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SWEEPS, CULTIVATOR SHANKS AND SHANK PROTECTION MECHANISMS

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The modern cultivator is a widely used machine in Western Canada. It has become part of every farmer's operation and is used for weed control, trash burial, seedbed preparation and chemical incorporation. Recently, with the introduction of air seeders, it is also being used for seeding and deep banding of fertilizer.

There are three main types of cultivators- the field cultivator, intermediate cultivator, and the heavy duty cultivator or chisel plow. The cultivator type and the field conditions that the cultivator can operate in depend on the shank assembly. The shank assembly is the heart of the machine and consists of the sweep, shank and shank protection mechanism.

THE SWEEP

The sweep (FIGURE 1) penetrates and moves the soil. The amount of sweep lift determines the amount of soil movement. The greater the lift, the greater the soil movement. Sweep suction provides penetration. The greater the suction, the better the penetration.

Soil movement and sweep penetration are also aided by an increase in sweep pitch. However, too much sweep pitch causes furrow bottom ridging, excessive sweep nose wear, and cultivator instability. Tests conducted by the Machinery Institute have also shown that the power required to pull a cultivator increases significantly with increased sweep pitch.

Sweeps should be matched to the shank to obtain a low and fairly constant sweep pitch that will provide adequate penetration while producing an even furrow bottom. Normal sweep pitch ranges from 0 to +5 degrees for a sweep that is not under load. A positive (+) sweep pitch occurs when the sweep tip is lower than its heel.

The pitch of the sweep under load is a combination of the no load sweep pitch and the increase in sweep pitch caused by flexing of the shank. For example, a cultivator with a no load sweep pitch of +1 degrees and a shank that flexes 3 degrees will have a sweep pitch of +4 degrees under load. The sweep pitch of a cultivator under load should not be more than +7 degrees or less than +2 degrees.

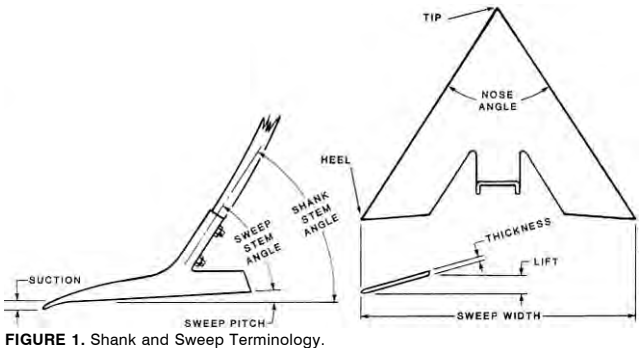

FIGURE 1. Shank and Sweep Terminology.

THE SHANK

The shank holds the sweep in its working position. During tillage, the soil force or draft on the sweep causes the shank to deflect rearwards, changing the sweep pitch. This change in sweep pitch with soil force is shown by the Sweep Pitch Variation graph in the Machinery Institute Evaluation reports on cultivators. FIGURE 2 shows the increase in sweep pitch of two different shanks for the range of typical field conditions. Shank A is much stiffer than shank B and maintains a much lower sweep pitch than shank B. Sweep pitch should not vary more than 4 degrees over the expected operating range of the machine. A 1¼ x 2 inch (32 x 50 mm) shank will be stiffer than a ¾ x 1¾ inch (19 x 44 mm) shank and will therefore be more suitable for heavy tillage.

SHANK PROTECTION

The shank protection mechanism protects the shank, sweep and cultivator frame from damage when encountering rocks or other obstacles.

The shank protection mechamism must hold the shank in position over the complete operating range of the cultivator and still allow the shank and sweep to move over obstacles. In FIGURE 3, the bend in the line ("trip" point) shows that shank C pivots upward before the lower limit of the primary tillage range is reached. Therefore, this shank protection mechanism cannot hold the shank in position for primary tillage. A cultivator equipped with this shank protection is a field cultivator and can only be used for secondary tillage.

Shank B pivots upward after the secondary tillage limit, but before the primary tillage limit. A cultivator equipped with this shank is an intermediate cultivator and can be used for secondary tillage and light primary tillage.

Shank A does not pivot until the upper limit of the primary tillage range is exceeded. Therefore, a cultivator equipped with shank A is a heavy duty cultivator or chisel plow, and can be used for all primary tillage.

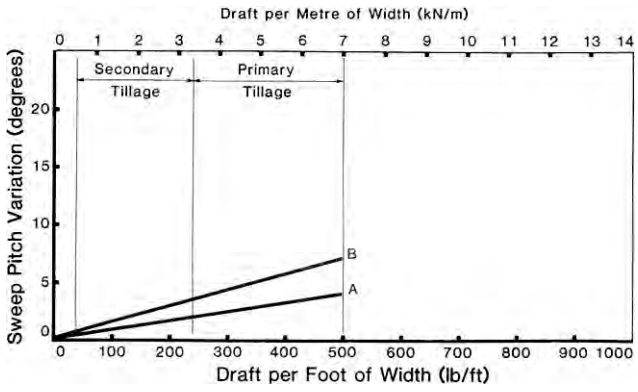

FIGURE 2. Sweep Pitch Variation.

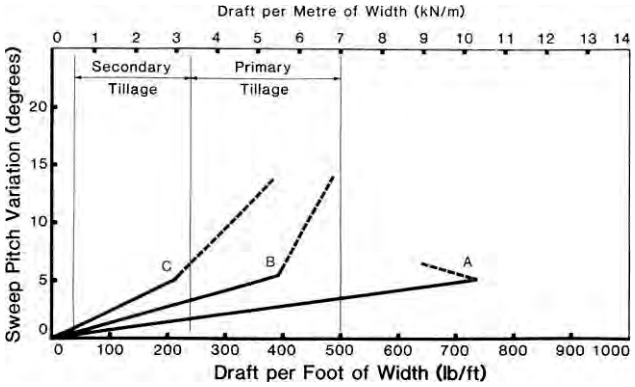

FIGURE 3. Sweep Pitch Variation and Shank Protection.

There are two main types of shank protection – the cushion spring mechanism (FIGURE 4) and the trip mechanism (FIGURE 5). The force on the shank as it trips usually decreases for a trip mechanism and increases for a cushion spring mechanism. This is shown by the dotted lines in FIGURE 3. Shank A has a trip mechanism and shank B has a cushion spring mechanism. Both systems can provide acceptable shank protection.

The springs on many shank protection mechanisms can be adjusted to change the amount of force required to trip the shank. Care should be taken when adjusting these springs to prevent excessive shank forces when operating in rocky conditions.

The shank protection mechanism must be durable. The cushion spring mechanism has fewer moving parts than the trip mechanism and is likely to have less wear. Wear on pins or castings can change the position of the shank and the sweep pitch. However, most shank protection mechanisms are designed to maintain the correct shank position regardless of the wear. The amount of force required to trip a shank can also change with wear. The springs on shank protection mechanisms should be occasionally adjusted to maintain the desired shank force. Finally, wear can increase the side-to-side movement of the shank and cause weed misses.

The shank lifting pattern is also important (FIGURE 6). The lift height must be adequate for the types of conditions encountered. In fields with a large number of large rocks, a lift height of 12 inches (300 mm) may be required.

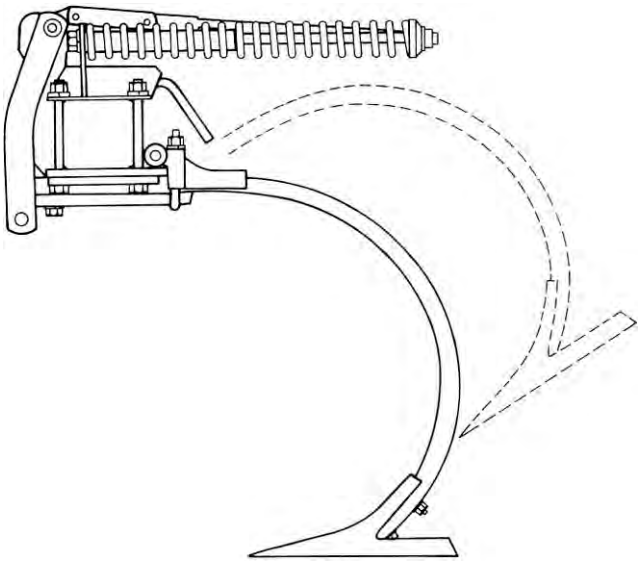

FIGURE 5. Trip Protection.

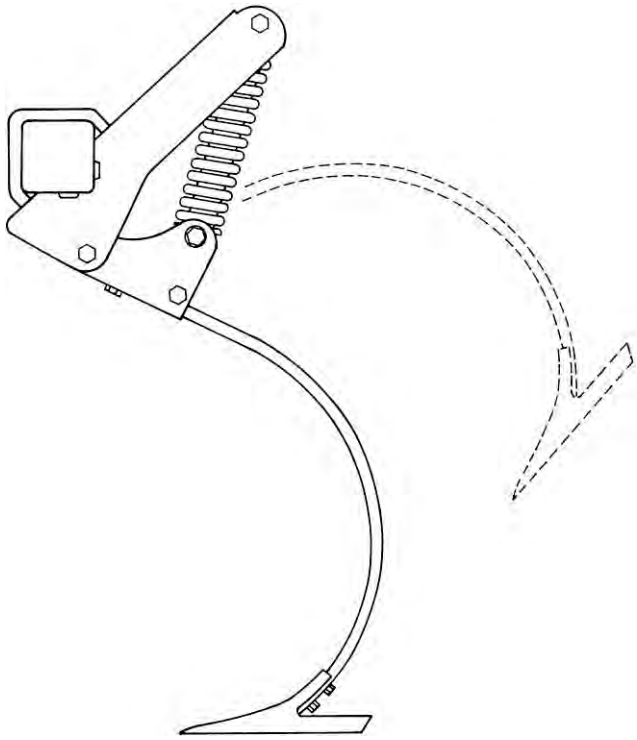

FIGURE 4. Cushion Spring Protection.

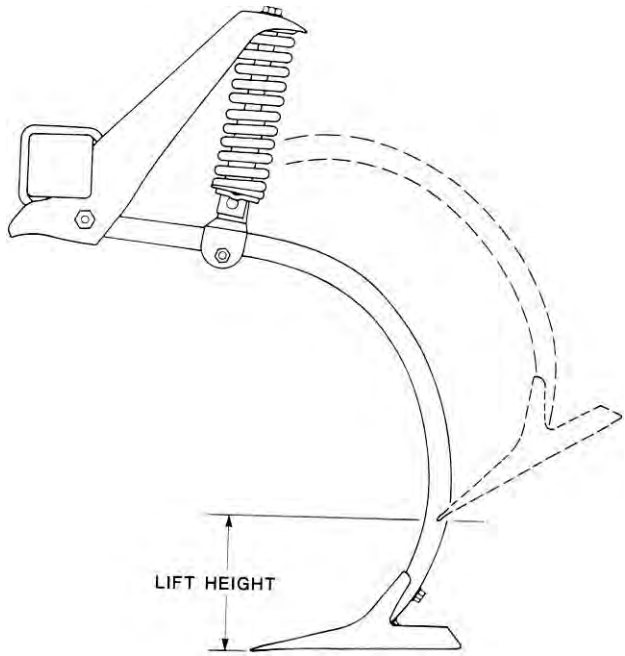

FIGURE 6. Shank Lifting Pattern.

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