INTERVAL OF DISCHARGE CLS

VOLTAGE LIMITER FOR SAFETY EQUIPMENT

In all cases when a dangerous potential difference may appear between one part of the circuit and earth or between two points in a circuit, it is necessary to install protection against the sometimes considerable dangers which may result from this, both to equipments and persons. The CLS interval of discharge, which is, in fact, an arc transfer voltage limiter, is perfectly suitable for this type of protection because its entirely static operation provides a rapid communication between two circuits on the case of temporary increase of potential of one compared with the other. On pages 2 and 3 may be found the various principal cases for the use of our equipment, initially designed for the French railways where it has had long use in normal service and now supplies many foreign systems.

PRINCIPAL USES OF THE CLS INTERVAL OF DISCHARGE

CONNECTION TO RAIL OF METAL MASSES

The metal supports (station framework, bridges, etc.) of catenaries of electrical traction lines may be taken to a dangerous voltage by rupture or flash over from an insulator and very serious accidents to personnel may result.
In order to eliminate this danger, it is sufficient to provide a connection between metalwork and the return rail by an interval of discharge which sets up and maintains the potential of the metal masses approximately 50 volts in relation to the rail. If the fault current passing through the CLS is sufficient to cut out the substation, the officials are alerted and seek the fault.
If the fault current is insufficient, the interval of discharge becomes short circuited and provides protection up to the moment when the officials ascertain its existence.

PROTECTION OF TRACK CIRCUITS

Insulated stretches of the rail used to operate the relays of track circuits at the time of the passage of trains run the risk of being taken to a dangerous potential if they come into contact with a wire under tension which has fallen owing to breaking. If by chance a worker is working in one of the stretches, the may be exposed to a dangerous voltage and furthermore the track circuit equipment may be damaged.
This is why one or more intervals of discharge are installed between the insulated rail and the conductor rail, so as to maintain insulation between them, and also to cause a short circuit as soon as the potential difference between the two becomes dangerous.

EARTHING OF RETURN FEEDER IN 25kV SINGLE PHASE

It happens, in single phase 25kV traction installations, that the returns feeder from the station feeding the rail has a considerable length (of the order of a kilometer). As the impedance per kilometer of the return feeder is ranging about 4.4 ohms, the voltage which may exist between feeder and earth may be about one thousand volts. In the event of the breaking of the return feeder, a voltage of 25kV may appear at a substation between the feeder and earth. It is therefore necessary for the interval of discharge to be able to support permanently a voltage ranging about 1000 volts and to flash-over for a voltage about 1500 volts.

As the manufacture of interval of discharge resistors having this characteristic is not industrially possible, we have produced a special type of interval of discharge IRD in which the priming resistor – is in series with an air gap. As soon as the voltage applied exceeds the priming voltage of the spark gap, the latter the passage of direct current causes the resistor to be by-passed and the arc strikes between the electrodes thus ensuring protection.

The characteristics of the equipment type IRD are adapted according to the length of the return feeder, its kilometric impedance and the maximum permanent current flow.

EARTHING OF THE NEGATIVE OF SUBSTATIONS

In sub-stations with direct current traction, the negative is insulated from the ground so as to reduce the effects of corrosion caused by ground return current.
This results in variations in potential between negative (rail) and earth.
Protection against this risk is provided by placing a CLS interval of discharge between negative and earth: it maintains the insulation of the negative whilst the difference of potential is some tens of volts (normal voltage drop in railway lines) and ensures the rail-earth connection as soon as the voltage becomes dangerous.

PROTECTION OF BATTERY-FED CONTROL CIRCUITS ON LOCOMOTIVES

In order to prevent the risks which would result from accidental connection between the auxiliary control circuits and the traction current, an interval of discharges is used between the negative of the battery and earth.

PROTECTION OF CATHODIC INSTALLATIONS OF PIPELINES NEAR TO A TRACTION LINE

Pipelines along electrified rail tracks frequently play the part of return conductor in parallel with the rail. However owing to the nature and relief of the land crossed the respective potentials of the pipeline and rail assume very variable values. This results in electrolysis phenomena with very serious consequences to proper maintenance and safety in functioning of the pipelines. The undertakings operating pipeline transport have provided, at intervals, posts for cathodic protection of pipelines by arranging to fix their potential in relation to that of the next rail by means of a polarized bleed device.
However, one danger subsists: if the rail potential is taken to a high value as the result of a fault or breakdown of insulation in the catenary, for example, the bleed point runs the risk of being seriously damaged and the protection of the pipeline is eliminated.

This drawback is very easity remedied by placing a CLS interval of discharge between the cathodic rail-post connection and earth. When the rail potential becomes too high in relation to that of the earth the interval of discharge sparksover and the short circuit current melts the 20A fuse placed at the intake to the rail side of the post. The whole of the installation is therefore insulated from rail and protected during the time necessary to clear the fault.

PROTECTION OF SILICON RECTIFIERS AGAINST OVERVOLTAGES

In view of the lack of capacity of silicon rectifier cells to withstand overvoltages and the material impossibility of making arresters capable of having a sufficiently weak residual voltage whilst correctly switching out, it is preferable; upon the appearance of an overvoltage, to short circuit the rectifier cells by an interval of discharge which results in the operation of the feed circuit-feeder.

For this application we have manufactured a special interval of discharge. In this equipment, a principal spark gap consisting of two circular electrodes is mounted on two blades enabling it to be placed between the terminals of the installation to be protected. Inside the principal spark gap is placed a semi-conductor carbosial priming resistor mounted in series with a spark gap (gas or air according to the flashover voltage required).

The flashover of the spark gap involves the by-passing of the resistor the arc of which is transferred between the electrodes.
The functioning of this equipment is very rapid: the operation of the spark gap requires several microseconds and that of the transfer resistor is ranging about 10 seconds. The transfer of arc to the electrodes is effected in approximately one thousandth of a second.

PROTECTION OF CABLE SHEATHING

The fault current to earth on very high voltage transport systems in the case of earthing of the sheaths of high tension cables normally insulated from the ground in order to avoid losses in the sheaths, may attain very high values, for example, ten thousand A X 0,5s. in order to withstand these currents and to avoid overfrequent short-circuiting our special interval of discharge with circular blowout is preferable.

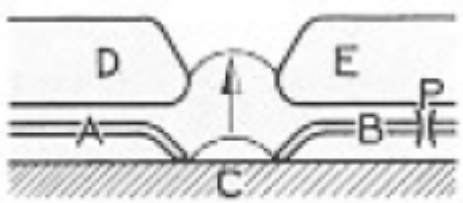
It is made up in the same manner as our normal intervals of discharge with regards to the priming device at very low voltage by carbosial resistor.
The arc once started, is transferred to the massive bronze electrodes with a gap between them which increases from the center towards the periphery. A blowout coil through which the discharge counter flows produces a magnetic field, the lines of force of which are parallel to the generators of conical electrodes, whereas the arc is perpendicular to them.
The arc is therefore blown in a circular manner and travels at high speed across the surface of the electrodes following a movement in the form of a spiral. It follows that the arc of the metal and the short circuiting of the electrodes.

This equipment has a flashover voltage between 200 V and 350 V and a discharge current of 10kA x 0,5s.

PRINCIPLE AND WORKING

The interval of discharge is based on the following principle: when two priming electrodes A and B in imperfect contact with a semi-conducting resistor – C with non-linear characteristics (such as carbosial) and when there is only a weak potential difference between electrodes A and B a slight leakage current flows through resistor C. When the potential difference becomes high the leakage current increases considerably owing to the non-linear characteristic of the resistor, the ionization at the contact points of the priming electrodes becomes intense and an arc strikes away from the resistor if the particular characteristics of conduction of the surface of the latter are properly chosen.

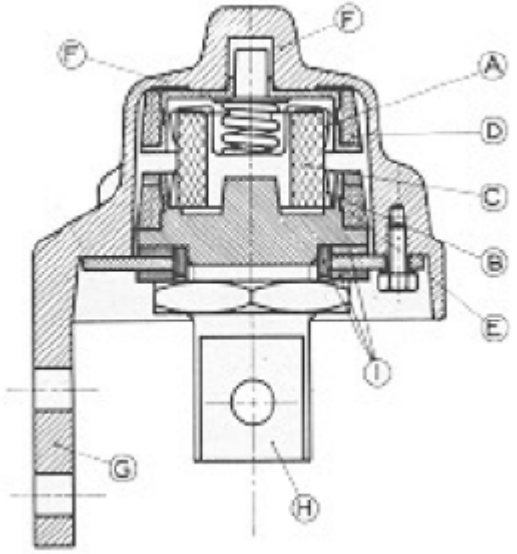
It is thus possible to strike an arc under a much lower voltage than in a spark gap. The time for the establishment of this arc is in a very rapidly decreasing proportion to the voltage applied. The arc, acting under electronic and electromagnetic repulsion, is transferred to the two massive metal electrodes D and E spaced from each other a sufficient distance so that the beads produced by the arc cannot cause them to short circuit rapidly.



DESCRIPTION AND SPECIFICATIONS

In accordance with the principle described on page 1, the interval of discharge comprises two priming electrodes A and B in contact with a semiconducting resistor of carbosial C, and two transfer electrodes D and E which surround them. The electrode D is integral with the protection housing F which carried a fixing lug G serving as a connecting terminal. The other electrode E is integral with the other terminal H insulated from the housing by insulating shims I.

The transfer electrodes D and E consist partly of a good conductor and not very fusible metal and partly of a fusible alloy, such manufacture permitting the discharge of an overvoltage of very short duration without beads from melting, or an overvoltage of long duration without risk of destruction, with the melting of the fusable alloy by thermal effect placing, in this second case, the equipment permanently in short circuit.
The characteristics of the equipment used for direct current traction installations appear in the table on the right hand of this page.



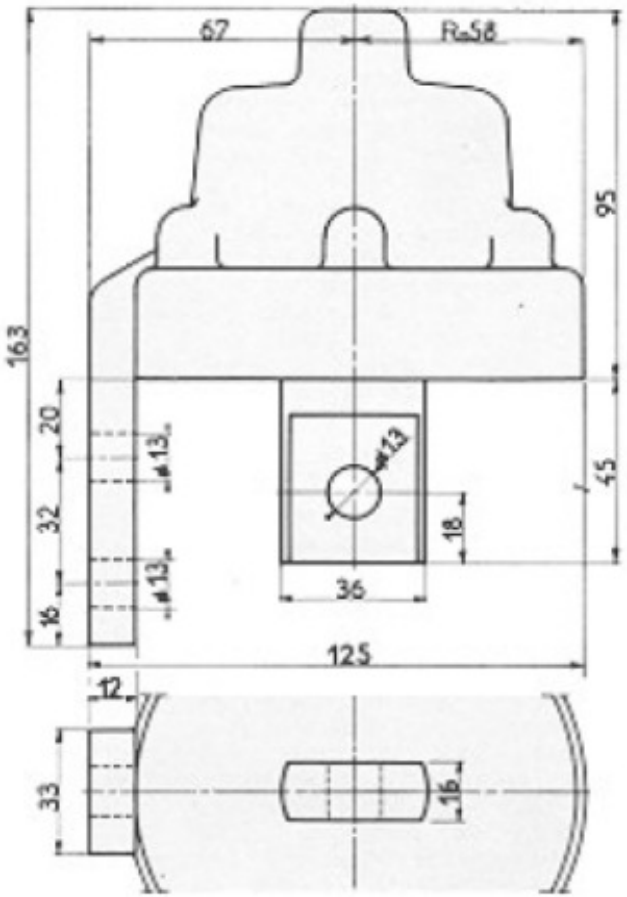
ELECTRICAL CHARACTERISTICS of type CLS Low Voltage Limiters

CLS type	1 RAY	1 RBY	1 RBCC	1 RCY	2 RAY	2 RBY	2 REY	SC
Working voltage	75 V AC	150 V AC	150 V DC	50 V DC	50 V DC	150 V DC	75 V AC	50 V AC
Withstand voltage	150 V AC	300 V AC	400 V DC	150 V DC	150 V DC	300 V DC	150 V AC	150 V AC
Maximum sparkover voltage	220 V AC	400 V AC	550 V DC	250 V DC	250 V DC	400 V DC	220 V AC	300 V AC
Maximum leakage current under working voltage (mA)	50	50	50	50	50	50	50	50
Short duration flow capability (A / s)	3 500 / 0,2	3 500 / 0,2	3 500 / ---	3 500 / 0,3	8 000 / 0,3	8 000 / 0,3	8 000 / ---	10 000 / 0,5
Continuous flow capability (A / 30 min)	1 000	1 000	1 000	1 000	4 000	4 000	4 000	---

AC applications DC applications

OVERALL MEASUREMENTS

CLS 1RAY
1RBY
1RCY



CLS 2RAY
CLS 2RBY