PROGRESS REPORT OF PROJECT COMMITTEE ON MAINTENANCE COSTS

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This committee presented at last year's meeting a report on the rise in maintenance costs from 1935 to 1947. The interest in this report was so extensive that it was decided to issue the index on a semi-annual basis. In June of this year we computed the index for the first half of 1948. A report on the subject was distributed throughout the States in the hope that it would be of value to the highway departments in substantiating their budgets for the coming year.

The most substantial rise, seven percent over 1947 and 113 percent over 1935 (Graph 1). Material costs have increased 11 percent over 1947 (Graph 2). This is principally due to the large rise in the cost of bituminous material, approximately two cents per gallon. Equipment costs have also increased materially, 12 percent over 1947 (Graph 3). As usual, the overhead costs have risen least of all, five percent since 1947 (Graph 4). Even this five percent increase is due principally to the rise in the lower salaries and wages; the engineering salaries have gone up even less.

TABLE 1

COST TRENDS

HIGHWAY MAINTENANCE AND OPERATION

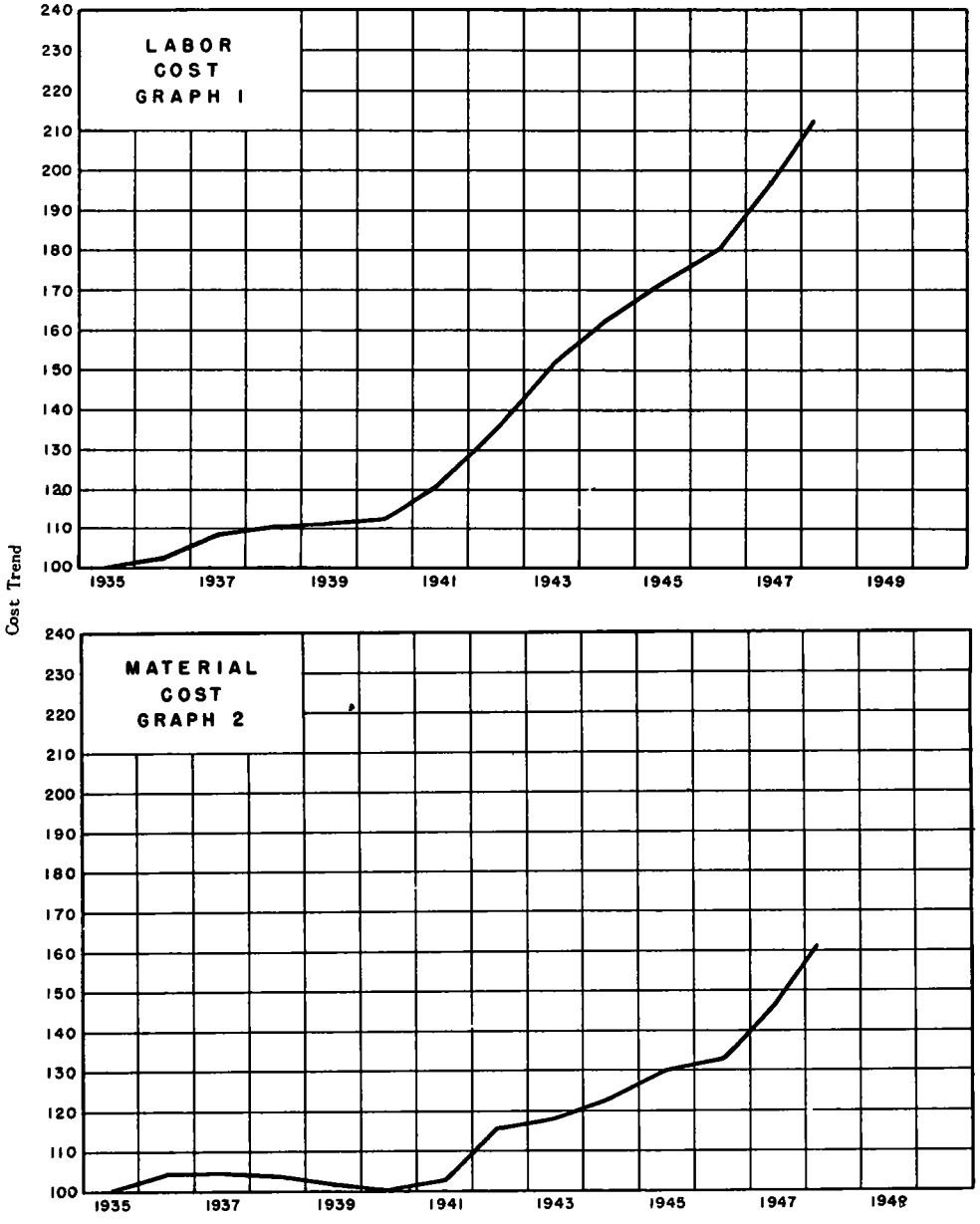
Year	Labor	Material	Equipment	Overhead	Total
1935	100.00	100.00	100.00	100.00	100.00
1936	102.19	104.31	97.97	100.29	101.24
1937	108.48	104.42	99.31	102.50	104.46
1938	110.17	103.73	103.51	103.97	106.36
1939	111.29	101.64	105.87	105.83	107.23
1940	112.33	100.30	107.12	110.20	108.13
1941	121.16	102.86	110.11	111.33	113.30
1942	134.93	115.68	113.27	113.93	122.83
1943	151.82	117.76	114.46	116.87	130.88
1944	162.42	123.22	116.77	119.81	137.34
1945	171.16	130.10	129.89	135.01	147.52
1946	180.56	132.62	141.28	148.30	156.40
1947	198.40	145.83	153.39	162.38	171.28
First 1/2					
1948	212.74	161.20	171.60	170.42	186.42

The maintenance cost index for the first half of 1948 showed an increase of eight percent over 1947, 72 percent over 1940 and 86 percent over 1935 (Graph 5 and Table 1.) Labor has, of course, shown

We are currently engaged in compiling the index for the second half of 1948. To

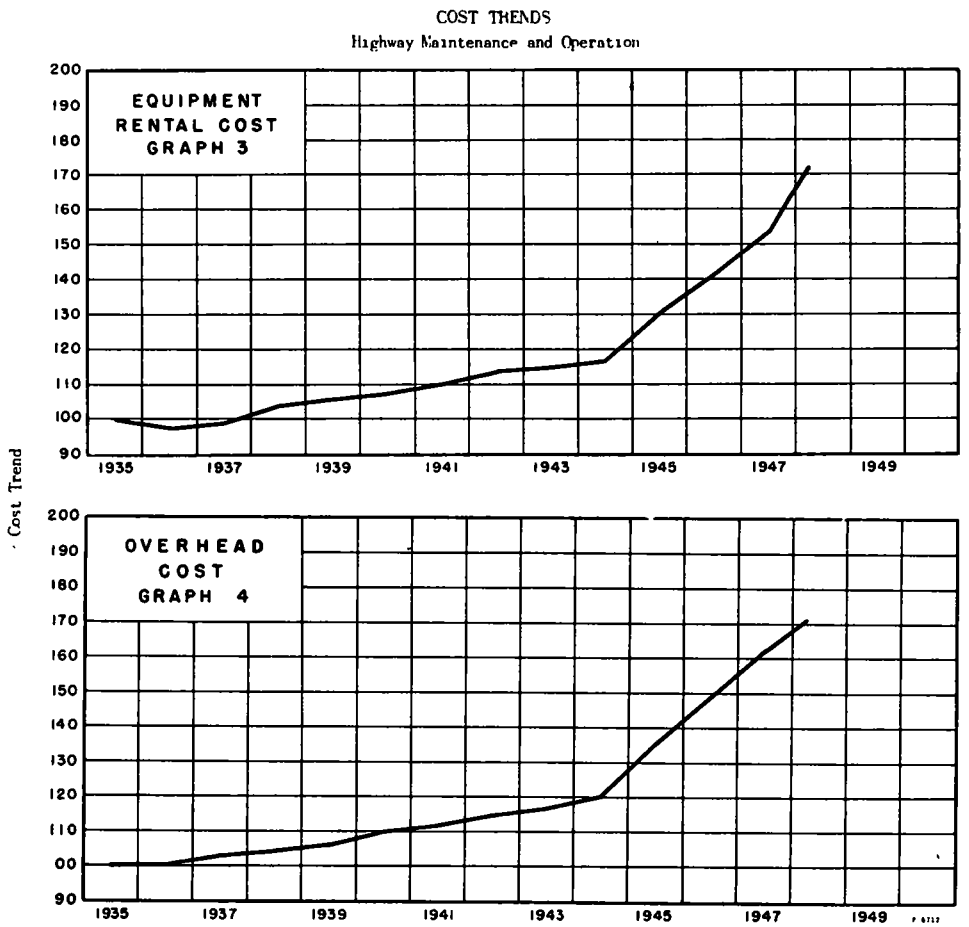
COST TRENDS

Highway Maintenance and Operation



date, sufficient data have not been received to indicate an exact index figure. It is estimated, however, from the data so far received that the index for the last half of 1948 will be approximately 190, two percent over the first half of 1948 and 90 percent higher than 1935. In this case, the average cost of maintenance for the year 1948 would be 88 percent above the 1935 cost. In other words, the 1948 dollar produced, in terms of the 1935 dollar, only fifty-three cents worth of maintenance.

This rapid increase in costs indicates that we, as maintenance administrators, must devise new and improved maintenance equipment and new and improved maintenance methods and procedures in order to



increase the productivity of our maintenance effort and thereby increase the value of the maintenance dollar.

With this increased production we can afford to improve our wage standards without increasing the actual cost of the work. As an illustration of this, we can recall the plight of the coal miners in the pick and shovel days. Today, the Bituminous Coal Institute reports, more than 91 percent of all bituminous coal mined underground is mechanically cut, about 60 percent is mechanically loaded and only four percent is mined by pick and shovel methods. This has not only made better wages possible but has also improved the working conditions of the coal miner.

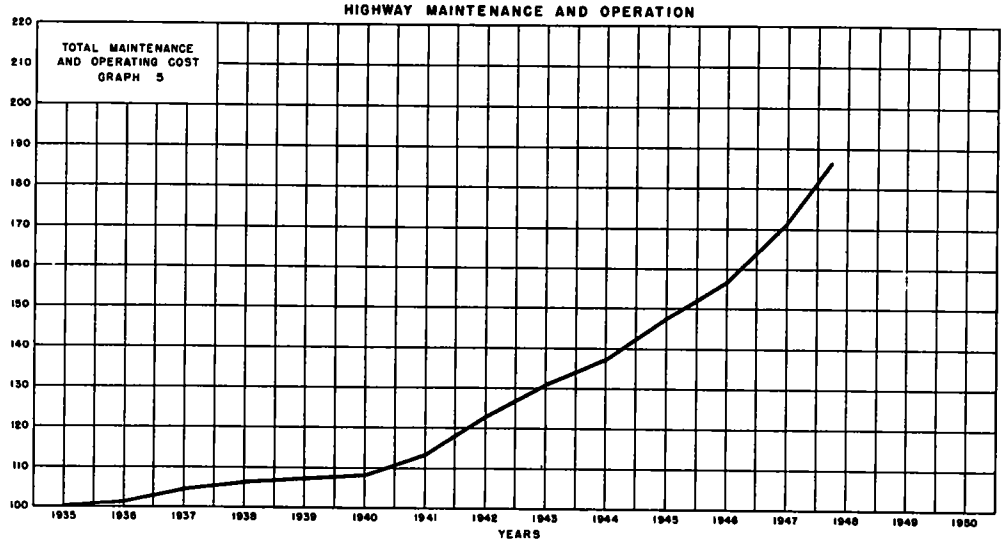
While these data reflect the advancements in other fields, it must be recognized that our maintenance organizations have also made great strides in holding the increase in the costs of certain operations well below the increase in the general level of prices. An indication of the increased productivity of the maintenance man, or at least the increased use of the highways that he was called on to service, may be obtained from the records of revenue-producing traffic. The following increases have occurred per maintenance man employed in 1947 as compared to the number of men employed in 1936:

Item	1947 percent increase over 1936 for each maintenance man employed
Motor vehicle registration .	60
Vehicle miles of travel . . .	79
Ton-miles of traffic . .	120

It is to be noted that the 1947 main-

COST TRENDS

HIGHWAY MAINTENANCE AND OPERATION

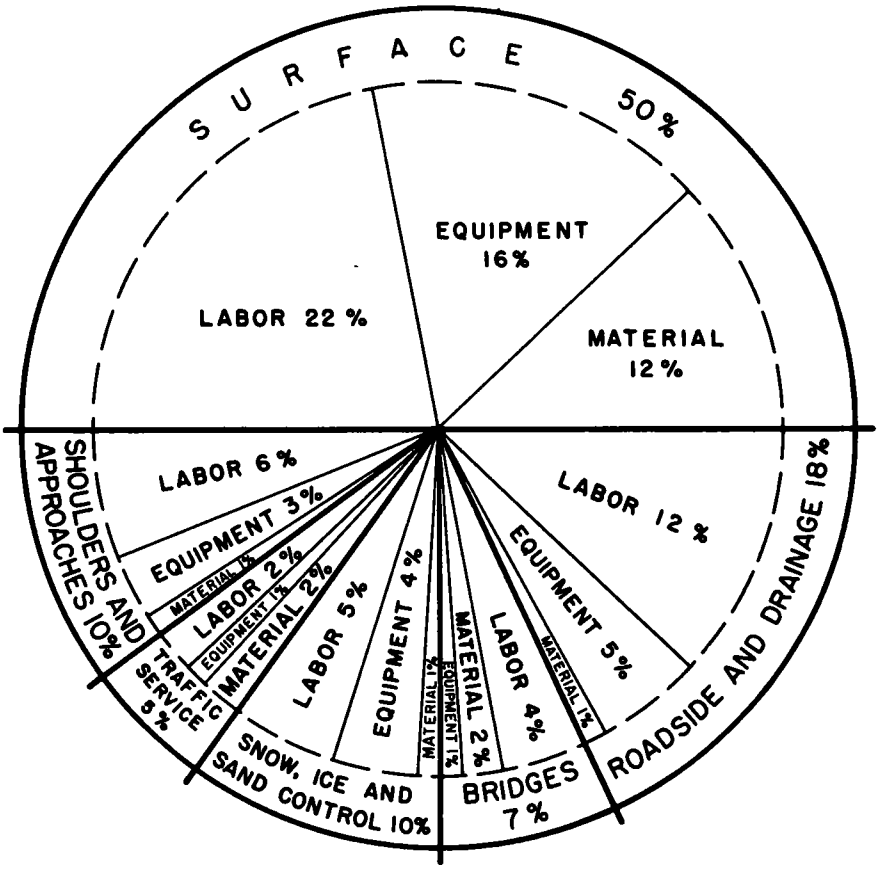


tenance man was assigned to repair the deteriorations caused on highways by the movement of over twice as many ton-miles of traffic as was the case 11 years earlier.

An analysis of the distribution of the expenditures for labor, material and equipment between the various highway maintenance operations is shown graphically on Chart 6. On this chart, the overhead charges have been distributed between the labor, material and equipment items. This chart indicates that half of the total maintenance expenditure is used in maintaining the highway surface. This, based on the 1947 expenditure for State highway maintenance, maintenance overhead and maintenance equipment, amounts to 220 million dollars. Based on the total maintenance expenditure of the Nation (States, counties, townships and municipalities) in 1947, it amounts to about 570 million dollars. The size of this expenditure indicates the large savings that could be accomplished by increasing the productivity of the direct labor engaged in these surface maintenance operations. It has been estimated by the Automobile Manufacturers Association that 30 percent of the 1946 pay roll costs of United States industry was attributable to material handling. It is further estimated that 80 percent of this handling was performed by manual methods. The use of almost half of the surface maintenance funds for direct labor shows that we, the highway maintenance industry, are not doing much better.

Material handling is an important part of all our maintenance operations. Due to the large expenditure for surface maintenance, it is particularly important in this operation. Here the material for surface treatment or patching, bitumen and stone, must be picked up, either from a plant, stock pile or from the surface itself; in some cases graded and screened; transferred to some type of mixing operation; and, finally, placed evenly on the surface and compacted. As you can see, this involves possibly four separate handling operations, loading, two transfers and placing. During the past 20 years, we have made many important advances in the handling of these materials and still almost half of our surface maintenance expenditure is used for labor.

Several new types of equipment are being developed that should measurably increase the productivity of this operation. Two equipment units that will perform parts of the surface reconditioning operation are being field tested. One tears up the old surface and pulverizes it for further manipulation. The other picks up previously scarified material from windrows and pulverizes it, discarding the fines on the surface and windrowing the



Graph 6. The Maintenance Dollar. Maintenance and Operation of State Highway Systems, 1948.

clean material for remixing. Both of these machines should reduce the handling costs on this type of work. A small continuous mix plant has recently been developed that prepares and loads or stock piles patching material without intermediate manual handling. Many new types of tractor- and truck- loaders have been placed on the market recently. These all reduce or eliminate the necessity for hand-loading.

Chart 6 also discloses that the next most costly operation is roadside and drainage maintenance. Two-thirds of the cost of this operation which amounts to slightly less than one-quarter of the total maintenance expenditure is due to direct labor charges. The two most important individual operations involved are the mowing and disposing of roadside vegetation and the cleaning of and the disposing of the spoil from the roadside ditches. Here again, the handling of the cuttings and spoil is the most costly part of the operation.

We have developed in the past few years, mowers that are much more adaptable to highway work than the original farm types. We can now cut at almost any angle, either above or below the horizontal. We have small mowers that can be used on very rough terrain. We have mowers that can cut brush up to three inches in diameter. The difficulty is that we must dispose of this material after it is cut. This is the part of the operation that now requires the greatest labor effort. Some of our States have developed raking de-

vices which collect the cuttings. They must still be loaded and hauled to a suitable dumping area. A machine is being developed which will pulverize the cuttings. This material can then be deposited on most roadsides without creating a fire hazard or spoiling the view. The development of a mobile incinerator such as is used in another industry has also been suggested. The cuttings could be burned and the ash deposited on the shoulder or roadside.

Several of the States are experimenting with or have adopted the use of some type of herbicide. These selective chemicals kill off the most troublesome vegetation and allow the better grasses to grow. In this way the necessity for removing the cuttings is reduced or eliminated.

The cleaning of the roadside ditches also entails much hand labor. Many types of tow and power graders have been developed which will do an excellent job of cleaning and reshaping the ditches. Here again, the difficulty is that we must dispose of the excess material. This is a handling operation, loading and hauling. Recently, power loaders have become available that will load this material at a fraction of the cost of hand labor. It is reported that the actual loading cost can be reduced to three cents per cubic yard. It is necessary in most cases, however, to blade this spoil onto the shoulder or surface of the highway in order to make it available to the loader. This is not adviseable on many of our surface types since the spoil usually contains an excess of fines. These should not be allowed to lower the quality of the stable shoulder or surface material. A machine which would shape the ditch and at the same time carry the spoil over the shoulder into a truck appears to be a desirable development.

Over half the cost of the remaining maintenance operations which together account for over one-quarter of our maintenance expenditure can be attributed to labor. The introduction of new equipment types together with the consequent improvement in our maintenance methods and procedures should materially increase the productivity and decrease the cost of these operations.

We have with us today two men who will discuss from the standpoint of economy two very common maintenance operations. These two men will give you the benefit of their experience in combating the high cost of maintenance through the development of new maintenance equipment and new maintenance methods. That they are well informed on the subject of costs will be readily apparent when I tell you that between them they are responsible for the expenditure of over $80,000,000 on the maintenance, operation and improvement of their State highways.

Mr. Forrer of Virginia will discuss the savings that can be accomplished by the use of mechanical loading methods. Mr. Beckley of Pennsylvania will discuss the cost of resurfacing disintegrated pavements. I feel sure that their experience will be of value to all of us.

COST OF MECHANICAL LOADERS IN DITCH CLEANING AS COMPARED WITH COSTS OF HAND OPERATIONS IN VIRGINIA

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Virginia Department of Highways

The information contained in this paper is compiled from data collected from the field engineer in charge of maintenance operations throughout Virginia only.

The Virginia Department of Highways maintains 9,000 miles of primary roads and 38,000 miles of secondary roads. As in most States, during and since the war, a very definite shortage of hand labor has existed. At the same time, naturally, many miles of ditches were becoming clogged with grass and washed in debris. Inadequate drainage was causing excessive base and surface failures. Grader equipment, both one-man and tractor pulled, was available for pulling material from the ditches onto the shoulders of the road. The complete disposal of this material was a real necessity and presented a big problem. Labor not being available, it became evident that the loading of this material onto trucks would have to be done by machinery. It was necessary that such a machine be capable of picking up wet or dry sandy or clayey materials containing grass, roots or small stones and load them onto trucks working in line so that there would be a minimum of interference to traffic. Also the machine would have to be capable of moving rapidly from one location to another under its own power.

In attempting to arrive at comparison

TABLE 1

ENGINEERS' REPORTS - COMPARING COSTS AND SAVINGS OF THE MECHANICAL LOADING OF DITCH CLEANING OVER HAND LABOR METHODS

Mechanical Loading Costs Per Mile (Both Ditches)		Hand Labor Loading Costs Per Mile (Both Ditches)		Difference in Cost Per Mile	Estimates of Number of Laborers Replaced by Loading Equipment	
Test Sections	Cost Per Mile	Test Sections	Cost Per Mile		No Engineers Reporting	No Laborers Replaced
1	$ 40 00	1	$ 274 00	$ 234 00	1	25
2	111 00	2	274 00	163 00	1	30
3	51 16	3	482 60	431 44	2	40
4	23 65	4	76 39	52 74	4	50
5	75 00	5	130 00	55 00	1	80
6	128 58	6	500 00	371 42		
7	135 00	7	225 00	90 00		
8	100 00	8	165 00	65 00		
9	80 00	9	100 00	20 00		
10	95 00	10	165 00	70 00		
11	35 00	11	102 00	67 00		
12	62 13	12	275 92	213 99		
NOTE-The engineers reported a rate of progress of from 1 to 5 miles per day		NOTE-The engineers reported a rate of progress of from 1/4 to ½ mile per day				
The outfits consisted of 1 Foreman 1 One-man or tractor pulled grader and operator 1 Mechanical Loader and Operator 4 to 5 1½ Ton dump body trucks and drivers 1 Rotary power broom 2 to 3 Laborers		The outfits consisted of 1 Foreman 1 One-man or tractor pulled grader and operator 4 to 6 1½ Ton dump body trucks and drivers 12 to 16 Laborers				

TABLE 2

TIME STUDIES OF LOADING ONE TRUCK
(3 Cubic Yard Load)

Test Number	Mechanical Loading Average Time Recorded Minutes	Hand Loading Average Time Recorded Minutes
1	1/4	3
2	1/2	5
3	2/3	10
4	2/3	12
5	1	12
6	1	15
7	1	25
8	1-1/4	17½
9	1-1/2	25
10	2	10
11	2	12
12	2	20
13	2-1/2	7½
14	2-1/2	10
15	2-1/2	15
16	3	10
17	3	15
18	3	12
19	4	20
20	5	12

TABLE 3

COST STUDIES OF LOADING ONE TRUCK
(3 Cubic Yard Load)

Test Number	Mechanical Loading Average Cost Recorded	Hand Loading Average Cost Recorded
1	$ 0.12	$ 0.70
2	0.24	1.33
3	0.25	2.88
4	0.33	1.63
5	0.39	1.55
6	0.43	1.23
7	0.72	2.13
8	0.78	4.07
9	0.81	1.65
10	0.91	3.17
11	0.92	2.19
12	0.95	1.50
13	1.01	2.06
14	1.05	2 01
15	1.32	4 89
16	1 67	5.87

costs it soon became obvious that practically every road had its peculiarities which reflected in the cost of the operation, i.e., the amount of material from the ditch, the kind of material handled, and the distance that the excess material had to be hauled for disposal, etc.

The disposal of the materials from the ditches, within a reasonable haul, does not present any problem. The materials that contain good soil and grass are used extensively for top dressing slopes and fills. The materials that contain stones or clay are dumped uniformly over the fills. Often the material is given to citizens along the road for filling low spots in fields and house lots. In many cases the citizens are so anxious to get the materials that they will furnish trucks at their expense.

The wide variation in operations and locations accounts for the wide variations in replies received from the field engineers (Table 1 - 3). Also the terrain in Virginia varies from the tidewater area in the east, rolling country in the central section and mountainous conditions in the west. The soils in each area are widely different, varying from sandy loams to heavy clays.

The machines capable of loading ditch materials are also used for many other purposes such as loading aggregates from stockpiles, light excavation work in widening narrow grades, and for loading snow. We are now operating in Virginia 85 mechanical loaders for these purposes.

It would be very desirable to have a machine that would clean ditches, and in the same operation load the material onto trucks. Such a machine, so far as known, has not been developed. It is believed there is a definite field for such a machine.