How to Build and Operate a Gladiolus Harvester

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This gladiolus harvester can be built in most machine shops, using standard materials obtained either at steel supply houses or large hardware stores. The machine has been designed so that a good welder and machinist should be able to build it. Materials should cost in the neighborhood of $1,000. It is estimated it will take from 300 to 400 man-hours to complete the harvester. Standardized parts are used in construction. In some instances, particular brand names are mentioned. This does not imply an indorsement of these materials, but merely suggests a type that has proved satisfactory in operation. Before construction of this harvester is begun, plan number 3134-1 should be procured from the Farm Building Plan Service for $4.35. This plan consists of 16 sheets of working drawings.

The machine has been field tested and found satisfactory. Trials have been made in clay loam and sandy soils. With a certain amount of care, good results were obtained in soils that were wet. The machine harvested an average of 1 1/2 acres in a 10-hour day. There were few breakdowns, and the machine maintained a steady output of corms. On an average, about 11 per cent of the corm tops were longer than 1 inch above the corms. Injuries, as a rule, were not higher than about 1 1/2 per cent. The remainder of the corms were harvested satisfactorily. Some corms were left in the field with their tops off, the number depending on the degree of botrytis present, the maturity of the crop, and the variety.

If the parts for the harvester are bought ahead of time, there should be few halts in construction of the machine. This will save many man-hours of time and consequently should result in a saving. Attention is called to the bill of materials on pages 12-16 which lists all parts required. Note that the bill of materials is divided into two parts: (1) Materials for Trailer Unit, page 16, and (2) Materials for Harvester Less Trailer Unit, page 12. Other than the 4-inch size D-section V-belt pulleys, which have to be made, parts can be obtained from supply houses in the Northwest.

Building the lifter frame

Figure 1 shows the lifter frame from the side view. Most of the work of construction of the lifter frame consists of measuring, cutting the steel to size, and welding it in place. Note particularly the construction of the front idler adjustment for the V-belts. (Sheets 1, 4, and 6 of drawing 3134-1). The large D-section V-belts have to be placed on the lifter frame before the lifter frame is placed on the trailer frame. If this is not done, it will be impossible to put the large D-section V-belts on the machine.

Attention is called to the fact that the large 10.6-inch P.D., double-groove A-section V-belt pulley on the gear box has to line up with the 4-inch P.D. double-groove A-section V-belt pulley on the clutch after the lifter frame is put in place. For this reason, it might be necessary to locate the holes for the gear box on the support platform after the lifter frame has been placed on the trailer frame.

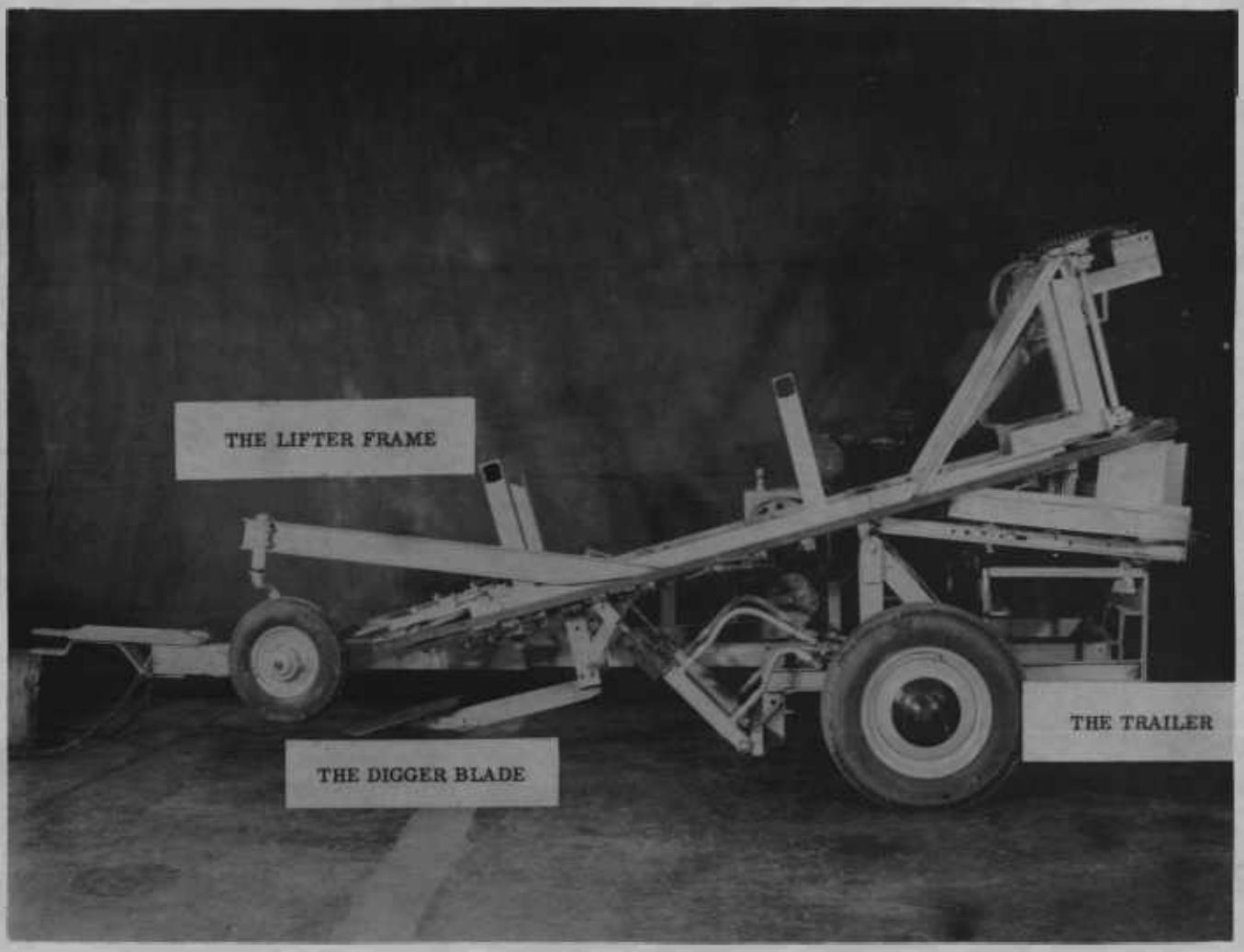

Figure 1. The gladiolus harvester.

Building the blade and blade support

The blade and the blade support shown in Figure 2 have been found satisfactory after many trials. The blade is made of one-fourth inch steel plate with a hardened edge ground sharp. Two quarter-inch bolts hold the blade on the blade support. The quarter-inch bolts will snap if a boulder or log is struck in the ground and, therefore, provide a safety.

Careful adjustment of the blade is required to obtain satisfactory results. The back end of the blade should be directly under the point where the two V-belts above grasp the tops of the gladiolus corms. See Figure 2. Normally, this is at a point where the two V-belts meet. Drop a plumb bob down from the point where the two V-belts meet to determine whether the back of the digger blade is in position. If the blade is not in the right position, it can be bolted either farther back or forward as required. The reason for this position is that, as the soil flows over the blade, it breaks open at the back of the blade. The gladiolus plant can be pulled easily from the earth at this point.

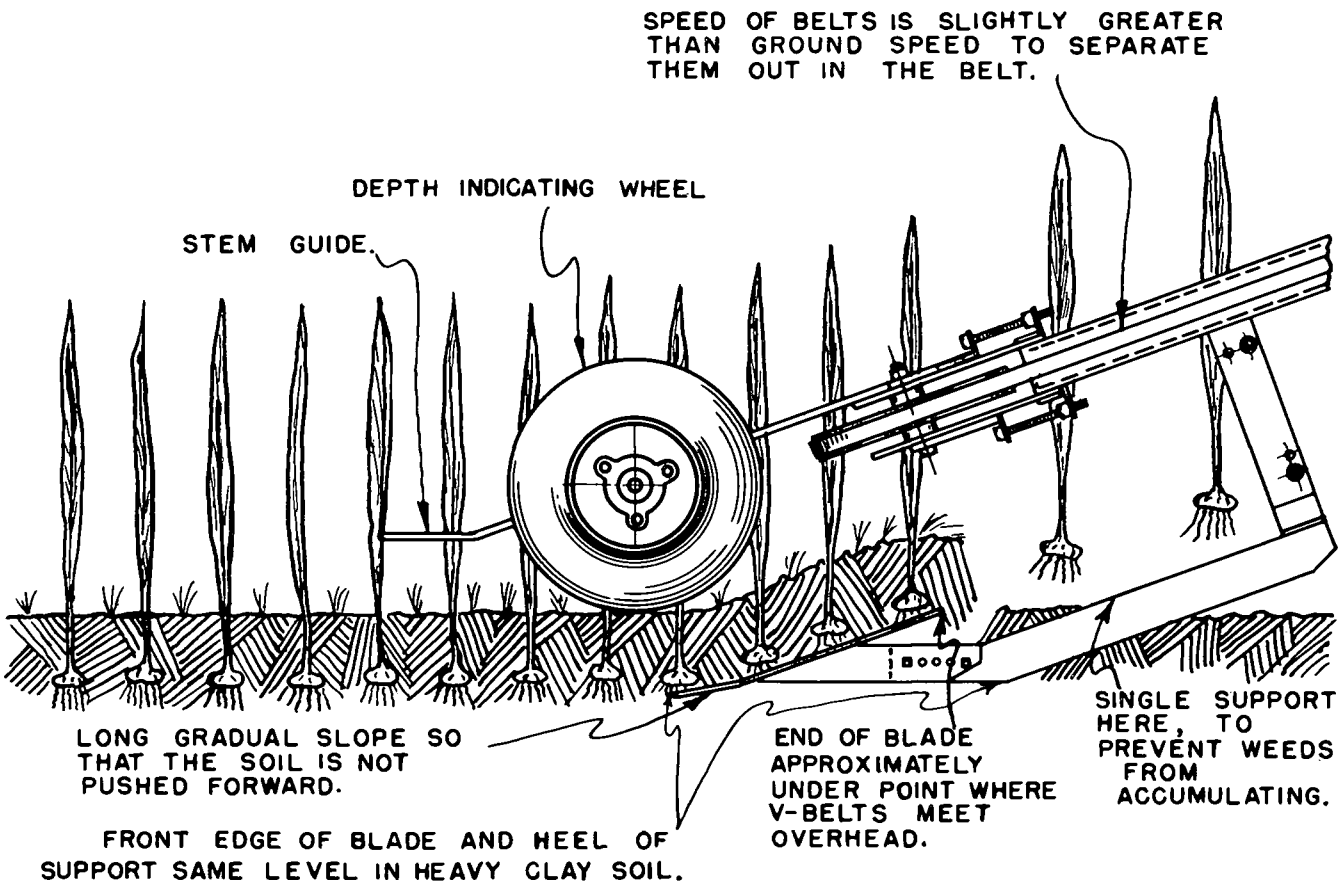

Figure 2. Drawing of blade and blade support.

A long gradual slope to the blade of about 20° with the horizontal is necessary. This prevents pushing the soil, and consequently pushing the gladiolus plant down and making it difficult for the V-belts to grasp the top.

Notice in Figure 2 the single piece of steel on the blade support that holds the blade. This single support runs down the center of the gladiolus row and in this position it follows the break in the soil when harvesting. When constructed in this manner, the machine stays fairly clear of weeds, even in very weedy fields.

In heavy, dry soils the blade and blade support are fastened on the machine with the point of the blade and the heel of the support at the same level. If this is not done, the blade either rides too deep or rides out of the ground, depending on where the point is in reference to the heel of the support. This is most important in heavy, dry clay soils. To determine this relationship, place the harvester on a level floor and allow the blade (when bolted on the blade support) to rest on the floor. Alterations in this position can be made by drilling the proper holes in the blade support. See Figure 2.

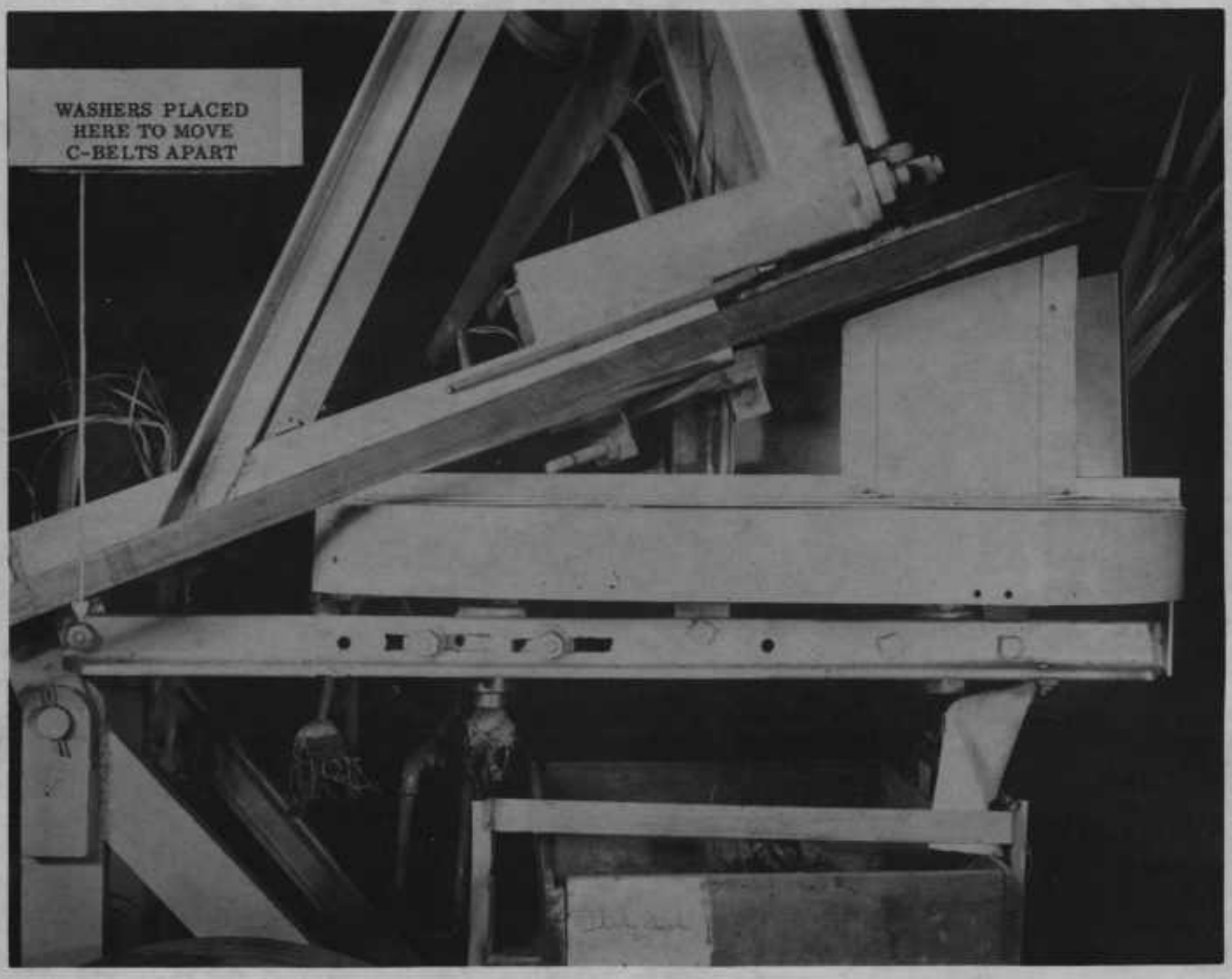

Figure 3. The stripper.

Building the stripper

The function of the stripper is to cut off the corm tops even with the top of the corms. See Figures 3 and 4. This is accomplished by pulling the corm tops up against the stripper bars or rods. After the corms reach the bars, they cannot rise higher, and, consequently, when they move into the two cutting disks at the rear, they are cut off even at the top of the corms. To assist the corms in moving back into the disks, the C-section V-belts push them into this position. Be sure that the two C-section V-belts are an inch above the stripper rods. This is extremely important. It allows a small corm that is pulled up between the bars to have a place to leave the machine and not push the C-section V-belts off their pulleys.

To assist the C-section V-belts in pushing the corm tops back, the face of the belts is roughened by vertical indentations about 1 inch apart as seen in Figure 4. These indentations are made with a grinder. To provide an even pressure along the two C-section V-belts, two

springs push on the insides of the belts. (See Sheet 2, drawing 3134-1). This is necessary to provide an even pressure on the C-section V-belts to help push the corms toward the cutting disks. In time, these springs wear through and replacement springs have to be made available.

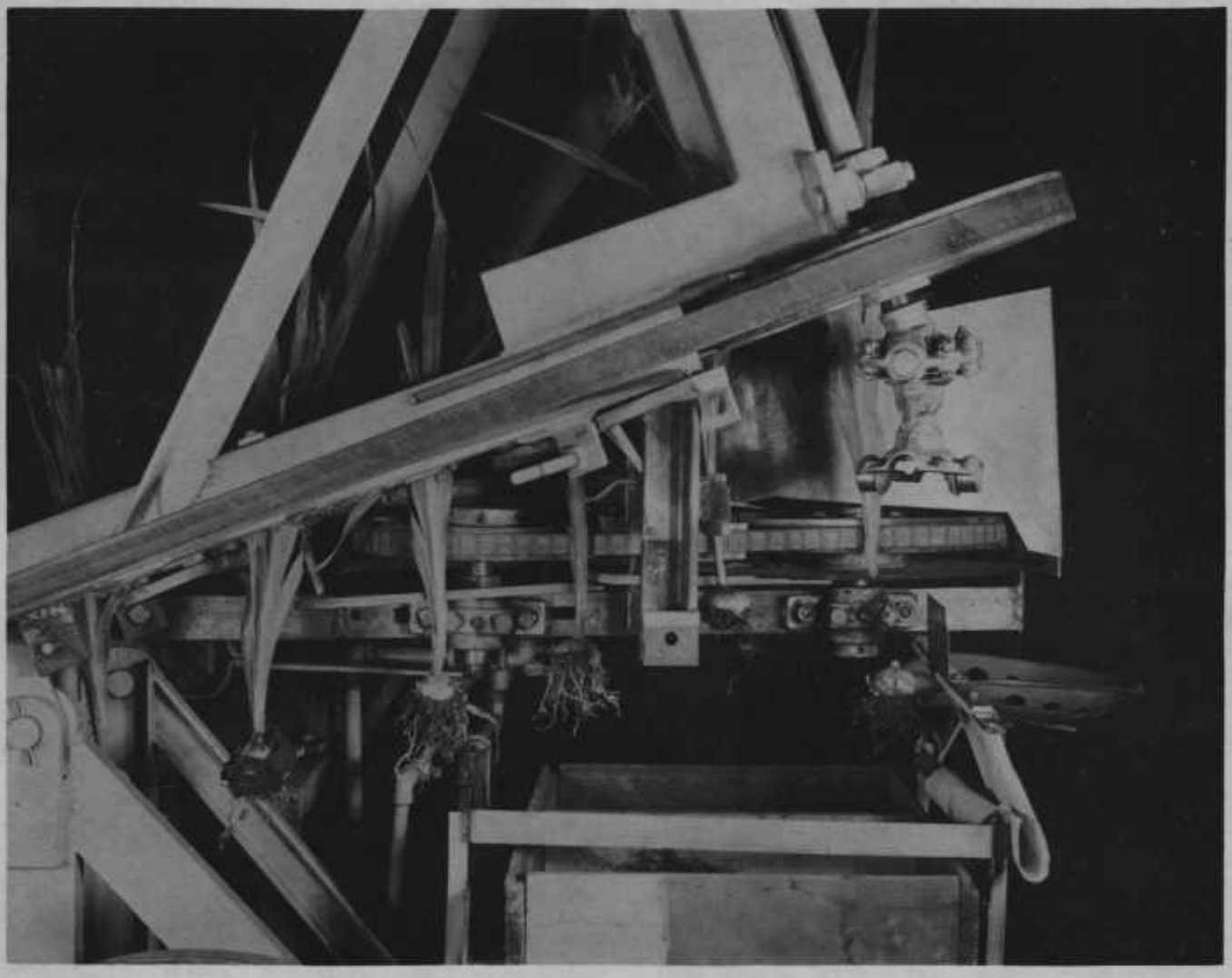

Figure 4. The stripper with one-half of section removed.

On the working drawings, the cross section of the stripper bars can be seen on sheet 2 of drawing 3134-1. The groove or slant on the inside edges prevents corms from being pulled up in between the bars and consequently being injured.

The two large cutting disks are made from 16-inch rolling coulters from standard plows. These coulters are placed in a lathe, centered, and one side ground to an edge. Normally, the final diameter is about 15 inches after this edge is made. Spacers are provided at the bottom of the pulleys to enable the two cutting disks to be placed one against the other.

There are two sets of stripper bars, one in front and one in the rear. Two sets are provided to lessen the probability of a large-topped corm spreading the bars wide enough to allow a small corm to slide up between them.

It is sometimes difficult for a large-stemmed corm to slide between the C-section V-belts. This will result in a corm cut with a long stem. In this particular instance, adjustment can sometimes be made on the stripper supports by placing washers on the bolts that support the framework of the stripper. See Figure 3. This will move the C-section V-belt pulleys out and consequently will provide less pressure on the corm stems. After the harvesting of large-stemmed corms is completed, the spacing on these C-belts should be returned to the original position. To facilitate the rapid change of this position, C-type washers are made from common washers by cutting a piece out of the end of the washer.

Building the trailer frame

The details of the trailer frame can be seen on sheet 15 of drawing 3134-1. It is made on a standard trailer axle and wheels. Check the planting rows in your setup to be sure that a 56-inch spacing of trailer wheels will meet your needs. On this particular trailer, an adjustment can be made on the axle for the various row spacings to be met in Oregon. Your particular axle setting can be built in on the machine if known.

Be sure the point of hitch is approximately over the center of the gladiolus row. See Figure 7. Most of the center of resistance of the gladiolus harvester is on the digger blade; consequently, to have the machine trail straight in back of the tractor, it is necessary to put the hitch at this point.

Also, notice that the pulley and clutch of the engine must be in line with the center of the pins of the supports for the lifter frame. See sheet 1 of drawing 3134-1. If this is not done, the A-belts from clutch pulley to gear box will become slack or too tight when the lifter frame moves.

Building the hydraulic system

Only one operation is done hydraulically, that of raising and lowering the lifter frame. This is accomplished with two standard 8-inch working stroke double-acting cylinders.

A hydraulic gear pump for tractor power takeoff capable of delivering 5 gallons per minute at 300 pounds per square inch from 600 to 1,000 r.p.m. will be found satisfactory, It may be necessary to reduce the rate of flow in the system to have less sensitivity. This can be accomplished by placing orifices in the lines. See sheet 16 of plan 3134-1.

Standard 3/8-inch pipe and fittings are used throughout. Note that four sections of flexible tubing lead into the hydraulic cylinders.

The operating valve can consist of a hydraulic selective control valve that can operate at pressures up to 1,000 pounds per square inch.

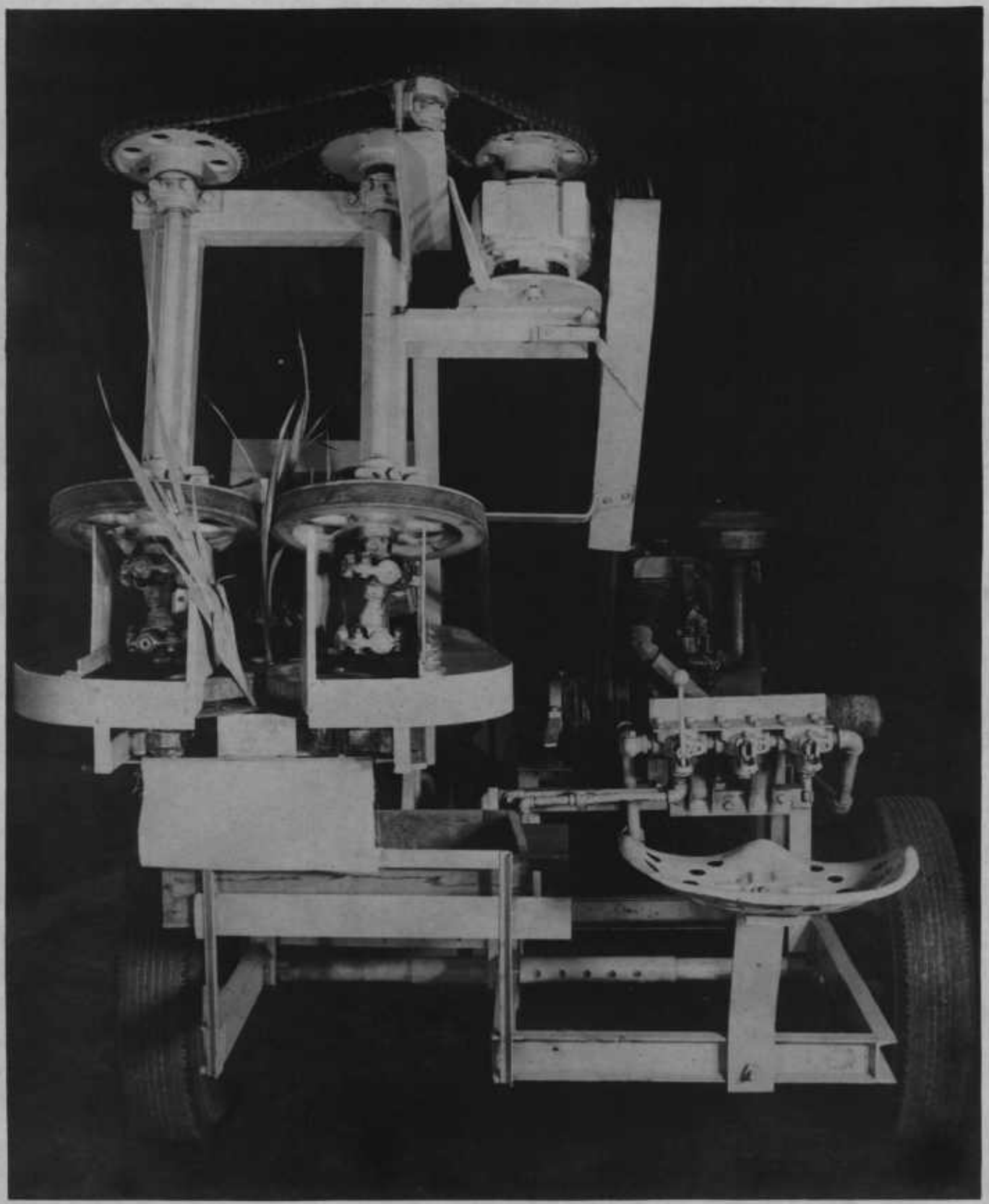

Figure 5. The power transmission system.

Power transmission

Power to operate the gladiolus digger is furnished by a 5 horsepower air-cooled Briggs-Stratton engine. Two A-type V-belts transmit power from a clutch pulley on the motor to the gear box on the lifter frame. The ratio between engine and gear box is about 2-1/2:1. The reduction on the gear box is 11 to 1. A number-60 roller chain transmits power from the gear box to the two vertical shafts that turn the D-section V-belts. These shafts turn in opposite directions. Down from these shafts the power is transmitted to the C-section V-belts.

Power to the hydraulic system is continuous and does not go through the clutch, but goes directly from the engine to the pump. This is necessary in order that the hydraulic system will work when the V-belt pulleys are not in operation.

Guards and safety

There are a number of guards that are absolutely necessary for safe operation of the machine. These are the guards around the cutters, around the universal joints, and around the A-section V-belts from clutch to gear box. One should not attempt to operate the machine without these guards. See Figures 3 and 5. Detailed drawings are shown on the plans as to how these might be constructed. See sheet 9 of drawing 3134-1. There are a number of other guards that would be helpful, such as over the D-section V-belts in the front and around the chain from the engine to the gear pump. It is suggested that guards be placed over these points.

Suggestions on operation of the machine

From his seat the operator can watch the harvesting operations, make adjustments on the machine, and exchange trays. On uneven ground, his most important function is to watch the depth of the digger. He can observe depth of digging from the depth indicator wheel (see Figure 6) and make adjustments with the hydraulic control valve. When a tray becomes filled, the operator pulls the tray out. It slips out the side of the machine from a rack. He then places a new tray on this rack.

Planting

Planting is important for successful harvesting. It is difficult to make many growers realize this necessity. While the machine will take care of small inequalities of depth, row spacing, and number of plants in a row, nevertheless, for best operation, all corms should be planted at the same depth, singularly, and in straight rows. In harvesting, this will reduce the number of injured corms to a very small fraction and the number of long stems on corms will be a minimum. In the long run, it will save considerable labor and result in a much better product to the grower and to the industry as a whole.

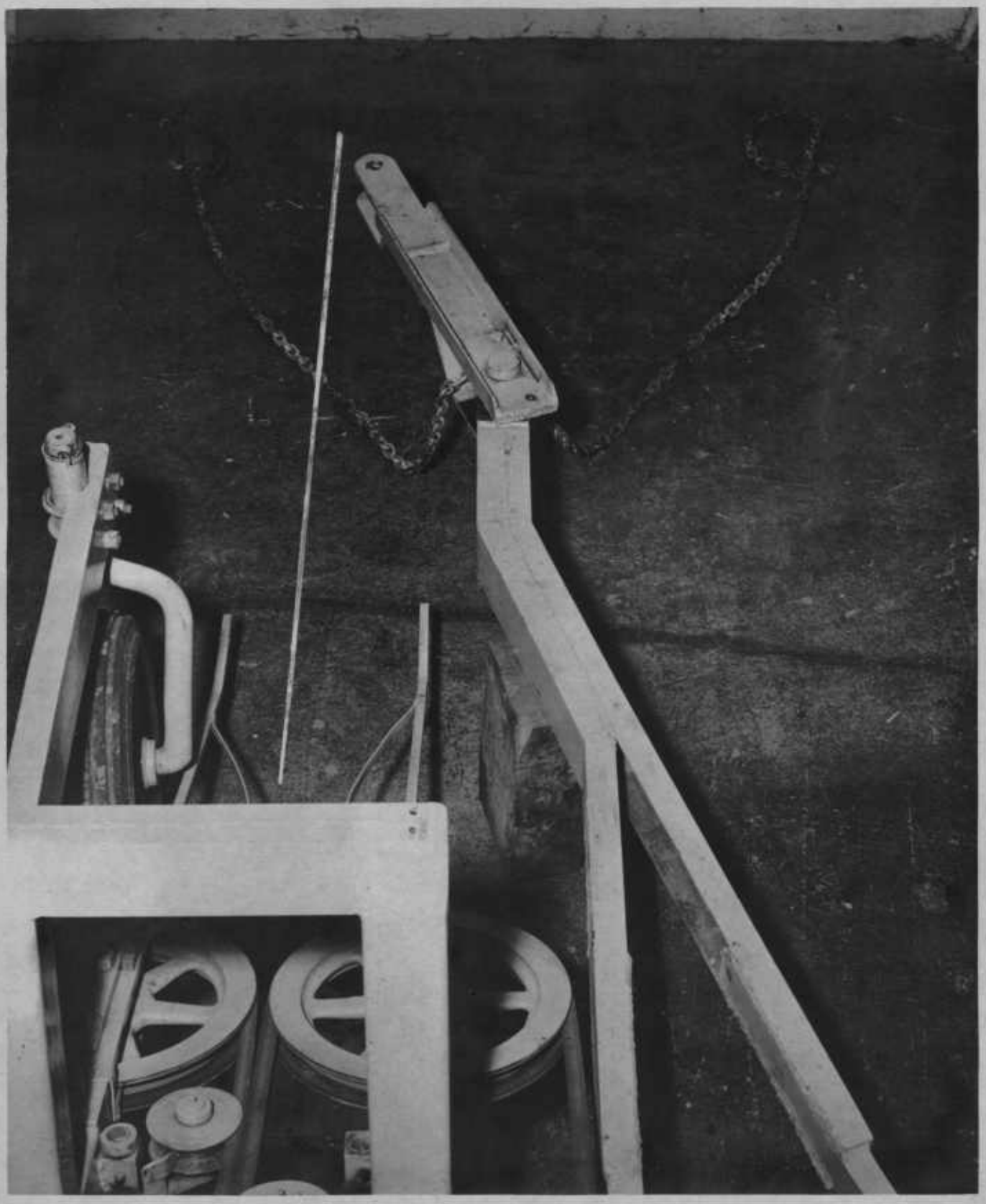

Figure 7. The point of hitch is almost over the gladiolus row.

BILL OF MATERIALS
for
Harvester Less Trailer Unit

Number required or quantity	Part
2	D-Section 240 V-Belts
2	C-Section 68 V-Belts
2	A-Section 105 V-Belts
1	3500-B V-Belt
2	Single groove D sheaves P.D. 13.0" bore 1-1/4", no Keyway
2	Single groove D sheaves P.D. 13.0" bore 1-3/16", Keyway 1/4"
2	Single groove C sheaves P.D. 10.6" bore 1-3/16", Keyway 1/4"
1	Single groove B sheave P.D. 10" bore 3/4", Keyway 3/16"
1	Two groove A sheave P.D. 4" bore 1", Keyway 1/4"
1	Two groove A sheave P.D. 10.6" bore 3/4", Keyway 3/16"
1	Single groove B sheave P.D. 4" bore 1", Keyway 1/4"
2	Single groove C sheave P.D. 13.0" bore 1-3/16", Keyway 1/4"
8	Feet #60 roller chain 3/4" pitch
4	Feet #41 roller chain 1/2" pitch
1	Connecting link for #60 roller chain
1	Connecting link for #41 roller chain
2	#60 Roller chain sprockets, 40 teeth, bore 1-3/16", Keyway 1/4"
1	#60 Roller chain sprocket, 36 teeth, bore 1", Keyway 1/4"
1	#60 Roller chain sprocket, 19 teeth, bore 3/4", Keyway 3/16"
1	#41 Roller chain sprocket, 16 teeth, bore 3/4", Keyway 3/16"
1	#41 Roller chain sprocket, 54 teeth, bore 1", Keyway 1/4"
1	Boston gear reductor, Model AV 38, 11 to 1 ratio
1	Rockford clutch and shifter yoke, Model #LMV4516
1	Tractor power takeoff hydraulic pump - 5 gpm, 300 psi at 600 rpm to 1000 rpm
1	Model 400 Gre-Sen Agr. valve selective hydraulic control for double acting cylinders
2	2" Hydraulic cylinders 8" working stroke, double acting with end yokes and pins (extended length of cylinder C.C. of pins 28")
4	Hydraulic hose connections for hydraulic cylinders 2 - approximately 18 inches long 2 - approximately 12 inches long
1	Caster wheel with tire and tube 4.00 x 9 from John Deere Power Mower #5
4	Complete universal joints, both ends drilled for 1-3/16" shaft, no keyway, old Dodge 4 universals or equivalent
2	16" Rolling coulter disks (from standard plows)
8	Split cast iron pillow blocks with porous bronze bearings for 1-3/16" D shaft
3	Split cast iron pillow block with porous bronze bearing for 3/4" shaft
8	Steel setscrew collars for 1-3/16" shaft
2	Steel setscrew collars for 3/4" shaft
28	Steel setscrew collars for 7/8" shaft
2	Steel setscrew collars for 1" shaft
2	Steel thrust washers 1/2" I.D. 1-1/4" O.D. 3/16" thick
13	Bronze thrust washers for 7/8" shaft
13	Bronze bushings 7/8" x 1-1/8" x 1-1/2" long for idler pulleys

Number required or quantity	Part
1	Bronze cored bar 1-1/4" O.D. 5/8" I.D. - 6" long for front D-section V-belt pulley
15	Alemite fittings rt. angle
15	Alemite fittings straight
1'-1"	Shafting 3/4" round
5'-4"	Shafting 7/8" round
8'-0"	Shafting 1-3/16" round
1'-4"	Shafting 1-1/4" round
	Mild Steel
24'-0"	3" Sq. steel tubing 3/16" thick wall (3" x 1-1/2" channel may be welded together as a substitute)
2	3/16" x 3/16" x 1" L.G. shaft keys
1	3/16" x 3/16" x 1-1/2" L.G. shaft keys
8	1/4" x 1/4" x 2" L.G. shaft keys
4	5/16" Ø pin x 2-5/8" L.G. shaft pins
2'-6"	3" x 3/4" Bar stock
10'-2"	3" x 1/2" " "
7'-6"	3" x 1/8" " "
1'-6"	2-1/2" x 1/2" Bar stock
7'-0"	2" x 1/2" Bar stock
2'-0"	2" x 3/8" " "
4"	2" x 1/4" " "
2'-4"	1-1/2" x 1/2" Bar stock
5'-2"	1-1/2" x 1/4" " "
1'-2"	1-5/8" x 3/16" Bar stock
1'-2"	1-1/4" x 3/16" " "
6"	1" x 1/2" Bar stock
7'-0"	1" x 1/4" " "
2'-6"	1" x 1/8" " "
5'-1"	3/4" x 3/16" Bar stock
10"	5/8" x 1/4" Bar stock
6'-0"	1/2" x 1/8" " "
1'-0"	1-1/2" round stock
1'-9"	4" round stock - For making 13 pulleys
2'-2"	1/2" round stock
2'-1"	3/8" " "
3'-0"	1-1/2" square stock
2"	1" square stock
6'-3"	1/2" square stock
4'-3"	3/8" square stock
1'-2"	5/16" square stock
6"	1/4" square stock

Number required or quantity	Part	
	Sheet Steel	
	#20 GA Galv. Steel 3-3/4" x 5" LG	for guards
	#20 " " " 1'-0" x 3'-6"	
	#16 " " " 3" x 2'-6"	
	#16 " " " 3-1/2" x 4'-9"	
	#16 " " " 6-1/4" x 5'-4"	
	#16 " " " 8-1/2" x 1'-8"	
	Plate Stock	
	1/4" x 4" x 8"	
	1/4" x 4-1/4" x 6-1/2"	
	3/8" x 9-1/2" x 12"	
	3/8" x 3-5/8" x 6"	
	1/8" x 5" x 12"	
	1/8" x 6" x 45"	
	1/8" x 10" x 25"	
	Channels	
1'-3"	1-1/2" x 1/2" x 1/8"	
1'-8"	2" x 1" x 3/16"	
9"	3" [@ 4.1#]	
5'-0"	4" [@ 5.4#]	
	Angles	
5'-4"	1" x 1" x 3/16"	
3'-4"	1-1/2" x 1-1/2" x 3/16"	
7"	2" x 1-1/2" x 1/4"	
9'-0"	1-3/4" x 1-3/4" x 1/4"	
1'-6"	3" x 3" x 1/4"	
	Spring Steel	
2'-0"	1-1/2" x 28 Ga. clock spring steel	
	Bolts	
2	5/8" x 6" machine bolts	
4	5/8" x 1-1/2" hex. hd. cap screws	
4	1/2" x 6" machine bolts	
1	1/2" x 4" machine bolts	
2	1/2" x 2-1/2" machine bolts	
2	1/2" x 1" hex. hd. cap screws	
1	3/8" x 1" machine bolt	
2	3/8" x 3" hex. hd. cap screws	
2	5/16" x 3" machine bolts	
4	5/16 x 1-1/4" machine bolts	
2	1/4" x 2-1/4" machine bolts	
1	1/4" x 1-3/4" " "	
10	3/16" x 3/4" stove bolts	
6	1/4" x 3/4" " "	

Number or length required	Part
	Std. Washer
4	1-1/4" std. washer
1	1-1/2" " "
10	1/2" std. washer
	Std. Pipe
7"	1-1/2" std. pipe
6"	3/4" std. pipe
	Lockwasher
9	1/2" lockwasher
	Hex. Nuts Std.
12	1/2" hex. nuts std.
	Cotter Pins
2	3/32" x 3/4" long
1	1/8" x 3/4" "
1	1/4" x 3" "
	Tension Springs
13	8" long (about 40 lbs. pull per inch of stretch)
4	8" long (about 2 lbs. pull per inch of stretch)
4	3-1/2" long (about 1 lb. pull per inch of stretch)
1 pc.	8 oz. canvas duck 1'-3" x 1'-3"
	Std. Pipe Fittings
8	3/8" close nipples 1-1/2" long
10	Reducers 1/2" to 3/8" - depends upon hydraulic hose
14	90° elbows 3/8"
4	3/8" unions
2	3/8" tees
10'	3/8" std. pipe cut and thd. to various lengths
1	1/2" pipe plug
1	1/2" nipple 3" long
1	1/2" street elbow
2	1/2" to 3/4" bushings
9	3/4" nipples 3" long
1	3/4" " 7-1/2" long
3	3/4" " 10-1/2" long
6	3/4" elbows 90°
2	3/4" " 45°
2	3/4" unions
1	3/4" tee
1	3/4" pipe 16-1/2" long
1	3/4" pipe 13-1/2" long
1	3/4" pipe plug
2	3/4" pipe couplings
1	1" " "
1	1" pipe cap
1	1" close nipple 2" long

MATERIAL FOR TRAILER UNIT

Number or length required	Part
2	Tire and wheel assemblies 6.00-16
1 pc.	Axle shafting for tires and wheels above
1 pc.	2" extra strong pipe x 1'-9" long - necessary if adjustable axle required
1	Plow seat
1	3/8" x 1" step bolt for above seat
1 pc.	Spring steel 3" x 1/4" x 1'-10" long
	Bar Stock
4'-6"	1/2" x 3"
1'-4"	1/4" x 3"
6"	5/8" x 2"
1'-4"	1/2" x 2"
8"	3/16" x 2"
10"	1/2" x 1-1/2"
4'-0"	1/8" x 1-1/4"
	Channels
1'-0"	1-1/2" x 1/2" x 1/8" [Channels
2'-0"	2" x 1" x 3/16" [
45'	3" [@ 4.1#
12'	4" [@ 5.4#
	Angles
4'-0"	3" x 3" x 3/16"
4'-0"	2-1/2" x 2" x 1/4"
8"	2 x 2 x 3/16"
6'-0"	1-3/4" x 1-3/4" x 1/4"
2'-6"	1-1/2" x 1-1/2" x 3/16"
6"	1-1/4" x 1-1/4" x 1/4"
5'-4"	3/4" x 3/4" x 1/8"

exact sizes listed here are not always necessary

1'-8"	1/2" bar stock
2	1/2" x 1-1/4" long machine bolts
1	1/2" x 3" hex. hd. machine bolt
1	1" x 7" long machine bolt drilled for cotter pin (for hitch pin)
1	3/16" x 2" cotter pin for 1" x 7" machine bolt
1	Briggs and Stratton 4-cycle gas engine, 5 HP, Model ZZ