Pin index system: Safety Mechanism?
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Citation

Abstract
In our plastic surgery operation theatre, as a routine practice, empty oxygen cylinder was replaced by a new 26 inches cylinder, black body with white shoulder and a valve on the top of it. However after assembling the valve of the cylinder on the yolk of the machine, a slight leak of gas was noticed and the cylinder was found to be slightly tilted and not exactly vertical as it should have been.

CASE REPORT
In our plastic surgery operation theatre, as a routine practice, empty oxygen cylinder was replaced by a new 26 inches cylinder, black body with white shoulder and a valve on the top of it. However after assembling the valve of the cylinder on the yolk of the machine, a slight leak of gas was noticed and the cylinder was found to be slightly tilted and not exactly vertical as it should have been. (FIG.1)

Immediately technician was called to find the fault. After thoroughly examining the cylinder body and the valve, we came to know that N₂O valve have been installed on the body of O₂ cylinder by mistake(FIG.2) N₂O has been inscribed on the valve and also the pin index was found to be of the N₂O.(FIG.3)Also the same cylinder, we were able to properly mount on the N₂O port of the machine, without any leak or any tilting. (FIG.4)

Next dilemma in front of us was, weather the faulty cylinder, supposed to be containing oxygen was containing oxygen or nitrous oxide. We did various clinically available tests to confirm the identity of the gas.

A volunteer inhaled 100% of the gas in the test cylinder for 5 min with faulty cylinder attached at oxygen port of machine and slight acceptable leak to by-pass master slave mechanism (FIG.5). However no decrease in saturation from previous value of 99% was noticed and all other vitals remained same as that of previous values, with no symptoms like giddiness and headache were observed. Technician further confirmed that the test cylinder was containing oxygen and not nitrous oxide. He was able to demonstrate ice deposition on the diaphragm (FIG.6) of the opened pressure reducing valve using N₂O(Fig.7), but not using O₂ cylinder (Fig.8) or the faulty cylinder (Fig.9) and also fumes were seen with N₂O cylinder but not with O₂ cylinder or the faulty cylinder. Final confirmation, however was done with a chemical test by the technician using O₂ purity system (FIG.10). This is based on the principal that the chemical reagent contained in it which is ammoniacal cuprous chloride, absorbs only O₂ among all the gases and the end point is that volume of oxygen absorbed is displaced by the volume of the indicator fluid. The gas contained in the faulty cylinder was found to contain 99.5% pure oxygen( FIG.11). The cylinder was clearly marked about the technical mistake and sent to an engineer for correction.
Pin index system: Safety Mechanism

Figure 1
Figure 1: Faulty cylinder slightly tilted

Figure 2
Figure 2: NO valve installed on the body of O cylinder with NO inscribed on the valve

Figure 3
Figure 3: Pin index of NO

Figure 4
Figure 4: Faulty cylinder mounted on NO yoke
Figure 5
Figure 5: Volunteer inhaling 100% of the gas in faulty cylinder

Figure 6
Figure 6: Demonstrating ice deposition

Figure 7
Figure 7: Ice deposited on opened NO valve

Figure 8
Figure 8: No ice deposited on opened O valve
DISCUSSION

Various cases of different types of technical mistakes have been mentioned in literature. Reports with cylinders containing correct gas as per label but incorrect valves have been mentioned. This usually will prevent the correct attachment of the cylinder on the yoke of the machine due to the pin index system.

In our case, due to pin index safety mechanism cylinder could not be mounted correctly on the yoke of the machine and continuous leak and slight tilt of the cylinder was noticed. Other reasons cited in literature for incorrect placement of cylinders include bent pins, using more than washer and yokes without having the pins. Especially in developing countries like India, where cylinders are recycled repeatedly over many years pin index system can be easily bypassed due to worn pin index system or broken pins.

Cylinders may not be containing the gas for which they are indexed and labeled. However in our case the faulty cylinder was containing the gas for which it was labeled i.e. oxygen and not N$_2$O, which we confirmed with the help of various tests as mentioned.

CONCLUSION

We conclude that such a mistake can occur even in today's computerized era. This report also emphasizes that although
many safety mechanisms have been incorporated in newer machines, pin index still stands as a distinct and trustworthy safety mechanism helping in correct placement of the cylinder on the correct yoke of machine without any modification.

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