from tripping it. When a foot is placed on the bar, anywhere along its length, the top contact of the limit switch is broken which breaks contact on the motor starter holding coil and stops the motor. As the bar goes on down, the bottom contact of the limit switch is closed and the solenoid on the 4-way air valve is energized, allowing air to flow to one side of the air cylinder. This forces the end cap from the roll, and in turn through a rod linkage also raises the top roll.

The solenoids for the 4-way valve, which operates the end cap cylinder, are normally controlled by two push button stations, one at each end of the roll. After the safety trip has been operated, it is necessary to push the "up" button at one of the two stations to close the end cap or the roll. Then the "start" button can be pressed to close the magnetic starter circuit and start the roll motor.

The approximate cost of this installation is $125 material and $125 labor.

If additional information is desired, contact Clifford Holt, Butler Manufacturing Company, 7400 East 15th Street, Kansas City 26, Missouri.

LOW VOLTAGE SHOCK HAZARDS

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If I were to say that high-tension electricity deserves the utmost respect, there would be no disagreement with the statement. Let's review some of the factors involved in the injuries and fatalities from voltage less than 440 volts which is usually called low voltage and see if some of this respect cannot be extended from the high to the lower voltages.

To illustrate my first point concerning the hazards of electric shock from low voltage electricity, I'd like to review two accidents involving electricity which were written in the daily paper a short time ago.

The first case involves a girl who had a habit of listening to the radio rather constantly and had even formed the habit of carrying the radio into the bathroom. The reconstruction of the accident estimated that the radio was on the side of the bath tub and accidentally fell in the tub and the girl grabbed hold of it to lift it out receiving a fatal shock from the standard house current.

Let's move on to another newspaper item. This concerns a Charles Brown, lineman for an eastern utility, who had been working on a de-energized 66,000 volt line, using ground chain and all standard precautions. At end of job he removed the chain just as the line was energized and received severe burns of hand arm and neck through his leather jacket. He was thrown clear, he came to, drove his car 6 miles to a hospital and then spent 6 months in the hospital recovering from his burns.

Why did Charles Brown live through an attack by 66,000 volts while the girl taking a bath and many others you have read about in the newspapers die with ordinary house current of 120 volts?

The difference between the two incidents is contact. By the law of electric circuits called Ohm's Law, current equals voltage over resistance. To rephrase this law as it might apply to a shock condition we can write this law as follows: Current through body varies directly with the voltage applied to body and the resistance of that body. Resistance in turn is dependent upon amount and condition of body contact.

$$\text{Current through body} = \frac{\text{Voltage applied to body}}{\text{Resistance of body and contact}}$$

By means of an illuminated meter and electrodes I will illustrate this principle.

If you will watch the movement of the needle on the meter you will see how much current flows through my body under different contact conditions although the voltage in the circuit is consistent throughout, 90 volts. You notice that when I touch the two contacts together the needle swings to about 100.

Now as I gingerly hold these contacts with the fingers of each hand you will notice that there is a movement on the needle but it is not very high. As I contact more of each hand onto the electrodes you will notice that there is an increased amount of flow and as I grip the electrodes tightly with each hand I get rather closely to the direct contact reading that we had initially.

What have I been doing? The voltage has been constant, there has been no change in the internal resistance in my body and this highly variable shock current has been produced merely by changes in the contact resistance.

We can now see why low voltage shock varies so much from a trifling tingle to a severe jolt and sometimes to a lethal dose of electricity depending upon how poor or how good the contact resistance is that connects us to the circuit.

Take a situation in your own home. Under what conditions are you likely to be making good connection to ground and at the same time a good contact to some defective electrical device? Your basement is a somewhat dangerous place because basements are damp, but of all places your bathroom is the most dangerous.

If you get into a tub of water you have a very large area of wet contact with ground through the water in the tub and piping eventually leading to the earth. If you handle any portable electrical device whatever, whether it be a defective curling iron or a defective portable heater or a defective motor-driven device or a radio that had fallen into the tub you may touch a part that has become charged and your resistance of the body and its contact will be extraordinarily low. You will get a correspondingly severe shock to your body.

Now to illustrate to you how accidental electric shocks may occur through use of common electrical devices we have what I will call a Robot. This Robot is an associate in a uniform, on which are fastened strings of small lamps. These lamps will show how the flow of electricity would pass through his body when handling defective devices. You may be sure however that we carefully insulate both of his hands and both of his feet from the contact in this demonstration.

These wands that I hold are now connected into the circuit supplied by the lighting system of this building. The most common form of contact is hand to hand, across one arm crossing near the heart and down the other arm. Again, the current may enter by the right arm, travel down the whole torso and leave by the right leg, or could cross over and leave by the left leg.

Now the Robot stands on two strips of metal, one foot on each and the wands are touched to the strips. Now this goes up one leg and into the torso and down the other leg and out. This is the type of shock received by a man stepping from the running rail to the third or live rail of a rapid transit system.

Now the Robot has both feet on a metal strip that represents a wet floor or ground outdoors and his right hand grasps a wand the other wand being moved down to the metal strip. Note this carefully as it is the most common way in which people get electric shocks. Standing on the ground they take hold of some electrical device that is defective and receive a charge in this manner. As you see, the current comes in through the hand and the current flows down the torso and slips into two branches, one going down each leg to each foot to ground. You will note that the lamps on the arm burn more brightly than those on the two legs.

The question of how electricity kills is one to be answered more properly by the medical profession, however, there seem to be basically two causes paralysis of the respiratory center and fibrillation of the heart muscles. The paralysis of the respiratory center has probably been well proven by the many instances of successful artificial resuscitation. This is a situation in which manual movement has overcome the paralysis of the respiratory center.

The situation in fibrillation is that when the stimulus given heart muscles by the electric current the heart is caused to flutter and operates so rapidly that it cannot perform its normal function and death follows very shortly. There have been instances of laboratory control, I am told, when the application of an equal and opposite electric