

# Design and Fabrication of Crimped Ribbon Flame Arrestors Element for Safety from Flame Flashback

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**Abstract**— A Flame arrester also spelled as arrestor is a device which allows gas to pass through it but stops a flame in order to stop large fire and explosion. The crimped ribbon flame arrester is an effective device for flame propagation. Crimped ribbon arrestor are important safety device in the chemical and thermal industries, especially for the dangerous situation. The design and geometry of arrestor are dependent on gas/air mixture and the tube geometry. Flame arrester elements offer three quarter of cross section area of arrestor for flow. The presented discussion give a better understanding about the design and fabrication of crimped ribbon type flame arrestor element.

**Keywords:** Flame Arrester, Crimped Ribbon, Gap size, Flame Protection

## I. INTRODUCTION

A flame arrestor is a device that stops the fuel combustion by extinguish the flame. This are passive mechanical device that are mounted to threaded or flanged connections in a processes piping systems.

An arrest or consist of a housing and an arrester element. Arrester elements are variable in anumber of different configuration i.e (parallel rectangular metal plate, wound crimped metal, parallel round metal plate). Flame arrestor element is made of wound corrugate and flat metal strip as the main part of flame arrestor.

As the main component of flame arrestor, the flame arrestor element is suitable for flammable gas pipelines, such as gasoline, kerosene, light diesel oil. The element provides the mechanical barrier to flame passage. The arrestor element is mounted in the arrestor housing. Flame arrestors are made of different materials depending on the gas passing through pipes. Flame arrestor element offer 70 - 80 per cent of cross section area of arrest to flow and remaining area is taken by ribbon for successful operation.

## II. LITERATURE REVIEW

### A. An Integrated Model for Predicting the Flame Propagation in Crimped Ribbon Flame Arresters

In this paper Zheng Wang, Fuhua Jiang, Huang, bing sun, have presented Crimped ribbon flame arresters are important safety devices in the chemical industry, especially for the dangerous situations. Although proper design of arresters by the numerical simulation method is promising, its reliability and accuracy are dependent upon the mathematical model. In this work, an integrated mathematical model for the microchannel in the crimped ribbon flame arresters was set up; the fluid flow behavior and the sensitivities of four chemical kinetics mechanisms of propane-air on the accuracy were analysed. It is shown that turbulence is predominant in the microchannel of the crimped ribbon flame arresters under the deflagration and detonation conditions. The species mass

fraction profiles and the temperature distribution, which are too difficult to measure due to the tiny dimension of the micro channel in experiments, are captured.

### B. Crimped Metal Ribbon Flame Arrestor for the Protection of Gas Measurement Systems

In this paper Dieter Lietze have presented This paper summarises the results of extensive research to determine the limit of safety against flame transmission for flame arrestors of relatively small size fitted with arrestor elements made of crimped metal ribbon. Depending on the reactivity of the fuel gas/air mixture and the tube geometry the running up to detonation and hence the stressing of a flame arrestor by a detonation is possible in longer tubes with relatively small diameters. Only with reactive gas phases of explosion group I this stressing case for a flame arrestor can be excluded. With detonative gas phases the stressing of the flame arrestor decisively depends on the place of installation with respect to the point of transition from deflagration to detonation in the system considered.

## III. OBJECTIVE

- 1) To stop the spread of an open fire.
- 2) Preventing potentially explosive material from ignition.
- 3) To prevent the spread of fire by design of its gap.
- 4) To prevent accident.
- 5) To build an effective and cost efficient model of crimped ribbon flame arrestor element.

## IV. RESEARCH METHODOLOGY

- Study of Flame arrestor element
- Study of working
- Selection of material
- Selection of machine for manufacturing
- Machine study
- Parts of Flame Arrestor Element
- Manufacturing procedure of Flame arrestor element

## V. PROPOSED METHODOLOGY

### A. Flame Arrestor Element

Flame Arrestor Element Allows Gas Passing and Extinguishes Flame. Flame arrestor element is made of wound corrugated and flat metal strips as the main part of flame arrestor. It prevents the spread of fire by the design of its gap.

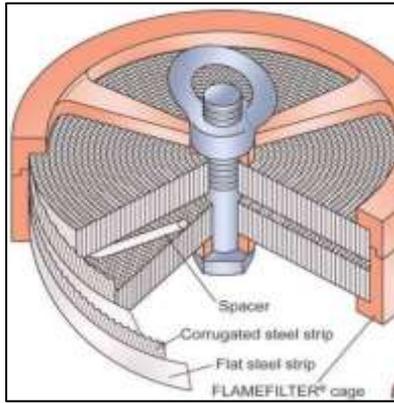


Fig. 1: Crimped Flame Arrester Element

**B. Working**

When a mixture ignites in a gap, the flame spreads towards the non-combusted mixture. The expansion in volume of the combusted mixture pre-compresses the non-combusted mixture and accelerates the flame. By heat dissipation in the gap layer of the flame arrester element, transferring flame to the surface of the waved gap and cooling-down the product below its ignition temperature, the flame is extinguished.

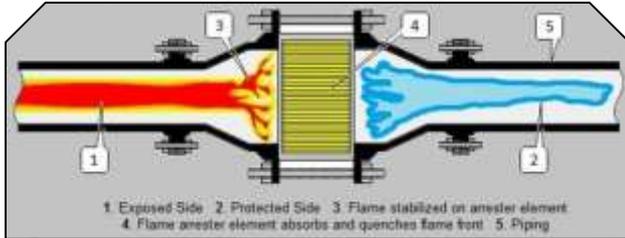


Fig. 2: Working of Flame Arrester

**C. Material of Flame Arrester Element**

The material used for housing of Crimped ribbon material is SS (Stainless Steel) 316. Material for Crimped Ribbon is SS316 and alternate Flat Ribbon is of SS316. Thickness of ribbon is 0.1 to 0.2 mm.

**D. Machine for Manufacturing of Element**

The machine Selected here is the crimping machine for crimping operation of the thin metal sheets.

Machine consist of motor which drives the driving gear and the sheet is passed through the driven gear and supporting gear.



Fig. 3: Metal Foil Crimping Machine

**E. Machine Study**

Machine for manufacturing of flame arrester element consist of Motor, Driving gear, supporting gear. The Motor is coupled with the driving gear. The element sheet is feed in the driving gear and the supporting gear. Which gives the element corrugated shape.



Fig. 4: Crimping Machine Driving and supporting Gears

The supporting gear is mounted on the same frame on which the driving gear is mounted. The sheet element of thickness 0.1 to 0.2 mm is feed into the machine for the crimped texture. Diameter of the driving gear is 15cm and support rotor is 13cm. on both the gear having pitch of 1mm.

**F. Parts of Flame Arrester Element**

1) Plain foil



Fig. 5: Metal flat ribbon (foil)

2) Crimped foil



Fig. 6: Crimped Foil

### 3) Flame Arrester Element Housing



Fig. 7: Housing of Element Roll

All this parts are then together installed with the help of machine. The Flat foil and the crimped foil are arranged in alternate way for making of element cell of Flame Arrester element. Generally the width of the foil is 10 cm. After installing of the Element cell in housing the element cell is locked with the locking nut.

#### G. Manufacturing Procedure of Flame Arrester Element

This type of arrester is probably the most widely used. The great majority of such arrester elements are constructed by winding a flat and crimped metal ribbon around a central metal core and then surrounding this structure by a suitable metal frame. First of all the foil of the thickness 0.1 mm is taken of material SS 316. Then the foil is crimped with the help of the foil crimping machine. The foil is feed in the driving gear and supporter gear and the crimped texture on the foil is achieved.



Fig. 8: Crimped Foil



Fig. 9: Crimping Gears

After Crimping of the SS316 foil. The Crimped foil and the flat foil is arranged in alternate ways with the help of machine and it is revolved around the locking nut which helps the element to keep them tight and together. The gear used

for crimping has the pitch of 0.9 mm and the shape made by the gear is isosceles triangle.

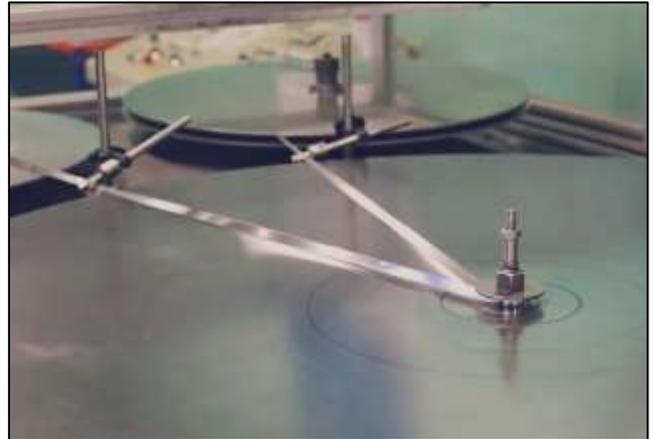


Fig. 10: Making of Element on machine

As shown above crimped and flat foil ribbon are arranged in alternate ways in circular manner. With the help of machine. After arrangement the locking nut is locked after manufacturing of the Element it is fixed in the element housing.



Fig. 11: Fixing of Element in Housing

Many crimped ribbon arrester elements are made either from stainless steel, or cupronickel ribbon there may be objections to the use of aluminium or its alloy, because they have low melting points and are capable of producing incensive sparks when struck with rusty iron. Crimped ribbon arrester have good mechanical strength Home models have reinforcement in the form of metal rode inserted within the element, there may be supported by external steel structures. There are many variants of these methods especially with arresters made for special applications as for instance for marine use, where resistance to corrosion End good mechanical strength are of great importance.

In practice the thickness of flame arresters, sometimes defined sa length of aperture, is not less than 18 mm, and may be up to 75 mm. There is no theoretical upper limit to the arrester diameter. In practice a diameter of approximately 500 mm is the maximum. Rectangular shaped arresters can be very large, but the larger size elements may be subdivided by steel elements to add strength and to confine thermal entrances to seller areas. The dimensions of the aperture are not defined to any standard but a certain range of dimensions in accepted and adhered to in industrial practice for good performance the crimp height must not exceed half of quenching diameter.

Typical crimped ribbon element offer 70-80 per cent of cross sectional area of arrester open for flow, the remainder being taken up by the ribbon. Because of their predictable performance, accuracy of manufacturer and robustness, crimped ribbon arresters have been widely used for many years.



Fig. 12: Flame Arrester Element



Fig. 13: Arrester element and housing

## VI. CONCLUSION

Crimped type Flame Arrester is the widely used type of flame arrester element and it is easily made with the help of above machines and by following above procedures. Typical crimped ribbon element offer 70-80 per cent of cross sectional area of arrester open for flow, the remainder being taken up by the ribbon

## REFERENCE

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