

What are Deadfront and Separable Arresters



Separable Arrester sketch
Courtesy Tyco Electronics



Deadfront Arrester Photo
Courtesy Hubbell Power systems

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Introduction

The Deadfront and Separable arresters are one of the latest types of arresters to be introduced to the surge protection world. It was not until the introduction of the MOV

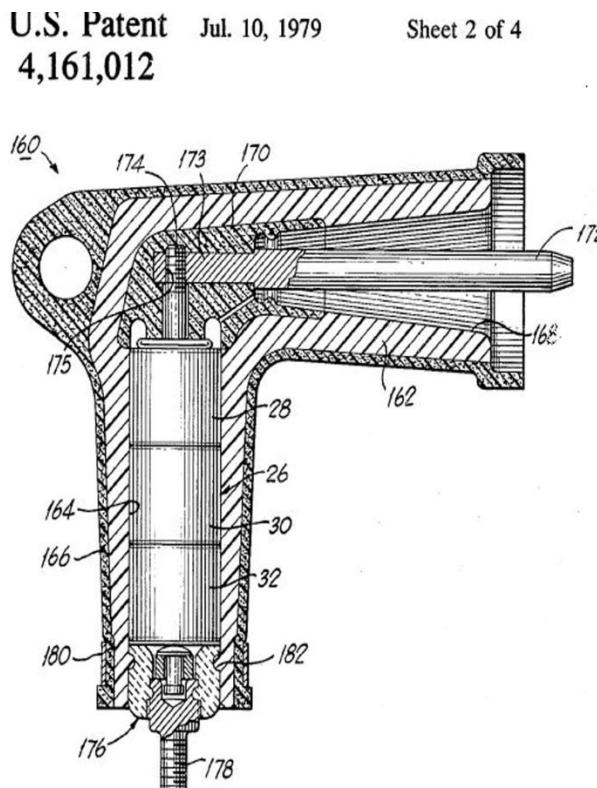


Figure 1 Diagram from 1979 Deadfront Arrester Patent

type arrester that the elbow arrester as it is known today was possible. In 1979 a US patent was issued to Francis Cunningham

and appears to be one of the earliest description of this device.

This ArresterFacts covers the fundamentals of these devices as well as the reasons why they are such important devices in the protection of cable systems. There are several other names for these devices including elbow arresters, parking stand arresters, and bushing arresters in the IEEE market. In the IEC market, the term separable arrester is the only term used to describe this type of arrester. In all cases, they are used to protect cable systems in the medium voltage range 11-42kV systems.

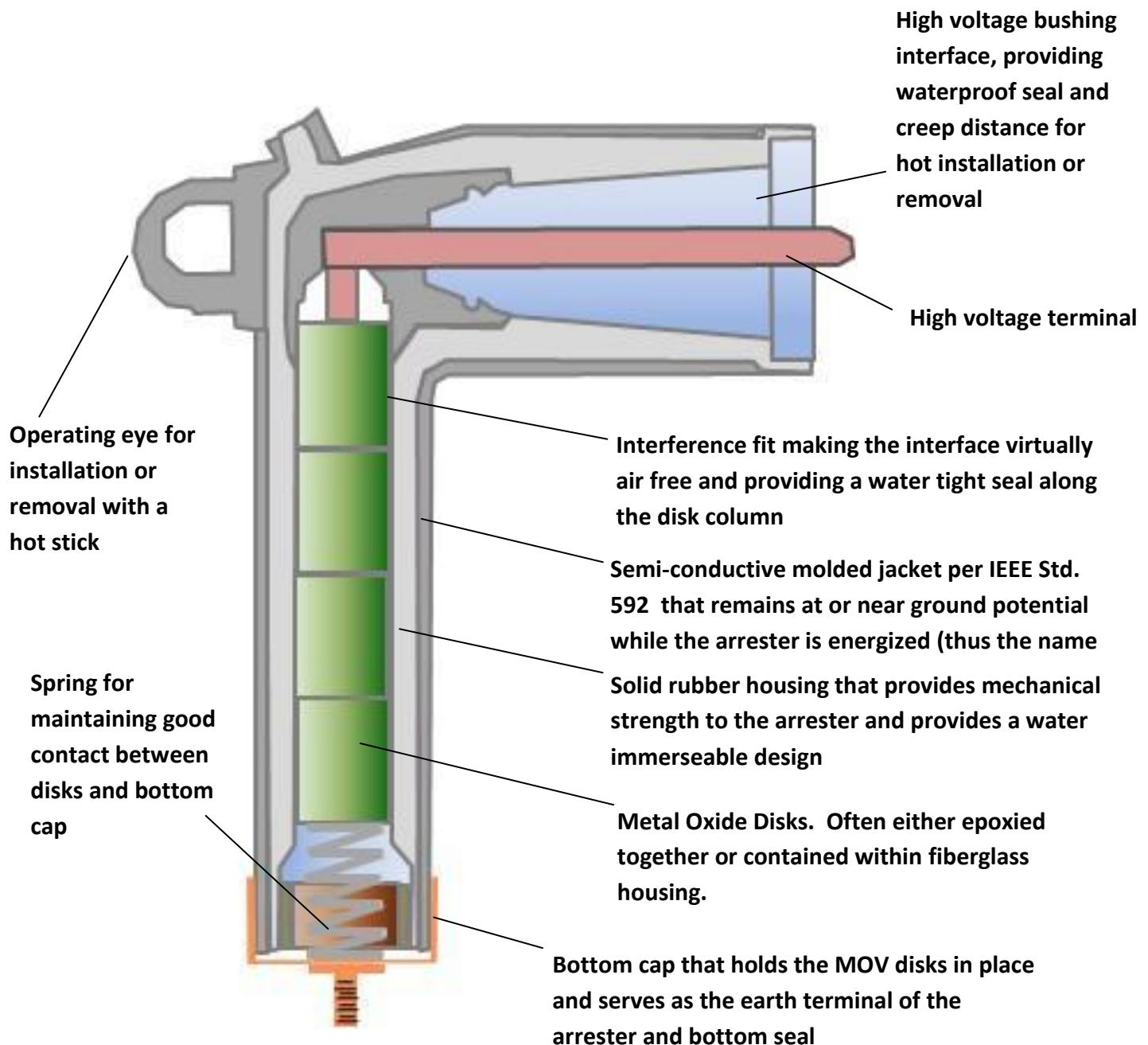
Definitions

Deadfront Arrester: An arrester assembled in a shielded housing providing system insulation and conductive ground shield, intended to be installed in an enclosure for the protection of underground and pad-mounted distribution equipment and circuits. Typically 200A load break versions can be connected or disconnected with the system energized however 200A deadbreak designs do exist (IEEE)

Separable Arrester: An arrester assembled in an insulated or screened housing providing system insulation, intended to be installed in an enclosure for the protection of distribution equipment and systems. Electrical connection may be made by sliding contact or by bolted devices; however, all separable arresters are dead-break arresters. (IEC)

Figure 2 Deadfront Arrester Cutaway

Deadfront Arrester



The Voltage Doubling Effect

The deadfront and separable arrester are special arresters used primarily to mitigate the real and ever present voltage doubling effect at open points on underground circuits.

When a lightning surge hits a riser pole arrester, the arrester clamps the surge, but allows an ongoing surge with the magnitude of the clamping voltage of the riser pole arrester to travel on and into the underground circuit.

Figure 3 shows a circuit that has two underground branches in a distribution underground circuit. Branch 1 has a deadfront arrester at its end point and Branch 2 has no endpoint arrester.

When the ongoing surge from the riser pole arrester meets an endpoint in the underground circuit, it will double in magnitude at that point in the circuit as shown in Figure 4.

When the same surge meets the endpoint in Branch 1 where a deadfront arrester was installed, the voltage is not doubled and is in fact decreased as shown in Figure 5. Even though the riser pole arrester and deadfront arrester are of the same rating, the clamping voltage at the deadfront is much less than at the riser pole because the riser pole arrester conducted nearly the full lightning stroke current as shown in Figure 6 and the deadfront arrester conducted only a few kA.

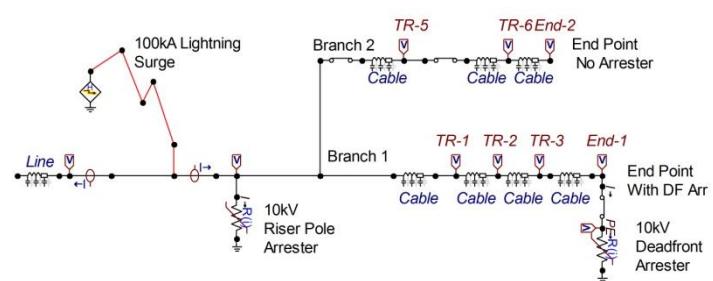


Figure 3 Overhead to Underground Circuit with two Underground Branches

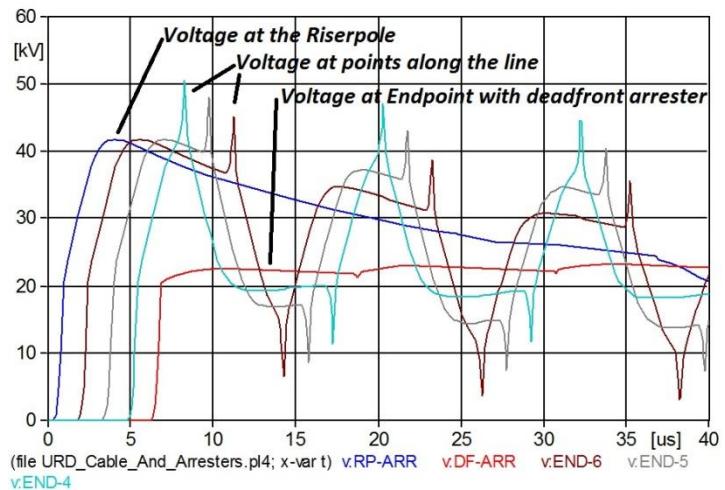


Figure 5 Branch 1 with Deadfront Arrester at End Point

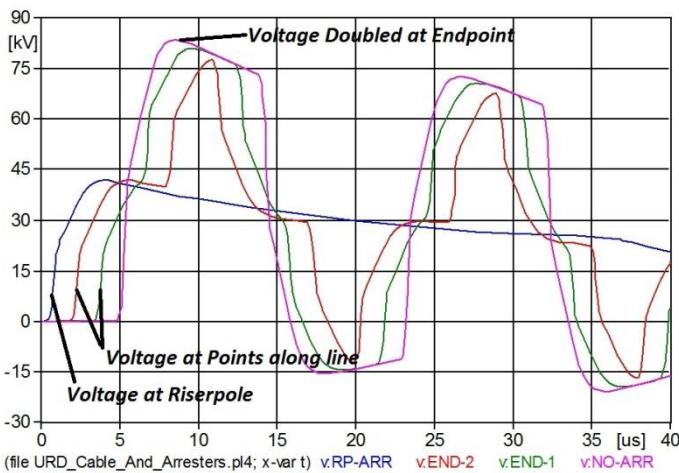


Figure 4 Voltage Along Branch 2 with no Deadfront Arrester

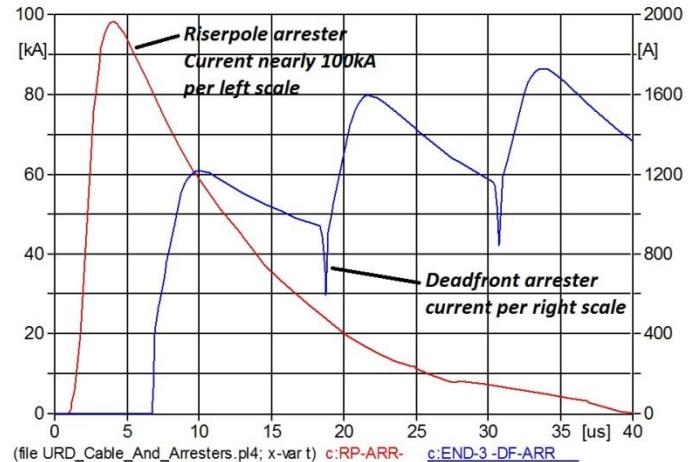


Figure 6 Current through Riser Pole Arrester and Deadfront Arrester

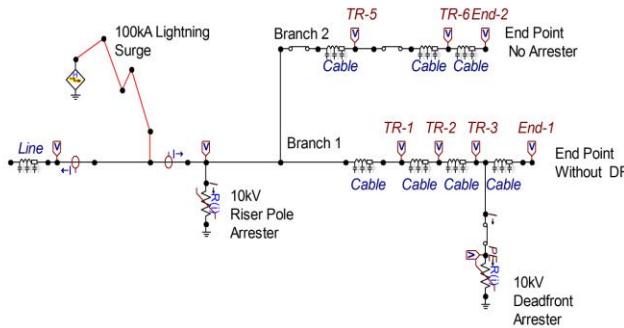


Figure 7 Underground Circuit with Deadfront Arrester one cable span from end point

Deadfront Arrester Not at End Point

In the case where a deadfront arrester is not located at the endpoint as shown in Figure 7 the results are interesting. The end point voltage with no arrester still doubles but is only double the level of the deadfront arrester Figure 8 and not double the level of the riser pole arrester as shown in Figure 4.

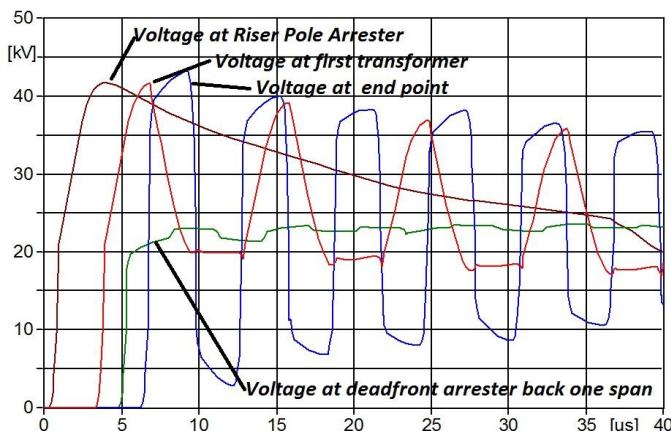


Figure 3 Underground Circuit with Deadfront Arrester one cable span from end point

Deadfront Arrester Rating Considerations

The deadfront and separable arresters are often rated as a 5kA arrester. The IEEE deadfront arrester may also be rated as a light duty arrester which is one energy handling class below the normal duty arrester (5kA arrester).

These lower energy ratings are quite appropriate since underground circuits are universally protected with an arrester at the riser pole and as seen in Figure 4 it conducts a

vast majority of the surge current, leaving only a few kA of current for the deadfront arrester.

A unique arrester characteristic of separable arresters and deadfront arresters is the configuration of the high voltage terminal of the unit. Since the high voltage end must mate intimately with a bushing, the designs are very specific to the available bushings in both the IEEE and IEC markets. In the IEEE market, there are three common interfaces, 15, 25 and 35kV. In the IEC market, several interfaces also exist. Among others, they include the 250A, 400A, and 630A, all are deadbreak

This type of arrester is also configured in several formats depending on how it must be installed



Figure 9 Underground Circuit with Deadfront Arrester one cable span from end point

in the circuit. For example the parking stand style is a design that is mounted in a bracket known as a parking stand of a pad mounted transformer (see center arrester of Figure 9). An incoming line can then easily be terminated directly into the arrester thus avoiding an open endpoint. Other variations include inline arresters where the incoming line feeds through the arrester and then into the transformer. In all cases, the arresters perform identically.

Failure Mode Considerations

The failure mode of this arrester is tested differently than all other arrester types. For this arrester, it is acceptable for the arrester to eject disks out the bottom of the unit but not out the side during a failure event. This is only acceptable because the arrester is generally installed in enclosed areas where ejection of parts would not be a safety issue as it would be for an overhead arrester. The fault currents used for testing is also much lower since it is uncommon for very high fault currents to be available in underground distribution circuits.

Installation Considerations

As with all arresters it is important for the ground lead of the arrester to be as short as possible. It should also be attached in such a way that it is not stressing the arrester and the arrester is allowed to operate normally.

Relevant Test Standards and Application Guides

The three IEEE standards that apply to this arrester are C62.11, IEEE 592 and IEEE 386 describe all the necessary tests that are required for certifications. Application Guides C62.22 and C62.22.1 are the appropriate application guides.

The IEC documents of relevance are 60099-4 and CENELEC 629.1 S1 for testing and 60099-5 for applications.

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