01 Jan 1972

An Inexpensive Electrical Vacuum Feedthrough

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Recommended Citation

D. R. Kastelein et al., "An Inexpensive Electrical Vacuum Feedthrough," *American Journal of Physics*, vol. 40, no. 10, p. 1550, American Association of Physics Teachers, Jan 1972.
The definitive version is available at https://doi.org/10.1119/1.1986896

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American Journal of Physics 40, 1550 (1972)
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For the elastic collision it is necessary to record the motion of both gliders separately. The setup for this experiment is as shown in Fig. 1. The short spark conductor is fastened to the glider on the left with a conducting screw. The two spark conductors are bent in such a fashion that they will be recorded on different halves of the sensitized paper strip so that the data will not be superimposed. The spark will jump from the high-voltage wire to the long conductor of the glider on the right, then through the sensitized paper to the trough recording the position of this glider. Then from the trough back through the sensitized paper to the short conductor of the other glider on the left, recording its position also. The spark will then pass down the conducting screw to the glider, jump to the air track and back to ground. In this way the position of both gliders is simultaneously recorded on the same strip of paper. To perform the experiment, the heavier glider on the right is launched at the stationary, lighter glider on the left.

The spark timers used are the standard model used for the free-fall experiment which produce sixty sparks per second. This spark rate is perhaps too high, and one might find data acquisition a less confusing task with a spark rate of ten or twenty per second. Attachments similar to the one described here will increase the versatility of your Eduquip air track and at the same time reduce your film costs.

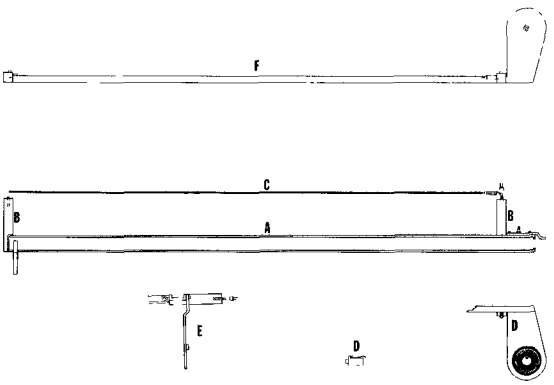

FIG 2. A, aluminum trough; B, insulating supports; C, high-voltage wire; D, details of wax sensitized paper roll holder; E, end view; F, back view.

An Inexpensive Electrical Vacuum Feedthrough*

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A simple electrical feedthrough for use in *vacuum* systems was made using standard automobile spark plugs. Installation of the plug was accomplished by boring and tapping a 14-mm hole in the vacuum flange and then wrapping several turns of Teflon tape around the threaded portion of the plug. Care was taken while turning the plug into the flange to ensure that the sealing tape did not gather entirely on the last few threads. A final full turn with a wrench to tighten the plug against the flange was all that was necessary to produce a leak-tight seal. The standard gaskets provided with the plugs were discarded before insertion into the flange. Both brass and aluminum were used as flange material in thicknesses of $\frac{3}{8}$ in. and $\frac{1}{2}$ in. The system was leak tested using a helium mass spectrometer leak detector.

Several different spark plugs were tested without any appreciable difference in performance.[1] Before use, the plugs were washed thoroughly in a detergent solution, rinsed, and then degreased with acetone. Pressures of 1×10^{-6} Torr were regularly attained which was the ultimate pressure of the system in use. Connections to the center electrode can be facilitated by breaking off the ground electrode; the high nickel alloy material of the center electrode allows spot welding for connecting wires to it. Standard spark plug cable connectors were used to make the external connections. It should be noted that some types of spark plugs have an internal resistor positioned between the external terminal and center electrode. This type of plug would not, of course, function in the application described.

One spark-plug feedthrough was used in a high-voltage application with as much as 3 Kv applied to it. A manufacturer rated the breakdown voltage from the center electrode to the metal shell with the ground electrode removed to be in the 7–8 kV range. In other applications direct currents of 5 A were drawn through the feedthrough for several hours at a time. During this time a slight warming of the feedthrough was noted but no degradation of vacuum was evident.

The automobile spark plug was found to be a very cheap and effective electrical feedthrough for use in vacuum systems. The spark plugs have also functioned acceptably as rf feedthroughs for a quadrupole mass spectrometer.

* Supported in part by the National Science Foundation.

[1] Spark plugs used in the test were Autolite AG52, AC 45XLS and Champion N-148.