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Evaluation Report 278

Hesston Model 4600 Beeline Baler

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

HESSTON MODEL 4600 BEELINE BALER

MANUFACTURER:
Hesston Corporation
Hesston Kansas 67062
U.S.A.

DISTRIBUTOR:
Hesston Industries Limited
No. 2, 2315 - 30 Avenue N.E.
Calgary, Alberta
T2E 7C7

RETAIL PRICE: $11,412.00 (May, 1982, f.o.b. Lethbridge, complete with quarter turn bale chute).

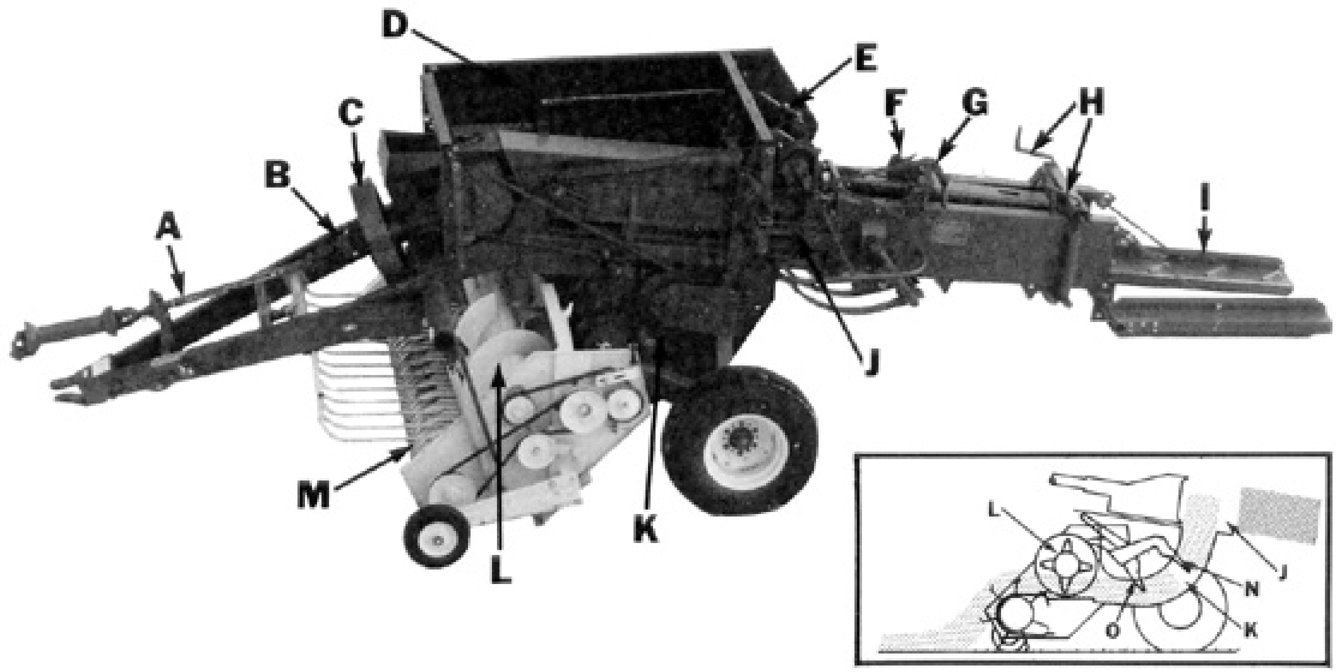

FIGURE 1. Hesston Model 4600 Beeline Baler: (A) Power Take-off, (B) Slip Clutch, (C) Flywheel, (D) Twine Storage, (E) Knotters, (F) Metering Wheel, (G) Metering Arm, (H) Bale Density Adjustment, (I) Quarter-Turn Bale Chute, (J) Bale Chamber, (K) Feed Chamber, (L) Feed Auger, (M) Pickup, (N) Stuffer Fingers, (O) Packer Fingers.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Hesston 4600 Baler was very good.

Average feedrates varied from 2 to 11 t/h (2.2 to 12.1 ton/h). Field speeds were usually limited to 10 km/h (6.2 mph) due to bouncing on rough ground and reduced pickup performance at higher speeds. Maximum instantaneous feedrates in excess of 22 t/h (24.2 ton/h) were measured in heavy uniform alfalfa windrows. Feeding was aggressive in all crops.

The Hesston 4600 was capable of producing firm, well formed bales. Length of the 356 x 457 mm (14 x 18 in) bales could be adjusted from 305 to 1320 mm (12 to 52 in). Bale length variation, at the 1000 mm (39 in) setting, wasabout 100 mm (3.9 in). For a certain length setting, longer bales were usually produced at higher feedrates. Average hay bales weighed from 21 to 41 kg (45 to 90 lb), while average straw bales weighed from 21 to 24 kg (45 to 53 lb). Bale density varied from 254 kg/m^3 (15.8 lb/ft^3) in heavy alfalfa-bromegrass to 127 kg/m^3 (7.9 lb/ft^3) in light barley straw.

The Hesston 4600 was easy to operate and adjust. Knotter performance was good with both sisal and synthetic twines as long as the knotters were properly adjusted.

Average power requirements were usually less than 23 kW (31 hp) but a 45 kW (60 hp) tractor was needed to overcome power take-off fluctuations and to provide sufficient power on hilly and soft fields.

Total leaf and stem loss was usually less than 3%, similar to that of other conventional square balers.

The Hesston 4600 was safe to operate if the manufacturer's safety recommendations were closely followed and normal safety precautions were observed.

Only minor mechanical problems occurred during the test. The slip clutch required adjustment beyond the manufacturer's recommended slip torque for efficient baling and the plunger safety stop required readjustment several times.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Re-evaluating the power take-off shaft slip clutch slip torque setting given in the operator's manual.

Senior Engineer: E. H. Wiens

Project Technologist: P. A. Bergen

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. This recommendation is under consideration at the present time.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DESCRIPTION

The Hesston Model 4600 Beeline is a pull-type, centre-feed, 540 rpm, power take-off driven, automatic twine tie baler. A floating drum pickup complete with an auger delivers hay to the feed chamber, where it is fed into the bottom of the 356 x 457 mm (14 x 18 in) bale chamber by a series of packer and stuffer fingers. Hay is compacted and bales formed by a slicing plunger operating at 92 strokes per minute.

FIGURE 1 shows the location of major components while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Hesston 4600 was operated in a variety of crops (TABLE 1) for 104 hours while producing 21,285 bales. It was evaluated for rate of work, quality of work, power consumption, ease of operation, ease of adjustment, operator safety and suitability of the operator's manual.

TABLE 1. Operating Conditions.

CROP	HOURS	NO. OF BALES
Alfalfa	39	8,373
Alfalfa, Bromegrass	36	9,503
Bromegrass	5	354
Greenfeed - Barley	1	75
- Oats	1	116
Wheat Straw	14	1,886
Barley Straw	3	280
Oat Straw	5	698
TOTAL	104	21,285

RESULTS AND DISCUSSION

RATE OF WORK

Average feedrates varied from 2 t/h (2.2 ton/h) in light barley straw to 11 t/h (12.1 ton/h) in heavy alfalfa. Average feedrate depended on windrow size and uniformity, crop condition, field surface, available tractor speeds and operator skill. Speeds were normally limited to about 10 km/h (6.2 mph) due to bouncing on rough ground and poorer pickup performance at higher speeds.

In heavy, uniform alfalfa windrows, instantaneous feedrates up to 22 t/h (24.2 ton/h) were measured. These were peak values, representing maximum baler capacity, which could not be maintained continuously.

Feeding was aggressive and smooth flowing in all crops. Feedrate was usually limited by slipping of the power take-off shaft slip clutch or shearing of the flywheel shear bolt.

QUALITY OF WORK

Bale Quality: The Hesston 4600 was capable of producing firm, durable bales with square ends in most crops (FIGURE 2). Average hay bales weighed 21 to 41 kg (45 to 90 lb), while average straw bales weighed 21 to 24 kg (45 to 53 lb). Average bale density varied from 134 to 254 kg/m^3 (8.3 to 15.8 lb/ft^3) in hay and from 127 to 146 kg/m^3 (7.9 to 9.1 lb/ft^3) in straw.

At higher feedrates the Hesston 4600 continued to produce bales of adequate quality for bale wagon handling. In long stemmed crops, bales with ragged looking ends would occasionally be produced (FIGURE 3).

A

B

C

D

FIGURE 2. Typical Bales: (A) Alfalfa, (B) Bromegrass, (C) Greenfeed, (D) Straw.

FIGURE 3. Ragged Bale Ends in Long Stemmed Crops.

Bale Length Variation: As with most conventional square balers it was difficult to obtain consistent bale length, especially in non-uniform windrows. Because of the high plunger speed, bale length variation, for the Hesston 4600, usually was less than for balers with lower plunger speeds. When set for 1000 mm (39.4 in) length, bale lengths typically varied from 950 to 1050 mm (37.4 to 41.4 in).

Bale length is adjusted by positioning the metering arm stop (FIGURE 4). The metering wheel advances the metering arm with each plunger stroke. Bale length uniformity depends on a consistent number of plunger strokes to form each bale. If the metering arm trips at the beginning of the last plunger stroke, rather than at the end of the stroke, bale length is increased by the length of compressed hay delivered during the last plunger stroke. Uniform feedrates are therefore important in reducing bale length variation.

For the same length setting, higher feedrates usually produced longer bales. For example, in a uniform alfalfa field, average bale length was 910 mm (35.9 in) when baling at 5 t/h (5.5 ton/h), but increased to 1010 mm (39.7 in) at 15 t/h (16.2 ton/h). The same trend was evident in wheat straw with average bale length increasing from 1025 mm (40.4 in) at 3 t/h (3.3 ton/h) feedrate to 1140 mm (44.8 in) at 15 t/h (16.2 ton/h).

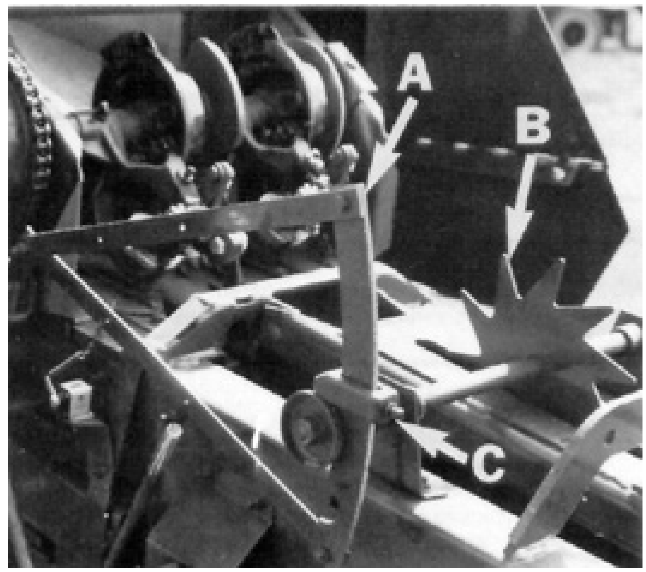

FIGURE 4. Bale Length Adjustment: (A) Metering Arm, (B) Metering Wheel, (C) Adjustable Stop.

Leaf and Stem Loss: As with most conventional square balers, leaf loss in dry hay was lower than with round balers. Total loss from the pickup and bale chamber was less than 3% in dry alfalfa. At optimum baling conditions in alfalfa the total loss was less than 2%. Pickup losses were normally insignificant unless ground speed was very high or windrows were poorly formed. Proper moisture content at the time of baling is the most important factor in keeping leaf loss to a minimum.

Knotter Reliability and Performance: The knotters when properly adjusted, performed well with both sisal and synthetic twines. Only minor field adjustments were required when changing from sisal to synthetic twine or vise-versa.

POWER CONSUMPTION

Power Take-off Requirements: FIGURE 5 shows typical instantaneous power take-off requirements for the Hesston 4600. Power requirements fluctuated from 0 to 67 kW (0 to 90 hp) on each plunger stroke. Due to these wide power fluctuations, average power requirements were less than instantaneous requirements, varying from 4 to 23 kW (5 to 31 hp) over a full range of feedrates. FIGURE 6 shows the average power take-off requirements at various feedrates in alfalfa and wheat straw.

Tractor Size: The manufacturer recommended that a 2 to 3 plow (about 25 kW) (35 hp) tractor be used. Average power take-off requirements were usually less than 23 kW (31 hp) and power required to pull the baler on level ground was usually less than 4 kW (5 hp). A 45 kW (60 hp) tractor was, however, needed to fully utilize baler capacity in soft or hilly fields and to overcome the power fluctuations illustrated in FIGURE 5.

Specific Capacity: Specific capacity is a measure of how efficiently a machine performs a task. A high specific capacity indicates efficient energy use while low specific capacity indicates inefficient operation. The specific capacity of the Hesston 4600 varied from 0.7 to 1.0 t/kW.h (0.6 to 0.8 ton/hp.h) in alfalfa and from 0.5 to 0.7 t/kW.h (0.4 to 0.6 ton/hp.eh) in wheat straw. This compares to an average specific capacity of 0.5 t/kW.h (0.4 ton/hp.h) for large round balers in alfalfa. These values represent average conditions and not peak output.

EASE OF OPERATION

Hitching: The Hesston 4600 was easily hitched to tractors equipped with a 540 rpm power take-off. The hitch jack was convenient for raising or lowering the hitch tongue and was conveniently stored, when not in use, on a tongue-cross member. The hitch clevis was not adjustable, however the baler could be leveled by repositioning the axle spindles. The power take-off shaft support bearing was adjustable to obtain proper power take-off alignment.

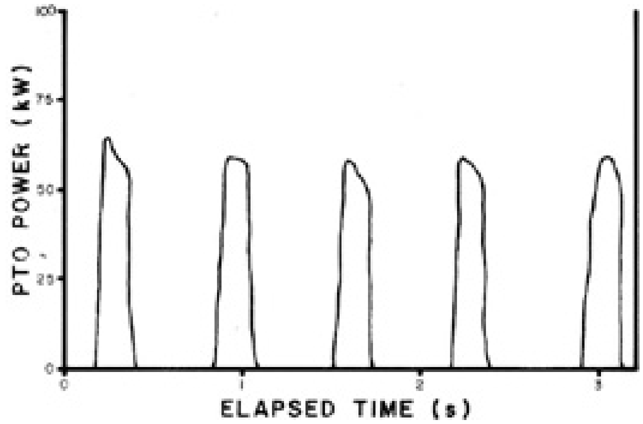

FIGURE 5. Instantaneous Power Take-off Requirements when Baling Alfalfa at an 11 t/h Feedrate.

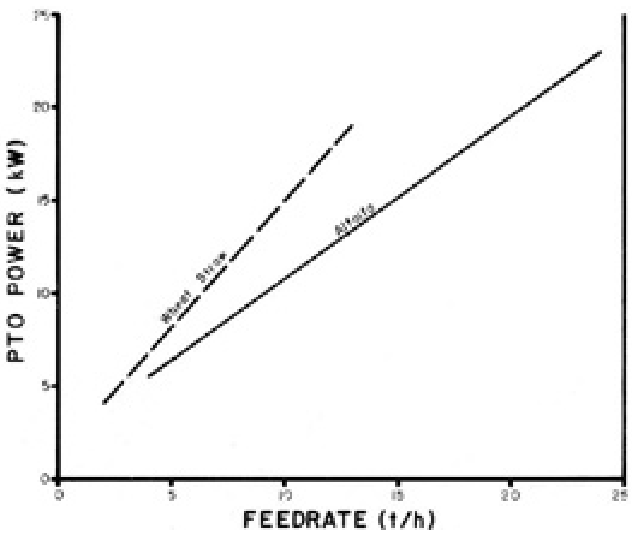

FIGURE 6. Average Power Take-off Requirements when Baling Alfalfa and Wheat Straw.

Transporting: The Hesston 4600 towed directly behind the tractor for both transport and field operation. Dismounting the tractor was necessary to fold the bale chute and raise the pickup. Normally it took about two minutes to prepare the baler for transport or field operation. A standard 75 x 200 mm (3 x 8 in) hydraulic cylinder could be installed under the right side of the baler to raise and lower the pickup.

The baler towed well behind a tractor or suitably sized truck.

Feeding: Feeding was aggressive and smooth flowing in all crops with only infrequent plugging. Unplugging the baler could usually be done by releasing the bale chamber tension and intermittently engaging the power take-off with the tractor at half throttle. The pickup was wide enough to accommodate most windrows. Tractor wheels should be set far enough apart to straddle windrows in order to minimize trampling. Pickup visibility was excellent from most tractors.

Maneuverability: With a little operator experience and skill, the Hesston 4600 was easily maneuverable for efficient baling. Care had to be taken on sharp corners to prevent rear tractor tire interference with the hitch tongue.

Visibility: Visibility to the rear was reduced due to the high baler profile. Baler misties did not become evident as soon as with lower profile balers.

Twine Threading: Twine threading was convenient. The operator's manual gave a clear description of twine threading procedures. Access to the twine storage compartment was somewhat inconvenient due to its 1.36 m (4.5 ft) height above the ground.

EASE OF ADJUSTMENT

Bale Length: Bale length was conveniently adjusted with a wrench. Bale length settings from 305 to 1320 mm (12 to 52 in) were possible. Obtaining a consistent bale length was difficult, since bale lengths varied, depending on windrow uniformity and feedrate.

Bale Density: Bale density was adjusted by hand cranks located at the rear of the bale chamber. Setting the cranks for a specific crop was a trial and error procedure and required the operator to dismount the tractor.

The hand cranks had sufficient adjustment range to produce bales of adequate density in most crops. Normally, twine knot strength was the only factor limiting bale density. In very dry conditions or light windrows, adding bale wedges in the bale chamber helped increase bale density.

Feeding System: No packer and stuffer fingers (FIGURE 1) adjustment was available and none was required to produce well formed bales in all crops. Periodic tension adjustment of the packer stuffer drive-chain was required.

Pickup: Pickup height was easily adjusted with a screw crank (FIGURE 7). A standard hydraulic cylinder could be installed under the right side of the baler to raise and lower the pickup for transporting. Wrenches were required to position the pickup gauge wheels. Damage to the guage wheels could occur on sharp turns if they were set too low. The pickup windguard was not adjustable.

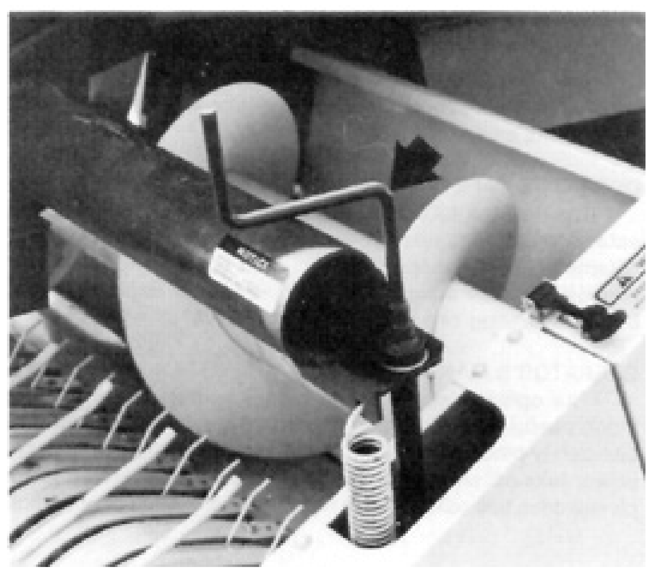

FIGURE 7. Pickup Height Adjustment.

Overload Devices: The power take-off shaft slip clutch slipped at each plunger stroke at normal feedrates, when adjusted to the manufacturer's specifications. The slipping caused excessive heating and slip clutch wear. For efficient baling, slip clutch torque settings up to 50 per cent higher were required. It is recommended that the manufacturer consider re-evaluating the power take-off shaft slip clutch torque setting given in the operator's manual. The pickup drive slip clutch required no adjustment during the test.

Replacing the flywheel, packer-stuffer pickup drive and the knotter drive shear bolts was convenient.

Bale Chute: The Hesston 4600 bale chute could be mounted as either a rear drop or quarter turn bale chute (FIGURE 8). The quarter turn bale chute was easily adjusted to place the bales on edge and was reversible so bales could be dropped on either the left of right side.

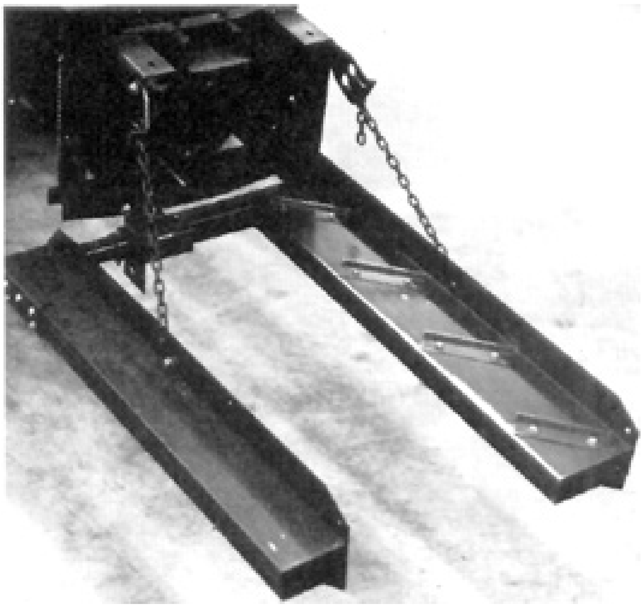

FIGURE 8. Bale Chute.

Servicing: The Hesston 4600 had one belt drive, three chain drives, 33 grease fittings and one gearbox. The operator's manual recommended frequent chain oiling, lubrication of 32 grease fittings every 8 hours, lubrication of one grease fitting every 16 hours, and annual servicing of the gearbox and wheel bearings. About eight minutes were needed to service the Hesston 4600. Servicing the knotters was inconvenient due to their height above the ground.

Tool Box: A tool box compartment located on the left side on the hitch tongue was convenient for carrying tools, spare shear bolts or spare parts.

OPERATOR SAFETY

The Hesston 4600 was safe to operate and service if normal safety precautions were observed. All moving parts were well shielded. As with most power take-off equipment, the power take-off must be disengaged and the tractor engine stopped before adjusting or servicing.

OPERATOR'S MANUAL

The operator's manual was well written and contained much useful information on operation, servicing, adjustments and safety procedures. Adjustment specifications given for the power take-off shaft slip clutch, plunger safety latch and the pickup drive belt tehsion were inadequate for efficient operation.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Hesston 4600 during 104 hours of field operation while baling 21,285 bales. The intent of the test was functional evaluation. The following failures represent only those which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT BALES
DRIVE TRAIN		
- The power take-off shaft slip clutch was readjusted at	beginning of test	
	46	11,130
	74	17,600
	81	18,300
	92	19,890
	96	20,280
	97	20,400
	103	21,180
- The power take-off latch pin broke and was replaced at	22	5,760
PICKUP ASSEMBLY		
- The pickup drive belt began to slip excessively and was tightened at	beginning of test	
	22, 57	5760, 13,250
- The pickup auger drive chain required tightening at	57	13,250
FEEDING ASSEMBLY		
- The packer-stuffer finger drive chain required tightening at	34, 57	8950, 13,250
- Two set screws on the packer finger drive sprocket and one on the stuffer finger drive sprocket were lost. All set screws were replaced complete with jam nuts at	97	20,400
PLUNGER ASSEMBLY		
- The plunger crank safety stop required readjustment at	1, 19	50, 5510
	48, 103	11,210, 21,180
KNOTTER ASSEMBLY		
- The wear pin in the eye of the left needle was lost and replaced at	36	9830
- The knotter brake was loose, allowing the needles to move into the bale chamber out of time. The brake was tightened at	40	10,770
- The knotter drive chain required tightening at	34, 81	8950, 18,350
BALE CHUTE		
- The bolt on the bale chute deflector arm was lost and replaced at	97	20,400

DISCUSSION OF MECHANICAL PROBLEMS

DRIVE TRAIN

Slip Clutch: Continual slipping of the power take-off shaft slip clutch (FIGURE 9) at the manufacturer's recommended torque setting, resulted in slip clutch disc wear and required frequent adjustment. It has already been recommended that the manufacturer consider re-evaluating the power take-off shaft slip clutch torque setting given in the operator's manual.

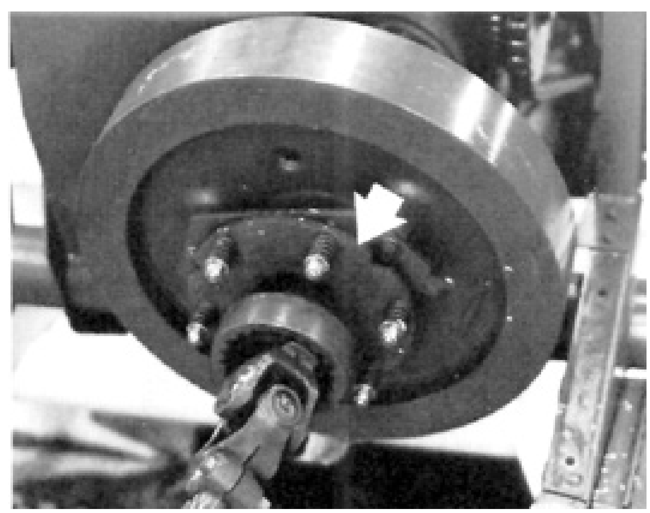

FIGURE 9. Power Take-off Shaft Slip Clutch.

PICKUP ASSEMBLY

Pickup Drive Belt Tensioning Spring: The belt tensioning spring had to be adjusted beyond the length recommended in the operator's manual to prevent excessive belt slipping. Following this adjustment, no further problems occurred.

PLUNGER ASSEMBLY

Plunger Safety Stop: The plunger safety stop to plunger crank arm clearance had to be adjusted beyond the clearance recommended in the operator's manual. This correction was later confirmed by a company service bulletin. Occasional readjustment of the plunger safety stop was required due to wear between the safety stop actuating lever and the needle carriage and due to flaring on the end of the plunger safety stop from striking the plunger crank arm.

APPENDIX I

SPECIFICATIONS

MAKE:	Hesston
MODEL:	4600
SERIAL NUMBER:	B46- 1450
OVERALL DIMENSIONS: (Field Position)	
- width	2520 mm
- length	6060 mm
- height	1720 mm
- ground clearance	105 mm
WEIGHTS:	
- left wheel	780 kg
- right wheel	660 kg
- pickup gauge wheels	0 kg
- hitch	360 kg
Total	1800 kg
TIRES:	
- left	9.5L-14, 6-ply rating, tubeless
- right	9.5L-14, 6-ply rating, tubeless
- pickup guage	3.00 x 12, 'semi-pneumatic'
PICKUP:	
- type	cam actuated drum pickup
- height adjustment	hand crank adjustment
- width	1960 mm
- number of tooth bars	4
- number of teeth	112
- tooth spacing	66 mm
- speed	113 rpm
FEEDING MECHANISM:	
- type	packer and stuffer fingers
- auger diameter	457 mm
- auger speed	113 rpm
- packer finger speed	101 rpm
- stuffer finger speed	92 rpm
PLUNGER:	
- strokes per minute	92
- length of stroke	584 mm
BALE CHAMBER:	
- width	457 mm
- height	356 mm
- range of bale lengths	305 mm to 1320 mm
- bale density control	compression rails (primary) hay wedges (secondary)
TWINE CAPACITY:	6 balls
DRIVES:	
- number of belt drives	1
- number of chain drives	3
- number of gear drives	1
- number of universal joints	3
SAFETY FEATURES:	
power take-off slip clutch	
flywheel shear bolt	
pickup drive slip clutch	
packer, stuffer, pickup drive shear bolt	
knotter drive shear bolt	
plunger safety stop	
SERVICING:	
- grease fittings	32, every 8 hours 1, every 16 hours
- chains	3, oil frequently
- gearbox	1, service annually
- wheel bearings	2, service annually

OPTIONAL EQUIPMENT: (* supplied on test machine)

bale chute kit* (combination rear drop and quarter turn chute)
bale chute extension
hydraulic density control kit
wagon hitch
decal kit
light kit
bale thrower kit

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent
(b) very good
(c) good
(d) fair
(e) poor
(f) unsatisfactory

APPENDIX III

CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 tonne (t)	= 2200 pounds mass (lb)
1 tonnelhour (t/h)	= 1.10 ton/hour (ton/h)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1 millimetre (mm)	= 0.04 inches (in)
1 metre (m)	= 39.4 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilogram/cubic metre (kg/m^3)	= 0.06 pounds mass/cubic foot (lb/ft^3)
1 tonne/kilowatt hour (t/kW.h)	= 0.8 ton/horsepower hour (ton/hp.h)

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