THE CFS V-BLADE

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ABSTRACT

Certain site preparation methods for regeneration in Ontario require a versatile and rugged tool such as the CFS V-blade which incorporates those features necessary for effective functioning of trailed single-row mechanical tree planters, seeders and scarifiers. Continuous removal of only the major debris from the path of the trailed equipment, with the fertile soil in the upper horizons left undisturbed, was the site preparation prescription upon which this V-blade was developed. The blade was to be economical to operate and adaptable to a range of makes and sizes of bulldozers commonly used in the forest and available for silvicultural work.

Two CFS V-blades were designed and built, the prototype in the spring of 1974 and a modified version in the spring of 1976. These V-blades have been used in conjunction with a variety of silvicultural implements with bulldozers ranging from the John Deere JD450 to the Komatsu D65A and Caterpillar D6C. This report deals with the modified CFS V-blade and contains complete plans for construction in Appendix B.

A striking feature of the blade is its central V-shaped nose which incorporates a rolling drum to provide blade "flotation" for continuous removal of debris without disturbing the soil. A rugged bunting frame is integral to the central V-nose. Wings for directing slash to the sides and for protecting the tractor are bolted to the sides of the V-nose at a prescribed height above the bottom of the central V-nose. The fixed radius trunnion arms and slotted clamps allow for bolt-on adaptability to a range of bulldozer C-frame sizes.

The CFS V-blade is thought to be a useful tool for applications where single-pass, single-row slash parting is required on cutover sites.

RÉSUMÉ

Certaines méthodes de préparation de station pour les fins de régénération dans l'Ontario exigent un objet versatile et fort dans le genre de la lame en V du Service canadien des forêts (SCF). Elle permet le fonctionnement efficace de planteuses (un rang) remorquées, de semeuses et de machines à scarifier. Cette lame fut conçue en sachant qu'il fallait enlever continuellement les gros débris du chemin sans toucher au sol fertile dans les horizons supérieurs. Elle devait être d'opération économique et attachable à maintes marques et grosseurs de bulldozers disponibles pour les travaux sylvicoles.

L'auteur conçut et construisit le prototype au printemps de 1974 et une lame modifiée au printemps de 1976. Il les essaya avec plusieurs instruments sylvicoles attachés à des bulldozers incluant le John Deere JD450 au Komatsu D65A et au Caterpillar D6C. Ici, l'auteur traite de la lame modifiée et fournit des plans complets de construction en appendice.

Sa particularité consiste en un nez en V dans lequel est placé le rouleau qui fait "flotter" la lame. Une solide structure de fond est placée dans le nez. De chaque côté de celui-ci, sont vissées des ailes à déplacer les rémanents et à protéger le bulldozer. Ces ailes sont placées à une hauteur pratique. Les bras des tourillons de rayon fixe et les brides de serrage à fente permettent de boulonner le tout à plusieurs sortes de bulldozers à structure de type C.

Cette lame sera utile là où d'un coup et formant une rangée on passe à travers les rémanents dans les stations coupées à blanc.

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Cover photo: CFS V-blade prepares site for Ontario Planter.

INTRODUCTION

The forest manager is often confronted with heavy logging debris, numerous stumps and large volumes of residual standing material on areas requiring artificial regeneration treatment after harvesting or fire. On such areas, successful treatment usually requires the removal or displacement of material that might impede the progress of a planter, prevent seed from reaching the soil, or inhibit growth once germination or tree establishment has occurred. Hence, site preparation is an important part of most reforestation operations.

Trailed site preparation units, seeders and mechanical planters have been in use for years in the United States and Scandinavia and have made inroads into Ontario and the rest of Canada. For most trailed units to function effectively and efficiently on slash-covered cutovers, it is essential that some pre-clearing be done. In most cases both pre-clearing and the followup treatment provided by the trailed unit can be accomplished effectively in a one-pass operation, the pre-clearing by a device mounted on the front of the prime mover and the followup treatment by a drag unit attached to the rear of the same prime mover. Of the front-mounted devices, V-shaped clearing blades have been effective in boreal conditions (Wang and Horton 1966, Haig 1969).

To date, in our silvicultural equipment testing program[1] (Cameron 1975a, 1975b, 1976, Gemmell 1975, Riley 1975), we have used V-blades of different shapes and sizes, but of similar design, for removing the major obstructing debris. The testing program revealed limitations in design and construction, and indicated a number of potential improvements. For example, V-blades available at present are designed to fit only one make or model of bulldozer, and to our knowledge, none comes equipped with a scalping foot. This means that a scalping foot must be designed and constructed for each blade, and special attachments must be made each time the blade is used with a different make or model of bulldozer.

The scalping foot, essentially a mini V-blade, is attached to the bottom of the central portion of the main blade. The vertical dimension of the scalping foot should be no greater than the ground clearance height of the bulldozer (cf. Cameron 1975b, p. 3). This allows stumps and slash on either side of the operating path of the trailed unit to pass under the bulldozer without hanging it up. Stumps and slash that are higher than the scalping foot contact the raised wings of the V-blade and are sloughed off to the sides of the bulldozer or crushed under its tracks. The scalping foot clears slash,

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[1]The Ontario Ministry of Natural Resources and Great Lakes Forest Research Centre have cooperatively tested a number of mechanical tree planters since 1970.

debris and stumps from the path of the trailed unit but only over the width required for proper functioning of the unit's operating components. To date such scalping feet have usually been makeshift and have been attached to the V-blade by welding. Without a scalping foot, however, the use of the V-blade results in full blade-width clearing, increased windrowing and reduced productivity for many single-row treatments. Acceptable results from commercially available blades, even when these are fitted with a scalping foot, are dependent largely upon operator skill and experience and constant operator control.

The choice of the best or the optimum tool for site preparation requires a concern for efficiency and prudence in the use of resources available, both man and machine. Such a tool must be able to clear efficiently the debris normally encountered on a boreal forest cutover. Is the clearing of 2½ m swaths in a single pass an economical use of tractor power if a smaller tractor clearing a 3/4 m swath will do? A scalping foot attached to do this job must perform efficiently. In terms of the use of manpower, a tool that does not require constant and skillful manipulation by the tractor operator to minimize skipping and scalping is more economical and produces more consistent results.

Simplicity of design and ruggedness of construction are essential for reliable and maintenance-free tools. The necessity of managing with the means at hand, however inadequate or unsatisfactory, is all too prevalent in site preparation experience. When a new job is begun, available equipment must be modified to fit the tractor or to work in a specific manner.

Site preparation equipment that will fit a variety of bulldozers is more economical in terms of both time and money. Inattention to the demands of safety can result in costly delays due to downtime or injury resulting from the use of unsafe equipment. The site preparation tool must provide the protection from debris for the tractor and its operator that safety and common sense require.

After consideration of the foregoing factors, a contract was let in March, 1974 for "construction of a V-blade which is readily adaptable to a number of bulldozer(s)...and which will improve the performance of planting machines, thereby reducing regeneration costs...."[2] This was the prototype CFS (Canadian Forestry Service) V-blade (Fig. 1). It incorporated a number of ideas that we felt were essential in a V-blade used with planting machines. On the basis of our experience with the prototype, a modified CFS V-blade was designed and constructed in 1976 to incorporate further refinements and improvements (Cover and Fig. 2).

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[2]Department of Supply and Services, Canada, Contract Serial No. OSV3-0289.

Figure 1. CFS V-blade used on Komatsu D65A bulldozer with Marttiini KLM 240 reforestation plow. Northeastern Ontario.

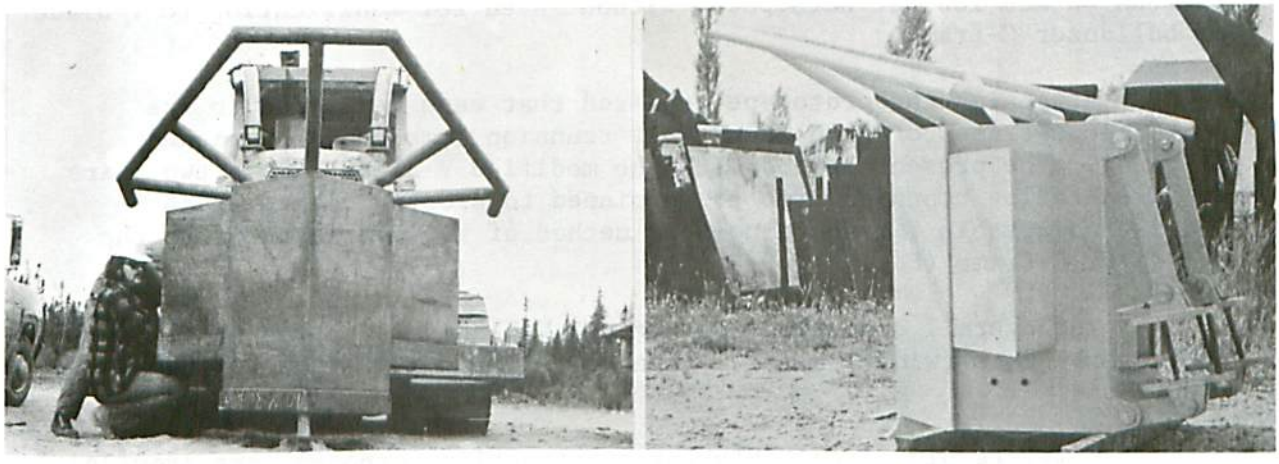


Figure 2. Front (left) and side (right) views of CFS V-blade. Note bunting frame on top and wings mounted on either side of central V-nose. The portion of the nose below the wings is also referred to as a scalping foot.

DESCRIPTION

The design is novel in that a narrow V-nose, fitted close to the C-frame of the tractor, is the main functioning part. The lower portion of this V-nose is considered the scalping foot. This effectively removes all debris from the direct path of the trailed unit, i.e., planter, seeder, or fire plow. At the same time, the attached wings serve to push larger debris, which might interfere with the forward movement of the bulldozer, further to the side, but no general full-width clearing takes place. This permits more efficient use of tractor power and allows the use of bulldozers of lesser power, with consequently reduced operating costs.

Although similar in many respects to the prototype, the scalping foot on the modified version is slightly wider to accommodate the larger drum (Appendix A). This additional width is such that it allows the attachment apparatus and bunting frame to be mounted on the central V-nose rather than on the V-blade wings as in the prototype, thereby simplifying design and construction. The wings are then bolted to the sides of the central V-nose.

The rolling drum colter (Fig. 3), which has been used in both fire-line plows and tree planters, makes the V-nose floatable so that it will clear debris without gouging into mineral soil. This results in more uniformly acceptable site preparation for planting or seeding and reduces the need for a high level of skill and attention on the part of the operator. The rear of the V-blade has attachment points for front-mounting the blade to the centre pin and C-frame of a range of bulldozers between 60 and 180 net horsepower without need for modification to V-blade or bulldozer C-frame.

Attaching the prototype required that ears be welded to the bulldozer C-frame to which adjustable trunnion arms could be pinned (Fig. 4). The present method with the modified V-blade allows two pairs of fixed-radius trunnion arms to be pinned to slotted clamps which provide adjustable fit and a no-weld method of rigid attachment to the bulldozer C-frame (Fig. 5).

The overall dimensions of the CFS V-blade are approximately 2 m (height) by 2½ m (width) by 2¼ m (length). The unit weighs approximately 1200 kg.

Complete plans, suitable for construction purposes, are provided in Appendix B.

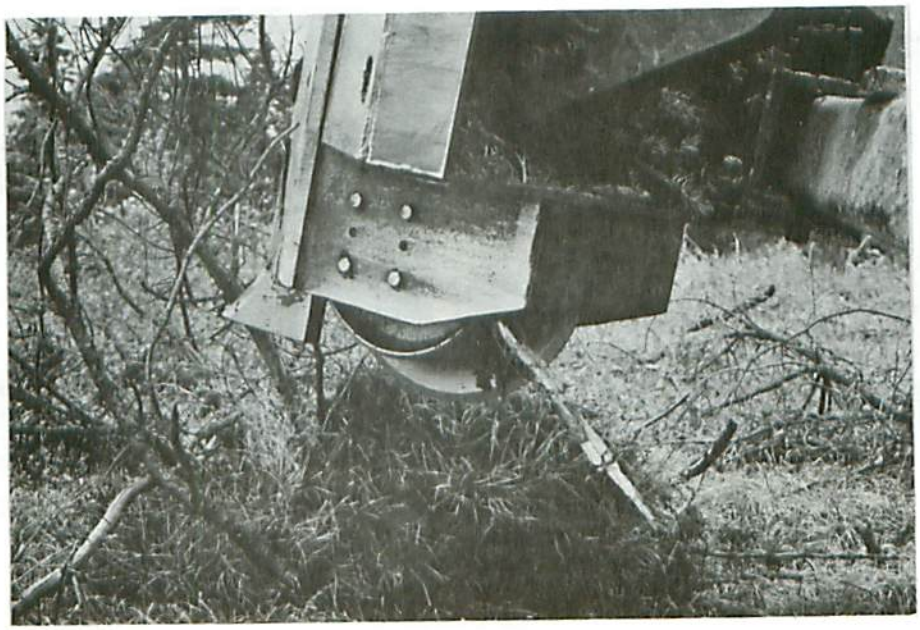


Figure 3. Close-up of drum colter (for flotation) on prototype CFS V-blade. Note also the 'stinger' in front which aids in lifting embedded debris.

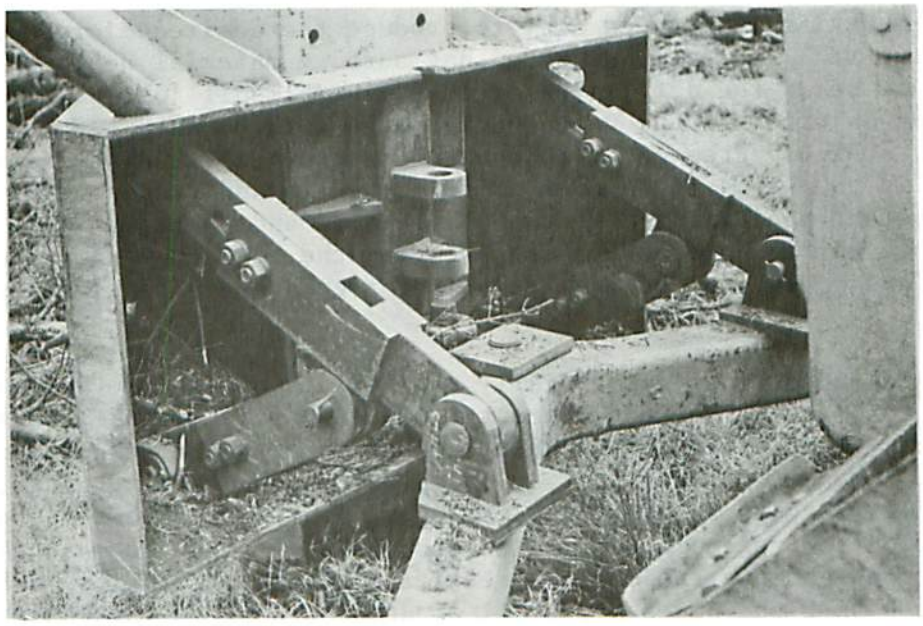


Figure 4. Attachment of prototype V-blade to bulldozer C-frame required that ears be welded to C-frame and adjustable trunnion arms be used as shown.

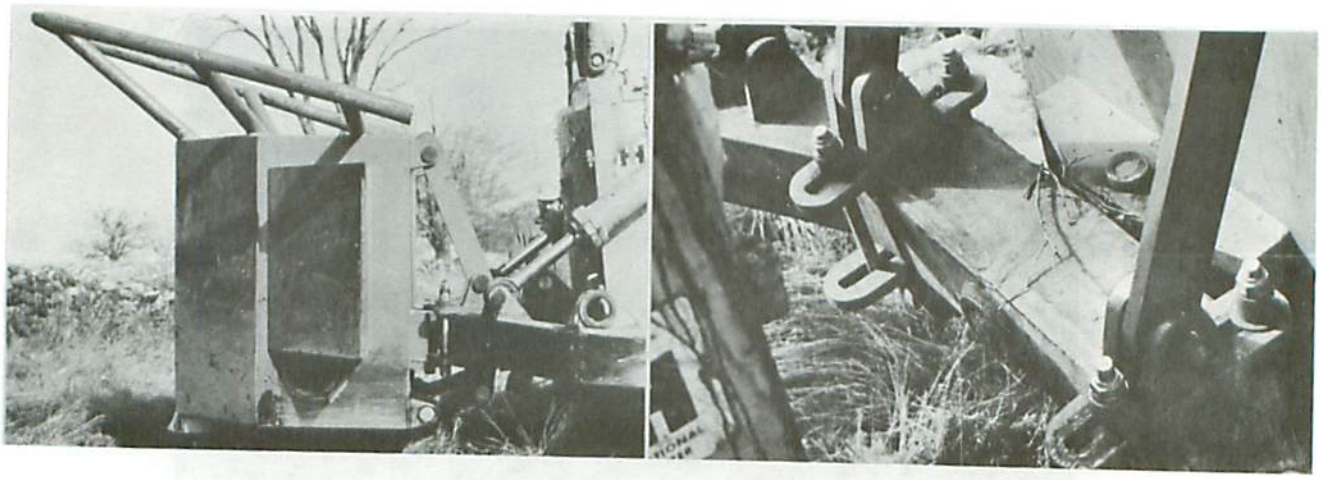


Figure 5. Method of attaching modified V-blade showing (left) fixed-radius trunnion arms at the rear of the V-blade, and (right) adjustable, slotted clamps with ears, bolted onto the bulldozer C-frame.

OPERATION

In most site preparation activities that employ front-mounted blades, material is scraped away to produce the desired microsite. Proper use will generally dictate that surface material be removed down to or just below the duff layer or that mineral soil just be exposed, depending on site and the regeneration method to be used. For consistent results, a high degree of blade control is essential. Blade floatability is the key. It enables uniform results and frees the operator from constant manipulation of the blade--a demanding task. This freedom allows him to concentrate on selecting the best route for the tractor and operating the trailed unit for greatest effectiveness and safety.

As noted, most commercially available V-blades are designed to have a broad ground surface contact. Although this provides some float capabilities, it is generally insufficient to prevent frequent deep gouging. When a scalping foot is added to reduce clearing width, some floatability occurs but it falls far short of that needed for good site preparation for regeneration. With such blades, only the most skillful operator can achieve the desired results with any regularity. When the operator hasn't the necessary skill or doesn't take the necessary pains, unwanted skipping and gouging usually result. To minimize the problem, the CFS V-blade was designed with a high degree of floatability.

During operation, with the tractor blade hydraulic control lever in the "float" position, the CFS V-blade is supported on the ground surface by the rolling drum built into the nose. The rolling action allows the blade to follow the contours of the ground closely. The two angled faces of the central V-nose, which travel just above the ground surface, part surface debris and clear it to the sides. Larger debris comes into contact with the wings of the V-blade and is further deflected so that it doesn't pass under and interfere with the bulldozer's undercarriage. The "stinger" projecting below the bottom of the central V-nose and forward from it serves to lift material located just below the surface of the ground onto the central V-nose, whereupon it is sloughed off to the sides as with normal surface debris. The width of the central V-nose is such that the path cleared is adequate for proper operation of single-row planters and seeders and for some trailed mechanical scarifiers. The blade is high enough and wide enough to protect the bulldozer from debris damage from the front. Where wider protection is required, larger wings can be fabricated and bolted readily to the permanent nose assembly. The forward-projecting bunting frame pushes aside any standing material that may be in the path of the bulldozer and provides additional protection from debris.

Although the CFS V-blade does not remove entirely the need for operator control, the degree of direct control required is greatly reduced by the built-in "float factor". Debris that builds up in front of the blade is cleared, when necessary, by manipulation of the blade and tractor, as with any regular V-blade.

Whether the site preparation requirements are for direct or natural seeding, or for hand or mechanical planting, a V-blade is an effective tool for clearing major debris from the path of the trailed unit (Fig. 6 and 7). On areas to be aerially seeded, a certain minimum of evenly distributed soil exposure is required for economical use of broadcast seed. Row seeding requires similar site preparation.

Handplanting productivity can be enhanced by site preparation in the form of slash removal, removal of competing vegetation, etc., for walking and planting ease as well as planting alignment and area control. Site preparation is necessary for effective use of mechanical tree planters. Both planting quality and production by planting machines are very positively related to the creation of suitable planting microsites (Fig. 8).

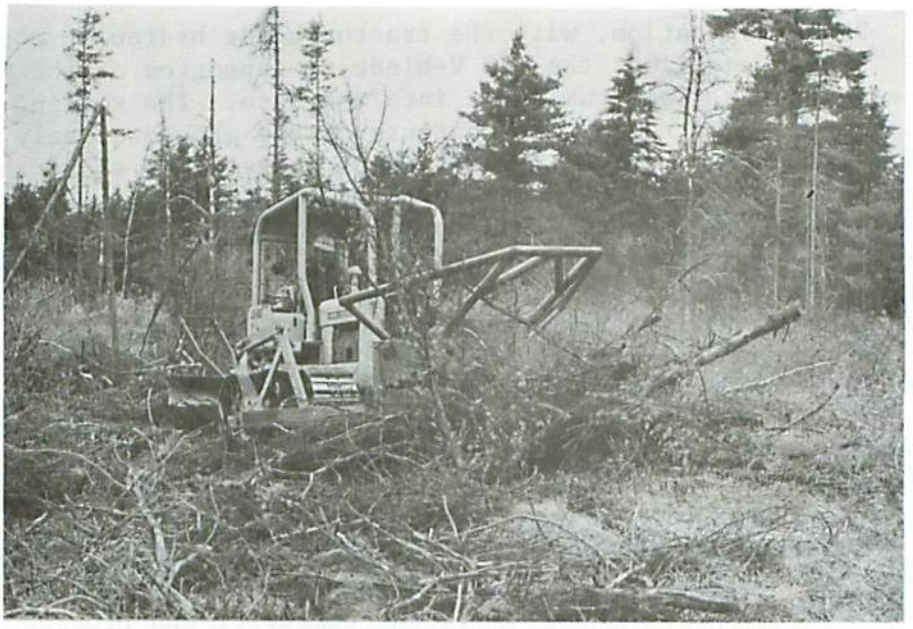


Figure 6. CFS V-blade mounted on JD450 bulldozer. The V-blade clears the major debris while the trailed, modified Sieco fire plow prepares the site for seeding.

Figure 7. Site preparation results from treatment shown in Figure 6.

Figure 8. CFS V-blade, Caterpillar D6C bulldozer and Ontario Tree Planter on a rugged planting chance in northeastern Ontario. V-blade clears logging debris to ensure productive operation of the planting machine.

SUMMARY

Site preparation with a V-blade is a logical and economical part of single-row, single-pass regeneration operations on boreal forest cutovers. Although commercially manufactured V-blades are available, they generally lack a scalping foot, and are designed to fit only one make and model of tractor. Even with a scalping foot attached, they tend to clear an unnecessarily wide swath, and require constant attention by a skillful operator to achieve effective site preparation.

The CFS V-blade is designed to eliminate these undesirable features. It consists of a relatively narrow V-blade nose with bolt-on wings, and is easily attached to a range of commonly available sizes and models of bulldozers. It incorporates a drum colter, which provides essential blade flotation and reduces skipping and gouging.

In boreal forest cutovers the CFS V-blade has been used as a site preparation tool by itself, and in conjunction with trailing site preparation equipment, tree planters, and row seeders. It is considered an effective tool where single-row, single-pass treatment is required on slash-covered sites.

REFERENCES

Cameron, D.A. 1975a. Testing and evaluation of mechanical tree planters. p. 59-69 *in* Mechanization of silviculture in northern Ontario. Can. For. Serv., Sault Ste. Marie, Ont. Symp. Proc. O-P-3.

Cameron, D.A. 1975b. A guide to planting machine operation in the boreal forest of Ontario. Can. For. Serv., Sault Ste. Marie, Ont. Report O-X-234. 23 p.

Cameron, D.A. 1976. Operational testing of planting machines in the boreal forest of Ontario. II. Taylor Drum tree planter. Can. For. Serv., Sault Ste. Marie, Ont. Report O-X-242. 31 p. + appendices.

Gemmell, J.R. 1975. The integration of site preparation with mechanical regeneration. p. 47-54 *in* Mechanization of silviculture in northern Ontario. Can. For. Serv., Sault Ste. Marie, Ont. Symp. Proc. O-P-3.

Haig, R.A. 1969. Operational trials of site preparation and planting methods in the Goulais River area. Can. Dep. Fish. For., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-111. 21 p.

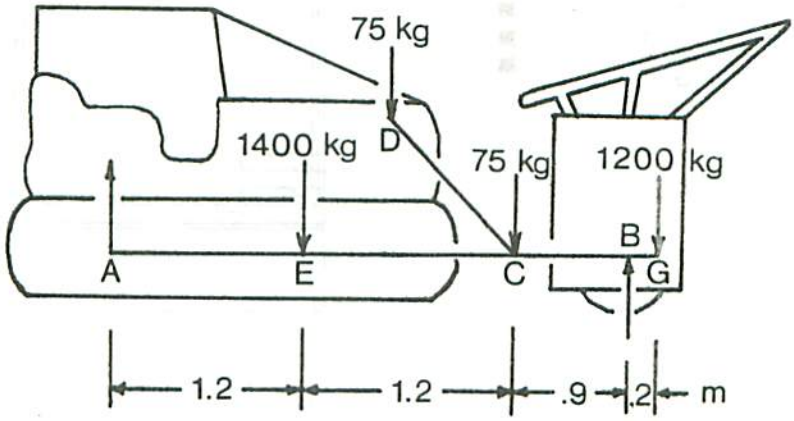
Riley, L.F. 1975. Operational testing of planting machines in the boreal forest of Ontario. I. Reynolds-Lowther heavy duty crank axle planter. Can. For. Serv., Sault Ste. Marie, Ont. Report O-X-219. 37 p. + appendices.

Wang, B.S.P. and K. W. Horton. 1966. Trials of underplanting in hardwoods. V-blade scarifier proves most efficient. Can. Dep. For., For. Res. Br., Ont. Reg. Inf. Rep. O-X-31. 10 p.

APPENDICES

APPENDIX A

Calculation of force acting on drum colter of CFS V-blade while stationary.



Schematic of bulldozer and CFS V-blade where:

A = pivot point of C-frame, AEC, and
B = centreline of drum colter, and
C = lower pivot point for hydraulic cylinders, DC, which raise and lower C-frame, and
E = centre of gravity for C-frame, and
G = centre of gravity for CFS V-blade.

By taking the moments of force about points A and B,

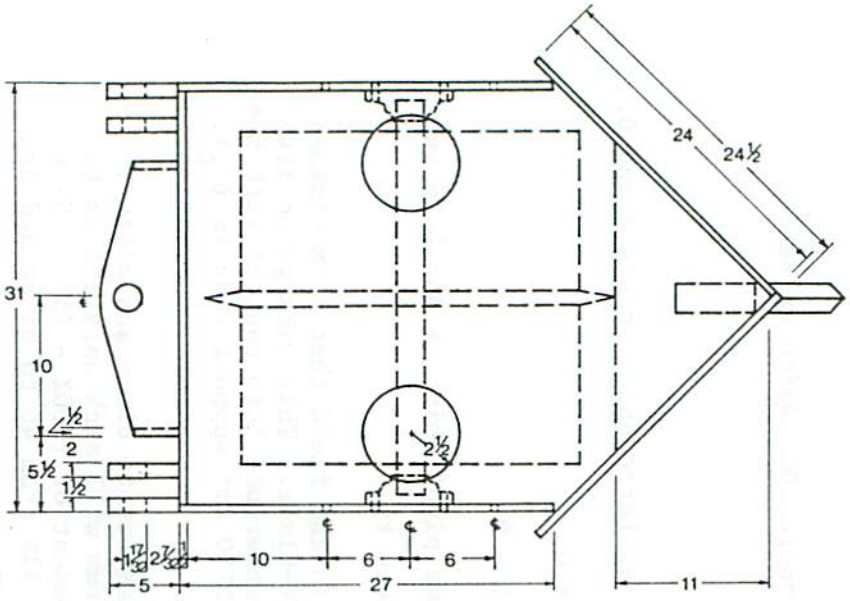
$$F_A(3.3) + 1200(.2) - 1400(2.1) - 75(.9) = 0$$

$$1400(1.2) + 75(2.4) + 1200(3.5) - F_B(3.3) = 0$$

we find that F_A, the weight on the C-frame pivot point is 838.6 kg and F_B, the weight on the drum colter is 1836.4 kg.

It has been observed in the field that 5 cm sinkage was not uncommon with the prototype CFS V-blade. This sinkage on its 36 cm diameter drum brings 25 cm of circumference into contact with the ground. The drum is 46 cm wide so that 1150 cm^2 support 1836 kg.(F_B). Thus, each cm^2 will support 1.5 kg.

By increasing drum diameter to 61 cm and width to 61 cm, as in the modified V-blade, the drum will sink only 1.5 cm to give the same area of support, an improvement of (100% - (5 ÷ 1.5) x 100%) = 233%. Width has been increased 33% from 46 to 61 cm and drum diameter increased by 58% from 36 to 61 cm.



CFS V-BLADE p.1 of 4

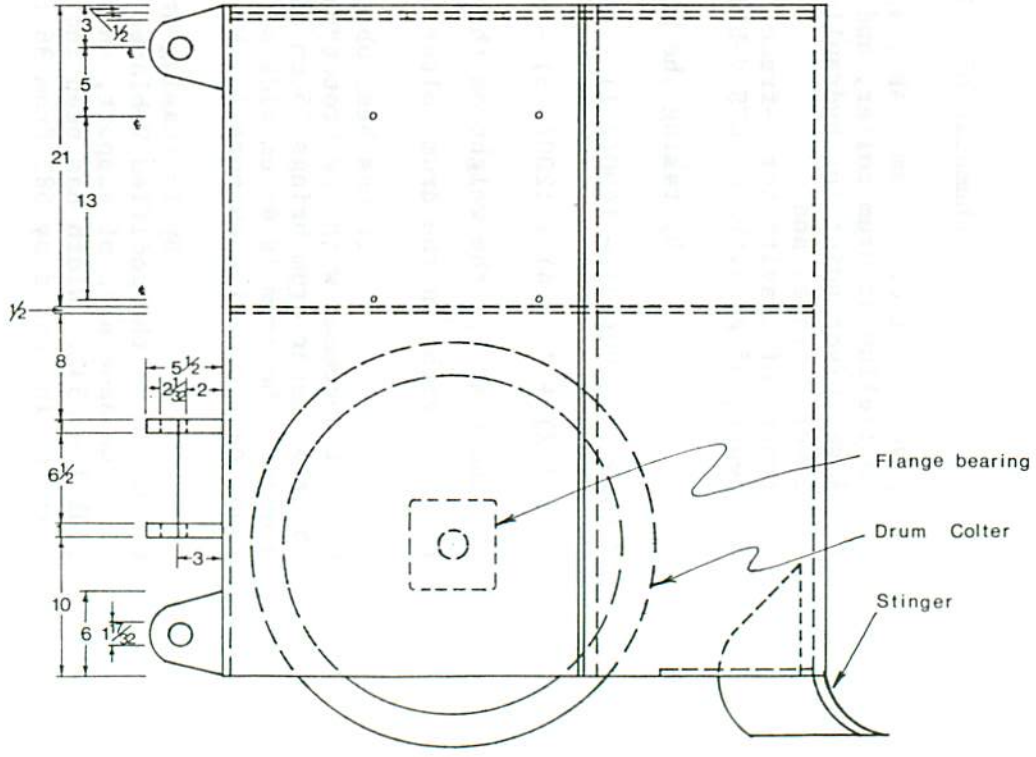
-Central V-Nose

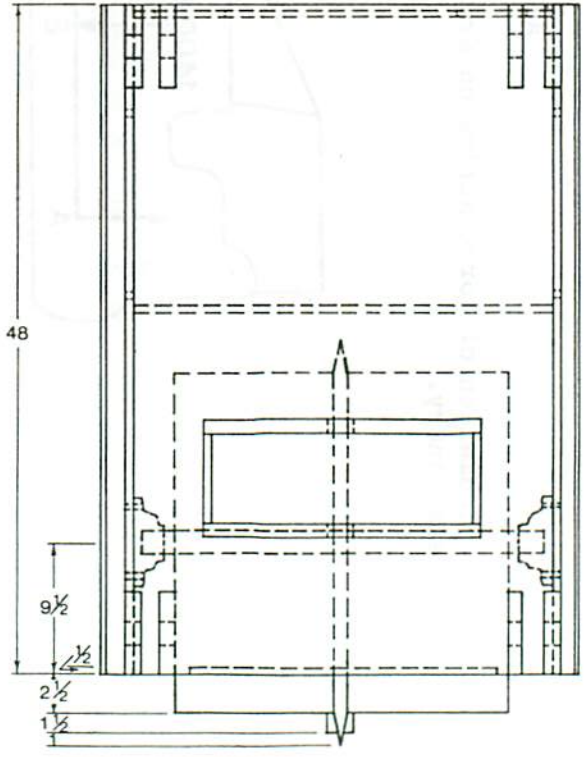
SCALE

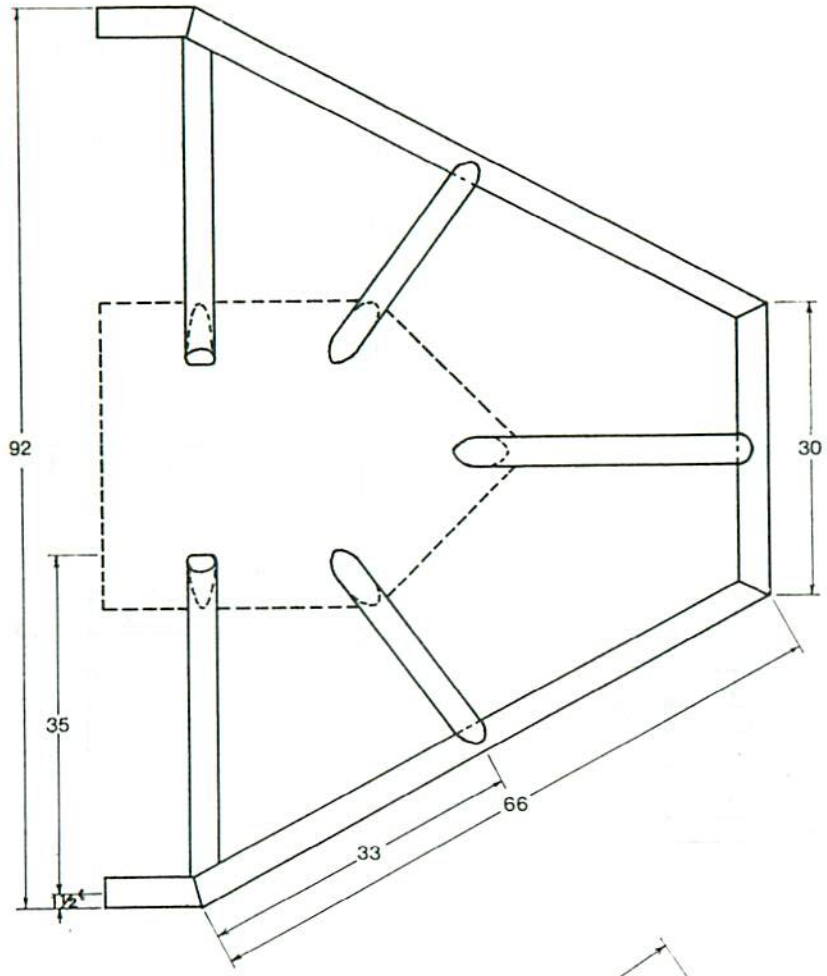
inches

0 6 12

March '76
DAC





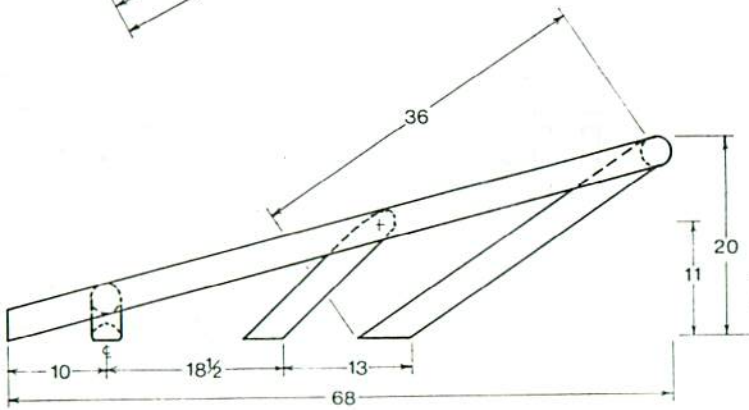


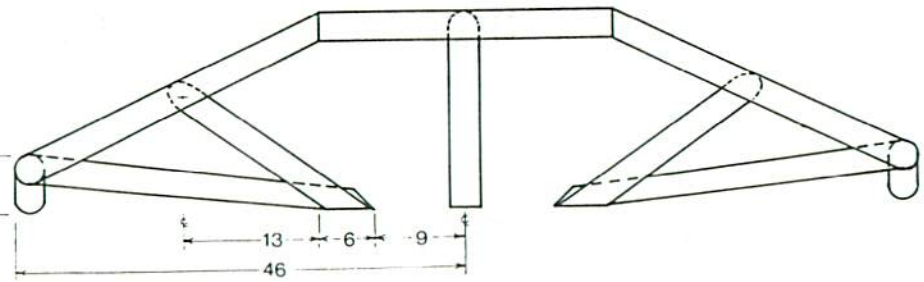
CFS V-BLADE p. 2 of 4

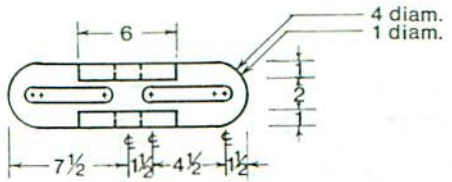
- Bunting Frame
- steel pipe ½ in. wall

SCALE
inches
0 6 12

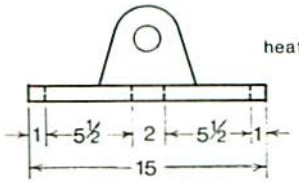
March '76
DAC

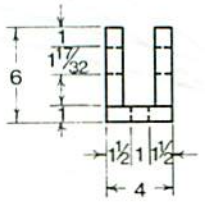


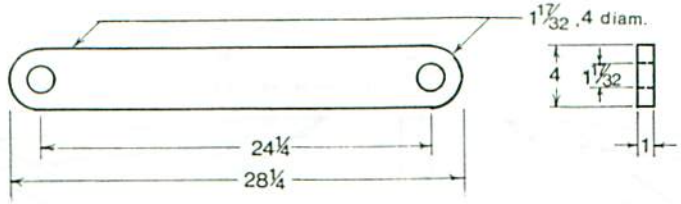




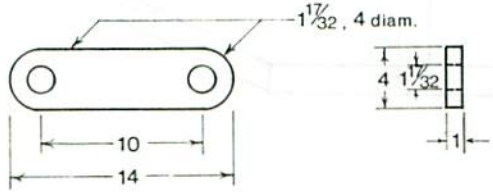
Clamp
- make four



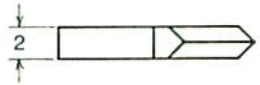


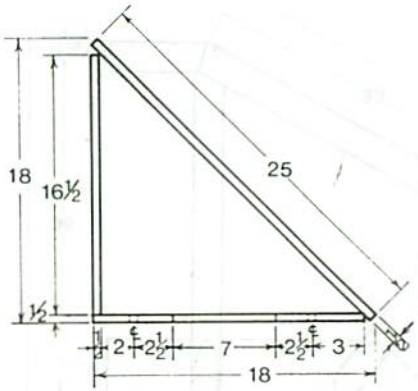


Trunnion Arms
- make two each

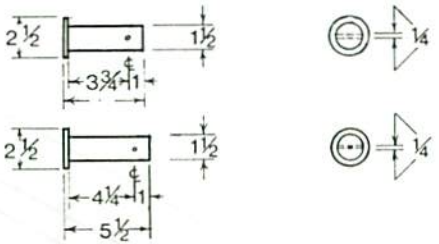


Stinger
make one





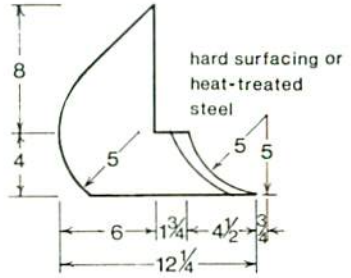
Pins - make four each



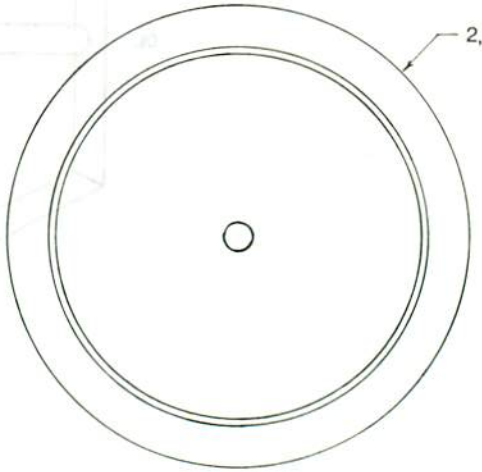
CFS V-BLADE p. 3 of 4
-Part Details

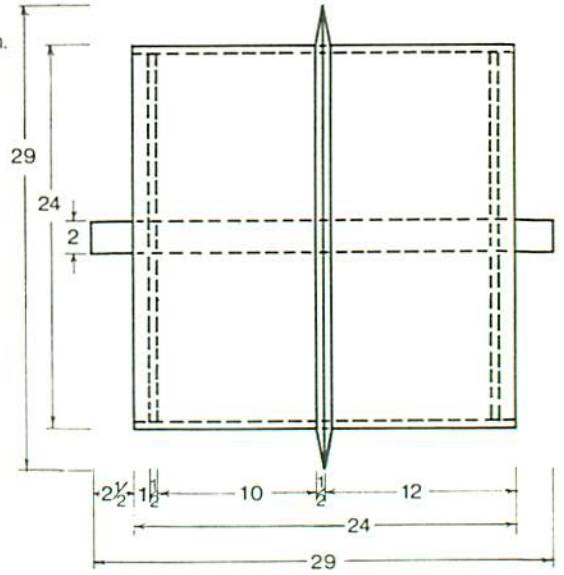
SCALE
inches
0 6 12

March '76
DAC

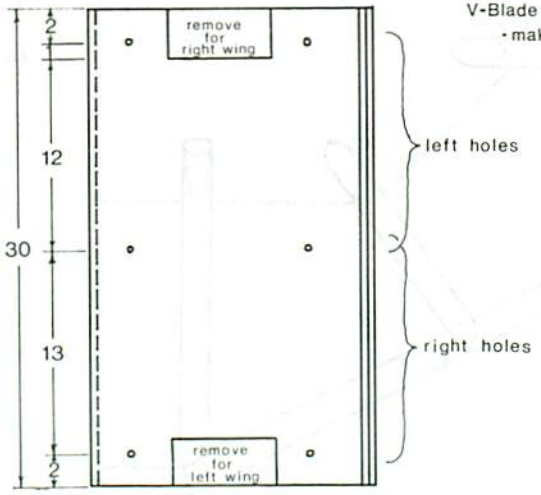


Drum Colter - make one

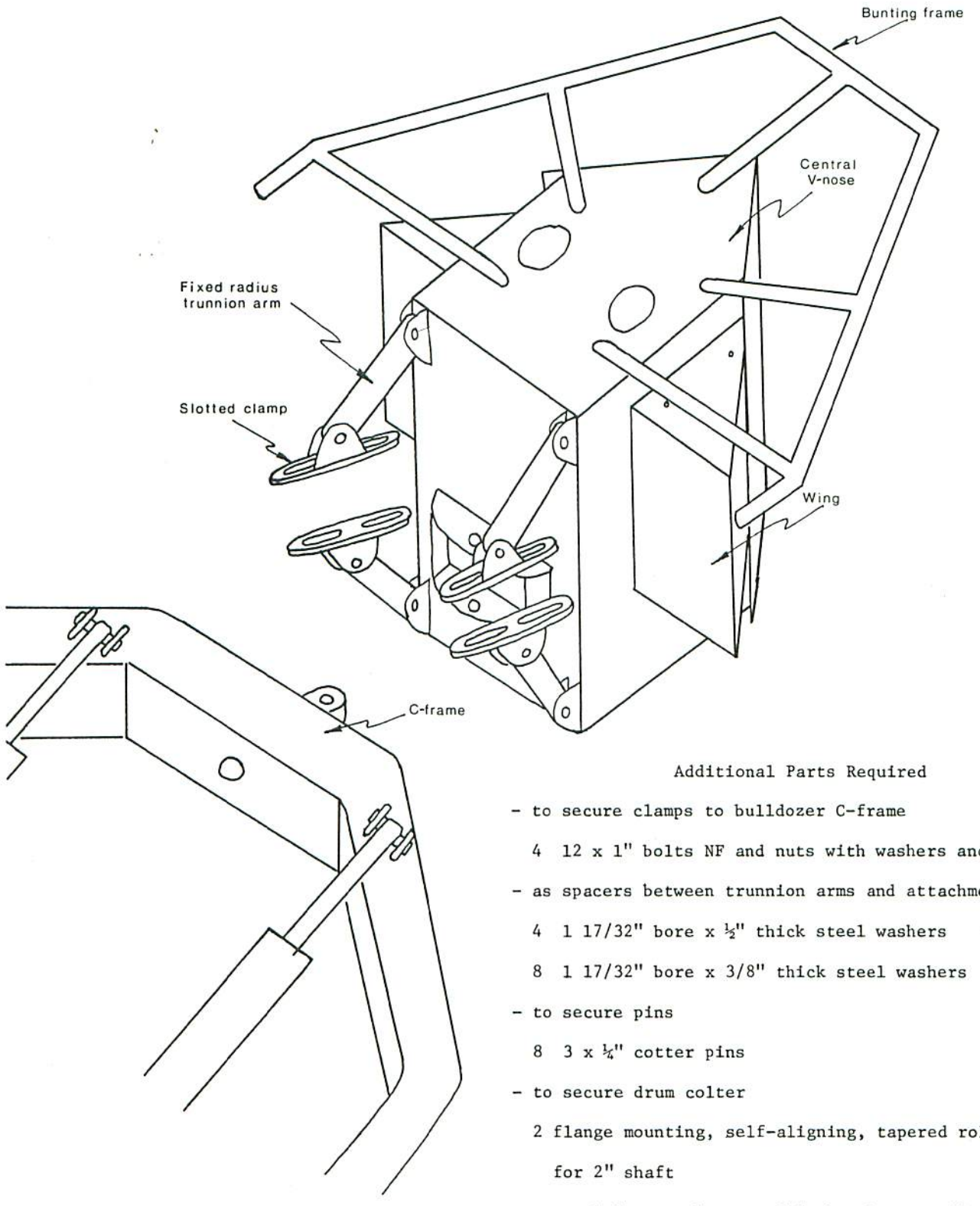




V-Blade Wing
- make two



-Assembled



Additional Parts Required

- to secure clamps to bulldozer C-frame

  4 12 x 1" bolts NF and nuts with washers and lockwashers

- as spacers between trunnion arms and attachment ears

  4 1 17/32" bore x ½" thick steel washers

  8 1 17/32" bore x 3/8" thick steel washers

- to secure pins

  8 3 x ¼" cotter pins

- to secure drum colter

  2 flange mounting, self-aligning, tapered roller bearings for 2" shaft

  nuts, bolts, washers, and lockwashers to fit

Conversion factor

1 inch = 2.54 cm