nounced a new E-13 mask for troops. It is designed to give the soldier complete protection against the inhalation of war gases, germ warfare agents and airborne radioactive fallout particles, but does not protect against direct radiation.

The new mask does not have the protruding canister used in current masks. This was made possible through development by the Chemical Corps of a new light-weight, pliable gas-aerosol filter material. Pads of this material are enclosed within cavities molded into the rubber facepiece of the mask. Lower breathing resistance, superior vision, better speech transmission, and greater comfort are claimed.

It should be noted that the CD V-800, the existing and the new Army gas masks should be used for purposes for which they were designed only. After both World War I and II, several instances were reported where "surplus" Army masks were used for protection against gases for which they were not designed, with serious consequences. It is important that gas masks are not misused.

B. *AIR-SUPPLIED RESPIRATORS*

Since the simplest solution to all respiratory problems is to supply pure air to the breather, the use of an air supply from some remote source where the air is not contaminated is both simple and logical. For many applications, air-supplied equipment has real advantages, but this equipment is subject to definite limitations. The simplest type is the Bureau of Mines Type B hose mask, which is a facepiece to which is attached a hose without a blower which must extend to a respirable source of air. This mask depends on the breathing action of the wearer to move the air. For this reason, a maximum hose length of 75 feet has been established for the hose mask without blower.

Low pressure blowers, operated either by hand or by power (power blowers do not carry Bureau of Mines approval) are used to supply Bureau of Mines Type A hose masks up to 150 feet. All hoses should originate at the blower.

A respirable source of air must be assured, and a safety man must be present at the blower at all times. Fouling of the hose may cut off the air supply, and the exit route must be the same as the entrance route. These hose masks can be used safely only if the above precautions are observed.

Airline-supplied Bureau of Mines Type C respirators are divided into two classes: (a) the continuous flow type and (b) the demand or intermittant demand flow type; (a) is usually used with a powered compressor or blower, while (b) is usually used with breathing air supplied from cylinders. The use of such equipment in atmospheres immediately hazardous to life is not recommended since failure of the air supply or fouling of the hose would be serious, and further, it is absolutely necessary to have respirable air of unquestioned quality.

We have previously noted the hazard of using a plant air supply for air-supplied breathing equipment. It is recommended that a separate air system be used exclusively for breathing air. Depending on the pressure available and the diameter of the hose, there is a limit to the length of hose which is practical.

Wherever possible, such systems should be piped as close to the outlet as possible, so possibility of fouling of the hose and cutting off the air supply will be minimized. Exit from areas where air-line respirators are used must, of course, be the same as the route in. If a compressor or tank supply is used, sufficient pressure relief control must be available to protect the wearer against pressure in excess of that prescribed for the equipment.

AIR-INFLATED SUITS

Air helmets, air hooks, and air-supplied suits have the same general limitations as for air-line respirators. An interesting development in this field is the use of air-inflated suits for protection of the whole body against hazardous materials.

In one form, the large impervious plastic tunnel or pipe allows a man to work in one room while using air from another—the slight air pressure supplied giving both breathing air and inflation (or body) to the suit. The front of the suit is tailored into a facepiece, and arms with gloves are attached. Mobility is reported good within the obvious limits imposed by the length of the tunnel attached.

In another form, a complete suit with built-in arms and legs is supplied with air for inflation and a hood, also air supplied, is used for head, face and respiratory protection. Depending on the particular fabric, plastic, or composition used in its construction, this suit allows work inside tanks, reaction vessels and other confined space which still contain a hazardous atmosphere.

Properly used, together with safeguards to insure that the wearer's air supply and lifeline are always in proper position and working order, this suit has increased safety and decreased operating costs in maintenance work inside tanks containing materials which are corrosive or are easily absorbed through the skin such as aromatic amino and nitro compounds. The same limitations noted above for air-line respirators should be noted.

Regardless of the type "respirator" used, a definite program of control is necessary to insure the device is used properly, is properly maintained, and that it is doing what is expected of it. After the Canadian Chalk River atomic reactor incident, respirators were used to prevent inhalation of radioactive contaminants. This program was successful only after a respirator official was appointed to control the use and maintenance of respirators, regular urine-samples were analyzed to show definitely the degree of absorption, and an improved respirator was made available.

C. *SELF-CONTAINED BREATHING APPARATUS*

Self-contained breathing apparatus supply complete respiratory protection in any concentration of toxic gases and under any oxygen deficient atmosphere. However, certain gases and vapor will cause systemic poisoning by skin absorption. Although a small group, these exceptions are highly important, including hydrogen cyanide, nitro and amino aromatic compounds, ethylene imine, phenols and a few others. These gases and vapors require complete skin protection of an impervious type in addition to respiratory protection.

EARLY REBREATHING APPARATUS

The early self-contained rebreathing apparatus, which was imported from Europe, had serious deficiencies. Loss of life was reported by users in this country; 19 accidents are reported involving 26 facilities between 1911 and 1940, due partly to equipment failure and partly to improper use. Where life-lines and standby rescue squads were employed, the apparatus was generally satisfactory in the hands of well-trained users.

The first self-contained breathing apparatus to be approved by the U. S. Bureau of Mines was of the two-hour rebreathing type.

The oxygen rebreathing type apparatus is relatively heavy (39# for the two-hour type) and is bulky. Most self-contained (closed circuit) oxygen breathing apparatus in use today require mouth breathing with a nose clip, but a full facepiece has recently been approved. Careful training is required in use and in maintenance of this apparatus. A minimum of 20 hours initial training is recommended by the Bureau of Mines.

RESTRICTS MOVEMENT

Demand-type air and demand-type oxygen breathing apparatus is available in half-hour, quarter-hour and 7½ minute ratings. Only the half-hour demand apparatus is Bureau of Mines approved; the Bureau has no approval schedule at present for any self-contained apparatus of less than a half-hour. Although the schedule of work on which the Bureau's half-hour rating is exhausting, large men under extreme stress have exhausted a half-hour (40 cu. ft.) cylinder in significantly less than a half-hour.

Differing only in whether it is supplied with compressed oxygen or compressed air, the apparatus weighs nearly 30 pounds for the half-hour type, with the large cylinder (40 cubic feet) on the back. It is relatively awkward to put on and it restricts action in confined spaces. With practice, it may be put on and into operation from a mounted backboard in less than 20 seconds.

The back position of the cylinder makes it difficult to crawl under equipment. Climbing in and out of small openings, such as manholes, requires care when wearing this type apparatus. Operation of a motor vehicle is awkward when wearing a cylinder on the back. (15-minute and 7½-minute demand apparatus use smaller cylinders slung on the side of the wearer, which overcomes this objection to some extent.)

The purity of the air or oxygen with which the cylinder has been charged should always be questioned since other gases such