

## ANNEXURE D.

## TECHNICAL ARTICLES.

MINE-RESCUE APPLIANCE: A DANGER OCCURRING IN THE USE OF AN APPARATUS  
IN WHICH AN INJECTOR IS EMPLOYED.

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SINCE the general introduction of self-contained breathing-appliances into mines a number of serious accidents have occurred, which have called attention to the dangers attendant on the use of such apparatus. The accidents at Felling, Cadeby, Caeduke, Bellevue, in the United Kingdom, and a number in the United States, all point to the necessity for a very searching inquiry into the design and application of these appliances.

Although a carefully prepared general scheme of training is laid down in a Home Office order, the type of apparatus to be employed is left to the selection of the mine-owner. As the number of manufacturers of such appliance is few, the owner must perforce make his choice from apparatus in many respects admittedly clumsy and imperfect.

The coal-owners of the South Midlands conducted a long series of experiments with a view to selecting an efficient and safe apparatus, and the results of the research brought about considerable improvement in nearly all the types then in existence; and although legislation to enforce the universal application was inevitable, and indeed desirable, it seems unfortunate that a little more time was not given to permit a more thorough investigation of the subject. Various designs have been adopted in different districts, and a large number of sets of apparatus have been installed, and it is only after a series of accidents as referred to at the commencement of this paper that certain fundamental defects are realized.

The writer wishes to draw attention to a serious defect in design which has been very clearly disclosed by the recent accident at Caeduke, near Swansea. The circumstances of the case are briefly as follows: It was found necessary to erect a stopping in a roadway from which gas was issuing from an area of goaf in which spontaneous combustion had occurred. Men wearing Draeger apparatus were employed to do the work. The superintendent accompanied the men, and after being at work for a period of from an hour to an hour and a half he collapsed, and succumbed to carbon-monoxide poisoning.

An examination of the apparatus revealed that the absorbent cartridge was punctured by two small holes, and that two of the tube-connections were leaking, and that such leaks were capable of permitting the atmosphere containing carbon-monoxide to get into the apparatus.

Small leakages in appliances where joints and tubes are used must inevitably occur, no matter how the apparatus is designed, and no matter how perfect it may be when first manufactured. With the wear-and-tear on the tubes and joints, the apparatus must sooner or later permit leakage, and when such leakage allows the foul atmosphere to penetrate into the breathing-circuit it must be admitted that such a design is imperfect.

In some of the apparatus at present in use an injector is introduced into the breathing-circuit, with the object of promoting circulation and keeping the air-supply cool and refreshing. The injector certainly brings about the desired effect, but in doing so it converts the apparatus into two zones of different pressure. On one side of the injector a positive pressure is obtained, and on the other side a negative pressure. It is in the negative-pressure zone that leakage from outside the apparatus to the inside may occur.

The following experiments have been made with different types of compressed-oxygen apparatus to demonstrate this point:—

| Apparatus.                                     | Pressure in Absorbent Chamber, in Inches, of Water.<br>(Subject at Rest.) | Pressure in Absorbent Chamber, in Inches, of Water.<br>(Subject working.) | Maximum Negative Pressure near back of Injector, in Inches of Water. |
|------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------|
| Draeger, new type single cylinder (mouthpiece) | From .2 to — .6                                                           | + .2 to — .6                                                              | — 2.65                                                               |
| Old type, twin cylinder (helmet)               | — .2                                                                      | + .1 to — .3                                                              | ..                                                                   |
| Meco (mouthpiece) .. .. .                      | + 1 to — .7                                                               | + 2.2 to — 2                                                              | — 3.3                                                                |
| Proto (Fleuss) .. .. .                         | + .4 to 1                                                                 | + .2 to .8                                                                | No injector.                                                         |
| Weg .. .. .                                    | + .6 to + 2.2                                                             | + .4 to + 4                                                               | „                                                                    |

It will thus be seen that the apparatus in which the injector is used has a negative pressure within the absorbent cartridge and within certain parts of the circulation-tubes, sufficient to allow extensive leakage to occur if punctures or leaky joints are present.

In order to ascertain how far leakage may occur, a further series of experiments were made upon a small orifice, such as a small puncture or a leaky joint.