

Research on remote control using magnetic fluid power generation

Yizhe Kang, Xiaoyu Zhou

School of North China Electric Power University, Hebei, China

Abstract. Aiming at the problem of serious environmental pollution and insufficient energy utilization caused by dry battery power supply in the existing remote control, this project has carried out technical improvement and innovation in power generation mode and the structure of remote control. The main contents include: 1. Magnetic fluid power: comparing with the traditional dry batteries power for remote control, this device adds the winding hose of magnetic coil to the basis of traditional remote control, will change the mechanical energy that produced by pressing into the electricity that the remote control need to output a signal, so as to replace the use of dry cell in the traditional remote control and reduce environmental pollution. 2. Remote control structure design: keep in the original signal control method, on the basis of innovation in tile around a coil hose between the original signal circuit and remote shell, realize the simultaneous press power and signal control hose as a whole, press any key will be to hose extrusion formation, promote tube MHD flow, to produce the electricity required to signal control. Below the hose has kept the original control signal circuit, press the process control signal synchronization connected, so as to realize the remote-control operation This device to keep the traditional signal control module and a button on the remote-control module, the hose by magnetic generator for replacement battery power supply module, has the advantages of lower manufacturing cost and zero emissions, in line with the concept of energy saving and emission reduction.

Keywords: Magnetic fluid; Electromagnetic transduction; Rectifier amplifier circuit.

1. Introduction

Lay a 3D thin plastic hose sealed with a certain concentration of magnetic fluid stock under the keys of the remote control according to the designed arrangement, and wrap a metal wire with a certain number of turns and small resistance around the plastic hose. When the person presses the key above the plastic hose, due to the plastic hose is squeezed, the magnetic fluid inside the tube flows with a certain flow rate, and the metal wire will cut the magnetic fluid, producing the induced electrodynamic force [1,2]. But the voltage generated by a press is not enough to make the infrared remote-control work normally, so the transformer is used to amplify the voltage. In addition, the current generated by electromagnetic induction is unstable alternating current, but the remote control needs stable direct current, so it uses the diode bridge rectifier circuit to change the unstable alternating current generated by electromagnetic induction into stable direct current, and then output. Finally, connecting the terminal of the remote control which was originally connected to the dry battery with the designed diode rectifier circuit, and the power supply for the remote control can be realized by pressing the button above the plastic hose.

The project focuses on the selection of the type and concentration of the magnetic fluid, the thickness and length of the coil, the arrangement of the plastic hose and the development of the plastic hose of a specific shape.

2. Design Scheme

2.1 Pressing Structure

After many experiments, the influence of velocity on voltage size, we found that the faster the magnetic fluid cutting coil, the greater the voltage generated. Preliminary experiment used ordinary plastic hose cannot get bigger velocity. To get more instantaneous voltage, our project designed a thin tube with small columnar disks. Special hose design is shown in Fig. 1 and Fig. 2:

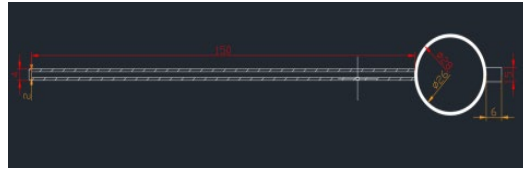


Fig. 1 Plane layout of fine plastic flexible rubber hose



Fig. 2 3D picture of fine plastic flexible hose

Since the inner diameter of the former is much larger than that of the latter, when pressing the small disk, the pressure generated can make the flow velocity of magnetic fluid liquid rapidly increase, thus cutting the metal coil to produce a larger voltage.

The part of the small disk is laid under the button. When the person presses the button above the remote control, the hose and the circuit board button below the hose can be squeezed at the same time to complete the instantaneous power supply and signal output.

In addition, it should be noted that:

- 1). In order to reduce the loss, the coil resistance should be as small as possible under circumstance of ensuring the number of turns of the coil.
- 2). The rebound speed of the magnetic fluid in the hose is related to the material of the hose. When the elasticity of the hose is large, the magnetic fluid can rebound rapidly within 1s.

2.2 MHD power generation

Different magnetic fluid flow rates produce different currents. In this experiment, we successively selected water, oil, edible oil and other dissolvers to mix with Fe₃O₄ iron powder to produce magnetic fluid, and the effect is shown in Table 1.

Table 1. Comparison of effects of different solvents

Dissolved liquid	Solvent:Fe ₃ O ₄ (volume ratio)	The effect
Water	3:1	If the viscosity is not enough, the iron powder cannot mix well with the solvent
The oil	3:1	Poor fluidity, easy to adhere to the hose wall
Cooking oil	3:1	Good viscosity and fluidity, can be fused iron powder in the hose flow smoothly and cut coil power generation

Through the comparison of the three solvents, it was found that edible oil was not only economically favorable, but also had good viscosity and fluidity, which met our experimental needs. Therefore, this project finally chose edible oil as the dissolving agent, and the ratio of magnetic fluid liquid was dissolving agent: Fe₃O₄(volume ratio)=3:1.

2.3 Stable voltage output

In order to output the electric energy required by the remote control, the electric energy generated by the magnetic fluid device needs to go through four links, namely amplification, rectification, filtering and voltage regulation, mainly involving the following four circuits (Figure 3).

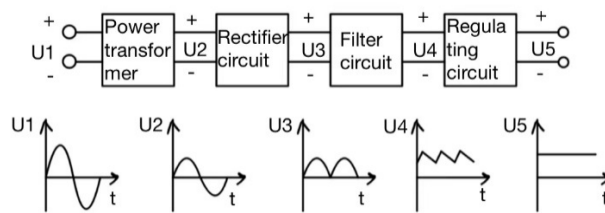


Fig. 3 Circuit design flow chart

The stable power supply of the infrared remote control is realized by converting the small and unstable AC voltage into the stable DC voltage output.

3. Experimental data analysis

3.1 Experimental device

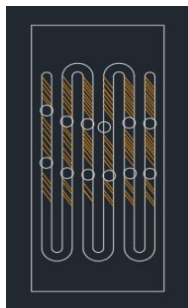


Fig. 4 Design drawing

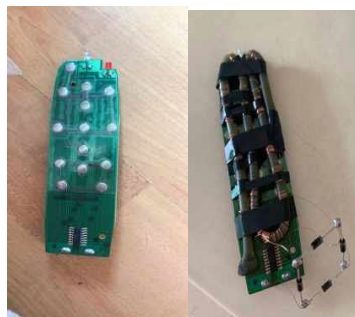


Fig. 5 Physical drawing

3.2 Experimental Data

3.2.1 Circuit structure

Repeat the experiment for five times by pressing the cylindrical disk once, the voltage data measured is shown in Table 2:

Table 2. The induced electromotive force obtained by a single extrusion

T(s)	V1(mV)	V2(mV)	V3(mV)	V4(mV)	V5(mV)
0	13	15.3	12.6	12	13.7
0.025	0.9	3.9	3.1	2.9	1.8
0.075	0.5	2.3	1.4	1.3	0.8
1	0	0	0	0	0

The relationship between the induced electromotive force and extrusion time can be obtained by making the above data into a broken line graph (1~5 line respectively corresponding to the first to fifth experiment induction electromotive force peak changes over time):

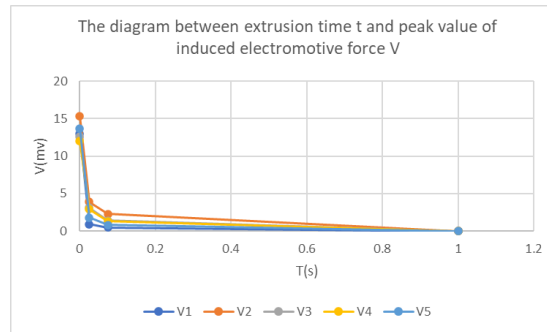


Fig. 6 The diagram between extrusion time t and peak value of induced electromotive force V

It can be seen from the graph, line slope greatly when extrusion time t tends to 0, which shows induction electromotive force peak produced by each extrusion along with the change of time decay quickly, and extrusion maximum induction electromotive force generated at the moment is the instantaneous voltage we need.

3.2.2 Amplifier rectifier filter circuit

Transformer amplification circuit used in the experiment: The turns ratio of the coupling coil is designed as $n_1 : n_2 = 1 : 200$, and the voltage obtained by the magnetic fluid cutting coil can be amplified 200 times through the bridge rectifier circuit. The average value of the output voltage is obtained:

$$U_{OL} = \frac{1}{\pi} \int_0^{\pi} \sqrt{2}U_2 \sin \omega t d(\omega t) = \frac{2\sqrt{2}U_2}{\pi} \approx 0.9U_2$$

After fitting the original data and passing through the amplification circuit and rectification circuit, the voltage obtained is shown in Table 3.

Table 3. The output voltage after amplification and rectification

Voltage(V)	V1(V)	V2(V)	V3(V)	V4(V)	V5(V)
$U_{OL}(\text{theoretical})$	2.08	2.754	2.268	2.16	2.466
$U_{OL}(\text{actual})$	2.05	2.72	2.22	2.10	2.38

The actual voltage after circuit integration has a little difference with the theoretical value, which is due to the existence of tiny losses in the circuit structure, which can be ignored. As shown in Table 3, the output voltage obtained by the amplifier rectifier circuit is $U_{OL} \geq 2V$.

After that, the 2V stable voltage regulator diode is connected in series with a current-limiting resistor and connected in parallel with the filter capacitor to output a stable 2V voltage. So the remote control can work normally.

4. Conclusion

Television production in about 150 million units in China each year. Assuming that the application of the remote control of electricity using magnetic of TV in our country, a TV need a remote control and the number of TV production almost remains the same every year: if 10% of the TV remote controls use the technology of MHD power generation, you can save 60 million dry cells within a year refer to the current output. In the whole service life of this batch of TV remote control (about 2~3 years), a total of about 150 million dry battery can be reduced. If the technology can be popularized and applied in a wider range, or for the existing remote control of magnetic fluid power technology transformation, it will be able to reduce the use of more batteries, and realize energy conservation and emission reduction.

The basic structure of this work is consistent with the traditional remote control, only in the signal circuit and remote-control shell added a coil with magnetic fluid special hose. So the device not only has the control function of the traditional remote control, but has the advantages of lower cost, better stability, longer service life and zero energy consumption.

References

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