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## TOUCH PROBE

This application claims the benefit of U.S. Provisional Application Nos.: 60/124,391 filed Mar. 15, 1999, No. 60/131,478 filed Apr. 29, 1999, and No. 60/142,333 filed Jul. 3, 1999, and are hereby incorporated by reference.

### BACKGROUND

Touch probes are devices known for uses such as measuring objects, determining positions of and defining shapes of work pieces, edges, hole centers and contours. There are many types of these devices available on the market. But, these devices can have complicated internal workings, which increase manufacturing costs and limit miniaturization of the device. With the increase capabilities in computers and software it is possible to transfer some of the complicated features away from the probe itself.

It is an object of the present invention to provide a touch probe which can be made smaller, which simplifies manufacture and which reduces the cost to manufacture.

### SUMMARY OF THE INVENTION

The present invention is a touch probe which can be connected to a computer controlled machine for determining positions of and defining shapes of work pieces, edges, hole centers and contours. The probe due to its design allows for a simpler and effective alternative to previous probes. The probe includes a body, stylus, a shank and an internal assembly. The body contains the internal assembly, which provide signals to a computer. The arrangement of the internal assembly is what makes the present invention simpler to manufacture and allow the probe to be miniaturized. The internal assembly includes an upper circuit board with a Light Emitting Diode (LED), a spring, a spring cap, a stylus mount, a housing, carbide balls, a lower circuit board, a support ring and wires.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a probe connected to a machine according to the present invention;

FIG. 2 is an exploded view of the probe according to the present invention;

FIG. 3 is a side view of the probe according to the present invention;

FIG. 4 is a cross-sectional side view of the probe according to the present invention;

FIG. 5 is a top perspective view of a stylus mount according to the present invention;

FIG. 6 is a bottom perspective view of a stylus mount according to the present invention;

FIG. 7 is a side view of a stylus and stylus mount according to the present invention;

FIG. 8 is a top perspective view of a housing according to the present invention;

FIG. 9 is a bottom perspective view of a housing according to the present invention;

FIG. 10 is a top perspective view of a housing and spring cap according to the present invention;

FIG. 11 is a bottom perspective view of a housing and spring cap according to the present invention;

FIG. 12 is a top perspective view of a lower circuit board according to the present invention;

FIG. 13 is a cross-sectional side view of a bottom of the probe according to the present invention;

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FIG. 14 is a cross-sectional side view of a bottom of the probe according to the present invention;

FIG. 15 is a schematic of the wiring of the probe according to the present invention;

FIG. 16 is a schematic of the wiring of the probe according to the present invention; and

FIG. 17 is a schematic of the electronics of the probe according to the present invention.

### DETAILED DESCRIPTION

The present invention is a touch probe **10** which can be connected to a computer controlled machine **12** for determining positions of and defining shapes of work pieces, edges, hole centers and contours. The probe **10** includes a body **14**, stylus **16**, a shank **18** and an internal assembly **20**, as shown in FIGS. 1-4. The body **14** contains the internal assembly **20**, which provide signals to the computer for defining an object **24**. The stylus **16** is a shaft with a round tip **22** that actually contacts the object **24** to be defined, as shown in FIGS. 1 and 7. The shank **18** extends upward from the body **14** and is inserted into a chuck **26** of the machine **12**, whereby the machine **12** moves the probe **10** about the object **24** to be defined.

The body **14** is an open ended cylinder **28** with an end cap **30**. The cylinder **28** includes a top **32** and bottom **34**. The bottom **34** of the cylinder **28** includes threading **36** slightly recessed from an outside surface **38** of the cylinder **28**. The end cap **30** includes an open ended top **40** having internal threading **42** and includes a closed bottom **44** having a stylus hole **46** to receive the stylus **16**. The end cap **30** screws onto the bottom **34** of the cylinder **28**. The stylus hole **46** includes a ridge **48** extending around it and extending outward from the end cap **30** to receive a molded rubber boot **50** to seal the stylus hole **46**. The boot **50** includes a hole **52** which seals around the stylus **16** as it projects from the bottom **44** of the end cap **30**. The cylinder **28** also includes three threaded set screw holes **54** near the top **32** of the cylinder **28**, a lens hole **56** and a connector hole **58** to receive a connector receptacle **60**. The connector receptacle **60** is wired to the internal assembly **20** and allows connection of a cable from the computer.

The shank **18** includes a machine attachment end **62**, a reverse tapered boss **64** and a top cap between the attachment end and the boss **64**. The boss **64** is inserted into the top of the cylinder **28**, whereby the top cap **66** seals the top **32** of the cylinder **28**. The shank **18** is secured to the body **14** using conical set screws **68**. Whereby, the set screws **68** are threaded through the set screw holes **54**, into the cylinder **28** and against the boss **64**. The use of conical set screws **68** and the reversed tapered boss **64** allows for the quick and easy adjustment of the probe **10** concentricity with the machine **12** to which the probe **10** is installed. A clear snap-in lens **70** is shown to be snapped into the lens hole **56**.

The internal assembly **20** includes an upper circuit board **72** with a Light Emitting Diode (LED) **74**, a spring **76**, a spring cap **78**, a stylus mount **80**, a housing **82**, carbide balls **84**, a lower circuit board **86**, a support ring **88** and wires **90**. The upper circuit board **72** is secured with screws to a top of the spring cap **78**. The upper circuit board **72** is wired to the connector receptacle **60** and contains solid state electronics for collecting and transmitting the signals to the computer connected to the probe **10**. The stylus mount **80** includes a top **96** and a bottom **98**, as shown in FIGS. 5-6. The bottom **98** of the stylus mount **80** is internally threaded to receive a threaded top **100** of the stylus **16**. The top **96** of the stylus mount **80** includes three equally spaced steel pins