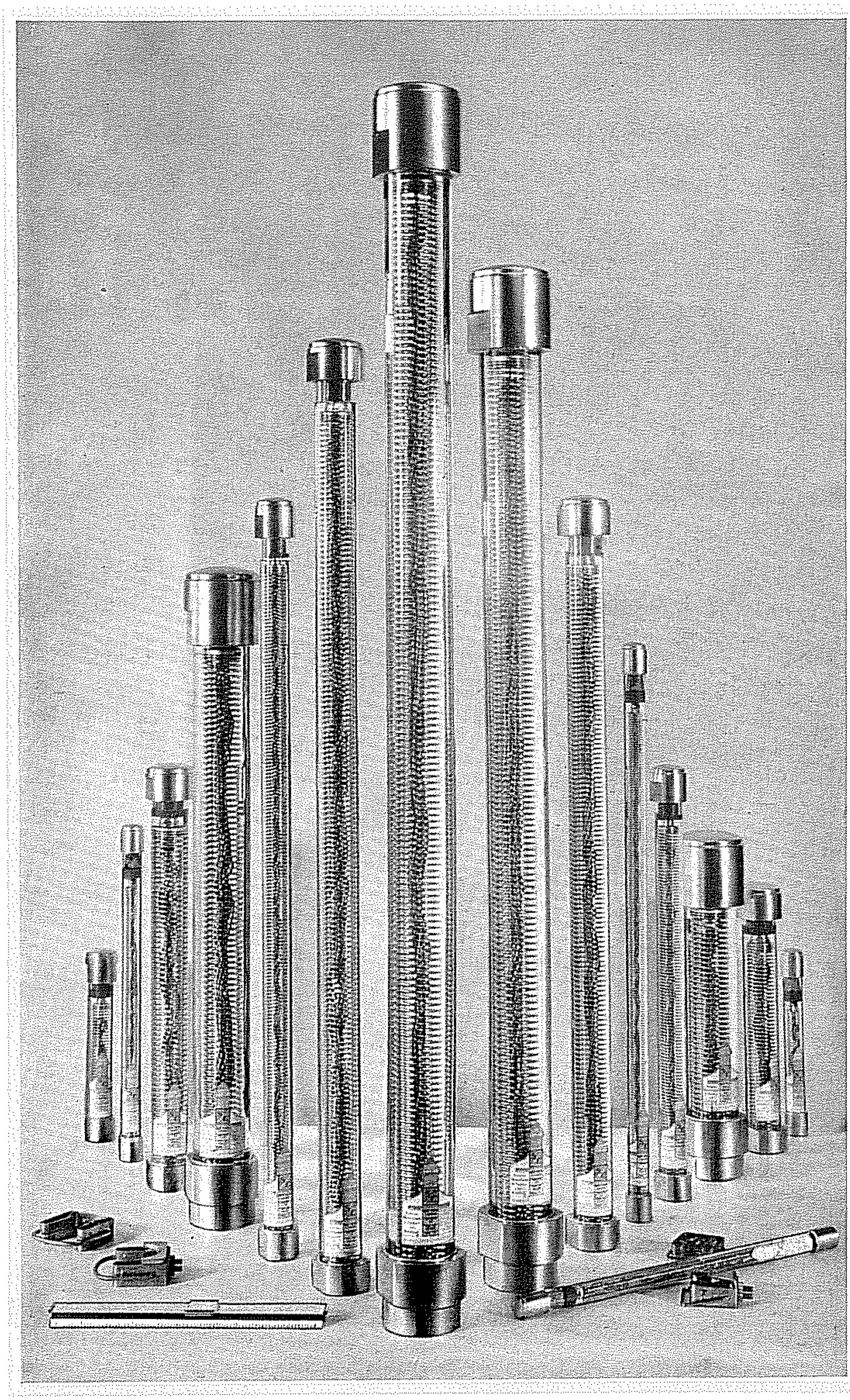
The S & C HIGH POTENTIAL FUSE

TRADE MARK REG. U. S. PAT. OFF.

SCHWEITZER & CONRAD, INC.

4435 Ravenswood Avenue Chicago, Illinois, U. S. A.

BULLETIN 200-B



The S&C Fuse

2,200
to
138,000
Volts

½ to 400
Amperes

Trade Name and Patents

Although it is occasionally referred to and described in the trade as "Carbon Tetrachloride," "Tetrachloride," "Pyrene," "Liquid," and "Chemical" Fuse, *the correct trade name is "S&C Fuse."*

The manufacture, sale and use are controlled by United States and Foreign Patents, granted and pending. In the United States of America, the S&C Fuse is manufactured only by Schweitzer & Conrad, Inc., Chicago.

The S&C Fuse

BULLETIN 201-E

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The S&C Fuse

And Its Relation to Electric Power Systems

Electric Power Systems

The extension and inter-connection of electric power systems has contributed largely to national prosperity, by making available an economical source of energy for power, lighting, and heating purposes in practically all communities.

These inter-connections have effected considerable savings in generation and distribution costs through the advantages obtained from a diversity of loads, and by making possible the construction of large and efficient generating stations at locations where electric production costs are a minimum.

A Problem in Transmission and Distribution of Power

Continuity of service on transmission and distribution systems is, however, difficult to maintain, because the failure of a transformer causes a service interruption of the primary circuit to which it is connected, unless means are provided for the rapid and effective isolation of the defective transformer.

A transformer failure may result from an overload, short circuit, or abnormal voltage. The rapid and effective isolation of a defective transformer requires the application of protective equipment which will successfully interrupt abnormal current of values ranging from the minimum required to operate the protective device to the maximum short circuit current.

The Isolation of Defective Equipment

The automatic isolation of defective equipment is accomplished by either oil circuit breakers or fuses. Oil circuit breakers, on account of their high initial and maintenance costs, and the installation space requirements, are in numerous cases not justified. For this reason fuses, and particularly S&C Fuses, have found an ever increasing field of usefulness.

High Voltage Arcs

Interrupting a high voltage circuit under load is certain to be accompanied by an arc which must be disposed of in some manner before it reaches destructive proportions.

A brief consideration of the characteristics of a high voltage arc will show the fundamental features which high voltage circuit interrupting equipment must possess in order to clear the circuit during both overload and short circuit conditions.

Fig. 1 shows in graphic form the relation existing between the line voltage, the current, and the arc voltage, during the opening but before the final clearing of a high voltage *non-inductive* circuit.

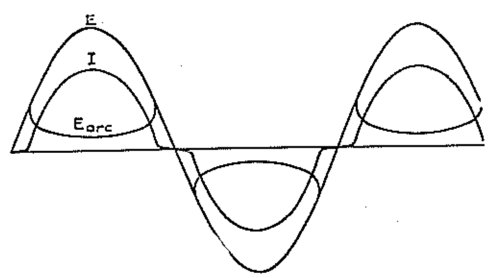


Fig. 1—Non-Inductive Circuit. E-Line Voltage; I-Current; E_{arc}-Arc Voltage

Immediately upon the opening of the circuit, a voltage appears across the gaseous gap (*i. e.* the arc voltage) which is in phase with the current. During the latter portion of each half cycle the arc becomes unstable and its resistance increases rapidly, causing the current to diminish to zero a small interval of time before the line voltage becomes zero. The arc is re-established during the following one-half cycle, as shown in Fig. 1, unless a gap has been established having a flash-over value greater than the highest instantaneous value of the line voltage.

The S&C Fuse

And the Requirements for Interrupting High Voltage Circuits

Fig. 2 shows in graphic form the relation existing between the line voltage, the current, and the arc voltage during the opening, but before the final clearing, of a high voltage

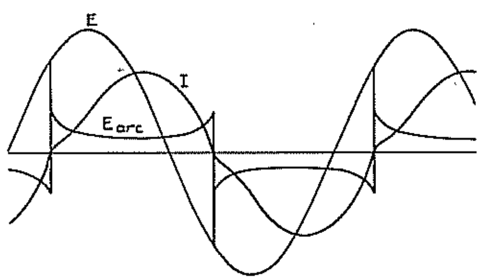


Fig. 2—Inductive Circuit—60° displacement between current and voltage. E-Line Voltage; I-Current; E_{arc}-Arc Voltage

inductive circuit. This graph shows that there is always a voltage available for the instantaneous re-establishment of the arc at the instant the current is zero. The voltage which causes the re-establishment of the arc increases with the inductance in the circuit, and becomes a maximum when a 90° phase displacement exists between the line voltage and the current. *Inductance, therefore, greatly increases the difficulty of interrupting the circuit.*

Fundamental Requirements for the Interruption of a High Voltage Circuit

From Figures 1 and 2 it is evident that a fundamental requirement for the successful interruption of a high voltage circuit is the introduction of a gap, the dielectric strength of which increases at a sufficient rate, following current zero, to prevent the recovery voltage from re-establishing the arc. It will also be apparent that such a gap must be established in a minimum of time to prevent destruction of the circuit-interrupting equipment due to the thermal effect of the arc.

An arc in reality is a conductor, which automatically adjusts its cross section so as to maintain a constant current density. An arc may develop considerable physical proportions during a short circuit, and this necessitates some reliable means for rapidly extinguishing the arc. Immediately following the interruption of a short circuit in modern systems, the system voltage often reaches several times its normal value due to the sudden release of the stored energy of the system, which phenomenon increases the chances for the failure of the circuit-interrupting equipment.

Methods Employed for Interrupting High Voltage Circuits

Several methods for interrupting high voltage circuits have been applied by manufacturers. In expulsion fuses, for instance, sufficient vaporization of the fuse element and fuse tube liner must take place to expel conducting vapors and metals from the fuse tube. Others place the fuse element in a tube filled with powdered or granular materials and depend upon this material to absorb the vaporized fuse metal, and to extinguish the arc. In the case of an oil circuit breaker or an S&C Fuse, the gap is formed in the circuit by positive mechanical means, and the arc is extinguished by a liquid dielectric.

The S&C Fuse

And the Fundamentals of High Voltage Fuse Design

Requirements for a Successful Fuse

During failure of equipment, the current may vary from over-current to short circuit of considerable magnitude. Also the phase relationship between the current and voltage, the point on the voltage wave at which the short circuit occurs during equipment failure, will be subject to wide variations. When these facts are considered together with the conditions outlined in foregoing paragraphs, it will be apparent that the fundamental requirements of a high voltage fuse are:

(1) The fuse element should be of minimum section and length so as to reduce the quantity of ionized metal vapor to a minimum.

(2) The fuse assembly must incorporate a positive means of lengthening and extinguishing the arc in the fuse tube, setting up a gap having a flashover voltage greater than the maximum transient value of the line voltage.

(3) The fuse assembly must be self vented to prevent destructive pressures during short circuits.

Principles of the S & C Fuse

An examination of the illustration on the opposite page will show that the following features which are so necessary for the interruption of high voltage circuits, have been incorporated in the design of the S&C Fuse.

(1) The fuse element is proportioned and assembled in a manner resulting in uniform time current characteristics and also in a minimum of ionized vapor when the fuse is blown.

(2) A vent cap is provided for releasing the pressure when the fuse is blown during short circuit. The entire assembly is enclosed in a heat resisting glass tube which will withstand a hydraulic test pressure in the nature of 1000 lbs. per square inch.

(3) A positive gap is introduced into the circuit by the rapid retraction of the moving arcing terminal through a liquid of high dielectric strength, this gap being formed by the action of the fuse spring, regardless of whether the fuse element is blown during overload or short circuit conditions.

(4) The fuse element is shielded by the brass ferrule, completely protecting it from corona, which makes possible the manufacture of successful fuses for 2.2 Kv. to 138 Kv. having an ampere rating as low as one-half ampere.

Compared With an Oil Circuit Breaker

The operation of an S&C Fuse immediately following the melting of the fuse element is similar to the operation of an oil circuit breaker, but in addition the former has the following advantages:

(1) The arc is quenched in a non-inflammable liquid of high dielectric strength. The vapors of this liquid will not support combustion.

(2) The moving arcing terminal of an S&C Fuse possesses practically no inertia, and as a result of the speed of the terminal the fuse clears short circuits in ½ to 2 cycles after the fuse element has melted, whereas, an oil circuit breaker will require from 8 to 60 cycles to clear the circuit, after the trip coil has been energized.

(3) When an S&C Fuse is blown under short circuit, the replacing of the fuse completes the necessary maintenance, whereas, under similar conditions an oil circuit breaker would require inspection of contacts, and filtering and drying of oil to restore it to its original condition; thus resulting in a maintenance expense many times greater than the refill cost of a set of S&C Fuses.

How the S&C Fuse Operates

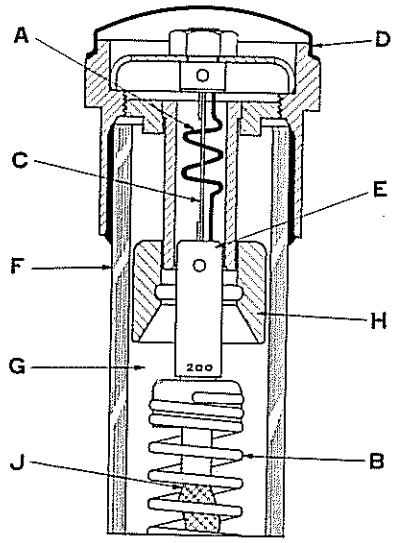


Fig. 3

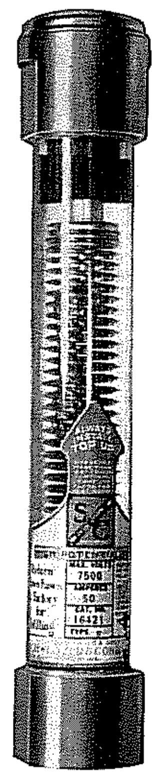


Fig. 4

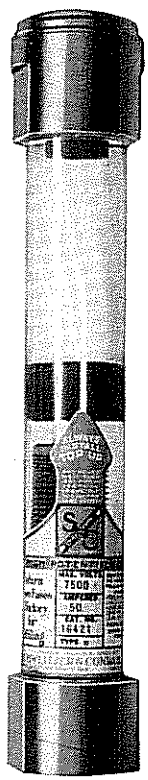


Fig. 4A

Normal S&C Fuse—and after blowing

The Principal Parts

A typical S&C Type D Fuse as shown, in three views at the left, consists essentially of:

A—Fuse Element—designed to melt at definite current values.

B—Coil Spring—normally extended.

C—Strain Wire of high resistance and high tensile strength — holding the coil spring extended.

D—Vent Cap—for relieving excessive pressure.

E—Moving Terminals—acts as arcing terminal when the fuse blows.

F—Heavy heat resisting Glass Tube—sealed into brass ferrules.

G—Arc-extinguishing Liquid—filling glass tube.

H—Funnel-Shaped Liquid Director or Nozzle—attached to arcing terminal.

J—Flexible Copper Cable—for carrying the current and thus preventing heating of the spring.

Fuse Operation

In a circuit protected by the S&C Fuse, when the current reaches a certain predetermined value, the fuse element (A) melts, shunting the load current to the strain wire (C) and this wire, being of small current carrying capacity, instantly melts and allows the coil spring (B) to contract.

The contracting of the fuse spring, accelerated by the volatilization of the fuse element during heavy short circuits, forces a stream of liquid into the confined arcing zone where it is rapidly volatilized, developing pressures which force the vapor through the arc stream. This action results in the rapid de-ionization, or in other words, the quick recovery of the dielectric strength of the space occupied by the arc as the current approaches zero. This process is very rapid, and complete extinction of the arc is accomplished in ½ to 2 cycles.

In most cases the fuse simply functions in the manner described above. In cases of severe operation, such as short circuit on a system of large capacity, the pressure in the fuse tube is released through the safety vent cap (D) provided for that purpose.

Two Types of Construction of the S&C Fuse

Two types of fuse construction, designated as "B" and "D" are manufactured to cover the range of 2,200 to 138,000 volts and ½ to 400 amperes, as listed on pages 14 and 15.

Fuses of type B construction are supplied in the lower current ratings and up to 69,000 volts. Fuses of the type D construction have extra high interrupting capacity and are always supplied in the higher current ratings up to 69,000 volts and all current ratings at higher voltages. Type D Fuses are available also for lower current ratings at the lower voltages in order to provide the extra high interrupting capacity sometimes desirable for those ratings. (See table of interrupting capacities, page 12-A.)

Type B Fuse Construction

The drawing at the right shows the Type B construction of the S&C Fuse. In this type, the fuse element is enclosed in an arc barrier of insulating material.

Type B Fuse Clips

In the Type B construction the ferrules of the fuse are cylindrical and the Type B Clips have a corresponding circular form where they grip the ferrules. A Type B Clip is illustrated at the right. It is to be noted that the fuse is held under spring pressure from the clip, and this is augmented by pressure from the retaining bale which exerts a squeezing effect upon the clip as the bale is swung into place over, and locked by, a projecting boss.

Not only do the S&C Fuse Clips provide ample contact, but in addition they hold the fuse with more than usual firmness. As a result, the contact surfaces are not easily corroded and the fuse will not be thrown out of the clips when it is subjected to the powerful magnetic forces resulting from a short circuit.

The S&C Fuse Clips just described are always included on fuse mountings regularly supplied by Schweitzer & Conrad, Inc. When fuse mountings are purchased elsewhere, the genuine S&C Fuse Clips should be specified for use with S&C Fuses.

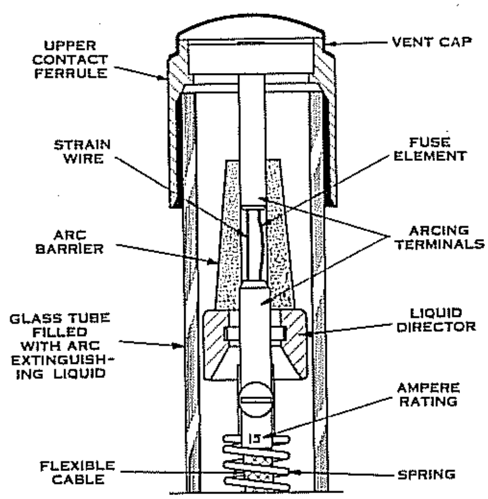
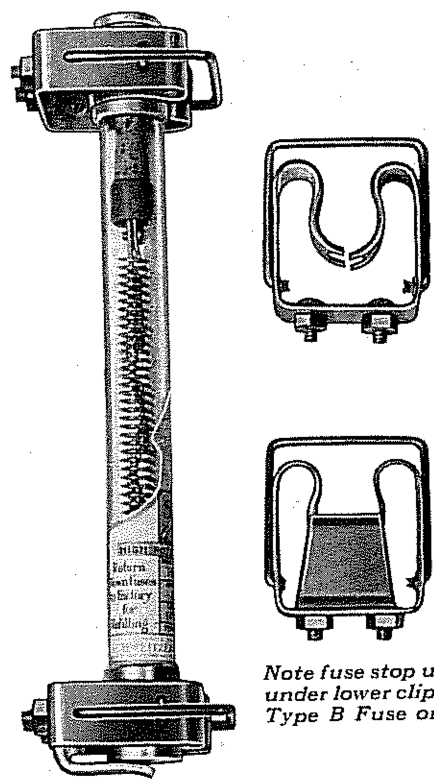


Fig. 5—Upper Portion of Type B S & C Fuse showing principal parts.



Note fuse stop used under lower clip for Type B Fuse only.

Fig. 6—Type B, S & C Fuse as supported in clips. Also bottom view of clips separately.

Two Types of Construction of the S&C Fuse—Cont'd.

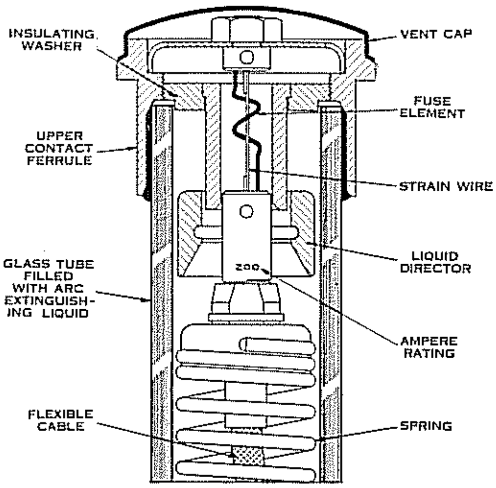


Fig. 7—Upper Portion of Type D, S&C Fuse Showing Principal Parts

Note extra support used under upper clip for Type D Fuse only

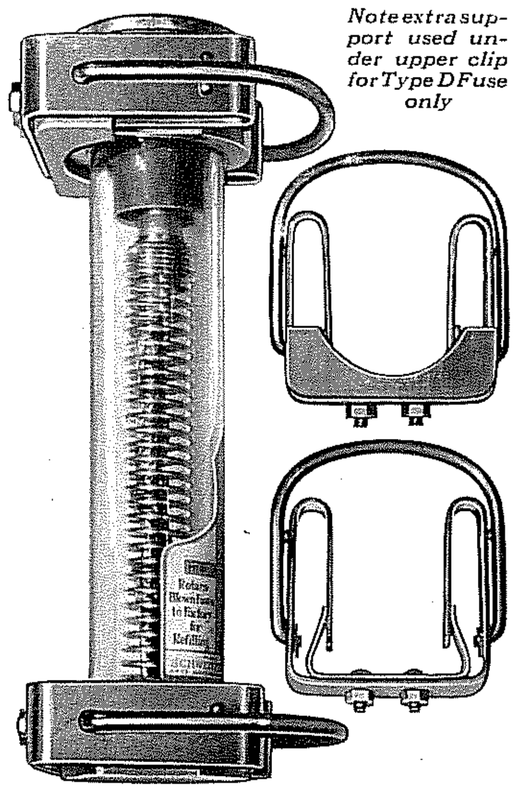


Fig. 8—Type D, S&C Fuse as Supported in Clips. Also Bottom View of Clips Separately

Type D Construction

In the Type D Construction, the fuse element is placed in a separate "explosion chamber" at the upper end of the fuse and above the level of the liquid.

When a Type D Fuse is blown during overload or short circuit, the pressure resulting from vaporization of the Fuse Element is confined to the chamber above the Arcing Terminal and below the Vent Cap. The result is that during short circuit the vent cap blows off before excessive pressures develop in the glass tube.

Type D Fuse Clips

In the Type D Fuse Construction the ferrules have flat contact surfaces. The ferrules of the Type D Fuse are larger than the Type B and the flat contact surfaces allow easy insertion and removal of the fuse regardless of the heavy pressure from the double spring action of the clips.

Like the Type B Clips described on the opposite page, the Type D Clips hold the fuse firmly under all conditions by means of the retaining baits and provide contact which is not likely to be impaired by corrosion. For that reason users of the S & C Fuse should specify the genuine S & C Fuse Clips if mountings are ordered from other manufacturers.

Type DLC (Low Current) Fuse

The Type DLC is a variation of the Type D Construction in which a very low current rating is combined with high interrupting capacity. This assembly consists of an ingenious combination of levers and fuse element arranged so that only a small fraction of the tension of the heavy spring is transmitted to the small fuse element.

The application of this assembly makes possible a current rating as low as ½ ampere, with an over-all mechanical strength equal to that of S&C fuses of the higher ampere ratings. This fuse element is sufficiently large to withstand the initial rush of current occurring during the energizing of the transformer, will carry the load current continuously, and will be blown by the current which flows through the primary winding of a standard potential transformer during a short circuit at or near the secondary terminals.

The S&C Fuse

Has Seven Important Advantages

1. Reliable Time-Current Characteristics

The time-current characteristics of the S&C Fuse are reliable because each fuse is made the same as every other one of its kind by precision methods which bring about strict uniformity.

2. Dependable Operation

Its current-interrupting ability at low or high short-circuit currents is the result of good design. Its dependability is the result of meticulous care in manufacturing, wherein each fuse is given seven different tests during the process.

3. Rapid Clearing Time

The clearing time of the S&C Fuse is equally rapid whether the fuse element is blown on overload or short circuit.

4. Does Not Hazard Adjacent Equipment

There is no expulsion of long pieces of conducting materials such as the unvaporized portion of the fuse element or cable.

5. Venting Is Upward

When an S&C Fuse is blown during short circuit the internal pressure is relieved at the top which means that it is in a direction away from an operator.

6. Factory Refill Restores Original Interrupting Capacity

The fact that an S&C Fuse must be refilled at the factory with special equipment results in the assurance that a subsequent operation of a fuse will not be hampered by an injury which might have occurred in a previous operation and go unnoticed by the repairman. (See also next column.)

7. Blown Fuse Distinguishable at a Distance

The S&C Fuse when blown is distinguishable at a distance (see Fig. 10.) This saves both time and expense.

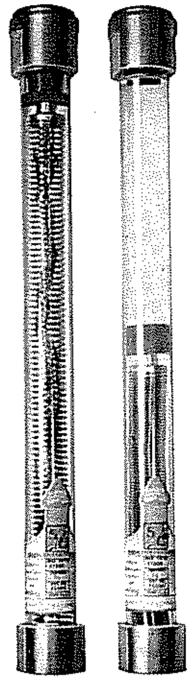


Fig. 9 *Fig. 10*

Liquid Will Not Freeze

The liquid used in the S&C Fuse will not freeze in any climate in which it might be used.

Return Blown Fuses to the Factory for Refilling

Blown fuses returned to the factory for refilling are first disassembled; all obsolete or damaged parts are discarded and the remaining parts which meet the mechanical and electrical requirements are thoroughly cleaned. The fuses are then re-assembled, just as new fuses are assembled, and the latest improvements are always incorporated. Thus when S&C Fuses are refilled they are made the same as new fuses of the current design.

This refilling, which is actually reconstructing, therefore, wipes out all depreciation or obsolescence which might be charged against fuses regardless of when they were originally purchased.

Although extreme care and special processes requiring special equipment are necessary to do the work properly, the cost of refilling is not high. When it is understood that the refill charge covers complete rejuvenation of the fuses, and therefore disposes of depreciation and obsolescence, the charge is found to be remarkably low.

The S&C Fuse

Special Field Tests Have Shown Definitely Satisfactory Results

For a number of years S&C Fuses have been applied by electric service companies in installations connected to their distribution and transmission systems where very high grade circuit-interrupting equipment is required. This extended service experience has developed a well earned reputation for the S&C Fuse as being capable and dependable under severe operating conditions.

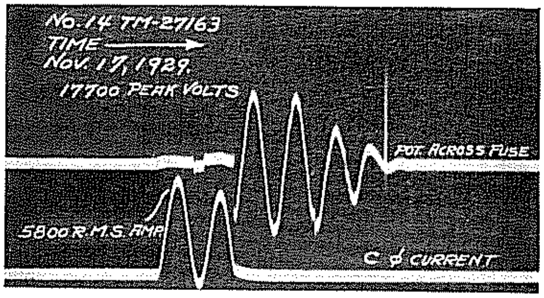


Fig. 11—S&C, 25 kv., 1 ampere, Size 3, Fuse clearing 5800 rms amperes

Numerous tests were made to determine the performance of new designs before placing them on the market. Also many tests have been made by power companies to verify the interrupting capacity. Such tests have been made under a variety of conditions and have shown the ability of this fuse to

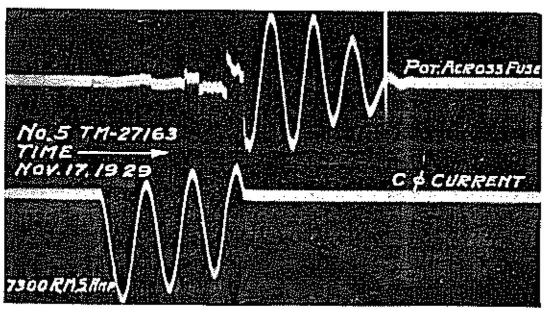


Fig. 12—S&C, 25 kv., 400 ampere, Size 5, Fuse clearing 7300 rms amperes

interrupt currents, from the smallest amount necessary to melt the fuse element, to enormous short circuits, with a certainty and rapidity not always attributed to this class of equipment.

The oscillogram records shown here were made during tests on large metropolitan systems. They are typical of the records of

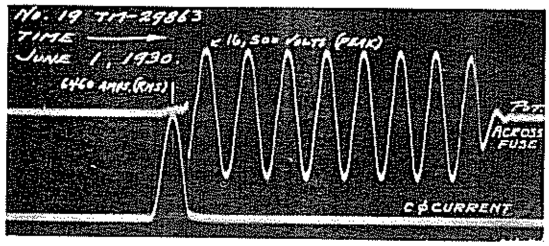


Fig. 13—S&C, 25 kv., 100 ampere, Size 4, Fuse clearing 6460 rms amperes

a large number of tests at each of the voltages shown and represent in a fair way the performance of the S&C Fuse on these occasions.

The oscillograms shown in Figures 11, 12 and 13 were obtained by short circuiting one phase of a 12 kv., 60 cycle system thru an S&C Fuse. From the standpoint of voltage across the fuses, these tests were the equivalent

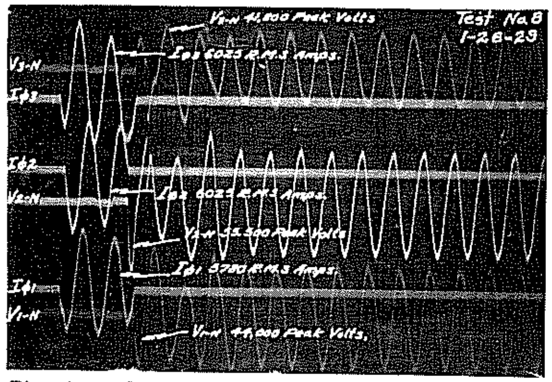


Fig. 14—S&C, 50 kv., 75 ampere, Size 4, Fuses clearing a 3-phase short circuit on a 44 kv. system

of a 22 kv., 3-phase short circuit to neutral or a 22 kv., 1-phase short circuit involving two fuses. These tests were unusually severe, because the high inductance in the test circuit resulted in approximately a 90° phase displacement between current and voltage.

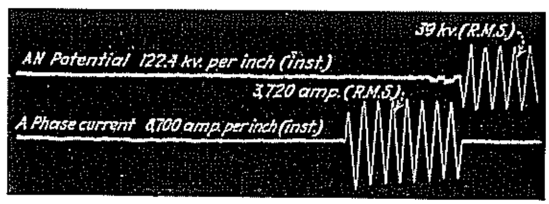


Fig. 15—S&C, Size 5, Fuse clearing a phase to neutral short circuit on a 66 kv. system

S&C Fuse Application Recommendations

For Power and Distribution Application

The proper application of high voltage fuses in power and distribution transformer installations requires that consideration be given to both the transient and normal load conditions which may occur during operation. Detailed investigation of transient conditions shows that:

(1) The energizing of an unloaded transformer is often accompanied by an initial rush of current several times the full-load current rating of the transformer, whereas the exciting current, a few cycles after energizing the transformer, is only from 3 to 5% of the full-load current rating.

(2) The energizing of an incandescent lamp load is accompanied by a rush of current approximately five times normal, because of the high positive temperature coefficient of the tungsten filament. This rush of current decreases rapidly due to the increase in the lamp filament resistance with increasing temperature, and becomes normal in a few cycles.

(3) The starting current drawn by squirrel cage motors amounts to from 250 to 400% of the full-load current rating of the motors.

No damage results from such momentary overcurrents, providing that they do not persist until destructive temperatures have developed in the transformer windings.

In the case of large transformers, the momentary over-capacity demands will generally be a smaller percentage of the transformer rating than in the case of small transformers, because large transformers supply a number of different loads, the transient current demands of which do not occur at the same instant.

After taking these facts into consideration it will be apparent that to prevent unnecessary interruptions to service, due to transient conditions, the high tension fuse must be selected by referring to its time-current characteristics, and in general its ampere rating must be several times the full load current rating of the transformer.

An attempt should not be made to apply high tension fuses to protect a transformer during overloads of 150 to 200 per cent of the transformer full-load current rating, because unnecessary fuse operation will result during transient conditions which do not last a sufficient length of time to develop destructive temperatures in the transformer windings. Where overload protection is considered necessary, it should be obtained by the installation of fuses or circuit breakers on the secondary side of the transformers.

The most satisfactory results will be obtained when S & C Fuses are applied for isolating the transformers, and for protecting the system during extreme overload or short circuits resulting from grounds or breakdown of equipment.

Table of Recommendations

The table, page 12, gives recommendations for the application of S & C Fuses in distribution and power transformer installations for the purpose of isolating the transformer from the system during short circuits or insulation failures.

Ampere Rating of S & C Fuse to Use

When a fuse is desired for carrying the normal and transient current in a transformer installation, the required ampere rating can

S & C Fuse Application Recommendations—Cont'd

be determined from the tabulation shown on page 12. Application of fuses according to this tabulation will result in very prompt isolation of the transformer in case of insulation failure. This tabulation, however, does not take into account the time delay which may be required in the high tension fuse for a particular installation.

When selective action is desired between secondary circuit-interrupting equipment and the high tension fuse, the ampere rating of the S & C Fuse can be determined readily by reference to the alignment chart on page 12B.

Interrupting Capacity

After selecting the ampere rating of the fuse required, the fuse tube size should be selected so as to obtain sufficient interrupting capacity to clear the maximum short circuit which can occur in the case of a failure at the primary terminals of the transformer. A table of interrupting capacities for the various tube sizes and voltages of S & C Fuses is shown on page 12A.

Voltage Rating

The voltage rating of the fuse should always be at least equal to the system voltage.

The voltage ratings given on S & C Fuses are in accordance with the recently adopted standard voltage ratings for general apparatus.

Number of Fuses to Use

Two fuses should always be installed in a single-phase installation and three fuses should always be installed in a three-phase installation.

For Potential Transformer Application

Either the Type B—"PT," or the Type DLC, S & C Fuse should be applied in potential transformer installations.

The Type B—"PT" is suitable for disconnecting the transformer in case of transformer failure.

The Type DLC ½ ampere fuse will disconnect a potential transformer during a short circuit at the secondary terminals, as well as during a transformer failure.

For 2300 to 33,000 volt potential transformer installations, the ½ ampere, Type DLC Fuse is recommended. In higher voltage installations, or where the capacity of the transformer is in excess of 200 volt-amperes, the 1 ampere, Type DLC Fuse should be applied.

When the possible short circuit current which will flow during a potential transformer failure exceeds the interrupting capacity of the potential transformer fuse, the S & C Wire Wound Resistor should be applied in connection with the S & C, Type DLC Fuse.

A bulletin describing S & C Current-Limiting Resistors and their application is available and will be furnished upon request.

Other Applications

The numerous applications of S & C Fuses not coming under the foregoing classes are best treated by individual recommendations. Among such applications are the following:

1. To disconnect carrier current coupling condensers in case of condenser failure.

2. To disconnect telephone equipment when telephone lines come in contact with power lines.

3. For the purpose of shunting distribution feeder reactors during normal operation so as to improve the circuit voltage regulation and reduce the loss. During a short circuit the fuse blows, cutting the reactors into service before the oil circuit breakers have time to open.

4. To prevent line interruptions due to suspension insulator flashovers during lightning disturbances.

5. To prevent service interruptions due to lightning arrester failure.

6. To prevent service interruption due to static condenser failure.

7. On high voltage D.C. electric railway circuits.

8. In radio broadcasting for interrupting the high voltage, highly inductive plate circuit during tube failure.

Table of Recommendations for Application of the S&C Fuse

Recommended fuse ratings for **SINGLE-PHASE** transformer installations at various system voltages

1-Ph. KVA	2,300 Volts Full Load Amp.	2,300 Volts Rating of Fuse Amp.	4,000 Volts Full Load Amp.	4,000 Volts Rating of Fuse Amp.	6,600 Volts Full Load Amp.	6,600 Volts Rating of Fuse Amp.	11,000 Volts Full Load Amp.	11,000 Volts Rating of Fuse Amp.	13,200 Volts Full Load Amp.	13,200 Volts Rating of Fuse Amp.	22,000 Volts Full Load Amp.	22,000 Volts Rating of Fuse Amp.	33,000 Volts Full Load Amp.	33,000 Volts Rating of Fuse Amp.	1-Ph. KVA
1.5	0.65	3	0.38	2	0.23	2									1.5
2.5	1.09	5	0.63	3	0.38	2	0.23	2	0.19	2					2.5
3	1.30	5	0.75	3	0.46	2	0.27	2	0.23	2					3
5	2.18	8	1.25	5	0.76	3	0.46	2	0.38	2	0.23	2			5
7.5	3.26	10	1.87	8	1.14	5	0.68	3	0.57	3	0.34	2			7.5
10	4.35	12	2.50	8	1.52	5	0.91	3	0.76	3	0.46	2	0.30	2	10
15	6.53	15	3.75	12	2.27	8	1.37	5	1.14	5	0.68	3	0.46	2	15
25	10.9	25	6.25	15	3.79	12	2.27	8	1.89	8	1.14	5	0.76	3	25
37.5	16.3	40	9.37	25	5.68	15	3.41	10	2.84	10	1.70	5	1.14	5	37.5
50	21.8	50	12.5	30	7.58	20	4.55	12	3.79	12	2.27	8	1.52	5	50
75	32.6	75	18.7	40	11.4	30	6.82	20	5.68	15	3.41	10	2.27	8	75
100	43.5	100	25.0	50	15.2	40	9.10	25	7.58	20	4.55	12	3.03	10	100
150	65.3	200	37.5	75	22.7	50	13.7	30	11.4	30	6.82	20	4.55	12	150
200	87.0	200	50.0	100	30.3	60	18.2	40	15.2	40	9.10	25	6.06	15	200
250	109	250	62.5	200	37.9	100	22.7	50	18.9	40	11.4	30	7.58	20	250
333	145	300	83.1	200	50.5	100	30.3	60	25.2	50	15.2	40	10.1	25	333
400	174	400	100	200	60.6	200	36.4	75	30.3	60	18.2	40	12.1	30	400

Recommended fuse ratings for **THREE-PHASE** transformer installations at various system voltages

3-Ph. KVA	2,300 Volts Full Load Amp.	2,300 Volts Rating of Fuse Amp.	4,000 Volts Full Load Amp.	4,000 Volts Rating of Fuse Amp.	6,600 Volts Full Load Amp.	6,600 Volts Rating of Fuse Amp.	11,000 Volts Full Load Amp.	11,000 Volts Rating of Fuse Amp.	13,200 Volts Full Load Amp.	13,200 Volts Rating of Fuse Amp.	22,000 Volts Full Load Amp.	22,000 Volts Rating of Fuse Amp.	33,000 Volts Full Load Amp.	33,000 Volts Rating of Fuse Amp.	44,000 Volts Full Load Amp.	44,000 Volts Rating of Fuse Amp.	66,000 Volts Full Load Amp.	66,000 Volts Rating of Fuse Amp.	3-Ph. KVA
4.5	1.13	5	0.65	3	0.39	2													4.5
5	1.25	5	0.72	3	0.44	2													5
7.5	1.88	8	1.09	5	0.66	3	0.39	2	0.33	2									7.5
9	2.26	8	1.30	5	0.79	3	0.47	2	0.39	2									9
10	2.50	8	1.45	5	0.88	3	0.53	2	0.44	2									10
15	3.77	12	2.18	8	1.31	5	0.79	3	0.66	3	0.39	2							15
22.5	5.65	15	3.27	10	1.97	5	1.18	5	0.99	3	0.59	3							22.5
25	6.30	15	3.64	12	2.19	8	1.31	5	1.09	5	0.66	3							25
30	7.54	20	4.33	12	2.63	8	1.58	5	1.31	5	0.79	3	0.53	2					30
37.5	9.43	25	5.42	15	3.28	10	1.97	8	1.64	5	0.99	3	0.66	3					37.5
45	11.3	30	6.50	15	3.94	12	2.36	8	1.97	8	1.18	5	0.79	3	0.59	3			45
50	12.6	30	7.24	20	4.38	12	2.63	8	2.19	8	1.31	5	0.88	3	0.66	3			50
75	18.8	40	10.9	25	6.58	20	3.94	12	3.28	10	1.97	8	1.31	5	0.99	3			75
100	25.1	50	14.5	40	8.76	25	5.27	15	4.38	12	2.63	8	1.75	5	1.31	5			100
112.5	28.3	60	16.3	40	9.85	25	5.92	15	4.93	15	2.96	10	1.97	8	1.48	5			112.5
150	37.7	75	21.8	50	13.1	30	7.90	20	6.58	20	3.94	12	2.63	8	1.97	8	1.31	5	150
200	50.3	100	28.9	60	17.5	40	10.5	25	8.76	25	5.27	15	3.50	10	2.63	8	1.75	5	200
225	56.5	150	32.7	75	19.7	40	11.8	30	9.85	25	5.92	15	3.94	12	2.96	10	1.97	8	225
300	75.4	150	43.3	100	26.3	60	15.8	40	13.1	30	7.90	20	5.27	15	3.94	12	2.63	8	300
450	113	250	65.0	200	39.4	100	23.6	50	19.7	40	11.8	30	7.90	20	5.92	15	3.94	12	450
600	151	300	86.7	200	52.7	100	31.6	60	26.3	60	15.8	40	10.5	25	7.90	20	5.27	15	600
750	188	400	109	250	65.8	200	39.4	100	32.8	75	19.7	40	13.1	30	9.85	25	6.58	20	750
1,000			145	300	87.6	200	52.7	100	43.8	100	26.3	60	17.5	40	13.1	30	8.76	25	1,000
1,200			173	400	105	250	63.2	200	52.7	100	31.6	60	21.2	50	15.8	40	10.5	25	1,200
1,500					131	300	79.0	200	65.8	200	39.4	100	26.3	60	19.7	40	13.1	30	1,500
2,000					175	400	105	250	87.6	200	52.7	100	35.0	75	26.3	60	17.5	40	2,000
2,500							131	300	109	250	65.8	200	43.8	100	32.8	75	21.9	50	2,500
3,000							158	400	131	300	79.0	200	52.7	100	39.4	100	26.3	60	3,000
3,750							197	400	164	400	98.5	200	65.8	200	49.3	100	32.8	75	3,750
5,000											131	300	87.6	200	65.8	200	43.8	100	5,000
6,000											158	400	105	250	79.0	200	52.7	100	6,000
7,500											197	400	131	300	98 5	200	65.8	200	7,500
10,000													175	400	131	300	87.6	200	10,000

Higher Voltage Recommendations will be given on application.
Time-Current Curves and Data applicable to S & C Fuses will be furnished on request.

Application of S&C Fuses

In Locations Where Blowing Time Is of Particular Importance

The following statements pertain to installations containing S&C Fuses and also other types of circuit-interrupting equipment, such as circuit breakers or fuses. In such installations it is usually required that the circuit interrupting devices function selectively during equipment or line failures.

For instance, selective action may be required between—

(a) Two fuses in the same circuit.
(b) A circuit breaker and a fuse in the same circuit.
(c) A low tension breaker and a high tension fuse.
(d) A low tension fuse and a high tension fuse.

In order to make a proper selection of S&C Fuses for such installations, the following factors must be considered—

(1) Normal Full Load Current Through the Fuse.

The normal load current in a transformer installation should be considered as the current flowing when the transformer is loaded to rated capacity.

The normal load current of a circuit should be considered as the maximum current which the circuit may be called upon to carry.

The ampere rating of the S&C Fuse should not be less than 154% of the normal load current.

(2) Possible Short-Circuit Current.

The possible short-circuit current should be calculated by the conventional methods.

Where fuses are applied on the high tension side of a transformer or transformer bank, it is usually permissible to neglect the impedance external to the transformer when calculating the possible primary current during a secondary short.

(3) Opening and Clearing Time.

The blowing time of an S&C Fuse or any other make of fuse for any value of short-circuit current can be determined by reference to the time-current curves issued by the fuse manufacturer. The clearing time of a fuse during short circuit can be approximated by adding from one to two cycles to the blowing time.

In the case of a circuit breaker the clearing time can be approximated by adding one quarter of a second to the time required for the relay to close the circuit of the circuit breaker trip coil.

(4) Required Margin in Time to Insure the Desired Selective Action.

To prevent the temperature of an S&C Fuse element rising to a value dangerously close to the melting point, during the time taken by some other device to interrupt the fault current, the blowing time of the S&C Fuse for this current should be approximately 50% greater than the maximum clearing time of the other device.

This margin of time will insure the desired selective action in all cases including those in which the fuse element will be subjected to the accumulation of heat during the operating cycles of an automatic reclosing breaker.

(5) Maximum Short-Circuit Current Which the Fuse May Be Called Upon to Interrupt.

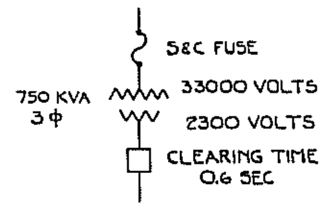
This current will determine the fuse tube size which will be necessary to provide sufficient interrupting capacity.

A tabulation giving the interrupting capacities of the various sizes of S&C Fuses is to be found on this page.

The Alignment Chart on the following page will facilitate the selection of the proper ampere rating of the TYPE D S&C FUSES* to give the desired blowing time at any predetermined short-circuit current value. The straight edge of a rule placed across the 3 scales (I_S), (I_F) and (t) will give the corresponding values of these three factors.

The scales (Z) and (I_T), have been included to allow the short-circuit current to be determined in the same simple manner, when fuses are to be selected for transformer installations, and when the rated full load current and the percent impedance of the transformer are known. It will be found that in the majority of cases this method of determining the ampere rating of the fuse to use will be sufficiently accurate, if the margin of time recommended in paragraph (3) is adhered to, although this method neglects the impedance of the circuit external to the transformer.

The two dotted lines appearing in the chart illustrate the solution of the example diagrammed at the right, in which



$Z=5\%$ $I_T=13.1$ amperes
$t=1.5\times0.6=0.9$ seconds
$I_F=?$

The line projected thru 5 on scale (Z) and 13.1 on scale (I_T) to scale (I_S), shows that the primary current during a secondary short amounts to 262 amperes. The line connecting 262 amperes on scale (I_S) and 0.9 seconds on scale (t), shows that the ampere rating of the fuse to use, $I_F=75$ amperes.

The smallest 75 ampere, S&C Fuse manufactured is supplied in the size 4 tube. The tabulation at the bottom of this page shows that a 34,500 volt, 75 ampere, **size 4** fuse has an interrupting capacity of 5500 amperes. If the maximum short-circuit current in case of an insulation failure at the primary terminals of the transformer exceeds this value but does not exceed 6400 amperes, the application of a 34,500 volt, 75 ampere, **size 5** fuse will provide the required interrupting capacity.

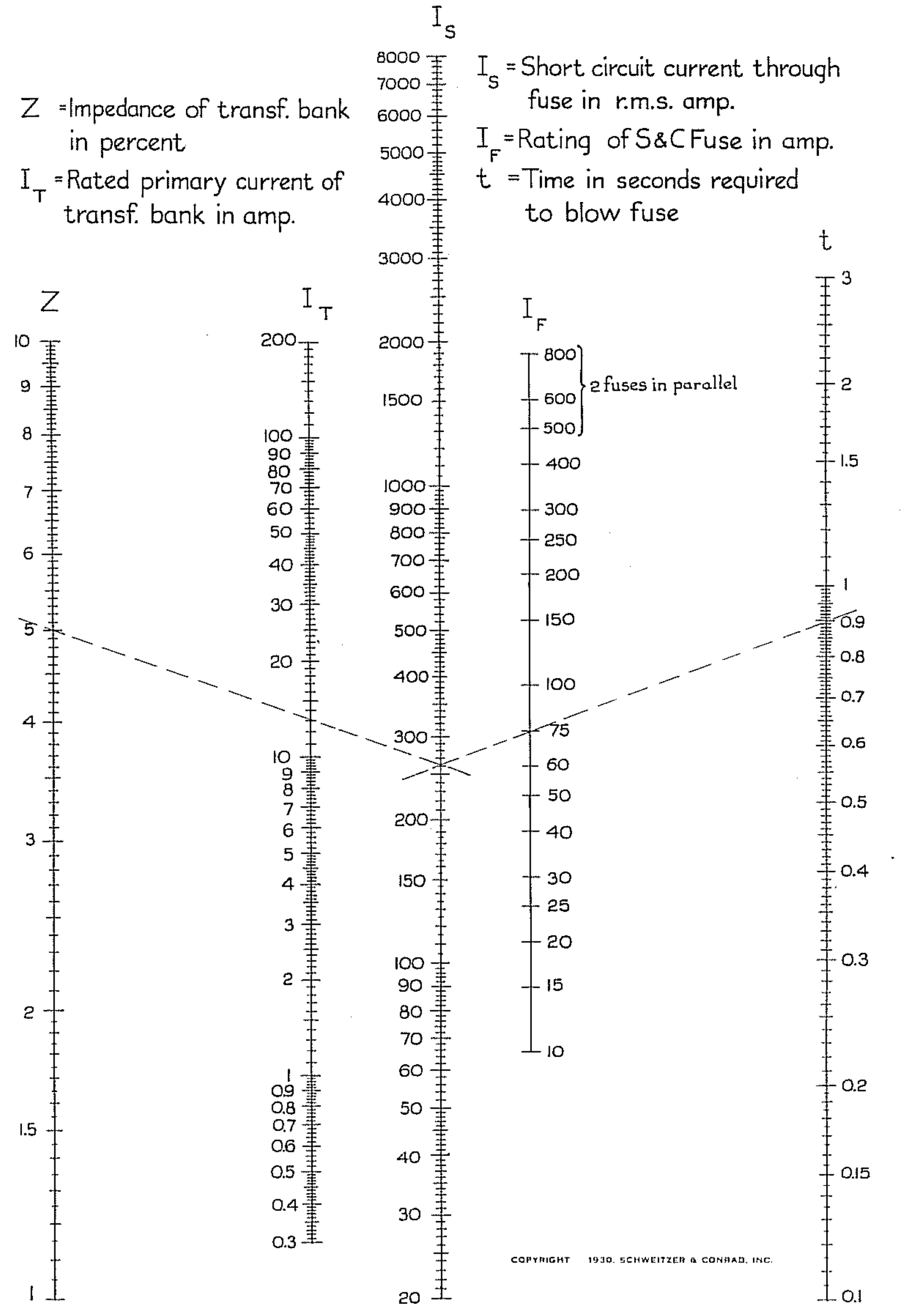
If Type B, S&C Fuses are to be applied in installations where selective action is required, the blowing time as a function of short-circuit current may be determined from the time-current curves of the Type B Fuses, which will gladly be furnished upon request.

Interrupting Capacity of S&C Fuses in r.m.s. Amperes at 60 Cycles

Voltage Rating S & C Fuse		7500	23000	23000	34500	46000	69000
System Voltage		4000	13200	22000	33000	44000	66000
Size of Fuse Tube	1 and 2	Amp. 4500	Amp. 3900	Amp. 3300	Amp. 2750	Amp. 2200	Amp. 1500
	3	6900	5900	5100	4300	3700	2700
	4	8600	7400	6500	5500	4600	3300
	5	10000	8700	7600	6400	5500	4000

For listing of available ampere ratings in various tube sizes for 7.5 to 138 kv., refer to pages 14 and 15.

*The scales (I_F), (I_S) and (t) represent that portion of S&C time-current curve No. 111, which is of most interest in this connection. Time-current curve No. 111 pertains **only** to S&C 10 to 400 ampere, Type D, sizes 3 and 4 Fuses, as manufactured beginning July 25, 1930, and to Type D, size 5 Fuses, as manufactured beginning August 11, 1930. The date of manufacture of any S&C Fuse is always stamped on the bottom of the lower ferrule of the fuse.



ALIGNMENT CHART

giving corresponding values of

Short-Circuit Current, Blowing Time and Ampere Rating

of 10 to 400 amp. Type D S&C Fuses (time-current curve No. 111)

The S&C Fuse

Should Be Installed with Top Up

The S&C Fuse is designed for installation in a vertical position with the vent cap up (see Fig. 3, page 5), in which position the blowing of the fuse element is followed by the maximum speed of the arcing terminal, and the maximum benefit is derived from the arc-extinguishing liquid. When it is necessary to install the S&C Fuse at an angle, the angle should never be greater than 45° from the vertical, and the pressure vent should always be up.

A few typical S&C Mountings shown here, illustrate correct methods of fuse support.

Broad experience on fusing problems, working in conjunction with electric utility engineers, has given S&C engineers a thorough understanding of the necessity for extra strength, in certain parts of fuse mountings, not ordinarily appreciated. S&C Fuse Mountings, therefore, embody the essential rigidity throughout and have the required gripping strength in the contact clips to enable S&C Fuses to operate unhampered by the mechanical deficiencies of incorrectly designed mountings.

Immediately following the interrupting of a short circuit, in a modern system, the voltage may rise to several times its normal value due to the sudden release of stored energy. S&C engineers realize the importance of taking this fact into consideration and have designed all S&C Fuse Mountings with a proper regard for normal and possible abnormal voltage stresses.

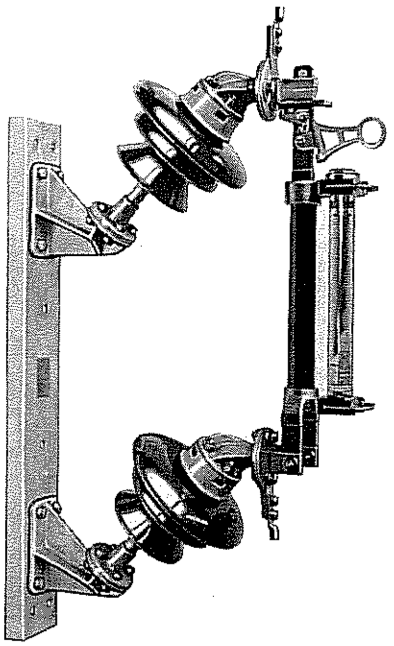


Fig. 16—37,000-Volt Type GK-SM Outdoor Fused Disconnect

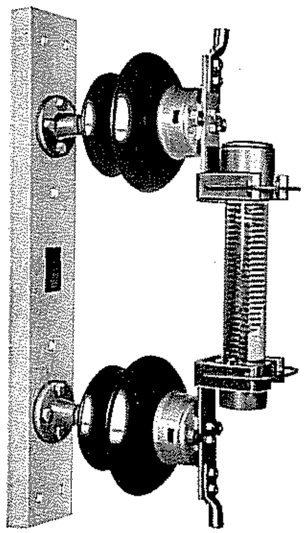


Fig. 17—25,000-Volt Type B-M Outdoor Fuse Mounting

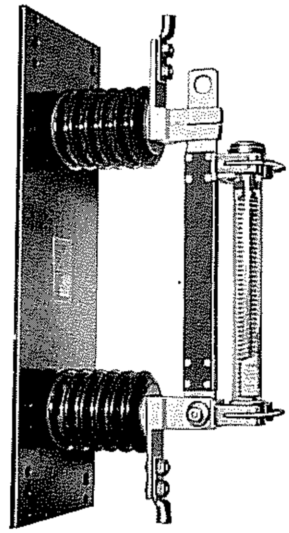


Fig. 18—15,000-Volt Type KC-SM Indoor Fused Disconnect

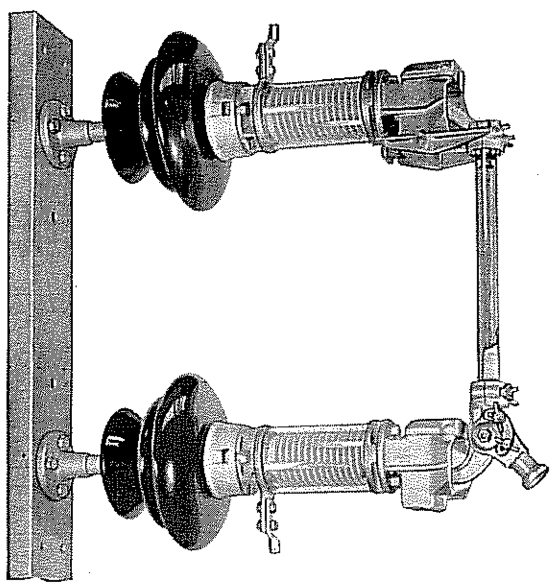


Fig. 19—37,000-Volt Type BJ-MRR-O "Pole-Pull" Fuse Mounting described on Page 18

The S & C Fuse

Ordering Information—7,500 to 46,000 Volts

Type ‡	*Rating Amperes	7,500 Volts Maximum Rating for Voltages up to 7,500 Volts Clip Centers 8″			23,000 Volts Rated Voltage for 7,501 to 23,000 Volts Clip Centers 11½″			34,500 Volts Rated Voltage Clip Centers 15″			46,000 Volts Rated Voltage Clip Centers 18″			*Rating Amperes	Type ‡
		Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size		
Type B	**P. T.†**	16001	$ 3.50	1	16003	$ 4.50	1	16004	$ 7.50	1	16005	$12.00	1	**P. T.†**	Type B
	1	16101	3.50	1	16103	4.50	1	16104	7.50	1	16105	12.00	1	**1**	
	2	16111	3.50	1	16113	4.50	1	16114	7.50	1	16115	12.00	1	**2**	
	3	16121	3.50	1	16123	4.50	1	16124	7.50	1	16125	12.00	1	**3**	
	5	16131	3.50	1	16133	4.50	1	16134	7.50	1	16135	12.00	1	**5**	
	8	16141	4.00	1	16143	5.50	1	16144	9.50	1	16145	15.00	1	**8**	
	10	16151	4.00	1	16153	5.50	1	16154	9.50	1	16155	15.00	1	**10**	
	12	16201	5.00	2	16203	8.00	2	16204	18.00	2	16205	28.00	2	**12**	
	15	16211	5.00	2	16213	8.00	2	16214	18.00	2	16215	28.00	2	**15**	
	20	16221	5.00	2	16223	8.00	2	16224	18.00	2	16225	28.00	2	**20**	
	25	16231	5.00	2	16233	8.00	2	16234	18.00	2	16235	28.00	2	**25**	
Type DLC	**½**	16901	8.20	3	16903	12.30	3	16904	22.00	3	16905	33.00	3	**½**	Type DLC
	½	14901	12.90	4	14903	17.60	4	14904	35.00	4	14905	45.00	4	*½*	
	½	15901	45.00	5	15903	55.00	5	15904	65.00	5	15905	80.00	5	*½*	
	1	16911	8.20	3	16913	12.30	3	16914	22.00	3	16915	33.00	3	**1**	
	1	14911	12.90	4	14913	17.60	4	14914	35.00	4	14915	45.00	4	*1*	
	1	15911	45.00	5	15913	55.00	5	15914	65.00	5	15915	80.00	5	*1*	
	2	16921	8.20	3	16923	12.30	3	16924	22.00	3	16925	33.00	3	**2**	
	2	14921	12.90	4	14923	17.60	4	14924	35.00	4	14925	45.00	4	*2*	
	2	15921	45.00	5	15923	55.00	5	15924	65.00	5	15925	80.00	5	*2*	
Type D	**5**	16331	8.20	3	16333	12.30	3	16334	22.00	3	16335	33.00	3	**5**	Type D
	5	14331	12.90	4	14333	17.60	4	14334	35.00	4	14335	45.00	4	*5*	
	5	15331	45.00	5	15333	55.00	5	15334	65.00	5	15335	80.00	5	*5*	
	10	16351	8.20	3	16353	12.30	3	16354	22.00	3	16355	33.00	3	**10**	
	10	14351	12.90	4	14353	17.60	4	14354	35.00	4	14355	45.00	4	*10*	
	10	15351	45.00	5	15353	55.00	5	15354	65.00	5	15355	80.00	5	*10*	
	15	16371	8.20	3	16373	12.30	3	16374	22.00	3	16375	33.00	3	**15**	
	15	14371	12.90	4	14373	17.60	4	14374	35.00	4	14375	45.00	4	*15*	
	15	15371	45.00	5	15373	55.00	5	15374	65.00	5	15375	80.00	5	*15*	
	20	16381	8.20	3	16383	12.30	3	16384	22.00	3	16385	33.00	3	**20**	
	20	14381	12.90	4	14383	17.60	4	14384	35.00	4	14385	45.00	4	*20*	
	20	15381	45.00	5	15383	55.00	5	15384	65.00	5	15385	80.00	5	*20*	
	25	16391	8.20	3	16393	12.30	3	16394	22.00	3	16395	33.00	3	**25**	
	25	14391	12.90	4	14393	17.60	4	14394	35.00	4	14395	45.00	4	*25*	
	25	15391	45.00	5	15393	55.00	5	15394	65.00	5	15395	80.00	5	*25*	
	30	16401	8.20	3	16403	12.30	3	16404	26.00	3	16405	38.00	3	**30**	
	30	14401	12.90	4	14403	17.60	4	14404	35.00	4	14405	45.00	4	*30*	
	30	15401	45.00	5	15403	60.00	5	15404	75.00	5	15405	90.00	5	*30*	
	40	16411	8.20	3	16413	12.30	3	16414	26.00	3	16415	38.00	3	**40**	
	40	14411	12.90	4	14413	17.60	4	14414	35.00	4	14415	45.00	4	*40*	
	40	15411	45.00	5	15413	60.00	5	15414	75.00	5	15415	90.00	5	*40*	
	50	16421	8.20	3	16423	12.30	3	16424	26.00	3	16425	38.00	3	**50**	
	50	14421	12.90	4	14423	17.60	4	14424	35.00	4	14425	45.00	4	*50*	
	50	15421	45.00	5	15423	60.00	5	15424	75.00	5	15425	90.00	5	*50*	
	60	16501	12.90	4	16503	17.60	4	16504	40.00	4	16505	50.00	4	**60**	
	60	15501	45.00	5	15503	60.00	5	15504	80.00	5	15505	100.00	5	*60*	
	75	16511	12.90	4	16513	17.60	4	16514	40.00	4	16515	50.00	4	**75**	
	75	15511	45.00	5	15513	60.00	5	15514	80.00	5	15515	100.00	5	*75*	
	100	16521	12.90	4	16523	17.60	4	16524	40.00	4	16525	50.00	4	**100**	
	100	15521	45.00	5	15523	60.00	5	15524	80.00	5	15525	100.00	5	*100*	
	150	16531	16.40	4	16533	22.30	4	16534	54.00	4	16535	68.00	4	**150**	
	150	15531	45.00	5	15533	60.00	5	15534	85.00	5	15535	110.00	5	*150*	
	200	16541	16.40	4	16543	22.30	4	16544	54.00	4	16545	68.00	4	**200**	
	200	15541	45.00	5	15543	60.00	5	15544	85.00	5	15545	110.00	5	*200*	
	250	16601	48.20	5	16603	62.30	5	16604	95.00	5	16605	120.00	5	**250**	
	300	16611	48.20	5	16613	62.30	5	16614	95.00	5	16615	120.00	5	**300**	
	400	16621	48.20	5	16623	62.30	5	16624	95.00	5	16625	120.00	5	**400**	

†P. T. is an abbreviation for Potential Transformer Fuse. ‡See Page 6 for explanation of Type Letters. *Ampere Ratings in light face italics indicate fuses in larger than standard tube size and, therefore, higher than standard interrupting capacity. (See Table, Page 12-A).

The S&C Fuse

Ordering Information—69,000 to 138,000 Volts

Type ‡	*Rating Amperes	69,000 Volts Rated Voltage, Clip Centers 24"			92,000 Volts Rated Voltage, Clip Centers 30"			115,000 Volts Rated Voltage, Clip Centers 36"			138,000 Volts Rated Voltage, Clip Centers 42"			*Rating Amperes	Type ‡
		Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size	Catalog Number	List Price	Tube Size		
Type B	**P. T.†**	16006	$18.00	2		$			$			$		**P. T.†**	Type B
Type B	**1**	16206	18.00	2										**1**	Type B
Type B	**2**	16216	18.00	2										**2**	Type B
Type B	**3**	16226	18.00	2										**3**	Type B
Type B	**5**	16236	18.00	2										**5**	Type B
Type B	**8**	16246	22.00	2										**8**	Type B
Type B	**10**	16256	22.00	2										**10**	Type B
Type DLC	**1**	16916	40.00	3	16917	45.00	3	16918	50.00	4	16919	150.00	5	**1**	Type DLC
Type DLC	*1*	14916	55.00	4	14917	65.00	4							*1*	Type DLC
Type DLC	*1*	15916	100.00	5	15917	110.00	5	15918	130.00	5				*1*	Type DLC
Type DLC	**2**	16926	40.00	3	16927	45.00	3	16928	50.00	4	16929	150.00	5	**2**	Type DLC
Type DLC	*2*	14926	55.00	4	14927	65.00	4							*2*	Type DLC
Type DLC	*2*	15926	100.00	5	15927	110.00	5	15928	130.00	5				*2*	Type DLC
Type D	**5**	16336	40.00	3	16437	45.00	3	16538	50.00	4	16639	150.00	5	**5**	Type D
Type D	*5*	14336	55.00	4	14437	65.00	4							*5*	Type D
Type D	*5*	15336	100.00	5	15437	110.00	5	15538	130.00	5				*5*	Type D
Type D	**10**	16356	40.00	3	16457	45.00	3	16558	50.00	4	16659	160.00	5	**10**	Type D
Type D	*10*	14356	55.00	4	14457	65.00	4							*10*	Type D
Type D	*10*	15356	100.00	5	15457	110.00	5	15558	130.00	5				*10*	Type D
Type D	**15**	16416	40.00	3	16477	50.00	3	16578	70.00	4	16679	170.00	5	**15**	Type D
Type D	*15*	14416	55.00	4	14477	65.00	4							*15*	Type D
Type D	*15*	15416	100.00	5	15477	110.00	5	15578	130.00	5				*15*	Type D
Type D	**20**	16426	40.00	3	16487	50.00	3	16588	70.00	4	16689	170.00	5	**20**	Type D
Type D	*20*	14426	55.00	4	14487	65.00	4							*20*	Type D
Type D	*20*	15426	100.00	5	15487	110.00	5	15588	130.00	5				*20*	Type D
Type D	**25**	16436	40.00	3	16497	50.00	3	16598	70.00	4	16699	170.00	5	**25**	Type D
Type D	*25*	14436	55.00	4	14497	65.00	4							*25*	Type D
Type D	*25*	15436	100.00	5	15497	110.00	5	15598	130.00	5				*25*	Type D
Type D	**30**	16446	50.00	3	16507	70.00	4	16608	130.00	5	16709	180.00	5	**30**	Type D
Type D	*30*	14446	55.00	4										*30*	Type D
Type D	*30*	15446	110.00	5	15507	120.00	5							*30*	Type D
Type D	**40**	16456	50.00	3	16517	70.00	4	16618	130.00	5	16719	180.00	5	**40**	Type D
Type D	*40*	14456	55.00	4										*40*	Type D
Type D	*40*	15456	110.00	5	15517	120.00	5							*40*	Type D
Type D	**50**	16466	50.00	3	16527	70.00	4	16628	130.00	5	16729	180.00	5	**50**	Type D
Type D	*50*	14466	55.00	4										*50*	Type D
Type D	*50*	15466	110.00	5	15527	120.00	5							*50*	Type D
Type D	**60**	16506	60.00	4	16607	140.00	5	16638	160.00	5	16739	190.00	5	**60**	Type D
Type D	*60*	15506	120.00	5										*60*	Type D
Type D	**75**	16516	60.00	4	16617	140.00	5	16648	160.00	5	16749	190.00	5	**75**	Type D
Type D	*75*	15516	120.00	5										*75*	Type D
Type D	**100**	16526	60.00	4	16627	140.00	5	16658	160.00	5	16759	190.00	5	**100**	Type D
Type D	*100*	15526	120.00	5										*100*	Type D
Type D	**150**	16536	130.00	5	16637	150.00	5	16668	170.00	5	16769	200.00	5	**150**	Type D
Type D	**200**	16546	130.00	5	16647	150.00	5	16678	170.00	5	16779	200.00	5	**200**	Type D
Type D	**250**	16606	150.00	5	16657	170.00	5							**250**	Type D
Type D	**300**	16616	150.00	5	16667	170.00	5							**300**	Type D
Type D	**400**	16626	150.00	5	16677	170.00	5							**400**	Type D

†P. T. is an abbreviation for Potential Transformer Fuse. ‡See Page 6 for explanation of Type Letters. *Ampere Ratings in light face italics indicate fuses in larger than standard tube size, and, therefore, higher than standard interrupting capacity. (See Table, Page 12-A).

Dimensions and Shipping Weights

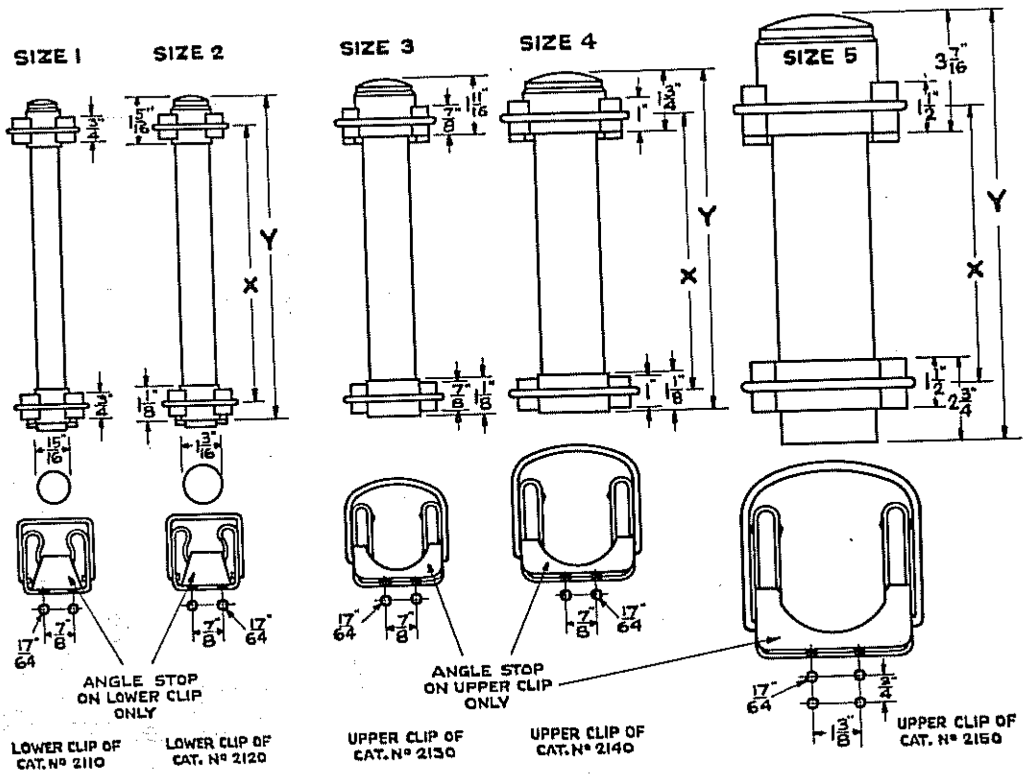


Fig. 20

	TYPE B CONSTRUCTION				TYPE D (Including Type DLC) CONSTRUCTION						
	Tube Size 1		Tube Size 2		Tube Size 3		Tube Size 4		Tube Size 5		Clip Centers All Tube Sizes "X"
Volts	"Y" Inches	Wt. Lbs. Pkd.	"Y" Inches	Wt. Lbs. Pkd.	"Y" Inches	Wt. Lbs. Pkd.	"Y" Inches	Wt. Lbs. Pkd.	"Y" Inches	Wt. Lbs. Pkd.	
7,500	9 5/16	1½	9 5/16	2	9 11/16	3½	9¾	6	12⅝	18	8″
23,000	12 13/16	1¾	12 13/16	2⅛	13 3/16	4	13¼	7	16⅛	24	11½″
34,500	16 5/16	2	16 5/16	2¼	16 11/16	4½	16¾	8	19⅝	30	15″
46,000	19 5/16	2¼	19 5/16	2⅝	19 11/16	5	19¾	9	22⅝	36	18″
69,000	....	....	25 5/16	3¼	25 11/16	5½	25¾	12	28⅝	50	24″
92,000	....	....	....	....	31 11/16	12	31¾	21	34⅝	70	30″
115,000	....	....	....	....	....	....	37¾	30	40⅝	85	36″
138,000	....	....	....	....	....	....	....	....	46⅝	100	42″

S & C Fuse Clips

Catalog Number	Type of Fuse	Fuse Tube Size (See pages 14 and 15)	List Price Per Pair
2110	B	1	$1.00
2120	B	2	1.00
2130	D or DLC	3	2.00
2140	D or DLC	4	2.50
2150	D or DLC	5	6.00

S&C Fuse Tongs

For the placing and removal of fuses, two types of Fuse Tongs, shown below, are offered. These tongs are made of seasoned hard wood, kiln dried, and given special treatment and finish to prevent moisture absorption.

The Type H is for use where the operator is at the approximate height of the fuse and can handle it with tongs which hold the fuse at a 90° angle with the handles. Quite often, however, the fuse is mounted above the operator, in which case the Type HA Tongs are better used. In cases where the fuse is mounted at a considerable height, the "Pole-Pull" Fuse Mountings on the following page offer the easiest method of inserting or removing a fuse.

Take 4 Sizes of Fuses

The size limit of fuses which it is possible to handle with these tongs will depend somewhat on the ability of the operator and the location of the fuse. However, the tongs will tightly grip S & C Fuses of the Nos. 1, 2, 3 and 4 sizes, dimensions of which are given on page 16. Size 5 fuses cannot be handled with tongs. For method of handling Size 5 fuses up to 34500 volts see "Pole-Pull" Fuse Mountings described on the following page.

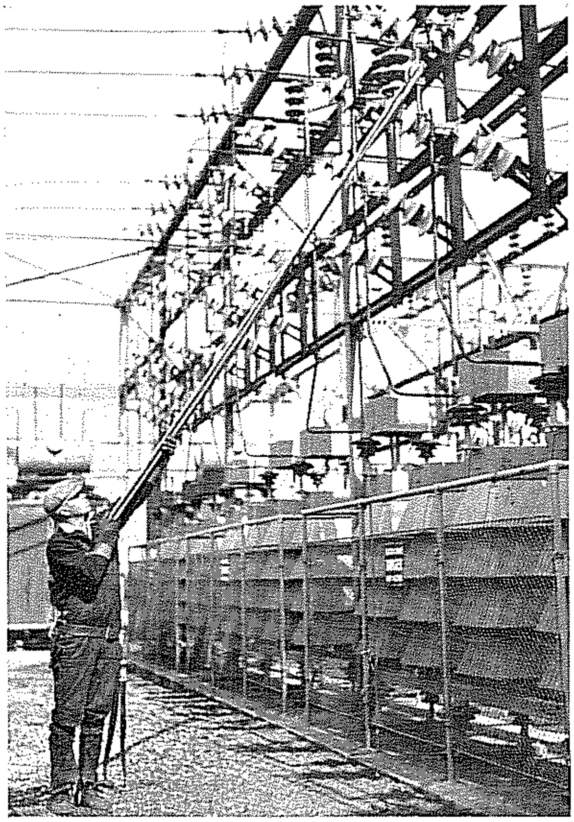


Fig. 21

Type H Fuse Tongs (90°)

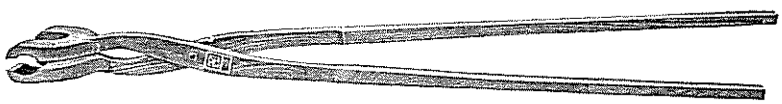


Fig. 22

Max. Volts	Cat. No.	Length	List Price	Wt. Pkd., Lbs
25000	1013	4 ft.	$15.00	15
73000	1016	7 ft.	18.00	25
88000	1017	12 ft.	25.00	45
88000	1018	16 ft.	27.00	75

Type HA Fuse Tongs (45°)

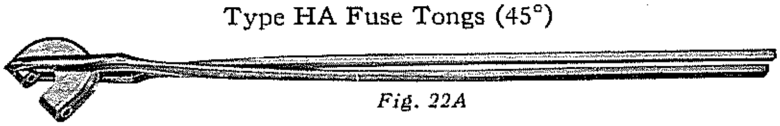


Fig. 22A

Max. Volts	Cat. No.	Length	List Price	Wt. Pkd., Lbs.
25000	1023	4 ft.	$16.00	15
73000	1026	7 ft.	19.00	25
88000	1027	12 ft.	26.00	45
88000	1028	16 ft.	28.00	75

"Pole-Pull" Fuse Mounting

primarily for high mounting of S&C Fuses

Where fuses are mounted at a considerable height above the ground the usual method of handling them with tongs is difficult and the "Pole-Pull" Fuse Mounting is offered to provide a practical means for changing fuses when they are mounted in high positions.

The "Pole-Pull" Fuse Mounting accomodates sizes 3 and 4 S&C Fuses up to 115,000 volts and size 5 S&C Fuses up to 34500 volts. It consists of the usual steel base and insulators with a set of contact clips of special design into which fit a set of contact terminals clamped to a standard S&C Fuse. The contact terminals slide easily into, or out of, the special contact clips. The fuse is handled by means of a treated wood pole having a coarsely threaded stud which screws into a socket at the lower end of the fuse. The angle of the socket is adjustable to meet the requirements of each installation.

The contact terminals, including clamps, although ample, both electrically and mechanically, are very light in weight, and the total weight handled at the end of the pole is very little more than the weight of the fuse alone.

The "Pole-Pull" Fuse Mounting, in types for either indoor or outdoor installations, is listed in Bulletins 200J and 200R.

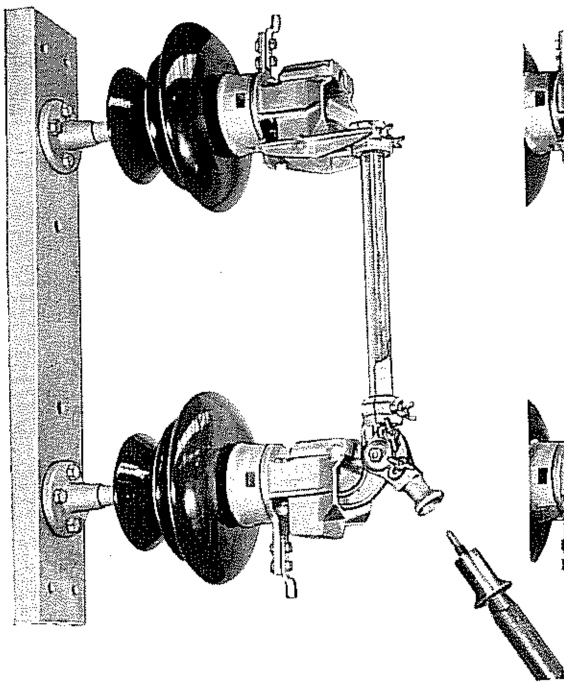


Fig. 23—Showing "Pole-Pull" Fuse Mounting as in Service. Pole ready to enter socket.

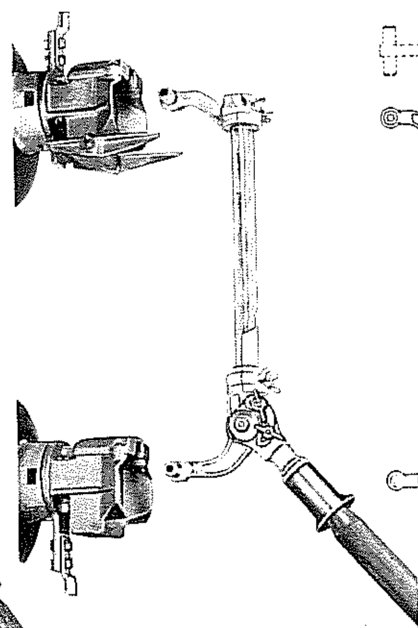


Fig. 24—Showing Pole Attached and Contactors withdrawn from clips

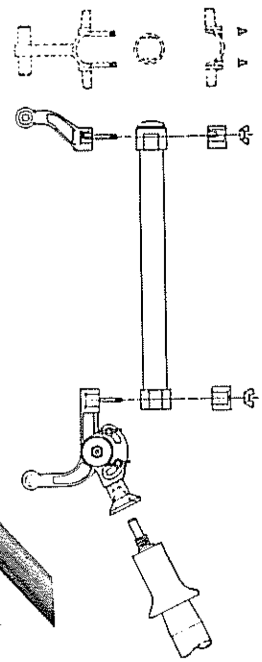


Fig. 25—Showing S&C Fuse Removed from Fuse-Ferrule Clamps

(Patent Pending)

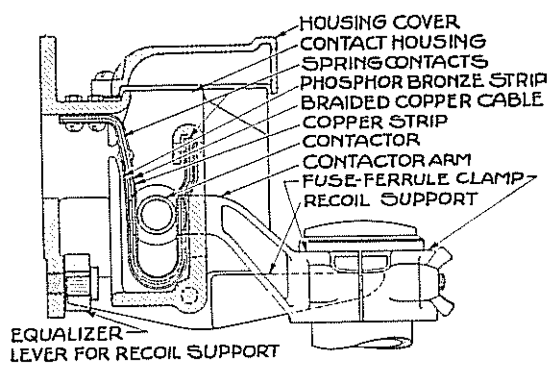


Fig. 26—Showing Details of the well housed contact Clip of the "Pole-Pull" Fuse Mounting

The S&C Fuse

For Distribution Circuits

For application on distribution circuits, the S & C Fuse is also supplied with a weatherproof,

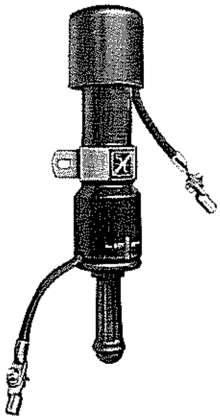


Fig. 27 — Type DP Cutout containing the S & C Fuse

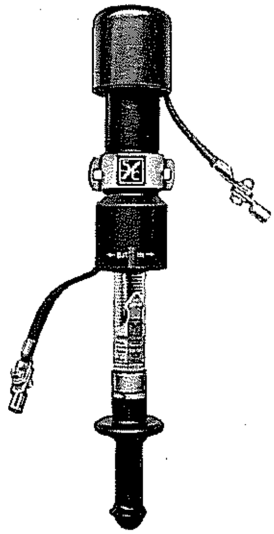


Fig. 32—Showing how the Fuse is removed from the Cutout by means of the Insulated Handle to which Fuse is attached

insulating housing, and this arrangement is called the Type DP Cutout. It is principally applied on 2200 to 6600 volt systems for primary protection on distribution transformers of 50 to 300 KVA capacity.

Type DP Cutout

This cutout consists of a special form of the S & C Fuse, designed for attachment to an insulated handle and for inserting in a weather proof, insulating housing. This housing contains adequate self-aligning contact clips to which are connected the flexible leads appearing in the illustration.

The complete cutout occupies a space of only 5″x5″x21″ and makes possible an unusually neat appearing installation.

Fuses for the Type DP Cutout are rated at 10, 20, 30, 40, 50, 60, 75, 100, 150 and 200 amperes.

High Interrupting Capacity

Numerous tests and wide use under service conditions have shown the interrupting capacity of the Type DP Cutout to be approximately 10,000 amperes at 2300-4000 volts.

Bulletin 201A gives complete information, and will be gladly supplied on request.

* * *

A Sturdy Convenient Carton

S & C Fuses of the smaller and medium sizes are packed for stocking in a strong cylindrical carton and labeled on the outside with the ampere and voltage ratings for quick identification.

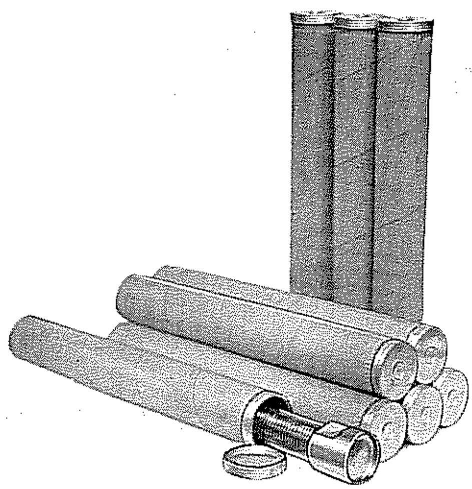


Fig. 28—Cartons in which S & C Fuses are packed

Keep the Container

Users are urged to preserve these containers in their fuse stockroom or other convenient location where they will be easily available for repacking S & C Fuses when returning them to the factory for refilling. Thus returns of blown fuses will be made with facility and at the lowest packing cost.

The S&C Fuse for Load Breaking

How to Interrupt Load Currents in Switch Operation, with the S & C Fuse, and Save the Cost of an Oil Circuit-Breaker

A Money Saving Arrangement

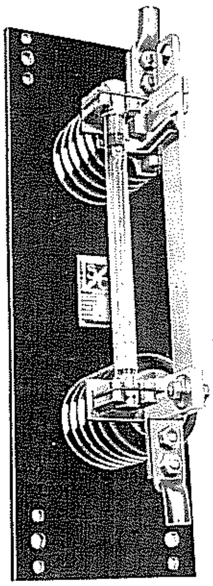


Fig. 29—Type YB Fuse-Break, Load-Interrupting Switch for Indoor Service. Patented

There are numerous places in every large generating or distributing system where it is desirable to have a simple means of interrupting load currents, at moderate and high voltage, without the use of an expensive oil circuit breaker. Where opening of the circuit is infrequent, this is conveniently accomplished at a great saving over the cost of an oil circuit breaker, by using the *S & C, Type YB, Fuse-Break, Load-Interrupting Switch.*

One form of this switch is shown in Fig. 29. It consists of a disconnecting switch arranged so that the blade is shunted by an S & C Fuse of low ampere rating. When the fuse is out of the clips the switch blade is locked in the closed position, but the inserting of the fuse releases the lock for the opening of the blade. The close up view of the top section of the switch, Fig. 30, shows the blade locked when the fuse is removed.

How It Operates

To interrupt a load the S & C Fuse is first inserted in the clips and then the disconnecting

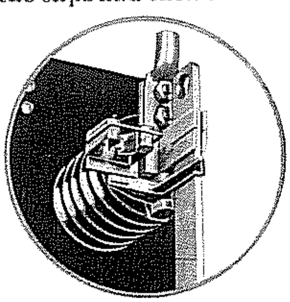


Fig. 30—Showing how the Switch Blade is locked until a Fuse is placed in the Fuse Clips

switch blade is opened rapidly. An arc is thereby drawn between the blade and the contact clip at the instant the blade leaves the clip.

The voltage maximum across the arc cannot exceed the product of the current in the circuit and the resistance of the fuse. This voltage is very small, being in the order of approximately 100 volts when interrupting a 200 ampere load. The arc quickly becomes unstable, due to the transfer of current to the fuse, and is extinguished as it is lengthened by the movement of the switch blade away from the clip. The extinction of the arc is followed by the blowing of the fuse which opens the circuit.

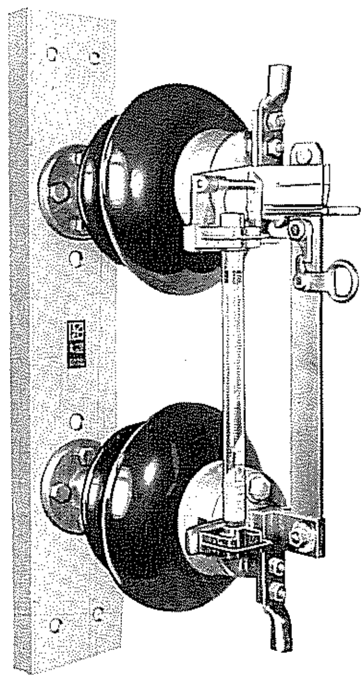


Fig. 31—Type YB Fuse-Break, Load-Interrupting Switch for Outdoor Service. Patented

Many Possible Applications

Another form of the YB Fuse-Break Load-Interrupting Switch is shown in Fig. 31. This form has an extra lock on the switch blade, which locks the switch blade in the closed position until released by a downward pull with a switch stick.

The possible applications of the YB Fuse-Break Load-Interrupting Switch are many and varied. Correspondence on this subject is invited, and recommendations and quotations will be made on request.

Many in Use

The YB Fuse-Break Load-Interrupting Switch has been time-tried-and-tested and is giving satisfactory service. More than four hundred are in use on one system.

TRADE MARK REG. U. S. PAT. OFF.