

Script: Demo #1, part 1

Before the digital chip and the transistor, the electromechanical age was king. It spanned about 100 years from 1840 to 1940. The telegraph, telephone exchanges, and early computers relied on electromechanical switching devices.

The relay is a prime example of such a device. It's an electrically operated switch. The first relays repeated telegraph signals -- hence the name, relay. Then relays found the perfect home in the automatic telephone exchange, also called a central office by the telephone's inventor, Alexander Graham Bell.

At its heart, a relay is a coil of wire around an iron core. When a current passes through the coil, the iron core becomes a magnet. This attracts a flexible arm that moves a set of electrical contacts.

Notice the first relay engaging now. The electrical contacts move, some making a circuit and some breaking a circuit. Watch the contacts make and break.

After the invention of the telephone in 1876, operators used manual switchboards to route calls. The first commercial board was installed in New Haven, Connecticut, in 1878. Switchboards had some simple supervisory relays, and these became the first generation of relays.

In 1891, Almon Strowger invented the electromechanical stepping switch often called a step-by-step switch. It was a clever device that responded to pulses, from say a dial, and rotated contacts to make connections. In 1892, Strowger's company installed the first automatic, 99-line, exchange in LaPorte, Indiana. No operators needed!

To complete a call, this marvel needed a few simple relays to control the stepping actions. In terms of a timeline, let's call these the second generation of telephone relays. By 1915, the Bell System was operating many small step-by-step exchanges using switches manufactured by the Automatic Electric Company, a legacy of Mr. Strowger.

Script: Demo #1, part 2

In about 1915, The Bell System began developing a new generation of relays for large automatic telephone exchanges. Over many years, the Bell System and its affiliates designed more than **10,000** different relay varieties. Each differs by contact configuration, form factor, speed, and other metrics. Several general-purpose families were developed starting in 1916 and production continued into the 1980's.

For this demo, 5 relay families are showcased, oldest to youngest. Each family is represented by a single relay. Sure, other specific relay types could have been chosen.

But these 5 types were all heavily used, especially in large metropolitan exchanges with names like Panel office and Crossbar office.

Special purpose relays and those used in smaller step-by-step exchanges are not included here.

"I am an E type and the first general purpose, flat-spring, relay. I'm the old man and began life in 1916. I was essential for Panel exchanges built in the 1920s and 30's. I replaced the barrel and similar type relays used before me."

"I am an R type and started life in 1923. People tell me that I look like the E. But I am more power efficient and can operate more contacts. Along with the E, at least 50 million of us were made in the 1920's. "

"I am a U type relay and the workhorse for the number 1 Crossbar Offices built in the 1940's. For the most part, I replaced the E and R types. I am widely admired and can support twice as many contacts as an R relay."

"I am a UB, and the stronger brother of the U relay. Use me when you need lots of contacts and many millions of operations per year."

*"Alas, I am the last in line and the youngest. They call me a wire-spring relay. I'm very clever, and designed for ease of manufacture, contact choice and low cost. I was extensively used in the number 5 Crossbar Office and can perform up to 1 **billion** lifetime operations."*

One relay can control others in infinite combinations to do math, route, classify, and perform logical operations.

In the 1920's, a typical 10,000-line automatic telephone exchange had about 50,000 relays. When a call is dialed, many relays are energized to create the end-to-end connection.

October 2022 is the 100th anniversary of the first 7-digit, metropolitan, Panel-type, automatic telephone exchange. It was installed in New York City and held the now famous, and still operating number, "Pennsylvania 6-5000".

This device is dedicated to the designers, engineers, technicians, and installers who built relay-based automatic telephone systems worldwide.

Script: Demo #1, part 3

Strowger's first phone system in 1892 was a small ripple in what became a massive wave of automatic exchanges being installed worldwide. Each new generation adds features and being more cost-effective. Relay based systems ruled the world until about 1965 when computer-based systems were launched.

At the highpoint of automatic exchanges, there were at least **500 million** relays installed in the Bell System.

In a large city exchange, making a single call could require about 1,300 relay operations. Exchange technicians had to endure a lot of noise. With, say, 20 callers dialing at once, imagine the *symphony of sound* made by 26,000 relay operations!

Here is a small sample of such sounds. Dial pulse counting, and timing were common operations.

A relay's contacts and coils are wired to other relays to produce varied operations. Now, for fun, see what operations just these 5 relays can create.

Demo number 2 is an interactive audio experience. Go to this Demo next and give it a try!