U.S. Army Soldier and Biological Chemical Command

HISTORY OF THE ARMY'S PROTECTIVE MASK

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The Project Manager for NBC Defense Systems is responsible for Army and Joint Service development, testing, production, fielding, and logistics support of assigned nuclear, biological, and chemical defense systems to include reconnaissance, obscuration and decontamination, respiratory protection, and detection systems.

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Introduction

The history of protective masks can be traced to the 16th century. The development of the U.S. Army protective mask dates back to World War I when chemical warfare was first introduced on a large scale. The next generation of protective masks will be a revolutionary advancement in mask technology.

This brief history covers some of the highlights of the long history of the protective mask.

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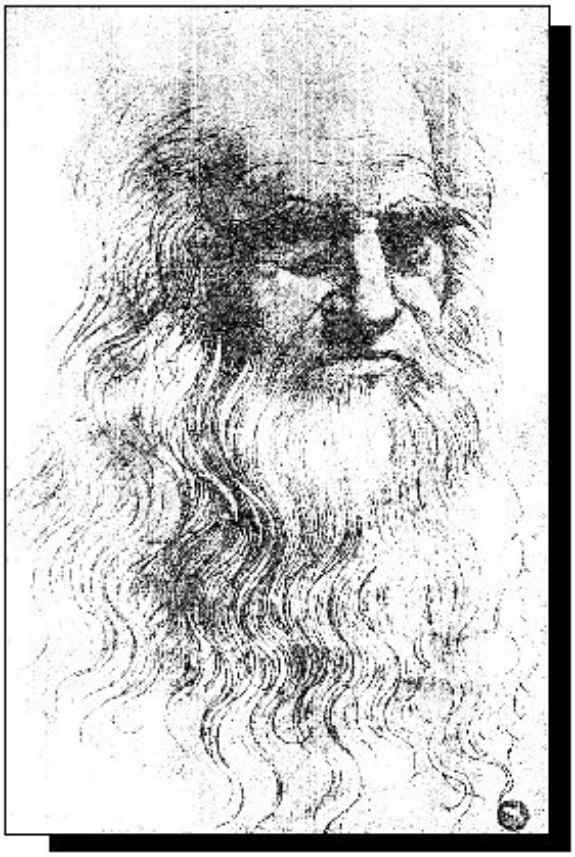
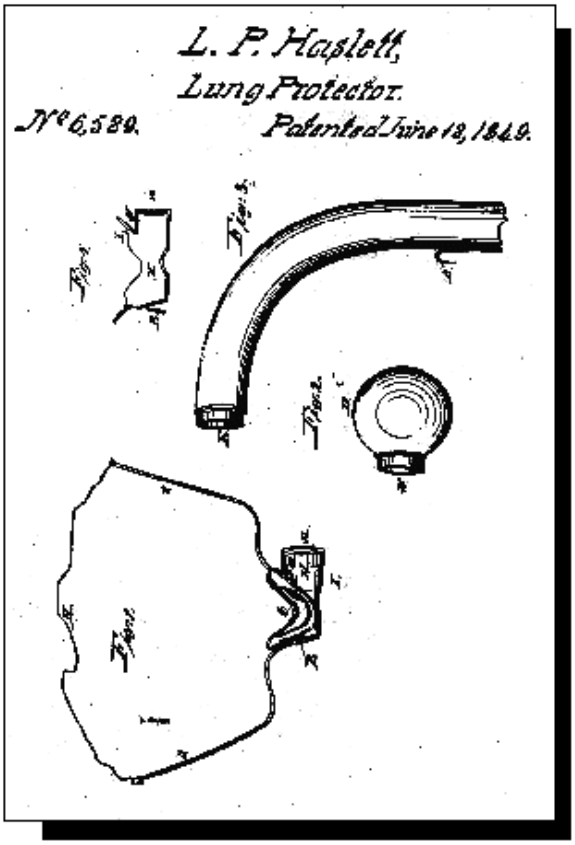
Pre-World War I Masks



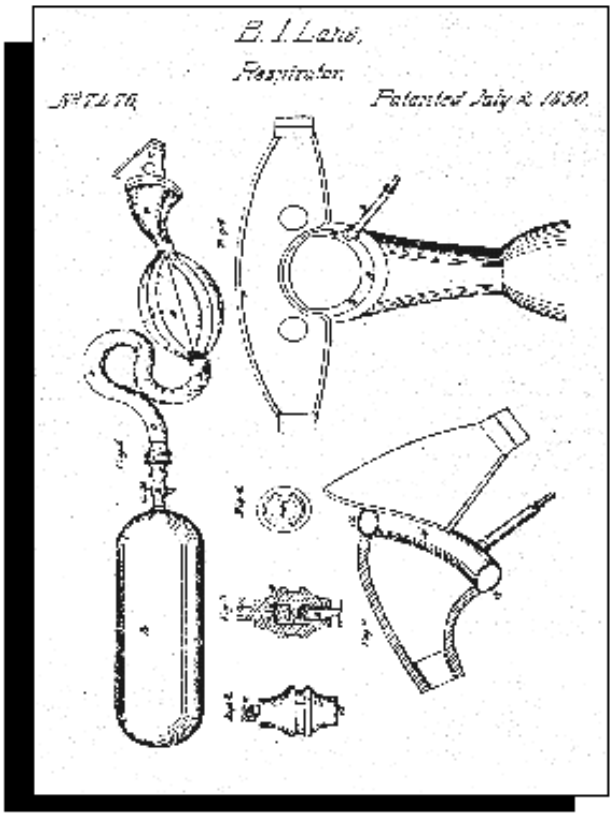
In the 16th Century, Leonardo da Vinci described a simple protective mask to protect sailors against a toxic powder weapon he designed:

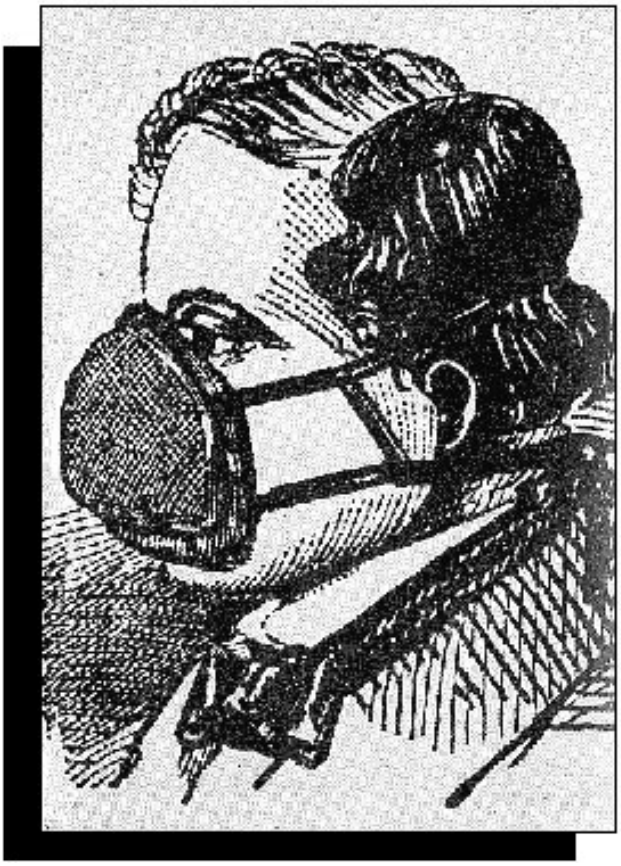
. . . have your nose and mouth covered over with a fine cloth dipped in water . . .



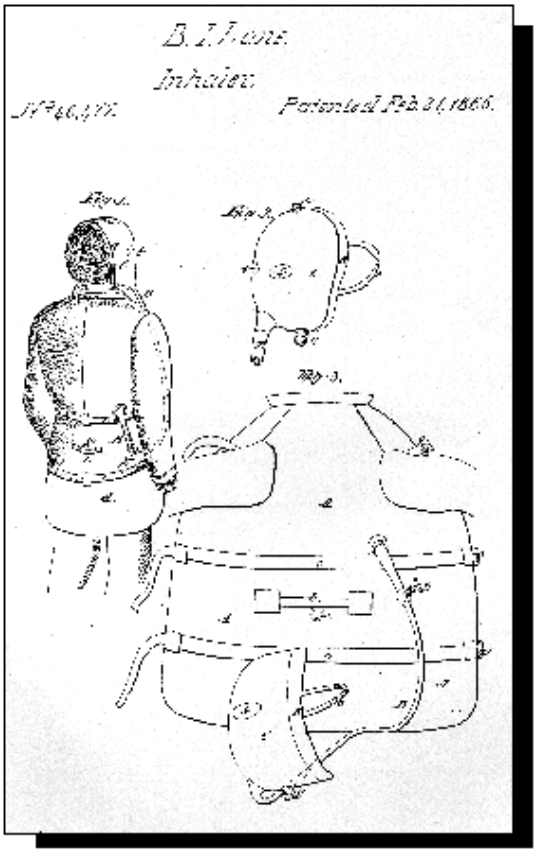
In 1849, Lewis P. Haslett of Louisville, KY, was issued the earliest known U.S. patent for a protective mask. He patented his Inhaler or Lung-Protector for *protecting the lungs against the inhalation of injurious substances*. The mask filter was wool or other porous substances moistened with water.

In 1850, Benjamin I. Lane of Cambridge, MA, patented his Pneumatic Life-Preserver to allow people to enter *buildings and vessels filled with smoke or impure air and into sewers, mines, wells, and other places filled with noxious gases or impure air*. The mask included goggles and was made of vulcanized rubber.





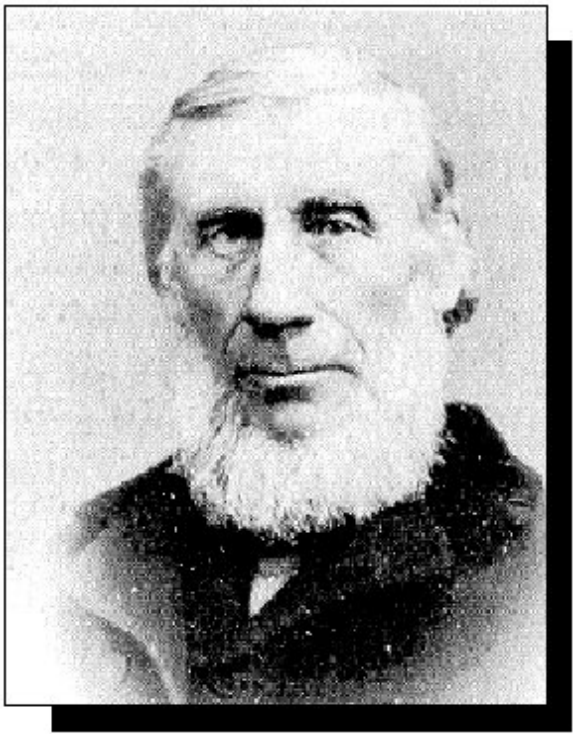
John Stenhouse, of Glasgow, Scotland, designed a mask in 1850 that used wood charcoal as a filtering material. The facepiece was velvet lined for a tight fit and used an elastic head band. Stenhouse did not patent his mask but gave it to the public. Within a few years, chemical manufacturers in London were supplying their workmen with charcoal respirators.

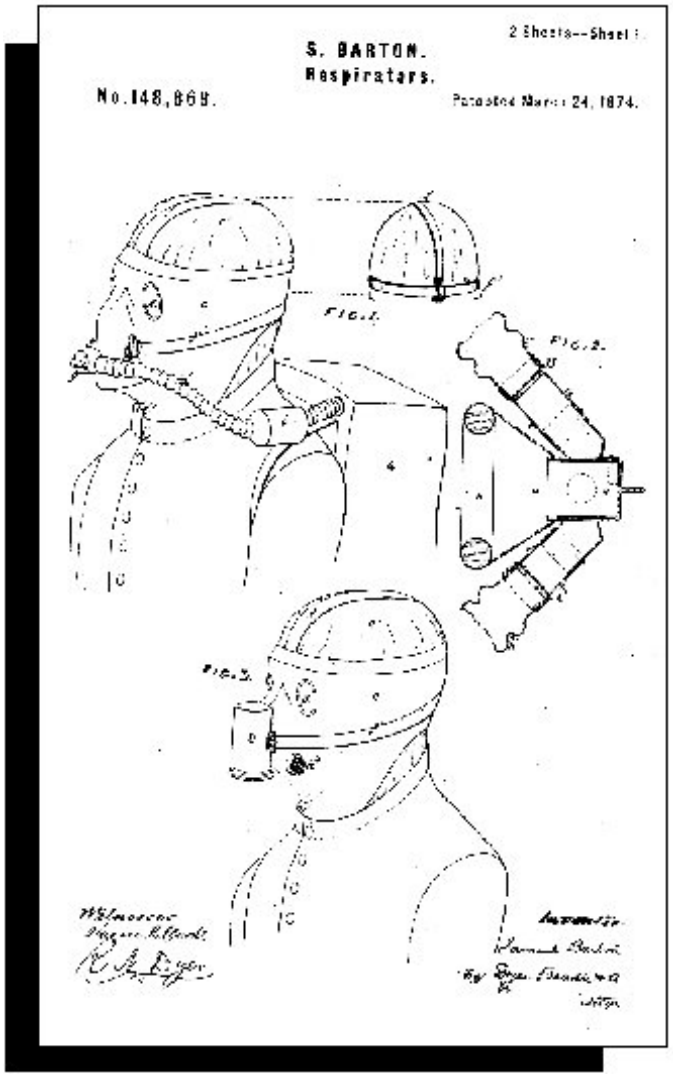


In 1865, during the American Civil War, Benjamin I. Lane improved upon his earlier 1850 mask and patented his Inhaler, which included a full facepiece.

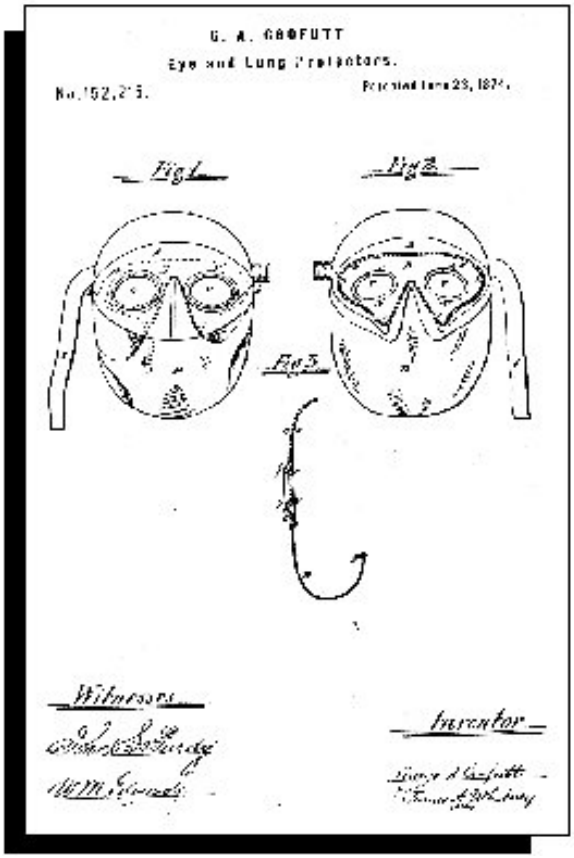
Theodore A. Hoffmann, of Beardstown, IL, patented his Respirator in 1866. His mask was intended to protect the lungs from *dust and foreign matters floating in the air* and the *respiratory organs from the influence of malarious and contagious elements which may be found in the atmosphere*. It used cotton fabric as the filtering material.

In 1871, John Tyndall, a British physicist, produced a respirator that included a cylindrical metal canister containing charcoal, lime granules, and cotton wool filters.



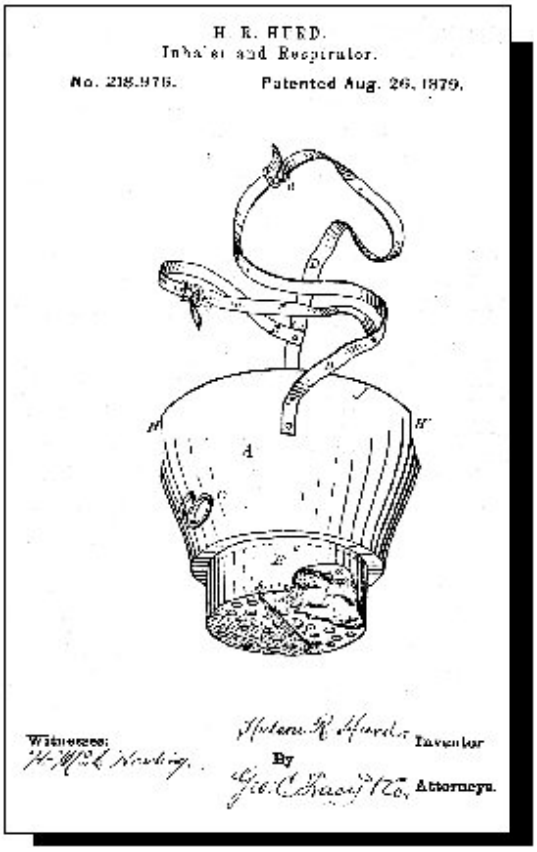


Samuel Barton, of London, England, patented his Respirator in the United States in 1874. His mask used both cotton or other fibrous materials and charcoal for absorbing poisonous vapors to allow one to *enter and remain with perfect safety in rooms or other places wherein the atmosphere is charged with noxious gases or vapors or smoke*.

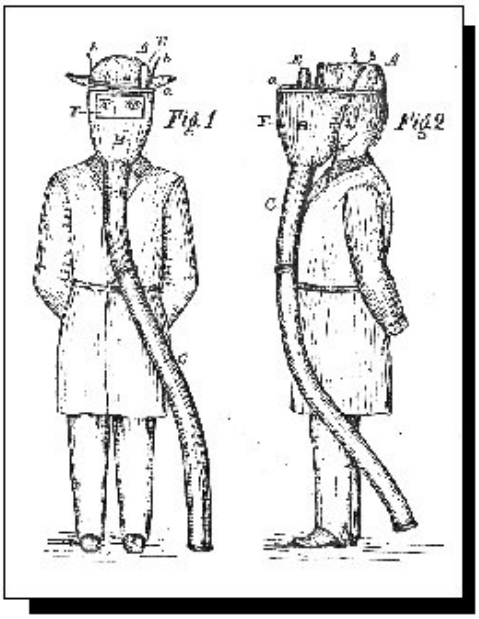


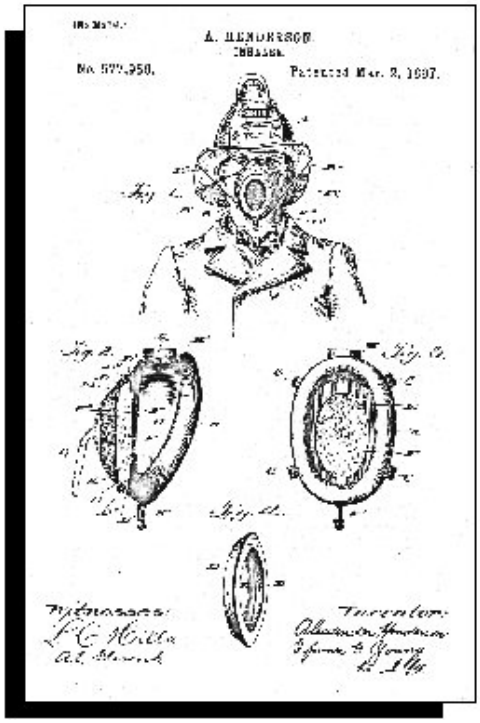
George A. Crofutt, of New York, NY, patented his improved Eye and Lung Protector in 1874. The most ingenious part of the mask was the facepiece made of India rubber. Sockets in the facepiece held the replaceable eye pieces in place and provided a gas-tight seal.

Hutson R. Hurd, of Cleveland, OH, patented an improved Inhaler and Respirator in 1879 designed to *prevent the admission of poisonous or noxious gases, or particles of dust or other matter, into the throat and lungs*. The facepiece was made of soft rubber held to the head by elastic webbing. The filter material was moistened cotton or wool fibers. This type of mask was used by industry well into the 20th century.

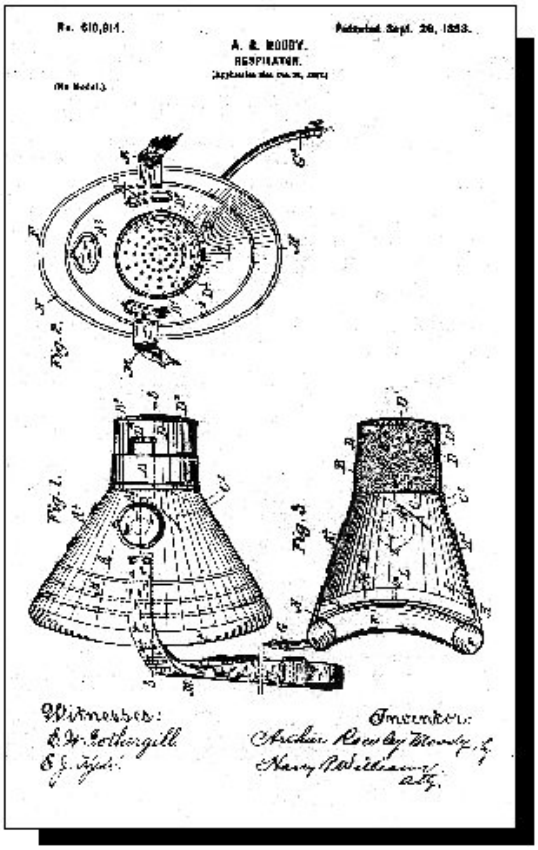


In 1889, Hutson R. Hurd patented a Respirator for Firemen that included a fabric facepiece with windows and an exhaust valve on top of the mask. A long hose drew clean air from the floor level to the facepiece. One unique aspect of the mask was that the gas-tight seal was around the periphery of the mask and therefore the mask did not require any mouthpieces or nose clips.

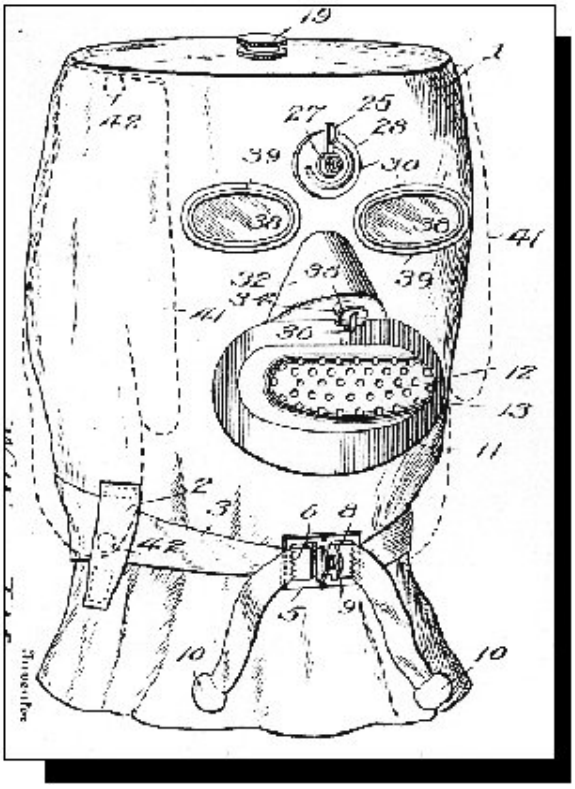




In 1897, Alexander Henderson, of Kansas City, MO, patented a cup mask *to protect the wearer from smoke or other impurities in the air, such as arise in cement manufacture, working in acids, or fumes arising from ammonia when working in cold-storage and manufacturing artificial ice*. The facepiece was made of rubber and three layers of different materials (wool, silk, and felt) provided the filtering. The silk was treated with glycerin (for smokes), ammonia (for acids) or vinegar (for ammonia). A gravity valve on the top of the facepiece served as an exhaust.

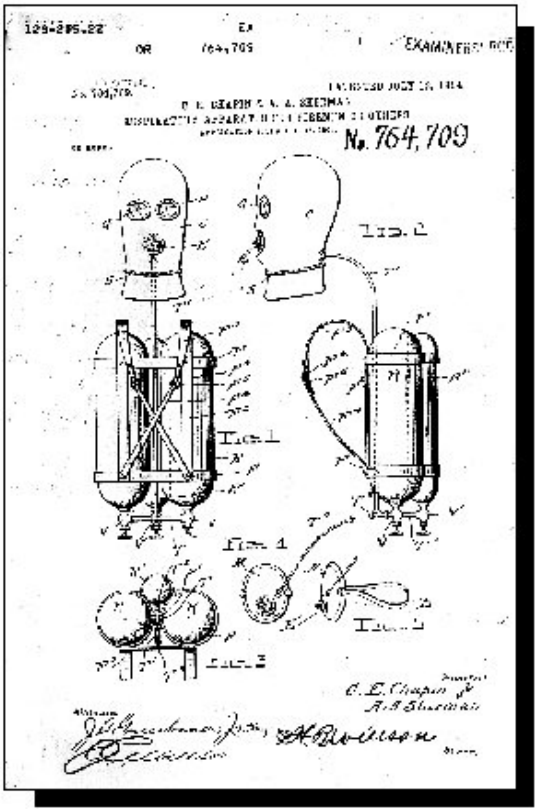


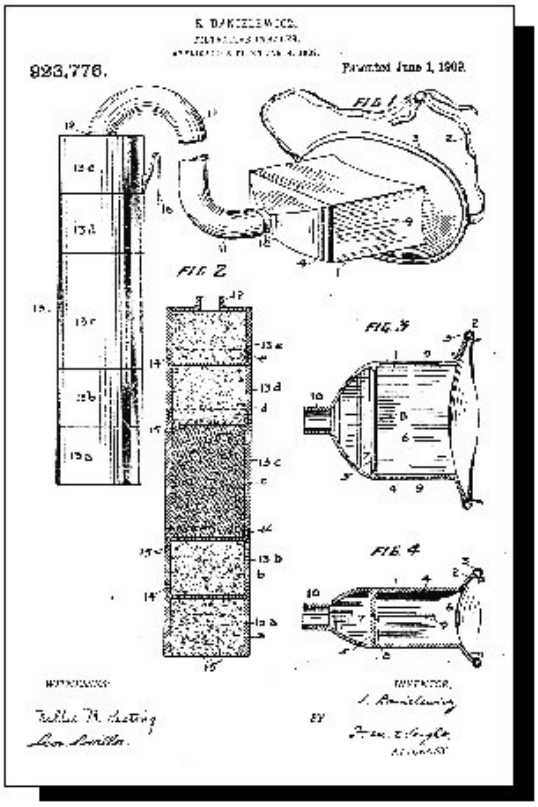
Arthur Rowley Moody, of Stoke-on-Trent, England, patented his Respirator in England in 1896 and in the United States in 1898 during the Spanish-American War. The unique aspect of Moody's mask was an inflatable rim that could be adjusted for a comfortable fit. The mask also had a flap-valve exhaust.



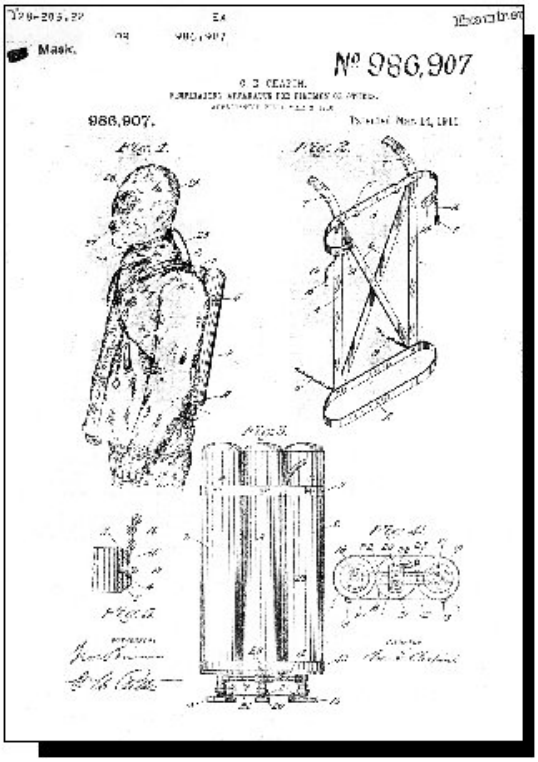
William J. Moran, of Yonkers, NY, patented a Fire-Mask in 1904 that was made of asbestos. A reservoir of water was used to keep a sponge wet to filter out smoke.

Charles E. Chapin and Arthur A. Sherman patented a Respiratory Apparatus for Firemen or Others in 1904. Two large air cylinders and a smaller emergency cylinder worn on the back provided fresh air to protect against smoke and noxious gases. The backpack included a place to attach an auxiliary mask for a rescued individual.



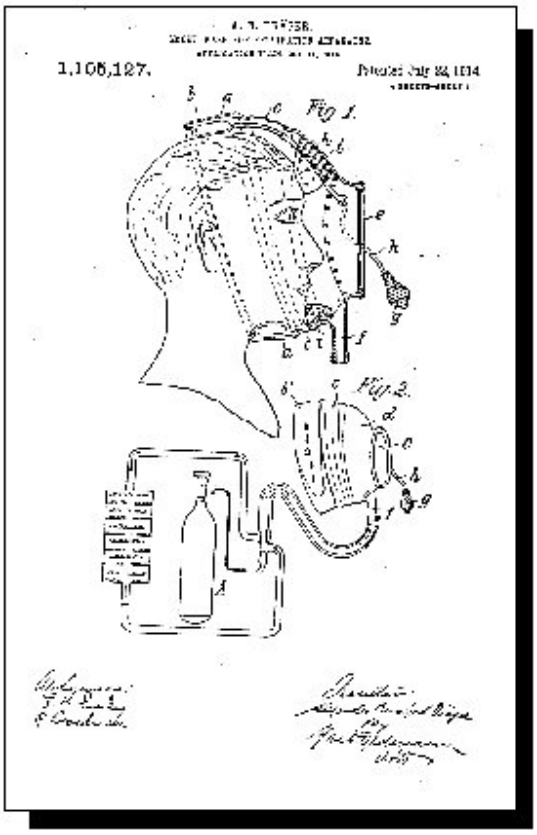


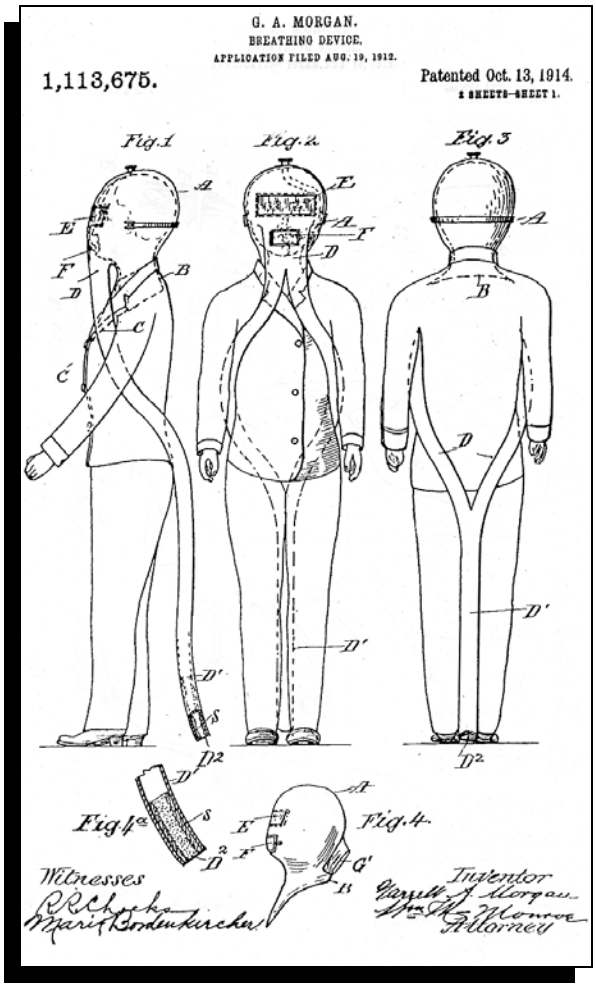
Samuel Danielewicz, of San Francisco, CA, patented a Filtrative Inhaler in 1909 that included a charcoal canister. The canister consisted of raw cotton saturated with glycerin alternating with pulverized charcoal.



Charles E. Chapin patented a Respiratory Apparatus for Firemen or Others in 1911. One unique aspect was the capability to replace depleted air cylinders without removing the back harness.

In 1914, Alexander B. Dräger, of Lübeck, Germany, patented a Smoke-Mask for Respiration Apparatus in the United States. The unique aspect of the mask was an improved pneumatic pump for controlling the inflatable tube around the facepiece to ensure a perfect fit.





Garrett A. Morgan, of Cleveland, OH, patented a Breathing Device in 1914 designed for fireman, engineers, chemists, and anyone else *obliged to breath noxious fumes or dust*. The hood was made of rubber cloth or asbestos cloth. A long tube provided cleaner floor air to the mask or could be elevated in situations where the noxious fumes were heavier than air. One unique design was the use of *ear trumpets* in the mask to amplify sounds.

World War I
Masks

Emergency Mouth-Pad

Following the German first use of chlorine gas at Ypres, Belgium, on April 22, 1915, British soldiers initially had no protective equipment despite the many masks available to private industry. Instead, they could do little more than follow advice to: *piss on your hanker-chiefs and tie them over your faces*. A plea for cotton mouth-pads for the troops resulted in 30,000 being completed within 3 days. These masks were untreated and had to be kept moist to have any affect against chlorine.

Black Veil Respirator

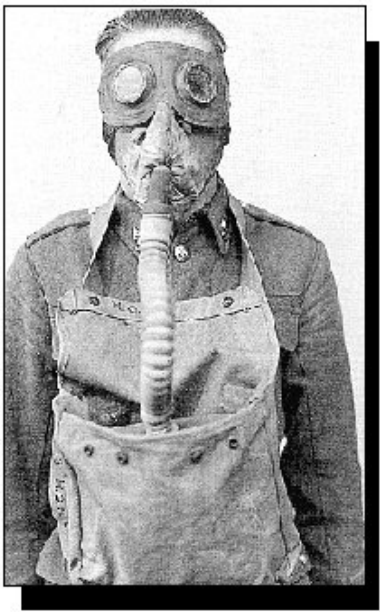
The British added a women's yard-long veil to hold the cotton pads in place and called it the Black Veil Respirator, first issued in April 1915. The cotton wadding was coated with sodium carbonate, sodium thiosulfate, glycerin, and water. Although the mask provided some protection against low levels of chlorine, one soldier commented that it was *about as much use as a sick headache*.

Hypo Helmet

After a Canadian soldier observed a German pulling a bag over his head during a gas attack, the British developed the Hypo Helmet in the summer of 1915. It consisted of a flannel bag soaked in sodium thiosulfate (called hypo). The mica window cracked easily and there was no exhaust valve, but the mask was effective against chlorine.

P, P.H., and P.H.G. Helmet

When the Germans began using phosgene gas against the British, the Hypo Helmet proved ineffective. A new version of the mask was developed in the summer of 1915 that treated the flannel with sodium phenolate and glycerin. Because this solution attacked flannel, two layers of flannelette had to be used. This required the mask to have an outlet valve. An additional ingredient, hexamethylenetramine, was later added which increased the effectiveness of the mask. Goggles were added in early 1916 to protect against lachrymators.



Large Box Respirator

As the Germans introduced new chemical warfare agents, the British in early 1916 found they had to constantly update the solution treatment for their helmet masks. To avoid changing the facepiece each time, the filtering system, consisting of charcoal, soda-lime, permanganate, and brimstone impregnated with sodium sulfite, was placed in a separate canister and attached to the facepiece by a hose. Known as the Large Box Respirator, the canister was large and bulky, and the mask was uncomfortable; therefore, it was only used for special purposes.

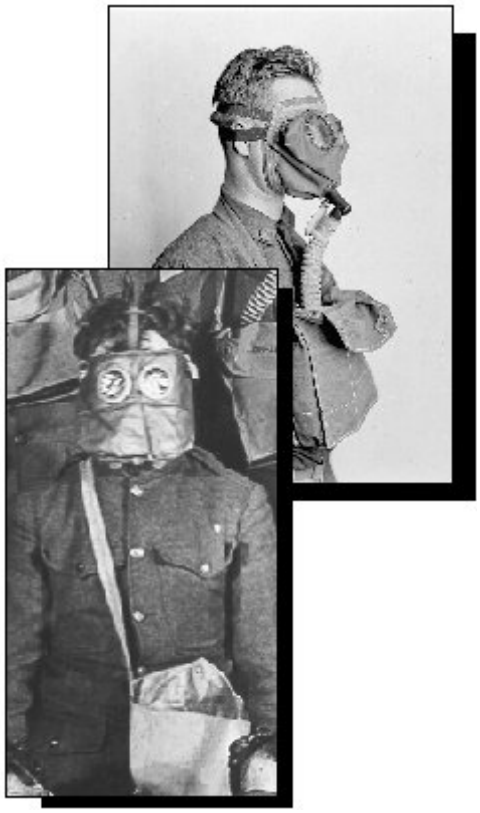
Small Box Respirator

In early 1916, British Lieutenant Colonel E.F. Harrison developed the Small Box respirator that remained the standard mask for the British for the remainder of the war. The mask used a nose clip and required breathing through a rubber mouthpiece. This arrangement proved extremely uncomfortable after a time; it was also difficult to shout commands. In addition, moisture constantly fogged the eyepieces.

French M2 Mask

French gas mask development during 1915 was similar to the British experience. By February 1916, they had developed the M2 Mask, a relatively comfortable mask made of treated layers of fabric. There were no inlet or outlet valves. Over 29 million of these masks were manufactured by 1918.

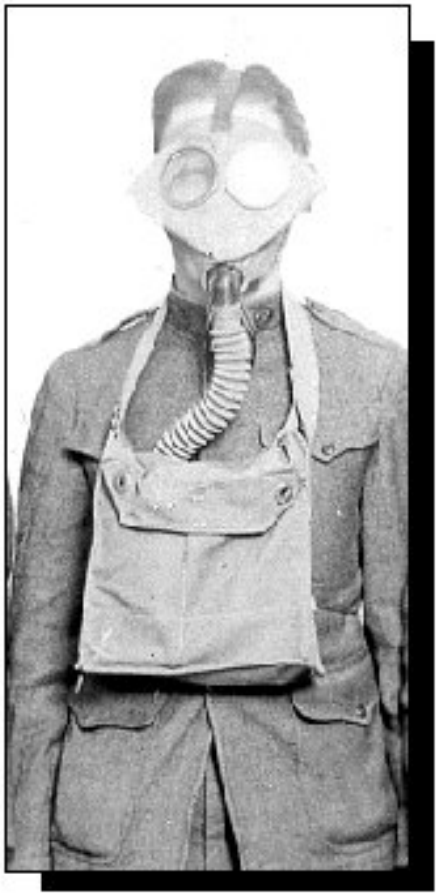
U.S. Gas Masks



When the United States entered the war in April 1917, the U.S. Army was unprepared for chemical warfare and had to use borrowed foreign equipment. Soldiers were issued a British Small Box Respirator (S.B.R.) for the highest level of protection and a French M2 Mask for long-term wear comfort. Unfortunately, the untrained troops had a tendency to initially put on the S.B.R. following a gas attack and then switch to the M2 when it appeared they would have to wear a mask for an extended period of time. Of course, during the mask switching, many soldiers inhaled toxic chemicals and became casualties.

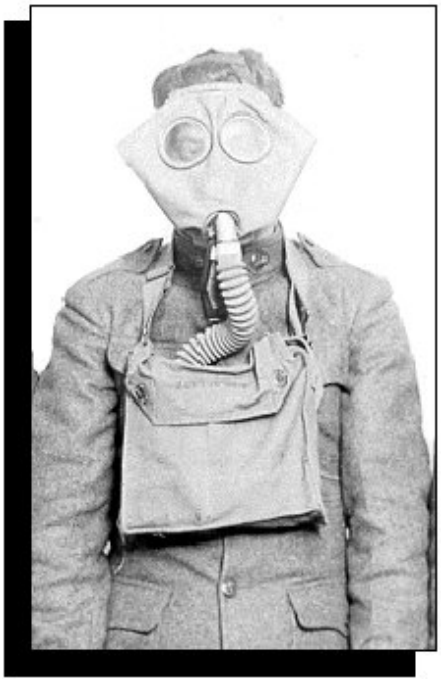
Training Mask

Despite the uncomfortable mouthpiece and nose clip of the British S.B.R., the U.S. Army decided this type of mask provided the best protection. The initial attempt in June 1917 to copy the mask was completed by the Bureau of Mines of the Department of the Interior and was not a success. The next attempt was the Training Mask in July 1917, which used an extra large canister of charcoal and soda-lime. Over 600,000 of the masks were manufactured and used only for training in the United States.



Corrected English (C.E.) Mask

An improved version of the British S.B.R. was developed in October 1917. This mask was slightly more comfortable to wear and used a canister containing activated coconut charcoal, soda-lime, and cotton pads to protect against toxic smokes. The facepiece was more impermeable to all known chemical warfare agents. Approximately 1.6 million of the masks were produced during the war.



Richardson Floy Kops (R.F.K.) Mask

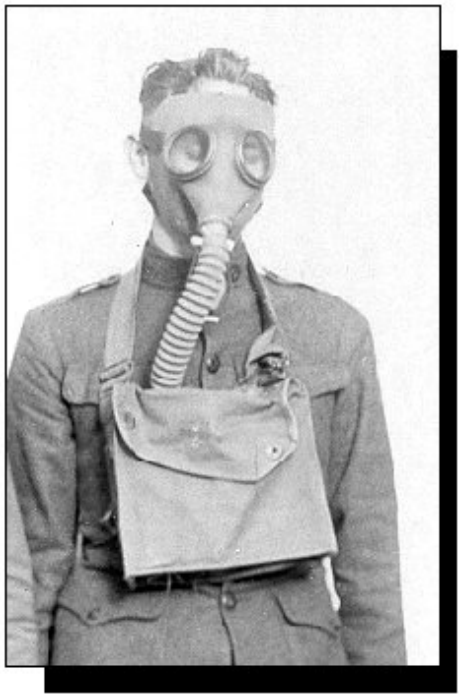
Continued improvements to the C.E. Mask resulted in the R.F.K. Mask introduced in early 1918. The facepiece was cotton fabric coated with rubber. The canister was reduced in size, which created less breathing resistance. In addition to being more comfortable to wear, the mask was also much easier to manufacture. Over 3 million of these masks were produced during the war.

Akron Tissot (A.T.) Mask

This mask was designed by the Akron Rubber Company in June 1918 and used a French design that eliminated the uncomfortable mouthpiece and nose clip of the S.B.R.-type masks. Instead, the incoming air was directed over the eyepieces, which helped prevent fogging. The facepiece was made of molded rubber covered with stockinet. The canister was the same as that used on the R.F.K. Mask. The mask provided far more comfort, but was more difficult to manufacture, so only 197,000 were produced during the war.

Kops Tissot (K.T.) Mask

This mask was similar to the Akron Tissot Mask and copied the French design of directing incoming air over the eyepieces. The facepiece was made of vulcanized fabric and used the same canister as the R.F.K. Mask. Because it also was difficult to manufacture, only 337,000 were made starting in September 1918.



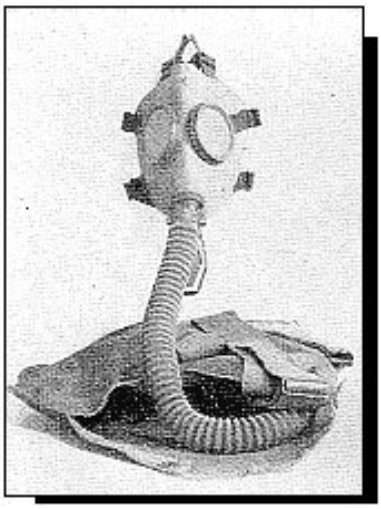
Kops Tissot Monro (K.T.M.) Mask

In October 1918, the best aspects of the Akron Tissot and Kops Tissot Masks were combined to create the K.T.M. Mask. It had a stockinet-covered rubber facepiece and used a new canister that added felt as a filter against toxic smoke particles. This was perhaps the best mask developed during the war although only 2,000 were produced prior to the armistice on November 11, 1918.

Between the World Wars

M1 Mask

Following the end of World War I, the K.T.M. Mask continued in production and became known as the Model 1919, and eventually the M1 Mask. The facepiece came in five sizes and had non-replaceable eyepieces. The original canister was replaced with improvements over the years. This mask was obsoleted in 1944.



M1A1 Mask

In 1928, the M1 Mask was improved by adding replaceable eye lenses. This made repairs much easier and increased the longevity of the mask. The mask was produced in five sizes. It was obsoleted in 1944.

M1A2 Mask

In 1934, the Army modified the M1A1 Mask by creating a universal size facepiece made of stockinet-covered rubber. This universal size was found to fit about 95% of soldiers. The smallest and largest sizes of the M1A1 Mask continued in production to fit soldiers unable to wear the new mask. The mask was obsoleted in 1944.

World War II

M2 Series Mask

In 1939, the Army developed a lightweight training mask with a fully molded rubber facepiece. This proved so popular and effective that the mask was standardized as the M2 Mask in 1941. This was the first mask to eliminate stockinet coverings due to improved age-resistant rubber. It came in three sizes: small, universal, and large. Improvements to the outlet valve resulted in the M2A1 in 1941, the M2A2 in 1942, and the M2A3 in 1944. Over 8 million of the masks were produced during World War II. The masks were obsoleted in 1949.

M3 Series Lightweight Mask

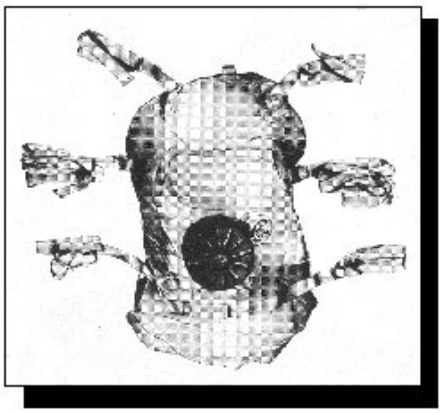
The bulky weight of the M2 series masks resulted in the demand for a lightweight mask. In 1942, the M3 Lightweight Mask was standardized. The overall weight was three-and-one-half pounds and used a fully molded rubber facepiece. To prevent lens fogging, the mask added an interior nosecup. An improved lightweight canister provided better protection. An improved outlet valve resulted in the M3A1 Mask in 1944. Over 13 million of the masks were produced during World War II. The masks were obsoleted in 1949.

M4 Series Lightweight Mask

The continuing demand for a lightweight mask for assault troops led to modifications to the existing M2A2 facepiece to speed up production. In 1942, the result was the M4 Lightweight Mask which added a nosecup, a new outlet valve and a new lighter canister. The Army ordered 250,000 of the masks. A modification to the outlet valve resulted in the M4A1 Lightweight Mask in 1945. The mask was obsoleted in 1949.

M5 Combat Mask

The need for a lightweight assault mask resulted in the M5 Combat Mask in 1944. The design was similar to a World War I German mask that eliminated the hose to the canister and put the canister directly on the facepiece. The facepiece was made of synthetic rubber (neoprene) and came in three sizes. The canister was lightweight, yet provided nearly the protection of the heavier canisters. Over 500,000 M5 Masks were produced during the war. American troops landing at Normandy on D-Day and during other amphibious operations carried this mask. The mask was obsoleted in 1947.



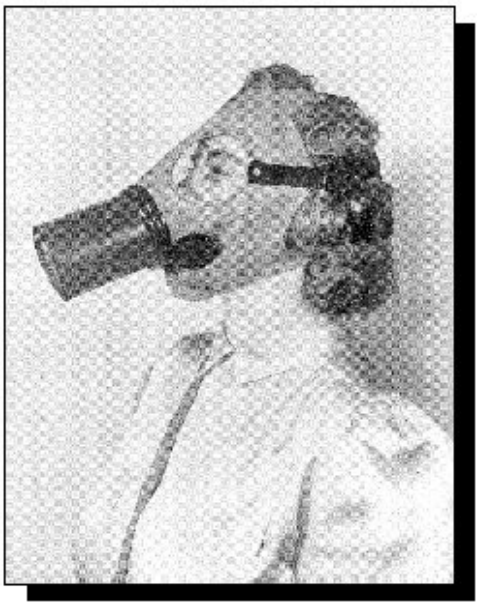
M7 Headwound Mask

Shortly after the Normandy invasion, the need for a gas mask for patients in hospitals with head wounds became a requirement. In 1944, the Army standardized its first mask designed for wounded soldiers. The hood was a Vinylite bag with an outlet valve and the lightweight canister. 10,000 of these masks were produced during the war.

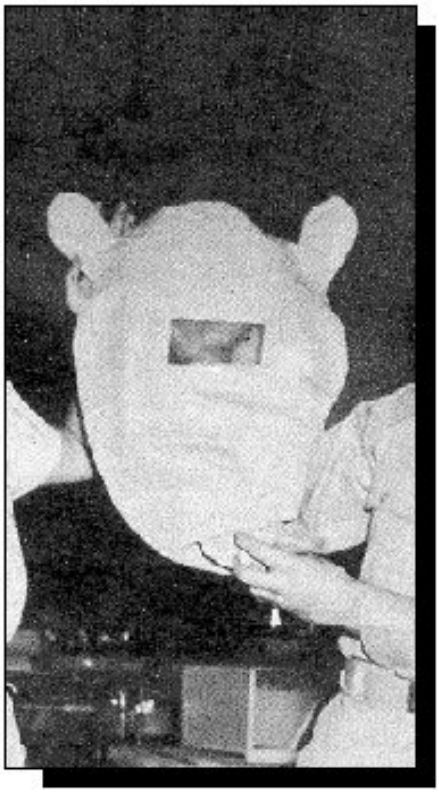
M8 Snout Mask

The slow production of the new M5 Combat Mask resulted in another emergency lightweight mask. Existing M2 and M3 facepieces were modified to attach the new lightweight canister directly to the chin of the facepiece. This resulted in the M8 Snout-Type Mask in 1945. An added bonus was that the rubber facepiece was found to hold up better in cold climates than the neoprene of the M5 Combat Mask. Only about 300,000 were produced and the mask was obsoleted in 1958.

M1 Series Noncombatant Masks



Prior to Pearl Harbor, the Army standardized a noncombatant mask that used a laminated non-rubber fabric facepiece, plastic eyepieces, and a lightweight cylindrical canister attached directly to the facepiece. About 50,000 of these masks were produced during the war. In 1941, an experimental rubber facepiece was added as the M1A1 Mask. At the same time, a rubber coated stockinet facepiece was added in the M1A2 version. Over 6 million of the M1A2 Masks were procured during the war. The masks were obsoleted in 1954.



Bunny Mask

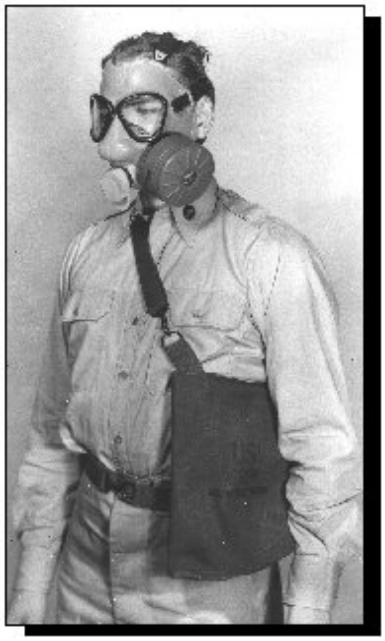
Following the attack on Pearl Harbor, the Hawaiian Department completed a light-weight hood for children made of treated muslin. To make it less threatening to the child, two ears were added and it became known as the Bunny Mask. During the war, over 38,000 Bunny Masks were completed and issued to children in the Hawaiian Islands.

Mickey Mouse Mask

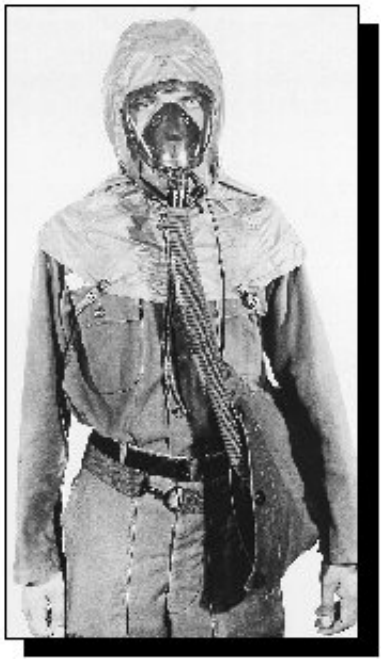
Although emergency masks like the Bunny Mask were issued following the attack on Pearl Harbor, a better mask was needed to protect children. This development led to the Mickey Mouse Mask, designed with the cooperation of Walt Disney. Although never standardized or mass produced, approximately 1,000 of the masks were completed during the war.

Post World War II
1945-1959

M9 Series Mask

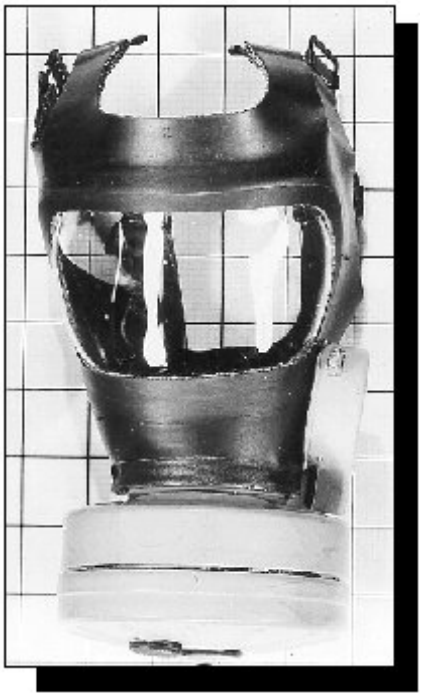


Improvements to the facepiece design of the M5 Combat Mask resulted in the M9 Gas Mask in 1947. The facepiece was made of synthetic molded rubber compositions and came in three sizes, with both right or left canisters. Changes to the carrying bag resulted in the M9A1 Mask in 1951. Over 3 million of the masks were procured until 1959.



M14 Series Tank Mask

The need for a collective protection system for tank crews resulted in the development of the M14 Tank Mask in 1953. The facepiece was made of molded rubber in three sizes with a single plastic lens. A hose connected the mask to the air purifier and a cable connected a microphone to the tank's communication system. A standard canister was available when the mask was disconnected from the three-man collective protection system. A redesigned facepiece resulted in the M14A1 Tank Mask in 1960. Additional improvements resulted in the M14A2 Tank Mask in 1961.



M16 Civilian Mask

The requirement for a mask for Civil Defense workers resulted in the M16 Civilian Mask in 1957. The rubber face-piece included a single vinyl plastic eyelens and the canister from the M9 Mask. It came in six sizes, with a special small size canister for the children's masks. The M16 Mask was obsoleted in 1975.

M17 Series Mask

To resolve problems associated with the M9 Mask, the Army standardized the M17 Mask in 1959. The need for a separate canister was eliminated by placing the filter material in cheek pockets. This also eliminated the need for right and left-handed masks. A voicemitter was added to improve speech transmission. The mask came in three sizes. In 1966, a drinking tube and a resuscitation tube were added resulting in the M17A1. The resuscitation tube was later dropped and a new extra small size added in 1983 when the M17A2 Mask was standardized.

M18 Headwound Mask

To replace the World War II era M7 Headwound Mask, the Army developed the M18 Headwound Mask in 1959. The new mask was made of filter material which eliminated the need for a separate canister. Both incoming and outgoing air passed directly through the material, thus also eliminating the need for an exhaust valve.

The 1960's

M22 Civilian Mask

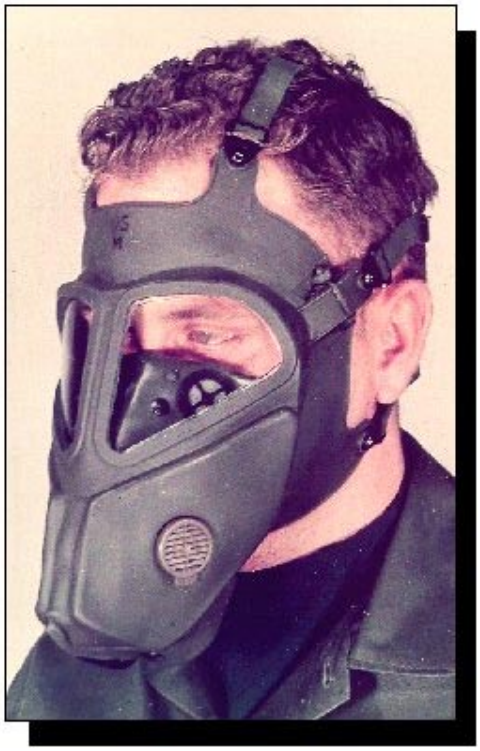
The M22 Civilian Mask, standardized in 1960, eliminated the need for a canister by incorporating the filter element directly into the facepiece. The facepiece was made of vinyl plastic and included plastic eyelenses. It came in six sizes. The mask was obsoleted in 1987.

M24 Aircraft Mask

The requirement for a protective mask for crew personnel of Army aircraft was initially established in 1933. Almost 30 years later, in 1962, the Army standardized a modified version of the M14 Tank Mask as the M24 Aircraft Mask. The mask comes in three sizes and has a backup canister for use outside the aircraft. It has a hood for over the helmet use, antiglare eyelens outsert, and an oxygen adapter for aircraft with oxygen.

M25 Series Tank Mask

In 1963, the Army updated the M14A2 Tank Mask by adding a new microphone system. The new version was designated the M25 Tank Mask. At the same time, minor improvements to the facepiece resulted in the M25A1 Tank Mask.



M28 Riot Control Agent Mask

During the Vietnam War, the need for a lightweight protective mask that protected only against tear gas resulted in the M28 Riot Control Agent Mask, first procured in 1968. The facepiece came in three sizes and the filtering material was located in cheek pockets. Over 270,000 of the masks were produced prior to 1970. The mask was obsoleted in 1977.

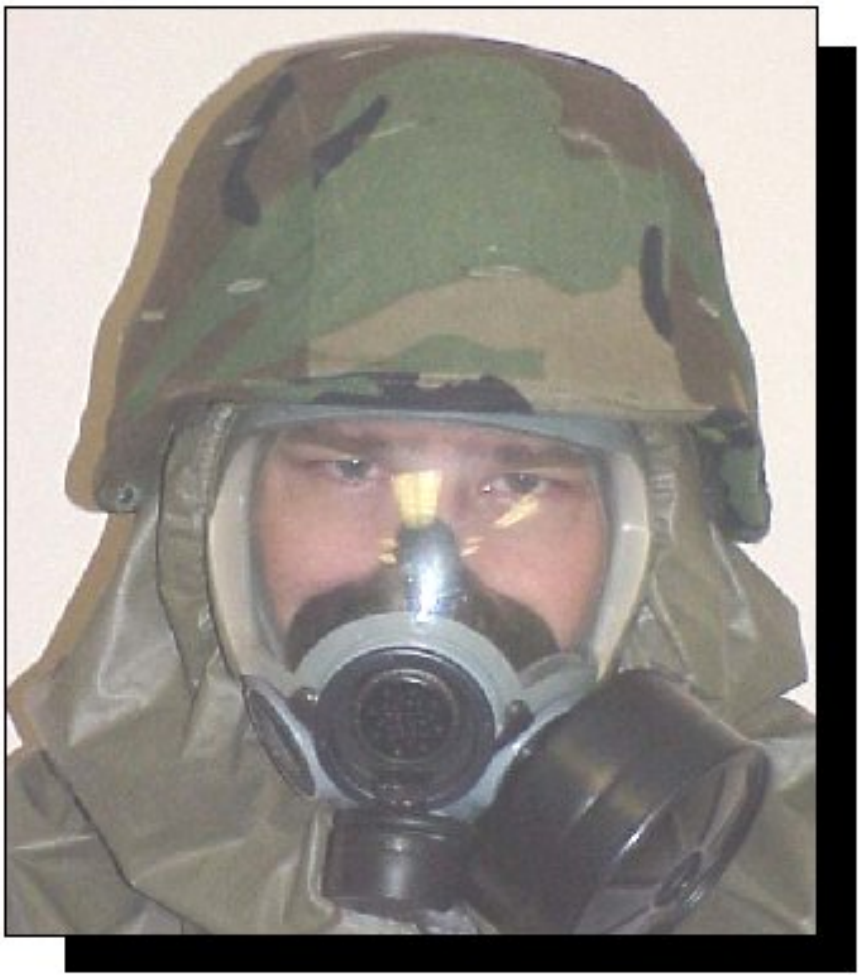
The1970's

XM29 Series Masks

During the 1970's, the Army experimented with two types of masks that were never standardized. The first was the XM29 Series which came in four different versions: combat, armor, aviation, and special purpose. The masks used a unimolded integral large flexible lens of transparent silicone rubber with a protective coating to enhance agent penetration and scratch resistance. Trouble with the lens coating led to redirecting the effort to the XM30 Series Mask in 1979.

XM30 Series Mask

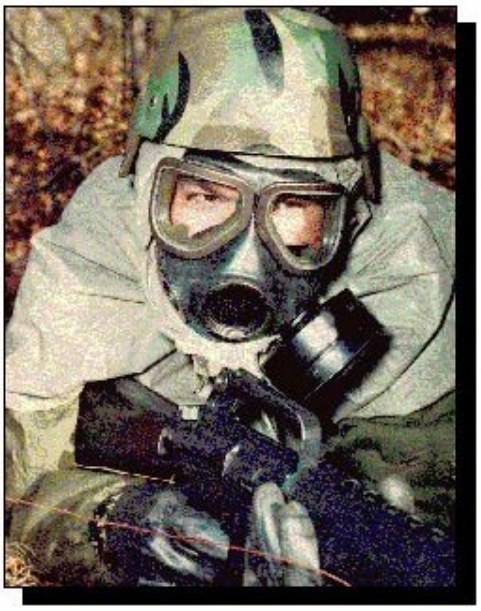
The XM30 Mask had a large, flexible bonded-in-silicone lens, which provided greater visibility than the M17 Mask. It had front and side voicemitters, a drinking device, rapid donning, and came in three sizes. The canister was developed by Canada and had NATO threads. The XM33 Aircraft Mask and XM34 Combat Vehicle Mask were similar. Marring of the lens and other problems resulted in dropping the XM30 Series Masks in the early 1980s.



MCU-2/P Mask

Although the Army chose not to standardize the XM30 Mask, the Air Force liked the mask and completed its development as the MCU-2/P. Both the Air Force and the Navy used the mask to replace the M17 series of masks. The MCU-2/P Mask was used extensively by both services during Operations Desert Shield and Desert Storm.

The1980's

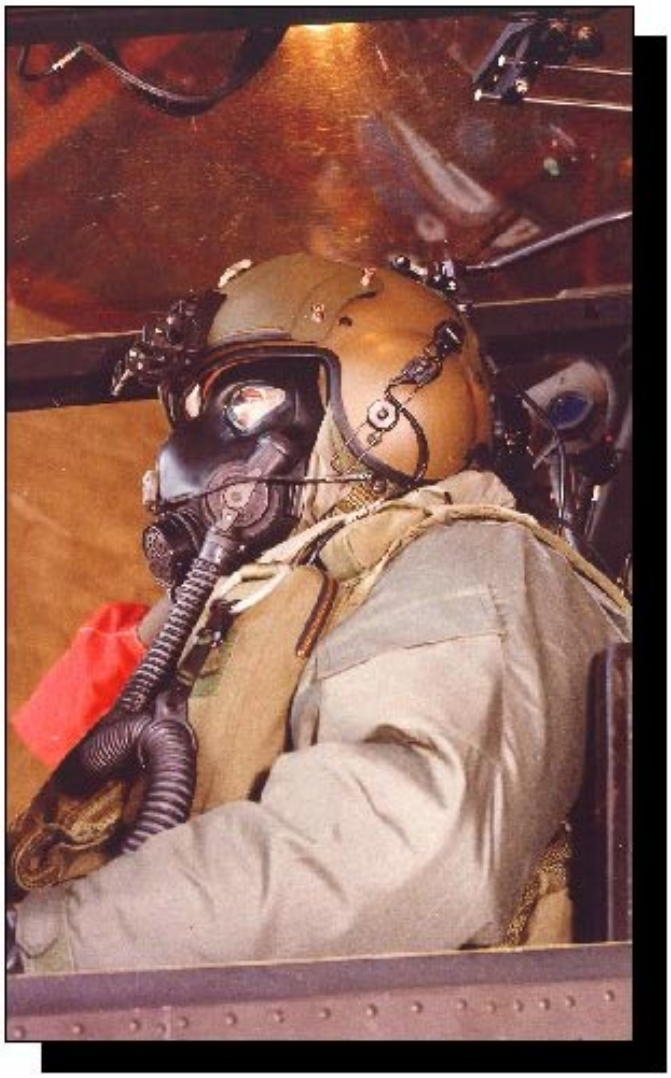


M40 Series Mask

Lessons learned from the XM30 Mask resulted in the M40 Mask in 1987. The facepiece was made of silicone rubber and came in three sizes. The canister was NATO interchangeable. Several improvements to the mask resulted in the M40A1 Mask in 1992. The new version included a Quick-Doff Hood and an improved nosecup.

M42 Series Combat Vehicle Mask

A version of the M40 Series Mask was standardized for combat vehicles as the M42 Mask in 1987. It came in three sizes and included microphone and air hose connections to the vehicle's collective protection system. Improvements to the mask, including a Quick Doff Hood and a better nosecup, resulted in the M42A1 Mask in 1992. A detachable microphone which simplified production led to the M42A2 Mask in 1995.



M43 Aircraft Mask

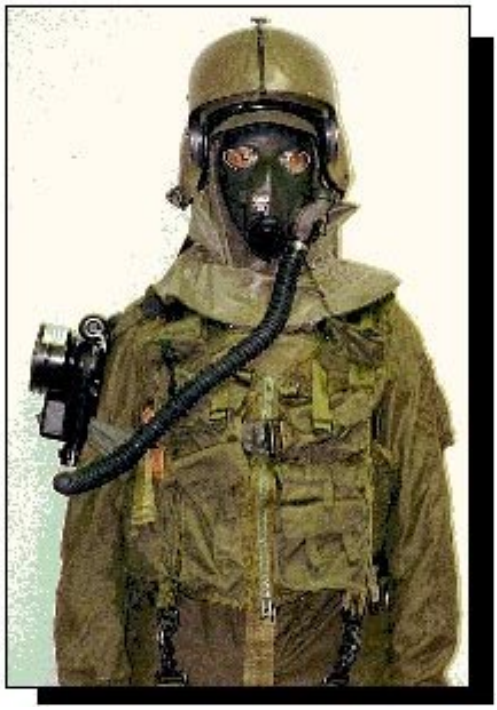
To meet the requirements for a protective mask for Apache AH-64 helicopter crews, the Army developed the M43 Aircraft Mask in 1986. It was compatible with the unique sighting system of the Apache helicopter, included a portable motor/blower filter assembly which operated on either battery or aircraft power, and came in four sizes. An improved version, the M43A1, was standardized in 1991.

The 1990's

M45 Chemical-Biological Mask

The continued requirement for a better aviator's mask resulted in the M45 Mask in 1996. The mask provides protection without the aid of forced ventilation air while still being compatible with the sighting systems and night vision devices of rotary-wing aircraft (except the Apache AH- 64). The mask comes in four sizes and will be used by both aviation and infantry.

M48 Apache Aviator Mask



Improvements to the M43 Type 1 Apache Aviator Mask to eliminate the aircraft-mounted motor-blower resulted in the M48 Apache Aviator Mask in 1996. The M48 mask is lighter in weight, contains a man-mounted blower, provides chemical/biological survivability, and does not require modifications to aircraft. The M48 Mask incorporates a lightweight motor blower that meets all the requirements of the aircraft-mounted motor blower of the M43 Type 1 Mask while being lighter in weight and providing longer operating life outside the aircraft.

The Future

XM50 Joint Service General Purpose Mask (JSGPM)

The JSGPM is a revolutionary advancement in protective mask technology providing increased soldier, marine, airmen, or sailor performance, reduced breathing resistance, and significant enhanced protection by providing protection against toxic industrial materiel. The JSGPM is being developed for all services to replace the Army's M40 and M42 Series Masks and the Air Force's and Navy's MCU-2/P Mask. The objective of the development program is to provide better protection, improved field of view, lower breathing resistance, and reduced weight. The mask will be developed through a performance specification sponsored by the Joint Services.