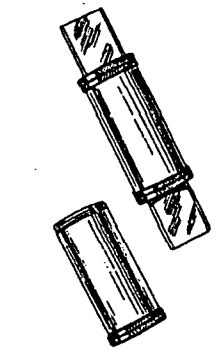
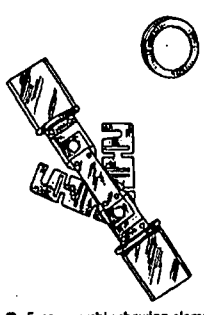
TYPICAL RENEWABLE FUSES SHOWING CONSTRUCTION AND LINK DESIGN

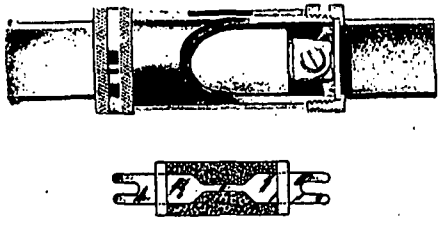




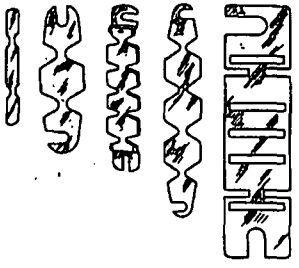
9 Fuse assembly showing element, cartridge case and end blades. Renewable element is held firm by washers and heavy bolts, reducing contact resistance to a minimum

10 Extra time-lag is provided by lag plates. Narrow sections of the link are kept from opening under momentary overload by the thermal capacity of plates

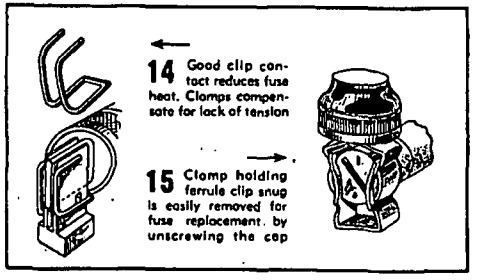
11 Series of thin sections decreases interrupting time of fuse. Short-circuit current results in series of arcs that quickly go out



12 Asbestos powder surrounding the renewable link olds in quenching the arc. Blade-end cartridge fuse shown is in the 70-600 amp, 250-v class. Most renewable elements are type in Fig. 13

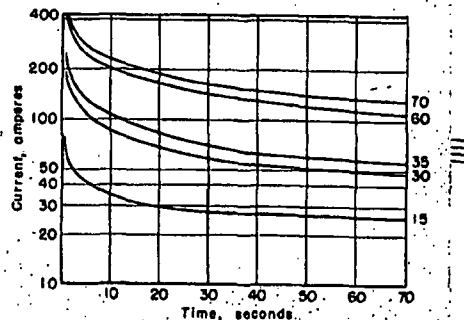


13 Renewable links commonly used are shown. The time-lag element to right has blowing areas along the edge. Center area provides time-lag



14 Good clip contact reduces fuse heat. Clamps compensate for lack of tension

15 Clamp holding ferrule clip snug is easily removed for fuse replacement, by unscrewing the cap



16 Typical time-lag characteristic curves for several renewable links, showing high lag at start

In replacing ordinary fuses with time-lags, the size often has to be reduced. This is important in motor protection since overfusing with time-lags reduces motor overload protection. Size reduction may be made without changing the original fuse holder. Reducers are available that fit into knife clips if it is necessary to change to ferrule-end fuses.

Renewable Time-Lag Link. The renewable link, at the far right in Fig. 13, consists of a series of narrow- and wide-element sections. Wide portions are called the thermal areas and act as heat-storage compartments. Under short-time overloads, these sections absorb the sudden heat from surrounding thin spots. Thus the fuse is prevented from blowing on momentary overloads. Should over-current continue, the heat-absorbing capacity of the thermal areas decreases, allowing reduced sections to melt.

On short circuit, thin blowing areas open since time does not permit heat dissipation to thermal sections. Large link-end connections provide points of heat dissipation through copper-fuse terminals besides assuring minimum contact resistance.

Time-lag link in Fig. 10 provides an extra degree of time delay. Two heavy lag plates separate three thin blowing sections. Heavy portions provide time lag by drawing heat from the adjoining thin spots. Principal blowing parts are the two thin sections, near the terminals, which open on short circuit. Since two arcs in series cannot be maintained at the same voltage as easily as one, fast interruption results. Hence less metal is vaporized, reducing pressure developed within the fuse. Because of this condition, there is less possibility of the fuse exploding or belching fire on short circuit. On gradual temperature rise, due to prolonged overload, the lag plates cannot absorb the extra heat and so the reduced center section opens.

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Why Fuses Blow. A blown fuse indicates trouble in a circuit. There are several reasons for blowing in addition to a short circuit and overload. Poor electrical contact at the fuse holder causes overheating, which lowers the fuse's current rating. Discoloration of the copper results, making this trouble easy to spot.

Fuses are often used in motor circuits for short-circuit protection, while a thermal device connected in series with the line operates if motor is overloaded. Here fuse rating is well above full-load current rating of motor to allow for heavy starting currents. If fuses are used for overload as well as short-circuit protection, select the time-lag type to prevent blowing on motor starting.

If a fuse is at a point where ambient temperature is high, it cannot carry its rated load. Since temperature changes affect fuse operation, they should be installed when possible where the fuse is subject to the same ambient temperature as the protected equipment. Observe this precaution generally in applying protective devices that operate on the thermal principle.

Overfusing. Overfusing is not the proper remedy for annoying circuit interruptions. Where fuse blowing is frequent due to overloads, the blowing prevents motor or wiring burnout. Too large a fuse reduces the degree of protection against overload and defeats the purpose of fusing.

Drilling holes in the sides of fuse cartridges, to cool the element, is a dangerous practice. On short circuit a high pressure is developed within the fuse that aids in quenching the arc. Small vents at each end of the cartridge relieve pressure after it has swept the arc. Holes in the tube reduce pressure, lowering rupturing capacity of the fuse. They also allow emission of hot gas and molten metal, both of which are hazardous.

Good Contact. Importance of good electrical contact at fuse clips cannot be overstressed. Keep in mind that a fuse blows when heat developed exceeds the element's melting point. Since total current passes through the fuse clips, any resistance at those points causes additional heat to be generated. As a result, the fuse blows below its rated current value.

Poor contact at fuse ends reduces spring tension of clips due to the heat developed. Tension loss introduces additional resistance, further increasing the heat. To insure good fuse contact, terminal clamps, Fig. 14 and 15, may be used. Replace any spring clips that may have lost their tension.

It is good practice to check fuse holders periodically, keeping the above points in mind. Fuses in critical circuits, which normally carry near rated current, should be replaced at regular intervals. At time of replacement, check fuse clips for tension. Fuses taken out of service may be returned to stock after inspection.

Fuses in Parallel. Fuses are ordinarily made with current ratings up to 600 amp. Those of higher rating are made on order. To protect circuits carrying more than 600 amp, fuses in the standard range are often paralleled. When so arranged, any additional resistance introduced in one fuse path results in the other fuse carrying a proportionately greater current. If fuses in parallel blow frequently, the cause may often be traced to poor contact at one fuse clip. Increased resistance at this point reduces current flow through that fuse; the fuse in parallel blows since it assumes a major portion of the circuit load. Current then shifts back to the first fuse, causing it to open on overload.

Where practicable, avoid paralleling of fuses.

On parallel installations, it is good practice to measure the current through each fuse periodically. A split-core ammeter serves this purpose in an alternating-current system. An appreciable unbalance should be corrected.

Renewable Links. Note these precautions in connection with renewable links: (1) After repeated blowing there is a tendency to end the annoyance by using two links in parallel or a link of higher current rating. This merely removes the symptom temporarily while cause of failure remains. (2) Renewable link often overheats and blows because of poor element contact at either end. When renewing, be sure element and link terminal are clean before screwing on end caps.