersome to the wearer, and highly efficient in operation.

The foregoing and other objects of my invention will be further apparent from the following detailed description and the accompanying drawing, illustrating one embodiment of my invention in an improved apparatus, of the many different forms and characters of apparatus each of which may be employed in the successful demonstration of the practical utility of my novel method and in the attainment of the manifest superior advantages and achievements thereof.

Reference is to be had to the accompanying drawing forming a part of this specification in which like reference characters indicate corresponding parts throughout the several views and in which:—

Figure 1 is a front view of a pair of goggles embodying the various features of my invention.

Figure 2 is a plan view of one element of the goggles the other element of which is arranged symmetrically upon the other side of the nose piece.

Figure 3 is a horizontal section on the line 3—3 of Figure 1,

Figure 4 is a sectional view on the line 5—5 of Figures 1 and 5 but including the face pad omitted for clearness in Figure 5.

Figure 5 is a sectional view on line 4—4 of Figure 4 showing the arrangement and detail construction of one element of my improved goggles,

Figure 6 is an enlarged perspective view of my Venturi member removed from the goggles.

Referring particularly to the drawing numeral 1 represents the lenses supported by frames 2. The frames 2 are hinged together at the point adjacent to the nose by adouble hinge member. I have found that by the use of a double hinge member such as that shown at 3 it is possible to produce goggles that will fit varying contours of the forehead and cheeks of different persons. Further, when the goggles are not in use they may be folded into a very compact unit, the floating member 3, to the opposite sides of which projections 2*a* of frame 2 are hinged allowing the lenses and frames to be placed adjacent each other.

The frames 2 consist of a cylindrical portion 4, the inner portion of which is flanged outwardly as at 5. The facial pad 6 rests firmly in place against the flanged portion 5 and is held in place by stitches 7 of thread or wire extending through a lip 8 of the facial pad 6 and through holes 9 in the cylindrical portion 4 of the frames 2.

The facial pad 6 is recessed as at 10 on the side

adjacent the face. This recess extends completely around the facial pad at a small distance within its periphery. When the facial pad rests against the face of the wearer a slight pressure upon the outside of the flexible apron 11 of the facial pad expels a portion of the air contained in the recessed portion of the pad. When this pressure is released the facial pad adheres to the face of the wearer by contact of the two rims 12 and 13 of the facial pad on opposite sides of recess 10 and resting firmly against the face of the wearer thus preventing an inrush of air into the recess 10 and maintaining a partial vacuum therein with resulting suctional adherence.

This adherence of the facial pad to the face of the wearer allows adjustment of the goggles to a comfortable position where they remain due to the adherence of the pad without appreciable tension upon the goggles by the strap 14 which extends around the head of the wearer. The strap 14 is fastened in place by hooks 15 engaging eyelet members 16 in the sides of the frames 2, or in any other well known manner.

The cylindrical portion 4 of the frames 2 is of such a length that the flanged portion 5 substantially conforms to the contour of the face.

The forehead curvature A is shown in Figure 2. The cheek curvature is shown in Figure 3.

I have found that it is possible to aid the facial pad 6 in holding the goggles in position by partially evacuating the eye cups back of the lenses 1. With this I have combined the ventilation of the eye cup to prevent fogging of the lenses 1 due to the difference of the temperature upon the inside and outside of the lenses.

I have accomplished this feature by placing Venturi members 17 upon the upper outer portion of each frame 2. For each position of the Venturi members 17, see Figures 1 and 2 it requires a change in curvature and cross-section of each Venturi member 17 but the type that I have found to be superior to the others is the position shown in the drawing in which the Venturi members 17 have a rounded top which neatly conforms with the contour of the frames. These Venturi members 17 are uniformly variable in cross-section. The larger cross-section is placed toward the rear and outer edges of the goggles and preferably has approximately 30% larger cross sectional area than the intake opening at the forward end of each member 17.

The Venturi member 17 that I have found most serviceable is one that is elliptical in cross-section. The intake of the Venturi member 17 is preferably an ellipse with its major axis horizontal. The exhaust port of each member 17 is preferably an ellipse of 30% larger area than the intake and has its major axis vertical. However, I have found that Venturi members 17 conical or pyramidal in shape have certain characteristics not possessed by the elliptical Venturi member 17, but that the elliptical Venturi member 17 possesses the largest number of advantages.

Within the Venturi member 17 there are one or more ports 18 in the frame 2 of the eye piece. These ports are partially covered by deflector plates 19 that form strictures within each respective Venturi member 17. The ports 18 and deflector plates 19 are so positioned with respect to each respective Venturi member that they lie within and conform to the shape of the Venturi member at points where the major axis of the ellipse is horizontal. I have found that it is preferable to make the intake ports at an angle to the axis of their respective Venturi members 17, see Figures 1 and 2. This structure causes increased velocity of the air within each member 17.

As the external air flowing through members 17 passes through each of the strictures between the extended edge of each of the angular deflector plates 19 and the shell of the Venturi member 17 the increased velocity of the air thereby created draws substantial volumes of air from the eye-cups of the goggles through the adjacent mouth of each of the said ports 18, thereby causing a substantial reduction of the pressure under the deflector plates and produces a partial vacuum within the eye cup of the goggles.

The conical shape of each deflector plate 19 terminating, at its enlarged end at the mouth of its respective air outlet port 18, in substantially a semicircle of lesser size than that of its adjacent portion of member 17, causes a semicircular shaped column of external air, (see Figure 4) which entered member 17 through its front angular opening at the high relative velocity of the air encountered by the goggles in flight, to be moved toward the rear past each outlet port 18 at higher velocity due to the said Venturi semicircular restriction. The cavity of said semicircular column of air flowing at high velocity over each of said outlet ports 18 is of substantially greater area than that of said port 18 in the plane of movement of said flowing air and affords substantially greater frictional and other driving contact with the air in said ports 18 than could be exerted were said areas equal, and which frictional and other driving contact causes air from within the eye-cup of each half of the goggles to be drawn through each of said ports 18 more efficiently and completely than would otherwise be possible in such a relatively narrow space. The narrowness of said space is essential for neatness to avoid undue weight and distance of the lenses from the eyes, as well as to provide the normal short distance between lenses and eyes necessary where vision correcting lenses may be required and without undue expense therefor.

This causes a substantial reduction of the normal atmospheric pressure within each eye-cup of each half of the goggles, which not only assists the partial vacuum cavity 10, surrounding each said eye-cup, in holding on the goggles with relatively little stress upon the hold-on strap 14, but it also, in conjunction with the arrangement of ports 18 and 20 on opposite sides of and close to each lens 1, and the action of deflector 21 deflecting the inlet outer air upward along the inner surface of each lens 1, keeps the resulting draft of air close to the inner surface of each lens 1 and away from the eyes of the wearer. This also substantially tends to promote vision and at high altitudes tends to retard freezing of the eyeballs, which has occurred with other goggles and to retard which is one of the objects of my invention.

It will be readily understood that the air velocity to which my improved goggles are subjected when in service, effects a positive air withdrawing action upon the cup chamber, through the outlets 18 and the connected Venturi tube air-impinging means as particularly set forth, in excess of the inlet flow to said chamber, which latter is definitely provided for as indicated by the oppositely arranged small ports 20. The restricted ventilating flow through said chamber and a partial vacuum therein are automatically produced by the passing air without the blowing action and objectionable pressure within the eye cup that is present in the goggles in com-

mercial production at the present time. Further in the goggles that I have developed there is a reduced pressure within the eye cup which permits the atmospheric pressure to act upon the outside of the eye-cup with the resulting firm adhesion of the goggles upon the face of the wearer. The restricted inlet flow of air is preferably directed toward the inner face of the lens by the baffle plate 21, which not only directs the inflow of air away from the eye of the wearer but also prevents fogging of the lenses.

The front of the cylindrical portion 4 of the frames 2 is flanged inwardly as shown at 22 in Figure 4. The lens 1 rests firmly against the flange 22 and is held in place thereon by a supplemental frame 23 secured at the nose piece to the cylindrical portion 4. The outer end of the supplemental frame 23 is held in place by a small screw 24 threaded in the cylindrical portion 4. When it is desired to replace a lens, the screw 24 is loosened and the supplemental frame, if hinged at the nose piece, may be swung outwardly releasing the lens, or if soldered at the nose piece the resiliency of the supplemental frame permits sufficient springing of the same to remove the lens.

In order to adapt my goggles to variations in the relative velocities of the wind and the goggles I have provided a slide 25 preferably upon the inner side of the cylindrical portion 4 of each of the eye-cups that varies the size of the ports 18. This slide is controlled by a button or operating means 26 extending through a slot 26*a* in the cylindrical portion of each eye piece.

Said variation of the operative size of outlet ports 18 is accomplished preferably by providing supplemental ports 18*a*, Figure 5, in each of said slides 25 adapted to fully register with said ports 18 when button 26 is at one end of its slot 26*a*, and to partially close ports 18 as the same are moved toward the opposite end of said slot 26*a*, and to substantially completely close ports 18 when the same are at the opposite end of said slot, its relative position in said slot indicating substantially the extent that ports 18 are obstructed.

It will be obvious that openings 20 and 18 constitute respectively inlet and outlet means, and that said slide 25 and its associated parts consitute means for varying the capacity of one of said means. While I prefer to employ said variable capacity means in connection with said outlet means, the factors of the problem incident to said preference are that the inlet means are so disposed as to be out of the direct relative velocity of the air by being placed at substantially a right angle thereto and therefore receive but a relatively small portion of said air while each of the outlet means receive not only the normal relative velocity of the air directly past the same but that said normal relative velocity past each of the same is augmented by the Venturi restriction aforesaid. A change in said factors, or any of them, may require a different preference as those skilled in the art may determine herefrom.

By said adjustment of the capacity of one of said inlet and outlet means the observer using my goggles may vary, within substantial limits, the pressure within each eye-cup to properly correlate conditions of relative air velocity, altitude, physical condition and comfort of the observer, user and otherwise.

As shown in Figures 1, 2 and 3, the substantially flexible material of which the eye-cups are formed are joined together at their adjacent edges where the lower portion 6*a* thereof, substantially conforms to the adjacent part of the average nose, while the flexibility of the edge of cup 6 and of said portion 6*a* enables them to conform to the particulars of the face of the wearer.

While the lens frame members 2 are separate from each lens 1, and are connected together by the last mentioned integral flexible portion, including 6*a*, of the eye-cups, said frame members 2 are further joined together by a hinge located adjacent the outer surface of the central and upper portions of said integral portion connecting the eye-cups, Figures 1, 2 and 3, said hinge being preferably formed of a substantially flat floatable member 3 substantially vertically disposed centrally between the adjacent edges of frames 2 and being relatively long in its vertical length, and which member 3 is provided at opposite edges with portions overlapping adjacent portions of projections 2*a* secured to the adjacent edges of said lens frames 2, and with hinge pins extending through said overlapping portions, said hinge pins and said overlapping portions each being relatively long.

The goggles essentially must be light enough for comfort and yet rugged enough to withstand the substantial strains of wear and being carried about, and in the successful solution of this problem I have provided each lens main frame 4 of every light metal, or other suitable material, having preferably the base flange 5 to which is secured, in any desirable air-tight manner, the substantially flexible face pad 6, and at its outer edge each frame 4 is provided with the inwardly projecting flange 22 against the outer surface of which rests the inner surface of each lens 1 adjacent its outer edge so that the direct pressure of the air against the outer surface of lenses 1 may be received upon such flanges 22 and wall 4.

The strain upon hinge member 3 may be substantial at times, and to prevent frames 4 from being cast and hence of excess weight and to enable the very thin light-weight walls 4 to withstand the same without distortion I have provided each hinge-butt 2*a* with feet extending at opposite sides, through which feet and wall 4 rivets are passed also through a stiffener-plate upon the adjacent insides of each wall 4 so that the upsetting of said rivets preferably rigidly clamps wall 4 between said feet and stiffener-plate.

The ports 18 being located in the side of each wall 4, which are preferably relatively narrow to minimize weight and avoid unsightly results and liability to injury, invited by substantially protruding parts, presents the ponderable problem of obtaining substantial discharge through said parts so located and of such relatively small area, either by substantially enlarging the area of ports 18 and extent of projection of walls 4 and their lenses 1 at the expense of weight, sightliness and liability to injury, or of obtaining the requisite flow through said ports 18 without said expense. This problem I have solved by the following method involving two contributing factors without entailing said expense in any of its said factors. Said method includes the steps of passing a confined column of air at relatively high velocity over each of said ports and which action is rendered more efficient by the further step of restricting the area, and/or increasing the velocity, of said column of air substantially at the point where it passes the port. Said column of air being confined by said first step, and said confining also producing said Venturi-like action

by said second step, such steps severally as well as jointly thereby draw a greater volume of air through said port than could be drawn therethrough by unconfined air because, for instance, of the greater relative velocity of said confined air and said port, as well as by the further factor of discharging said column of air, comprising the originally confined air and that drawn from said port, in a direction substantially opposite that of the relative motion of said confined air and said port thereby the unconfined air surrounding and moving past said point of said discharge tends to accelerate the rate of said discharge. Said restriction of the area, and/or increasing the velocity, of said column of confined air substantially at the point where it passes said port substantially accelerates the flow of air through said port. Said confined column of air is intaken at a point exposed to the relative velocity of air and the agency confining said column, so that said relative velocity furnishes the force required to move said confined air.

I have further found that the Venturi action of said confined air over said port may be substantially improved whereby larger volumes of air may be drawn from said ports 18 so that lesser weight and shorter walls 4 and otherwise lighter and neater goggles may be produced of greater comfort and durability, and clearer vision obtained under the most adverse conditions. In order to accomplish this I have devised the following improved steps of my said method; relatively passing a confined column of air past said port with that portion of said column passing said port being of greater area than the area of said port in a plane in the direction in which said column passes said port. The preferred manner of obtaining said greater area being by forming a relatively deep channel in that portion of said confined column of air which moves past said port.

By the further improved step of restricting the area, and/or increasing the velocity of said greater area portion of said column passing said port substantially greater flow of air is obtained through said port. This step may be otherwise, and more understandingly, stated as permitting air within a port to extend through said port to an extent high toward the center of said port and preferably to an extent but little, if any, above the edges of said port adjacent the sides of the column of air adapted to pass said port, and relatively moving said column of air past said port with a channel in said column substantially conforming to and adapted to impinge upon and frictionally and otherwise engage with and move said port-extended air and draw substantially greater volumes of air through each of said ports due, it is believed, to the substantial increase of the area of said frictional and other engagement afforded by this step of said method of said velocity air with said port-extended and port-emitting air.

A further step of my said method is to further vary the volume of either the air intaken to or the air ejected from each eye-cup of the goggles to the degree required for the comfort and better vision of the wearer of the goggles under the varying conditions of speed, altitude, weather, temperature, humidity of the air and otherwise.

In an apparatus sense the air entering port 17*a* of member 17, substantially at the relative velocity of the air and member 17, is confined within said member 17 and passes the port or ports 18 drawing air from within the eye-cup through said port or ports 18 to ventilate said cup and at higher velocities and with the inlet port or ports 20 more restricted in area than the outlet port or ports 18 said action will form a partial vacuum within each eye-cup. The providing of the angular deflector plate 19 on the side of each port 18 nearest the inlet 17*a* of member 17 increases the volume of air ejected through ports 18 by the column of air flowing through member 17, while the restriction of the area between the high point of each plate 19 and the adjacent wall of members 17 forms a Venturi restriction, and a higher velocity of said column of air at said point, which further substantially increases the volume of air ejected through said ports 18.

The formation of each of said deflector plates 19 in the form of substantially half of a cone, with its largest diameter at the highest point of said plate 19, as shown in Figure 4, causes the column of air adapted to flow through member 17 and to have a channel formed in said column of the contour of said high point of plate 19 so that said channel extends over the adjacent port 18. The substantial increase in the area of said channel over the area of said port 18 affords greater frictional and other engagement of said air column channel and the air extending through port 18 and substantially increases the volume of air ejected through said port 18. The restriction of the area of said column of air, at the point where said channel is formed therein, gives greater velocity of said restricted column, Venturi-like, past said port 18 with the mouth of said channel extending over said port, further substantially increases the volume of air ejected through port 18 due in part to the greater velocity of the air flowing past said port and in frictional and other driving or ejector engagement of the same with the air which is thereby drawn through port 18.

It must be considered that it is the relative velocity of the air and the goggles that enables the method and means to function, and attain the results, as aforesaid. Considering Figure 4 it would seem that the relatively moving air flowing past airports 20 would cause air to be evacuated from said ports 20 and that the greater exhausting power of the members 17 will force air to be intaken into each eye cup through ports 20. But as said velocity increases, and viewing Figure 4 solely, more or less turbulent air will bank-up against portions 5 and 6 and the face of the wearer, so that said velocity past ports 20 will be reduced and thus the duty upon members 17 of maintaining a partial vacuum within each eye-cup will be accordingly increased. But, when considering Figures 3, 4 and 5 with the characteristics of the face of the wearer, it will be considered that in the preferred location of ports 20 they are designedly arranged in a row extending between the high point of each cheek-bone and the base of the nose. The velocity of the encountered air is deflected by the nose, and by the eye-cup connecting portion 6*a*, successively past said ports 20 which tends to overcome said banking-up tendency of the air and to lessen the liability of air being driven through ports 20 into each eye-cup and which also lessens said duty upon members 17. Said air, deflected by the nose, and portion 6*a*, past ports 20, passes over the adjacent high part of each cheek and its velocity is progressively increased by the relatively sharp receding of the cheeks and the successive increments of air encountered by the face.

It must be borne in mind that the term relative velocity contemplates ground-travel speeds of as much as several hundred miles per hour and the intense pressures incident thereto. At the higher velocities and pressures the air banking-up against the face, especially in the hollow between the nose and each cheek-bone high point will be of little, if any, velocity and under a pressure substantially proportionate to said relative velocity and a higher than the prevailing atmospheric pressure will be within each eye-cup in order to avoid discomfort to the wearer as well as the liability of said pressure breaking the lenses 1.

It will thus be appreciated that my method and apparatus function differently at substantially different relative velocities, and that the functions are relatively complex under the many different conditions likely to be encountered and applicant has painstakingly endeavored to present his theories and reasons which he believes explain the superior novel accomplishments of his invention and which are conducive to a better understanding of his invention to those skilled in the art.

Consequently, it should be remembered that throughout the specification and claims the term partial vacuum is intended to refer to and comprehend only a reduction of the prevailing adjacent pressure.

By this means, which demonstrates the practicability of my said method by one of the many types of apparatus by which it may be practiced, I obtain a very light, comfortable, neat and serviceable goggle capable of most efficient use in many conditions so adverse as to render other goggles inefficient or hazardous.

It will be understood that the above description and accompanying drawing comprehend only the general and preferred embodiment of my invention and that minor detail changes in the method steps or in the construction and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of my invention.

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

Having thus described my invention what I claim is:

1. The method of preventing the fogging in low temperatured atmosphere of the inner surface of the lens of a goggle while affording a comfortable temperature at the eyes of the wearer, comprising the steps of maintaining in a relatively quiescent state a volume of air between the lens and the eye and in contact with and receiving heat and moisture from features of the wearer; flowing a limited volume of said atmosphere across the line of vision and between the lens and the quiescent volume; entraining in said flowing volume moisture condensed in the quiescent volume; and discharging from the goggle said flowing volume bearing the condensate.

2. The method of claim 1 whose discharging step is further characterized as maintaining in said volumes a pressure less than that which prevails on the exterior of the worn goggle.

3. The method of preventing the fogging in low temperatured atmosphere of the inner surface of the lens of a goggle while affording a comfortable temperature at the eyes of the wearer, which includes the steps of flowing a limited volume of said atmosphere through the goggle in a path localized across the inner surface of the lens, while maintaining within the goggle a pressure less than is exerted on the exterior of the worn goggle.

4. The method of claim 1 whose maintaining step is contributed to by sealing the goggle to features of the wearer.

5. The method of claim 1 whose maintaining step is contributed to by suction sealing the goggle to skin of the wearer, and maintaining the smoothness of the kin at the seal to preserve the efficiency of the suction seal.

6. The method of claim 1 whose maintaining step is contributed to by suction sealing the goggle to skin of the wearer, and pressing the goggle against the skin at the seal by the pressure of the medium in which the goggle is worn to maintain the smoothness of the skin at the seal and thus preserve the efficiency of the suction seal.

7. The method of claim 1 whose discharging step is further characterized by passing a fluid across a portion of the goggle, and entraining into said fluid the flowing volume bearing the condensate.

8. The method of claim 1 whose discharging step is further characterized by passing a column of fluid across a portion of the goggle, restricting said column, and entraining into the fluid column at the restriction the flowing volume bearing the condensate.

9. The method of suction sealing a goggle to features of its wearer, comprising the steps of manually pressing the goggle against skin of its wearer; continuing said pressing and thereby expelling at least a part of the air from a volume between the goggle and skin of the wearer, said volume being annularly disposed about but removed from the eye of the wearer; and smoothing the skin of the wearer in contact with the goggle by pressure of the goggle upon said skin to retard leakage of air into said volume, and which pressure being applied upon the exterior surface of the goggle by the medium in which the goggle is worn.

10. The method of ventilating a goggle worn in the medium having velocity relative thereto, comprising the steps of passing a column of said medium across a portion of the goggle and discharging the same near the temple edge of the goggle; and entraining into said column, portions of the content between the goggle and its enveloped features of the wearer.

11. The method of ventilating a goggle worn in a medium having velocity relative thereto, comprising the steps of passing a column of said medium across a portion of the goggle and discharging the same near the temple edge of the said goggle; restricting said column; and entraining into the column at the restriction, portions of the content between the goggle and its enveloped features of the wearer.

12. In combination in a pair of goggles, a one piece cushion member conforming to the contour of the face about the eyes of an observer and provided with a concave surface adapted to have formed thereon a partial vacuum against the face of the observer, frames secured to said cushion member and connected together to form a nose piece, lenses carried by the frames, and means for partially exhausting and ventilating the pocket formed by the frames and lenses at a pressure lower than atmospheric pressure.

13. A pad for goggles consisting of a one piece

cushion member conforming to the contour of the face of an observer, a concave surface upon the inner side of the cushion forming a vacuum cup against the face of the observer.

14. A pad for goggles consisting of a one piece cushion member conforming to the contour of the face of an observer, a concave surface upon the inner side of the cushion and extending around the cushion forming a vacuum cup against the face of the observer.

15. A pad for goggles consisting of a one piece cushion member conforming to the contour of the face of an observer, a concave surface upon the inner side of the cushion and within the inner and outer edges thereof and extending around each eye forming a vacuum cup against the face of the observer around each eye.

16. In a ventilating system for goggles comprising a nose piece, and lens holding eye cups, the combination of means for exhausting the air within the eye cups, the said means including a Venturi member having openings at opposite ends exposed to the atmosphere with one of said openings adapted to receive the outer air at its relative velocity encountered by the wearer of said goggles, a series of exhaust openings from within the eye cup to the inside of said member for the production of ventilation within the eye cup at a pressure lower than atmospheric pressure.

17. In a ventilating system for goggles comprising a nose piece and lens holding eye cups, the combination of means for exhausting the air within the eye cups, the said means comprising a Venturi tube of varying cross-section, the smaller end of the Venturi tube placed toward the nose piece, a series of openings from within the Venturi tube into the eye cup, deflector plates over the openings and within the Venturi tube, and a series of openings from within the eye cup to the outside thereof for the production of ventilation within the eye cup.

18. In a ventilating system for goggles comprising a nose piece and lens holding eye cups, the combination of means for making an air tight seal between the eye cups and the face of an observer, means for exhausting the air within the eye cups, the said means comprising a Venturi tube of varying cross-section, the smaller end of the Venturi tube placed toward the nose piece, a series of openings from within the Venturi tube into the eye cup, deflector plates over the openings and within the Venturi tube, and a series of openings from within the eye cup to the outside thereof for the production of ventilation within the eye cup.

19. A goggles eye-cup comprising a framed lens and a facial pad forming when in service an enclosed air chamber, said cup having separate air inlet and outlet means adjacent substantially opposite edges of said lens, and means for receiving and confining a portion of the outer air at substantially its relative velocity, encountered while wearing said eye-cup, and passing said confined air past said outlet means whereby a limited ventilating air flow and a partial vacuum are simultaneously produced within said chamber.

20. A goggles eye-cup comprising a framed lens and a facial pad forming when in service an enclosed air chamber, said cup being provided with means when in service for producing air circulation through said chamber over substantially the whole of the inner surface of said lens and removed from the eye of the wearer at less than atmospheric pressure.

21. Eye-cup goggles comprising a pair of framed lenses and a connecting facial pad forming when in service eye-cup chambers, each eye-cup being provided with means when in service for producing air circulation therethrough over the inner surface of its said lens and removed from the eyes of the wearer and at less than atmospheric pressure, and means for operating said circulation means by confining outer air and relatively moving said confined air past an element of said means.

22. Eye-cup goggles comprising a pair of framed lenses and a connecting facial pad forming when in service eye-cup chambers each eye-cup having separated air inlet and outlet means adjacent substantially opposite edges of its said lens, and separate means for each of said chambers for receiving and confining a portion of the outer air at its relative velocity encountered while wearing said goggles and passing said confined air past said outlet means whereby a limited ventilating air-flow and a partial vacuum are produced in both the chambers.

23. In a goggles eye cup comprising a relatively rigid lens-holding frame, a flexible face-contacting ring member tightly secured to said frame and provided with a means whereby a partial vacuum may be formed upon the face-contacting surface of said member when applied to a face.

24. In a goggles eye cup comprising a relatively rigid lens-holding frame, a flexible face contacting ring member the inner portion of which is tightly secured to said frame and the outer portion of which is conformed substantially to the contour of the face and means whereby a partial vacuum may be formed upon and substantially throughout the extent of the face-contacting surface of said member when applied to a face.

25. Eye-cup goggles comprising a pair of relatively rigid lens-holding frames, and a flexible frame-connecting member tightly secured to said frames and provided with a cavity in and separating its face-contacting portions.

26. Eye-cup goggles comprising a pair of relatively rigid lens-holding frames, and a flexible frame-connecting member tightly secured to said frames and provided with a face contacting edge having a recess extending substantially midway of and along said edge.

27. Eye-cup goggles comprising a pair of relatively rigid lens-holding frames, and a flexible frame-connecting member tightly secured to said frames and provided with means whereby a partial vacuum may be formed within the area of its edges adapted to contact with the features of the wearer; said frames being pivotally connected to form a nose-bridge.

28. A goggles eye cup comprising a relatively rigid lens-holding frame, a flexible face-contacting ring member tightly secured to said rigid frame and provided with a face-contacting portion conformed substantially to the contour of the face and provided with raised separated ribs upon the face-contacting edge of said portion, and means for producing a partial vacuum in the applied cup.

29. Eye-cup goggles comprising a pair of relatively rigid lens-holding frames; a flexible frame-connecting member tightly secured to said frames, and provided with a face-contacting portion forming eye-cup members, means for forming a partial vacuum substantially throughout the extent and within the area of the face-contacting edge of said member; and separate means for each

of the cup chambers for producing a partial vacuum therein.

30. In a lens-holding eye cup having a face-contacting portion; cup-ventilating means including air inlet and air outlet means for said cup, and a cover extending over said outlet means and being open at its front and rearward portions for the passage of air therethrough and over said outlet means.

31. In vision conserving devices, lens means, a mounting therefor forming eye-cups back of said lens means, means for exhausting air from and leading the same rearwardly of said mounting, and means for varying the capacity of said exhaust means.

32. In vision conserving devices, lenses, a support therefor comprising an eye-cup for each eye and face contacting means, means for forming a partial vacuum within each eye-cup, and means in the face contacting means mounted on said support for forming a separate partial vacuum against features of the wearer and in an area extending along and outside of the eyecup.

33. In vision conserving devices, lenses, a support therefor having a separate eye-cup for each eye, means for forming a separate partial vacuum within each eye-cup, and against the features of the wearer, and means for forming a separate partial vacuum against the features of the wearer and surrounding each said eye-cup vacuum.

34. In vision conserving devices, lens means, a support therefor, port means in said support; and means for confining past said port means a portion of the air encountered by the relative movement of the air and said support, for drawing air from within said support through the port means and discharging the same with the confined air outside of the support and adapted to form a lesser pressure within said support than prevails on the outer surface of the goggle when worn in high air velocity.

35. In vision conserving devices, lens means, a support therefor, a plurality of ports in said support, and means for confining successively past said ports a portion of the air encountered by the relative movement of the air and said support, for drawing air from within the support through said ports.

36. In vision conserving devices, lens means, a support therefor, port means in said support, and means for confining a portion of the air encountered by the relative movement of the air and said support and increasing the relative velocity of said confined air adjacent its passage of said port means, for drawing air from within the support through the port means.

37. In vision conserving devices, lens means, a support therefor, a plurality of ports in said support, and means for confining a portion of the air encountered by the relative movement of the air and said support and increasing the relative velocity of said confined air adjacent its passage of each of said ports, for drawing air from within the support through each of said ports.

38. In vision conserving devices, lens means, a support therefor, port means in said support, and means whereby in the relative movement of the air and said support a Venturi action of the air is obtained on the external surface of said support in a path extending across the outlet side of said port means, the Venturi restriction of said Venturi action being adjacent the port means.

39. In vision conserving devices, lens means, a support therefor, a plurality of ports in said support, and means whereby in the relative movement of the air and said support a Venturi action of the air is obtained on the external surface of said support in a path extending across the outlet side of each of said ports, the Venturi restriction of said Venturi action being adjacent the plurality of ports.

40. In vision conserving devices, lens means, a support therefor, port means in said support, and means whereby air may be relatively passed over said port means in a column having a recess therein, into which recess air is adapted to enter from said support through said port means.

41. In vision conserving devices, lens means, a support therefor, a plurality of ports in said support, and means whereby air may be relatively passed successively over said ports in a column having a recess therein adjacent each port and into each of which recesses air is adapted to enter from said support through its respective port.

42. In vision conserving devices, lens means, a support therefor, port means in said support, means whereby air may be relatively passed over said port with its surface adjacent said port means being of greater area than the area of said port means in the plane of said relative movement, and means for increasing the relative velocity of said air adjacent said port means.

43. In vision conserving devices, lens means, a support therefor, a plurality of ports in said support, means whereby air may be relatively passed successively over said ports with its surface adjacent each of said ports being of greater area than the area of each of said ports in the plane of said relative movement, and means for increasing the relative velocity of said air adjacent each of said ports.

44. An annular pad for a goggle adapted to surround the eye and conform to the contour of and contact with features of the wearer and having at least a portion of its contacting surface concaved to provide a volume bounded wholly by said pad and features and from which volume air may be excluded after said surface is in contact with said features.

45. In a device of the character described, an eye cup frame adapted to hold a lens, a resilient face contacting member having a portion adapted to be secured to the frame and whose face contacting portions are provided with a channeled edge adapted to form a vacuum connection for face engagement, and means for securing the member to the frame.

46. In a device of the character described, an eye cup frame adapted to hold a lens and having an intake opening on one side thereof and an outlet opening on the opposite side thereof, a hood member over one of said openings having one end open, the longitudinal axis of which is substantially parallel with the plane of the lens and so positioned that an open end will be in a rearward direction when the eye cup frame is on the face of the wearer, and a face contacting member on the eye cup frame; whereby passage of air over the hood member will cause suction to draw air through the openings to ventilate the eye cup.

47. A pad for goggles comprising a cushion member conforming to the contour of the face of an observer, at least a portion of the inner side of the cushion member having a concave surface so as to form at least a partial vacuum against the face of the observer.

48. In a device of the character described, an eyecup having means for holding a lens and having a vent and a hood over the vent having a

solid unpierced wall and a channel therethrough open at both ends, the axis of said channel being substantially parallel with the plane of the lens holding means for the length of the channel and said vent communicating with said channel between its ends, the axes of the vent and channel being at an angle to each other and the vent opening being so arranged that air will be drawn through it from the interior of the eyecup by a current of air through the channel from an end thereof.

49. In a device of the character described, an eyecup having lens holding means and having a vent and a hood over the vent having a solid unpierced wall and a channel therethrough open at both ends, the axis of said channel being substantially parallel with the lens holding means for the length of the channel and said vent communicating with said channel between its ends, the axis of the vent being substantially normal to the axis of the channel and the vent opening being so arranged that air will be drawn through it from the interior of the eyecup by a current of air through the channel from the end thereof.

50. An interchangeable face contacting member for use in combination with a goggle eyecup having means to receive it comprising a resilient ring having a grooved portion on one side thereof adapted to contact with the face of the wearer and a rib on the opposite side thereof adapted to engage the receiving means on the eyecup whereby said ring may be applied interchangeably to a number of eyecups.

51. In a device of the character described, an eyecup frame adapted to hold a lens and having an intake opening and an outlet opening and a hood member over one of the openings having one end open, the longitudinal axis of which is substantially parallel with the plane of the lens and so positioned that the open end will be in a rearward direction when the eyecup frame is on the face of the wearer.

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