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The South Dakota Pasture Furrower

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THE SOUTH DAKOTA

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Agricultural Engineering Department
Agricultural Experiment Station
SOUTH DAKOTA STATE UNIVERSITY
Brookings

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Use of a trade name does not imply endorsement of one brand over another.

THE SOUTH DAKOTA

Pasture Furrower

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INTRODUCTION

South Dakota has a vast acreage in permanent pasture and rangeland for livestock grazing. Oftentimes during low moisture periods, heavy demands are placed upon summer pastures in July, August and September resulting in an overgrazed situation and consequently leaving the open areas subject to reduced production. In addition, the danger of erosion exists from high intensity rainfalls.

Much of the State's pastureland is on gently rolling land to steeply sloped hillsides. Usually, permanent pasture areas are not the most desirable for agricultural cash crop production for reasons of topography, fertility and geology. It is not uncommon to find scatterings of surface and imbedded rocks ranging from pebbles to boulders in many pastures, particularly those located on hilly topography near surface streams and waterways.

Two major problems confronting South Dakota livestock farmers and ranchers are to conserve moisture to keep pastures at a high productivity during the summer months, and to reduce water runoff and erosion of the soil. One accepted method to help control runoff and erosion is construction of pasture furrows on the contour at a proper slope and spacing as determined by sound engineering design. These furrows are normally single, rather shallow, with a flat base.

However, landowners and farm operators have been reluctant to use standard moldboard plows, listers and other tillage machines for pasture furrow construction. The common objections are that these

implements destroy the removed sod, expose soil for erosion and weed growth and the implements themselves may be damaged in rocky ground.

After several years of research and field testing, agricultural engineers have introduced a new model tractor-drawn pasture furrower specifically designed to overcome these objections. It can be made in a well-equipped farm shop from commercially available parts.

Detailed plans and design information for construction of the pasture furrower are included in the back (pages 11 -15) of this publication. Method of operation and results of testing are included in the discussion which follows.

DESIGN CRITERIA

Knudson and Hamann at the outset of the investigations interviewed engineers, agronomists, soil conservationists and farmers concerning design criteria for a pasture furrower. (See South Dakota *Farm & Home Research*, Vol. XII, No. 2, Spring 1961). The original purpose of the study was to design, construct, develop, and field test an agricultural implement that would have the following features:

1. **The machine should construct a relatively permanent small furrow on the contour.**
2. **The furrows should be constructed without exposing the underlying soil or destroying the protective sod.**

Figure 1. General View of the Pasture Furrower Developed at South Dakota State University.

3. **The furrows should be easily crossed by and resistant to the destructive forces of livestock and vehicles.**
4. **The implement should be versatile and lend itself to two-way operation.**
5. **It should be simple enough to be built in a well equipped farm shop with commercially available parts.**
6. **It should work in many soil conditions and be rugged enough to use in hard and rocky pasture soils.**
7. **Its power requirement should be within the range of an available farm-size tractor.**

DEVELOPMENT AND TESTING

The first furrower built by Knudson is shown in figure 1. It consisted of a furrowing tool mounted on a 4¼ x 4¼-inch tool bar which was purchased.

The furrowing tool consisted of (a) 43-inch V-shaped horizontal blade, (b) sod rack attached to the rear of the blade, and (c) small disc furrow opener below the sod rack. The furrowing implement functions by the forward motion of a V-blade parallel to the ground surface at a depth of approximately 4 inches. In operation, a sod slice about 43 inches wide is made. A vertically mounted disc or coulter divides the sod slice in the center resulting in two slices of equal width and remaining attached to the soil at the extremities. As the forward motion continues, the rear mounted sod racks elevate the two narrow sliced halves of sod in a manner that permits them to slide over the disc assembly which is mounted below the sod rack. The disc assembly is set at an angle to remove soil from the furrow center, scattering the soil to the side without leaving a noticeable ridge. After the soil is removed the sod rack is so designed to replace the sod slices in the newly formed depression. The disc angle is adjustable by means of a lever and may be reversed for two-way operation. A constructed and resodded furrow is shown in figure 2.

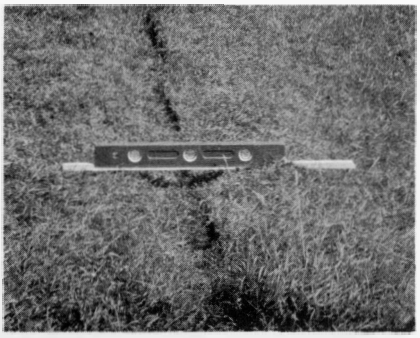


Figure 2. Contour Furrow Constructed in a Blue Grass Pasture

The implement was tested under various soil and moisture conditions at several locations. Its operation was satisfactory in a light loam soil but it was evident that a more rugged construction was needed for satisfactory performance in hard and rocky soils.

In 1962 a second model was constructed. A Graham-Hoeme tool frame was used with a mounted Sunflower Manufacturing Company 36-inch stubble mulch blade. The same sod lifting bars and rack were used as on the first model. A heavy

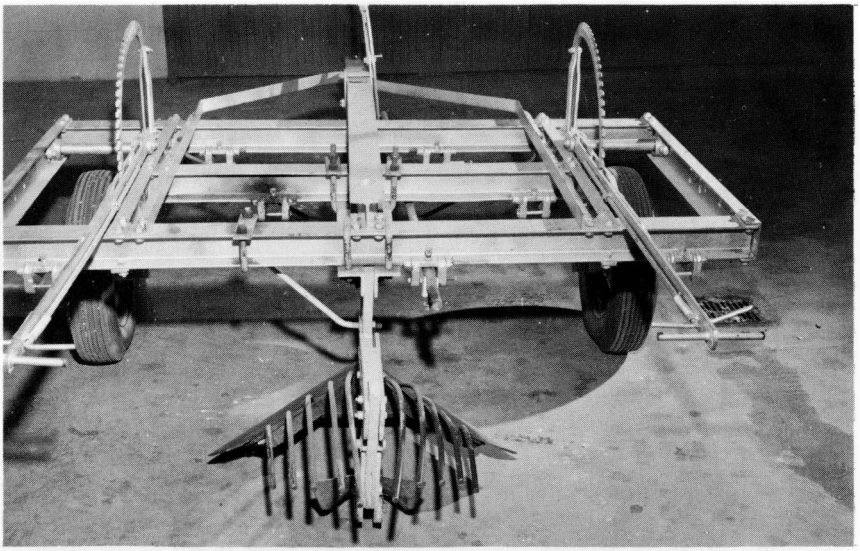
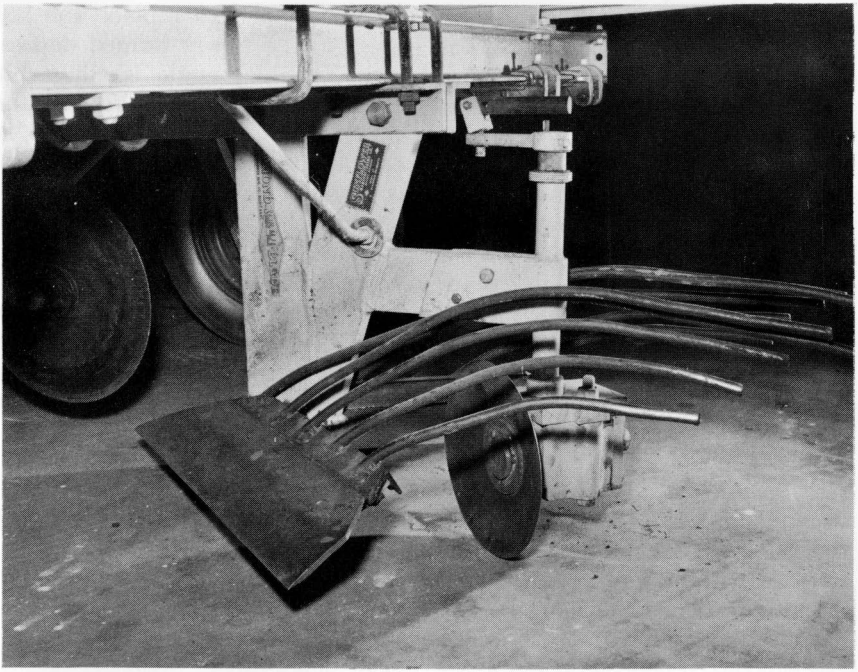


Figure 3. The 1962 model. A Graham-Hoeme tool frame with stubble mulch blade.

Figure 4. A second model furrowing tool with heavy disc plow bearing.



disc plow bearing replaced the original on the disc assembly. Figure 3 shows an overall view of the machine and a close-up of the second model of the furrowing tool is shown in figure 4.

The 1962 model was initially tested in sandy-loam soil on a 10% to 15% slope, with a rather heavy concentration of rocks. A three-bottom plow tractor provided adequate power. A 12-inch diameter, one-inch cavity disc was used in the disc assembly. The implement performed well in constructing three to four inch deep sodded furrows in one operation. A small lister-type furrow opener as shown in figure 5 was also used as a replacement for the disc opener. This assembly increased the draft and power requirements and also resulted in a rather uneven furrow.

With either furrow opener assembly it was advisable to pack the sod uniformly into the newly constructed furrow. This was accomplished by driving the rear tractor wheel over the sod the length of the furrow.

EXTREME SOIL CONDITIONS

When using the furrower in a dry, hard gumbo type soil, one of the difficulties encountered was proper penetration into the soil and holding the desired depth. Under these same conditions the side draft effect caused by the earth moving disc was excessive and had a tendency to push the implement out of the soil. To counteract and reduce

Figure 5. The 1962 model with lister type furrow opener replacing a disc opener.

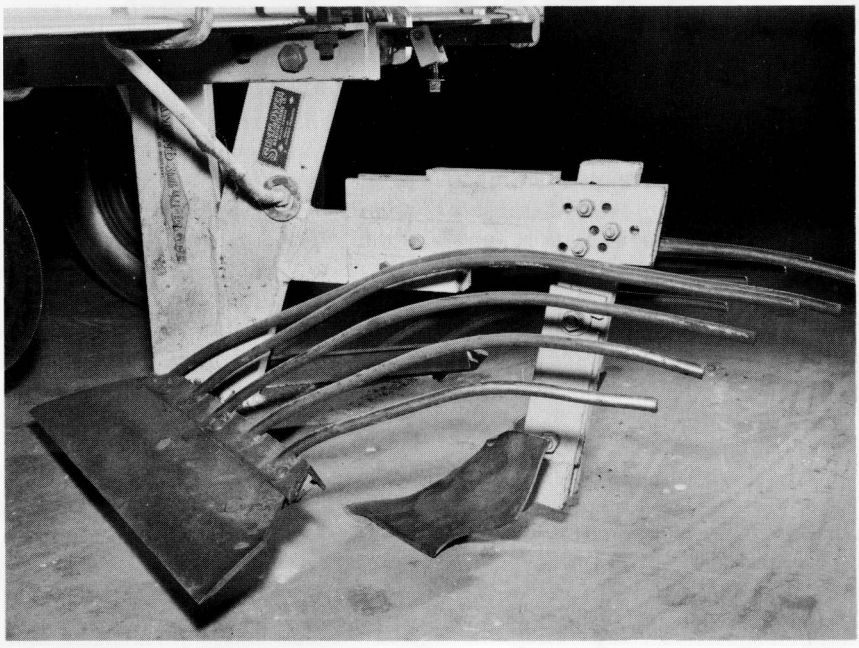


Figure 6. Three-point hitch model.

the side draft an extension was welded to the V-blade point. This consisted of a 6-inch long, $1\frac{1}{4}$ x $1\frac{1}{4}$-inch steel bar protruding at a 30° downward angle from the horizontal. This correction feature proved itself satisfactory as the subsoiler effect did loosen the hard soil to the extent of permitting the disc to penetrate easily without causing a noticeable sidedraft.

THREE-POINT HITCH MODEL

For improved maneuverability and obtaining more weight transfer for better traction and more uniform implement depth control, a three-point hitch model was built in early 1964. A channel and angle iron frame with three hitch points was shop constructed and the furrowing tool attached to it. At the rear a gauge wheel was attached for depth control, sod packing and better furrow forming. This gauge wheel packed the sod into the newly constructed furrow by running directly behind the furrowing disc in a once-over operation. Furrows were constructed in several areas of South Dakota under various soil conditions with this model. Even under extremely hard soil conditions near Newell, excellent furrows were constructed without difficulties. The furrower was pulled with a three-plow tractor.

FURROWS FOR WATER SPREADING

In addition to the original intended use of a newly designed pasture furrower, a potential use of the implement would be in areas where "water spreading" is practiced. Often it is almost impossible to adequately control the water sufficiently to obtain uniform distribution by spreading without extensive land preparation. By the construction of small, shallow furrows with a pasture furrower it would be possible to control the flow of water. This in turn would result in water more uniformly distributed and spread over a larger area from one outlet point. Reduced water runoff with more efficient water utilization would be evident.

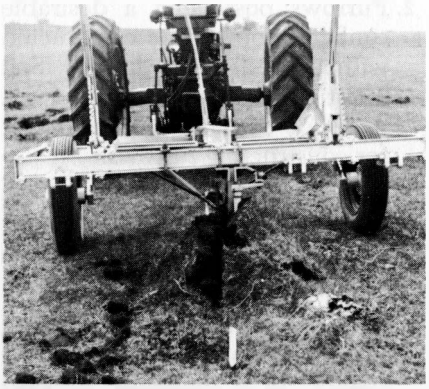


Figure 7. Constructing furrow in native pasture, western South Dakota.

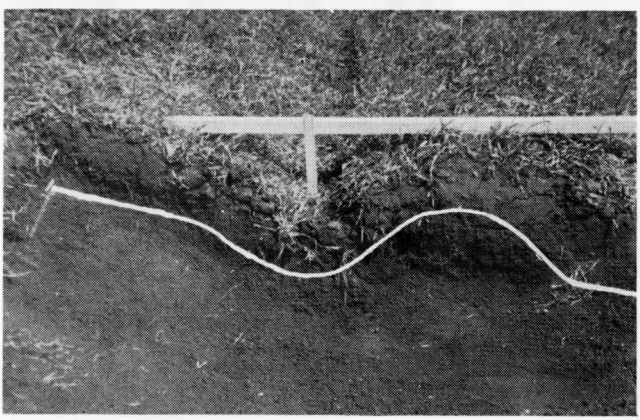
WATER STORAGE POTENTIAL

The average effective height of the lower slope side of a settled furrow is approximately 3 inches above the original soil grade. The bottom of the furrow is about 2 inches below the original soil line. Figure 8 shows a typical cross section of a constructed furrow. Knudson calculated storage potentials for pasture furrows on different slopes and furrow spacings necessary for storing varying quantities of runoff. The calculated values based on no infiltration are tabulated in table 1.

CONCLUSIONS

1. The pasture furrower has been successfully used in native pastures in both Eastern and Western South Dakota under various soil types and conditions.

Figure 8. Cross section of finish furrow (white line denotes the lower surface of the sod slices).



2. Furrows possessing a desirable configuration can be constructed without destroying the sod. Soil moisture content desirable for a good job of plowing is also best for constructing furrows.
3. By strong and rugged construction it can be used in rocky, dry, hard soil without major damage or breakage.
4. Power requirements were within the range of three-plow farm tractor for a moderate forward motion without excessive wheel slippage.
5. Both a pull-type and a three-point mounted model operated successfully. The addition of a gauge wheel on the three-point hitch model gave the advantage of having a packer wheel in the furrow.
6. The furrower can be constructed in a well equipped farm shop from commercially available parts.

Table 1. The Calculated Storage Potential* of Contour Furrows and Furrow Spacings Required for Storing Various Amounts of Surface Runoff

Slope percent	Storage potential cu. ft. per ft. of furrow	Furrow spacing (in feet) required to store runoff 0.25 in.	0.5 in.	0.75 in.	1.0 in.	1.25 in.	1.5 in.
1	1.90	57.3	28.7	19.1	14.4	11.5	9.6
2	1.02	49.0	24.5	16.3	12.3	9.8	8.2
3	0.92	44.0	22.0	14.7	11.0	8.8	7.3
4	0.68	32.7	16.3	10.9	8.2	6.5	5.5
5	0.61	29.2	14.6	9.7	7.3	5.8	4.9
6	0.46	22.0	11.0	7.4	5.5	4.4	—
7	0.43	20.5	10.3	6.8	5.1	4.1	—
8	0.40	18.7	9.3	6.2	4.7	—	—
9	0.35	16.7	8.3	5.6	4.2	—	—
10	0.31	14.8	7.4	5.0	—	—	—
11	0.28	13.5	6.8	4.5	—	—	—
12	0.26	12.3	6.1	4.1	—	—	—
13	0.22	10.4	5.2	—	—	—	—
14	0.21	9.9	5.0	—	—	—	—
15	0.20	9.5	4.7	—	—	—	—
16	0.19	9.0	4.5	—	—	—	—
17	0.18	8.5	4.3	—	—	—	—
18	0.17	8.0	4.0	—	—	—	—
19	0.16	7.6	—	—	—	—	—
20	0.15	7.1	—	—	—	—	—

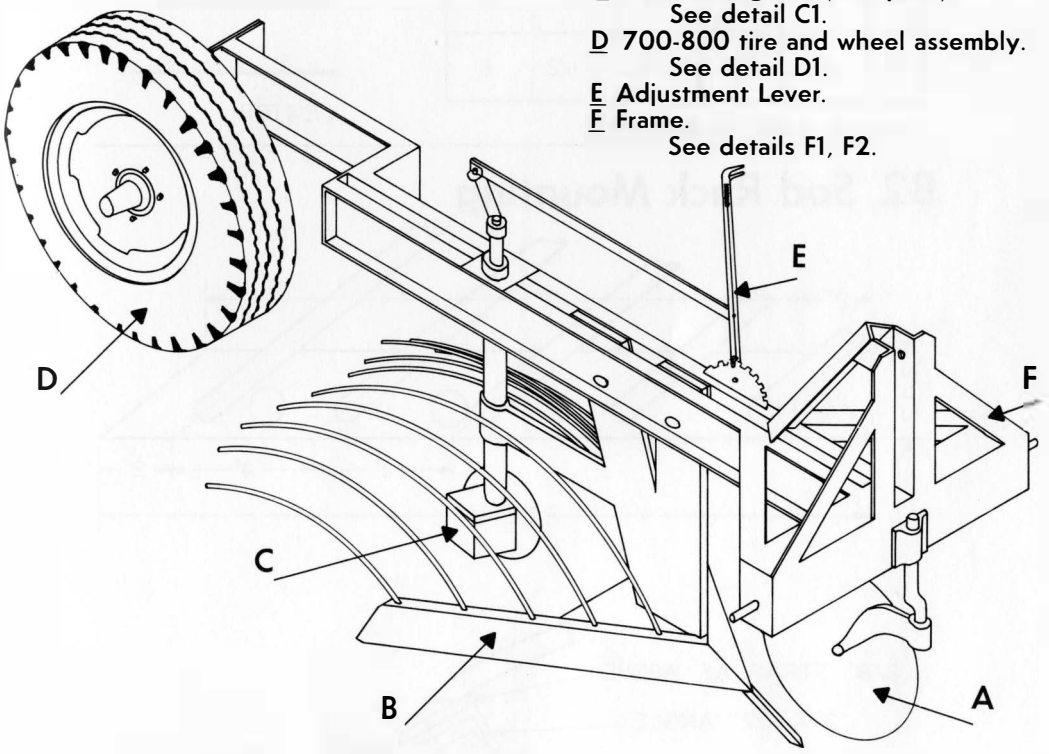
*Table was calculated from the measured furrow cross section and is based on nonfiltration.

APPENDIX

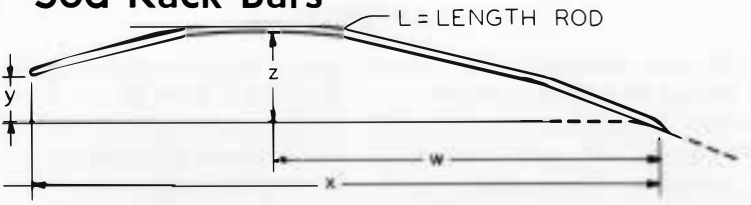
Here are presented the plans and design information for the construction of a pasture furrower. All of the parts and individual units are available commercially; however, a number of components may be interchanged with or salvaged from existing farm implements. To assure ruggedness and rigidity, care should be taken in the selection of proper materials and workmanship. If additional information is desired, contact the Agricultural Engineering Department, South Dakota State University, Brookings, South Dakota, 57006.

THE SOUTH DAKOTA
PASTURE FURROWER

A Plow Coulter
B Noble blade by Sunflower Mfg. Co.
See details B1, B2, B3.
C Disk bearing unit (disk plow).
See detail C1.
D 700-800 tire and wheel assembly.
See detail D1.
E Adjustment Lever.
F Frame.
See details F1, F2.

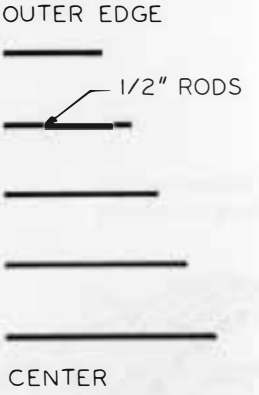


B1 Sod Rack Bars

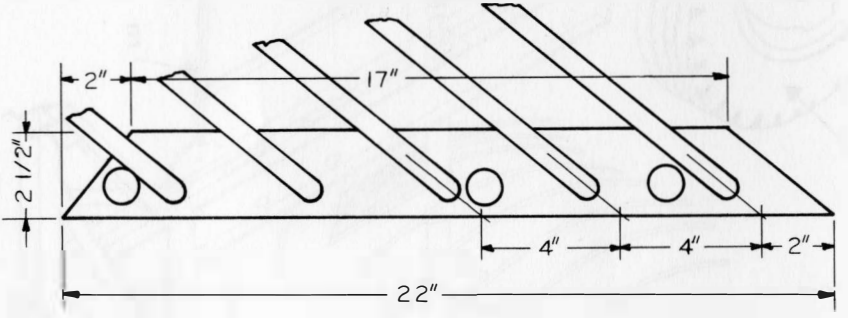


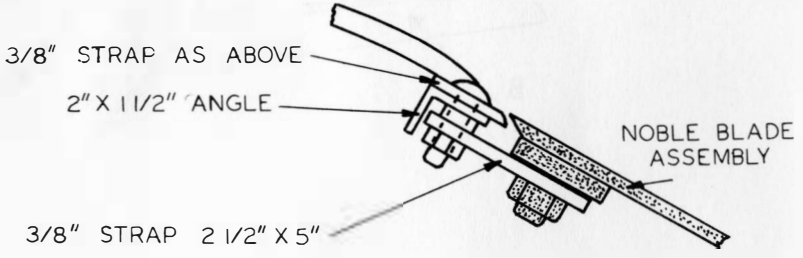
NO.	L	W	X	Y	Z
1	20	9	19	0	1
2	25	12	23	1	2
3	31	14	28	1 1/2	4
4	36	17	33	2	5
5	40	19	38	2 1/2	6

TWO OF EACH IS REQUIRED

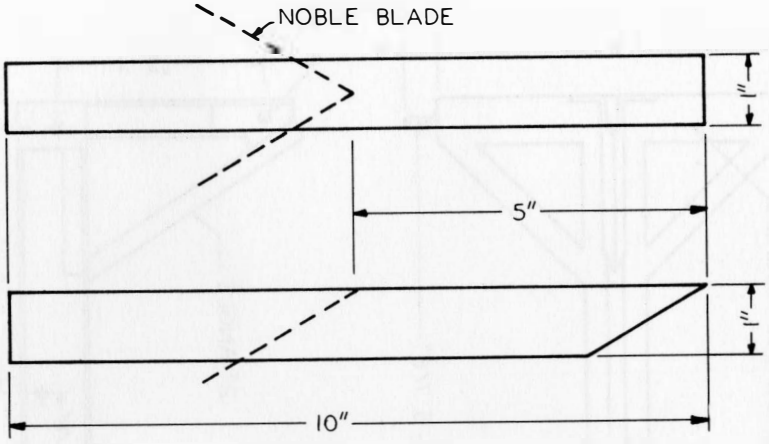


B2 Sod Rack Mounting

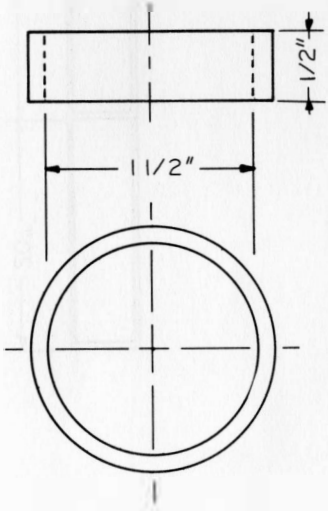




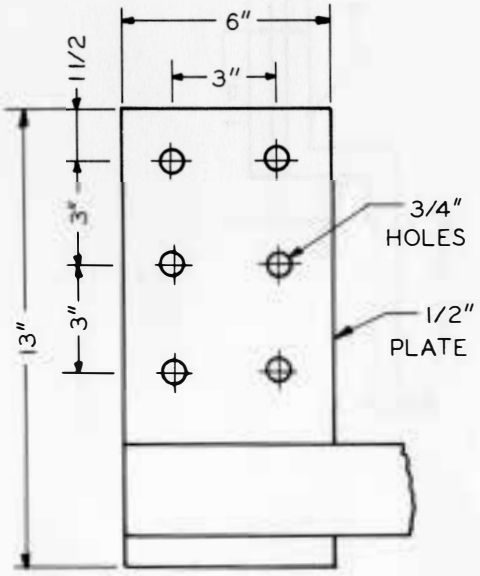
B3 Sub-soiler

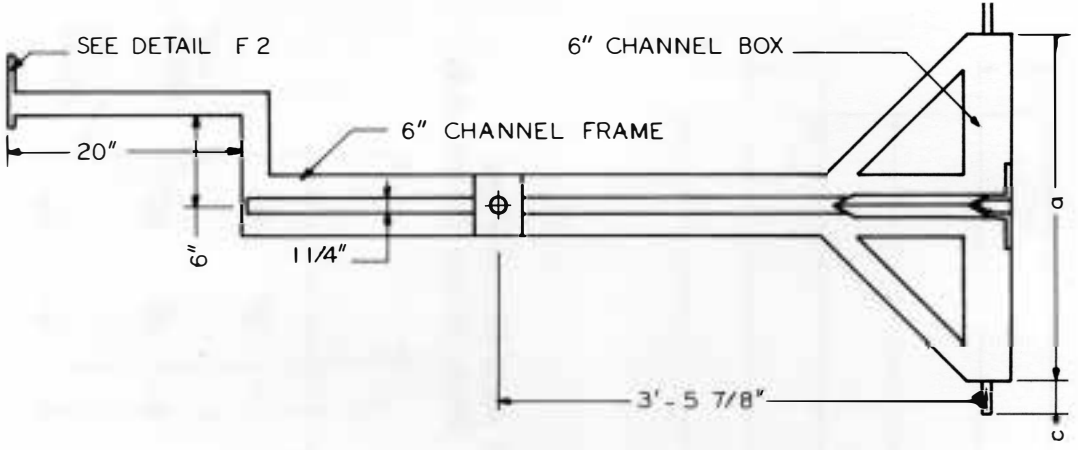


C1 Height Adjustment Sleeve

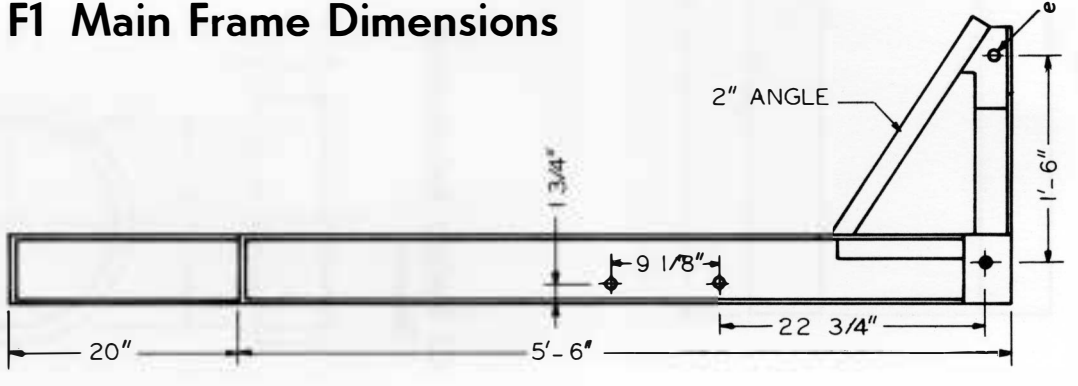


D1 Axle Mount Plate Pack Wheel Height Adj.





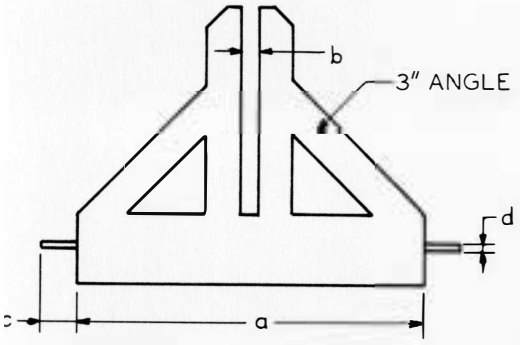
F1 Main Frame Dimensions



(F1 Continued)

HITCH DIMENSIONS

ITEM	CATEGORY 1	CATEGORY 2
a	27"	32 1/2"
b	1 3/4" MIN.	2 1/16" MIN.
c	1 7/16"	1 15/16"
d	0.86"	1.11"
e	0.77"	1.02"



F2 Rear Mounting Plate