

# Fire Engineering®

## Construction Concerns: Electrical Needs

Article and photos by Gregory Havel

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Electricity has been in use in North America for more than 100 years. During much of this time, the safe use of electricity has been a concern. Underwriters Laboratories (UL) and other independent laboratories have developed tests that ensure that the electrical appliances and equipment we buy will perform safely for us. The National Fire Protection Association (NFPA) has developed NFPA 70, *National Electrical Code* (NEC), the first edition of which was published in 1897 and which is updated every three years to keep pace with technology and best wiring practices. The NEC has been adopted, in whole or in part, by most states and cities in North America.

Photo 1 shows an electrical service panel that was typical in new residential and light commercial occupancies from the 1930s through the 1960s. These typically were fed by a 60-ampere 120-240 volt single phase service. The fuse block on the left was typically labeled "MAIN", and when pulled out disconnected the power to the plug fuse circuits below, but not to the fuse block on the right, typically labeled "RANGE".



(1) Photos by author.

When these fuse blocks were pulled out, the cartridge fuses were exposed on their back sides, as shown in Photo 2. If there was no electric range, this fuse block could be used to provide power to another fuse box elsewhere in the house, or to a garage or other outbuilding. When a fuse block was inserted so that the word "ON" was right side up at the top, the copper blades on the fuse holders made contact inside the panel, and energized the fuses and wiring in the lower part of the panel. When the fuse block was inverted and inserted so that the word "OFF" was right side up at the top, the fuse block could be inserted, but no contact was made.



(2)

The plug fuses protected the wiring in the circuits throughout the building. In those decades, four or eight circuits was considered adequate for a house or small commercial building since the level of lighting that was considered adequate was much lower than today; only one receptacle might be provided per room, since there were few electrical appliances compared to today. Any capacity of plug fuse would fit in the socket including 10-, 15-, 20-, and 30-ampere capacities. It was recommended that the homeowner keep a supply of replacement fuses of each size so that, if a fuse blew, it could be replaced with one of the correct capacity.

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If a fuse blew regularly, the homeowner would often run out of fuses of the proper capacity and replace it with one of a higher capacity. Or, just as often, a blown fuse was unscrewed and deliberately replaced with one of a larger capacity, which could overheat the wiring and cause a fire. This was simpler and less expensive than searching for the cause or installing additional circuits.

This type of service panel is still in use in some houses and other buildings. They are not a problem if they were properly installed, if they have not become corroded or if the connections are all kept tight, if the proper size fuse is used with the size and capacity of the wiring, and if they are still acceptable to the building officials.

Photo 3 shows the electrical panel in a single-family house that was built in 1963. The circuit breaker box on the right is the original panel with a 100-ampere, 120- to 240-volt single-phase service. It has four MAIN breakers; each two-pole connects a 120-240 volt circuit. The upper left disconnects all of the single-pole circuit breakers below, the two-pole breaker below disconnects the subpanel to the left, the upper right two-pole breaker disconnects the electric kitchen range, and the two-pole breaker below it disconnects the electric clothes dryer.



(3)

Over the decades, the number of circuits in the original panel became inadequate because of the addition of more appliance circuits in the kitchen and in other parts of the house. In 1999, the subpanel to the left was added so that more circuits could be added as needed. The two two-pole circuit breakers at the top are not mains; one provides power to the central air-conditioner and the other provides power to the detached



garage. The single-pole circuit breakers in the subpanel are for dedicated appliance circuits in the kitchen and in other parts of the house.

Circuit breakers have an advantage over plug fuses: if they trip, they can be manually reset and turned back on after at least part of the load on that circuit is shut off. If they trip regularly, they are more difficult to exchange for one of a larger capacity. However, this can be done with most brands with a screwdriver after disconnecting the power to the panel.

The key to electrical safety whether using plug fuses or circuit breakers is maintenance:

- Connections must be kept tight.
- Water and moisture must be kept out of the panel to prevent corrosion of the metal parts, which can cause them to overheat.
- If fuses blow or circuit breakers trip frequently, additional circuits must be installed rather than increasing the capacity of the fuse or circuit breaker.
- If the wire insulation becomes brittle or discolored in the panel or near a terminal, the electric service needs professional attention.

Electrical work is specialized and can be hazardous. Electricians are required to serve an apprenticeship (four or five years in most states and provinces) and may need to be licensed by the municipality or by another government entity to obtain permits and to work. Hiring an electrician to maintain the electric service and to install more circuits when needed is less expensive and more convenient than the risk of fire or personal injury that could result from electrical work performed by less qualified persons.



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