FROM BULLS TO BULLDOZERS

A Memoir on the Development of Machines in the Western Woods from Letters of Ted P. Flynn.

Edited by Joseph A. Miller

Ted Flynn at wheel of "Trail Mule"

How important were the mechanics, logging superintendents and construction engineers of the Northwest in developing power machinery for woods work? Part of the answer may be found in the late Ted P. Flynn's contributions to the development of the tractor bulldozer—"the most valuable all round material moving machine in the world." As a construction engineer in the Forest Service, Flynn was often faced with jobs beyond the capability of existing machines. The answer was innovation. Between 1923 and 1950 Ted Flynn was associated with or responsible for such developments as the two drum logging hoist, power cable lifts for tractors and graders, the angle blade bulldozer, the "Clarke airborne" tractor and the adjustable tooth bulldozer blade. In the words of George Drake, "Flynn did more to promote and develop the bulldozer than any other man."

Of course the bulldozer dates from the days of animal power, and many men played a part in its development. During the construction of the Central Pacific Railroad in Utah, bull powered "Mormon boards" were used to shove loose dirt over the edge of a fill. The catalog of the Western Wheeled Scraper Co. in 1880 shows a farm wagon equipped with a pusher board on the front end of the tongue which was controlled by a trip rope. After 1900 came the first bulldozers on self-propelled prime movers. In 1916 Holt was experimenting with a hand-operated, chain-lift bulldozer, model T-11. But these developments were not well known. In the early 1920s, the possibilities of bulldozers were but dimly realized.

Mr. Flynn's observations on the evolution of the bulldozer are contained in two letters he wrote in 1950 and 1952. The text below follows the longest letter, written to George Drake in 1952. Clarifying or additional information has been inserted from the earlier letter in order to produce a fuller narrative. We hope this note on the history of woods technology will encourage others who have contributed to the mechanical revolution to set down their own experiences.

I'd like to boast a little about early experience that qualifies me as a logger. Born on the banks of the Gatineau River, Province of Quebec, I won a log burling contest against a big French Canadian river driver when I was 13 years old. My uncle coached me for a month ahead, and guess how I did it? I shouted, "Baptiste your shoe lace he's untied." He look down and when he look he was in de reevaire. I won a camera. I came to Oregon at 15 and Uncle Mike put me to work greasing skids for an ox team.

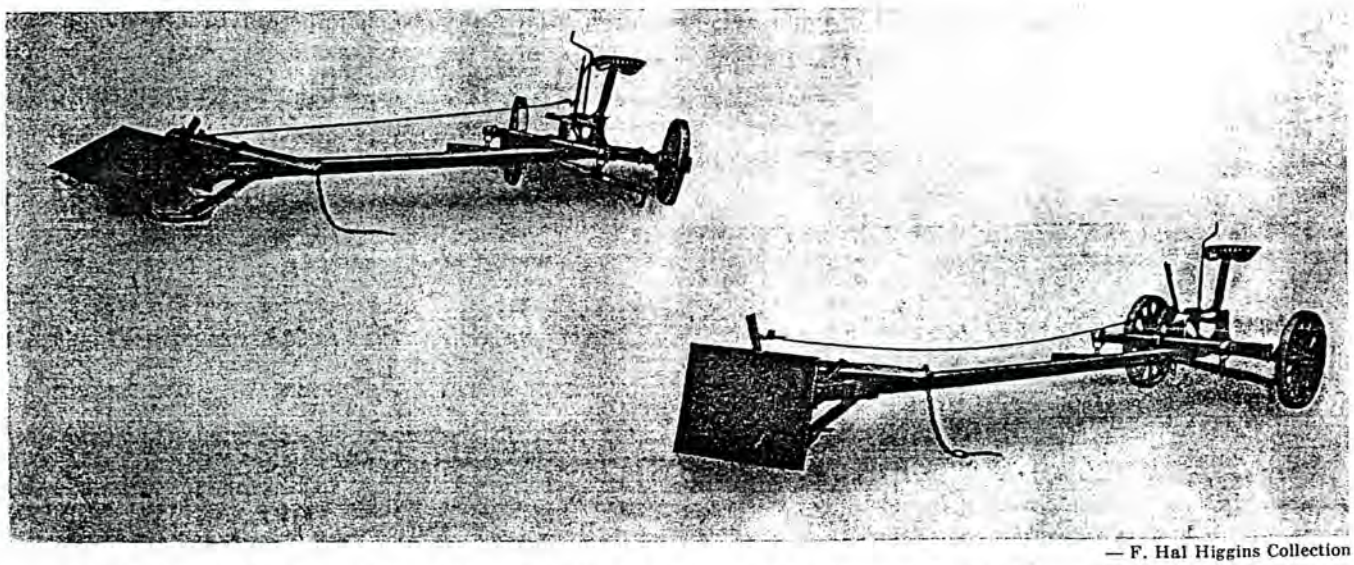
I remember a big flowing mustached guy named Jack Mulkey who wore only a red wool undershirt almost year around. He was the ox skinner. He could spit Peerless clear across the skidroad and hit the lead-off ox in the eye. Mulkey and I both graduated to horse teams and when the little steam donkeys came along I graduated to whistle punk. Mulkey was so disgusted with me for leaving the skidroad he said I never would amount to a damn from then on. I learned to find the ride of log ends so they wouldn't butt and turn the skids over. Saddling skids and sniping, and dogging logs was a real fine art them days. When I graduated to the log pond and then the mill, Mulkey quit speaking to me completely.

At 19 they shipped me to school in Portland and all the real fun was over for me. But all that was a wonderful experience. It taught me how to move logs by taking the utmost advantage of every pound of leverage that could be applied. I think it was a fine background to develop an imagination for things and problems to come later in the fields of engineering. A skidroad was located with a tremendous amount of practical science. It could not be too steep or the logs would run over the bulls and it couldn't have any adverse at all. You had to know where to use cross skids and why and where to use fore'n afters — to get logs out from behind stumps. You had to know more about block and tackle leverages than Einstein knows about atoms.

A Chronology of Inventions

In 1923–1924, with Ralph B. Moore (John Wood Iron Works), I designed, built and installed the first two-drum hoist on a crawler tractor, a 10-ton Artillery Holt Tractor, for logging a right of way on the Old Spirit Lake Road in the state of Washington. This was one of the first very important steps in extending the use of crawler tractors to the logging woods. A circuit court case, Willamette vs. Moore, later definitely established this invention as the first two-drum hoist on any tractor. Fred Brundage backed this experiment and his faith and vision in our idea is not only a credit to him, but also advanced this means of yarding logs by several years. Willamette Hyster got their cue from this development by U.S.F.S. Their engineers came to our camp and took notes, pictures, etc., and in 1926 they came out with their first commercial two-drum hoist. I was an observer at the first test of this hoist which was really the foundation of Hyster business. Powers Wickes designed the commercial version of our hoist for the old Will-Hyster Co.; he can verify this.

In September 1923, watching a little Cletrac pulling a small grader behind trying to open a new road up to Mt. Adams on a very steep hillside, where the grader rolled over about 10 times one day, gave me the idea of why not an angle blade in front of the tractor. The Foreman Ralph Anderson and Ranger Mann said that's it. Without funds Blacksmith Joe Meadows and



— F. Hal Higgins Collection

Was this the first bulldozer? This machine appears on a page of the Western Wheeled Scraper Co. catalog about 1880 according to F. Hal Higgins, curator of the Agricultural Engineering Research Collection of the University of California at Davis. The machine is identified as a "Western Bulldozer" and is described as a "machine designed for pushing earth ahead of the team; for instance, over a bluff, down a steep hillside, into a swamp or a trench where it is impossible or impracticable to drive a team. The blade of the machine is 4 feet long and 2 feet wide and can be tilted as illustrated, which facilitates the backing up of the machine or hauling it from place when not in operation. The tongue is 7 feet 7 inches in length; wheels, 30 inches high. A device is provided for turning the axle at an angle with the tongue, which tends to prevent the machine from sluing and is of value in backing for a new cut. A box (not shown in illustration) is provided under the operator's seat for weighting down the rear end of the machine. This machine has been reported to save the labor of 40 men. It is very quick in operation and can handle a large amount of material. Weight, 800 pounds."

myself built a counterbalanced, hand-lift, angle blade bulldozer using a worn horse grader blade and scrap metal. We attached it to this little Cletrac tractor and put it to work early in 1925 on our Carson-Guler forest road. It was very good for side casting and moved as much material as three teams of horses with fresnoes. It fell off in a few days but it proved an idea. We fixed it better and in 1926 this early haywire bulldozer ran the horses off the job. But the idea was hatched and design made in 1924 for this first bulldozer I ever saw or heard of, and I searched the machinery market pretty well before building it.

After getting a Killifer engineer to look at ours they built a walking beam (no power lift) model and sent it to us for trial in early 1926. Also in 1925 I connected cable power to our old 1924–25 bulldozer, then transferred it to a 2-ton Holt tractor and provided power lift. *This was the first cable power lift.* Late in 1927 I got word that Mack Woolridge was building a few power-lift bulldozers for 20 Cletracs.

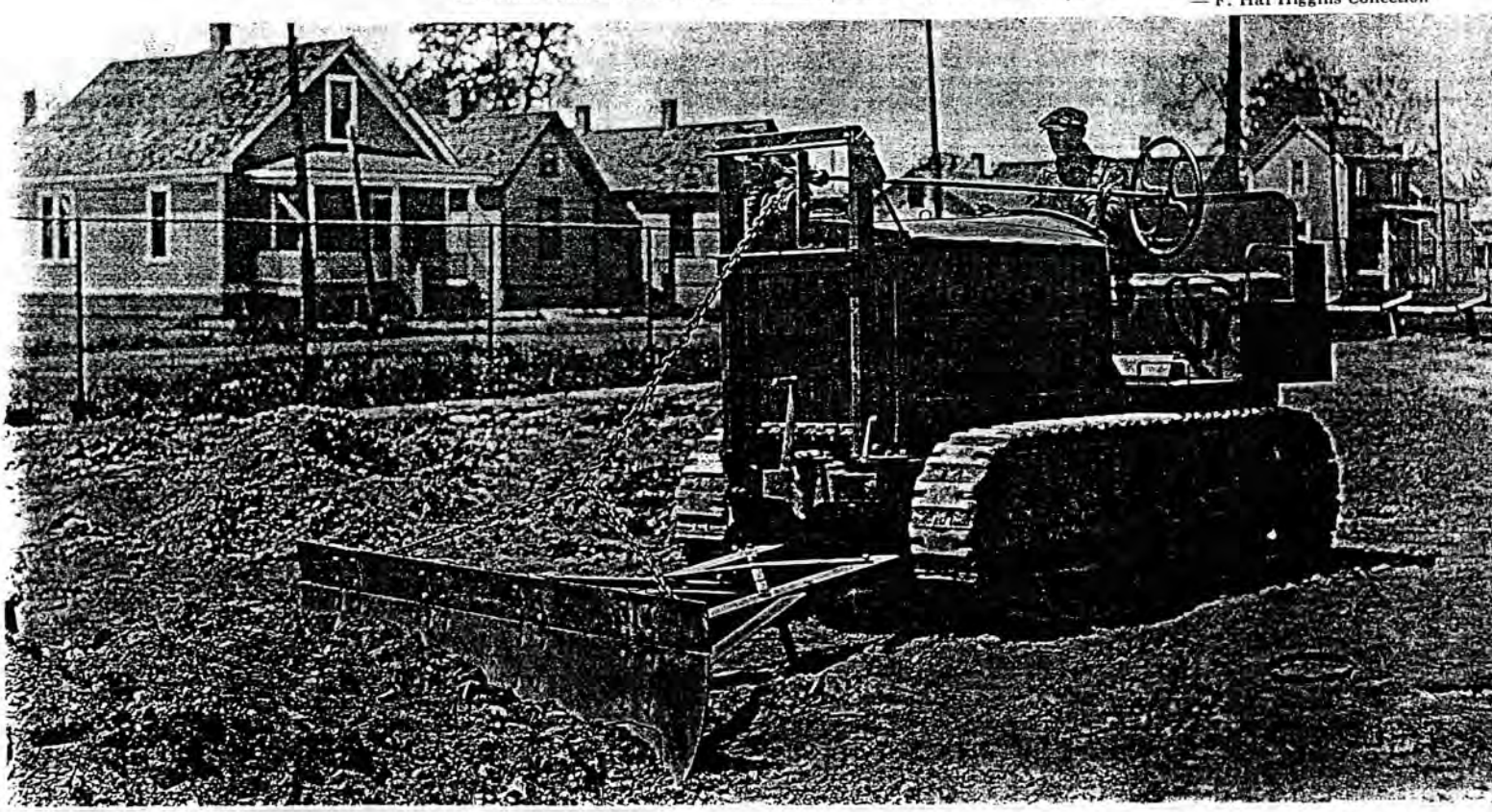
In 1928 all forest engineers were invited to a big road meeting near Santa Barbara, Calif. The equipment committee did not want to show a bulldozer at this meeting. They had a tractor-drawn road grader, a tiny gas shovel, and some horses and fresnoes for the show. I got to Santa Barbara ahead of the meeting and tipped off Woolridge, Killifer and Earl Hall to be at the show. Some way or other I jammed their dozers right into the field demonstrations, and after bribing two Mexican operators with five bucks each they kept one little bulldozer going at all times. The bulldozers stole this show. I'm quite sure this show was the real or first big awakening to the possibilities of bulldozers, because there was a large attendance including Caterpillar Tractor engineers, highway and forest engineers from Washington, D.C.

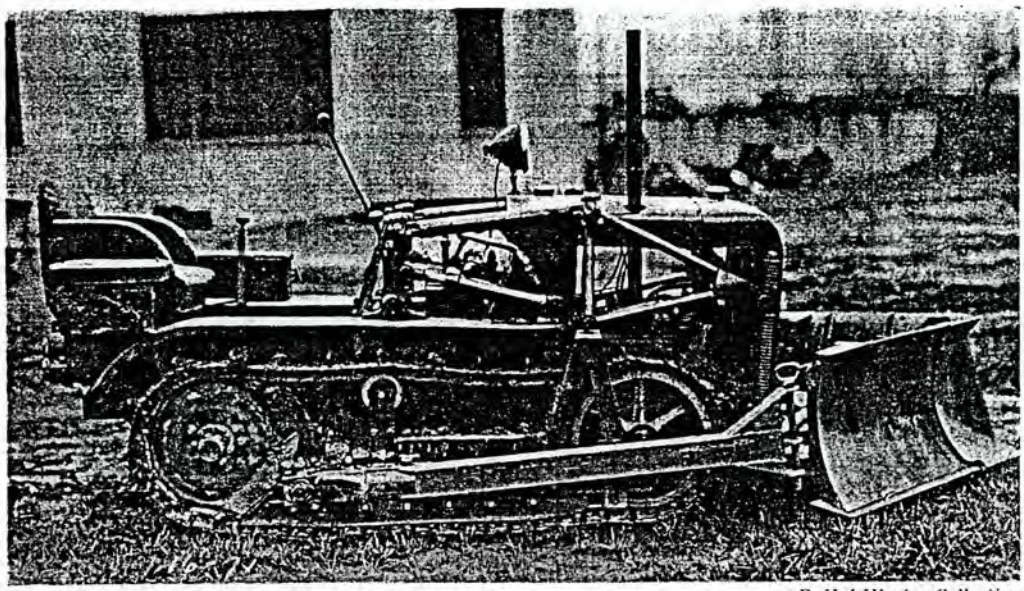
From 1928 on things started buzzing among manufacturers like Master of Los Angeles, La Plante Choate, and others. Some noteworthy or outstanding improvements to the bulldozer in its evolution from the first little hand-lift models up to now were inspired and brought about by leaders in the logging industry like Ed Stamm and George Drake who had the vision and were willing to bet on these pioneer developments in the days when the majority of operators were skeptical or hanging back. As an example, with Stamm's and Drake's support and encouragement, Powers Wickes, design engineer for Willamette-Hyster, developed in 1929 and 1930 an important improvement in bulldozers by providing the first concave or crescent-shaped bulldozer blade to be used anywhere in the world.

This pattern of blade improved steep sidehill excavation and greatly increased the delivered payload when pushing materials endwise because it retained all of its excavated load by preventing materials from wasting or spilling around the outer ends of the blade. This fine idea faded out of bulldozer design after a few years, probably because of lack of enthusiasm or a realization of its value. But to further illustrate the inventive genius we had in the Northwest, 20 years later the huge Caterpillar Company revived this idea by featuring a U or crescent-shaped bulldozer blade in all their late sales propaganda. Maybe as Wyckoff said about some of the features of the Tomcat, that Stamm,

The Holt Model T-11 tractor bulldozer built approximately 1916

— F. Hal Higgins Collection





— F. Hal Higgins Collection

The tractor bulldozer Flynn developed for the U.S. Forest Service at Portland, Oregon, in 1939, proved to be a machine of vital importance during World War II. Small enough to be carried by planes it was leap-frogged over the Japanese lines in the South Pacific and air-dropped to clear landing strips in the jungles in the enemy's rear.

Drake, and Wickes were 20 years ahead of the times with their bulldozer blade.

Crawler tractors were originally designed strictly for agricultural use — draw bar pull only — and as the use of bulldozers increased it was very evident that tractors had to be improved a lot to withstand the new severe strains imposed by the bulldozer. I actually saw a tractor factory engineer walk away from myself and some forest engineers when we had pleaded with him for two days to strengthen up their final drives, steering-drum setup, and final drive-gear cases. He wasn't sure that the bulldozer was here to stay and such improvement to the tractor would cost a lot of money. That poor fellow is dead now; I'll bet his conscience killed him. I'm confident that the Northwest woods operations in the earlier days, and of course road contractors later, made the crawler tractor what it is today and that we did contribute a lot more than just the bulldozer.

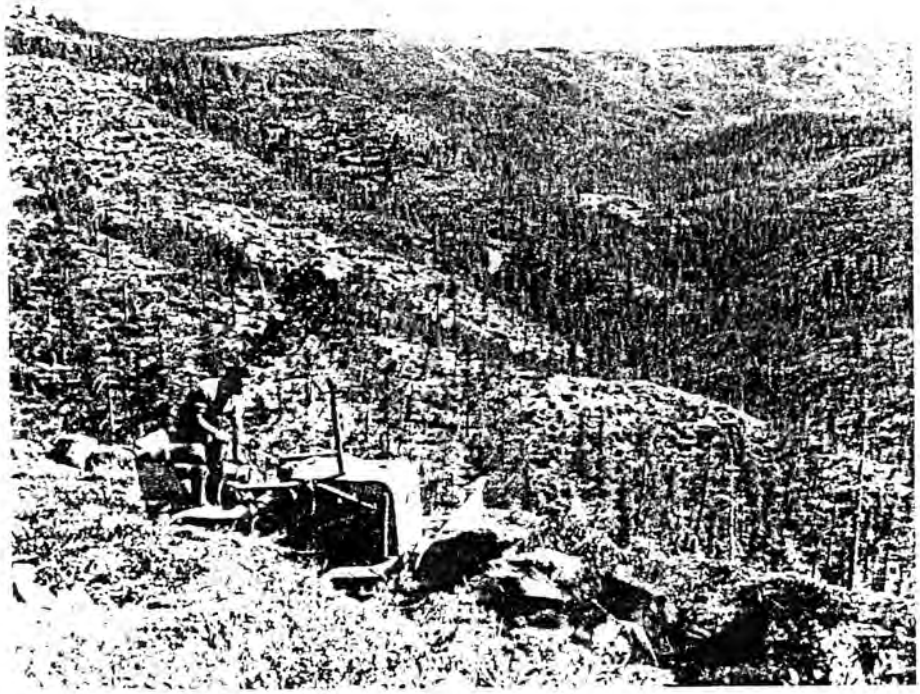
The Forest Service at Portland built the first power-lift pull grader that I know of in 1930. Engineers from all the grader companies came here to see our power lift in use and a year or so after that power lifts or pull graders started to appear commercially. We developed a hundred or more valuable ideas of improvement which were adopted and used by equipment manufacturers.

In 1936 I was put in charge of the Forest Service Equipment Laboratory at Portland. Our next outstanding contribution came in 1937 when I designed a new midget trail tractor which had several advanced design features. In 1942 this little tractor was adopted by the U.S. Army for its Airborne Engineers. I went east and got its construction started. A general in the Airborne Division sent me a citation stating that the quick availability of the Airborne Tractor Design (our 4000-pound trail tractor) advanced their North African schedule three months.

The latest thing and quite important is the adoption of my snow tractor. I began this over-the-snow tractor in 1935. My latest model is being built for Army Ordnance, delivery of the first models will be made next week. This will be the fifth item of importance that my Equipment Lab gave to the war effort and all these items entirely originated here. In fact I have patents pending or completed on all of them and have dedicated the patents to the government.

Another important improvement to bulldozers took place when 14 years ago I patented the *first adjustable tooth blade*, assigned the patent to Issacson who featured it as the Land Klearing Blade and used all over the world by now for land clearing, brush bunching and rock removal. So that was another for the Northwest.

There is only a small percent of the world today that has any idea of how much the rough and ready mechanics, the welders, the woods bosses, and logging superintendents of the Northwest woods contributed toward developing the most universally used and by far the most valuable all round material moving machine in the world, "The Tractor Bulldozer."



The little tractor can take its share of punishment. Building trail from distant horizons through rock formations. The Japanese incendiary bomb landed near here.

DOING BIG THINGS WITH LITTLE MACHINES

Baby tractor, narrow tread truck and portable compressor designed for special work by Forest Service.

SINCE the time factor of forest fire suppression depends in a great measure upon the speed with which men and equipment can be rushed to the scene, the only sure way to prevent incipient forest fires from reaching menacing or catastrophic proportions is to jump on them quickly. That calls for an adequate system of roads and trails over which men and supplies can be moved.

Standard width truck roads possess many advantages but to criss-cross a remote forest area with facilities of this kind, which bear little or no regular traffic takes a lot of money. Pack trails, the only alternative until recently, are often inadequate and movement of men and supplies over such routes is a slow and costly procedure.

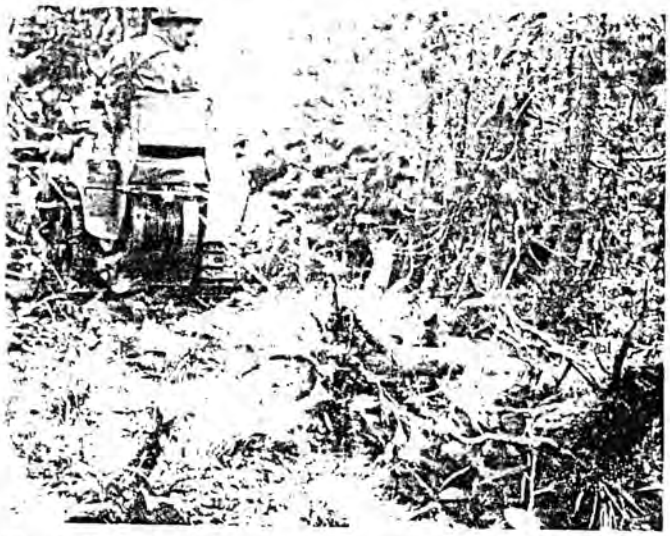
Narrow Roads Evolved

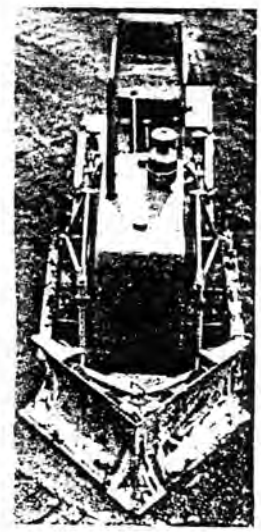
Several years ago, officials of Region Six of the United States Forest Service with headquarters at Portland, saw the possibility of evolving a narrow truck road that could be built at approximately one-fifth the cost of a standard width road. All this came about because the engineers of the supply and equipment depot in Portland, headed by T. F. Flynn, had conceived and built a small trail tractor, smaller than anything available on the market, yet possessing most of the features of its larger commercial brothers, plus a good many of its own to accomplish certain objectives.

and 72 inches in length, weighed 3400 pounds bare. Addition of a small bulldozer and a hoist at the rear brought the total weight up to 4200 pounds and gave it an overall length of 10 feet. Conceived originally for trail building and scooping out firelines, it was found ideally suited for punching out narrow roads at surprisingly low cost. The next step logically followed—the design and construction of a narrow tread jeep type truck, capable of hauling payloads up to 1500 pounds and scampering up grades of 20 per cent and more with utmost ease. Then, coincidental with these developments, came the portable trail compressor, also designed to negotiate the narrow truck road when towed behind

Upper slope stake illustrates actual cross section of excavation and clearing required for standard truck trail road. Compared with narrow excavation required for midget



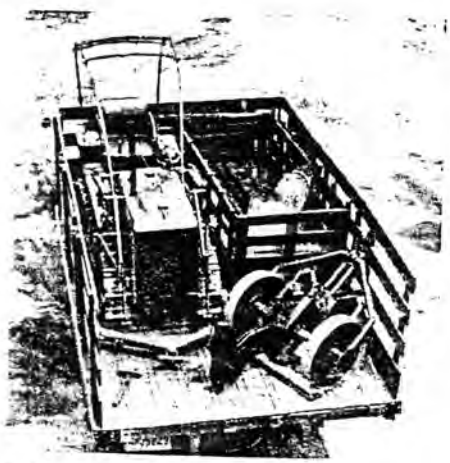




(Top left) Grading narrow trail on steep hillside; note how many large trees are missed. (Top right) Moving supplies in trailer cart. (Lower left) Pulling three small stumps at a time. (Lower right) Showing convertible bulldozer in two positions.

either tractor or truck. It is also capable of being broken into two parts, motor element on one set of wheels and compressor unit on the other.

These three useful little road building and transport elements are expected to revolutionize fire protection schemes for many remote areas where the investment in other types of roads and equipment would be excessive.



Baby tractor, bulldozer, trailer cart and all accessories are easily carried in the bed of a one and a half-ton truck.

The Forest Service shops at Portland have built 32 of these baby tractors, since the first one was turned out in 1937. The power plant is an FC Waukesha with 28 brake horsepower at 1700 r.p.m. The motor torque is rated at 93 foot pounds at 1500 r.p.m. Drawbar pull in first gear is 5000 pounds; in second, 2750; in third, 1520; and in fourth, 895 pounds at 1700 r.p.m.

Clutch Runs in Oil

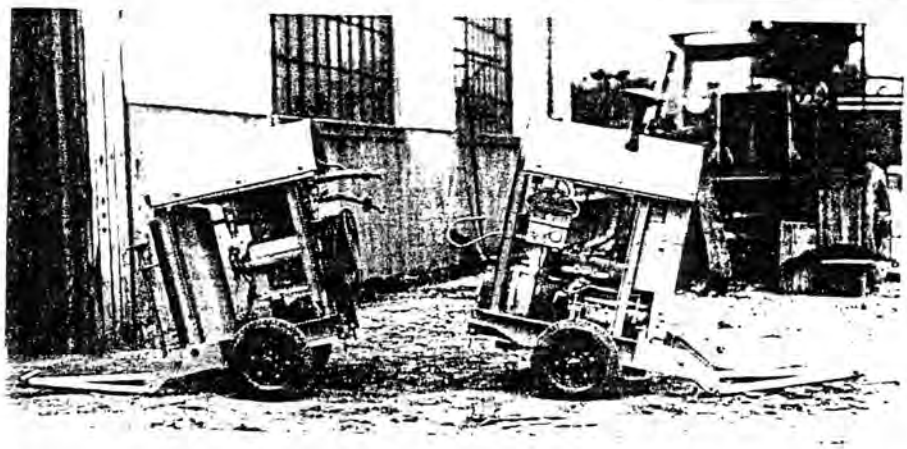
The little trail tractor has four speeds forward and four reverse. At the governed speed of 1700 r.p.m. these are as follows: 1.45, 2.70, 5.05 and 8.55 miles per hour in forward gears and 1.67, 3.18, 5.8 and 9.85 miles per hour in reverse. The master reversible clutch back of the engine, and both steering clutches, run in oil. "An oil clutch is almost impossible to abuse," said Mr. Flynn. "We have clutches that have outworn two tractors and then we installed them in a third machine. In severe tests we have invited drivers to try and tear them out but they have withstood any condition we have yet been able to impose upon them. The clutch, never intended for tractor service, was designed chiefly for the textile industry by the Twin Disc Clutch Co."

The bulldozer used with the baby tractor is an ingenious device with several interesting features. It is hinged in the center and by adjusting three pins may be converted quickly from a straight blade to an angle type. A special shoe is attached over the point when used as an angle blade.

Seven-tooth ripper, weighing 200 pounds, designed for the baby tractor. The ripper teeth have three depth adjustments.

The hoist carries 300 feet of 7/16-inch line and has a line pull of 10,000 pounds. The drum is operated from the rear power take-off and has the benefit of the four speeds in the transmission as well as the reversing clutch, thus giving four speeds in either direction to the drum. Several other types of equipment may also be driven from the rear power take-off such as, built-in fire pump or electric generator.

Newest item of equipment designed for the tractor is the little 200-pound ripper with a three-hole adjustment for increasing or decreasing digging depth.



(Above) New model midget truck. Features are overhanging motor suspension, load concentration over rear axle and short turning radius. (Left) Portable air compressor, broken into two parts for field transport, motor on one end, compressor on other. (Below) Breaking rock with portable compressor on forest road job.

This tool is expected to be useful in dealing with stretches of hardpan. There is also a two wheeled cart which is drawn behind the tractor for carrying tools and supplies.

The air compressor, mentioned previously, delivers 60 cubic feet of air at 100 pounds gauge pressure, running at 900 r.p.m. It measures 29 inches in width outside the wheels; length 90 inches; height 54 inches; weight 1300 pounds with a low center of gravity. Nine units of this type are in use in Forest Service regions 2, 4, 5, 6 and 10. Normally broken into two parts for transport on the light truck, it may be further pulled down for moving by pack animals if the need arises.

The little jeep type truck, the latest model of which is illustrated in this connection, is powered with a Waukesha motor. Motor suspension follows the design of the big FWD, wherein the motor weight is placed well forward and the payload over the rear axle. This also allows the wheels to be close coupled to give it a turning radius of 10 feet.

With the narrow type truck road, supplies can be transported at a cost of 15 cents per ton mile, compared with $1.50 per ton mile with pack animals. The difference is accounted for in speed, miles per day and the ability of truck to maintain a 24-hour schedule.

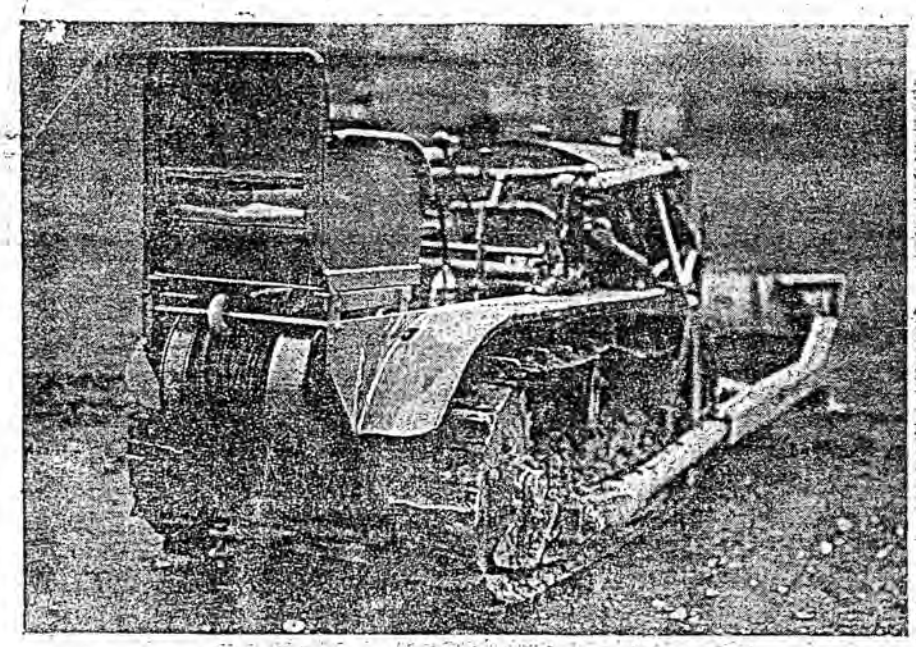
In the opinion of all competent observers [illegible]

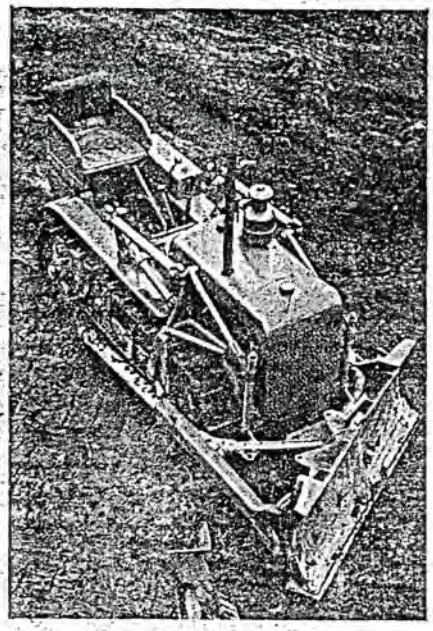
ized equipment that the Forest Service and its designing engineers have made a most important contribution to the science of forest protection, especially vital during these critical times when the Pacific Coast is in danger of attack. Incidentally, one of these little tractors has been working close to the area in southwestern Oregon, where the first Japanese incendiary bomb fell early in September. In that immediate district one of the little fellows is completing 52 miles of the Chetco grade, which will cost under $50,000. Were this road constructed in standard width the cost would have been at least $250,000.

The interesting sequel to this account of the development of the baby tractor is the fact that it has joined the Army Air Corps and it will be built on a mass production basis, probably by the thousands at the plant of the Clark Tructractor Co., at Battle Creek, Michigan. The educational order of 20 is virtually complete. These machines, equipped with straight bulldozer and winch, will be carried throughout the world on bombers and gliders and set down on our far-flung network of air fields. Carefully hidden near the air bases, these speedy little dirt movers will spring into action as soon as an enemy bomb rips a crater on the airport runway and smooth it down. Being small and fast, they can accomplish [illegible]

Ship Match Blocks and Plank

THE lumber industry in the Kootenay-Boundary region of British Columbia is actively producing lumber, cedar poles, cottonwood veneer boxes, white pine match blocks and shingles. The lumber scale in board feet: 1940, 44,525,000; 1941, 58,282,376. Production in 1942 (seven months) exceeds by 5,599,172 the same period in 1941. Approximately 120 mills are operating in the region. Lumber is being shipped direct from the saws. Special orders are not accepted. There is a scarcity of men and mills and logging camps are [illegible]

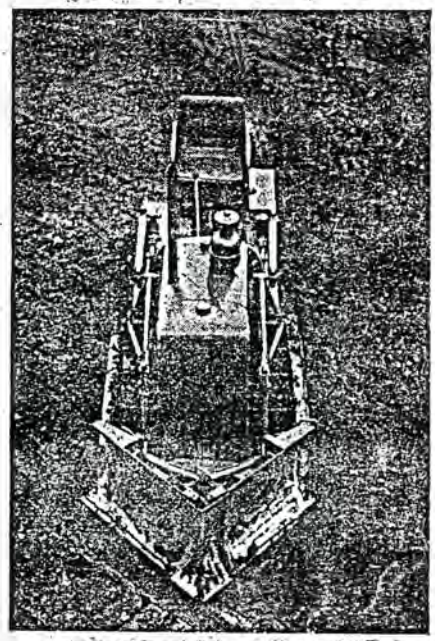




SMALL but powerful is this tractor with drum hoist developed by the Forest Service for building trails in Oregon and Washington. It reduces costs.

Building 46,000 Miles of Forest Trails

One of the primary functions of fire protection in national forests is building of access roads. The service has designed a special tractor and bulldozer unit for this specialized road building.



TOP—the little tractor has a bulldozer which can be operated as a straight blade or (lower) as a V-blade. It merely folds on a hinge.

UNITED States Department of Agriculture, Forest Service, Region 6, lying mostly in Oregon and Washington, contains 20 national forests covering 23 million acres. What most people look upon as "the forest primeval, untrod by man" is, in reality, covered by a network of trails of comparatively recent origin. In this No. 6 region there are 16,000 miles of minor forest roads, called truck trails, traversible by trucks and motor cars, plus another 30,000 miles that make good going for pack horses or plain shank's mare.

One of the most important jobs of the Forest Service in that area is conservation and protection against fire. Regional headquarters are in Portland, under Regional Forester Lyle F. Watts. All equipment for the work comes under the division of engineers, headed by R. F. Grefe and James Frankland, division engineers. The equipment laboratory, where special equipment is developed for the work, and which is, by the way, the only laboratory of its kind in the United States, is in charge of T. P. Flynn, junior equipment engineer.

"There are three primary phases of the problem of forest protection," said Mr. Flynn. "They are detection, communication and transportation. Detection is seeing the fire by lookouts. Communication is by telephone lines strung in the trails, and by short wave radio, to a central dispatcher. Transportation is for getting men and fire-fighting equipment to the danger point in the shortest possible time."

Mr. Flynn then went on to explain that, in building truck roads, the most important item of equipment is the tractor equipped with bulldozer and hoists. In the majority of these roads, the clearing is the major item of cost. This requires an operation equivalent to light logging, which is accomplished in a large part with the drum hoist and light wire rope for the main line and chockers.

The chockers are short lengths of cable fitted with an eye splice on one end and a hook on the other. The chocker setters, of which there may be two or three working ahead of the hoist man, quickly throw a couple of turns of the chocker around a log or stump, and hook back onto the chocker line. The hoist man then comes up with his drum cable and hooks into the chocker eye. As the drum winds up, drawing direct on the log, or around an anchored sheave, the log is snaked out of the roadway. A con-

TYPICAL of Forest Service Problems is this scene; the tractor handles logs.

siderable amount of clearing can be done with one setting of the tractor.

Nearly all the drum hoists on tractors have small drum barrels. Preformed wire rope is, therefore, particularly advantageous for this application since it winds smoothly and evenly on the small drum. As the ropes are dragged around by hand a great deal, the fact that the preformed will not "porcupine" makes it safer to handle because the broken wires will not protrude to cut the operator's hands. Another great advantage is that it will not kink or spiral when cast off. For these reasons, preformed rope is used almost exclusively by the Forest Service for this class of work, on nearly 100 such drum-equipped tractors, averaging 50 horsepower drawbar pull.

In contrast to truck trail building, the ordinary forest trail construction, until recently, has been done wholly by hand labor, and it was tough work. However, last year a small, specially constructed tractor was developed at the laboratory after designs by the Forest Service, and a number of them put into operation for trail building. In this tractor are incorporated special operating features of advantage in trail construction, particular attention being paid to providing a light but at the same time powerful drum hoist carrying 350 feet of wire rope.

Operation of these special rigs in the summer of 1939 proved conclusively that a small tractor such as this, provided with a special Forest Service bulldozer and drum hoist, could construct trails, particularly in rough country, at less cost than if performed by hand labor. The bulldozer attachment is very ingenious, being hinged in the middle, so that it can be operated as a straight blade or as a V-blade. In the case of these small tractors, preformed wire rope is used for drum line and chockers, with the same advantages as in the case of the larger machines.

The Forest Service has developed still another unusual and radical feature in connection with the clutching of the drum hoist, in that there is no clutch directly on the hoist runner. Clutching is done from a reversible clutch, running in oil, which is mounted back of the motor. This arrangement provides for longer life, greater ease of operation, with four speeds forward and four in reverse on the drum hoist.

In this area, there are also operated a number of gas shovels, logging hoists, draglines and other types of heavy equipment, used in operations larger than ordinary trail building. Such is the leaning of the Service to the preformed type of rope for all purposes, that by far the bulk of the rope used on this equipment is of that type.

Equipment of all kinds is kept in a main field headquarters, of which there is one in each of the 20 forests. Each is equipped with a machine shop and has a supervisor in charge. Every winter, all equipment is brought in and given a thorough overhauling and reconditioning, then stored — ready for the next summer's work.

It was mentioned that these trails and roads are for fire fighting and prevention primarily. However, they have great recreation value as well, being open to the public under certain rules and control on the part of the Forest Service in the interest of fire prevention.

One of the best known of these trails is the Skyline Trail in Oregon, which is over 300 miles in length, following the crest of the Cascades. After jumping the Columbia River Gorge, if, of course, you are a Paul Bunyan, its counterpart will be found in the Cascade Crest Trail in Washington, from the foot of Mt. Adams to the Canadian boundary. Along these trails, shelter cabins are provided at easy intervals, together with magnificent views that never lose sight of grand snow-capped peaks. To take a pack train or hiking trip over one of these trails provides a thriller long to be remembered.

Bids Called on Second Willamette Project Flood Control Dam

Second in the series of flood control dams of the Willamette River Basin project, bids will be received June 14 for construction of Cottage Grove Dam. Proposals for the earth-fill structure will be taken by the U. S. Engineer Office in Portland.

First of the project dams was Fern Ridge, located near Eugene, Oregon. Morrison-Knudsen Co. of Boise received the contract for construction of the dam recently at a price of $723,591.

Cottage Grove Dam will be located on the Coast Fork of the Willamette River about six miles south of the town of Cottage Grove, Oregon. It will be of rolled earth-fill construction, 92 feet high and 2100 feet long with a reinforced concrete spillway located in the easterly end. A Congressional allocation of $2,450,000 has been provided for construction of the project; of this, an estimated $881,000 will be needed for the dam and the balance for relocation of the Black Butte Road which now intersects the site.

The dam will create a reservoir about four miles long and one mile wide, with capacity of regulating 30,000 acre feet of water.

BRIDGE: Tacoma Narrows steel work completed

Steel work for Tacoma Narrows Bridge in Washington was completed last month when the last 50-foot section of the west side of the east tower was set. Pouring of the concrete deck began last month as the structure was prepared for opening soon.