Elementary Electronics

A Brake Light Warning System

We have seen many designs of indicators which warn when a brake light has failed. Most were quite ingenious, but all suffered from the same objection — they were either too expensive or too involved to warrant Mr Average fitting them to the family car. This design should change all that . . .

Most systems we have seen relied on a solid state device sensing the current across a low resistance placed in series with the lights. While this works very well, it involves a lot of messing around with the brake switch wires and the line to the lights themselves.

Other systems use a light sensing device (usually an LDR) to determine whether or not light is coming from the globe when power was applied. This arrangement does alleviate some of the former problems, but introduces new ones of its own, in that wires must be run back to the indicator lamp on the dashboard, and also that the brake light housing may have to be modified to accommodate the LDR.

But our brake light indicator requires only one break in the line — and if your car is typical of the majority these days, you won't even have to cut the wire; there will be a barrel type connector available at a convenient point for the circuit to be intercepted.

Another advantage of our indicator is that it works equally well on either polarity electrical system, with no changes necessary.

But the biggest advantage of all us is that it should cost well under two dollars to build.

Unfortunately, we cannot claim this as an original idea. It was suggested by a contributor to "The Radio Constructor" (September 1971) and appealed to us so much for its simplicity and inherent reliability that we felt we must pass it on to our readers. Accordingly, we built our own version, tried it out, and prepared this article.

The heart of our system is a dry reed switch. The one used, the XS7, is an economy type which retails somewhere around seventy cents.

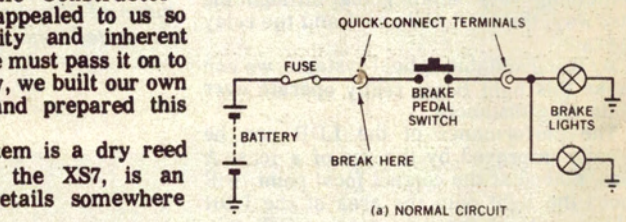
This, and the price of an indicator bezel, is the only real cost. The other parts, a few inches of wire and a couple of tagstrips, can probably come from the junk box. Even if you have to buy them, they won't cost more than a few cents.

Briefly, the construction and operation of our indicator is as follows. Wound around the reed switch is a coil of wire. This wire is connected in series with the wire from the brake pedal switch to the brake lights. One end of the reed switch connects to this same line, the other end connects to the indicator lamp, and the other side of the indicator lamp cannects to chassis.

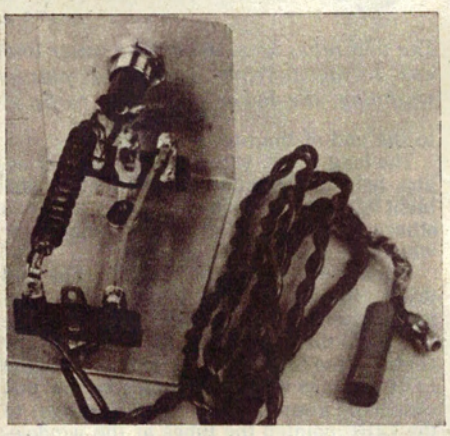
When the pedal is pressed, the brake light switch is turned on. Current flows through the brake lights via the coil. When current flows in the coil it becomes an electromagnet. If the magnetic field is strong enough the contacts of the reed switch will close, allowing the bezel lamp to light. When the brake is released, the whole system returns to normal. Thus, every time the brake pedal is operated the driver is given a visible indication that the brake lights are working.

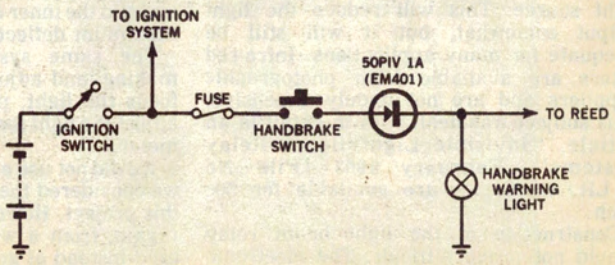
On the other hand, if there is no current, or insufficient current, the reed will not close and the indicator lamp will not light. This warns the driver that there is a fault somewhere in the brake light system.

From this simple description it will be realised that the system is almost completely "fail safe". Regardless of what can go wrong, from a burnt out indicator lamp

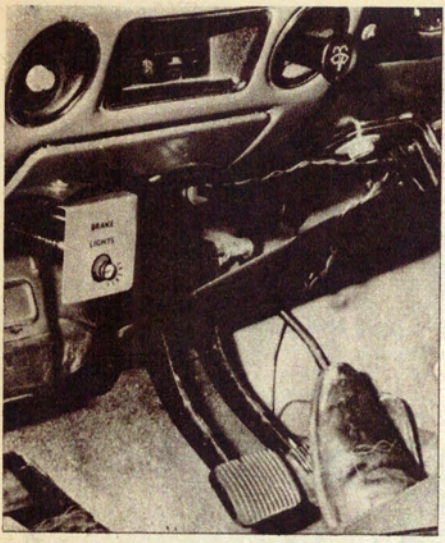


Right: At (a) is a normal brake light circuit. At (b) as modified to include the warning light. Below: Construction of the finished unit.





How the system may be wired to allow the handbrake warning light to double as a brake light failure indicator.



A typical installation. When the brake pedal is depressed the indicator light comes on.

to welded contacts in the reed switch (a most unlikely situation anyway), the result will always be to draw the driver's attention to it. And having done that, it has served its purpose.

A major requirement which this system must satisfy is that it will indicate the failure of only one lamp in the normal two lamp brake light system. This is not hard to do, and a few simple facts about the reed and the lighting system will make it easy to understand.

There are two strengths of magnetic field needed to operate a reed switch. One is the "operating" field, needed to close the contacts, and the other is the "holding" field, needed to hold them together. The operating field needs to be — typically — about three and a half times stronger than the holding field.

When a lamp is cold, its filament resistance is much lower than when it is hot; typically the cold resistance would be only about one eighth of its hot resistance. This means that, at the moment of switch-on, the lamp will draw, for a brief instant, about eight times its normal running current.

We make good use of these two facts. They enable us to adjust the sensitivity of the system so that the reed will just hold in reliably on the current needed to operate two lamps. If one lamp should fail, there will not be enough current to hold the reed in.

In this regard we are fortunate that the cold surge of the lamps is so much greater than their running current. Otherwise we could not adjust the system for such a critical value of holding current and still ensure that the reed would pull in reliably. As it is, the reed will pull in reliably on the surge current from only a single lamp, but it will not hold in, resulting in only a brief flicker.

In practice, this simply means winding the correct number of turns around the reed switch. This isn't hard, even if your brake light system is not the same as the one we used. In our case we took an educated guess and tried 12 turns, which turned out to be spot on. We did try adding and subtracting

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from this number, but this only confirmed that our original figure was correct.

If you have a 12 volt system, with 18 to 20 watt bulbs, this figure will not be very far off the mark for you, too. But just in case, here is how to select the number of turns.

Start by winding 12 turns of wire (16 to 20B&S) directly onto the glass case of the reed switch. Leave a couple of inches at each end, in case you need to add more turns. With a multimeter, check the wires from the brake pedal switch, identify which is the "hot" lead from the battery, and disconnect if.

Connect the hot lead to the junction of the coil and reed switch and the other end of the coil to the vacant brake switch contact. (See circuit diagram.) Connect one side of the indicator light to the reed switch and the other side to the frame of the car.

Now press the brake pedal. Both brake lights should be on. Check to see if the indicator light goes on and stays on. If it does, good. If not, add one or two turns.

Next, remove one of the brake lights from the circuit. In most cars, this involves no more than separating a quick connect terminal, or removing the bulb. Press the brake pedal. The indicator lamp should give a brief flash and then go out. If it does not, add another turn or two until it does. If it comes on and stays on while the pedal is pressed, remove turns, one by one, until it goes out.

We have not described a 6 volt system, as there are not many 6 volt cars on the road these days. But there is no reason at all why the idea will not work with a 6 volt system.

Once the unit is working properly, it can be assembled. We found the that the simplest arrangement was a pair of 3 lug tagstrips mounted on a scrap piece of aluminium. (See photo)

Two leads run from the indicator to intercept the brake line, the most convenient place normally being at the brake light switch, as explained in the coil testing discussion. The leads should be terminated in barrel type connectors to suit those already used in the car.

One other arrangement which comes to mind involves the handbrake warning light with which most modern cars are fitted. With only a little additional effort, this could be made to double as the brake light indicator. There appears to be no objection to this from an operational point of view, and it could be achieved quite simply by connecting the lead from the reed switch direct to the brake lamp, in parallel with the existing connection.

However, one possibility must be considered. If the car is parked with the handbrake on and the brake pedal is pressed, for example by the driver simply using it as a footrest, a circuit will be completed to the ignition coil. At the very least this is undesirable, since it could lead to overheating of the coil. In some other circumstnnces it might even be dangerous.

This objection can be overcome by a simple modification, as shown in the amended circuit. A silicon rectifier diode of at least 1A, 50PIV rating is connected netween the handbrake switch and the lamp.

In this position, it will be reverse biased in the circumstances mentioned, and will not conduct. Under normal running conditions, it will be forward biased with the ignition switch and handbrake on, and the lamp will light. If the footbrake is pressed, the lamp will light because of the direct connection to footbrake indicator.

While this arrangment involves the cost of a diode, it saves the cost of the indicator bezel, and the overall cost should be about the same. It also has the advantage of not requiring that a place be found to mount the indicator bezel, and that the installation will look rather more professional.

Either way, this little device may well save some embarrassment if it warns, in time, that all is not well with your brake lights.