April 15, 1969 N. T. NEAPOLITAKIS 3,439,184

TAPE PLAYER CARTRIDGE EJECTOR CIRCUIT

Filed Nov. 14, 1967

FIG. 1

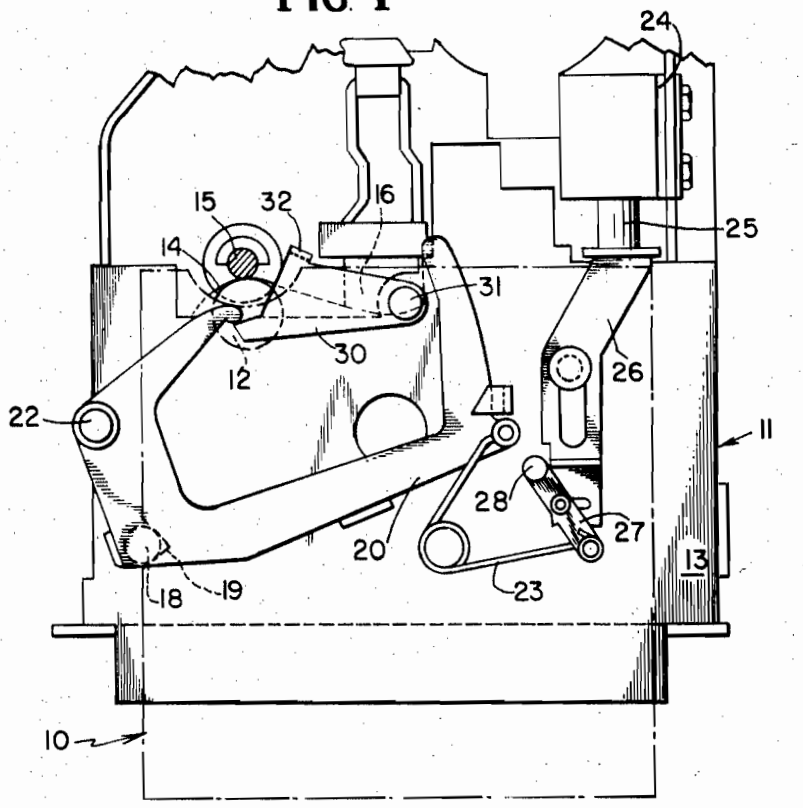
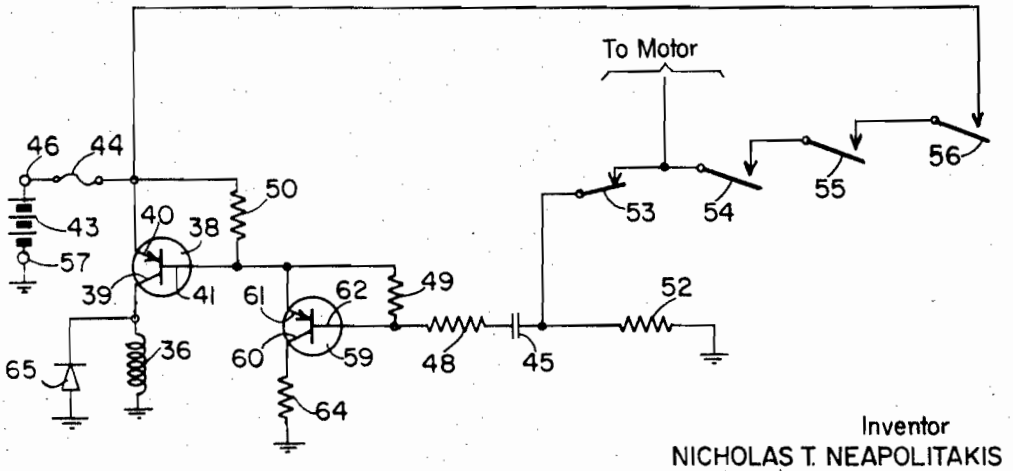


FIG. 2



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TAPE PLAYER CARTRIDGE EJECTOR CIRCUIT

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U.S. Cl. 307—141 6 Claims

ABSTRACT OF THE DISCLOSURE

A tape cartridge ejector mechanism for a tape player has a circuit for energizing a solenoid coil including a capacitor. A first terminal of the capacitor is coupled to one terminal of the power supply through a first resistance and the second terminal of the capacitor is coupled to the same power supply terminal through a series of switches. The second terminal of the capacitor is also coupled to the other terminal of the power supply through a second resistance means. With the switches closed the voltage across the capacitor is substantially zero. Opening of any switch causes a momentary charging current to flow until the capacitor is fully charged. Transistors are coupled to portions of the first resistance and the charging current therethrough biases the transistors to conduction. The conducting transistors provide an energizing current to the solenoid coil.

Background of the invention

In a tape player employing a cartridge for storing the tape during the playing and non-playing periods, it is desirable that the tape cartridge be automatically ejected whenever the tape player is not in use. This relieves the pressure on the capstan drive mechanism reducing the tendency of the capstan to develop flat spots which reduce the quality of sound reproduction. In a number of tape players such automatic ejection means are necessary in order for the cartridge to be positioned so that it can be removed. This is particularly true in certain automobiles where the cartridge is mounted on or under the dashboard in such a manner that it is very difficult or impossible for the cartridge to be withdrawn manually.

Ejector mechanism used in tape players incorporate a solenoid to actuate the mechanism. Because of the small size of the solenoid coil and the necessity for developing relatively large amounts of mechanical force, such solenoids are subject to overheating if energized for too long a period of time. If the cartridge jams or wedges during ejection, or if the ejection switch is carelessly held closed by the operator, damage or destruction to the solenoid coil could result.

Summary

It is, therefore, an object of this invention to provide an improved circuit for energizing a tape cartridge ejector mechanism.

Another object of this invention is to provide an energizing circuit for a tape cartridge ejector mechanism which provides momentary energization of the solenoid coil.

Another object of this invention is to provide an energization circuit for a tape cartridge ejector mechanism which operates automatically to eject the cartridge when the tape player is turned off.

The invention is illustrated in the drawings of which:

FIG. 1 is a drawing of a tape cartridge ejector mechanism; and

FIG. 2 is a schematic diagram of the circuit of this invention used to energize the ejector mechanism of FIG. 1.

Description of the invention

In practicing this invention a tape ejector mechanism is provided having a solenoid for actuating the mechanism. An output terminal of a power supply is coupled to one terminal of a capacitor through a first resistance and to the other terminal of the capacitor through one or more switches. The other output terminal of the power supply is coupled to the other terminal of the capacitor through a second resistance. Thus, with the switches closed, the potential across the capacitor is zero. If a switch is opened, a momentary charging current is provided which charges the capacitor to the potential of the power supply. One or more transistors coupled across portions of the first resistance are biased to conduction by the momentary flow of charging current. These transistors act to provide an energizing current for the solenoid coil. When the capacitor is fully charged, the bias current is removed and the solenoid coil is de-energized. Reclosing the switch causes a charging current to flow in the opposite direction thereby biasing the transistors to non-conduction.

The ejection mechanism is illustrated in FIG. 1. A tape cartridge **10** is shown by dot-dash lines inserted in a tape playing mechanism **11**. The cartridge **10** when inserted into the playing mechanism is positioned below plate **13**. The tape **14** within the cartridge is held by roller **12** against the capstan **15** of the playing mechanism. Capstan **15** is driven by a motor (not shown) to move the tape past recording head **16**. The tape cartridge is locked in position by pin **18** inserted in groove **19** in the cartridge. Pin **18** extends from bell crank **20** which is pivoted on the plate **13** by pin **22** and biased into position by over center spring **23**.

To eject the cartridge, solenoid **24** is energized causing the plunger **25** to move into the solenoid and to move slidable arm **26**. The movement of arm **26** causes lever **27** to rotate about pivot **28**. The rotation of lever **27** moves over center spring **23** so that it biases bell crank **20** in a clockwise direction to a new position. The rotation of bell crank **20** about pivot **22** causes pin **18** to be removed from groove **19** freeing the cartridge for ejection. Rotation of bell crank **20** also causes ejection lever **30** to be rotated about pivot **31**. A projection **32** extending from ejection lever **30** is forced against cartridge **10** pushing the cartridge out of the tape player.

In FIG. 2 there is shown a schematic of the energizing circuit for solenoid **24** of FIG. 1. The coil of solenoid **24** is shown as coil **36** in FIG. 2. Coil **36** is coupled to one terminal **46** of battery **43** through collector **39** and emitter **40** of transistor **38** and fuse **44**. A capacitor **45** has one terminal connected to terminal **46** of power supply **43** through resistors **48**, **49**, **50** and fuse **44**. The second terminal of the capacitor **45** is connected to terminal **46** through switches **53**, **54**, **55**, **56** and fuse **44**. The second terminal of capacitor **45** is also connected to terminal **57** of battery **43** through resistor **52**.

The base-emitter junction of transistor **38** is connected across resistor **50** and the base-emitter junction of transistor **59** is connected across resistor **49**. Collector **60** of transistor **59** is coupled to terminal **57** of power supply **43** through resistor **64**. Diode **65** is coupled across solenoid coil **36** with reverse polarity to provide a shunt path for the energy stored in the solenoid coil when the coil is de-energized.

The circuit shown in FIG. 2 is one which is incorporated in an automobile. Switch **56** represents the ignition switch so that the tape player is not operative unless the ignition is turned on. Switch **55** is an on-off switch for the tape player. With the tape player turned on and with switches **55** and **56** closed, the tape player is ready for operation. Motor switch **54** is closed by inserting the cartridge into the tape player; thus the tape player is not

operative unless a cartridge is inserted in the player. Switch **53** can be a separate ejection switch or it can be mechanically coupled to pushbutton radio switches for actuation thereby. As will be described subsequently the opening of any switch will energize solenoid coil **36**.

With a cartridge inserted in the tape player and with switches **53**, **54**, **55** and **56** closed, both terminals of capacitor **45** will be connected to terminal **46** of battery **43** and the potential across capacitor **45** will be zero. If any of the switches **53–56** are opened, one terminal of capacitor **45** is connected to terminal **57** of battery **43** through resistor **52**. With this connection a charging current flows into capacitor **45** until the potential across capacitor **45** is equal to the battery potential. The duration of this current depends upon the time constant of the circuit consisting of capacitor **45** and resistors **48**, **49** and **50**, **52**.

During the time that the charging current is flowing through resistors **48**, **49**, **50** and **52**, a bias voltage is developed across resistor **49** sufficient to bias transistor **59** to conduction. With transistor **59** biased to conduction current flows from emitter **61** to collector **60** through resistor **64**. This additional current flows through resistor **50** producing sufficient voltage drop across resistor **50** to bias transistor **38** to conduction. With transistor **38** biased to conduction, solenoid coil **36** is energized operating the ejection mechanism. When capacitor **45** is charged the charging current ceases and transistors **59** and **38** are biased to non-conduction de-energizing solenoid coil **36**. Thus solenoid coil **36** is energized only while capacitor **45** charges.

If the switches again are closed a discharge current flows through resistors **48**, **49**, **50** and **52** until the potential across capacitor **45** is reduced to zero. This discharge current flows in the opposite direction from the charging current and therefore biases transistors **38** and **59** further into non-conduction so that the ejection mechanism is not actuated.

Thus a simple circuit for actuating a tape player cartridge ejection mechanism has been disclosed. The circuit provides a momentary impulse to actuate the solenoid coil which operates the ejection mechanism. The opening of any one of a number of switches, such as the on-off switch or the ignition switch, acts to operate the ejection mechanism automatically.

I claim:

1. A tape cartridge ejector system, including in combination, ejection means positioned against the cartridge and including a solenoid coil, power supply means coupled to a reference potential and having an output terminal, capacitor means having first and second terminals, first resistance means coupling said first terminal to said reference potential, switch means coupling said power supply output terminal to said first terminal, second resistance means coupling said power supply output terminal to said second terminal, transistor amplifier means coupled across at least a part of said second resistance means, and circuit means coupling said transistor amplifier means to said solenoid coil, said capacitor means having a potential thereacross of zero with said switch means being closed, said power supply means providing a charging current through said first and second resistance means with said switch means being open, said charging current acting to increase the potential across said capacitor means from zero to a potential greater than zero, said transistor amplifier means being responsive to said charging current to become energized to provide a momentary operating current to said solenoid coil.

2. The tape cartridge ejector system of claim **1** wherein, said transistor amplifier means includes a first transistor having a base electrode coupled to said second terminal, an emitter electrode coupled to said power supply output terminal and a collector electrode coupled to said solenoid coil, said base and emitter electrodes of said first transistor further being coupled across a first resistance portion of said second resistance means, said charging current through said second resistance means acting to bias said first transistor to conduction whereby said solenoid coil is energized.

3. The tape cartridge ejector system of claim **2** wherein, said amplifier means further includes a second transistor having a base electrode coupled to said second terminal, an emitter electrode coupled to said base electrode of said first transistor and a collector electrode coupled to said reference potential, said second resistance means including a second resistance portion coupled in series with said first resistance portion, said base and emitter electrodes of said second transistor further being coupled across said second resistance portion, said charging current through said second resistance means acting to bias said second transistor to conduction whereby the current through said first resistance portion is increased to increase the conduction of said first transistor.

4. The tape cartridge ejector system of claim **3** wherein, said switch means includes a plurality of switches connected in series, the opening of any one of said plurality of switches acting to cause said charging current to flow through said second resistance means.

5. The tape cartridge ejector system of claim **4** wherein, said plurality of switches includes a normally open switch, said tape cartridge acting to close said normally open switch with said tape cartridge inserted within the tape player, whereby said tape cartridge ejector system is de-energized with said tape cartridge removed.

6. The tape cartridge ejector system of claim **3** wherein, a discharge current flows through said first resistance means with said switch means being closed, to change the potential across said capacitor means from said value greater than zero to zero, said first and second transistors being poled whereby said charging current acts to bias said first and second transistors to conduction, and said discharge current acts to bias said first and second transistors to nonconduction.

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3,287,608	11/1966	Pokrant	317—148.5 X
3,393,604	7/1968	Lundin	317—148.5 X

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With a cartridge inserted in the tape player and with switches **53**, **54**, **55** and **56** closed, both terminals of capacitor **45** will be connected to terminal **46** of battery **43** and the potential across capacitor **45** will be zero. If any of the switches **53–56** are opened, one terminal of capacitor **45** is connected to terminal **57** of battery **43** through resistor **52**. With this connection a charging current flows into capacitor **45** until the potential across capacitor **45** is equal to the battery potential. The duration of this current depends upon the time constant of the circuit consisting of capacitor **45** and resistors **48**, **49** and **50**, **52**.

During the time that the charging current is flowing through resistors **48**, **49**, **50** and **52**, a bias voltage is developed across resistor **49** sufficient to bias transistor **59** to conduction. With transistor **59** biased to conduction current flows from emitter **61** to collector **60** through resistor **64**. This additional current flows through resistor **50** producing sufficient voltage drop across resistor **50** to bias transistor **38** to conduction. With transistor **38** biased to conduction, solenoid coil **36** is energized operating the ejection mechanism. When capacitor **45** is charged the charging current ceases and transistors **59** and **38** are biased to non-conduction de-energizing solenoid coil **36**. Thus solenoid coil **36** is energized only while capacitor **45** charges.

If the switches again are closed a discharge current flows through resistors **48**, **49**, **50** and **52** until the potential across capacitor **45** is reduced to zero. This discharge current flows in the opposite direction from the charging current and therefore biases transistors **38** and **59** further into non-conduction so that the ejection mechanism is not actuated.

Thus a simple circuit for actuating a tape player cartridge ejection mechanism has been disclosed. The circuit provides a momentary impulse to actuate the solenoid coil which operates the ejection mechanism. The opening of any one of a number of switches, such as the on-off switch or the ignition switch, acts to operate the ejection mechanism automatically.

I claim:

1. A tape cartridge ejector system, including in combination, ejection means positioned against the cartridge and including a solenoid coil, power supply means coupled to a reference potential and having an output terminal, capacitor means having first and second terminals, first resistance means coupling said first terminal to said reference potential, switch means coupling said power supply output terminal to said first terminal, second resistance means coupling said power supply output terminal to said second terminal, transistor amplifier means coupled across at least a part of said second resistance means, and circuit means coupling said transistor amplifier means to said solenoid coil, said capacitor means having a potential thereacross of zero with said switch means being closed, said power supply means providing a charging current through said first and second resistance means with said switch means being open, said charging current acting to increase the potential across said capacitor means from zero to a potential greater than zero, said transistor amplifier means being responsive to said charging current to become energized to provide a momentary operating current to said solenoid coil.

2. The tape cartridge ejector system of claim **1** wherein, said transistor amplifier means includes a first transistor having a base electrode coupled to said second terminal, an emitter electrode coupled to said power supply output terminal and a collector electrode coupled to said solenoid coil, said base and emitter electrodes of said first transistor further being coupled across a first resistance portion of said second resistance means, said charging current through said second resistance means acting to bias said first transistor to conduction whereby said solenoid coil is energized.

3. The tape cartridge ejector system of claim **2** wherein, said amplifier means further includes a second transistor having a base electrode coupled to said second terminal, an emitter electrode coupled to said base electrode of said first transistor and a collector electrode coupled to said reference potential, said second resistance means including a second resistance portion coupled in series with said first resistance portion, said base and emitter electrodes of said second transistor further being coupled across said second resistance portion, said charging current through said second resistance means acting to bias said second transistor to conduction whereby the current through said first resistance portion is increased to increase the conduction of said first transistor.

4. The tape cartridge ejector system of claim **3** wherein, said switch means includes a plurality of switches connected in series, the opening of any one of said plurality of switches acting to cause said charging current to flow through said second resistance means.

5. The tape cartridge ejector system of claim **4** wherein, said plurality of switches includes a normally open switch, said tape cartridge acting to close said normally open switch with said tape cartridge inserted within the tape player, whereby said tape cartridge ejector system is de-energized with said tape cartridge removed.

6. The tape cartridge ejector system of claim **3** wherein, a discharge current flows through said first resistance means with said switch means being closed, to change the potential across said capacitor means from said value greater than zero to zero, said first and second transistors being poled whereby said charging current acts to bias said first and second transistors to conduction, and said discharge current acts to bias said first and second transistors to nonconduction.

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