

MUSICAL

By E.G. PRENTICE

DOORBELL

THIS circuit provides a novel doorbell giving a musical tune. Unlike most doorbells it has the added advantage that a number of loudspeakers can be connected to announce callers in any room in the house.

The cheerful sound triggered off by the caller originates in a clockwork musical box mechanism. The output from this mechanism is converted into an electrical signal which is then amplified. An ingenious but simple contact transducer is made from a crystal pickup cartridge.

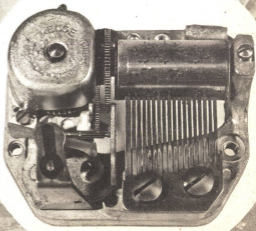
CIRCUIT DESCRIPTION

Transistor TR1, relay RLA, and associated components (see Fig. 1) form a timing circuit which allows the doorbell to "play" for a preset period (about seven seconds) irrespective of the length of time the caller has his thumb on the bell push. The relay is additionally responsible for the mechanical start and stop of the musical box mechanism.

The remainder of the circuit is a conventional push-pull audio amplifier which raises the transducer output to loudspeaker level.

On pushing the bell push S1, a negative voltage is applied to the base of TR1, via the normally closed relay contact RLA1, causing a rise in collector current. This energises the relay, which closes RLA2 (the speaker muting contact) and RLA3 (the main power contact), and opens RLA1. The large capacitor C1 starts to charge, and the charging current keeps TR1 biased on. As C1 continues to charge, the bias current progressively falls until the point is reached where the corresponding collector current is insufficient to sustain the relay, which then drops out and switches off the whole assembly. The charge remaining in C1 is now discharged through RLA1 and R2.

When the relay is energised, a lever attached to its armature (see Fig. 4) releases the clockwork musical box mechanism and the resulting sound is picked up and converted by the crystal transducer to an electrical signal.



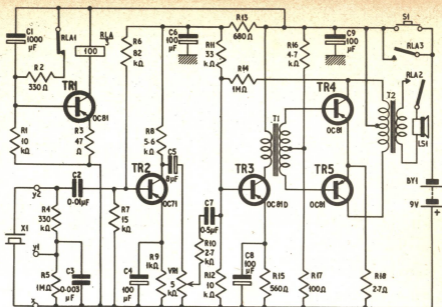


Fig. 1. Circuit diagram of the amplifier and timer

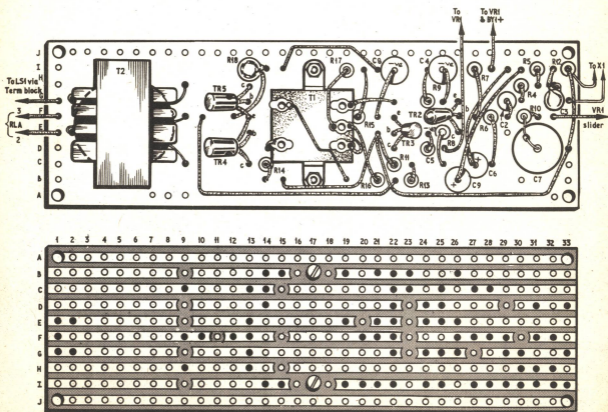


Fig. 2. Amplifier layout and wiring with (below) the underside of the Veroboard

This signal is applied to the base of TR2, the amplifier input stage, and is thus amplified and applied to the volume control VR1 via the d.c. blocking capacitor C5. The appropriate level of signal is tapped off by the slider of VR1 and applied to the base of the driver transistor TR3. The resulting amplified signal at the collector of TR3 is conveyed by T1 to the base of the push-pull output transistors TR4 and TR5 in opposite phase, and after further amplification is recombined by the output transformer T2.

PLAYING TIME

The length of playing time is of course governed by the charging time of C1. This can be varied to suit requirements: raising the capacitance of C1 and/or the resistance of R1 lengthens the playing time, and vice versa.

The mechanical noise of the lever hitting the butterfly on cutting up is prevented from reaching the speaker by the relay contact RLA2, which is adjusted by careful bending to break the speaker connection before the lever actually comes into contact with the butterfly.

MECHANICAL CONSTRUCTION

The unit is assembled on a $\frac{3}{8}$ in thick plywood baseboard measuring approximately 8in by 4 $\frac{1}{2}$ in, to which is screwed a vertical panel of similar size and material.

On the baseboard is mounted the amplifier board, the battery BY1, and the terminal block for the loudspeaker and bell push. The front panel carries the musical movement and transducer, as well as the relay and the volume control VR1. A $1\frac{1}{2}$ in diameter hole in the panel gives access to the winding key of the movement.

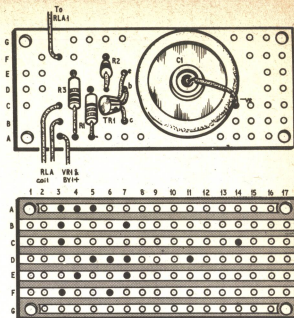
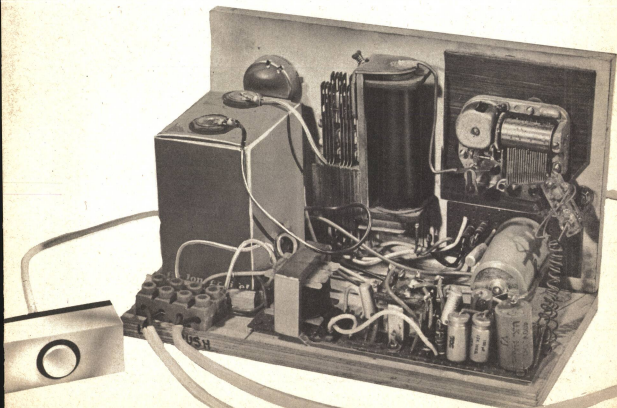


Fig. 3. Layout of the timing module



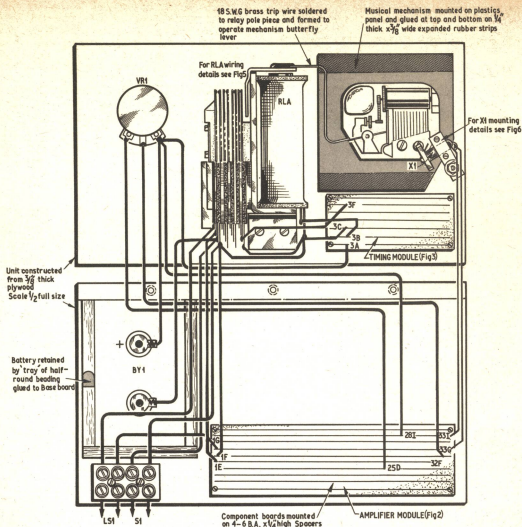


Fig. 4. Flattened-out view of the front panel and baseboard, showing interconnections. The crystal transducer, X1, is positioned to make light mechanical contact with one of the comb-fixing screws of the musical movement

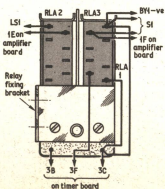


Fig. 5. Relay wiring details

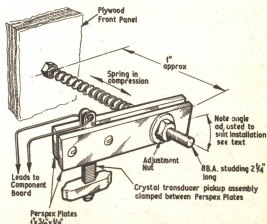


Fig. 6. Construction of the transducer. Electrical connection to the foils of the crystal is made by sandwiching two metal shims between it and the Perspex plates

COMPONENTS . . .

Resistors

R1	10k Ω
R2	330 Ω
R3	47 Ω
R4	330k Ω
R5	1M Ω
R6	82k Ω
R7	15k Ω
R8	5-6k Ω
R9	1k Ω
R10	2-7k Ω
R11	33k Ω
R12	10k Ω
R13	680 Ω
R14	1M Ω
R15	560 Ω
R16	4-7k Ω
R17	100 Ω
R18	2-7 Ω wirewound 3 watt
All 10% $\frac{1}{4}$ watt carbon, except R18	

Potentiometer

VR1 5k Ω log.

Capacitors

C1	1,000 μ F elect. 12V
C2	0-01 μ F 15V
C3	0-003 μ F 15V
C4	100 μ F elect. 12V
C5	8 μ F elect. 12V
C6	100 μ F elect. 12V
C7	0-5 μ F 15V
C8	100 μ F elect. 12V
C9	100 μ F elect. 12V

Transistors

TR1	OC81
TR2	OC71
TR3	OC81D
TR4	OC81
TR5	OC81

Transformers

T1	(driver) Radiospares type T/T6
T2	(output) Radiospares type T/T7

Relay

RLA Post Office type 3000. 100 Ω coil with minimum of two make and one break

Switches

S1 Bell push

Loudspeaker

LS1 Any p.m. type of about 5in diameter or larger, and having a 3 Ω coil

Battery

BY1 9 volt (PP9 or equivalent)

Transducer

X1 Crystal element removed from BSR cartridge type TC8M or TC8H (see text)

Musical box mechanism

Hobbies' Swiss Musical Movement No. 1 (tune as selected)

Miscellaneous

Battery clips. Four-way terminal block. Rubber strip. Cellulose cement and contact adhesive. Materials for transducer (see text and Fig. 6)

To minimise microphony and mechanical noise, the movement is mounted on to a piece of laminated plastics, the screws passing through rubber grommets, which is then attached with adhesive and $\frac{1}{4}$ in thick strip rubber spacers to the front panel, as in Fig. 4. Ensure that the heads of the mounting screws cannot touch the panel.

Before installing the relay, a 3in length of 16 s.w.g. brass wire is soldered to the armature and bent in the form of an elongated L (see Fig. 4). The relay is then mounted on the panel by means of a small bracket made from $\frac{1}{2}$ in sheet brass, and so positioned that the wire comes into contact with the butterfly governor of the musical movement when the armature is open, and releases it when the armature is closed.

THE TRANSDUCER

Construction of the transducer is rather a delicate task. It uses the element from a crystal gramophone pickup cartridge type TC8M or TC8H.

Remove the cartridge from its cradle and pull out the two styli. The cartridge is held together by two rivets: when these are carefully drilled away, the two plastic halves can be parted and the crystal removed. Two small "Perspex" sideplates are cut and drilled to take 8 B.A. screws, as in Fig. 6, and a small metal shim is glued to each plate with contact adhesive so that when the two sideplates are screwed together they form a clamp across the crystal and make contact with its connecting foils.

The completed assembly is mounted on a 2 $\frac{1}{2}$ in length of 8 B.A. screwed studding at an angle of about 45 degrees and held in place by a nut compressing the assembly against a spring.

The transducer is then screwed to the wooden panel in such a position that the plastic bridge at the end of the crystal comes into contact with one of the comb-attaching screws of the musical movement. Final adjustment for best tone and volume is made when the amplifier is completed. The nut can then be locked into position with a little cellulose cement. Beeswax applied to the junction of the transducer and comb screw will remove chatter.

AMPLIFIER CONSTRUCTION

Building the amplifier and timer circuits is quite straightforward and layout is not critical. The prototype used Veroboard (wiring and interconnection details in Figs. 2, 3, and 4), but a chassis or tag board approach is equally suitable. Connections for the bell push and loudspeaker should be taken to a terminal strip.

When connecting the transducer to the input of the amplifier, very thin wires, previously coiled, should be used to avoid microphony. The soldering must be done very quickly to prevent damage to the crystal. A safer alternative would be to attach the leads to the metal shims already described, before assembling the transducer.

Crystals from TC8M cartridges should be connected between points X and Y2 in the circuit diagram, and TC8H types between X and Y1.

SETTING UP

Connection of the battery, speaker, and bell push completes the general construction. On turning up the volume and pressing the push, the relay should energise and release the movement. The amplified tone should issue from the speaker for about seven seconds and then cut off automatically.

If a loud howl is produced, reverse the connections to the primary of T1.

If the unit shows no signs of life, check first the battery polarity and then the relay connections. The amplifier can be tested by manually holding down the armature of the relay to apply power, and then feeding in a signal to the transducer terminals (X and Y1 or Y2 in Fig. 1) from a crystal set, a gramophone pickup, or a microphone. The speaker muting contact (RLA2) is a possible source of intermittent operation—it should be cleaned carefully with a proprietary fluid or with fine emery paper. Failure of the timing circuit to switch off after the appropriate period may be caused by a "leaky" C1.

FINAL INSTALLATION

The movement will need winding about once a week—dependent on how popular you are—so the unit should be accessible. It should also, if possible, be protected from dust and the products of cooking (if installed in the kitchen) since these could in time contaminate the relay contacts.

Connection to the speaker and bell push can be via ordinary twin bell wire, but if your long leads to the speaker are involved, 5 amp lighting flex is preferable to avoid loss of volume. It is possible to mount the speaker and "electronics" in one box, but microphony caused by mechanical feedback from speaker to transducer may limit the maximum useable output.

In conclusion the author finds that component values are not critical and can be varied somewhat to suit available parts, with the exception of the relay and timing components C1 and R1.

Current consumption averages 45mA and battery life should be about a year. ★

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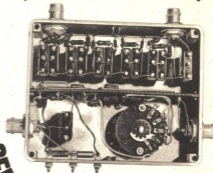
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