FABRICATION OF PNEUMATIC OPERATED EMERGENCY EXIT SYSTEM IN AIRCRAFTS

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Abstract:
Designing evacuation slides has grown more complex as the FAA has tightened performance standards. In the early 1960s, slides had to deploy in 25 seconds in non-extreme weather: no wind and medium-range temperatures. Today’s slides must deploy in six seconds in temperatures ranging from –65 to 160 degrees Fahrenheit and unfurl in winds up to 25 knots (28.7 mph). Airlines impose further challenges: Slides must be light and compact enough to fit inside an aircraft door or below the door sill or emergency exit window. So each slide is uniquely developed for its location on an aircraft model.

So to overcome the above mentioned problems we are fabricating a pneumatic operated emergency exit system in aircrafts, which uses pneumatic cylinder to slide down the roller when the magnetic switch used in doors repels each other. The magnetic switches are connected to a microcontroller which in turn activated the relay. Once the relay is activated the solenoid valve connected to the relay will allow the air from compressor to pass through the pneumatic cylinder and the roller will slide down immediately for the passengers to exit the aircraft at emergency situations.

Introduction:
An emergency evacuation slide is an inflatable slide used to evacuate an aircraft quickly. An escape slide is required on all commercial (passenger carrying) aircraft where the door sill height is such that, in the event of an evacuation, passengers would be unable to step down from the door uninjured (FAA requires slides on all aircraft doors where the floor is 6 feet (1.8 m) or more above the ground). Escape slides are packed and held within the door structure inside the slide bustle, a protruding part of the inside of an aircraft door that varies with aircraft size, door size and door location. In many modern planes, to reduce evacuation time, evacuation slides deploy automatically when a door is opened in an "armed" condition. Modern planes often indicate an armed condition with an indicator light. Many slides are also designed to double as life rafts in case of a water landing.

Emergency exits are found on passenger aircraft to provide a means of evacuation onto the wing, where passengers either continue off the trailing edge by sliding down the extended flaps or by using an evacuation slide that deploys when the exit is opened.
Emergency exits are smaller in width and height than standard emergency exits on an aircraft, and therefore have a reduced evacuation capacity, and are typically added to aircraft where there is insufficient evacuation capacity at the main doors to obtain a 90 second evacuation, but where the addition of another set of full sized exits is not necessary to accomplish this. Emergency exits are primarily self-help exits meaning that in an emergency evacuation the passengers seated immediately adjacent to the exit will be responsible for assessing external hazards and opening the exit.

**Background:**

The first aircraft evacuation slide was developed and produced by Air Cruisers, founded by James F. Boyle, inventor of the World War II life vest, the "Mae West". The patent for the inflatable escape chute assembly was submitted by Boyle in 1954 and the designs was patented in 1956 under patent number 2,765,131. Today Air Cruisers provides slides for over 65% of the aircraft slide market. Prior to inflatables, some passenger aircraft utilized canvas type slides which required the crew to undertake an extensive rigging procedure. Canvas type slides are still found on some Russian aircraft.

The Airbus met almost to the letter the Federal Aviation Administration requirement that an airliner be capable of being evacuated within 90 seconds in the dark and with half the exits blocked—"almost" to the letter because the crash occurred not in the dark but on an August afternoon. But the evacuation was successful even though several exits were compromised by the fire and jagged metal and one slide was inoperable, apparently jarred loose when the airliner plunged into a ravine. Currently there are no pneumatics operated emergency exit systems in aircrafts. So we didn’t get much information about it.

**Objectives:**

- More number of passengers can be evacuated within short period of time.
- To work on the principle of pneumatic system.
- To consume less power and easy to operate.
- The width and height of the emergency door must be designed within limited standards.
- The emergency pneumatic slider must roll out without any malfunctioning.
- Must be feasible to employ in all aircrafts occupying less space.

**Methodology:**

In the beginning we studied some journals, research paper & googled too to get the good project to carry on with, after some researches finally we concluded the project topic and decided to go with it. And titled our project name as FABRICATION OF PNEUMATIC OPERATED EMERGENCY EXIT SYSTEM IN AIRCRAFT. In this project we will design an emergency exit system for an aircraft using pneumatic cylinders which will help passenger and crew of the aircraft to evacuate aircraft easily and safely very quickly without any injuries.

Then we studied about the requirements and advancement for our project and designed a conceptual design for it, once we knew that our requirements were satisfied then we decided to go with preliminary and detailed design, in detailed design we assumed some specification for our project, selected the materials and components as per our requirement which are explained in detail below why we selected those and decided frame structure as rectangle since the aircraft door is in rectangle shape. And we created CAED model for our project and fabricated the very same CAED model and tested our model to get the good results compared to the one which exist.
Model Specifications

<table>
<thead>
<tr>
<th>Height</th>
<th>Width</th>
<th>Angle of Slider</th>
<th>Slider Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5ft</td>
<td>2.5ft</td>
<td>60°</td>
<td>2.3ft</td>
</tr>
</tbody>
</table>

Material Selection
We selected Iron for frame

<table>
<thead>
<tr>
<th>Melting Temperature</th>
<th>Young’s Modulus $E_X$ $10^6$ Psi</th>
<th>Tension $X$ $1000$/In$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1535 °C</td>
<td>11.6</td>
<td>20a</td>
</tr>
</tbody>
</table>

Used normal Std CF fiber for the slider
CAED Model

COMPONENTS USED

- Pneumatic cylinder
- Over wing exit door
- Solenoid Valve
- Magnetic switches
- Microcontroller
- Relay
- Battery 12 v, 1.3 AH

WORKING PRINCIPLE

- Initially in normal safe functioning of aircraft the emergency exit door will be closed and the magnetic switches will be attached.
- During an emergency situation, when the emergency exit door is opened the magnetic switches will get apart and there exists some repelling force which generates a small voltage of about 5volts which can be sensed by micro controller.
- The function of micro controller is to sense the voltage generated by the magnetic switches and activates the relay/switch and also it sounds the alarm to indicate the pilot about the activation of emergency exit.
- When the switch gets on or activated, it allows the air to flow from compressor to the solenoid valve.
- The solenoid valve passes the air flow from compressor to the pneumatic cylinder.
- The pneumatic cylinder will roll out from emergency exit door to the ground within in 5seconds of time when the air is passed into it through solenoid.
- As soon as the pneumatic cylinder rolls out to the ground the passengers can slide on it easily and can be quickly reach the ground.
- Time period of deploying can be increased by increasing the compressor pressure.
- A typical block diagram is shown as follows.
RESULT AND CONCLUSION

Result and conclusion:
The prototype model fabricated during the conducted project work provides following results:

- As soon as the emergency exit door is opened the evacuation slider deploys within 2-3 seconds which is the best result we have got comparing to the existing emergency exit system in aircraft.
- Once the purpose of the evacuation slider is complete and the exit door is closed, the slider retracts back to its initial position.
- Easy to slide since the slider deploys at 60 degree angle (sliding angle may vary depending on the requirements).
- Since the pneumatic operated emergency exit system deploys within 2-3 seconds, more number of passengers can be evacuated quickly and safely.
- If the air supplied to the pneumatic system is highly compressed then the slider deploys even faster.

ADVANTAGES

- Not affected by cross-wind and medium-range temperature, since the slider is supported by the pneumatic cylinder and the slider material can withstand more temperature.
- Puncture resistant
- Cost saving

LIMITATIONS

- As there are mechanical linkages used in our concept, there may be problems arising with loads acting on them.
- It cannot be adaptable to shapes for emergency evacuation such as window exits. But in present days most of the aircrafts use trailing edge flaps deployment which are
enough to reach the ground and enables passenger’s evacuation. So, this limitation does not possess much problem.

• One more limitation is that the pneumatic cylinder does not withstand more weight.

FUTURE SCOPE

• More number of Passengers can be evacuated by increasing the size of the emergency exit door. Depending on the size of the door the slider size also varies.
• Since the sliders are puncture resistant they can be used in all types of aircrafts.
• Can also be used in Helicopters.
• This emergency exit system is retractable, therefore it is cost efficient when compared to the conventional emergency exit system which is non retractable and one time usage of it will cost about 20 million dollars.
• May be the engine bleed air can also be used for the pneumatic cylinder to roll down the slider, since it is highly compressed air which will there by require no extra compressor to compress the air.
• By using good material for the slider we can use this emergency exit system in extreme weather conditions, high range temperature and also cross wind without not much damage to the slider and also successful evacuations is possible using this slider at this conditions.
• Since the slider is light and compact enough it can fit below the door sill or emergency exit window.
• Furthermore researches should be made on this concept in order to make feasible to use at emergency evacuation system in aircraft.

Emergency evacuation, which is an event which seldom occurs at the scale of airlines and that is extremely rare at that of individuals. However, it is under these scenarios that the improvement at the design stages in order to prevent the accident and to develop best methods to deal with the reality of emergency evacuation. Improving survivability will therefore necessitate comprehensive review of all promising options available to regulation and industry.

It is essential that we do more research on our project in order to better understand the reality and prepare effective solutions. These options could lead to incorporating new features to aircraft at the development stage and also use of other tools during the certification exercise and put in place the technologies which will increase the efficiency during evacuation.