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Equipment for Shredding Sweet Potatoes Prior to Drying for Livestock Feed

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THE PRODUCTION of sweet potatoes for livestock feed has recently gained considerable importance and widespread interest among Southern farmers. One of the primary requirements for the development of a successful feed-processing program, especially for the small grower who intends to process his own sweet potatoes for feed, is simple equipment. The equipment must be capable of slicing or shredding sweet potatoes in sufficient quantities to facilitate rapid drying of large volumes in order to take advantage of favorable weather conditions. The finished product must be of such quality as to make it suitable for livestock feed and for convenient storage. Certain basic features, such as low cost of construction, the use of available materials, and mobility to eliminate long hauls are essential. Because of the variability of power available on farms, the equipment must be readily adaptable to different types of power units. With these requirements in mind, a machine was developed which has given satisfactory results.

CONSTRUCTION PROCEDURE

In order to construct a satisfactorily working machine, it is necessary that the following instructions and plans for making the parts and assembling the machine are followed closely. It should be remembered that the construction of this machine requires a certain amount of skill and adequate shop facilities.

Drive Assembly.—For the driving mechanism, an automobile rear axle assembly, complete with differential, wheels and drive shaft, should be selected. The differential gears, bearings, axles and all other parts must be in good condition or should be replaced. In addition, it is necessary to secure a rear wheel hub flange, one extra axle and one drive shaft roller bearing. After removing the torque tube from the drive shaft assembly, it is cut off 18 inches from the flange of the differential. The drive shaft is cut 9 inches from the flange of the differential, and from the extra rear axle a section 12½ inches long is cut off which includes the tapered and threaded end. All dimensions for fitting and cutting these parts are shown in detail on drawing B-5. The drive shaft section and rear axle are joined together as shown and constitute the drive shaft extending out from the differential. On rear axle assemblies having a solid drive shaft,

the two parts can best be joined by slipping a steel sleeve 4 inches long over the cut ends. The two shaft ends are fastened to the sleeve with 5/16 inch steel pins as shown. On assemblies having a tubular drive shaft and a spline near the differential, the drive shaft may be cut off and the spline welded directly to the axle shaft. In this case, the axle section must be made proportionately longer. If steel pins are used to fasten these parts together, all pins should be riveted at both ends to prevent their slipping out of the holes.

Care should be taken to check the alignment of the shaft after the two sections are joined.—Improper alignment will result in undue wear on the drive shaft bearing and also cause excessive vibration in the machine. In order to produce a positive drive from the wheel which is to be used as a driving pulley, the opposite axle must be locked in the axle housing. This may be done by rotating the driving wheel and at the same time holding the opposite wheel in a locked position. When viewed from above, with the drive shaft in a vertical position, the drive shaft should rotate in a clockwise direction. Then, the wheel and axle housing opposite the driving wheel are removed and the axle cut off 12 inches from the center of the differential housing. By drilling through the axle and the gear hub extending out from the differential, a 5/16 inch steel pin may be driven through both sections as shown in dotted lines on drawing E-13.

The two parts should not be welded together, because the weld may break loose under a heavy load making it necessary to disassemble the machine and axle housing. Next, a short section of the remaining part of the axle having the tapered and threaded end, is welded into the axle housing opposite the driving wheel, as shown on drawing E-13. By slipping this part slightly deeper into the axle housing before welding and by removing the key from the tapered end, it is possible to slip the wheel on the axle housing and allow it to idle freely on the large wheel bearing. The stub axle thus welded into the axle housing merely acts as a means to hold the wheel in position.

To complete the driving mechanism, the section of the axle which was joined to the original drive shaft must be machined on the lathe to fit the drive shaft roller bearing, as shown on drawing B-5. By fitting the bearing into the steel sleeve, E-13, or the original drive shaft race with the machined part of the drive shaft in the bearing, a good fit is assured. The bearing housing is then turned to the desired diameter and welded into the top of the torque tube. The tapered part of the drive shaft should extend approximately 1 inch above the top of the torque tube. To provide lubrication for the bearing, a hole is drilled through the torque tube and sleeve and tapped to fit a standard grease fitting. This completes the driving mechanism.

Construction of Cutter Disk.—The construction of the cutter disk requires considerable skill and adequate shop facilities, because the successful operation of the machine depends primarily upon the proper functioning of this part. In some instances it may be advisable to have this disk made in a well equipped machine shop. The disk should be of steel, 20 inches in diameter and 5/16 inch in thickness. The slots for the cutter knives should be milled or cut accurately so that the knives fit properly and a smooth edge is obtained along the cutting edge of the knife, as shown on drawing C-8. The cutting edges of the disk slots should be in line with the center of the disk. The center hole, 1¾ inches in diameter, should be machined on the lathe so that the center runs true with the circumference of the disk. This will assure proper balance of the disk when the machine is operating. After the disk is machined to size and the slots and center hole are completed, a steel plate ¼ inch thick, 2½ inches wide and 8 inches long is bolted to the underside of each slot as indicated by the dotted lines on drawing C-8. The cutting knives may be bolted to these plates after drilling two ⅜ inch holes in each plate as shown. Slightly riveting the ends of the bolts will prevent the nuts from working loose.

The extra wheel hub flange is used to attach the disk to the tapered end of the drive shaft. The flange is first removed from the brake drum by extracting the lug bolts. Next, the roller bearing is removed and that section cut off from the flange and squared off on the lathe. The flange is chucked in the lathe, and the hub having the tapered hole and keyway is turned to 1¾ inches diameter to fit into the center hole of the disk as shown on drawing C-9. After the hub is turned, it is chucked and the flange is turned to 3¾ inches diameter as specified. A better method of obtaining a true flange by turning, however, is to fasten the hub flange to the tapered and threaded section of a rear axle. The flange may then be turned between centers to all dimensions in one lathe operation. The finished flange is bolted to the cutter disk with the hub extending through the center hole of the disk as shown on drawing C-8. By countersinking the bolt holes at the top of the cutter disk and by using 5/16 inch stove bolts, the flange can be fastened flush to the cutter disk without the bolt heads protruding on top of the disk. The bolts should be riveted over the nuts to prevent the nuts from turning.

Cutting Knives.—The cutting knives (drawing C-8) may be obtained from Henry Disston & Sons, Inc., Philadelphia, Pennsylvania. The proper setting of the knives is important and should be done carefully. Improper setting will result in pulping the potatoes rather than shredding them. In order to assure satisfactory operation of the machine, the following adjustments are suggested:

1. The lower cutting edge of each shredder knife should be 1/16 inch below the surface of the cutter disk. It may be necessary to use shims under the back of each knife to obtain the correct setting.

2. The cutting edge of each knife should also be moved back 1/16 inch from the edge of the slot in the cutter disk as shown on drawing C-8.

3. All three knives must be set at the same distance from the center of the disk in order that the ribs in each knife follow the corresponding ribs in the other knives. This setting produces longer and more uniform shreds.

4. Because of the rectangular shape of the cutting knives, it is necessary to grind off the left rear corner of each knife until it fits easily into the slot.

The completed cutter disk, with the cutting knives in place, is mounted on the tapered end of the drive shaft. A key is placed in the keyway on the tapered end of the shaft. The disk is tightened with the nut and secured with a cotterpin. This assembly provides an excellent and safe mounting and should be followed in every detail to prevent loosening of the disk and possible serious accidents.

Hopper Frame Assembly.—The parts of the hopper frame are cut out, shaped and drilled as shown on drawings B-6 and B-7. The two base angles are provided with a semi-circular section as shown on A-3 and A-4 to fit the underside of the axle housing. The base angles are welded to the underside of the axle housing. They are placed on each side and 15 inches from the center of the differential. In welding, care should be taken to prevent the housing from being pulled out of alignment. This may be done by starting at the top and welding a short distance each way. Electric welding is preferred. The hopper frame angles (B-6) are welded to the base angles. However, the three brace angles (B-7) should be bolted to the side frames so that the axle housing may be removed in case it becomes necessary to repair the axle or differential. One brace angle is bolted to the top and one to the bottom of the side frame at the front of the machine. Only one brace angle is bolted to the top of the frame at the rear in order to provide clearance for the removal of the shredded material.

Hitch Assembly.—The hitch for transporting the machine may be constructed in various ways. One of the simplest methods is to weld a 2 inch pipe, 48 inches long to the center of the differential and brace it with two automobile radius rods as shown on drawings A-1, A-2 and the assembly. A triangular angle iron hitch, welded to the base angles, will serve the purpose equally well.

Hopper Mounting.—The hopper consists of one-half of a 55-gallon steel oil drum with the end removed as shown on drawing D-10. The flange remaining in the bottom of the drum is necessary because it rests directly on the cutter disk with a minimum of clearance to prevent unshredded material from escaping below the disk. The hopper section of the barrel is placed on top of the disk and the flange is allowed to rest directly on the disk. The barrel is then centered over the disk with special care being taken to provide sufficient clearance for the cutting knives through one whole revolution. The hopper is attached to the angle frame by means of the angle hopper bracket C-12. The remaining half of the oil drum (D-11) is fastened in a similar manner beneath the disk to act as a guard to prevent scattering of the shredded material.

POWER AND SPEED REQUIREMENTS

A power unit of at least 5 h.p. capacity is needed to operate this machine. During one test run, using tractor power, 80 bushels of sweet potatoes were shredded in 15 minutes with this machine. By using an automobile wheel with tire as drive pulley on the machine, the normal operating speed will be about 750 r.p.m. on the cutter disk. This speed has given the most satisfactory results. If other sources of power are not available, it is possible to transmit the driving power from the rear wheel of an automobile or truck.

OPERATING PRECAUTIONS

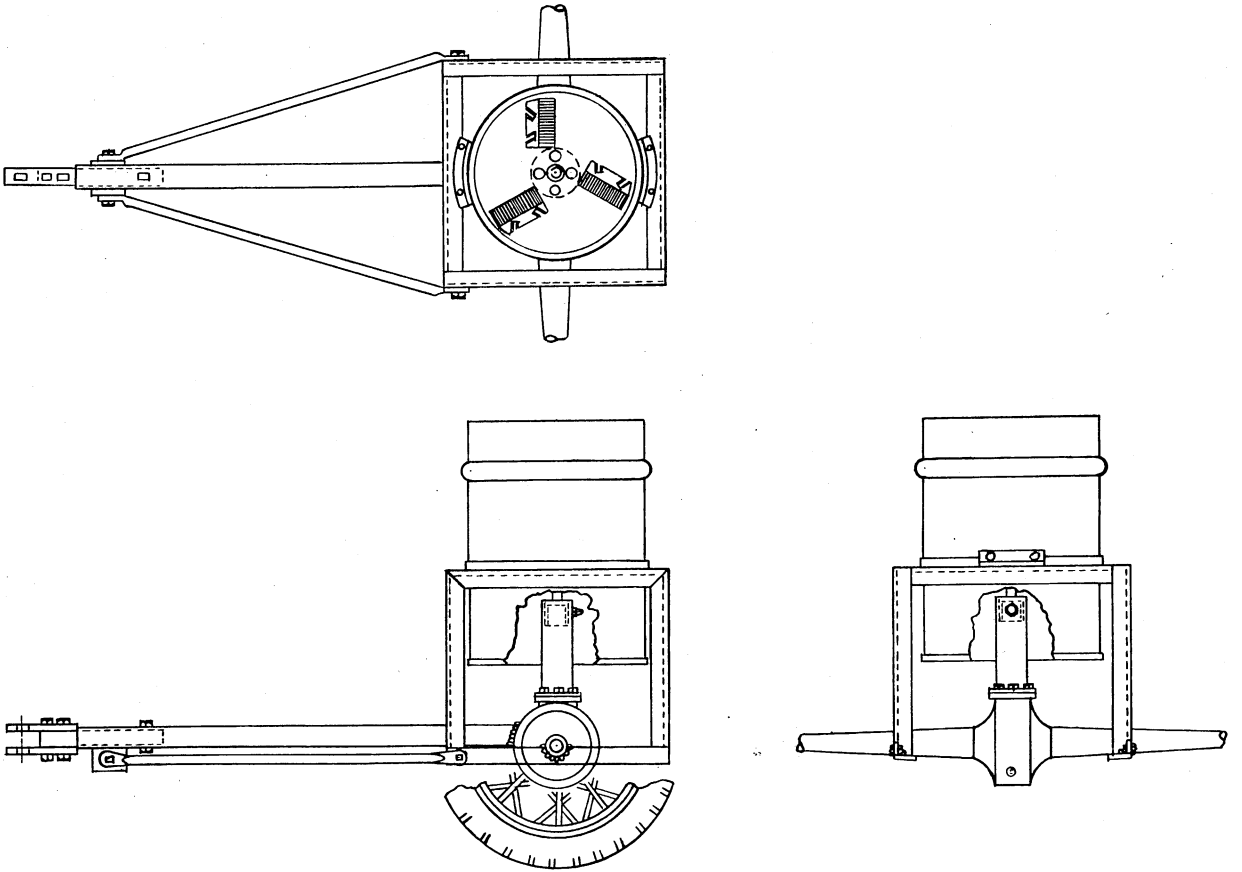
1. The machine should always be operated with the cutter disk in a horizontal position.

2. Before the machine is started, the disk, nut and cotterpin should be checked.

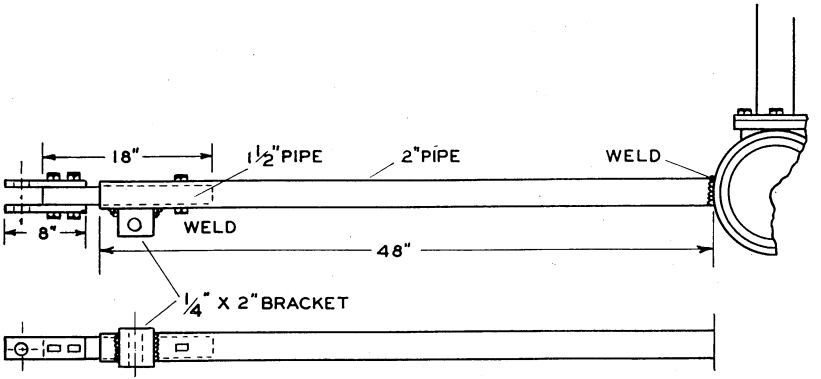
3. Operators should be warned against putting their hands inside the hopper.

4. The rate of feeding should be regulated to provide a uniform pressure on the potatoes in contact with the cutting knives. For best results, the hopper should be kept full when shredding.

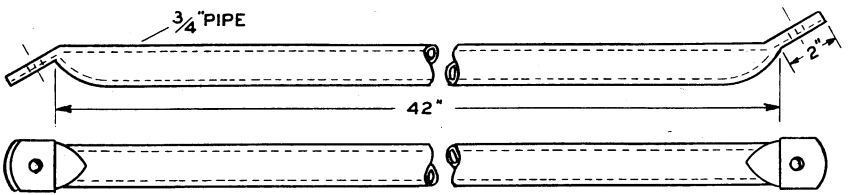
5. Washing of the potatoes is to be preferred but not absolutely necessary if the potatoes are reasonably clean and free from rocks, wood and other damaging materials. It should be remembered that sand is a highly abrasive material and that one rock may injure the cutting knives to the extent that they are unfit for further use.



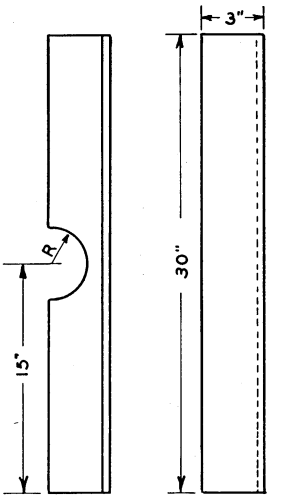
SWEET POTATO SHREDDER ASSEMBLY



DRAWBAR A-1



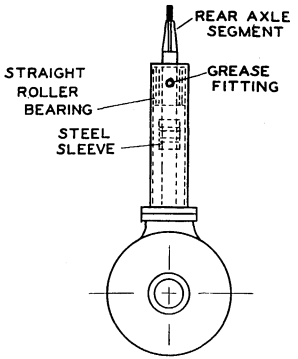
DRAWBAR BRACE A-2
(MAKE TWO)

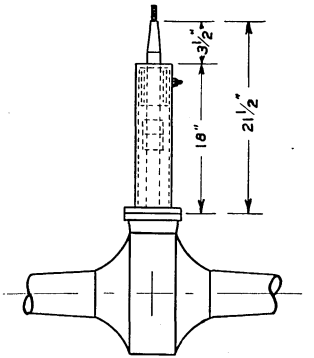


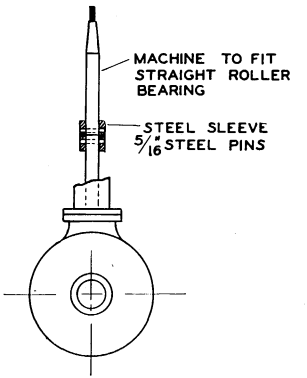
A-3
&
A-4

BASE ANGLE
(MAKE TWO)

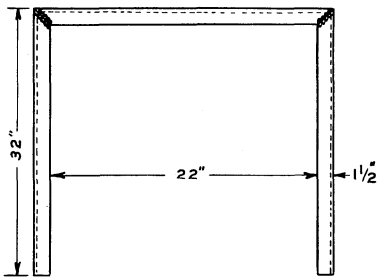
Make R equal to ½ dia. of rear axle housing weld to housing 15" from center of differential.



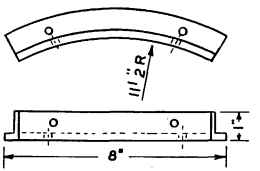




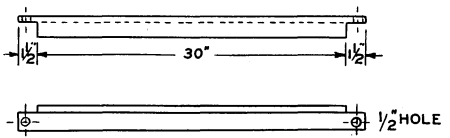
CUTTER DRIVE ASSEMBLY B-5



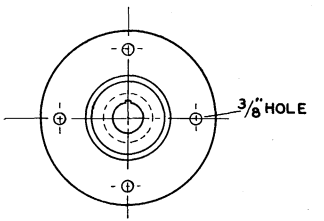
HOPPER FRAME B-6
(MAKE TWO)

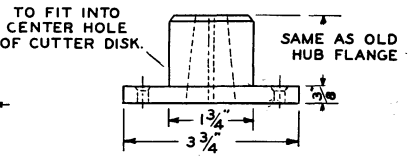


HOPPER BRACKET C-12

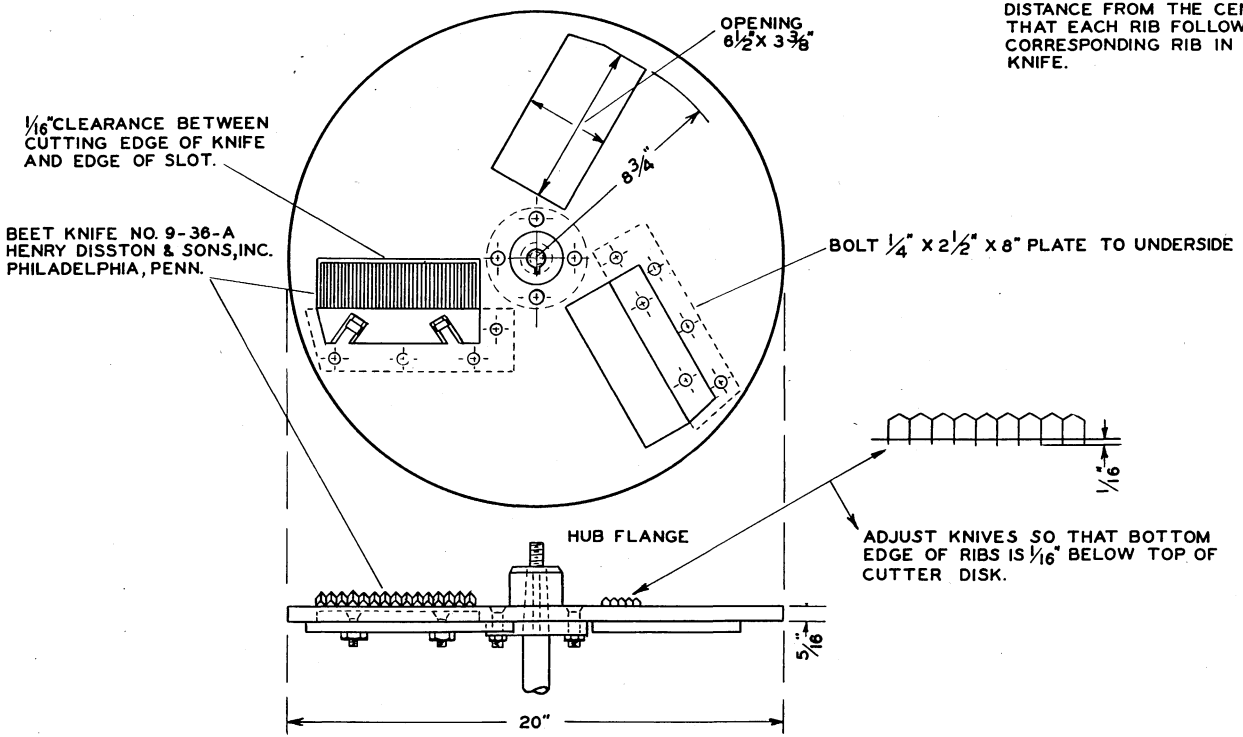


HOPPER FRAME BRACE B-7
(MAKE THREE)

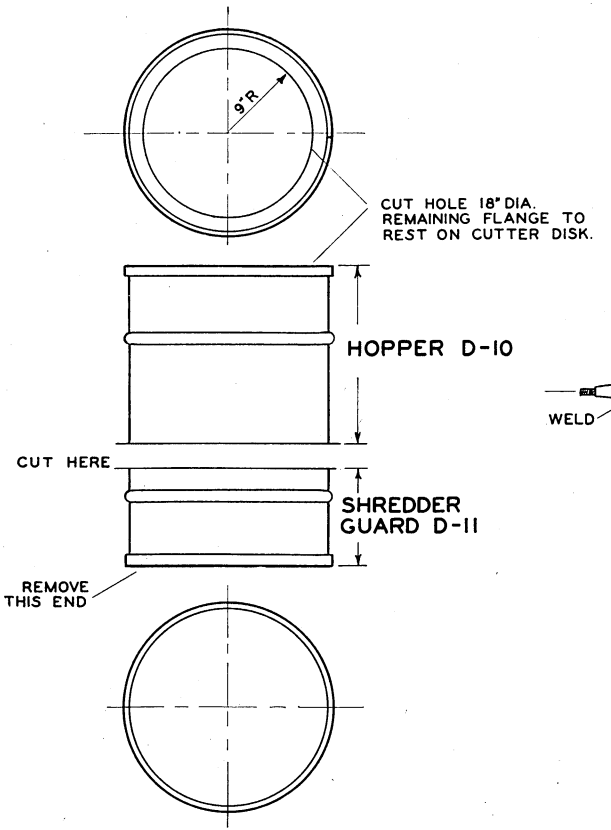




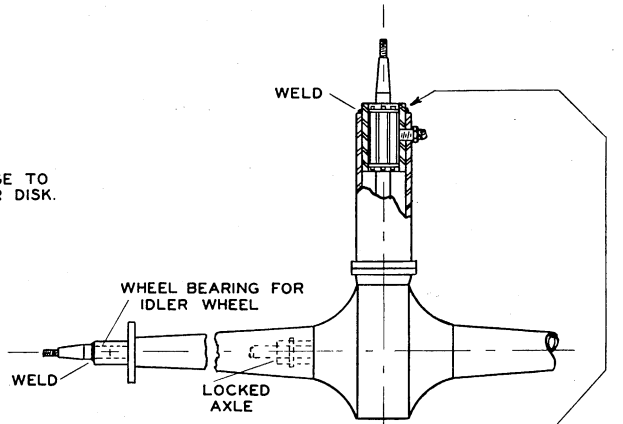
HUB FLANGE C-9



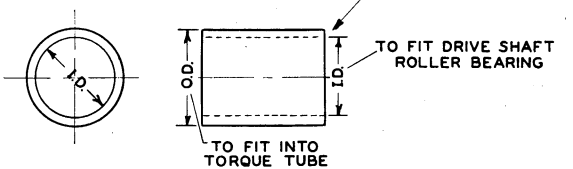
CUTTER DISK C - 8



HOPPER & SHREDDER GUARD
D-10 & D-11



DRIVE BEARING AND IDLER
WHEEL ASSEMBLY E-13



STEEL SLEEVE FOR DRIVE
SHAFT ROLLER BEARING

6. All bearings and the differential should be lubricated frequently.

7. The cutting knives must be properly adjusted before the shredder is operated.

8. The machine should be kept painted and well covered when it is not in use.

If these operating precautions are followed and the machine is given reasonable care, it will operate satisfactorily for a long time. It will shred up to 300 bushels of sweet potatoes per hour. This amount of shredded material would require one-half acre of drying surface and produce approximately three tons of dried feed.

ACKNOWLEDGMENTS

Acknowledgment is made of the pioneer work done in this field and also the assistance rendered the author in developing this machine by J. W. Randolph and W. O. Gordon, Bureau of Plant Industry, Chemistry and Engineering, U. S. D. A., Laurel, Mississippi.

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