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Glew

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[54] **STROBOSCOPE WITH VISUAL SPEED INDICATING SYSTEM EMPLOYING LIGHTS**

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[52] **U.S. Cl.** ..... **324/16 R,** 324/161, 324/169, 340/263

[51] **Int. Cl.** **F02p 17/00**

[58] **Field of Search** ..... 324/16 R, 16 T, 161, 324/169, 170; 340/263, 268; 317/5

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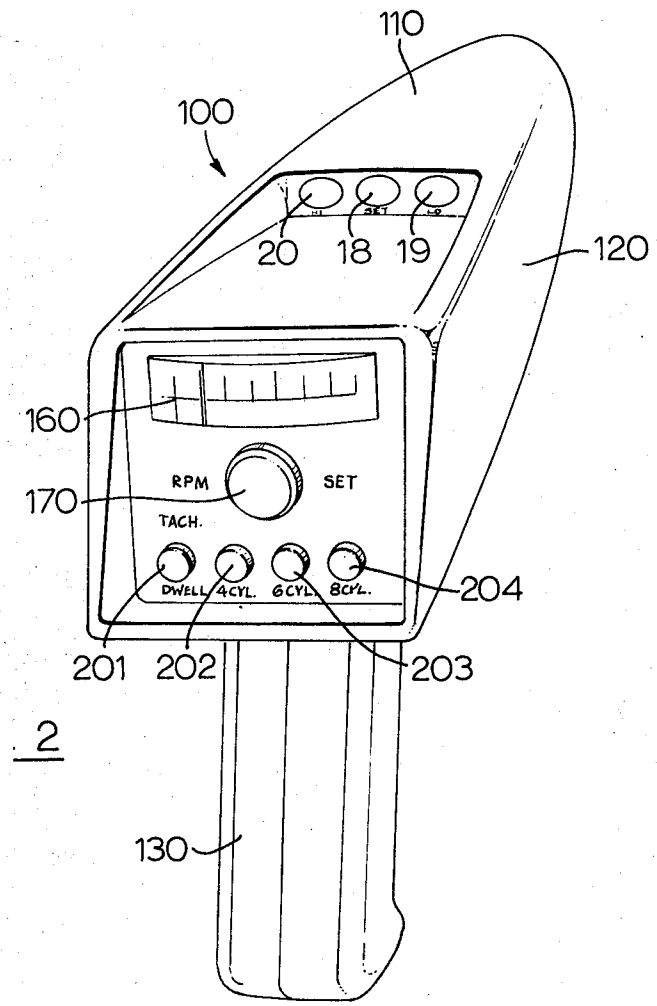
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Attorney—Peter W. McBurney et al.

[57] **ABSTRACT**

A stroboscope that may be used as a timing light is provided with a system for visually indicating to the user whether the engine being timed is running at, under or above the desired speed. The system includes three lights, one for indicating an on speed condition, the second an underspeed condition and the third an overspeed condition and a network for energizing an appropriate one of the lights depending upon and responsive to engine speed.

8 Claims, 3 Drawing Figures



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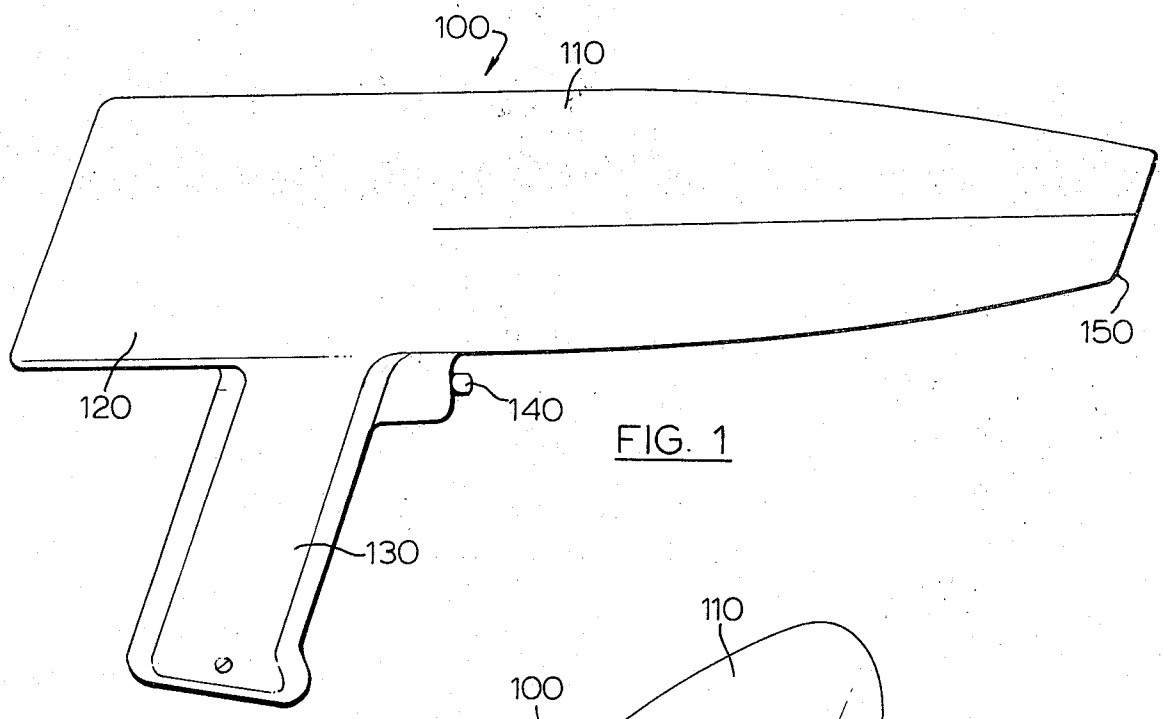

100
110
150
120
140
130

FIG. 1

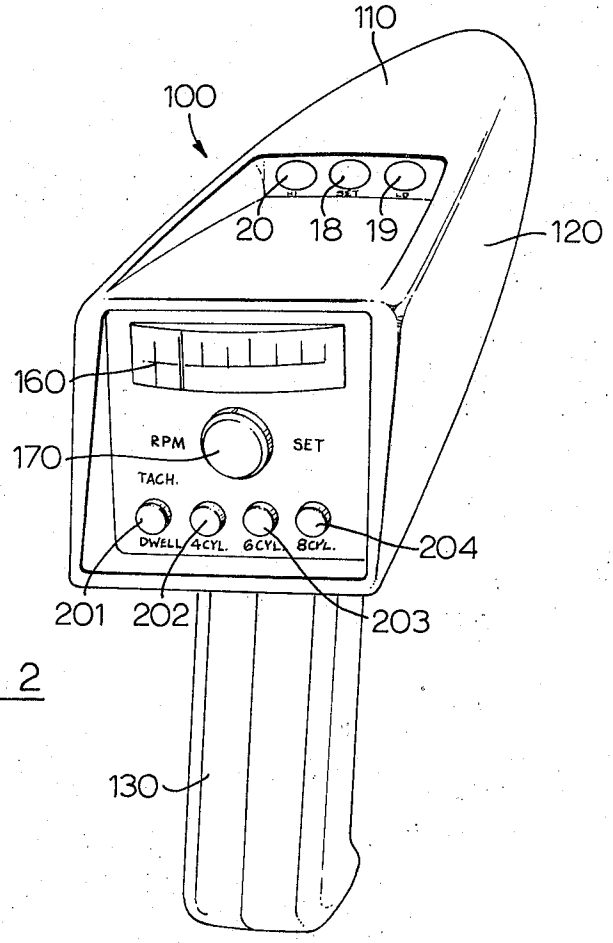

110
100
20
18
19
120
160
170
RPM
SET
TACH.
DWELL
4CYL.
6CYL.
8CYL.
204
201
202
203
130

FIG. 2

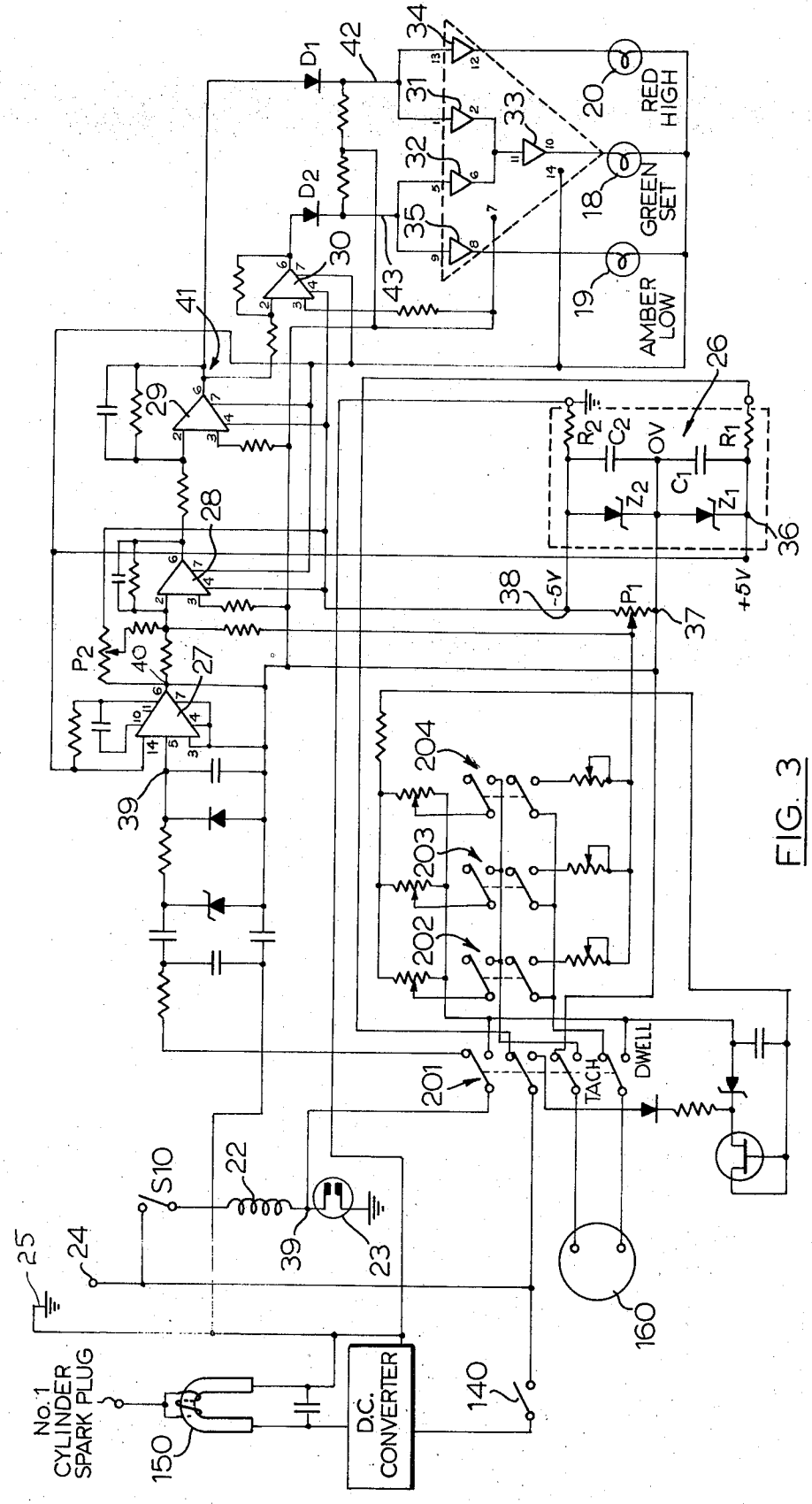

D1
D2
42
34
31
33
32
35
30
41
43
20
RED HIGH
18
GREEN SET
19
AMBER LOW
29
28
27
26
R2
C2
OV
C1
R1
Z2
Z1
36
38
-5V
P1
37
+5V
P2
40
39
204
203
202
201
TACH
DWELL
S10
22
23
24
25
160
No.1 CYLINDER SPARK PLUG
150
D.C. CONVERTER
140

FIG. 3

STROBOSCOPE WITH VISUAL SPEED INDICATING SYSTEM EMPLOYING LIGHTS

BACKGROUND OF THE INVENTION

This invention relates to stroboscopes. More particularly, this invention relates to timing lights for timing engines.

Stroboscopes are used for many purposes, one of which is in the setting of the timing of engines. In this procedure it is important for the mechanic to know the speed of the engine and, to this end, timing lights have been provided with a meter which indicates engine RPM. However, it is difficult for a mechanic, working in a darkened engine compartment and watching crankshaft timing marks, also to watch the engine RPM meter.

SUMMARY OF THE INVENTION

In accordance with this invention, a stroboscope is provided with a system including three lights for visually indicating to the user the speed at which the device being inspected is operating, the first light, when energized, indicating an underspeed condition, the second the on speed condition and the third an overspeed condition. The system includes a unique analogue frequency comparator for deriving speed responsive signals that control the state of illumination of the lights.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be more apparent from the following detailed description, taken in conjunction with the appended drawings, in which:

FIGS. 1 and 2 are a side elevation and a perspective view respectively of a timing light embodying this invention; and

FIG. 3 is a circuit diagram showing some conventional circuitry and other circuitry embodying this invention that, for the most part, is enclosed within the housing of the timing light of FIG. 1.

Referring to FIG. 1, there is shown a timing light **100** that includes certain conventional components, namely a housing **110** that may be gun-shaped in configuration consisting of a barrel **120** and a handle **130**, an on-off switch **140** (FIG. 2), a flash tube **150** (FIG. 2) mounted at one end of barrel **120** and a meter **160** for indicating dwell angle. Meter **160** also is designed to indicate the revolutions per minute at which the operator wishes to preset the reference engine speed. Also provided, as shown in FIG. 2, are four push to operate switches, **201, 202, 203, 204** to select the required function and range and a knob **170** that controls a potentiometer to preset the engine speed required.

As shown in FIG. 2, timing light **100** is provided with three lights **18, 19** and **20.** These are speed indicating lights and may be appropriately coloured, green for on speed, amber for below speed and red for above speed. These lights are arranged so that they can be seen readily from behind the timing light, just as is meter **160,** it being understood that, in operation, the timing light is hand held and pointed like a gun at the component of the engine having timing marks thereon, so that lights **18 – 20** are readily visible to the user.

Referring now to FIG. **3,** the only components shown therein that are not enclosed in housing **110** are the primary winding **22** of the ignition coil, the breaker points **23** and ignition switch **S10,** these being components of the electrical system of the engine that are connected

in series with each other between two terminals **24** and **25** that are connected to a battery (not shown). Terminal **25** may be grounded, while terminal **24** is at, say, +12 volts.

The circuit and components to the left of winding **22** and points **23** as well as switches **201 – 204** and their associated circuits are conventional, are connected in a conventional manner and will not be described in any detail for these reasons. The former include flash tube **150,** meter **160** and switch **140.** The potentiometer **P1** that in the tachometer position of switch **201** is connected across meter **160** is controlled by control knob **170** (FIG. 2). The circuit functions in a conventional manner, when switch **140** is closed to apply power to the circuit from terminal **24** and the engine being timed is operating, resulting in flash tube **150** flashing whenever the distributor applies high voltage to No. 1 spark plug on and off with the opening and closing of the points. If switch **201** is set to the dwell position, meter **160** will indicate degrees of contact point dwell. Of course, prior to closing switch **140,** the appropriate one of switches **202 – 204,** which depends upon the number of cylinders that the engine being timed has, should be closed.

On the right hand side of winding **22** and points **23** is an analogue frequency comparator embodying this invention. The frequency comparator is energized when switch **201** is set to the tachometer position. The frequency comparator includes a DC converter **26** consisting of resistors **R1** and **R2,** capacitors **C1** and **C2** and zener diodes **Z1** and **Z2,** a monostable multivibrator **27,** three operational amplifiers **28, 29** and **30,** potentiometers **P1** and **P2,** NAND gates **31 – 35,** lamps **18 – 20** and various resistors, capacitors and diodes associated with the foregoing and shown in FIG. **3.** The way in which these components are connected is readily apparent from FIG. 3 and does not require verbal description.

When power is connected to terminals **24** and **25** and switch **201** is set to the tachometer position, DC converter **26** is energized, providing stable DC voltages of, for example, +5v, 0v and −5v at terminals **36, 37** and **38** respectively.

When the engine is operating, a signal having a frequency that is directly proportional to engine speed and the number of cylinders of the engine is derived at terminal **39** and is applied to monostable multivibrator **27.** The output signal of monostable multivibrator **27** that appears on conductor **40** consists of a series of square wave pulses having the same frequency as the input signal. The output pulses are of constant width and amplitude. The output pulses are superimposed on the positive bias of the monostable multivibrator. This positive bias is cancelled by the negative DC voltage derived at the slider of potentiometer **P2.** The average value of the resultant signal is directly porportional to engine speed and the number of cylinders and increases and decreases in value with increases and decreases respectively in speed.

At the slider of potentiometer **P1** there is derived an adjustable reference voltage which, when combined with the bias cancelled output signal of monostable multivibrator **27,** provides a signal having a ground potential reference base that is applied to operational amplifier **28** and that also has a net average value that is directly proportional to engine speed for any fixed number of cylinders. In other words, when potentiom-

eter P1 (the externally adjusted control) is varied by means of knob 170, the RPM reading indicated on meter 160 is the set RPM at which the set light 18 will illuminate, providing the correct switch (202 for 4 cylinders, 203 for 6 cylinders, 204 for 8 cylinders) has been selected, and also results in a negative DC voltage at the slider of potentiometer P1 that will exactly equal the positive average value of the bias cancelled output signal of monostable multivibrator 27 produced when the signal at terminal 39 is derived with an engine operating at set speed, resulting in a 0 volt input signal to amplifier 28. By the same token, however, if the engine speed should increase or decrease above or below the set speed, full cancellation will not take place. A net positive signal will be applied to amplifier 28 in the former case, while a net negative signal will be applied to amplifier 28 in the latter case, and, in both cases the value of the net signal will be directly proportional to engine speed.

Operational amplifiers 28 and 29, both of which are of the inverting type, as is amplifier 30, filter and amplify the DC signal that varies with engine speed providing a speed responsive DC signal at the output terminal of amplifier 29 that is used to control the illumination of lights 18 – 20.

In order to understand how lights 18 – 20 are controlled, the operation of NAND gates 31 – 35 must be appreciated. Each NAND gate has an input terminal and an output terminal. When the input voltage to a gate is equal to or less than +2 volts (this value being exemplary only), the gate will open and the output voltage thereof will be +5 volts. When the input voltage is greater than +2 volts, the gate will close and the output voltage therefore will be 0 volts.

The speed responsive output of amplifier 29 could, at this point, be a positive or a negative depending on whether the speed is higher or lower than the set speed. If the signal is positive, NAND 31 and 34 gates receive a positive signal via diode D1, but the same signal from amplifier 29 is inverted by operational amplifier 30, resulting in a negative output which is blocked by diode D2. Conversely, if the output of amplifier 29 is negative, it is blocked by diode D1, but when inverted by amplifier 30, the resultant positive signal is passed by diode D2 to NAND gates 32 and 35. Thus, positive outputs of amplifier 29 are blocked on conductor 43 but passed on conductor 42, the reverse being the case for negative outputs.

If the output of amplifier 29 is 0, indicating set speed, 0 volts will be present at the NAND gates 31, 32, 34 and 35, resulting in a 5 volt output at each gate. This 5 volts is applied to the input of NAND gate 33, resulting in a 0 volt output and hence a 5 volt drop across light 18 which illuminates.

The 5 volt output at NAND gates 34 and 35 results in a 0 volt condition across lights 19 and 20 and they remain off.

High speeds result in a positive signal through diode D1 and output voltages of NAND gates 31 and 34 of 0 volts when the input signal exceeds +2 volts, which it does for a 1 cycle increase above the set speed. The 0 voltage output of NAND gate 31 applied to the input of NAND gate 33 results in a 0 voltage condition across light 18, which remains off, but the 0 volt output of NAND gate 34 results in a 5 volt condition across light 20 which illuminates. Conversely, low speeds result in light 19 becoming energized and lights 18 and 20 extinguished.

Use of the same integrated circuit for control of the lights results in a positive operation where only one condition, LOW, SET or HIGH can be evident at one time. The switching differential, being arbitrarily of 1 cycle, is the optimum speed differential that can normally be controlled by the engine accelerator, particularly at high speeds.

Strictly by way of example, the following components may be used in the circuit of FIG. 3.

Monostable multivibrator N74121 Signetics Corporation

Operational amplifiers μ741CV Signetics Corporation

NAND gate package N7404 Signetics Corporation

What I claim as my invention is:

1. In combination with a timing light for timing an engine, said timing light including a housing and a flash tube, a system for visually indicating whether the engine being timed is operating at a predetermined speed or above or below said predetermined speed, said system comprising means responsive to the speed of the engine being timed for providing a first signal having a frequency that varies in response to the speed of the engine being timed, means for providing a variable reference signal which, when added to said first signal, provides a third signal having a predetermined DC value when the engine being timed is operating at said predetermined speed and DC values above and below said predetermined DC value when the engine being timed is operating above and below said predetermined speed, means connecting said means providing said first signal and said means providing said reference signal for adding said first signal and said reference signal, at least first, second, third, fourth and fifth devices each having a NAND gate function and each having an input terminal and an output terminal and an open and closed state, each of first to fifth devices being closed when the signal applied to said input terminal thereof is of a first polarity and greater than a predetermined magnitude and being open when the signal applied to said input terminal of said first polarity and less than said predetermined magnitude, means for applying said third signal to said input terminals of said first and fourth devices when said third signal is of said first polarity, means for inverting the polarity of said third signal to provide a fourth signal having the same DC value as said third signal but opposite polarity, means for applying said fourth signal to said input terminals of said second and fifth devices when said fourth signal is of said first polarity, means connecting said input terminal of said third device to said output terminals of said first and second devices, first, second and third engine speed indicating lights, means connecting said first light in a first circuit including said output terminal of said third device, said first circuit having current flowing therethrough sufficient to illuminate said first light when said third device is closed, said first light being unilluminated when said third device is open, means connecting said second light in a second circuit including said output terminal of said fourth device, said second circuit having current flowing therethrough sufficient to illuminate said second light when said fourth device is closed, said second light being unilluminated when said fourth device is open, and means connecting said third light in a third circuit including said output

terminal of said fifth device, said third circuit having current flowing therethrough sufficient to illuminate said third light when said fifth device is closed, said third light being unilluminated when said fifth device is open, said lights being associated with said housing and readily visible to a user of said timing light.

2. The invention according to claim 1 wherein said means providing said first signal includes a monostable multivibrator.

3. The invention according to claim 1 wherein said means providing said reference signal includes a potentiometer.

4. The invention according to claim 1 wherein said predetermined DC value is 0 volts.

5. The invention according to claim 1 wherein said means providing said first signal includes a monostable multivibrator and said means providing said reference signal includes a potentiometer.

6. The invention according to claim 5 wherein said predetermined DC value is 0 volts.

7. The invention according to claim 6 wherein said means for applying said third signal include a diode and said means for applying said fourth signal include a diode.

8. The invention according to claim 1 wherein said means for applying said third signal include a diode and said means for applying said fourth signal include a diode.

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