Durable Timing Devices for the Peanut Grading Screen Vibrator[1]

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ABSTRACT

Peanuts are graded at farmer marketing for value determination. The grading procedure requires kernel sizing which is facilitated with perforated screens oscillated with a mechanical vibrator. The vibrator operates for 20-sec periods and is controlled by a hand-adjustable, mechanical timer. The durability of the timer is unsatisfactory and it frequently fails during a single grading season. Subsequent maintenance and replacement costs prompted the development of two more durable timing units. Solid state timers were utilized in both units. Construction of the two units was the same except a mechanical relay was used for switching in one but a solid state relay in the other. During durability testing, a prototype timing device with a mechanical relay switched on and off 11,020 times over an 8-d period before failing. A timing device with a solid state relay switched on and off 68,621 times over a 22-d period without failing. During field testing, six timing units with mechanical relays and five timing units with solid state relays operated an estimated 6000 cycles each at peanut buying points throughout a peanut harvest season without failure.

Key Words: Grade, *Arachis hypogaea* L., farmer marketing.

Farmer stock peanuts are inspected at farmer marketing by a detailed grading procedure that determines factors for computing lot value (1, 2, 3). During grading, screens with 33.0 cm x 33.0 cm or 45.7 cm x 45.7 cm frames are used for separating peanut kernels into different diameter classifications (2). The screens are clamped to an electrically powered vibrator that provides an oscillating screen motion for the kernel separation. The vibrator operates for a prescribed 20-sec period (2) and is controlled by an adjustable (0 to 60 sec) timer which often fails during a single peanut marketing season. The adjustment feature of the timer is not supposed to be used in normal peanut grading (2). The timer is normally attached to the vibrator mounting table. The vibrator severely shakes the mounting table and transfers mechanical stress to the timer during operation and contributes to timer failure including disassembly of various components. Additionally, the 20-sec setting occasionally is inadvertently altered by vibration during vibrator operation. The timer can be manually set at an incorrect vibrator operation time since the timer is readily adjustable. Because of above difficulties, the Federal State Inspection Service requested that a vibration-resistant timing unit be developed for the screen vibrator.

The objective of this research was to develop and evaluate tamper proof, fixed 20-sec, vibration-resistant timing units for the grading screen vibrator. Durability of commercially available timers is questionable because of the harsh vibration. The timing units would be designed to allow installation on current, in-use, screen vibrators.

Materials and Methods

Solid state circuitry was used in the development of two prototype timing devices to control the 110 vac electrical supply for the vibrator. Both devices were assembled using bread-board construction. Device A consisted of an adjustable Diversified Electronics, Inc., external resistor, single shot, solid state timer (TSE-120-ARC-060) with a maximum adjustment of 60 sec; a Potter & Brumfield general purpose double pole, double throw, mechanical relay (KA-11AG-120) with 10 amp contacts; and an Arrow Hart (80541 ER) momentary, single pole, single throw, push button switch (Fig. 1). The components were mounted in a metal enclosure and wired with 20 gauge hook-up wire and a 15 ft., 16 AWG, three conductor, SJO portable cordage for power supply cord. Device B had the same solid state timer and push button switch but a different relay. The relay for Device B was a Continental Industries, Inc., solid state, single pole, single throw relay (S505-OSJ425-009) with 10 amp contacts (Fig. 2).

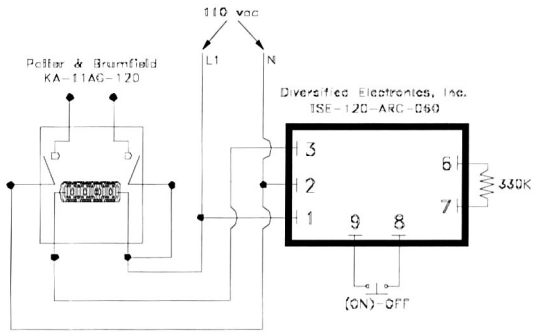

Fig. 1. Schematic of a screen vibrator timing device with a mechanical relay.

Repetitive, on-off switching endurance tests were conducted for both devices prior to field testing. For the endurance tests, a cycle counter and a remote, programmable controller were wired to replace the push button switch. Both timing devices switched a screen vibrator on and off for each cycle. The controller for Device A tests was programmed to include a 20-sec screen vibrator operation period followed by a 40 sec delay for each cycle. The controller for Device B tests was programmed for a 20 sec screen vibrator operation period followed by a 7-sec delay for each cycle. Delays were adjusted to meet motor start-

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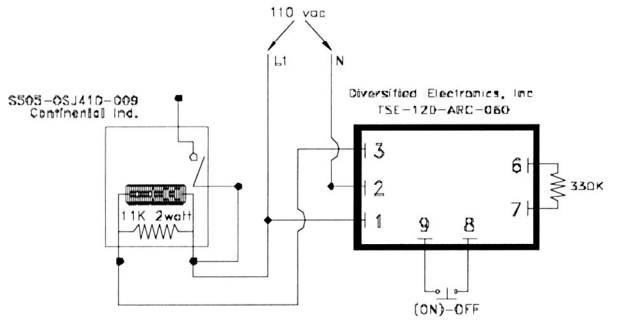

Fig. 2. Schematic of a screen vibrator timing device with a solid state relay.

ing and stopping characteristics of the two vibrators. Following the endurance testing, six Device A and five Device B timing devices were constructed and installed at peanut buying points for field testing. Construction details and field testing locations are presented in Tables 1 and 2.

Results and Discussion

During endurance testing, Device A operated a screen vibrator for 11,020 timing periods over an 8-d period before failing. Device B was tested and operated a screen vibrator for 68,621 times during a 22-d period and it did not fail.

After endurance testing, both prototype devices were disassembled for inspection. Some wires within Device A were charred, indicating evidence of shorting out against the metal enclosure. Therefore, enclosures for the timing devices to be used in field testing were increased in size or made from a non-conductive material such as plastic. Both metal and plastic enclosures were used in construction of the timing devices used in the field tests (Table 1).

The initial field testing of a timing device began at Terrell Peanut Co., Parrott, GA. The device failed after three operations. Manufacturer examination of the device timer revealed that the timers being used in the project had exceeded "shelf life without operation" (5 yr) and all timing devices were replaced (Diversified Electronics, Inc., unpubl. data). The manufacturer reported that timers should function for at least 20 yr as long as they were in use.

The remaining timing devices were installed in various peanut buying points in Georgia and Florida for field testing during a peanut buying season (Table 2). The timing device at Location 3 (Table 2) was assembled with a remote, push button, pendant/cord switch rather than the push button switch as in other units. After 21 d of use, the remote switch was replaced with a standard push button switch because of operator preference. The push button switch on the timing device at Location 8 failed after 22 d of use. Inspection indicated that failure may have been caused by electrical contact lubricant drying during assembly from soldering iron heat. The switch was replaced with one designed for soldering and the timing device returned to use. All the other timing devices have functioned an estimated 6000 cycles for five peanut buying seasons.

Table 1. Major components of the screen vibrator timing units evaluated during field testing.

Timing unit	Box type	Box size	Relay type	Switch type
		cm x cm x cm		
1	Aluminum	10.2 x 5.1 x 7.0	Mechanical	PB[a]
2	Aluminum	10.2 x 5.1 x 7.0	Mechanical	PB
3	Plastic	15.2 x 11.4 x 5.7	Mechanical	RPC[b]
4	Aluminum	10.2 x 5.1 x 7.0	Mechanical	PB
5	Plastic	19.1 x 11.4 x 5.7	Mechanical	PB
6	Aluminum	10.2 x 5.1 x 7.0	Mechanical	PB
7	Aluminum	15.2 x 12.7 x 10.2	Solid State	PB
8	Plastic	19.1 x 11.4 x 5.7	Solid State	PB
9	Plastic	15.2 x 11.4 x 6.4	Solid State	PB
10	Plastic	19.1 x 11.4 x 5.7	Solid State	PB
11	Plastic	12.7 x 11.4 x 5.7	Solid State	PB

[a]PB = Push button.

[b]RPC = Remote pendant/cord

Table 2. Companies and locations where screen vibrator timing units were field tested.

Timing unit	Company	Location
1	Terrell Peanut Company	Parrott, GA
2	Federal State Inspection Service	Dawson, GA
3	Cargill Industries, Stevens Regrade	Dawson, GA
4	Sasser Peanut Company	Sasser, GA
5	Jay Peanut Company	Jay, FL
6	Birdsong Peanut Company	Dawson, GA
7	Peanut Services, Inc.	Edison, GA
8	Mac Peanut Company	Edison, GA
9	Locke Farm Center	Dawson, GA
10	USDA, ARS, National Peanut Res. Lab.	Dawson, GA
11	Tom's Foods	Columbus, GA

Summary and Recommendations

Frequent failure of the mechanical components of timers for the peanut grading screen vibrator prompted development of a more durable electronic timing device. To evaluate durability, 11 prototype electronic timing devices were developed and operated successfully through 5 yr of peanut grading. We suggest the following recommendations as design criteria for an electronic timing unit for the peanut grading screen vibrator:

The enclosure should be no smaller than 15.2 cm x 11.4 cm x 6.4 cm and made of plastic to reduce the risk of wires shorting out during operation. The plastic box should have two 0.5-cm holes drilled through the back for mounting to the vibrator.

The electrical source wire should be a 4.6-m, 16 AWG, 3 conductor, SJO portable cordage with a NEMA 5-15P end. The cord should be anchored into the box through a 1.27-cm hole using a rubber grommet to reduce the hole to 0.95 cm.

A single shot, solid state timer with an external resistor and a maximum time of 60 sec should be used for the device. The resistor should be sized to operate the timer for 20 sec.

All components should be mounted within the enclosure with screws with locknuts or locking glue.

The timing device power switch should be a medium or heavy duty momentary contact push button. This switch should be mounted and locked onto the top of the box with a locking glue.

All hook-up wires should be 16 AWG stranded wire.

After component assembly, the box should be sealed with an official sealing label with a warning against tampering.

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