

Aug. 16, 1966

K. G. WILLIAMS
BREATHING APPARATUS

3,266,489

Filed May 17, 1963

4 Sheets-Sheet 1

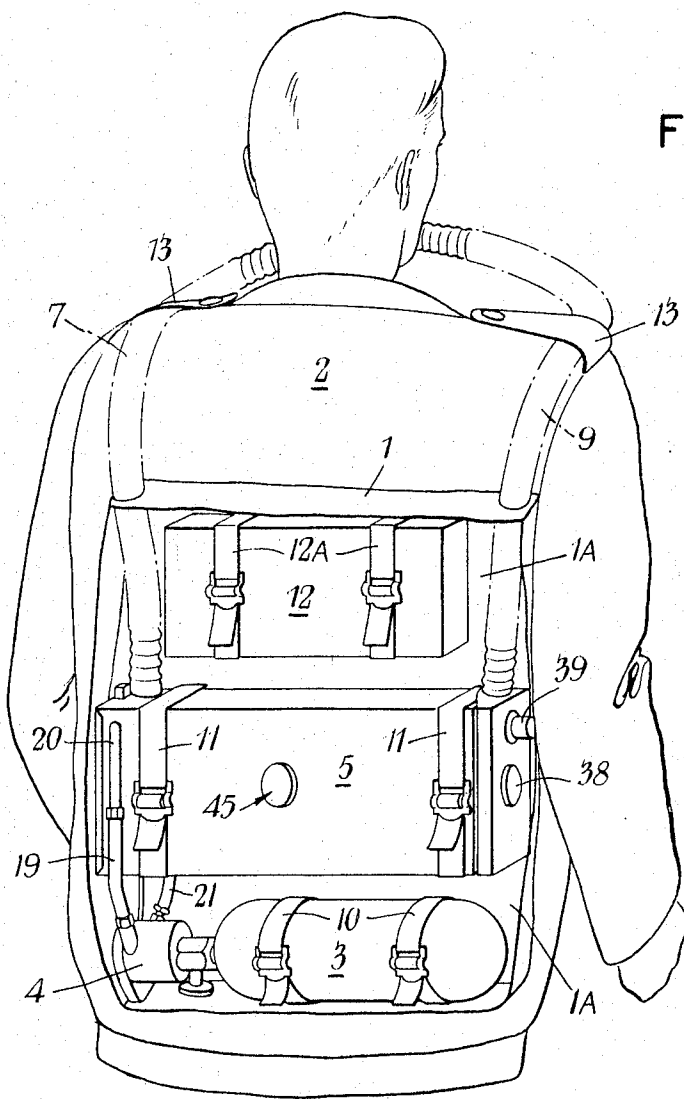


FIG. 1

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4 Sheets-Sheet 2

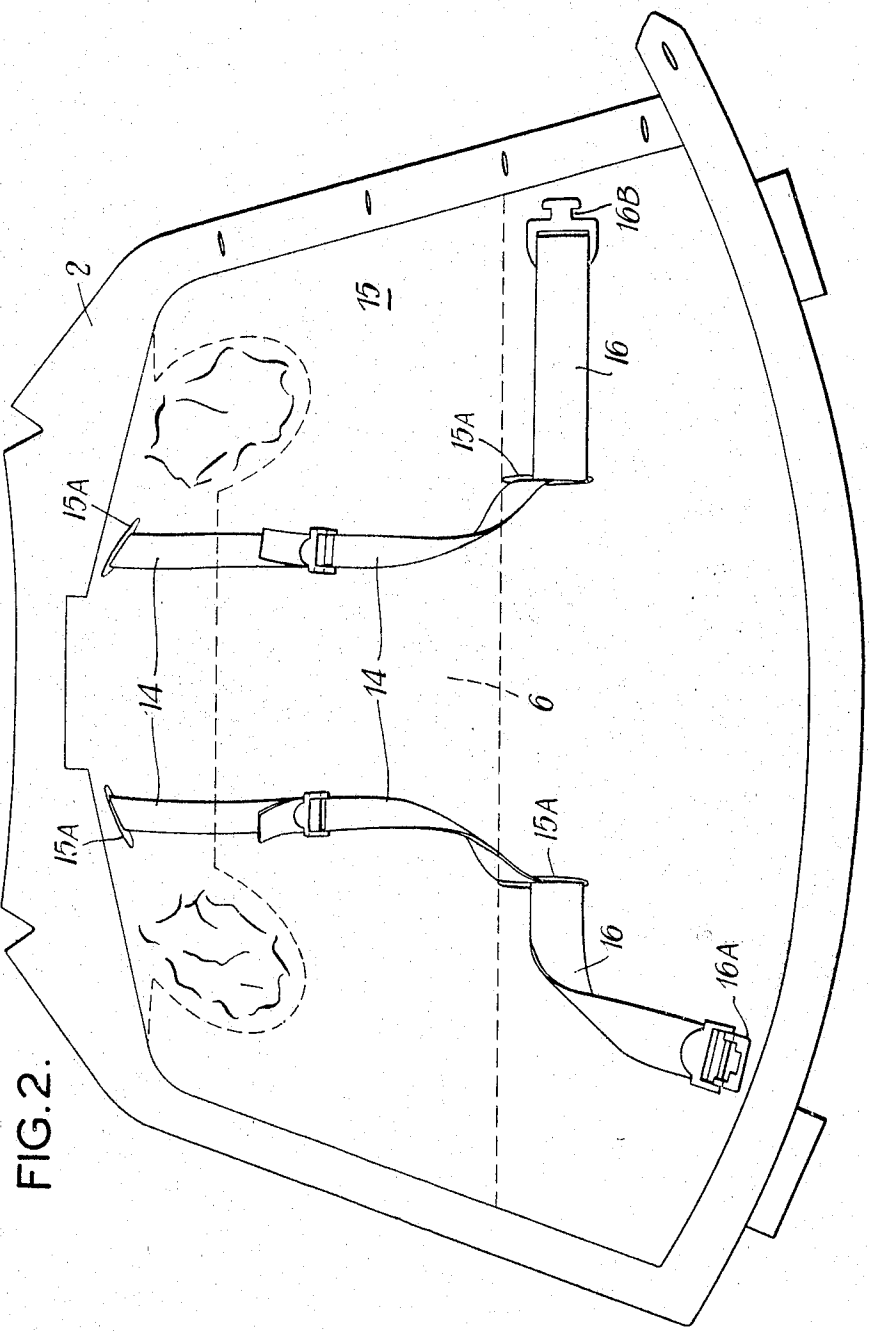


FIG. 2.

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4 Sheets-Sheet 3

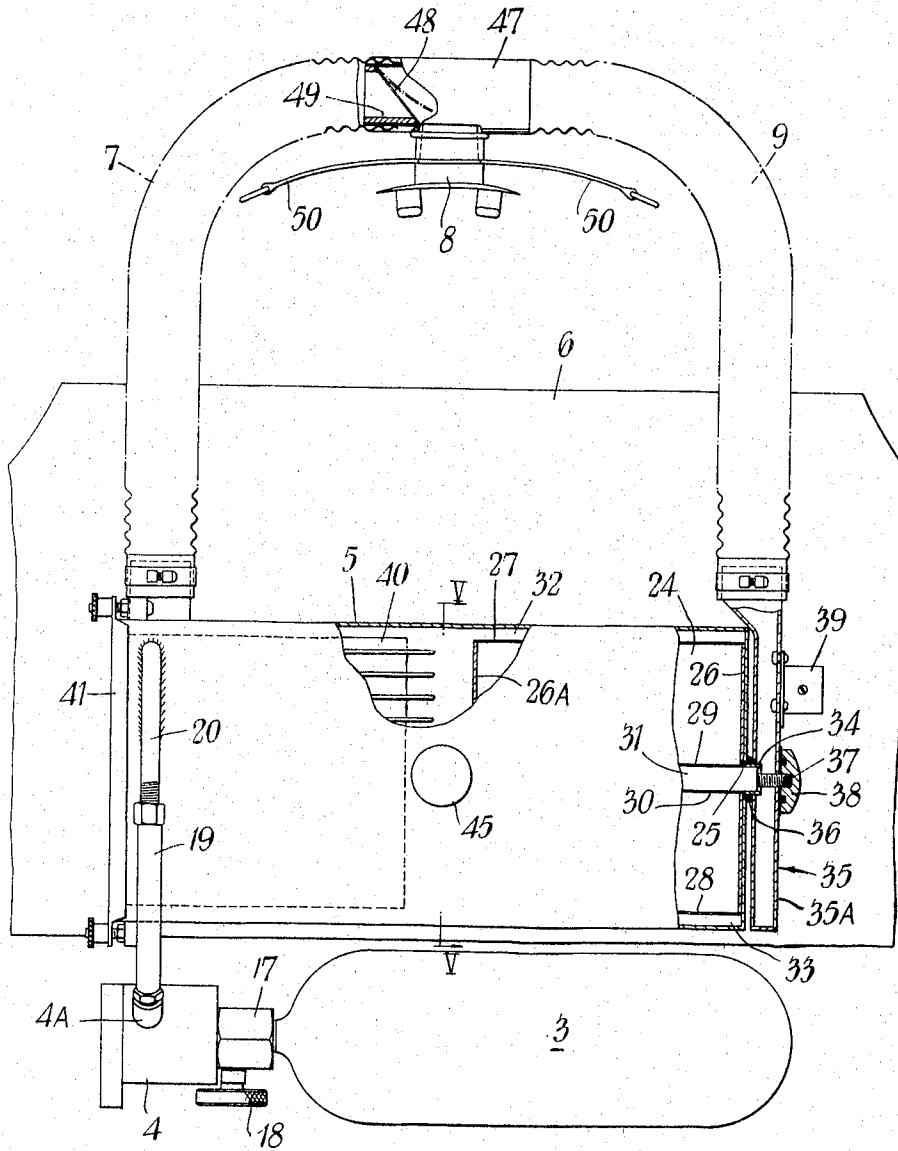


FIG. 3

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4 Sheets-Sheet 4

FIG. 4

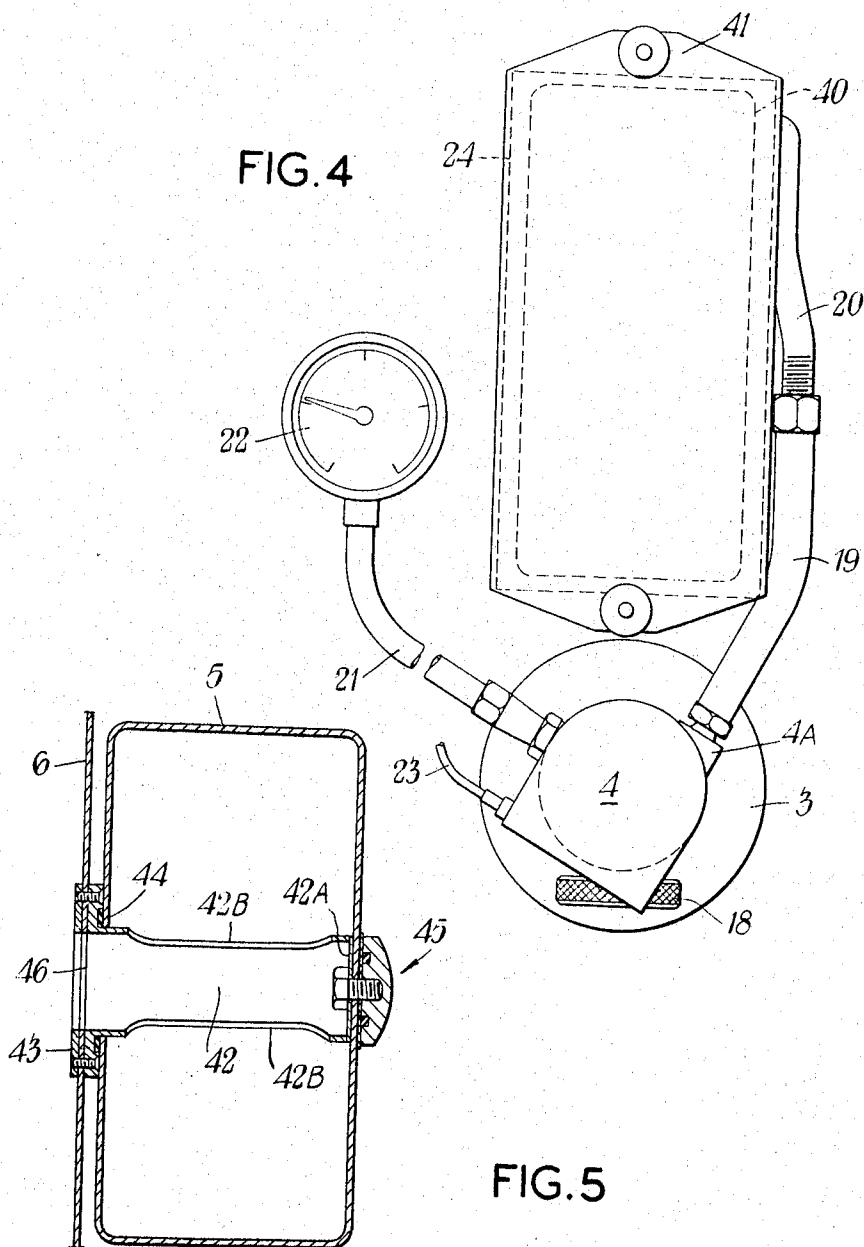


FIG. 5

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1

3,266,489

BREATHING APPARATUS

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Filed May 17, 1963, Ser. No. 281,290

1 Claim. (Cl. 128—142)

This invention relates to a closed circuit breathing apparatus.

According to the present invention there is provided a closed circuit breathing apparatus comprising means for attachment to the user's face for communicating with the breathing passages of the breathing apparatus, such as a mouthpiece or face mask, a bag for containing the gaseous medium to be breathed, a first conduit for conveying gaseous medium from the bag to the mouth-piece or face mask through a first non-return valve permitting flow in the direction from the bag to the mouth-piece or face mask, a second conduit for conveying gaseous medium from the mouth-piece or face mask to the bag through a second non-return valve permitting flow in the direction from the mouth-piece or face mask to the bag, wherein the bag is incorporated in a garment to be worn by the user of the apparatus, the bag being arranged for bearing on the chest of the user of the apparatus.

For a better understanding of the present invention and to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

FIGURE 1 is a back view of a fireman wearing a jacket having a closed circuit breathing apparatus incorporated therein, the jacket being shown in a portion cut-away to reveal parts of the breathing apparatus,

FIGURE 2 is a front view of the jacket when opened out,

FIGURE 3 is, to an enlarged scale, an elevational view, partly in section, of the breathing apparatus with the jacket removed,

FIGURE 4 is, to an enlarged scale, an end view of part of the apparatus of FIGURE 3, and also showing a pressure gauge, and

FIGURE 5 is, to an enlarged scale, a part-section on the line V—V of FIGURE 3.

The breathing apparatus is carried by a jacket 2 having a compartment 1 on the back thereof. Within the compartment 1 are an oxygen bottle 3, a reducing valve 4 connected to the outlet of the bottle, a container 5 for air cooling and purifying elements, and a box 12 containing radio and other electronic equipment. This electronic equipment forms no part of the present invention and will therefore not be described further. A gastight inflatable bag 6 is incorporated in the jacket 2 so that in use the bag 6 extends over the chest and the upper part of the back of the wearer. A flexible air supply pipe 7 leads from one end of the container 5 to a mouth-piece 8 and a flexible air return pipe 9 leads from the mouth-piece 8 to the other end of the container 5. Straps 10, 11 and 12A hold the oxygen bottle 3, the container 5 and the box 12 in the compartment 1. The pipes 7 and 9 are led through holes in the upper wall of the compartment 1 and under the shoulder loops 13 of the jacket 2. Most of the weight of the components in the compartment 1 is carried by shoulder straps 14 which are attached to the part of the jacket 2 forming the wall 1A of the compartment 1. The straps 14 pass through upper and lower slits 15A in the lining 15 of the jacket 2. A belt 16 is also secured to the wall 1A of the compartment 1, the belt 16 being passed through the lower slits 15A and provided with a buckle 16A and fastener 16B for enabling the belt when passed around the waist of the wearer to

2

be secured at the front of the jacket 2. The bag 6 is disposed between the lining 15 and the jacket 2 and is attached to the lining 15 by means of press studs (not shown).

The oxygen bottle 3 has an on-off valve 17 (FIGURE 3) at its outlet, the control of this valve being by means of a knob 18. The reducing valve 4 is fitted to the bottle outlet on the downstream side of the valve 17 and a flexible pipe 19 connects an outlet 4A of the reducing valve 4 to an inlet tube 20 of the container 5. A flexible pipe 21 (FIGURE 4) connects the valve 4 to a pressure gauge 22 which is carried on a front upper part of the jacket 2 where the gauge 22 is visible to the wearer. The gauge 22 serves to give an indication to the wearer of the amount of oxygen remaining in the bottle 3. A so-called Bowden cable 23 leads from the valve 4 to a control lever (not shown) manually operable by the wearer to cause oxygen from the bottle 3 to by-pass the reducing valve 4 and flow from the valve 17 directly to the flexible pipe 19.

A box 24 is housed in the right-hand part (FIGURE 3) of the container 5, the vertical walls of the box 24 being imperforate except for a rectangular aperture 25 in the middle of the right-hand end wall 26 (FIGURE 3). The top and bottom walls 27 and 28 of the box 24 are of wire mesh, as are two intermediate walls 29 and 30 which form the top and bottom walls of the channel 31 of rectangular cross-section extending from the aperture 25 to the left-hand wall 26A of the box 24. The side walls of the channel 31 are constituted by walls of the box 24. Soda lime for absorbing carbon dioxide is contained in the chambers formed between the walls 27 and 29, 28 and 30. Two further channels 32, 33 are defined by the walls 27 and 28 and the top and bottom walls of the container 5. An outwardly protruding flange 34 extends around the perimeter of the aperture 25 and is inserted through a correspondingly sized aperture in the adjacent end wall of the container 5 to penetrate another rectangular aperture in the side wall of a narrow box 35. A sealing ring 36 surrounds the part of the flange 34 that is between the container 5 and the box 35, and a screw-threaded projection 37 is mounted on a bridge between opposite sides of the flange 34 to penetrate a hole in the wall 35A of the box 35 remote from the container 5. A screw cap 38 on the projection 37 secures the box 24 inside the container 5 and the narrow box 35 to the adjacent end of the container 5. A relief valve assembly 39 is provided on the wall 35A of the box 35 for permitting controlled escape to atmosphere. The relief valve assembly 39 is adjusted so that it allows escape of gas from the box 35 when the pressure therein is slightly above atmospheric, say, two inches of water above atmospheric.

A finned cooling unit 40 is housed in the left-hand part of the container 5 (FIGURE 3). Ice is packed and sealed inside the unit 40 prior to use, and the fins allow gaseous medium in the container 5 to circulate past the unit 40 to be cooled thereby. A cover 41 hermetically seals the adjacent end of the container 5. The cover 41 is removable to permit replacement of the unit 40 by a fresh one.

The bag 6 is provided with an insert 42 (FIGURE 5) in the form of a hollow cylinder projecting from the bag 6. The insert 42 is closed at its end 42A that is remote from the bag 6 and has two axially extending apertures 42B. The insert 42 is introduced through a hole in the wall of the container 5 that is normally adjacent the user's back and its closed end abuts the opposite wall of the container 5. A flange 43 around the base of the insert 42 contains a sealing ring 44 and a screw cap assembly 45 sealingly connects the insert 42 and bag 6 to the container 5. A hole 46 places the inside of the bag 6

3

in communication with the interior of the container 5 via the axially extending apertures 42B of the insert 42.

The flexible supply pipe 7 for the mouth-piece 8 leads from the left-hand end (FIGURE 3) of the top wall of the container 5 to one end of a rigid tube 47. Two non-return valves are housed in the tube 47, one acting as an inlet valve, the other as an outlet valve, for the mouth-piece 8. The inlet valve is shown in FIGURE 3 and consists of a flap 48 of impermeable resiliently flexible material such as that sold under the trade name Melinex, secured at one point to the angled end of a sleeve 49 which fits snugly in the left-hand end part of the tube 47. The closed position of the flap 48 is shown in full lines in FIGURE 3 and the open position in chain-dotted lines. The outlet valve (not shown) is of similar construction to the inlet valve and is housed in the right-hand end part of the tube 47, the flap (not shown) of the outlet valve being disposed on the right-hand side (FIGURE 3) of the associated angled sleeve (not shown). The return pipe 9 leads from the tube 47 to the narrow box 35. The mouth-piece 8 is secured over an aperture in the tube 47 between the inlet and outlet valves and is provided with extensions 50 for attachment to a head-harness (not shown).

The operation of the breathing apparatus, starting from the moment the user of the apparatus begins to inhale, is as follows. At this moment the bag 6 is filled with oxygen, and a steady supply of oxygen is flowing from the bottle 3 into the container 5. The valve 4 permits flow of oxygen from the bottle 3 to the pipe 19 at a rate of 2 to 4 litres a minute at normal temperature and pressure. As the user breathes in the flap 48 of the inlet valve is opened and oxygen is drawn from the bag 6, through the insert 42, past the cooling unit 40 and along the supply pipe 7. The unit 40 serves not only to cool the oxygen supplied to the mouth-piece 8 but also condenses water vapor that may be contained in oxygen. The unit 40 thus both cools and dries the oxygen fed to the mouth-piece 8. Oxygen issuing from the inlet tube 20 is also drawn up the pipe 7. The outlet valve in the tube 47 is maintained in its closed position by this inhalation. When the bag 6 is filled with oxygen it exerts a pressure on the user's chest and on the upper part of his back. As oxygen is drawn from the bag 6, the latter deflates thus facilitating chest expansion. Furthermore the chest expansion by squeezing the bag 6 assists in the circulation of gas through the apparatus. The supply of oxygen from the bottle 3 serves only to replace losses incurred and is not sufficient to keep the bag 6 inflated during inhalation.

When the user starts to breathe out the exhaled gases are directed by the non-return valves in the tube 47 along the return pipe 9 into the narrow box 35 and through the aperture 25 into the channel 31, water vapour in the gases condensing in the box 35. From the channel 31 the gases permeate through the mesh walls 29 and 30 and the soda lime in the chambers of the box 24 where carbon dioxide is absorbed, to emerge through the mesh walls 27 and 28 into the channels 32 and 33. The gases from which carbon

4

dioxide has been extracted then pass to the bag 6 via the insert 42, the inflation of the bag 6 being aided by the supply of oxygen from the bottle 3. The pressure on the user's back and chest exerted by the inflating bag 6 as he breathes out assists the user's lungs in exhaling.

As gaseous medium in use of the apparatus is circulated back and forth between the bag 6 and the mouth-piece 8 it will be understood that the breathing apparatus is a so-called "closed circuit" one.

The capacity of the bag 6 is such that a user of the apparatus cannot exhale it in one breath.

It will be understood that, instead of the mouth-piece 8, a face mask may be used.

I claim:

In a closed circuit breathing apparatus, including a garment having front and back portions for supporting elements of the apparatus and arranged to be worn by the user, a gas-tight inflatable and deflatable bag for containing gaseous medium to be breathed by the user, said bag being incorporated in said garment, means for conducting a breathing gas to the breathing bag, an attachment means for mounting on the face of the user, a first conduit including a one-way inlet valve for conducting gaseous medium from the bag to the face attachment means, a gas purification chamber carried on the garment, and a second one-way conduit for conducting exhaled gases from the face attachment means to the gas purification chamber and for conducting purified gases therefrom to the breather bag, the improvement in which the breather bag extends horizontally around the user's body when in use, and has oppositely mounted portions incorporated respectively in the front and back of the garment in positions respectively bearing only on the chest and back of the user of the apparatus, said garment including means for retaining and holding said portions of the breather bag to the chest and back of the user, said breather bag being inflatable and deflatable respectively in timed relation to the contraction and expansion of the chest of the user while breathing, the breathing of the user of the apparatus being facilitated by the inflation and deflation of the bag in cooperation with said retaining and holding means whereby chest expansion and contraction together with the circulation of the gaseous breathing medium through the apparatus is facilitated.

References Cited by the Examiner

UNITED STATES PATENTS

996,135	4/1910	Poe	128—191
2,402,984	7/1946	Browne	128—142

FOREIGN PATENTS

733,473	7/1955	Great Britain.
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