TELEPHONE CALL TIMER

Submitted by Mr A. M. Tucker of Dorchester.

TO CARRY OUT its function, which is to display the cost of individual calls, and also to keep a running total of all metered calls, the circuit must add the amount of the unit charge (at present 3p) to each register when the call commences, and subsequently at the end of each charge period. This period will vary for peak, standard and cheap times, and with distance. Provision should be made for altering the settings of the counting circuits if there is a change in the Post Office charges.

Various circuits were considered, and this was considered to be as cheap to make as any for the facilities provided, as although there is a large number of ICs, the bulk are low priced.

The two sets of figures are circulated in a single shift register, the digits being interlaced; ie, the least significant figure in one register is followed by the least significant figure in the other register, and then by the next figure in the first register, and so on.

In order to be able to adjust the unit charge, and the periods available per unit, the outputs of the dividers are connected to sockets into which leads from the inputs of the resetting gates are plugged. These sockets, plus "parking places" for spare gates, can be made from IC sockets, or soldercon pins in plastic supports. To prevent damage to the pins of sockets when cutting into sections, push into a piece of rigid foam plastic. The wander leads are just lenghts of connecting wire. Solid core is suitable: if stranded wire is used, tin the end and check that it is thin enough to insert into the socket.

In the interests of economy, small low consumption displays have been used. If larger displays are required, it will probably be necessary to add segment drivers. The drivers should then be supplied from the unregulated side of the supply, and S1 made a double-pole switch.

The 9-volt standby battery is essential, as otherwise the "total cost" register would be cleared in the event of a mains failure. In order to reduce consumption during idle time, the counters IC1 and IC2 and their associated gates, the oscillator IC21 and the display buffers and driver IC23-IC26 are switched off by S1. It is unwise to try to include other ICs, as some inputs may be high. In any case, with the oscillator off, power consumption is very low in the remaining circuits.

It may simplify the wiring of a 4001 and a 4011 are substituted for the 4069. One NOR gate can be used instead of IC20a and IC22a, and a choice of ICs is available for the other inverters.

The meter can be adapted for battery power only by including a 4518 to divide the 10 kHz oscillator frequency down to 100 Hz, and doubling the division in IC1 by shifting each flying lead one place to the right. Setting the oscillator frequency exactly can be carried out either by comparing the 100 Hz output with 50 Hz from the mains on an oscilloscope, or by varying the setting until the charges are incremented at 10 second intervals for long distance calls at peak rates.

Decoupling capacitors for pulses in the supply lines may be required. While CMOS is less exacting than TTL in this respect, 10n non-inductive capacitors should be fitted across the supply pins of ICs at the end of supply lines, and across each of the more complex ICs.

A flashing LED is provided as an indication (and reminder!) that the timing circuits are operating.

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HOW IT WORKS

TO commence timing a call, SW1 is switched on, and SW4 and SW5 set. When the person replies, SW2 is closed. This removes the reset from IC1 and IC2, which start counting 50Hz mains pulses. At the same time IC6a is trigged, producing a 1mS pulse which clears the single call register — the digits being selected by IC21b and IC18b.

At the termination of the pulse, Q goes low and triggers IC6b. The Q output of this IC then goes low for 7mS or until reset by IC7, which is enabled by the high Q output of IC6b, and is clocked through IC20b each time the LSB of the registers are present at Q_0 and Q_1 of C11, until the output connected to IC22e goes high, when IC6b resets and inhibits IC7.

The output from IC7 is fed through IC8 to the 'carry in' of the adder (IC14) driving the LSB. Three cycles of the shift registers are required to increment the registers by 3p.

SW4 and SW5 set the time available for one unit. For present Post Office rates, IC1 is preset to divide by 250, giving an output pulse every 5S,IC2a divides by two, three or twelve. IC2b by three or twelve.

A pulse stretcher (R3, C3, D5) is included to ensure IC1 resets.

When the timing pulse reaches IC20d, IC6b is retriggered, clocking up another unit charge. The two sets of figures are stored in four 8 stage shift registers IC12 and IC13 and are circulated through the adder (IC14). The digits are selected for display by the divider IC11.

Clocking of these ICs and IC10 is effected by the 10k oscillator IC21a, b. The exact frequency of this is not important, but must be related to the length of the monostables IC6a and IC6b.

IC21c is a buffer and the low clocking pulse required by the shift registers is provided by IC21d.

When the call is completed, SW2 is switched to off, and the resets on IC1 and IC2 go high, stopping the count. The cost of the call remains in the register until SW2 is closed for the next call. At the end of a quarter, the 'total cost' register can be cleared by pressing SW3. C4, D4, R6 provide a 'power-on' reset which ensures that the flip-flops are correctly set initially, and that IC7 is not started in the middle of a charge period.

When no more calls are expected to be made for a while, SW1 is opened, dropping current consumption to a very low figure so that a battery backup can be used against mains failure.

PARTS LIST

RESISTORS all 5% ½W	
R1, 2, 14-20	1k
R3	12k
R4, 5, 10	100k
R6, 7, 9, 11, 13	1M
R8	1M5
R12	3M3
R21, 22	1k5
POTENTIOMETERS	
RV1	500 k trimmer
CAPACITORS	
C1, 2	470u electrolytic
C3	47p ceramic
C4	1u electrolytic
C5, 7	1n polyester
plus various 10n ceramic decoupling capacitors.	
SEMICONDUCTORS	
D1	4×1N4001 or 1A bridge
D2-5	1N914 or equivalent
IC1	4040
IC2	4520
IC3, 5	4082
IC4	4073
IC6	4098
IC7, 11	4022
IC8, 16, 21	4072
IC9, 20	4071
IC10	4027
IC12, 13	4006
IC14	4008
IC15	4511
IC17-19	4081
IC21	4011
IC22	4069
IC23, 24	4050
IC25, 26	74592
IC27	LM78L12
Displays	HP5082-7414
MISCELLANEOUS	
100mA transformer, etc.	

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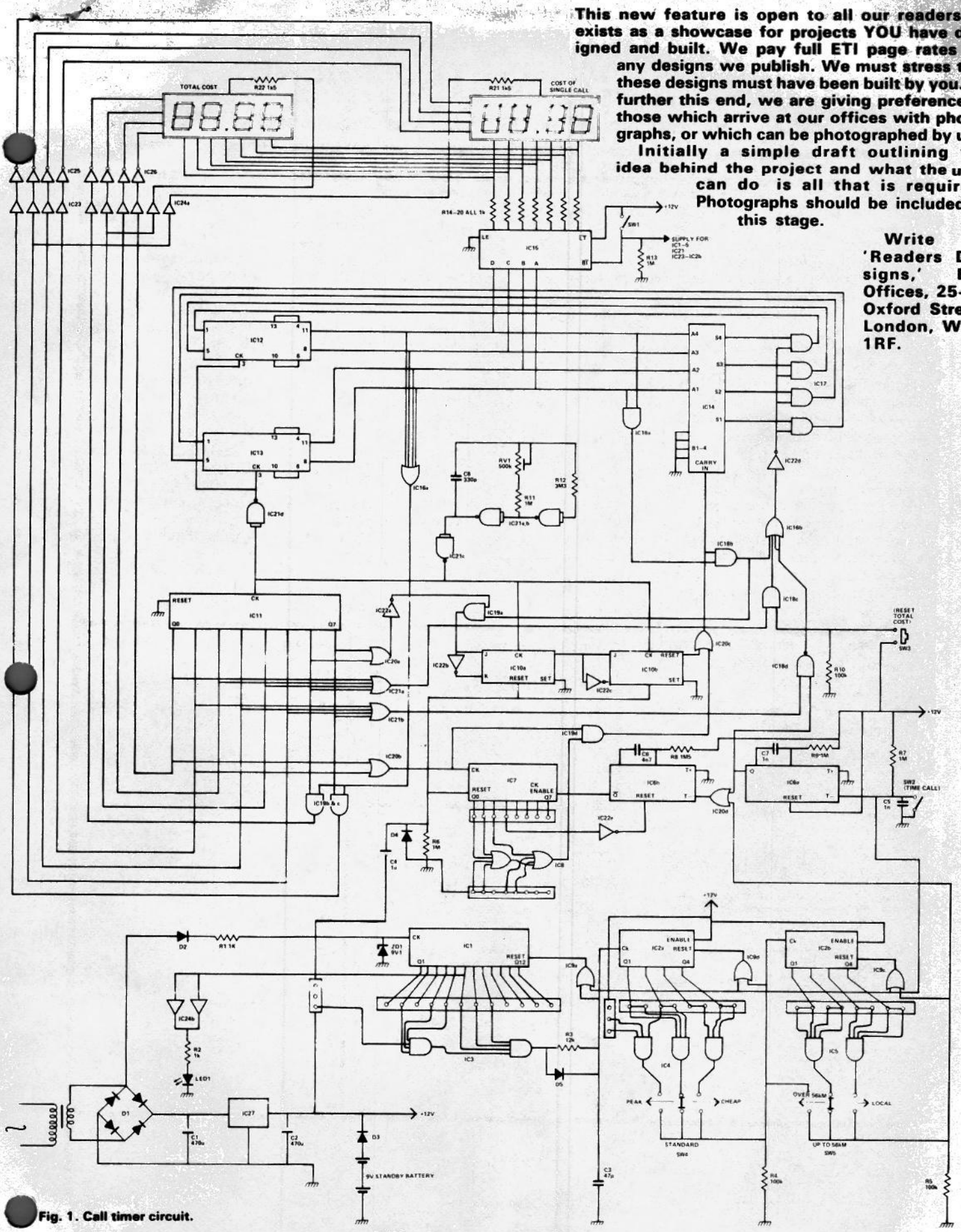

Fig. 1. Call timer circuit.