(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 034 401**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **81300106.2**

(22) Date of filing: **12.01.81**

(51) Int. Cl.³: **H 05 B 41/04**

(30) Priority: **08.02.80 GB 8004226**

(43) Date of publication of application:
26.08.81 Bulletin 81/34

(84) Designated Contracting States:
AT CH DE GB IT LI NL

(71) Applicant: **THORN EMI LIMITED**
Thorn House Upper Saint Martin's Lane
London, WC2H 9ED(GB)

(72) Inventor: **Pegg, John Cyril**
Hillcrest Whiley Hill Road Coatham Mundeville
Darlington Durham(GB)

(74) Representative: **Marsh, Robin Geoffrey et al,**
THORN EMI PATENTS LIMITED Blyth Road
Hayes Middlesex, UB3 1BP(GB)

(54) **Discharge lamp circuit.**

(57) Two (or more) gas discharge lamps (10, 110), each in series with a choke ballast (18, 118) across A.C. supply terminals (16*a*, 16*b*) are started by a single starter circuit (70), the lamps being connected to the starter circuit through respective rectifying diodes (150, 152). The starter circuit (70) operates with rectified half-cycles of the A.C. supply, and resistors (154, 156) balance the cathode heating currents between the two lamps. Preferably the starter circuit is rendered ineffective in a failed-lamp condition, and to this end (per DE-OS 28 16 415) it includes a thyristor (26) triggered by a control circuit which includes a capacitor (32) effective to increase the instantaneous applied voltage which is required to trigger the thyristor with successive cycles of the applied voltage after initial switch-on of the circuit. A Zener diode (30) is in series with the capacitor (32).

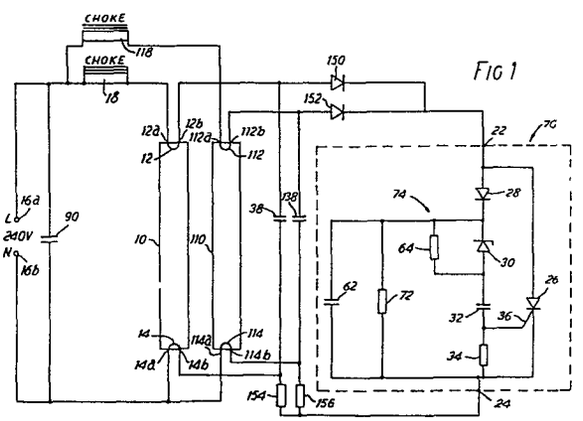


Fig 1

EP 0 034 401 A2

DISCHARGE LAMP CIRCUIT

This invention relates to the starting of discharge lamps.

In many applications several discharge lamps, for example fluorescent tubes, are used together. Typically they are used in pairs. Special starter circuits have been developed for starting two lamps, but in general they only work with two lamps and will not start the remaining lamp properly if one lamp fails. The lamps are either simply connected together in series or are an integral part of the starter circuit, and the arrangement is thus inflexible.

The most common starter arrangement for two lamps treats the two lamps quite independently, in that each lamp has its own starter unit.

The glow-switch starter is still the most common commercially available starter. However, over the years various different types of electronic starter circuit have evolved, as is illustrated by British Patents 1,264,397; 1,278,839; 1,342,026; 1,397,265 and 1,411,575, and our German laid-open Patent application (Offenlegungsschrift) 28 16 415.

According to the present invention there is provided a discharge lamp circuit, comprising two or more discharge lamps each in series with a choke ballast across supply input terminals, a starter circuit of a type which is operative with a cyclically-varying unidirectional supply voltage, and two or more rectifier elements, each element connecting a respective one of the lamps across the common starter circuit.

The invention enables a single starter circuit to be used to start two or more lamps, without adverse results if one of the lamps should fail.

The invention will be described in more detail by way of example with reference to the drawings, in which:

Figure 1 is a block circuit diagram of a discharge lamp circuit embodying the invention for starting two tubes; and

Figure 2 is a block circuit diagram of a circuit with four tubes.

The circuit illustrated in Figure 1 has two gas discharge lamps, (fluorescent tubes), 10 and 110, each connected through a respective choke 18, 118 across A.C. mains supply input terminals 16a, 16b. The tubes are of the heated cathode type and have cathodes 12, 14, 112, 114 with terminals 12a, 12b, 14a, 14b, 112a, 112b, and 114a, 114b. A conventional power factor capacitor 90 is preferably connected across the supply input terminals.

A single starter circuit 70 having starter input terminals 22, 24 is used to start both tubes 10, 110. To this end the starter circuit 80 is connected across each of the tubes 10, 110 through a respective diode 150, 152, the diodes having their cathodes connected together and to the terminal 22. The terminal 24 is connected to the tubes 10, 110 through respective resistors 15, 156. Two capacitors 38, 138 may be connected directly across the two tubes 10, 110 respectively.

The illustrated starter circuit 70 is of the type shown in Figure 6 of our aforementioned German Application 28 16 415, to which reference should be made for a detailed description of its construction and operation. Briefly, the starter circuit comprises a thyrister 26 connected across the starter input terminals 22, 24, and a control circuit 74 for triggering the thyristor 26 into conduction once during each cyle of the applied voltage. The control circuit 74 comprises a series circuit of a diode 28, a Zener diode or other avalanche diode

having a zener-like characteristic 30, a capacitor 32, and a resistor 34, with the gate 36 of the thyristor connected to the junction between the capacitor 32 and the resistor 34.

A resistor 64 is connected across the Zener diode 30, and a capacitor 62 and resistor 72 are both connected in parallel across the Zener diode 30, capacitor 32 and resistor 34.

The starter circuit has the following characteristics. First, it is capable of working with a unidirectional cyclically-varying input voltage, particularly with half-cycles of rectified A.C.

Secondly, with the preferred type of circuit illustrated, after initial switch-on of the circuit, the instantaneous applied voltage across the terminals 22, 24 which is required for the thyristor to be triggered into conduction increases progressively as the starter circuit operates, until a point is reached where no such conduction occurs. This has the result that in the failed-lamp condition the starter circuit is automatically rendered ineffective a relatively short time after switch-on.

In operation of the circuit, the starter circuit 70 operates as described in our aforementioned German Application, and the thyristor trigger point progresses until one tube, say tube 10, is ready to strike. There will then be a partial discharge in this tube which will continue until, on the next half cycle, the thyristor 26 conducts and shorts out the tube 10. The thyristor is however triggered on this half cycle because the tube 110 which is not ready to strike maintains a high voltage across the starter. Trigger point progression continues further until the second tube 110 is ready to strike, when both tubes will strike together, and drop the voltage across the starter to a value below the voltage necessary to cause triggering.

If one tube, say tube 110, fails to start, the starter circuit 70 will continue to the end of its progression, and then the thyristor 26 will cease conducting, allowing the other tube 10 to strike. This delay does not produce any measurable damage to the cathodes.

The diodes 150, 152 provide isolation between the two tubes 10, 110. The capacitors 38, 138, if used, provide pulse enhancement on the negative half-cycle of the supply, as described in our aforementioned German Application.

The resistors 154, 156 are current sharing resistors incorporated to reduce the effects of differing resistances of cathodes 14 and 114. Differences in cathode resistance may result from manufacturing tolerance, cathode type and, importantly, from ionization between the cathode supports during the starting period. Since each current sharing resistance is in series with a cathode, the whole forming a parallel network, the higher the resistance of resistors 154/156, then the smaller is the effect of differing cathode resistance. The resistors 154/156 are chosen to be large enough to reduce the effect of differing cathode resistance sufficiently without being so high that excessive power is dissipated in them during starting or the total cathode pre-heat current is unduly reduced. Where the circuit components are otherwise as described in our aforementioned German Application, a suitable value for resistors 154 and 156 is 5 ohms.

Putting the cathodes in series is not very practicable, because a double arc current would pass through one of the cathodes which could cause damage to the cathode.

Typical circuit values for the Figure 1 circuit are as follows, for 65W tubes:

Resistor 34	1 KΩ
Resistor 72	10 MΩ
Resistor 64	3.9 MΩ
Resistor 154/156	5Ω
Capacitor 32	0.1μF

Capacitor 62	0.01μF
Capacitor 38/138	6 nF
Diode 28	G.I. type IN4007G
Diode 30	110V Zener
Diode 150/152	G.I. type GP15M
Thyristor 26	GE type C118M

The circuit of Figure 1 can be modified to pass starting current on negative rather than positive half cycles of the mains A.C. supply. Not only is the starter circuit 70 reversed in polarity, i.e. the terminals 22 and 24 are connected the other way around, but also the diodes 150 and 152 must be reversed. In order to minimise the D.C. current component taken from the mains supply during starting in a large lighting installation equal numbers of starters of positive and negative half cycle starting-current types are preferably used.

The illustrated starter circuit 70 is based on Figure 6 of our aforementioned German Application. The circuits of other figures of that application could be used, particularly Figures 1 and 4. It would be possible to use other types of starter circuits which work with unidirectional current, even though these may trigger at a fixed rather than a progressively increasing value.

Figure 2 illustrates how Figure 1 can be adapted for more than two lamps. In Figure 2 two further lamps 210 and 310 are shown with associated diodes 250 and 252 and resistors 254 and 256. The starter circuit 70 is unchanged except that the thyristor 26 has an appropriately increased current - carrying capacity. The circuit of Figure 2 is shown without the pulse enhancement capacitors (38, 138 on Figure 1) connected across the lamps, although these could be added if desired.

What we claim is:-

1. A discharge lamp circuit, comprising two or more discharge lamps each in series with a choke ballast across supply input terminals, a starter circuit of a type which is operative with a cyclically-varying unidirectional supply voltage, and two or more rectifier elements, each element connecting a respective one of the lamps across the common starter circuit.

2. A discharge lamp circuit according to Claim 1, in which the starter circuit is adapted to be rendered ineffective in a failed-lamp condition.

3. A discharge lamp circuit according to Claim 2, in which the starter circuit has two starter input terminals, and comprises a controlled switch connected across the starter input terminals, and a control circuit for rendering the switch conductive at a desired point during the cycle of the applied voltage, the control circuit including means tending to increase the instantaneous applied voltage which is required for such condition to occur, with successive cycles of the applied voltage after switch-on of the circuit.

4. A discharge lamp circuit, comprising two or more discharge lamps each in series with a respective choke ballast across supply input terminals adapted to receive a cyclically-varying voltage, and a common starter circuit connected across each of the lamps through a respective rectifier element, the starter circuit having two starter input terminals and comprising a controlled switch connected across the starter input terminals, and a control circuit for rendering the switch conductive at a desired point during the cycle of the applied voltage, the control circuit including means tending to increase the instantaneous applied voltage which is required for such conduction to occur, with successive cycles of the applied voltage after switch-on of the circuit, to a point at which no such conduction occurs.

5. A discharge lamp circuit according to either Claim 3 or Claim 4, in which the controlled switch comprises a thyristor.

6. A discharge lamp circuit according to any one of Claims 3, 4 and 5 in which the control circuit includes a capacitor the charge upon which progressively changes with successive cycles of the applied voltage to vary the trigger point at which conduction occurs.

7. A discharge lamp circuit according to Claim 6, including an avalanche diode having a zener-like characteristic connected in series with the capacitor.

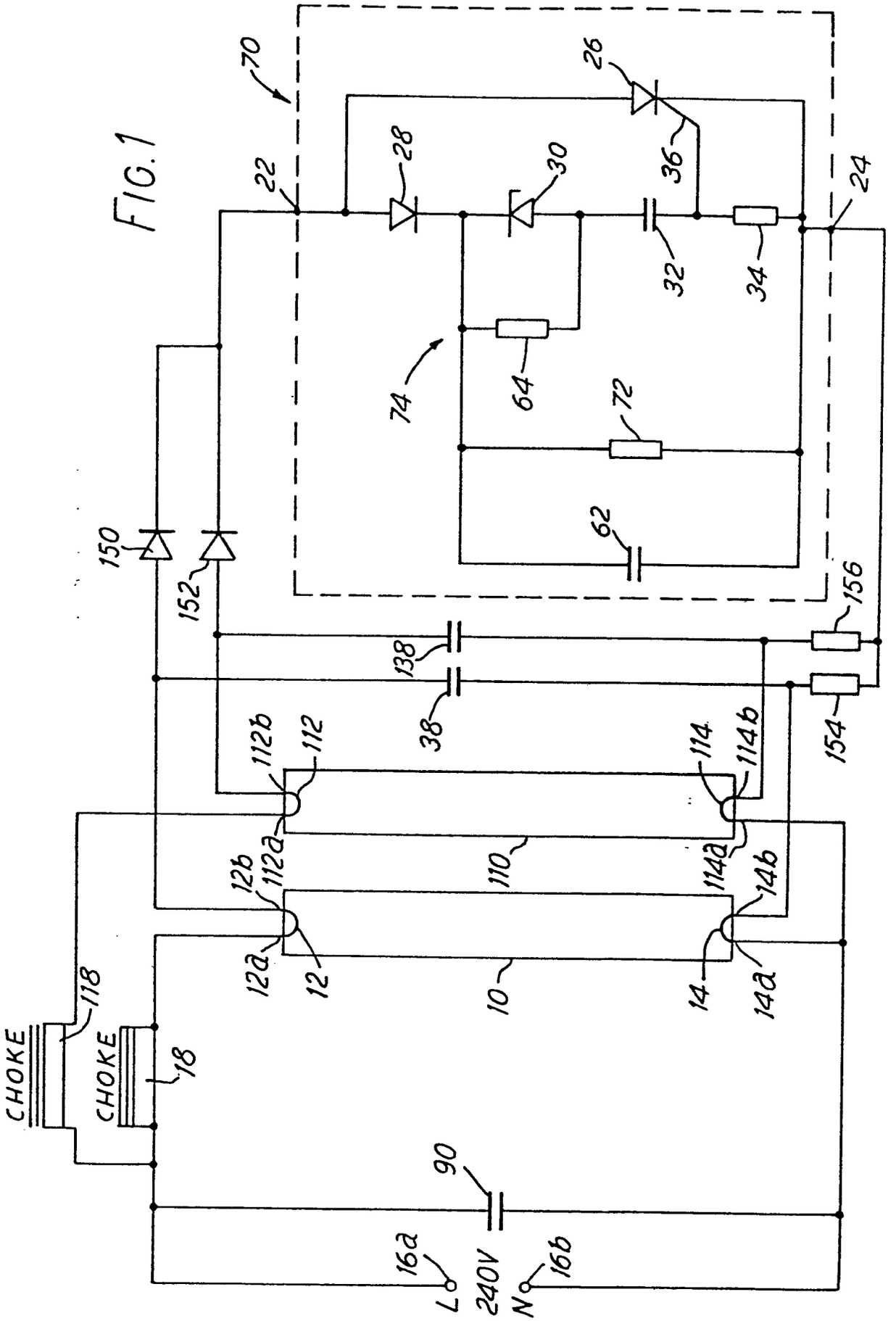
8. A discharge lamp circuit according to any one of the preceding claims including a capacitor connected across each lamp.

9. A discharge lamp circuit according to any one of the preceding claims including current-sharing means between the lamps and the starter circuit.

10. A discharge lamp circuit according to Claim 9, in which the current-sharing means comprises a respective resistor connected between each lamp and the starter circuit.

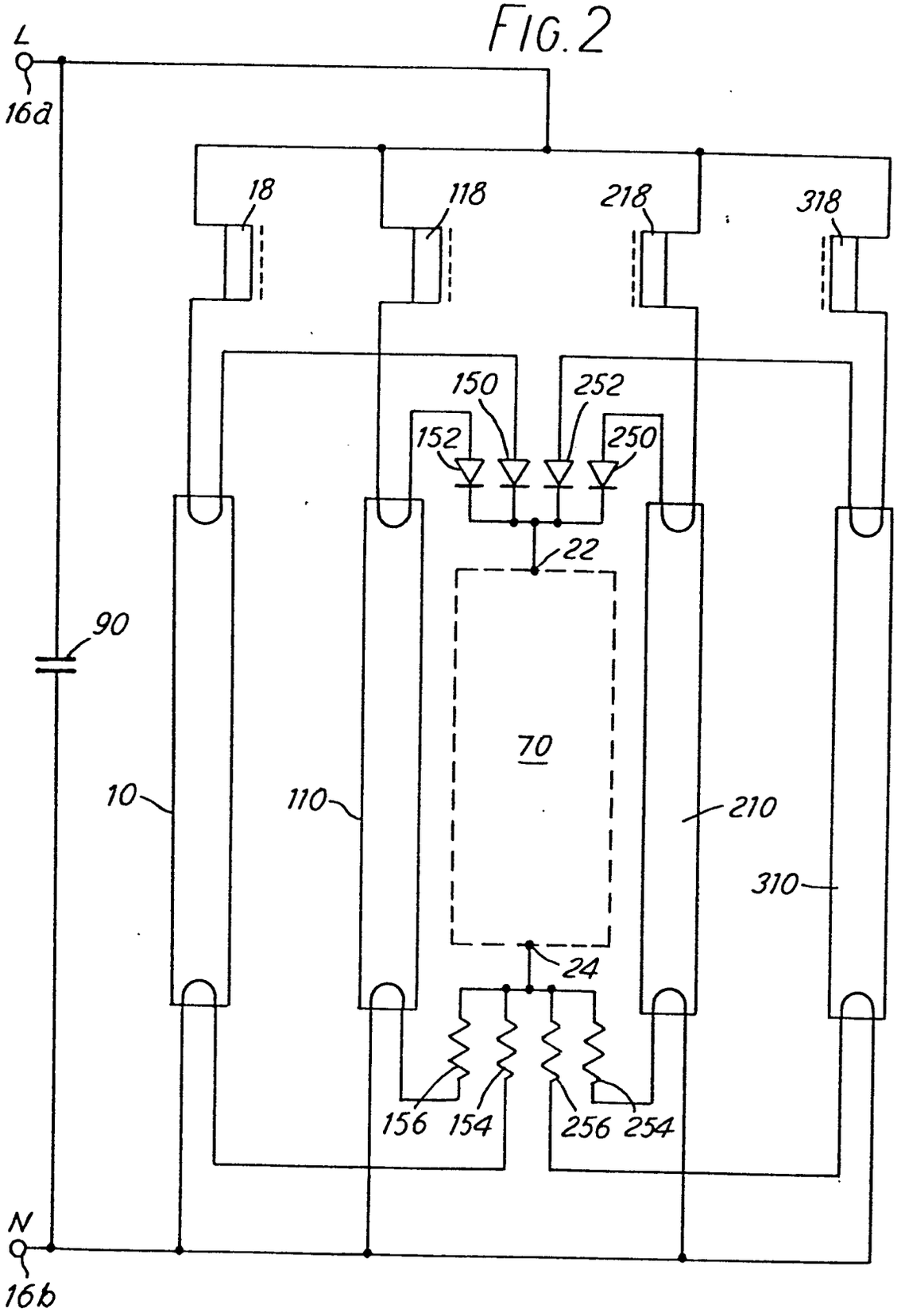
0034401

FIG. 1



2/2

FIG. 2


L
16a
18
118
218
318
150
252
152
250
22
90
70
10
110
210
310
24
156
154
256
254
N
16b