RESEARCH NOTES

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THE BRUSHLAND PLOW

by

Thomas Coldwell, Engineering-Aide, Sellwood Shop
U. S. Forest Service, Portland, Oregon
and
Joseph F. Pechanec, Forest Ecologist
Pacific Northwest Forest and Range Experiment Station
U. S. Forest Service, Portland, Oregon

A new implement, the "Brushland Plow," has been developed primarily for killing sagebrush or other undesirable shrubby plants on the rough, brushy range lands of the West.[1/] This plow, developed by the United States Forest Service, incorporates strength, flexibility, and clearance with a minimum of friction (fig. 1).

The need for such an implement became apparent early in the program of reseeding range lands to desirable grasses. These lands are rough and often rocky with a cover of stiff, shrubby vegetation. This vegetation had to be killed before grasses could be successfully planted. Available commercially made disks and wheatland plows were the most successful but they had been constructed for use primarily on relatively rock-free, level, and brush-free ground. Frames and disk assemblies were rigid, friction was high, and on many models the hitch and front parts of the plows did not have adequate clearance. When these plows or disks were used on brushy ranges where rocks and lava reefs were hidden beneath the brush, disks, castings, hitches, frames, and frame supports were bent and broken. Costs in terms of breakage, short life of the implements, lost time on the part of crews and tractors were excessive. A new type of plow was needed.

1/ The authors wish to express their deep appreciation to the many Forest Service employees in the field whose helpful suggestions and criticisms added further to the successful performance of the plow, and to Mr. T. P. Flynn to whom much of the credit should be given for the design of the Brushland Plow. Mr. Flynn, until he retired in January 1949, was in charge of the Forest Service Equipment Laboratory at Portland, Oregon.

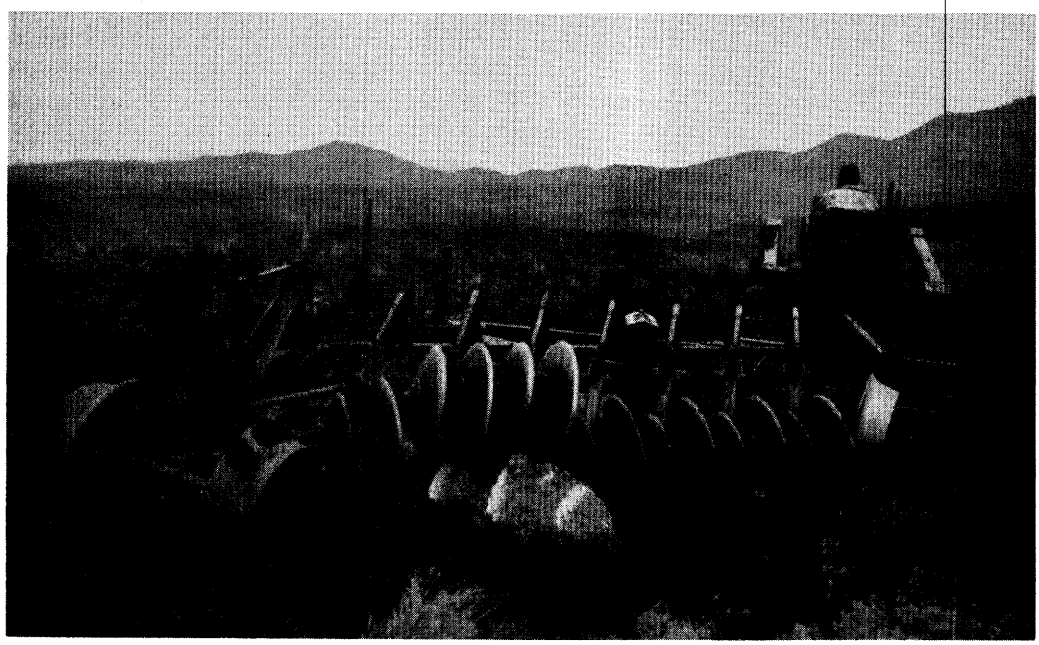
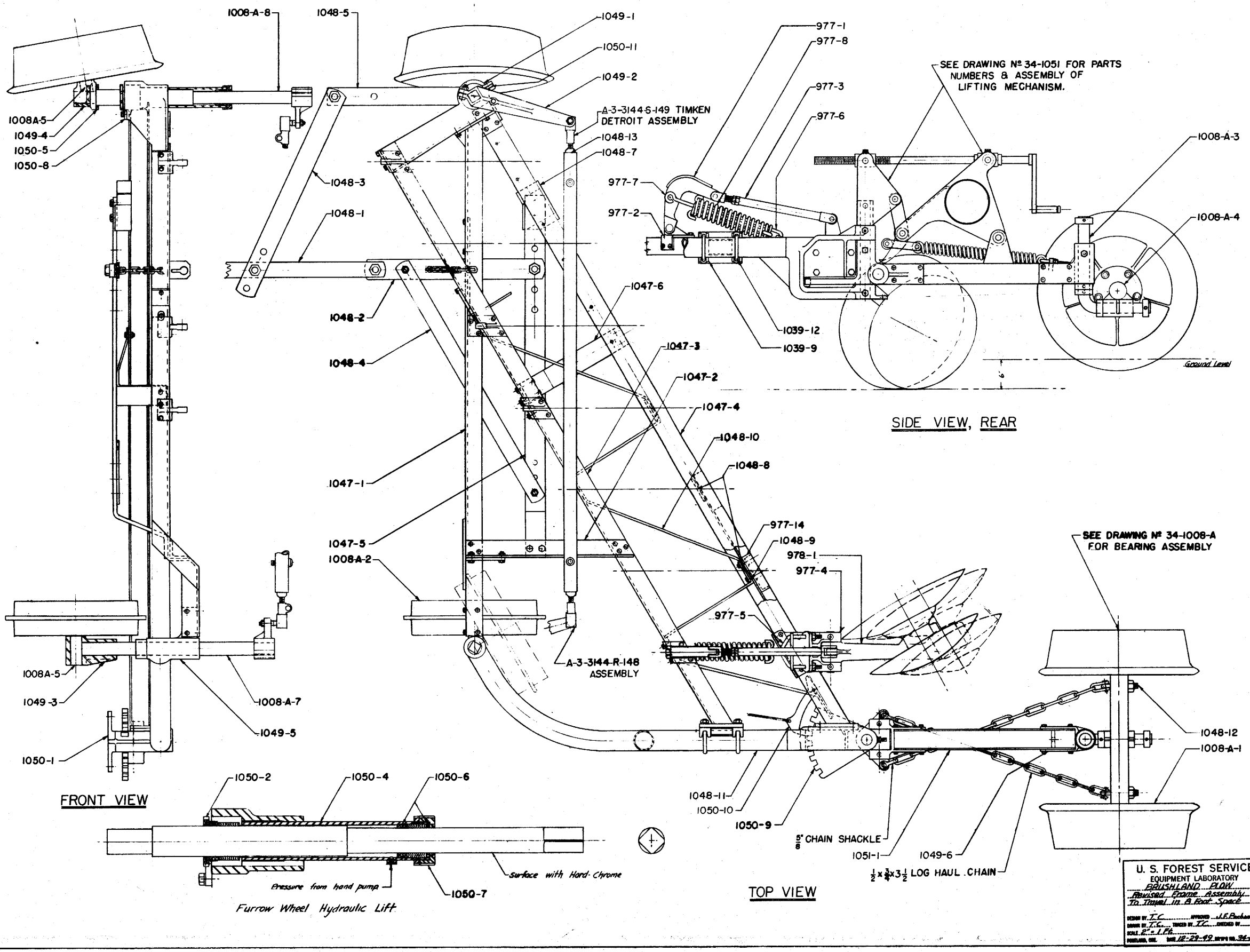


Figure 1.--The Brushland Plow was developed by the U. S. Forest Service specifically for rough and brushy range lands of the West. It combines strength, flexibility, high clearance in front of the disks and a minimum of friction in moving parts. (The plow shown in this photograph is the first model and differs in some important details from the present design shown in figure 2.)



U. S. FOREST SERVICE
EQUIPMENT LABORATORY
BRUSHLAND PLOW
Revised Frame Assembly
To Travel in 8 Foot Space
DESIGN BY T.C. APPROVED J.F. Parkinson
DRAWN BY T.C. TRACED BY T.C. CHECKED BY
SCALE 2" = 1 Ft.
PORTLAND, ORE. DATE 12-29-42 DRWG NO. 34-1046

In the hope that it would be the needed type of implement, a Stump-Jump Plow was imported from Australia in 1947. It was much better than any implement made in this country. Its chief advantage lay in its flexibility. Disks were mounted in pairs and could rise out of the ground to ride over obstructions. But it lacked in strength and clearance, and it had excessive friction in moving parts. It did, however, furnish a clue to a desirable solution.

This clue led to the development of the Brushland Plow. By May 1948, the first model was completed. During that field season, it was subjected to a series of rigorous trials and its performance exceeded fondest expectations. It was decided, however, that before the Brushland Plow design was released, several units should be constructed and put into operation under various conditions in the West. Ten additional units were constructed during the winter of 1948-1949. These performed very satisfactorily in six different western states last summer. Two of the plows in Utah were used to plow over one thousand acres each with a total repair cost of less than $15.00.

As a result of the use of these eleven plows during the field season of 1949, several profitable changes were found in design and materials. The main features of the revised design are shown in figure 2 and described below. Maximum strength, flexibility and clearance, and minimum friction in moving parts are still the major features.

The major item in achieving strength in the Brushland Plow is the main frame. This can be best described as a triangle with its points connected to the wheel assemblies. The principal part is composed of a heavy four-inch H-beam (1047-4)[2/] interconnected to a heavy parallel angle (1047-3) by truss work of one-half by two-inch straps. This trussed framework is set at 30 degrees from the straight across angle (1047-1) which forms the front of the plow framework. This framework holds and supports the seven disk arms with their spring assemblies and disks. Extending from the left front wheel backward toward the rear wheels is a bent section of heavy tube (1048-11) to complete the tie-up of the triangle and add rigidity.

Another major item in increasing the strength of the plow is the use of steel in all of the castings.

Actually the heart of the Brushland Plow, the individually sprung disk assemblies, is built into this central oblique framework. The H-beam carries supporting castings to which the disk arms are fastened. These arms which carry the disks can move up and down to pass over obstructions. On top and between the parallel beam and angle in front of it are located the spring assemblies which are used to control the downward pressure on the disks.

2/ Number in parentheses refers to corresponding number of part shown in figure 2.

The independently sprung pairs of disks are the major feature of the Brushland Plow leading to flexibility and low breakage, and to efficiency of sagebrush kill. Each of the seven dual disk sets is mounted at an angle to the forward motion to allow the disks to scoop as they roll. The forward disk is 28 inches in diameter and the rear one, 24 inches. These two disks roll on anti-friction bearings, easily replaced since they are self-contained units with grease and dust shields. Each has provision for quickly removing the shaft from the bearing as well as the bearing from the disk arm. A hidden advantage in using the two disk sizes solidly connected on the same rolling shaft is that the different periphery of the disks sets up a slicing action as they roll forward. Consequently, they are more likely to cut the brush roots instead of just rolling over.

The disk arm (978-1) for each pair of disks is carried by a heavy pin and bushing hinge at its forward top end and has a free hinge motion backward and upward. This arm is fastened to a casting (977-4) which in turn is bolted to the heavy four-inch H-beam of the frame. This casting also provides means to stop the downward motion of the arm beyond a set depth of the plow, but still permits upward motion of the disk while traveling over rocks projecting above normal cutting depth, all regardless of the spring pressure setting.

A heavy coil spring (977-8) is used for each of the seven arm assemblies. The spring is a compression type assembled to work in tension by the use of stirrup rods running through the spring core. One of these rods (977-6) is held by an eye bolt to the arm anchor casting at the rear of the spring. This eye bolt serves as a spring tension adjustment. The other spring rod stirrup (977-7) is fastened to a lever or evener (977-1) by a pin between the bottom hinge point (977-2) located on the parallel angle in front of the H-beam, and the upper or top pin connection holding the push rod (977-3). This push rod is joined at the other end to a projecting segment of the disk arm proper.

The manner in which this whole assembly works is as follows: When the disks are rising while rolling over any high obstruction such as rocks, the push rod is moved forward to force the front lever or evener forward, which in turn increases the tension on the spring. While the spring tension in itself is a direct proportion to the coil movement, overlooking any loading for initial spring pressure, the use of this specially designed spring linkage allows a variable and adjustable ratio of downward pressure on the disk assembly.

The action in the spring linkage employed on the Brushland Plow is such that almost a maximum pressure is maintained when the disks are at full set depth of plowing. As soon as the disk arm (978-1) is forced back while traveling over some hard object, there is slightly increasing

pressure. After traveling a short distance backward, the effective spring pressure on the disks is then decreased at a rate determined by the length of the push rod connecting the evener and extended disk arm, so that at a full lift position the spring (977-8), though it may be nearly compressed, has little or no effect to force the disks on the arm back into the ground, the weight of the dual disks and arm taking care of this. Once returned to the original angle at near cutting depth, the effect of the spring tension is again felt.

The point to note here is the advantage of the small force exerted by the spring while the arm is in a raised position. There is no tendency for the plow frame to be lifted by force and thus add extra strain to the framework. Also considerable pressure on the disks while plowing does help to cut and drag out the sagebrush but whenever the disks become overloaded with the brush in front, they are free to climb over it without being retarded by extreme spring pressure. The other disk assemblies are still left to travel at their own plowing depth. This feature probably accounts for the great percentage of sagebrush which is killed by this plow. With more rocks covering the ground, the example is more impressively demonstrated.

The degree of arc traveled by the disk arm before the spring on it changes to a decreasing value can be regulated within limits by simply changing the length of the push rod. With these combined variables permitted by the spring tension adjustment and the push rod adjustment, most any condition encountered in sagebrush removal is met. Stated in another way, we can by changing these two adjustments get a choice of heavy equivalent spring pressure acting on the disks through a prolonged arc or acting through a short arc of travel, or we can start with a light pressure on the disks, then increase the pressure as the arc is traveled, tapering off again toward the final swing of the arm's travel. All of these values depend on choosing the position of the arm levers in degrees of arc with respect to one another.

As shown in figure 1, in traveling over high projecting objects such as rocks, relief to the disks is provided by a combination action resulting from the angular setting of the disk arm and the arbor shaft of the revolving disks. As the disks are raised and roll over a rock, they become aligned nearly straight. Then there is more rolling action than scraping. Consequently, less strain is placed on disk edges and arms.

Maximum clearance in front of the disks is essential, particularly in heavy brush where there is always a chance of getting brush lodged in moving parts or large wads of brush accumulated in front of the disks. Location of the spring assembly on top of the main frame, and location of the hitch (1048-1) as high as possible have aided in getting clearance. Operation of the units now in the field has proved the advantage of this design with high underbody clearance and freely oscillating disk arms to be effective in preventing clogging of brush within the plow.

Minimum needless friction in moving parts has been achieved through the use of anti-friction bearings in all major moving parts. In addition to the anti-friction bearings on which each pair of disks rolls, each of the wheels is mounted on anti-friction bearings. The result is that even though the Brushland Plow weighs nearly three and one-half tons, drawbar tests conducted by the United States Forest Service show that less power is required to pull the Brushland Plow than a conventional one-way disk plow or wheatland plow of the same width and one-half the weight.

Even though the Brushland Plow has been developed primarily for sagebrush removal, the possibilities for its use seem unlimited. Its initial cost is much higher than the present wheatland or one-way disk plows because of the heavier construction, anti-friction bearings and the general high quality throughout. Such features contribute to trouble-free operation on the range lands for which the plow is adapted and should guarantee exceedingly long life where relatively few rocks are encountered.

Complete blueprints for the Brushland Plow are available to interested manufacturers on request from the Pacific Northwest Forest and Range Experiment Station, 423 U. S. Court House, Portland 5, Oregon, or from the Chief, United States Forest Service, Washington 25, D. C.