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PUBLIC ROADS

ISSUED BY

OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING



Looking down Salmon River canyon on an Idaho Federal Aid project.

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1918

OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING.

Logan Waller Page Director.
P. St. J. Wilson . . . Chief Engineer.

J. E. Pennybacker . Chief of Management.
Jules L. Goldberg Editor.

SALUTATORY.

WITH this issue of PUBLIC ROADS the Office of Public Roads and Rural Engineering inaugurates the publication of a periodical devoted to better highways in the States of the Union and dedicated to those, both in official and private life, who are concerned in developing means of better rural communication, in facilitating the marketing of the crops of the Nation, and in aiding in the solution of the daily more perplexing traffic problem. If it may help in even a small measure toward the stimulation of ideas making for a standardization of effort in road construction and maintenance during the stressful period through which the civilized world is passing then, indeed, will it be justified, will it be a source of satisfaction to both its sponsors and supporters. But even to approach the attainment of its ends there must be between PUBLIC ROADS and those to whom it is dedicated a free and unrestricted interchange of honest, unbiased thought, and open mindedness to helpful suggestion, and a manful disposition to give and take constructive criticism, and with a single purpose—the greatest good for the greatest number.

It is not the purpose to allow this publication to supersede the bulletins issued intermittently by this Office since its establishment. Rather is it the purpose to supplement these bulletins and add to their value by the regular and frequent incorporation in these pages of the results of researches, experiments, and studies of those connected with this Office, and of highway officials of the various States who have in mind the ambition and at heart the desire to advance to as near perfection as possible the science of road building. It is not the desire of this Office from its position as a Federal institution to pose through the pages of this publication as a dictator in respect to highway affairs, nor as a mentor or a pedagogue, but rather to give, through the superior facilities at its disposition through the Federal Government, the best of the results of its researches, studies, and efforts periodically, rather than at long intervals, as has been the practice through the publication of bulletins. It is the desire to make this publication helpful to builders of highways, official and private, in both high and low stations. And in return it offers its columns and invites their use for the dissemination of such information as the officials of the various States may desire to spread for the benefit of their contemporaries. And by the liberal use of its pages for this purpose will it gain in value.

With increasing interest among the State highway officials in the Federal aid road act and the rapidly spreading desire to apply the benefits of this act to the roads of their States it becomes necessary to preserve a progress record of the projects under it. In this number will be found a complete compilation from the record of every State project submitted up to and including February 28, 1918, covering practically 18 months of progress under the act. A table will be carried in every issue, corrected and extended to the close of the month next preceding publication. Thus the highway officials of each State will have, in addition to the records preserved by them, the record of the Federal office in respect to their projects, and the story of the progress of Federally aided construction in every State in the Union.

It will be our earnest effort—always with the support and cooperation of the highway organizations of the States—to present matters of special interest to those directly concerned with the construction and maintenance of roads, to bring to all the progress of road improvement throughout the country, to discuss its problems and record its results. Always with the single purpose and devout hope that from this closer association will be born a determined and united disposition to bring to road betterment that which is best in and for this generation, that which, in this period in our history, will make for the greatest strength of our Nation, that which in fullest measure will aid those who are leading us in this strife to bring it to a speedy and victorious issue.

LOGAN WALLER PAGE,
Director.

FIFTY-TWO ON THE OFFICE ROLL OF HONOR.

Fifty-two stars decorating the field of the service flag on the front of Public Roads building mark the loss to the Office of the services of that many of its men and their entry into the service of the world in the mighty struggle. The force directly concerned with the construction of highways has contributed the largest number of men—18 in all—among them one district engineer, C. H. Sweetser.

The Drainage Division has given an even dozen of its force, 6 have gone from Irrigation, 4 from the Laboratory, 2 from Rural Engineering, and the clerical force has been decreased by 10.

Every man of the 52 offered his life to his country. Not one was called in the draft. Almost every branch of the service and every rank from private to major is represented in the following list:

EMPLOYEES OF THE O. P. R. & R. E. WHO HAVE ENTERED MILITARY SERVICE.

Name.	Office Title	Rank.	Branch of Service.	Station so far as known.
Wallace Ashby	Barn Architect	1st Lieut.	Engineers Corps	
F. Russell Lyons	Jr. Highway Engineer	2nd Lieut.	Engineers Corps	Am. Expeditionary Force.
W. B. Booth	Jr. Drainage Engineer	2nd Lieut. U. S. R.	116th Engineers	Am. Expeditionary Force.
Q. C. Ayres	Jr. Drainage Engineer	2nd Lieut. U. S. R.	Co. B 1st U. S. Engineers	Am. Expeditionary Force.
O. N. Powell	Highway Engineer	Captain	Engineers Corps	Camp Lewis, American Lake, Wash.
Dan S. Helmick	Jr. Drainage Engineer	1st Lieut. U. S. R.	Co. B 1st U. S. Engineers	Am. Expeditionary Force.
Harris E. Petree	Clerk and Stenographer	1st Lieut. U. S. R.	13th Aero Squadron	Am. Expeditionary Force.
I. G. Kohlmeier	Clerk and Stenographer	Dental Surgeon	U. S. Navy	U. S. S. <i>Wyoming</i> .
A. L. Hooper	Jr. Highway Engineer	2nd Lieut. U. S. R.	Co. A, 25th Engineers	Am. Expeditionary Force.
P. A. Rideout	Jr. Highway Engineer	Sergeant	110th Engineers Corps	Am. Expeditionary Force.
R. E. Toms	Jr. Highway Engineer	Captain	Artillery	Ft. Sam Houston, Texas
W. A. McCalla	Sr. Highway Engineer	Major	In Charge Road Battalion	
Wm. H. Rhodes	Sr. Highway Engineer	Captain	25th Engineers Corps, E. R. O. T. C.	Am. Expeditionary Force.
Wells A. Hutchins	Asst. Irrigation Engineer			Chickamauga, Ga.
J. H. Skeggs	Sr. Highway Engineer	Major	In Charge Road Battalion	Am. Expeditionary Force.
Geo. R. Boyd	Sr. Drainage Engineer	Captain U. S. R.	Unassigned	Am. Expeditionary Force.
J. H. Haswell	Sr. Drainage Engineer	Captain U. S. R.	Unassigned	Am. Expeditionary Force.
J. C. Stirton	Instrument Man	2nd Lieut.	E. O. R. C.	
C. E. Proudley	Laby. Asst.	Sergeant	Coast Artillery	
H. H. Barrows	Sr. Drainage Engineer	Captain U. S. R.	302nd Engineers	Camp Upton, N. Y.
C. F. Bessee	C. E. Draftsman	Private	361st Infantry	
Guy L. Smith	Jr. Drainage Engineer	2nd Lieut. U. S. R.	C. A. R. C.	Ft. Hamilton, N. Y.
L. A. Jones	Sr. Drainage Engineer	Captain U. S. R.	514 Service Battalion, R. O. T. C.	Camp Gordon, Ga.
Carl Rohwer	Asst. Irrigation Engineer			Ft. Riley, Kans.
Albert L. Lane	Jr. Drainage Engineer	1st Lieut. U. S. R.	Co. H. 50th Infantry	Camp Greene, Charlotte, N. C.
C. A. Miller	Draftsman	Corporal	Artillery	
I. D. Lucal	Clerk and Stenographer	Private	Hospital Corps	Ft. Sheridan, Ill.
Chas. H. Moorefield	Sr. Highway Engineer	Lieut.	Naval Reserve	Haiti.
H. H. MacPherson	Chief of Survey Party	1st Lieut.	Engineers Corps	
W. G. Franks	Clerk	Captain	Signal Corps	Ft. Bliss, El Paso, Tex.
W. B. Gregory	Irrigation Engineer	Major U. S. R.	Unassigned	Am. Expeditionary Force.
John H. Chapman	Clerk and Stenographer	Clerk	Signal Corps	Am. Expeditionary Force.
R. A. Brown	Supt. of Road Construction	Corporal	23rd Engineers Corps	
R. P. Sleight	Asst. Irrigation Engineer	1st Lieut.	Signal Corps	Washington, D. C.
W. M. Jeffrey	Jr. Highway Engineer	1st Lieut.	Engineers Corps	
W. H. Waugh	Sr. Highway Engineer	Captain	Engineers Corps	
D. O. Wolfe	Laby. Asst.	Cadet	Aviation Corps	
C. H. Sweetser	U. S. District Engineer	Captain	Engineers Corps	Camp Humphrey, Va.
S. L. Taylor	Jr. Highway Engineer	2nd Lieut.	E. R. O. T. C.	Camp Lee, Va.
W. G. Sloan	Drainage Engineer	1st Lieut.	E. R. O. T. C.	Camp Lee, Va.
O. G. Baxter	Sr. Drainage Engineer	Captain	E. R. O. T. C.	Camp Lee, Va.
F. G. Eason	Sr. Drainage Engineer	Captain	E. R. O. T. C.	Camp Lee, Va.
T. H. McCarthy	Asst. Irrigation Engineer		E. R. O. T. C.	Ft. Riley, Kans.
L. L. Beebe	Asst. Mechanical Engineer	Captain	Ordnance Corps	Camp Lee Va.,
Edw. Buckoff	Clerk		347th Engineers	
R. H. Harrison	Highway Engineer	Private	23rd Engineers	Camp Meade, Md.
J. R. Boyd	Laby. Apprentice	Private	Ordnance Corps	
D. L. McBeath	Supt. Road Construction	1st Lieut.	Engineers Corps	
H. S. Fairbank	Highway Engineer	1st Lieut.	Ordnance Corps	Edgewood, Md.
Wm. H. Barton, Jr.	Computer, Div. of Management	Corporal	Medical Corps	
W. P. Holland	Clerk	Cadet	Aviation Corps	
H. C. Diesem	Irrigation Engineer	Captain		

FIVE MILLION MOTOR CARS ON ROADS OF THE UNITED STATES.

Prepared in the Management Branch, Office of Public Roads and Rural Engineering.

By

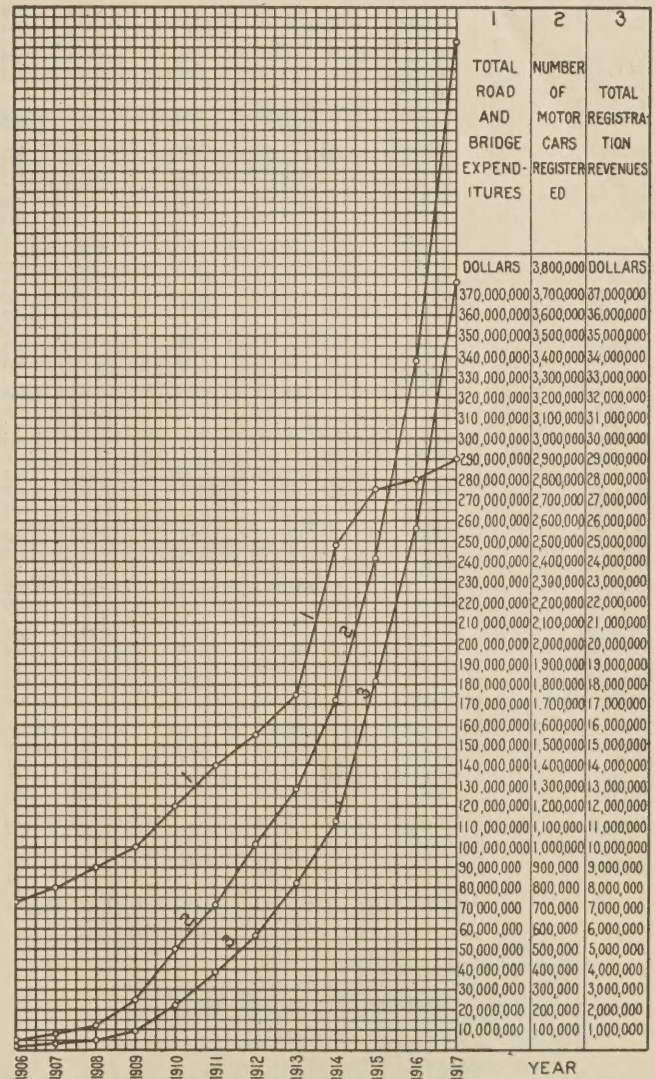
ANDREW P. ANDERSON, Highway Engineer.

A total of 4,983,340 motor cars, including commercial vehicles, and 257,522 motorcycles were registered in 1917 in the 48 States and the District of Columbia. The sum of \$37,501,237 was collected in registration and license fees, including those of chauffeurs, operators, and dealers. As compared with 1916 this represents an increase of 1,470,344, or 44 per cent, in the number of cars and \$11,637,867, or 45 per cent, in revenues. Approximately this same rate of increase over each preceding year has continued during the past five years. There is as yet no indication that either the curve for motor cars or that for the motor-vehicle registration revenues is approaching a maximum or has even reached the saturation point.

There is very little definite information available as to the number of motor cars in countries other than the United States. According to the best available data and estimate, however, about 85 per cent of all the motor cars at present in existence are in the United States. About 200,000 cars are in Canada, in all Provinces of which annual registrations now are in force. Probably 50,000 cars are found in all the rest of North and South America. The present number of cars in Europe is not known with any degree of accuracy. Estimates based on data available for 1914 would place the total number below 500,000, or about the same as the number of motor cars existing in the two States of New York and Connecticut. Thus, according to the best available data, nearly 90 per cent of all existing motor cars are in North and South America and about 10 per cent in all the rest of the world.

The increase in motor-car registrations and revenues in the United States during the past dozen years presents some interesting comparisons. This is true especially in regard to the use made of the registration revenues. In 1906 the total State registrations were approximately 48,000 cars, or less than one-hundredth of the present number and the revenues collected in the same year amounted to about \$193,000, only slightly

more than one two-hundredth of the total revenue collected in 1917. In 1906, however, the total gross revenues amounted to less than three-tenths of 1 per cent of the total rural road and bridge expenditures for that year, and, furthermore, only a small portion of this revenue was



Industry, saving, and lending to the Government are national needs and national duties.

really applied to road work. In 1917, however, the total gross motor-vehicle revenue of \$37,501,237 amounted to about 12 per cent of the total rural road and bridge expenditures, and of this nearly 93 per cent was applied directly to the improvement or maintenance of the public roads in 47 States. Of

the total amount applied to road work about 67 per cent, or \$23,235,898, was expended more or less directly under the control or supervision of the State highway departments. The 7 per cent, or \$2,812,633, not applied to road work was expended very largely for plates and in carrying out other administrative provisions of the motor-vehicle regis-

On January 1, 1918, all but two States, Minnesota and Mississippi, had made provision for some definite form of annual State registration. In Minnesota the registrations are for a three-year period, the first of which closed December 31, 1917. In Mississippi the State registrations are perennial, but an annual county privilege license is required.

TABLE I.—Motor-vehicle registrations, licenses, and revenue, 1917.

State.	Automobiles.	Motor trucks and commercial vehicles.	Motor-cycles.	Reregistrations or transfers.	Owners' and chauffeurs' licenses.	Manufacturers' and dealers' licenses.	Motor-vehicle fines and penalties turned into State road fund.	Total gross motor-vehicle registration and license revenues.	Motor-vehicle revenues available for road work.		Average gross revenue return per motor-car registration.	Population per motor car.	Motor cars per mile of public rural road.
									By or under State highway department.	Under direction of local authorities.			
Alabama.....	26,952	¹ 5,921	1,240	.....	1,631	110	.....	\$217,700.00	.....	.....	\$6.62	72	0.6
Arizona.....	19,890	(²)	868	1,037	911	230	.....	117,643.00	\$117,643.00	.....	5.91	13	1.6
Arkansas.....	28,693	(²)	.....	445	485	.....	\$354.00	205,176.50	191,175.00	.....	7.15	62	.6
California.....	³ 306,916	(²)	30,489	.....	315,935	2,649	.....	2,846,030.00	1,247,268.80	\$1,247,268.80	9.27	10	5.0
Colorado.....	87,460	(²)	4,504	4,598	76,141	2,133	.....	296,808.00	136,615.65	.....	3.39	11	2.2
Connecticut.....	62,723	⁴ 11,922	4,925	8,984	100,812	160	33,810.23	1,080,757.31	1,080,757.31	.....	14.48	20	4.5
Delaware.....	10,700	(²)	730	1,045	12,590	510	.....	133,883.00	83,883.00	.....	12.51	20	2.9
District of Columbia.....	⁵ 15,493	(²)	(²)	.....	12,471	.....	.....	55,928.00	.....	.....	3.61	24	.....
Florida ⁶	27,000	(²)	800	.....	.....	.....	.....	170,000.00	25,500.00	.....	6.30	34	1.5
Georgia.....	70,324	(²)	1,600	1,284	4,190	586	.....	229,653.00	144,500.00	143,514.00	3.27	41	.9
Idaho.....	23,771	960	752	313	1,182	497	.....	412,641.48	103,160.37	309,481.11	16.69	18	1.0
Illinois.....	340,292	(²)	13,740	.....	43,679	3,745	.....	1,588,834.69	1,588,834.69	.....	4.67	18	3.6
Indiana.....	192,194	(²)	10,315	2,562	5,063	1,121	.....	1,096,159.08	.....	899,818.07	5.70	15	2.6
Iowa.....	254,462	(²)	4,187	32,015	.....	2,753	.....	2,249,655.19	112,482.76	2,024,689.67	8.84	9	2.4
Kansas ⁷	159,343	(²)	5,599	.....	.....	1,575	.....	830,878.00	.....	787,619.50	5.21	11	1.4
Kentucky.....	47,420	(²)	1,450	.....	2,500	.....	.....	287,314.13	257,300.00	.....	6.06	51	.8
Louisiana.....	28,394	(²)	382	352	.....	403	.....	166,834.67	.....	150,151.32	5.88	65	1.2
Maine.....	38,117	3,382	1,516	(²)	47,568	442	.....	491,696.30	487,873.00	.....	11.84	19	1.8
Maryland.....	56,787	⁸ 4,156	5,436	3,314	40,264	2,786	38,509.97	807,395.45	580,612.69	145,153.17	13.25	23	3.7
Massachusetts.....	147,310	26,964	11,065	(²)	214,229	2,379	83,640.00	1,969,994.00	1,731,552.00	.....	11.30	21	9.3
Michigan.....	226,693	20,313	8,727	11,534	446,850	938	.....	2,471,270.77	1,272,246.66	1,199,024.11	10.00	12	3.3
Minnesota.....	⁹ 54,000	(²)	11,000	400	3,500	500	.....	⁶ 100,000.00	50,000.00	.....	1.85	43	.6
Mississippi ⁶	35,000	1,600	900	.....	.....	.....	.....	250,000.00	.....	175,000.00	6.83	54	.8
Missouri.....	147,528	(²)	4,179	4,891	169,067	1,392	.....	617,942.50	572,372.30	.....	4.19	23	1.5
Montana.....	42,749	(²)	923	854	3,056	333	.....	290,936.00	130,921.20	.....	6.81	11	1.1
Nebraska.....	148,101	(²)	3,500	.....	.....	1,600	.....	451,303.00	.....	400,000.00	3.05	9	1.8
Nevada.....	6,885	275	215	.....	.....	46	.....	31,166.00	.....	31,166.00	4.35	16	.6
New Hampshire.....	¹¹ 22,267	(²)	2,218	2,400	27,645	197	3,974.82	425,305.09	376,773.63	.....	19.10	20	1.6
New Jersey.....	134,964	¹² 6,954	13,198	26,114	177,568	1,242	54,664.25	1,923,163.63	1,887,965.21	.....	13.55	21	9.6
New Mexico.....	14,086	.....	345	.....	.....	161	.....	80,843.50	35,739.34	.....	5.74	31	1.2
New York.....	338,682	¹⁶ 67,334	28,775	.....	133,686	2,728	.....	4,284,144.00	2,222,130.12	2,061,983.88	10.55	30	5.1
North Carolina.....	55,950	(²)	1,245	4,651	.....	540	.....	321,922.63	214,114.41	12,835.92	5.75	43	1.1
North Dakota.....	62,993	(²)	1,834	480	.....	1,016	.....	211,536.12	105,707.82	72,164.14	3.36	12	.9
Ohio.....	346,772	(²)	21,892	8,989	.....	3,576	.....	1,766,426.88	1,609,781.02	.....	5.09	15	4.0
Oklahoma.....	100,199	(²)	2,368	.....	.....	1,500	.....	853,658.91	768,293.02	.....	8.52	23	.9
Oregon.....	48,632	(²)	3,400	.....	3,476	375	.....	196,787.50	167,834.34	.....	4.05	18	1.3
Pennsylvania.....	¹³ 306,001	¹⁴ 19,152	24,567	23,287	178,417	7,891	.....	3,268,025.50	3,268,025.50	3,268,025.50	10.05	27	3.6
Rhode Island.....	30,267	6,779	1,133	3,011	35,388	65	7,535.00	346,117.50	313,350.94	.....	9.34	17	17.1
South Carolina.....	38,332	(²)	1,250	1,000	.....	650	.....	113,553.71	22,157.49	88,629.98	2.96	43	.9
South Dakota.....	67,158	(²)	1,554	1,900	.....	1,012	.....	210,592.00	.....	179,003.20	3.14	11	.7
Tennessee.....	48,000	(²)	1,000	1,400	.....	480	.....	322,200.00	289,980.00	.....	6.71	48	1.0
Texas ⁷	192,961	(²)	3,468	6,359	12,714	10,008	.....	858,978.50	720,119.85	.....	4.45	24	1.5
Utah.....	21,576	2,500	1,385	100	1,547	161	.....	170,707.25	¹⁵ 170,707.25	.....	7.09	19	2.4
Vermont.....	20,367	1,266	758	1,817	23,265	167	.....	363,540.93	326,032.00	.....	16.80	17	1.4
Virginia.....	55,661	(²)	2,135	(²)	3,530	400	.....	518,565.84	492,170.47	.....	9.32	40	1.0
Washington.....	79,680	11,657	6,320	.....	.....	2,385	.....	519,526.00	.....	435,129.00	5.69	18	2.2
West Virginia ⁷	31,300	(²)	825	1,250	2,713	525	.....	359,339.45	276,048.62	.....	11.48	46	1.0
Wisconsin.....	158,637	(²)	8,458	4,663	.....	2,171	.....	861,278.00	198,768.36	596,305.07	5.43	16	2.1
Wyoming.....	12,523	(²)	352	.....	.....	115	.....	57,421.00	.....	45,992.80	4.59	15	.8
Total.....	4,792,205	¹⁷ 191,135	257,522	¹⁷ 162,049	¹⁷ 2,101,073	64,253	¹⁷ 222,488.27	37,501,237.01	23,235,897.82	11,452,705.93	7.62	21	2.0

¹ Includes all trucks and cars used for hire.² Included under automobiles.³ Does not include 2,750 nonresident and 5,134 exempt cars.⁴ Does not include 2,038 public-service registrations.⁵ Includes motor trucks and motor cycles.⁶ Approximate; exact data not obtainable.⁷ Includes only period from July 1 to December 31.⁸ Does not include 3,051 hiring and bus licenses.⁹ Registrations during 1917. Total registrations for 3-year period, 192,000.¹⁰ Registration not required.¹¹ Does not include 1,721 nonresident registrations.¹² Includes only cars weighing more than 4,000.¹³ Does not include 2,827 tractors and 854 trailers.¹⁴ Includes only vehicles with solid tires.¹⁵ Used to pay interest and sinking fund on \$2,000,000 road bond.¹⁶ Includes 11,932 omnibuses.¹⁷ Partial totals.

tration laws of the several States. The approximate relation and rates of increase of the three factors, total rural road and bridge expenditures, motor-vehicle registration and license revenues, and the number of motor-car registrations from 1903 to 1917, inclusive, are shown graphically in the accompanying chart.

Texas and South Carolina, which previously had only local registrations, made provision in 1917 for annual State registrations.

At present all or a major portion of the motor-vehicle revenues are applied to road work in all the States, except Alabama and the District of Columbia, in which cases the revenues go to the general

fund. The tendency last year toward placing the expenditure of the motor-vehicle revenues directly in the hands of the State highway departments was very marked. Thus, Delaware, Florida, Nevada, North Carolina, North Dakota, Oregon, South Carolina, Texas, and West Virginia, each enacted legislation providing for this feature. Other States, among which may be mentioned Missouri, Tennessee,

or the direction of the State highway departments: Arizona, Connecticut, Delaware, Illinois, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Missouri, New Hampshire, New Jersey, North Carolina, North Dakota, Ohio, Oregon, Oklahoma, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, and Wisconsin.

TABLE II.—Motor-car registrations and gross motor-vehicle revenues, 1913 to 1917.

	Motor-car registration. ¹						Total gross revenues.				
	1913	1914	1915	1916	1917		1913	1914	1915	1916	1917
Alabama.....	5,300	8,672	11,634	21,636	32,873	Alabama.....	\$83,000	\$113,202	\$180,744	\$203,655	\$217,700
Arizona.....	3,613	5,040	7,753	12,300	19,890	Arizona.....	27,545	34,077	45,579	73,000	117,643
Arkansas.....	3,583	5,642	8,021	15,000	28,693	Arkansas.....	17,411	56,420	80,551	150,000	205,176
California.....	² 100,000	123,504	163,797	232,440	306,916	California.....	75,000	1,338,785	2,027,432	2,192,699	2,846,030
Colorado.....	13,000	17,756	28,894	43,296	87,460	Colorado.....	60,833	80,047	120,801	197,795	296,808
Connecticut.....	23,200	27,786	41,121	56,048	74,645	Connecticut.....	316,677	406,623	536,970	768,728	1,080,757
Delaware.....	2,440	3,050	5,052	7,102	10,700	Delaware.....	24,735	35,672	55,596	85,249	133,883
Dist. of Columbia.....	4,000	4,833	8,009	13,118	15,493	Dist. of Columbia.....	13,228	20,147	29,396	47,624	55,928
Florida.....	³ 3,000	³ 3,368	³ 10,850	² 20,718	² 27,000	Florida.....	⁴ 6,000	⁴ 6,736	² 60,000	127,176	² 170,000
Georgia.....	² 20,000	20,915	25,000	46,025	70,324	Georgia.....	12,000	104,575	125,000	154,735	229,653
Idaho.....	2,113	3,346	7,071	12,999	24,731	Idaho.....	35,160	58,580	121,259	213,758	412,641
Illinois.....	94,656	131,140	180,832	248,429	340,292	Illinois.....	507,629	699,725	924,906	1,236,566	1,588,835
Indiana.....	45,000	66,500	96,915	139,065	192,194	Indiana.....	150,345	432,309	587,318	817,285	1,096,159
Iowa.....	70,299	106,087	145,109	198,587	254,462	Iowa.....	787,411	1,040,136	1,533,054	1,776,170	2,249,655
Kansas.....	34,550	49,374	72,520	112,122	159,343	Kansas.....	186,066	268,471	387,588	585,762	830,878
Kentucky.....	7,210	11,766	19,500	31,500	47,420	Kentucky.....	52,000	85,883	117,117	184,741	287,314
Louisiana.....	10,000	² 12,000	11,380	17,000	28,394	Louisiana.....	² 10,000	² 12,000	75,600	112,000	166,835
Maine.....	11,022	15,700	21,545	30,972	41,499	Maine.....	138,509	192,542	268,412	363,562	491,696
Maryland.....	14,217	20,213	31,047	44,245	60,943	Maryland.....	150,000	268,231	386,565	565,302	807,395
Massachusetts.....	62,660	77,246	102,633	136,809	174,274	Massachusetts.....	764,154	923,961	1,235,724	1,602,958	1,969,994
Michigan.....	54,366	76,389	114,845	160,052	247,006	Michigan.....	190,329	(⁴)	373,833	1,739,344	2,471,271
Minnesota.....	46,000	67,862	93,269	⁵ 46,000	⁵ 54,009	Minnesota.....	40,000	132,398	² 160,540	82,469	100,000
Mississippi ²	² 3,850	5,694	9,669	25,000	36,600	Mississippi ²	51,146	76,700	175,000	250,000	350,000
Missouri.....	38,140	54,468	76,462	103,587	147,528	Missouri.....	173,510	235,873	323,289	439,315	617,942
Montana.....	5,916	10,200	14,540	25,105	42,749	Montana.....	12,000	27,000	33,120	52,768	290,936
Nebraska.....	13,411	16,385	59,000	101,200	148,101	Nebraska.....	26,000	34,325	² 183,000	311,334	451,303
Nevada.....	1,091	1,487	2,009	4,919	7,160	Nevada.....	3,323	4,331	7,875	20,116	31,166
New Hampshire.....	8,237	9,571	13,449	17,508	22,267	New Hampshire.....	152,834	185,288	257,776	344,434	425,305
New Jersey.....	51,360	62,961	81,848	109,414	141,918	New Jersey.....	661,446	814,536	1,062,923	1,406,806	1,923,164
New Mexico.....	1,898	3,090	5,100	8,228	15,000	New Mexico.....	15,084	19,663	29,625	47,865	80,843
New York.....	134,495	168,223	255,242	314,222	406,016	New York.....	1,275,727	1,529,852	1,991,181	2,658,042	4,284,144
North Carolina.....	10,000	14,677	21,000	33,904	55,950	North Carolina.....	60,000	89,580	123,000	206,101	321,923
North Dakota.....	15,187	17,347	24,908	40,446	62,993	North Dakota.....	41,961	55,964	79,245	125,283	211,536
Ohio.....	86,156	122,504	181,332	252,431	346,772	Ohio.....	457,538	685,457	984,622	1,286,405	1,766,427
Oklahoma.....	² 3,000	13,500	25,032	52,718	100,199	Oklahoma.....	3,000	13,500	154,824	555,011	853,659
Oregon.....	13,975	16,447	23,585	33,917	48,632	Oregon.....	56,873	77,592	108,881	146,232	196,787
Pennsylvania.....	80,178	112,854	160,137	230,578	325,153	Pennsylvania.....	841,062	1,185,039	1,665,276	2,325,057	3,268,025
Rhode Island.....	10,295	12,331	16,362	21,406	37,046	Rhode Island.....	129,851	157,020	206,440	264,737	346,117
South Carolina ²	10,000	14,000	15,000	⁶ 25,000	38,332	South Carolina ²	10,000	14,000	15,000	10,000	113,557
South Dakota.....	14,457	20,929	28,724	44,271	67,158	South Dakota.....	89,170	125,000	² 180,000	140,746	210,592
Tennessee.....	² 10,000	⁷ 19,769	⁸ 7,618	² 30,000	48,000	Tennessee.....	² 9,000	39,538	² 34,000	186,953	322,200
Texas ²	32,000	40,000	40,000	⁶ 125,000	192,961	Texas ²	16,000	20,000	20,000	20,000	858,978
Utah.....	4,000	2,253	9,177	13,507	24,076	Utah.....	3,000	4,852	² 60,000	93,494	170,707
Vermont.....	5,913	8,475	11,499	15,671	21,633	Vermont.....	111,460	154,267	218,480	297,992	363,541
Virginia.....	9,022	13,984	21,357	35,426	55,661	Virginia.....	83,611	120,814	176,875	271,266	518,566
Washington.....	24,178	30,253	38,823	60,734	91,337	Washington.....	48,356	60,506	238,717	350,052	519,526
West Virginia.....	5,144	6,159	13,279	20,571	31,300	West Virginia.....	40,000	60,648	128,952	198,436	359,339
Wisconsin.....	34,346	53,161	79,741	115,645	158,637	Wisconsin.....	190,770	293,580	431,977	615,721	861,278
Wyoming.....	1,584	2,428	3,976	7,125	12,523	Wyoming.....	7,920	12,140	19,880	35,625	57,421
Total.....	1,258,062	1,711,339	2,445,664	3,512,996	4,983,340	Total.....	8,192,253	12,381,951	18,245,711	25,865,370	37,501,233

¹ Does not include motor cycles nor dealers' and manufacturers' licenses.

² Estimated.

³ State registrations only.

⁴ Registration law declared unconstitutional.

⁵ Cars registered during 1916; total number of cars, approximately 138,000.

⁶ Estimated number of cars in State.

⁷ Total cars registered under perennial system.

⁸ Registrations 1915 only.

⁹ Cars registered, 1917.

and Wisconsin, greatly increased the powers of the highway departments over the control of the motor-vehicle revenues. In the following 26 States all or a major portion of the net motor-vehicle revenues of 1917 were expended by or under the supervision

In Arkansas, California, Colorado, Idaho, Michigan, Montana, New Mexico, and New York one-fourth to one-half of the State motor-vehicle revenues were expended either by or under the direct supervision of the State highway departments and the remainder by the local authorities. The 10 States in which the State government exercised no appreciable direct supervision or control over any of the net automobile revenues, and which are not included in the above classification, are Alabama, Georgia, Indiana, Kansas, Louisiana, Mississippi, Nebraska,

The determining factor in the outcome of this war is the organized might of America. Work, save, and lend to the Government.

TABLE III.—Motor-vehicle registration and license fees in force January 1, 1918.

State.	Motocycles.	Pleasure cars.	Motor trucks and commercial cars.	Chauffeurs.	Owner operators.	Dealers and manufacturers.
Alabama.....	\$3; with side-car attachment, \$5.	Less than 25 horsepower, \$7.50; 25 to 29 horsepower, \$12.50; 30 to 39 horsepower, \$17.50; 40 horsepower and over, \$20; electric cars, \$12.50; steam cars, \$15.	Same as pleasure cars, except that those over 40 horsepower pay \$25 each. ¹	Original, \$5; renewal, \$2.50.	None.....	\$25 to \$125.
Arizona.....	\$2.....	25 horsepower and under, \$5; 26 to 40 horsepower, \$10; over 40 horsepower, \$15.	Same as pleasure cars.....	Perpetual, \$5.....	.....do.....	1 vehicle of each class at pleasure-car rates.
Arkansas.....	None.....	All motor vehicles, \$10.....	.....do.....	\$1.....	.....do.....	Do.
California.....	\$2.....	Electric cars, \$5; all others, 40 cents per horsepower; trailers, \$2.	Equipped with pneumatic tires, same as pleasure cars; others pay additional; less than 2 tons unloaded, \$5; 2 to 3 tons, \$10; 3 to 5 tons, \$15; over 5 tons, \$20.	Original, \$2; renewal, \$1.	No fee.....	5 cars, \$25, and \$2 for each additional; motorcycles, \$5.
Colorado.....	\$2.....	20 horsepower and under, \$2.50; 21 to 40 horsepower, \$5; 41 horsepower and over, \$10.	Same as pleasure cars.....	\$1.....	None.....	5 cars, \$5.
Connecticut.....	\$2.....	50 cents per horsepower.....	½ ton or less, \$11; 1 ton, \$15, and increasing to \$225 for 10 tons, and \$50 per ton for each ton additional.	License, \$2; examination, \$2.	License, \$2; examination, \$2.	Motocycles, \$10; others, \$50. ²
Delaware.....	\$5.....	\$2 each 500 pounds gross weight of car and load; passengers figured at 125 pounds each.	Same as pleasure cars.....	\$3.....	\$3; family, \$8.....	\$20 for 2 pairs of tags; extra tags, \$10 pair.
District of Columbia.....	\$2.....	24 horsepower or less, \$3; 25 to 30 horsepower, \$5; over 30 horsepower, \$10.	.....do.....	\$2.....	\$2.....	Regular rates for each car demonstrated on public roads.
Florida (3).....	\$2.....	Cars seating not more than 5 persons, \$5; 25 to 40 horsepower, \$12; 41 to 60 horsepower, \$15; over 60 horsepower, \$30; any car seating more than 10 persons, \$100.	1 ton or less, \$10; 1 to 2 tons, \$25; 2 to 4 tons, \$35; more than 4 tons, \$100.	\$2.....	None.....	5 cars, \$15.
Georgia.....	\$2.....	Not exceeding 25 horsepower, \$3; 26 to 40 horsepower, \$4; over 40 horsepower, \$5; electric cars, \$4.	Not exceeding 1 ton weight, \$3; not exceeding 3 tons, \$4; not exceeding 5 tons, \$5; exceeding 5 tons, \$6.	\$2.....	.....do.....	\$10 for 2 number plates and \$1 for each duplicate.
Idaho.....	\$5.....	All weighing less than 2,001 pounds, \$15; 2,001 to 3,000 pounds, \$20; 3,001 to 4,000 pounds, \$30; over 4,000 pounds, \$40.	Same as pleasure cars.....	\$2.....	.....do.....	\$35 for one make and \$25 each additional make.
Illinois (6).....	\$3.....	10 horsepower or less, \$4.50; 11 to 25 horsepower, \$6; 26 to 35 horsepower, \$9; 36 to 50 horsepower, \$16; over 50 horsepower, \$20; electric cars of 2 tons capacity or less, \$10; over 2 tons capacity, \$20.	.....do.....	Original, \$5; renewal, \$3.	.....do.....	\$10 for 2 plates and \$10 for each pair duplicates.
Indiana.....	\$2.....	Electric cars, \$3; others, 25 horsepower or less, \$5; 26 to 40 horsepower, \$8; 41 to 50 horsepower, \$15; over 50 horsepower, \$20.	All commercial cars, \$5.....	\$2.....	.....do.....	\$25; duplicate plates, \$1 each.
Iowa.....	\$3.....	20 horsepower or less, \$8; over 20 horsepower, 40 cents per horsepower; all electric and steam cars, \$15 each.	Same as pleasure cars.....	None.....	.....do.....	\$15.
Kansas.....	\$2.....	All cars, \$5 each.....	.....do.....	.....do.....	.....do.....	\$15 for 3 sets of tags; extra tags, 50 cents each.
Kentucky.....	\$5.....	Less than 25 horsepower, \$6; 25 to 50 horsepower, \$11; 50 horsepower and over, \$20.	.....do.....	Original, \$2; renewal, \$1.	.....do.....	1 registration for each class at regular rates.
Louisiana.....	\$2.....	25 cents per horsepower, with a minimum fee of \$5 per car.	All motor trucks, \$7.50 each.	None.....	.....do.....	1 regular registration for each make; second-hand dealers, \$10.
Maine.....	\$3.....	15 horsepower or less, \$5; 16 to 35 horsepower, \$10; over 35 horsepower, \$15.	Commercial cars, \$10.....	\$2.....	\$2.....	\$25 for 5 pairs of plates; extra plates, 75 cents each.
Maryland.....	\$3.....	50 cents per horsepower; minimum charge, \$5; \$1 per horsepower if operated for hire.	Trucks with solid tires and rated capacity of not more than 1 ton, \$8; for each additional ton capacity, \$6; trailers, \$5 each.	\$3.....	\$2.....	\$20 for 2 sets of tags and \$10 for each additional set. For dealers in motorcycles, 4 tags, \$8; additional tags, \$2 each.
Massachusetts.....	\$2.....	Under 20 horsepower, \$5; 20 to 29 horsepower, \$10; 30 to 39 horsepower, \$15; 40 to 49 horsepower, \$20; 50 horsepower and over, \$25.	Trucks under 1 ton, \$5, and \$3 for each additional ton.	Original, \$2; renewal, 50 cents; examination, \$2.	Original, \$2; renewal, 50 cents.	\$10, motorcycles; \$25, motor vehicles, and \$5 additional for each car over 5 operated on public roads.
Michigan.....	(4)	Electric cars, \$1 for each motor horsepower plus 25 cents for each 100 pounds of weight; others, 25 cents per horsepower plus 25 cents for each 100 pounds of weight.	Electrics, 50 cents per motor horsepower plus 25 cents for each 100 pounds of weight; others, 15 cents per horsepower plus 15 cents per 100 pounds of weight.	\$2.....	None.....	\$50 for 5 cars and \$10 for each additional car. ⁵
Minnesota.....	\$5.....	All cars, \$5.....	Same as pleasure cars.....	Original, \$1.50; renewal, \$1.	.....do.....	\$20; extra plates, \$1 per set.
Mississippi.....	State, \$2; county, \$2.40.	State, \$2; county, electric cars, \$4.80; others, 36 cents per horsepower.	4,400 pounds capacity or less, \$8.40; over 4,400 pounds, \$16.80.	None.....	.....do.....	Regular rates for 4 sets of plates.

¹ Cars used for transportation of passengers paying fare, 5 or less passenger capacity, \$25; 6 to 9 passenger capacity, \$40; 10 or more passenger capacity, \$60; operating between towns or cities 10 miles or more apart, a flat fee of \$40.

² In case of manufacturers, \$25, plus \$1 for each car tested on public roads.

³ Any county or municipality may charge an additional license tax, not to exceed 50 per cent of State license tax, on motor vehicles used for hire.

⁴ Same rate as pleasure cars.

⁵ In case of manufacturers, motorcycles \$20, including 10 number plates.

⁶ Both cars and trucks may be registered in municipality in which owner resides.

TABLE III.—Motor-vehicle registration and license fees in force January 1, 1918—Continued.

State.	Motocycles.	Pleasure cars.	Motor trucks and commercial cars.	Chauffeurs.	Owner operators.	Dealers and manufacturers.
Missouri.....	(¹)	Less than 12 horsepower, \$4; \$12 to 23 horsepower, \$6; 24 to 35 horsepower, \$10; 36 to 47 horsepower, \$14; 48 to 59 horsepower, \$16; 60 to 71 horsepower, \$20; 72 horsepower and over, \$24.	Same as pleasure cars.....	\$1.50.....	None.....	\$10; for each duplicate, \$5.
Montana.....	\$5.....	23 horsepower or less, \$5; 24 to 50 horsepower, \$10 over 50 horsepower, \$15.	One ton capacity or less, \$5; over 1 ton and less than 2, \$15; over 2 tons and less than 3, \$25; over 3 tons, \$40.	\$2.....	do.....	Cars, \$50; motorcycles, \$15.
Nebraska.....	\$2.....	All cars \$3 each.....	All \$5 each.....	None.....	do.....	Registration for each class, \$5.
Nevada.....	\$3.....	20 horsepower or less, \$3; 21 to 40 horsepower, \$5.50; over 40 horsepower, \$8.	Same as pleasure cars.....	do.....	do.....	\$10 for 4 number plates; \$1 for each duplicate.
New Hampshire.....	\$2.....	15 horsepower or less, \$10; 16 to 30 horsepower, \$15; 31 to 40 horsepower, \$20; 41 to 50 horsepower, \$25; 51 to 60 horsepower, \$30; over 60 horsepower, \$40.	do.....	Original, \$5; renewal, \$1.	Original, \$3; renewal, \$1.	Cars, \$50; motorcycles, \$5;
New Jersey.....	\$2.....	10 horsepower or less, \$4.50; 11 to 29 horsepower, \$7.50; 30 horsepower or over, \$15.	With solid tires loaded weight 2 tons or less, \$15, and \$2 additional for each one-half ton gross weight (over 2 tons; trailers, \$3.	\$3.....	\$3.....	\$ per car not to exceed 5.
New Mexico.....	\$2.....	Less than 12 horsepower, \$2; 12 to 19 horsepower, \$4; 20 to 29 horsepower, \$6; 30 to 39 horsepower, \$8; 40 to 49 horsepower, \$10; 50 horsepower or over, \$12.	Same as pleasure cars.....	None.....	None.....	\$12.
New York.....	\$2.50.....	25 horsepower or less, \$5; 26 to 34 horsepower, \$10; 35 to 49 horsepower, \$15; 50 horsepower and more, \$25.	Gross loaded weight 2 tons or less, \$10, and \$5 each additional ton to 14; 14 tons, \$70, and \$10 each additional ton.	Original, \$3; renewal, \$2; examination, \$2.	do.....	\$15, plus \$1 for each duplicate tag.
North Carolina.....	\$2.....	26 horsepower or less, \$5; 26 to 40 horsepower, \$7.50; over 40 horsepower, \$10.	Same as pleasure cars.....	None.....	do.....	\$10, plus \$1 for each duplicate plate.
North Dakota.....	\$3.....	20 horsepower or less, \$6, and 50 cents additional for each horsepower above 20.	do.....	do.....	do.....	\$15; extra plates, 50 cents per set.
Ohio.....	\$2.....	Electric cars, \$3; all others, \$5.	do.....	\$3.....	do.....	\$10 each make of motorcycle and \$20 each make of automobile.
Oklahoma.....	(¹)	50 cents per horsepower first year; second, 40 cents per horsepower; third, 30 cents per horsepower; and thereafter, 20 cents per horsepower.	do.....	None.....	do.....	\$15 for 2 tags and \$1 each for additional tags.
Oregon.....	\$3.....	Electric cars, \$6; others, 26 horsepower and less, \$6; 27 to 36 horsepower, \$10; 37 to 40 horsepower, \$15; above 40 horsepower, \$20.	Electric trucks, \$10; others 1½ to 2 tons, \$15, and \$3 for each additional one-half ton up to 5 tons; over 5 tons allowed only on special permits.	\$2.....	do.....	\$10 for 2 tags and \$2.50 for duplicate sets.
Pennsylvania.....	\$3.....	Less than 20 horsepower, \$5; 20 to 34 horsepower, \$10; 35 to 49 horsepower, \$15; 50 horsepower and above, \$20.	With pneumatic tires, same as pleasure cars; others, including load, less than 2 tons, \$5; 2 to 2½ tons, \$10; 2½ to 5 tons, \$15; 5 to 7½ tons, \$20; 7½ to 12 tons, \$25; trailers, including load, less than 5 tons, \$3; 5 to 12 tons, \$5.	\$2.....	No fee.....	\$10.
Rhode Island.....	\$2.....	15 horsepower or less, \$5; 16 to 30 horsepower, \$10; 31 to 40 horsepower, \$15; over 40 horsepower, \$25.	Carrying capacity 1 ton or less, \$7, with \$3 additional for each ton to 4 tons, and then \$4 for each ton above 4 tons; over 9-ton capacity, \$40 each; trailers, \$10 to \$30 each.	\$1.....	\$1.....	\$25 for 5 vehicles and \$5 for each additional vehicle.
South Carolina.....	(¹)	25 cents per horsepower.....	Same as pleasure cars.....	None.....	None.....	\$15 for each make.
South Dakota.....	\$2.....	All cars \$3 each.....	No registration required.....	do.....	do.....	\$5.
Tennessee.....	(¹)	30 cents per horsepower.....	30 cents per horsepower plus \$3 per ton carrying capacity.	do.....	do.....	\$10.
Texas.....	\$3.....	35 cents per horsepower.....	Same as pleasure cars except when used for hire.	\$3.....	do.....	\$15; extra numbers, \$5 each.
Utah.....	\$3.....	Electric cars, \$10; others 25 horsepower and less, \$5; 26 to 40 horsepower, \$10; above 40 horsepower, \$15.	\$10.....	\$2.....	do.....	\$25, and \$2 for each set of duplicate plates.
Vermont.....	(¹)	First registration, \$1 per horsepower; second, 75 cents per horsepower; third registration and thereafter, 50 cents per horsepower.	Same as pleasure cars.....	\$3.....	\$2.....	\$50.
Virginia.....	(¹)	40 cents per horsepower.....	do.....	\$2.50.....	None.....	\$50.
Washington.....	\$2.50.....	25 horsepower and less, \$5; 26 to 39 horsepower, \$7.50; 40 horsepower and over, \$10.	Automobiles and busses for hire, \$1 per horsepower; motor trucks under one-half ton capacity, \$5; 1 ton, \$10; 2 tons, \$15; 3 tons, \$25; 4 tons, \$35; 5 tons, \$50; 6 tons, \$100; 7 tons, \$250.	None.....	do.....	Cars, \$25; extra plates, \$5 per pair; motorcycles, \$3.
West Virginia.....	\$5.....	Cars weighing 1 ton or less, \$10, and 25 cents additional for each 100 pounds over 1 ton.	Same as pleasure cars.....	\$3.....	do.....	Cars, \$15 per set of plates; motorcycles, \$5.
Wisconsin.....	\$4.....	All cars \$10 each.....	Capacity less than 2,100 pounds, \$15; 2,100 to 5,100 pounds, \$20; 5,100 pounds or more, \$25.	(²)	do.....	\$25.
Wyoming.....	\$2.50.....	All cars \$10 each.....	Same as pleasure cars.....	None.....	do.....	\$10 for 4 plates, \$1 for each additional plate.

¹ Same rate as pleasure cars.² Drivers of cars operating for hire may be licensed by municipality.

TABLE IV.—Administrative provisions in force January 1, 1918, affecting motor-vehicle registrations, licenses, and revenues.

State.	Registration and licenses.					Revenues from registrations and licenses.			Traffic regulations made by—	
	Official or department in charge.	Renewals.		Requirements for operators' and chauffeurs' licenses.	Non-residents' exemptions.	Applied to—	Proportion expended for roads under supervision of—			Revenues from fines and penalties applied to roads.
		Car registrations.	Operators' and chauffeurs' licenses.				State highway department.	Local road authorities.		
Alabama.....	State board of equalization through probate judge.	Annual, Oct. 1.	Chauffeur, annual, Oct. 1.	Chauffeur must be 18 years old	Reciprocity.	State, county, and city general funds.	None.....	None.....	None.....	Statute.
Arizona.....	Secretary of state.	Annual, Jan. 1.	Chauffeur, perpetual.	No examination.	6 months..	State road tax fund.	All of net.....	do.....	do.....	Statute and local ordinance. Do.
Arkansas.....	Commissioner of state lands, highways, and improvements.	do.....	Chauffeur, annual from date.	Chauffeur must be 18 years old.	Reciprocity.	State and county road fund.	One-half.....	One-half.....	One-half of penalty for delinquency.	Do.
California.....	Superintendent of motor-vehicle department.	do.....	Chauffeur, annual.	do.....	3 months..	State and county road work.	One-half net.....	One-half net.....	All, by local community.	Do.
Colorado.....	Secretary of state.	do.....	Chauffeur, annual, Jan. 1.	No examination.	90 days....	do.....	do.....	do.....	Same as registration revenues.	Do.
Connecticut.....	Commissioner of motor vehicles.	do.....	All operators, annual, Mar. 1.	Examination.	No limit..	Maintenance State roads.	All of net.....	None.....	do.....	Do.
Delaware.....	Secretary of state.	do.....	All operators, Jan. 1.	Must be 16 old; no examination.	Reciprocity.	State highway department.	All.....	do.....	None.....	Do.
District of Columbia.	Automobile board.	do.....	All operators, perpetual.	Examination.	do.....	General fund....	None.....	do.....	do.....	Do.
Florida.....	State comptroller.	do.....	Chauffeur, annual, Jan. 1.	Chauffeur, examination.	Reciprocity.	State highway department and State maintenance fund.	All of net.....	do.....	do.....	Do.
Georgia.....	Secretary of state.	Annual, Mar. 1.	Chauffeur, annual, Mar. 1.	Must be 16 years old.	30 days....	Net to State road fund for apportionment to counties.	None.....	All of net.....	do.....	Do.
Idaho.....	State highway commission through county assessor.	Annual, Jan. 1.	Chauffeur, annual.	Chauffeur, must be 18 years of age.	Reciprocity.	State highway fund.	25 per cent.....	75 per cent.....	Same as registration revenues.	Do.
Illinois.....	Secretary of state.	do.....	Chauffeur, annual, Jan. 1.	Chauffeur, examination.	60 days....	State "road fund."	All.....	None.....	All, by local community.	Do.
Indiana.....	do.....	do.....	do.....	do.....	do.....	Net, county road work.	None.....	All of net.....	Same as registration revenues.	Do.
Iowa.....	do.....	do.....	None.....	Must be 15 years of age.	Reciprocity.	State and local road work.	(2).....	(2).....	Local road work.	Do.
Kansas.....	Secretary of state through county treasurer.	Annual, July 1.	do.....	Must be 14 years of age.	30 days....	Net, maintenance county and township roads.	None.....	All of net.....	None.....	Statute and city ordinance.
Kentucky.....	Commissioner of motor vehicles.	Annual, Jan. 1.	Chauffeur, annual, Jan. 1.	Chauffeur, examination.	Reciprocity.	Net to State road fund.	All of net.....	None.....	do.....	Statute and local ordinance.
Louisiana.....	Secretary of state.	do.....	None.....	do.....	do.....	90 per cent to parish road work; 10 per cent for expenses.	None.....	90 per cent gross.....	Same as registration revenues.	Local ordinance.
Maine.....	do.....	do.....	All operators, annual, Jan.	Examination optional.	30 days....	State road work.	All.....	None.....	None.....	Statute and local ordinance.
Maryland.....	Commissioner of motor vehicles.	do.....	Owner, perpetual; chauffeur, annual.	do.....	Reciprocity; two periods of 7 days each.	Net 20 per cent Baltimore street work; 80 per cent State road maintenance.	80 per cent of net.....	do.....	Same as registration revenues.	Do.
Massachusetts.....	State highway commissioner.	do.....	All operators, annual from date.	Chauffeur, examination.	Reciprocity.	Net 20 per cent small town roads; 80 per cent maintenance State roads.	All net.....	do.....	do.....	Statute, State highway commission, and local ordinance.
Michigan.....	Secretary of state.	do.....	Chauffeur, annual, Jan. 1.	No examination.	Reciprocity to 90 days.	State and county road work.	One-half net.....	One-half net.....	None.....	Statute and local ordinance.
Minnesota.....	do.....	Triennial	do.....	Chauffeur, examination.	30 days....	Net, State road and bridge fund.	All net.....	None.....	do.....	Do.
Mississippi.....	State auditor and county tax collector.	Perennial with State; annual Jan. 1 with county.	None.....	do.....	60 days....	State revenues to general fund; county to county road work.	None.....	Net county revenue.	Net, same as county revenue.	Local ordinance.
Missouri.....	Secretary of state.	Annual, Feb. 1.	Chauffeur, annual, Feb. 1.	Must be 18 years of age; no examination.	do.....	State road fund..	All of net.....	None.....	None.....	Statutes and local ordinance.
Montana.....	do.....	Annual, Jan. 1.	Chauffeur, annual, Jan. 1.	No examination.	No limit..	Net to State and county road work.	One-half net.....	One-half net.....	do.....	Do.

¹ After 3 years' fee reduced to one-half.

² Sufficient funds set aside to meet Federal aid, provide maintenance of highway department and expenses of registration; remainder to counties for road work.

TABLE IV.—Administrative provisions in force January 1, 1918, affecting motor-vehicle registrations, licenses, and revenues—Continued.

State.	Registration and licenses.					Revenues from registrations and licenses.				
	Official or department in charge.	Renewals.		Requirements for operators' and chauffeurs' licenses.	Non-residents' exemptions.	Applied to—	Proportion expended for roads under supervision of—		Revenues from fines and penalties applied to roads.	Traffic regulations made by—
		Car registrations.	Operators' and chauffeurs' licenses.				State highway department.	Local road authorities.		
Nebraska.....	Secretary of state through county treasurer.	Annual, Jan. 1.	None.....	Must be 16 years old.	30 days....	Net to county road work.	None.....	All net....	None.....	Statute and local ordinance.
Nevada.....	Secretary of state.	..do.....	..do.....	..do.....	..do.....	Net to State road work.	All net....	None.....	..do.....	Do.
New Hampshire.	Commissioner of motor vehicles.	..do.....	All operators, annual, Jan.	Examination, all operators.	20 days....	Road maintenance.	..do.....	..do.....	Same as registration revenues.	Do.
New Jersey.....	..do.....	..do.....	..do.....	..do.....	Reciprocity; 15 days.	..do.....	..do.....	..do.....	..do.....	Statute and motor vehicle commission.
New Mexico.....	Secretary of state.	..do.....	None.....	Must be 14 years old.	60 days....	Net State and county road work.	50 per cent net.	50 per cent net.	None.....	Statute and local ordinance.
New York.....	..do.....	Annual, Feb. 1.	Chauffeur, annual, Feb. 1.	Chauffeur, examination.	Reciprocity.	State and local road work. ¹	50 per cent gross.	50 per cent gross.	Maintenance of State roads.	Statute, State highway commission, and local ordinance.
North Carolina.	..do.....	Annual, July 1.	None.....	Must be 16 years of age.	Reciprocity to 60 days.	Net to State road maintenance.	All net....	None.....	None.....	Statute and local ordinance.
North Dakota	..do.....	Annual, Jan. 1.	..do.....	..do.....	No limit.	Net to State and county road work.	Two-thirds of net.	One-third of net.	..do.....	Do.
Ohio.....	..do.....	..do.....	Chauffeur, annual, Jan. 1.	Chauffeur, examination.	..do.....	Net to State road fund.	All net....	None.....	..do.....	Statute, State highway department, and local ordinance.
Oklahoma.....	Department of highways.	..do.....	None.....	..do.....	Reciprocity.	10 per cent appropriated for State highway department; 90 per cent county road work.	All.....	..do.....	All.....	Statute and local ordinance.
Oregon.....	Secretary of state.	..do.....	Chauffeur, annual, Jan. 1.	Must be 18 years of age; no examination.	30 days....	Net to Federal aid road work.	All net....	None.....	County road fund.	Do.
Pennsylvania	State highway department.	..do.....	..do.....	Affidavits as to competency.	Reciprocity.	State and State-aid road work.	All gross..	..do.....	Certain ones locally.	Do.
Rhode Island.	State board of public roads.	..do.....	All operators, annual from date.	Examination, all operators.	10 days....	Maintenance State roads.	All net....	..do.....	Same as registration revenues.	State board of public roads statute and local ordinance.
South Carolina.	State highway engineer.	Annual, Jan. 1.	..do.....	..do.....	30 days....	Maintenance highway department and county road work.	20 per cent	80 per cent	None.....	Statute and local ordinance.
South Dakota	Secretary of state through county treasurer.	..do.....	..do.....	Must be 15 years old.	Reciprocity.	85 per cent county road work.	..do.....	85 per cent	..do.....	Do.
Tennessee.....	State department of highways through county clerk.	..do.....	..do.....	..do.....	30 days....	10 per cent to State highway department; 90 per cent to county road work.	All net....	..do.....	Same as registration revenues.	Do.
Texas.....	State highway department.	..do.....	Chauffeur, annual, Jan. 1.	Must be 18 years of age.	90 days....	All to State highway fund.	..do.....	None.....	County road work.	Do.
Utah.....	Secretary of state.	Annual, Mar. 1.	..do.....	No examination.	30 days....	Motor vehicle registration fund.	All net? ²	..do.....	None.....	Do.
Vermont.....	..do.....	Annual, Jan. 1.	All operators, annual, Jan. 1.	Examination, chauffeur.	Reciprocity.	State maintenance fund.	..do.....	..do.....	..do.....	Do.
Virginia.....	Secretary of commonwealth.	..do.....	Chauffeur, annual, Jan. 1.	No examination.	2 periods of 7 days each.	Net maintenance State aid roads.	..do.....	..do.....	..do.....	Do.
Washington..	Secretary of state through county auditor.	Annual, Mar. 1.	None.....	Operators must be 15 years of age, chauffeurs 21.	90 days....	Net to permanent highway fund for maintenance.	None.....	All net....	Same as registration revenues.	Do.
West Virginia	State road commission.	Annual, July 1.	Chauffeur, annual, July 1.	Must be 14 years of age.	Reciprocity.	State road fund.	All.....	None.....	None.....	Do.
Wisconsin....	Secretary of state.	Annual, Jan. 1.	None.....	Must be 16 years of age. ³	Reciprocity.	Net to State highway fund and county road work.	75 per cent net.	25 per cent net.	..do.....	Do.
Wyoming.....	..do.....	..do.....	..do.....	Must be 15 years of age.	Reciprocity to 90 days.	80 per cent to county road work.	None.....	80 per cent	..do.....	Statute.

¹ Does not apply to revenue collected within New York City, one-half of which goes to city general fund.² To pay interest and sinking fund on \$2,000,000 State road bond.³ Drivers of cars operating for hire may be licensed by municipalities.

South Dakota, Washington, and Wyoming. The States of Florida, Iowa, Nevada, and South Carolina are not included in the above classification. Beginning January 1, 1918, the States of Florida and Nevada came into the first class and Iowa the second.

The total road mileage of the United States outside of incorporated towns and cities was 2,455,761 in 1917. With a registration of 4,983,340 motor vehicles there was, therefore, an average of two motor cars for each mile of rural public road in the United States. The distribution of cars among the several States, however, naturally varies a great deal. Thus, Arkansas and Nevada have but three cars to every 5 miles of road, while California has 5, Connecticut 4.5, Massachusetts 9.3, New Jersey 9.6, and Rhode Island 17.1 cars to each mile of rural road. While there was an average of one motor-car registration for every 21 persons in the United States, in the State of Iowa and Nebraska there was one car for every 9 persons, but only one for every 72 persons in Alabama, one for every 65 in Louisiana, and one for every 62 in Arkansas. The population per motor car and the number of motor cars per mile of public road are shown more fully in columns 12 and 13, Table 1.

There are still 21 States in which motor trucks are registered at the same rates as pleasure cars. But the past year has shown quite a decided tendency to increase the fees required for heavy motor trucks. This increase is based generally on either the weight of the truck, its carrying capacity, or a combination of its carrying capacity and its horsepower. However, there is no evidence of any well-defined goal toward which this movement is tending. The term motor truck and commercial vehicle, moreover, is very indefinite. In some States a commercial vehicle is held to be any vehicle used for carrying freight or articles of commerce, while in others only those vehicles used for hire are classed as commercial.

The amount of fees collected per car for either pleasure or commercial vehicles is as yet far from uniform and is still further complicated by the widely varying requirements for the registration or licensing of chauffers, owner operators, dealers, etc. Thus, if the total gross registration and license revenues be used as a basis of revenue, and the total automobile trucks and vehicles as the basis for motor cars, it is found that for the entire United States the average fee per car was \$7.62. On the same basis the State of New Hampshire received in 1917 a gross revenue of \$19.10 for each motor car, while Minnesota received only about 50 cents annually for each car, as the registration in that State is for a three-year period.

In most States motor cars are taxed as personal property in addition to the required registration fees. In Alabama, Delaware, Idaho, Iowa, Michigan, New York, North Dakota, Oklahoma, Pennsyl-

vania, Vermont, and West Virginia the registration fees are in lieu of all other taxes. Therefore, in making any comparison of fees as between the several States this fact should be borne in mind.

The registrations of automobiles, motor trucks, commercial vehicles, chauffeurs and operators, dealers, and manufacturers are the total gross registration and license revenues and the amount of this available for road work either by or under the State highway department or local subdivision for the year 1917 is given in Table 1. The number of registrations given in this table do not necessarily indicate the exact number of motor vehicles of any one or of all of the several classes in actual use or existence in the several States except so far as the laws of the several States require and enforce an annual registration under these classifications. However, as all the States with the exception of Minnesota and Mississippi now require annual State registrations, these furnish a very definite index of the total number of cars in existence. But many States make distinction so far as the registration laws are concerned between pleasure cars and commercial vehicles. Hence, the column headed "Motor trucks and commercial vehicles" does not show the total number of such vehicles except in some States. Reference to the principal requirements in the registration of motor vehicles which are charted in Table 4 will serve to make clear what the data in Table 1 represents.

Table 2 gives a comparison of the motor-car registrations and total revenues for the years 1913 to 1917, inclusive. For further information in regard to registrations and revenues previous to 1913 the reader is referred to Office of Public Roads Bulletin No. 48, "The Repair and Maintenance of Highways," pages 68-71.

RECORD IN CROSSING ELIMINATION.

District No. 4 has received a project statement in Iowa County, Wis., from the Wisconsin Highway Department, the principal feature being that it will eliminate, so far as the project is concerned, 10 railroad grade crossings in 8.66 miles. This is believed to be the record so far in this district in the number of crossings eliminated on any one project or so short a mileage.

The proceeds of the Liberty Loan, including the greater part of that loaned to our Allies, are being spent for American products—the products of our factories, our farms, our mines, and other industries. In lending to the United States the people of the United States are lending to their best and largest customer.

BUY LIBERTY BONDS

CLEARING ROADS FOR ARMY TRANSPORT.

THIS is the story of how the Pennsylvania State Highway Commission, under the direction of J. Denny O'Neil, State highway commissioner, planned early last fall to cooperate to the fullest extent possible with the Federal Government, so that the movement of United States Army transport trains from the West to the seaboard could be made over Pennsylvania's State highways in a speedy and safe manner.

The main highway, over which passes a large portion of interstate traffic, extends from the Ohio State line, through Beaver Falls, Pittsburgh, Greensburg, Bedford, McConnellsburg, Chambersburg, Gettysburg, and Littlestown, to the Maryland State line, a distance of about 225 miles, and runs through mountainous regions. Commissioner O'Neil realized that snow-removal work would enter largely into the success of the project and plans were laid accordingly. George H. Biles, second deputy State highway commissioner, who is in direct charge of all maintenance work on the Pennsylvania State Highway System, devised a system for the effective removal of snow.

In describing the methods used Deputy Commissioner Biles says:

By GEORGE H. BILES.

A system of operation for handling this work was established by the maintenance division of the State highway department, which will be described briefly:

Through arrangements made with the Weather Bureau office at Pittsburgh, weather forecasts were wired to the main office of the State highway department, by which conditions could be anticipated and instructions issued immediately to the various districts to organize men and equipment for action. The field organization of the State highway department consists of the assistant engineer, who has control of all work in a number of counties—usually about five—followed by the superintendent of highways of the county, who has charge of all maintenance work; under the men come the gang foremen, patrolmen, laborers, etc. This organization had complete charge of this work in their respective counties and is under the direction of the second deputy commissioner, in charge of maintenance.

Stationed at the larger towns along the line of this route were motor trucks equipped with snow-plow, attachments, road machines, drags, shovels, etc. The patrol system of about 34 men was engaged continuously in repairing and patrolling this highway, each man looking after his particular section, and this plan was a most important factor in reporting emergency conditions of consequence to the district head, or superintendent, who reported by wire or phone to the main office directly. The caretaker was empowered to organize forces, if need be,

to take care of conditions until the arrival of the superintendent. If conditions were unusual, the superintendent reported by phone to the assistant engineer, who arranged to inspect and handle the work accordingly.

The report made by the caretaker was either by wire or telephone, and was followed by a postal-card report form, giving details, and addressed to the main office at Harrisburg. This information was charted as soon as received and the same practice followed upon the completion of the work. If the drifts were abnormal and the road not opened within 24 hours the office had to be advised by wire, and in this way headquarters was in direct touch with and control of the entire route at all times.

The first snowstorm of consequence occurred on December 7 and 8 and was general over the entire route. For many miles drifts averaged 3 and 6 feet in depth. The work was begun by breaking a track through the drifts with teams and drags. This was followed by road machines, or trucks, with the plow attachments, and shovelers. Turnouts were made along the line, and thereafter the road was widened out to a width of between 14 and 16 feet, depending upon the location. The entire travelable width of the roadway was opened finally in order that traffic would not track and cut through the road surface during periods of freezing and thawing. The snow was removed at first to within 3 inches of the road surface and what did not melt was afterward removed entirely. After a track was broken through the deep cuts it was necessary to resort to shoveling.

As soon as any section of the road was opened, shovelers followed, cutting openings from the side to the ditches at various intervals along the road. When this work was completed the road was again turned over to the caretaker, or patrolman, to look after drainage details.

From observations taken since 1913 it had been found that at certain locations the construction of snow fence would be advantageous and economical, and while it was impossible to get all of the necessary fence in place this season some of it had been constructed, and before another season arrives the remaining sections will be provided for.

There were certain sections along the line of the route where it became necessary to work night and day shifts, and after the organization had been perfected each succeeding storm was handled with increased celerity and efficiency.

In the beginning the work was handled with the following organization and equipment, which was augmented from time to time: Seven motor trucks and plows, 22 road machines, 20 drags, 105 teams, 3 tractors, and 200 men."

MAINTENANCE IS RHODE ISLAND'S BIG PROBLEM.

State Confronted by Fact that Many of Earlier Built Roads Can Not Stand Present-Day Traffic.

By

I. W. PATTERSON, Chief Engineer, Rhode Island.

STATE road building in Rhode Island is under the control of the State board of public roads, which body is made up of five men, one from each of the five counties of the State. The term of one of the board members expires each year and appointments are made for a term of five years. Appointments to the board are made by the governor with the advice and consent of the senate. The legislative act creating the board was passed in 1902 and the actual building of roads under the act was begun in 1903. Since that time the building and maintenance of State roads has continued uninterruptedly.



Concrete arch bridge, Rhode Island.

The building of all of the main through trunk lines in Rhode Island has been completed for five years and the big problems to-day are the maintenance and reconstruction of the roads already built. The financing of maintenance and reconstruction has not kept pace with the financing of new construction and in consequence we are confronted by the fact that a great many of our earlier built roads are not in condition adequately to withstand the travel passing over them to-day.

The traffic to which the State roads of Rhode Island are subjected is severe. This State is essentially a manufacturing community and for this reason our State roads are called upon to carry a heavy commercial travel during the entire 12 months of each year. The presence of a large number of popular shore resorts in our State involves

also a very heavy motor tourist traffic during the summer months.

We have not employed a large number of types of construction in the building of our State highways. Water-bound macadam, bituminous macadam, and bituminous concrete are the only types built to date. For the first three years that State roads were built in Rhode Island water-bound macadam was employed exclusively. In 1906 an experiment with bituminous concrete was carried out successfully, but this type was not built to any considerable extent until 1909. Since 1913 no water-bound macadam has been built. One of the chief obstacles to the success of water-bound macadam in this State is the absence of good road building stone in many sections so isolated from railroad facilities that in the earlier days of road building the importing of stone was deemed prohibitive. There are a number of sections where the only stone available is granite, which is so badly decomposed as to be of very little value for road building, and yet there are many miles built of this material. Until motor travel became heavy much of the road built of this inferior rock gave very good satisfaction, but of late years the task of maintaining these roads is almost hopeless.

The first use of bituminous binders in State road work was by the cold hand-mixing method, employing crusher-run stone from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches for the mineral aggregate. During the years from 1906 to 1913, inclusive, approximately 80 miles of road was constructed by this method. The details of construction varied considerably during this period and many different types of bituminous binders were employed. Machine mixing did away with hand mixing to some extent during the latter part of the period in which roads of this type were built.

Upon the whole, our mixed roads have proved satisfactory. Processes and materials employed or selected by way of experiment occasionally proved of little value and were the direct cause of failure in several instances. Practically all of these roads are, however, still taking care of the travel which passes over them in a very satisfactory manner.

Since 1913 the use of bitumens as binders has been confined to the construction of bituminous macadam by the penetration method, with very few exceptions. The details of this construction and the types



Reverse curve on a Rhode Island highway, showing one-way slopes on curves.

of binders employed have varied but slightly. The use of crushed stone screened to comparatively large and uniform sizes, the employment of a heavy binder at a rate per square yard of at least $2\frac{1}{2}$ gallons, particular attention to rolling and careful treatment of subsoil difficulties have characterized this work. The results secured by the pentetration method have been more satisfactory upon the whole than were the results secured by the mixing method as we employed it in our earlier work. We appreciate, of course, the fact that our mixing work was greatly handicapped by the use of an aggregate which was not well graded as to sizes.

The conditions affecting the design and construction of roads in Rhode Island are considerably diversified in spite of the fact that our State is diminutive in size. There are sections of the State where subsoil difficulties do not exist because of the presence exclusively of sand or gravel. There are, upon the other hand, sections where a heavy clayey soil very much subject to frost action is found to the exclusion of all other soils. Certain sections of the State, furthermore, offer variety of subsoil characteristics, alternate streaks of freely permeable

soil and of heavy retentive soil occurring at short intervals. Excavation is made very difficult in a number of localities because of the presence of boulders in great numbers, varying in size from one-man stones to stones weighing from 10 to 25 tons. We have no mountainous section to contend with, but we have in the entire western section of the State a hilly region which offers more or less difficulty in highway location as compared with the difficulties encountered in the eastern portion of the State.

Previous to 1912 the bridges located upon State highways were under the control of the towns in which they lay. In 1912 these bridges were placed under the control of this department. Few of the bridges at that time were in good repair and many were in dangerous condition. The work of replacing the weak structures was begun at once and has been continued without interruption since that time.

We do not employ standard designs of bridges. The number of bridges for which we are responsible and the small size of our State makes desirable to our minds the treating of each bridge as a problem by itself and the designing of each structure independently.

The principal developments in the bridge department during the past season are the introduction of force account for the construction of bridges, the elimination of centering and saving of material in a modified type of girder bridge, the innovation of split piles devised for the solution of special foundation problems, the incorporation into designs

President Wilson looks to the toil, intelligence, energy, foresight, and patriotism of the American farmer to win this war.

BUY LIBERTY BONDS

of a feature which allows increasing widths of bridges at a future time when traffic makes such a course necessary, the adoption of a new large-size test mold for compression tests of concrete, the use of portable steel office buildings, and the solution of a troublesome detail in the practical construction of circular balusters. The statement that the results obtained by the adoption of the above new features generally fulfilled our expectation may safely be made.

At the end of 1917, or the sixth construction season since the organization of our bridge department, more than half our bridges are of permanent construction. One bridge in every three is of concrete, 22 per cent stone, 18 per cent steel, and 27 per cent wood. Five wood bridges have been replaced with concrete this season and for the first time the number of concrete bridges on the system exceeds the number of wood structures. We now have a permanent bridge for every 4 miles of State highway.

The State pays the entire cost of building and maintaining of State roads. We have a State aid law which makes possible State aid for towns, but advantage has been taken of this law in only one

instance since its passage seven years ago. There have been three bond issues for the building of State roads, the last of these having been made available in 1912. The money secured from the registration of motor vehicles is employed for the maintenance of State roads. Direct appropriations for State road work by the legislature have been frequent. The legislature meets annually in Rhode Island and it has always been the custom to take action in regard to the appropriation of funds for State road work at each session. Frequently appropriations are not made until April or May of the year in which it is purposed to spend the funds appropriated. It is apparent that this system of making appropriations imposes a hardship upon this department by seriously limiting the time available for preliminary work.

For the past two years we have had to spend in addition to the motor vehicle fund the proceeds of a State highway tax of 3 cents on each \$100 of the ratable property of the towns and cities of the State. This tax has amounted to over \$200,000 each year. Bridge work is financed separately from road work in Rhode Island.

STATUS OF HIGHWAY WORK IN WISCONSIN.

By

A. R. HIRST, State Highway Engineer.

HIGHWAY construction in Wisconsin is carried out under three distinct systems: First, the Federal aid construction, performed under the authority of the Federal aid road act and the State trunk highway law; second, the State aid construction, performed under the State aid law; and, lastly, the township construction, performed under the State statutes relating to this work. In the interest of strict accuracy, it may be well to say that actual construction under the Federal aid plan will not be begun until the season of 1918, and that the State highway commission is at present nearing the completion of the preliminary work necessary to undertaking actual construction.

The most important part of this preliminary work has been the selection of the State trunk highway system, authorized under the State trunk highway law. Under the law this system must not exceed 5,000 miles and must interconnect all county seats and cities with a population of 5,000 or more. The selection of the system is a duty of the State highway commission, but the statute provides for a special legislative committee consisting of five members, appointed by the governor, to whom appeals from the selection of the commission may be taken. It

is provided that in counties where the commission felt there was special difficulty in the selection of the system the legislative committee might be invited to hold a joint session at the county seat, and the selection thus made jointly be final.

Under the law all construction with State and Federal aid must be confined to this trunk highway system. The Federal law requires that the State must provide an amount at least equal to the Federal aid allotted to the State. The State law requires that the county in which construction is done shall provide an amount equal to one-half of the sum of the joint State and Federal allotments. All construction costs thus will be borne in the proportion of one-third by each of the units concerned. The joint State and Federal funds are apportioned to the counties, one-third on the basis of area, one-third on the basis of valuation, and one-third on the basis of total road mileage. Provision for the State's share

In the organized might of this Republic every American has a place, a station, and a duty. Some fight; others must work, save, and give financial support to the Government.

of the cost of Federal aid construction is made from the proceeds of the automobile license fees, which have been increased to \$10 for ordinary cars, with trucks licensed at rates from \$15 to \$25, depending

through local initiative. The improvements projected aggregate approximately 190 miles of earth roads, 70 miles of gravel surfacing, 20 miles of stone macadam, and 45 miles of concrete or brick pavement, a total of 325 miles. The total estimated cost is approximately \$2,000,000. The completion of these projects will mean the improvement of the worst spots on the system, and the improvement of the entire system by the improvement of its poorest portions.

As stated financial provision for the maintenance of the State trunk highway system is made through the proceeds of automobile license fees. The law provides that the maintenance shall be carried out by the counties under the supervision of the State highway commission. The greatest weak-

ness of the State highway work as done heretofore has been inadequate maintenance. It is the intention to establish a maintenance system under the new law as adequate as the financial provision therefor will permit and by this means to keep the entire system in good condition all the time. The commission is now making a study of the best methods of accomplishing this result, and it may be said that it is the intention to improve a large mileage of roads by blade grader work and to keep these roads in



A stretch of Wisconsin's State Highway System.

upon capacity. The net proceeds of automobile licenses are to be expended in the following manner:

1. One-fourth to the counties in proportion to the amounts paid in.

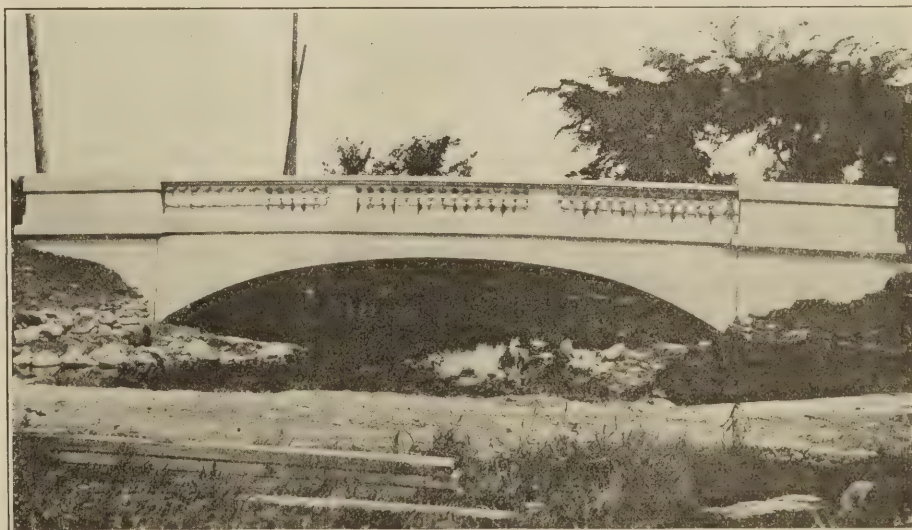
2. A sum not to exceed \$80,000 is then allotted to the State highway commission for the administration of the State trunk highway law.

3. The amount necessary for the State's share of Federal aid construction funds is then allotted for that purpose.

4. The remainder is then apportioned for maintenance and distributed among the counties in proportion to the State trunk highway mileage in the county.

The State highway commission is charged by law with designation of the location of improvements. There need not be construction in each county each year, but at the end of the three-year period contemplated by the law each county must receive the full amount allotted. Under the authority thus conferred the State highway commission has designated improvements in 57 counties. These improve-

ments have been selected with a view of serving the greatest public interest and have been placed on the worst portions of important roads where there is but little prospect of securing the improvement



One of Wisconsin's 1,500 State aid bridges.

passable condition as far as can be done by systematic dragging. Surfaced roads will be maintained by the method appropriate to each particular type. The work will be done by a combination of the gang and

patrol systems; where the work is of such a nature as to require more than one or two men, a force equipped with proper machinery will be utilized; where reasonably possible the maintenance work will be executed by one patrolman with additional assistance only when necessary through some unusual condition.

The best estimates which can be made at this time indicate that there will be available about \$875,000 for this work in 1918, which provides \$175 for each mile on the trunk highway system. It is not contended that this amount is fully adequate, but it is certain that the results which will be secured will far surpass anything done heretofore in Wisconsin.

Another important duty of the State highway commission under the State trunk highway law is to mark the roads on the State trunk highway system. The law provides that after the system has been finally selected, the commission shall cause the various roads comprising the system to be marked distinctly with some standard design which shall be uniform throughout the State, except that numbers occurring thereon shall correspond to the numbers given the various roads by the commission which shall coincide with the numbers placed on the commission's official maps. This map shall be published in the spring of 1918 and as often thereafter as necessary. The commission is required also to erect such standard guide and warning signs as may be deemed necessary.

This task is one of great magnitude and importance and will require much pioneer work. A study of the most practical and feasible method of accomplishing the desired results which are to give the traveling public a maximum of information with a minimum of confusion is now under way.

The State-aid system has been in effect since July, 1911, and construction under its provisions has been carried out during the seasons of 1912 to 1917, inclusive. Since its original enactment this law has been amended in some of its details by each legislature, but the basic plan of the law has remained unchanged though there has been a constant tendency toward a concentration of improvements on the main lines of travel. Originally any town might initiate an improvement and be certain of receiving a like appropriation from the county and to participate in the distribution of the State highway fund. As might be expected this plan resulted in a scattering of the work which was not to the best interests of the work itself, considered purely from a construction standpoint. But it did have a very great educational influence. People who never had seen

properly improved highways and who had no idea of what an improved highway might be like, had these improvements brought to their very door, and having thus learned the value of properly improved roads, forthwith desired more of the same kind. The result is that the people of the State have been educated to an appreciation of the value of highway improvement, without which any very far reaching program would have been impossible and prepared for larger undertakings under both the State aid and Federal aid laws.

As the law now stands, the State provides an appropriation of \$785,000 per year, which is allotted to the counties in proportion to their assessed valuation. To receive this money the counties must raise certain amounts by county appropriation, and assess certain taxes against their municipalities, as hereafter explained. One-half of the allotment to each county, together with one and one-half times this amount, provided by the county, must be spent in improvements on the State trunk highway system at points designated by the county boards. The remaining one-half of the counties' State aid allotment then is distributed among these towns, villages, and cities of the county, which are unbenefited by a State trunk highway system improvement the same year, in proportion to their assessed valuation. A county appropriation is made at least equal to the State money allotted to the municipalities, and a tax not less than the State money nor greater than the county appropriation is levied against each municipality. It will thus be seen that the cost of State aid improvements made jointly by the State and a county is born 40 per cent by the county and 60 per cent by the State, and the cost of improvements made by the State, a county, and a municipality is borne one-third by each. The State percentages given are maximum, the counties may raise amounts greater than the minimum required to claim the State aid, thus reducing the State's percentage.

All improvements made under the State aid law must be made on the county system of prospective State highways at locations designated by the county board and approved by the State highway commission. The actual execution of the work is by the county highway commissioner and his forces working under a county State road and bridge committee. The entire work is under the supervision and direction of the State highway commission and must be carried out in accordance with its plans and regulations and the terms of the law.

The average annual cost of all road and bridge construction under the provision of this act has been approximately three and one-fourth millions of dollars ever since the enactment of the law. The result has been the improvement of approximately

Are our hearts with our soldiers? The response to the Third Liberty Loan will be the answer.

ROADS PIERCE ALASKAN WILDERNESS.

Less Than Dozen Miles Have Become 980, While Trail Mileage Has Passed 2,000.

By

CAPT. W. H. WAUGH, President Board of Road Commissioners.



Typical Alaska wagon road, Gastineau Channel.

The Board of Road Commissioners for Alaska, constituted by act of Congress in 1905, and composed of three officers of the Army, has been in existence for 13 years. The board was heralded by a demand throughout the 600,000 square miles of the Territory for immediate results. The magnitude of the problem, coupled with the great variety of unusual difficulties, was not encouraging.

There presented itself a great wilderness (ten times the area of the State of Wisconsin) untracked for the most part by the foot of the white man, broken and rugged in many parts, heavily timbered and with a dense undergrowth in the coastal belt, underlaid throughout most of the valleys of the interior with permanent frost to a great depth protected by a thick blanket of moss, with the whole area buried under snow for many months of the year, and in summer intersected by numerous deep, swift, and changing streams fed by the melting glaciers and snows of the mountains. Throughout the Territory there existed less than a dozen miles of wagon road, with a few hundred miles of pioneer trail, most of which was constructed by various expeditions under the War Department.

The population consists chiefly of miners, fishermen, lumbermen, and a very few homesteaders, scattered along the coast of southeastern Alaska and through the interior, separated in most cases by great distances, with but little common interest, all needing and demanding roads, but giving little thought to the fact that it required much money to build roads, and time to perform the work.

The board has constructed 980 miles of wagon road, 623 miles of sled road, and 2,291 miles of trail, and has expended for all purposes to June 30, 1917, a total of \$3,969,611, of which sum \$2,265,000 has been appropriated by Congress and \$1,704,611 from Alaska.

Brig. Gen. W. P. Richardson, who will always be known as the pioneer road builder of Alaska, has been president of the board from its organization until December, 1917, when he was placed in command of a brigade in the National Army. The present board is composed of Capt. W. H. Waugh, president and engineer officer; Capt. John Zug, assistant engineer officer; and First Lieut. Sidney L. Carter, disbursing officer, all being commissioned in the United States Engineer Reserves.

The Office of Public Roads and Rural Engineering is now making a location survey and expects to start their Alaska highway work in the Tongass and Chugach National Forests in 1918. F. A. Kirtledge, highway engineer, has made the location surveys in southeast Alaska and construction will be undertaken as soon as the season opens in the spring. This work is handled through the district engineer, Portland, Oreg., by Capt. Waugh, in co-operation with the Territorial Road Commission. Ninety-three thousand dollars is now available for roads within the national forest reserves and an



Building Grade Auke Bay Road near Juneau, Alaska.

additional \$46,000 becomes available July 1 each year until 1925.

A third highway organization is the Territorial Board of Road Commissioners, comprised of the governor of the Territory, the surveyor general, and the Territorial treasurer. The Territory is divided into four Territorial road divisions in charge of the divisional road commissioners. The divisional road commission is composed of an elected chairman and two members appointed by the governor. These officers serve for two years. Fifty thousand dollars is appropriated annually for each division.

MICHIGAN TOUCHES HIGH POINT IN CONSTRUCTION.

By
FRANK P. ROGERS, State Highway Commissioner.

Twenty per cent of the entire mileage of roads built in the 12 years since the State reward law became operative was constructed in the year ended June 30, 1917. In that year 1,052.8 miles were built and \$1,241,306 State reward paid. The rapid increase in road building is shown by the accompanying table.

Indications are that a smaller mileage will be constructed in the fiscal year 1918, largely, of course, on account of the war conditions. The first six months of this year show a falling off of about 30 per cent as compared with the same period last year.

Fiscal year.	Miles built.	Reward paid.
1906.....	18.1	\$13,675
1907.....	64.4	51,701
1908.....	96.4	71,729
1909.....	162.2	117,021
1910.....	204.4	137,327
1911.....	304.2	193,876
1912.....	382.6	249,671
1913.....	522.0	329,392
1914.....	682.3	581,736
1915.....	759.8	783,566
1916.....	744.6	757,532
1917.....	1,052.8	1,241,306
Total.....	4,993.8	4,528,532

The State reward law became operative July 1, 1905. It created the State highway department and provided for the payment of rewards ranging from \$250 to \$1,000 per mile on roads which were to be built under State specifications. These roads were to have a metal surface not less than 9 feet in width and a turnpike not less than 18 feet in width. At that time no provision was made for an increase of reward on roads having a greater width of metal surface. The law has been amended more or less by every succeeding legislature and rewards at present range from \$250 a mile for a single track, sand-clay road to \$8,400 a mile for roads having a metal surface 20 feet in width, when built on trunk line routes and of such materials as concrete, brick, or asphaltic concrete.

The legislature of 1913 passed the trunk-line highway act, providing for the establishment of approximately 5,000 miles of trunk lines in the State, which were defined in a general way by naming the cities and towns to be connected by this system of roads, but leaving to the local authorities and the State highway commissioner the power to determine the exact routes to be followed. This law provided that trunk-line routes were to receive twice as much reward as had been paid formerly on State reward roads or would be paid hereafter on roads not on the trunk lines. It was provided further that all bridges of more than 30 feet clear span on the trunk lines should be designed, built and maintained by the State, provided the township or county build three or more miles of road, including the bridge site.

The construction of bridges by the State, together with the payment of double the amount of ordinary State reward on road construction, has done much to hasten the improvement of these main roads. Many communities that have been able to improve their trunk-line roads would have found it practically impossible without this additional aid. Up to January 1, 1918, the State has expended \$562,830.45 on the construction and

Victory does not depend solely on our fighting men; it depends on all Americans. Work, save, and lend to the Government.

maintenance of trunk-line bridges. Seventy-six new bridges have been built and 14 existing structures have been repaired temporarily in such manner as will make them adequate for several years. Thirteen new bridges now are under construction.

The 1915 legislature passed the assessment district act, commonly called the Covert Act, by which road improvement could be initiated on a



Old covered wooden bridge replaced with modern steel truss type of construction by Michigan State Highway Department.

petition signed by a majority of the frontage on any given road not less than two miles in length, thus making it possible to improve the road by spreading a portion of the cost on an assessment district, somewhat similar to a drainage district, the remainder of the cost being paid by the townships and counties in which the road lies or which are especially benefited by reason of the improvement. A provision also was included making it possible to sell bonds for the improvement and extend the period of payment over from 1 to 10 years.

Under this act 204 petitions, aggregating 1,070 miles, which probably will cost more than \$7,000,000, have been filed with the State highway commissioner.

Until the law was amended by the 1917 legislature and declared valid by the supreme court the State highway department found it impossible to sell bonds. The supreme court handed down a favorable decision the latter part of July, 1917, and since that time 11 roads, aggregating 64½ miles, have been placed under contract at a total cost of \$445,340. On all of these roads bonds have been sold for all but the first year's assessment. If no serious difficulties are encountered in the way of letting contracts it is highly probable that during the summer of 1918 the State highway department will have in process of construction under the Covert Act more than 200 miles of road.

The foregoing gives a general summary of the activities of the State highway department. A great deal has been accomplished looking toward

the completion of the trunk-line system in the State, and with the help of Federal money, which will be available, it is expected that a few more years will see these main roads practically completed.

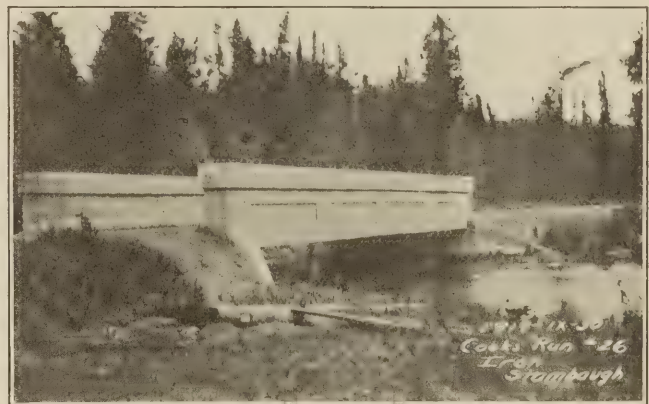
Bridge construction has been one of the most important features of the work of the department for the last four years, and much has been done to study local conditions and work out the best methods in design and construction. Standard designs have been prepared for several different types of structures. Up to within a year ago the low steel truss with a reinforced concrete floor was used quite commonly. In building these the department has adopted the plan of pouring one-half of the floor at a time so as to interfere with traffic during construction as little as possible.

Many old and inadequate bridges have been replaced by the department with well-built, modern structures, capable of carrying a moving load of 18 tons.

An interesting type of covered bridge erected a number of years ago has been replaced recently with a four-span low truss.

Under present conditions the reinforced concrete girder is used most widely on account of the relatively low cost of construction and the adaptability of the design to conditions encountered. A typical view is shown of a single-span girder built by the department in one of the upper peninsula counties.

Another problem of increasing importance is the matter of elimination of railroad crossings at grade. In laying out State trunk lines such crossings have been avoided wherever possible. In numerous in-



Reinforced concrete girder bridge built by the Michigan State Highway Department in Stambaugh Township, Iron County, Upper Peninsula.

stances dangerous crossings have been avoided by making new locations by purchasing new rights of way, the cost of which were insignificant in comparison with the benefits derived.

A number of grade separations have been made throughout the State at considerable expense. The most important of these in which the State is involved is located on the trunk line, about 1 mile

north of the city of Ann Arbor, crossing the tracks of the main line of the Michigan Central Railroad between Detroit and Chicago. In this separation two structures were necessary, one over the railroad and one to the north over the Huron River. An earth fill is being constructed between the two structures and at each approach. The total cost of the two structures and earth fill will be about \$80,000, and it is expected they will be completed ready for travel early this coming summer.

SOUTH CAROLINA WILL CONTINUE CONSTRUCTION.

By
C. O. HEARON, Member State Commission.

Although South Carolina's State Highway Commission is only a year old, it has completed the organization of its two branches, laid out a system of State roads, and taken steps to provide for aid to counties in building a number of necessary large bridges. The commission was authorized under an act approved February 20, 1917, and directs the highway department, which, in turn, is composed of two divisions—engineering and automobile licenses and registration.

Under the provisions of the State highway act 80 per cent of the fees collected by the last-named division are returned to the counties from which they are collected to be expended by the local authorities on roads and bridges; the remaining 20 per cent is deposited with the State treasurer as an operating fund for the State highway department.

The commission has been handicapped somewhat in its work due to the calling into national service of a number of officials and members of our organization, thirteen of whom are now serving their country in the present crisis.

Primarily the object for which the State highway department was created is to cooperate with the local road authorities in the counties of the State and to advise with them whenever so requested in the preparing of plans and specifications for their road and bridge work, and also to comply with requirements and conditions of the Federal aid road act, so that the State might secure its apportionment of the Federal aid funds for road and bridge construction.

The first work done was to appoint a State highway engineer, secure offices and office equipment, purchase automobile license plates, and organize an office force; consequently the office was not actually in working order until about the 15th of April. The commission then proceeded with the organizing of the engineering division and the preparing of necessary forms and blanks, specifications and standards for road and bridge construction. In this work it was assisted materially by the United States Office of Public Roads.

Prior to the organization of this department there was no systematic plan for the development of a State system of highways. The only work that had been done up to that time was by a few counties with bond issues or special taxes, each working according to its own plans without respect in most cases to a connected State system.

The first work of the department was to outline and prepare a map of the proposed system of State roads. This system was designed so as to facilitate communication between the important market centers and various county seats, and at the same time afford through lines of communication between adjoining States. It is not expected that the proposed system as outlined can be entirely completed with Federal aid funds apportioned to this State, but it is hoped that the counties will continue the work of constructing this system until it is finally completed. There are two main north and south highways through the State, one known as the National Highway, which passes through the western part of the State, and the Washington-Atlanta Highway, which passes through the eastern portion of the State. Federal aid projects have been approved for work on sections of both of these highways, and it is the hope of the commission that with the assistance of Federal aid both of these highways will be improved eventually, so they will be in condition for through traffic at all seasons of the year.

Investigations have shown that the proposed State highway system, as mapped out by the commission will be incomplete without the construction of several large bridges over the main rivers of the State. In view of the fact that the magnitude of these projects is such that the county or counties adjacent thereto could not possibly finance them without assistance from the State, the commission has recommended that present State highway act be amended to provide that 50 per cent of the amounts required to be returned to the counties from the automobile license fees under the present act be set aside each year for the next five years to form a State bridge fund, to be used in the construction of these proposed bridges under the supervision of the State highway department, the remaining 50 per cent to be returned to the counties to be used as specified by the act.

It is not expected that the lack of transportation facilities at the present time will seriously affect the 1918 road-building program for the State. Three out of four of the projects which will require rail shipments of material are for roads leading to the three national cantonments in the State. These roads are of vital importance to the operation of these camps, and we have been assured that material for the construction of these roads can be shipped as material for Government use. With the exception of some prospective bridge construction, the remaining projects will be sand-clay, top-soil, or local gravel construction which will require no rail shipments.

EIGHTEEN MONTHS OF FEDERAL AID.

LEADERS IN FEDERAL AID.

First State to submit project under Federal aid act.....	California
First State to complete construction of project.....	California
Leading State in number of projects submitted.....	Texas
Leading State in number of miles of proposed improvement.....	Texas
Leading State in estimated expenditure on improvement.....	Ohio
Leading State in amount of Federal aid asked.....	Texas
State submitting greatest mileage in single project.....	Illinois

APPROXIMATELY 18 months have elapsed since the beginning of actual progress under the Federal Aid road act, approved July 11, 1916. California has the distinction of having filed the first project statement, that having been one of five submitted on September 1, 1916. California also has the distinction of having completed the first Federal aid project, No. 3, on May 9, 1917. This was 2.55 miles of concrete construction in Contra Costa County, which cost \$54,723.66, upon which there was paid \$24,244.56 of Federal aid.

Up to and including February 28, 1918, there was a total of 383 project statements submitted, of which 265 have been approved, 6 disapproved, 3 canceled, and 4 withdrawn. Plans, specifications, and estimates have been approved to the number of 86. The total mileage covered by these projects was 4,453.66 and the total estimated cost \$28,164,672.77, of which the States asked the Federal Government to assume the payment of \$11,129,815.69.

In the number of projects submitted Texas leads with 36, for improvements in 29 counties. Of these 11 have been approved. Texas also leads in aggregate amount of Federal aid requested. The first project statement from that State was submitted on October 13, 1917, and the last on January 22, 1918. They describe improvements upon 494.69 miles of road at an estimated cost of \$1,864,565.03, and Federal aid to the extent of \$857,453.71 is asked. In 1917 Texas expended between eight and nine millions of dollars in construction, improvement, and maintenance on about 13,000 miles of road.

In number of projects filed Alabama is second to Texas, with 29 covering improvements in 28 counties.

Illinois has submitted a single project, but it is the longest in point of mileage of any submitted, being for 75.6 miles of concrete and bituminous macadam resurfacing of the Lincoln Highway to traverse Dupage, Kane, Dekalb, Ogle, Lee, and Whiteside Counties at a cost of \$1,146,673.50. The State requests 50 per cent Federal aid. The next longest single project is one in Georgia of 73.85 miles of sand-

clay or top soil to traverse Clayton, Henry, Spaulding, Pike, and Monroe Counties and to cost \$180,630.72, of which the Government is asked to assume half.

Ohio has submitted 12 projects, aggregating some 68.62 miles, but the estimated cost is \$2,201,757.26, and the Federal aid requested \$651,080. It is noticeable that this entire proposed construction is of either concrete or brick, with two exceptions, one being of 4.48 miles with optional macadam or concrete construction, and another of 5 miles with optional bituminous macadam or brick. Ohio leads the States in estimated cost of improvements to be undertaken.

Kansas has come forward with three projects which cover 82 miles of construction upon which it proposes to expend \$1,635,532.49 and requests only, \$245,329.87 of Federal aid.

The Central States in general have laid out fairly extensive programs. Michigan has filed 15 statements, of which 12 have been approved. Plans call for improvement of 141.25 miles at an estimated cost of \$1,185,717.11, for which the State asks \$603,978.54 of Federal aid. Gravel construction predominates largely, although the longest project—42.86 miles—is of graded earth.

Fourteen projects, of which 11 have been approved, have come from Iowa. They call for the improvement of 239.56 miles of road at an estimated cost of \$1,034,525.28, toward which the Federal Government is asked to contribute \$318,373.50. Proposed improvements are largely graded earth and gravel. Of the 14 project statements filed by Minnesota, 13 have been approved and 1 withdrawn. Improvements are contemplated on 268.42 miles of road, upon which it is planned to expend \$781,673.41, with \$358,742.18 of it in the form of Federal aid. Considerably more than three-fourths of the improvements are of gravel, the longest project of this type being for 50 miles.

Among the Southern States there has been considerable activity.

Every step taken by the respective States under the Federal aid act is covered in the following tables.

RECORD OF FEDERAL AID, TO MARCH 1, 1918.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
Ala.	1	Mar. 7, 1917	Aug. 18, 1917	Oct. 13, 1917	Montgomery - Union Springs Road.	Bullock	8.83	Sand-clay	\$23,733.93	\$11,866.96	\$11,866.96
	2	June 15, 1917	Aug. 31, 1917	Oct. 17, 1917	Forest Highway	Escambia	9	do	20,042.06	10,021.03	10,021.03
	3	June 9, 1917	do	do	Ozark, Troy, and Montgomery Road.	Pike	9.11	do	20,662.73	10,331.36	10,331.36
	4	do	Sept. 4, 1917	do	do	Dale	8.71	do	20,064.58	10,000.00	10,032.29
	5	June 15, 1917	Sept. 18, 1917	Nov. 3, 1917	Telegraph Road	Mobile	7.1	Clay-gravel	19,965.00	9,982.50	9,982.50
	6	do	Aug. 31, 1917	Nov. 5, 1917	Andalusia-Opp Road	Covington	7.67	Sand-clay	20,003.50	10,000.00	10,001.75
	7	do	(1)		Bay Minette and Daphne Road.	Baldwin	11	do	20,011.20	10,000.00	10,000.00
	8	June 26, 1917	Dec. 13, 1917	Dec. 31, 1917	Eufaula and Clayton Road.	Barbour	7	Sand-clay	20,353.38	10,176.69	10,000.00
	9	June 23, 1917	Aug. 31, 1917	Dec. 10, 1917	Columbus and Tuskegee Road.	Russell	7.18	do	22,055.90	11,027.95	11,027.95
	10	Dec. 18, 1917	Jan. 5, 1918		Greenville-Georgiana Road.	Butler	8.07	Sand-clay or topsoil.	27,071.65	13,535.82	
	11	July 19, 1917	(2)		Peakes Trail	Lowndes	.75	Gravel	14,032.70	7,000.00	
	12	do	(3)		Fort Deposit and Greenville Road.	do	2.05	do	6,029.60	3,000.00	
	13	Aug. 4, 1917	Aug. 27, 1917	Nov. 14, 1917	Anniston and Lincoln Highway.	Calhoun	5.5	Chert	22,834.35	11,417.17	11,417.17
	14	Aug. 21, 1917	Oct. 17, 1917		Talladega-Truss Ferry-Lincoln Road.	Talladega	9.37	Chert and gravel.	26,370.33	11,866.65	
	15	Aug. 29, 1917	Sept. 7, 1917	Dec. 28, 1917	Dothan and Headland.	Houston	4.3	Sand-clay	21,665.44	10,832.72	10,832.72
	16	Aug. 21, 1917	Sept. 21, 1917	Dec. 4, 1917	Opelika-Loachapoka	Lee	11.31	Sand-clay and topsoil.	23,556.77	11,778.38	11,778.38
	17	Aug. 25, 1917	Sept. 17, 1917	Nov. 16, 1917	Eufaula-Tuscaloosa Road.	Greene	4.6	Clay-gravel	15,939.00	7,969.50	7,969.50
	18	Sept. 3, 1917	Nov. 16, 1917		Birmingham-Montgomery Road.	Jefferson	6	Bituminous macadam.	23,735.37	11,867.69	
	19	do	do	Feb. 28, 1918	Attalla and Hokes Bluff Road.	Etowah	4.47	Slag and sand-clay; gravel treated with bituminous material.	17,992.40	8,996.20	8,996.20
	20	Sept. 8, 1917	Sept. 21, 1917	Dec. 6, 1917	Quenelda Road	Clay	2.5	Bituminous macadam.	21,564.10	10,782.05	10,782.05
	21	Sept. 24, 1917	Oct. 17, 1917		Linden and Demopolis Road.	Marengo	4.26	Gravel and sand-clay.	20,000.00	10,000.00	
	22	do	do	Dec. 21, 1917	Jackson Highway	Colbert	6.79	Gravel, bituminous surface, and chert or slag macadam bit. surface.	23,425.73	11,712.86	11,712.86
	23	do	do		Between Elba and Troy	Coffee	9.34	Sand-clay	23,304.35	11,652.18	
	24	Oct. 4, 1917	Oct. 20, 1917		Jasper-Birmingham Road.	Walker	4.5	Gravel	21,205.66	10,602.83	
	25	Oct. 5, 1917	do	Dec. 28, 1917	North and South State Highway.	Morgan	9.18	Macadam	21,583.98	10,791.99	10,791.99
	26	Oct. 27, 1917	Dec. 5, 1917		Heflin-Anniston Road.	Cleburne	3.5	Gravel	23,296.44	11,648.22	
	27	Nov. 8, 1917	Nov. 22, 1917		Florence and Huntsville Highway.	Lauderdale	5.91	Chert	32,432.12	11,999.88	
	28	Nov. 10, 1917	Jan. 5, 1918		Turnpike Road	Coosa	5.8	Topsoil	19,994.12	9,997.06	
	29	Nov. 12, 1917	Nov. 23, 1917		Tuscaloosa-Birmingham Road.	Tuscaloosa	6.02	Gravel	19,885.25	9,942.62	
Ariz.	1	Mar. 30, 1917	Apr. 25, 1917	Oct. 2, 1917	Bridge across Gila River.	Pinal	1.02	Approaches to be gravel surface treated with oil.	115,799.79	55,749.70	57,899.89
Ark.	1	Mar. 31, 1917	Sept. 4, 1917	Oct. 10, 1917	Eureka Springs-Seligman Road.	Carroll	3.11	Gravel	11,891.88	5,945.77	5,945.77
	2	July 5, 1917	July 16, 1917	Sept. 13, 1917	Batesville Road and Mount Vernon Road.	Pulaski	5.5492	Warrenite surface on macadam base.	112,788.77	53,000.00	55,492.00
	3	Aug. 27, 1917	Sept. 15, 1917	Oct. 9, 1917	De Queen-Gilham Road	Sevier	7.95	Gravel	45,102.00	10,000.00	10,000.00
	4	Sept. 20, 1917	Oct. 4, 1917	Oct. 17, 1917	Garland City Road	Miller	5.994	Cementitious gravel.	34,883.09	17,441.52	17,441.52
	5	Sept. 24, 1917	Oct. 11, 1917	Nov. 20, 1917	Cache River Road	Lawrence	5.68	Gravel	29,541.49	11,590.86	11,590.86
	6	Sept. 29, 1917	do	do	"Walnut Ridge north to county line."	do	3	Macadam	8,596.76	2,500.00	2,500.00
	7	do	do	do	Fulton Road	Miller	2	Cementitious gravel.	12,397.67	2,558.48	2,558.48
	8	Nov. 19, 1917	Dec. 4, 1917		England-Keo Road	Lonoke	1.97	Macadam	8,871.72	3,169.00	
	9	Nov. 24, 1917	do		Brinkley-Clarendon Road.	Monroe	8.08	Gravel; asphalt carpet coat.	74,943.66	37,471.83	
	10	do	Dec. 10, 1917		Wynne-Memphis Road.	Cross	1.45	Gravel	4,532.15	2,266.07	
	11	Dec. 3, 1917	Dec. 18, 1917		Cotton Plant-Des Arc Road.	Woodruff	2.99	Bituminous macadam.	22,459.69	10,000.00	
	12	Dec. 31, 1917	Jan. 21, 1918		Wheatley and Bon Air Roads.	St. Francis	7.6	Gravel	29,427.20	10,000.00	
	13	do	do		Fishing Lake Road	do	4.94	do	26,180.00	5,467.10	
Cal.	1	Sept. 1, 1916	Nov. 15, 1916	Mar. 29, 1917	Beresford to Redwood City.	San Mateo	4.24	Portland cement concrete.	70,654.40	35,327.20	35,327.20
	2	do	(4)		Springville to Santa Clara River.	Ventura	5.63	do	57,361.68	26,150.84	
	3	do	Oct. 18, 1916	Apr. 7, 1917	Alameda County line to Richmond.	Contra Costa	2.55	do	54,723.66	25,500.00	25,500.00
	4	do	(2)		Lolita to Beatrice.	Humboldt	4.3	do	37,334.00	18,667.00	
	5	do	(4)		Roseville to Penryn	Placer	7.52	do	74,044.65	37,022.32	
	7	Dec. 5, 1917	Dec. 22, 1917		Weaverville Road	Shasta	16	Graded and drained earth.	203,132.60	191,566.30	
	8	do	do		Trinity River Road	Trinity	48	do	510,455.44	255,227.72	
	9	do	Feb. 8, 1918		San Diego-El Centro Road.	San Diego	15	Concrete	373,010.00	150,000.00	
Coto.	1	Oct. 10, 1916	Aug. 9, 1917	Nov. 28, 1917	Denver-Littleton Road.	Arapahoe	3.95	do	74,396.98	30,467.52	37,198.49
	2	July 21, 1917	do		Pueblo, Walsenburg, Trinidad, Raton Pass.	Huerfano and Las Animas	77	1 mile brick, balance gravel.	260,191.91	130,095.95	
	3	Nov. 22, 1917	Jan. 29, 1918		Granite-Twin Lakes Road.	Chaffee	11.94	do	37,089.80	18,544.90	
	4	Aug. 4, 1917	Sept. 18, 1917		Rifle-Meeker Road	Garfield and Rio Blanco	42	20 gravel or stone and balance earth.	79,082.85	39,541.43	
	5	do	Dec. 27, 1917		Placerville-Norwood Road.	San Miguel	2.99	Graded and drained earth.	7,480.00	3,740.00	
	6	do	Sept. 18, 1917		Lamar-Springfield Road	Prowers	3.08	Gravel and shale.	10,030.90	5,015.45	

1 Withdrawn.

2 Disapproved.

3 Canceled.

4 Disapproved May 4, 1917.

5 Disapproved Nov. 15, 1916.

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length, in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
Colo. (con.)	7	Aug. 30, 1917	Nov. 28, 1917	.....	Norwood-Naturita-Paradox Road.	Montrose...	26	Graded and drained earth.	\$29,999.20	\$14,999.60	.....
Conn...	8	.....do.....	.....do.....	.....	Moecker-Craig Highway.	Rio Blanco.	17.5	.....do.....	21,916.40	10,958.20	.....
	1	Sept. 18, 1916	May 29, 1917	Oct. 13, 1917	New Haven-Cheshire Road.	New Haven	5.3	Concrete.....	148,694.04	53,000.00	\$53,000.00
	2	Oct. 13, 1917	Oct. 25, 1917	Oct. 29, 1917	Groton-Norwich River Road.	New London.	2.54	.....do.....	69,275.25	25,400.00	(1)
	3	Jan. 19, 1918	.....	.....	Norwich-Westerly Road	.....do.....	10.2	Bituminous macadam.	220,797.50	102,000.00	.....
Florida.	1	Aug. 7, 1917	Oct. 15, 1917	.....	Old Spanish Trail.....	Okaloosa..	10.31	Sand-clay.....	24,987.38	12,493.69	.....
	2	Oct. 29, 1917	Nov. 7, 1917	.....	Kissimmee-Loughman Road.	Osceola....	4.12	Brick.....	67,233.22	20,000.00	.....
Georgia.	3	Dec. 5, 1917	Jan. 9, 1918	.....	Bridge.....	Jackson....	(2)	.....	105,013.31	52,556.65	.....
	1	Nov. 6, 1916	Sept. 13, 1917	.....	Atlanta-Macon Highway.	Clayton, Henry, Spalding, Pike, and Monroe.	73.85	Sand-clay or top soil.	180,630.72	79,315.36	.....
	3	Nov. 13, 1916	Oct. 20, 1917	.....	Blue Springs Road.....	Brooks and Lowndes.	5.7	Sand-clay.....	56,045.22	28,022.61	.....
	4	Nov. 22, 1916	.....do.....	.....	Monroe-Athens Road...	Oconee and Walton.	11.1	Top soil.....	31,000.00	15,500.00	.....
	5	Mar. 25, 1917	Sept. 4, 1917	.....	Alma-Waycross, Alma-Nichols.	Bacon.....	17.71	Sand-clay.....	30,193.02	15,096.51	.....
	6	Sept. 24, 1917	Oct. 20, 1917	Jan. 28, 1918	Brookton and Dahlonega Highway.	Hall and Lumpkin.	8.47	.....do.....	37,728.90	17,214.45	18,864.45
Idaho..	2	Oct. 1, 1917	Nov. 16, 1917	.....	Lost River Highway...	Custer.....	57	Graded earth gravel surface where needed most.	190,410.00	75,000.00	.....
Illinois.	1	Dec. 3, 1917	Dec. 17, 1917	.....	Lincoln Highway.....	DuPage, Kane, DeKalb, Ogle, Lee, and Whiteside.	75.6	Concrete and bituminous macadam resurfacing.	1,146,673.50	573,336.75	.....
Indiana.	1	Dec. 26, 1917	Jan. 21, 1918	.....	.....do.....	Elkhart....	5.5	Brick, concrete, or bituminous concrete.	147,400.00	55,000.00	.....
	2	.....do.....	.....do.....	.....	Main Market Highway.	St. Joseph..	4.68	.....do.....	117,000.00	46,800.00	.....
	3	Jan. 22, 1918	.....	.....	National Old Trails Road.	Johnson....	3.75	Brick or concrete.	99,435.00	37,500.00	.....
	4	.....do.....	.....	.....	.....do.....	Putnam and Hendricks	7.25	.....do.....	189,000.00	72,500.00	.....
	5	.....do.....	.....	.....	.....do.....	Wayne....	1.5	.....do.....	47,300.00	15,000.00	.....
	6	Jan. 22, 1918	.....	.....	National Old Trails Road	Terre Haute, Clay, and Vigo.	3.75	Brick or concrete.	107,520.00	42,500.00	.....
	7	Jan. 24, 1918	.....	.....	National Old Trails Road, Madison Road, and Range Line Road	Marion.....	17.8	.....do.....	579,700.00	57,000.00	.....
Iowa...	8	Feb. 9, 1918	.....	.....	Range Line Road.....	Hamilton..	3.3	.....do.....	89,775.00	33,000.00	.....
	1	July 19, 1917	Aug. 10, 1917	Nov. 16, 1917	Mason City-Clear Lake Road, also known as North Iowa Pike.	Cerro Gordo	4.07	Concrete.....	99,541.81	22,453.75	22,453.75
	2	Aug. 8, 1917	Dec. 6, 1917	.....	Sioux City-Demison Cut-off and Hawkeye Cut-off.	Woodbury..	54.75	1 mile concrete, 53.75 graded earth.	190,151.50	34,285.90	.....
	3	Oct. 20, 1917	Nov. 16, 1917	.....	Blue Grass Road.....	Jefferson...	20.5	Graded earth...	44,123.20	16,830.55	.....
	4	Dec. 1, 1917	Jan. 14, 1918	.....	Hawkeye Highway.....	Delaware...	15	Gravel.....	77,001.30	22,297.55	.....
	5	Oct. 20, 1917	Nov. 5, 1917	.....	.....do.....	Buchanan...	14.5	.....do.....	65,921.98	22,141.35	.....
	6	Sept. 26, 1917	Oct. 20, 1917	.....	Four sections leading out of Mount Ayr.	Ringgold...	12	Graded earth...	42,173.89	21,086.95	.....
	7	Oct. 20, 1917	Dec. 6, 1917	.....	Four radial roads out of Knoxville.	Marion.....	18	.....do.....	61,600.00	22,531.85	.....
	8	Nov. 1, 1917	Dec. 3, 1917	.....	Jefferson Highway.....	Decatur....	10.4	.....do.....	41,625.10	20,812.55	.....
	9	Nov. 6, 1917	.....do.....	.....	3 sections radiating from Iowa City.	Johnson....	11.1	1½ miles brick or concrete, balance earth.	71,775.00	23,859.55	.....
	10	Jan. 11, 1918	.....	.....	Lake City Road and Pomeroy Road.	Calhoun...	18.4	Gravel.....	80,608.00	22,297.55	.....
	11	Nov. 28, 1917	Jan. 8, 1918	.....	Jefferson Highway.....	Warren....	15.5	Graded earth...	55,671.00	22,297.55	.....
	12	.....do.....	Jan. 14, 1918	.....	Perry-Adel Road.....	Dallas....	16.25	Gravel.....	57,326.50	23,117.60	.....
	14	Jan. 11, 1918	.....	.....	Lincoln Highway.....	Harrison...	18.2	Graded earth...	69,740.00	27,803.60	.....
	16	Jan. 21, 1918	.....	.....	Stand Pipe Road.....	Montgomery	16	.....do.....	57,266.00	16,557.20	.....
Kans...	2	Jan. 14, 1918	.....	.....	Thirty-second Street Road, Ozark Trail, and King of Trails.	Labette....	44.5	Gravel or macadam.	510,099.39	76,514.91	.....
	3	.....do.....	.....	.....	Santa Fe Trail.....	Barton.....	27.5	Brick.....	852,032.50	127,804.87	.....
	4	.....do.....	.....	.....	Lawrence and Topeka State Road.	Shawnee...	10	Concrete.....	273,400.60	41,010.09	.....
Ky.....	1	June 14, 1917	Sept. 28, 1917	.....	Ashland and Cannonsburg.	Boyd.....	8.13	Brick, concrete, bituminous concrete, etc.	215,268.00	81,300.00	.....
	2	May 25, 1917	Dec. 1, 1917	.....	Winchester Pike.....	Fayette....	9.96	Bituminous concrete, bituminous macadam, or Kentucky rock asphalt.	111,280.24	55,640.12	.....
La ⁴	1	Mar. 31, 1917	Nov. 5, 1917	Jan. 29, 1918	Alexandria-Marksville Highway.	Rapides Parish.	16.9	Gravel.....	70,047.60	19,724.76	21,014.28
	6	.....do.....	Canceled	.....	Marksville-Ville Platte Highway.	Avozelles Parish.	7.06	.....do.....	39,515.25	(5)	.....
	7	July 28, 1917	Nov. 5, 1917	Jan. 19, 1918	Fausse River Highway.	Pointe Coupee Parish.	22.28	.....do.....	95,982.29	40,000.00	40,000.00
	8	.....do.....	Oct. 26, 1917	Feb. 1, 1918	Ruston-Arcadia and Ruston Farmerville Roads.	Lincoln Parish.	7.36	2 miles sand-clay gravel, balance graded and drained earth.	27,977.49	10,000.00	13,988.74
	10	.....do.....	Jan. 26, 1918	.....	Rayville-Tallulah Road	Richland Parish.	7.77	Gravel.....	83,486.00	41,743.00	.....
	12	.....do.....	Nov. 3, 1917	Jan. 28, 1918	Baton Rouge-New Orleans Highway.	Ascension Parish.	27.3	.....do.....	153,267.77	26,949.32	37,699.28
	13	Aug. 27, 1917	Sept. 17, 1917	.....	Alexandria-Camp Beauregard Road.	Rapides....	4	Warrenite pavement.	93,192.19	44,250.00	45,242.76
	14	Nov. 22, 1917	Dec. 4, 1917	.....	Columbia-Monroe Highway.	Caldwell...	10	Sand-clay gravel.	50,286.12	20,000.00	.....

1 Withdrawn.

2 968-foot bridge.

3 Or 50 per cent.

4 No. 2 withdrawn; Nos. 3, 4, and 5 canceled.

5 13.76 per cent.

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length, in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
Maine	1	Mar. 26, 1917	May 4, 1917	Aug. 22, 1917	"Post Road" between Brunswick and Gardiner.	Sagadahoc.	15.57	Bituminous macadam.	\$282,666.91	\$128,624.43	\$141,333.46
	2	Apr. 26, 1917	Canceled		Pittsfield or main road from Bangor to Waterville.	Somerset	6.98	Gravel	53,156.03	16,730.07	
	3	Oct. 1, 1917	Dec. 1, 1917		Bangor Road, between Augusta and Waterville.	Kennebec	12.88	Bituminous macadam.	246,268.23	123,134.11	
Md.	1	May 28, 1917	June 23, 1917	Aug. 13, 1917	Between Buckeystown and county line.	Frederick	2.01	Concrete	34,308.12	16,550.21	17,154.06
	2	June 1, 1917	do		Defence Highway on Washington-Annapolis Highway.	Prince George	3.32	do	71,103.00	33,200.00	
	3	Aug. 13, 1917	Aug. 23, 1917	Oct. 25, 1917	Ellerslie Road	Allegany	2.33	do	52,349.90	23,300.00	23,300.00
	4	Jan. 28, 1918			Oakland-Hutton Road	Garrett	2.12	do	50,018.32	21,200.00	
	5	Aug. 13, 1917	Aug. 28, 1917	Oct. 25, 1917	Between Monocacy River and Hopland.	Frederick	2	do	45,883.20	20,000.00	20,000.00
Mass.	1	June 9, 1917	Aug. 4, 1917	Aug. 27, 1917	Acushnet-Fairhaven Road and Long Plain Road.	Bristol	2.182	do	47,483.42	21,820.00	21,820.00
	2	June 14, 1917	(1)	Oct. 31, 1917	"Washington Street" between Norwell and Hanover.	Plymouth	2.708	Bituminous concrete.	38,960.72	19,480.36	19,480.36
	3	June 9, 1917	August 4, 1917	do	Newburyport Turnpike	Essex and Middlesex	1.162	Bituminous macadam.	28,223.05	11,620.00	11,620.00
	4	June 14, 1917	(2)	Feb. 13, 1918	"Andover Street" between Middleton and Peabody.	Essex	1.325	do	30,920.45	19,070.00	13,250.00
	5	July 25, 1917	Aug. 31, 1917	Dec. 21, 1917	"North Road"	Berkshire	3.24	Macadam	78,185.25	32,400.00	32,400.00
	6	Sept. 7, 1917	Oct. 29, 1917		Sandwich and Mashpee Road.	Barnstable	1.818	Bituminous concrete.	20,001.30	10,000.00	
	7	Jan. 18, 1918	Mar. 5, 1918		Main Road between Goshen and Windsor.	Hampshire	4.61	Macadam	123,890.80	46,100.00	
	8	do	do		Athol-Petersham Road.	Worcester	6.896	Bituminous macadam.	163,374.00	68,900.00	
Mich.	1	Aug. 7, 1917			West Michigan Pike	Muskegon and Oceana	9.922	do	123,080.54	61,540.27	
	2	May 7, 1917	June 28, 1917	Sept. 29, 1917	Saugatuck-Holland Road.	Allegan	5.983	do	77,589.46	39,886.28	38,794.73
	3	June 4, 1917	Sept. 17, 1917		Baraga Road	Baraga	48.262	Graded earth	227,713.86	113,856.93	
	4	July 6, 1917	Sept. 29, 1917		Rogers City-Onaway Road.	Presque Isle	8.62	Gravel	59,536.18	29,768.09	
	6	July 16, 1917	Sept. 18, 1917		Reed City-Cadillac Road.	Osceola	14.08	do	124,000.00	62,000.00	
	7	Nov. 14, 1917	Dec. 5, 1917		Mikado-Oscoda Road	Alcona	5.971	do	50,602.75	25,301.37	
	8	June 28, 1917	July 25, 1917		South Haven-Saugatuck Road.	Allegan	7	Bituminous macadam.	98,000.00	49,000.00	
	10	Nov. 21, 1917	Dec. 10, 1917		Dixie Highway, between Standish and Omer.	Arenac	6.683	Gravel	58,322.00	29,161.00	
	12	Jan. 28, 1918			East Tawas-Oscoda Road.	Iosco	9.718	do	66,000.00	33,000.00	
	13	do			Howell-Fowlerville Road.	Livingston	6.382	do	91,533.20	40,136.50	
	14	Feb. 8, 1918			Battle Creek-Hastings Road.	Barry	4.399	do	47,512.57	23,756.28	
	15	Nov. 28, 1917	Jan. 17, 1918		Brighton-Howell Road	Livingston	4.232	do	32,428.00	16,214.00	
	16	Dec. 15, 1917	do		Ann Arbor-Jackson Road.	Washtenaw	2	Concrete, asphaltic-concrete, or brick.	51,661.50	20,000.00	
	17	Dec. 20, 1917	do		St. Ignace-Soo Road	Chippewa and Mackinac	8	Gravel	77,737.00	38,868.50	
	19	Feb. 2, 1918			Three Rivers-Kalamazoo Road.	St. Joseph	3.97	Stone bottom with gravel top.	42,978.65	21,489.32	
Minn.	1	Dec. 22, 1916	June 9, 1917		Twin Cities-Duluth Road.	Pine	50	Gravel	160,000.00	80,000.00	
	2	Apr. 23, 1917	do	Sept. 6, 1917	do	Chisago	31.5	do	110,000.00	55,000.00	55,000.00
	3	Mar. 24, 1917	Aug. 27, 1917		Scenic Highway	Mill Lake	40	do	100,000.00	50,000.00	
	4	Mar. 1, 1917	Oct. 29, 1917		do	Crow Wing	21	do	60,000.00	30,000.00	
	5	do	June 9, 1917		Capitol National Highway.	Freeborn	16	do	46,200.00	23,100.00	
	6	June 18, 1917	Nov. 16, 1917		Yellowstone Trail	Carver	26.5	Graded and drained earth.	30,000.00	15,000.00	
	7	Mar. 24, 1917	(4)		Minneapolis and Albert Lea Trail.	Hennepin, Carver, and Scott	3.75	do	45,000.00	15,000.00	
	8	do	June 23, 1917		River Road	Winona	6.25	Graded and drained earth.	24,000.00	12,000.00	
	9	Mar. 26, 1917	Aug. 8, 1917		Scenic Highway	Sherburne	8	Gravel	30,000.00	15,000.00	
	11	Aug. 9, 1917	Sept. 29, 1917	Jan. 24, 1918	State Road No. 2	Goodhue	7	do	43,931.15	15,000.00	15,000.00
	12	June 18, 1917	July 19, 1917		St. Paul-Stillwater Road.	Washington	5.3	do	22,506.00	10,000.00	
	13	July 12, 1917	Aug. 14, 1917	Oct. 17, 1917	State Roads Nos. 14 and 15.	Redwood	13.72	Graded and drained earth.	42,739.26	15,742.18	15,742.18
	15	July 19, 1917	Oct. 15, 1917		State Road No. 3	Becker	30.9	Gravel	60,000.00	30,000.00	
	18	July 26, 1917	Sept. 19, 1917		Kellogg-Smithfield Road.	Wabasha	7.5	Graded earth	32,297.00	15,000.00	
Miss.	1	Sept. 11, 1917	Oct. 23, 1917		Tupelo-Fulton-Hamilton.	Itawamba	24	Gravel	90,200.00	45,100.00	
	3	Sept. 3, 1917	Sept. 25, 1917		Raymond-Edwards Road.	Hinds	3	Clay-gravel	13,578.90	5,000.00	
	4	do	Feb. 27, 1918		Forest Road	Scott	5.5	do	11,165.00	5,000.00	
	6	do	Dec. 1, 1917		Meridian Road	Newton	14	Earth	23,122.00	11,217.52	
	7	do	Sept. 28, 1917		Natchez and Mobile Highway.	Greene	22	Graded earth	34,237.00	15,000.00	
	8	do	Sept. 20, 1917		do	Perry	21	do	32,972.00	10,000.00	
	9	Oct. 15, 1917	Dec. 12, 1917		Electric Mills-Porter-ville Road.	Kemper	5.8	Gravel	26,646.00	10,000.00	
	10	do	Dec. 3, 1917		Brookhaven-Summit Road.	Lincoln	10.7	do	36,784.00	10,000.00	
	11	do	Nov. 28, 1917		Smithdale-Summit Road.	Amite	7	do	26,223.56	10,000.00	
	12	do	Dec. 13, 1917		Clarksburg-Morton Road.	Scott	5.3	do	23,848.00	10,000.00	
	13	do	Dec. 27, 1917		Scott Ferry Road	Madison	4.3	Clay-gravel	19,206.00	8,000.00	

¹ Approved as to portion used for mails, Aug. 9, 1917, and Aug. 24, 1917.

² Approved as to post road part, Aug. 17, 1917, and Aug. 27, 1917.

³ No. 5 withdrawn.

⁴ Withdrawn.

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length, in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
Miss.— Cont.	14	Nov. 2, 1917			Howells Ferry Road...	George	13.8	Sand-clay	\$20,955.00	\$10,000.00	
	15	Dec. 21, 1917	Jan. 17, 1918		Woodville-Centreville Road.	Wilkinson	9	Clay-gravel	31,839.50	15,000.00	
Mo....	16	Dec. 21, 1917			Dixie Highway	Simpson	8.4	do	20,313.09	10,000.00	
	1	July 11, 1917	Nov. 16, 1917		St. Louis and Kansas City.	Cole	25.3	Gravel	114,297.92	28,574.48	
	2	July 21, 1917	Sept. 19, 1917	Feb. 18, 1918	Galena-Joplin-Webb City Road.	Jasper	7.5	Concrete	119,211.40	24,376.75	\$23,802.85
	3	Aug. 18, 1917	Oct. 15, 1917		Nevada-Milo Road	Vernon	6.5	Macadam	38,420.42	9,605.10	
	4	Feb. 15, 1918			National Old Trails Road.	Boone	3	Bituminous macadam.	21,458.36	10,729.18	
Nebr...	1	Oct. 6, 1917	Oct. 20, 1917		O. L. D. Highway	Lancaster	5.5	Brick	204,683.05	17,847.50	
	2	Oct. 18, 1917	Dec. 10, 1917		Washington Highway and King of Trails.	Richardson, Nemaha, and Otoe.	57.25	1 mile gravel, balance earth.	69,198.80	34,599.40	
	3	Jan. 8, 1918			Lincoln Highway	Hall	32.1	Earth	39,531.58	19,765.79	
	4	Nov. 1, 1917			Omaha-Yankton Highway.	Wayne and Cedar.	61.25	Sand-clay	59,525.51	25,698.75	
	5	Feb. 2, 1918			Columbus-Norfolk Road.	Madison and Platte.	52.25	Earth and sand-clay.	53,166.52	26,583.26	
	6	Nov. 5, 1917			Kearney-Broken Bow Highway.	Buffalo, Sherman, and Custer.	76	Earth	92,399.91	46,199.95	
	7	Feb. 2, 1918			Minden-Superior Highway.	Kearney, Adams, Clay, and Nuckolls.	94	Sand-clay	86,773.52	43,386.76	
Nev....	1	Oct. 22, 1917	Dec. 12, 1917		Part of Overland Trail.	Humboldt	17.5	Gravel	92,189.94	46,094.97	
	2	do	Dec. 6, 1917		Part of Midland Trail, also section Route No. 4.	Nye	14.3	do	35,790.66	17,895.33	
	3	Nov. 12, 1917	Dec. 15, 1917		Fallon-Hazen Road	Churchill	8	Sand-clay	57,195.20	28,597.60	
	4	do	Dec. 5, 1917		Gardnerville-Holbrook Road.	Douglas	4	25 per cent macadam, balance graded earth.	11,230.12	5,615.06	
	5	Dec. 22, 1917	Jan. 17, 1918		Carlin-Elko Road	Elko	20	Gravel	97,812.00	48,906.00	
	6	Jan. 10, 1918	Feb. 27, 1918		Ely-Hamilton Road	White Pine	12	Gravel or macadam.	62,469.33	31,234.66	
N. H....	1	Dec. 21, 1916	May 4, 1917	Aug. 16, 1917	"Lafayette Road"	Rockingham.	1.15	Bituminous gravel.	16,341.14	7,494.85	8,170.57
	2	June 4, 1917	Aug. 31, 1917	Dec. 11, 1917	South Side Road	Cheshire	1.26	Gravel and macadam.	14,051.13	7,000.78	7,025.56
	3	Dec. 29, 1916	(1)	Dec. 18, 1917	"Winnepesaukee" or "Lake Shore Road."	Belknap	2.25	Gravel	15,725.16	7,500.00	7,862.58
	4	June 4, 1917	Aug. 23, 1917	Dec. 6, 1917	Dover and Rochester Road.	Rockingham and Strafford.	2.26	do	14,952.85	7,500.00	7,476.42
	5	do	do	Oct. 31, 1917	"Newport Road"	Merrimack	1.51	do	11,863.23	4,750.00	5,931.61
	6	do	do	Nov. 3, 1917	Mascoma Valley Road.	Merrimack and Grafton.	2.42	do	20,343.23	7,500.00	10,171.61
	7	do	do		Part of road from Claremont to Plymouth.	Sullivan	.74	Telford with modified asphalt surface.	11,797.00	5,898.50	
	8	do	do		East Side Road	Coos	.85	Bituminous gravel.	12,991.68	6,495.84	
	9	do	do		Sunapee Lake Road	Grafton and Merrimack.	1.55	Gravel	16,007.31	8,003.65	
	10	Jan. 30, 1918			do	Merrimack	1.52	do	9,937.84	4,968.92	
	11	Feb. 4, 1918			Rockingham Road	Rockingham.	1.75	do	11,989.89	5,994.94	
	12	Feb. 16, 1918									
N. J....	1	May 28, 1917	Nov. 5, 1917		Malaga-Penn's Grove Road.	Salem	9.25	Concrete, bituminous macadam, and gravel.	164,988.01	59,212.68	
N. Mex.	1	Sept. 18, 1917	Dec. 27, 1917		Old Santa Fe Trail	Colfax	71.6	Gravel	157,900.00	78,950.00	
	2	do	do		Part of State Road No. 21.	Mora	12.9	Crushed rock or gravel.	68,200.00	34,100.00	
	3	Oct. 11, 1917	do		National Old Trails Route.	Santa Fe	9	Gravel	26,965.00	13,480.00	
	4	Oct. 19, 1917	do		National Old Trails Road.	Valencia	34.7	Graded earth, surfaced where needed.	37,570.50	18,785.25	
	5	Nov. 14, 1917	Dec. 11, 1917		Tucumcari-Montoya	Quay	22	Plain macadam	84,782.24	42,391.12	
	6	do	do		Tucumcari-Glenrio Highway.	do	1	Gravel	4,179.66	2,089.83	
	7	Oct. 30, 1917	Nov. 17, 1917		Revuelto Road	do	3	Graded earth, surfaced with gravel where needed.	10,575.99	5,287.99	
	8	Nov. 14, 1917	Dec. 1, 1917		Mescalero Sand Road	Chaves	7	Macadam	27,999.86	13,999.93	
	9	Nov. 17, 1917	Dec. 3, 1917		Silver City-Gila River Road.	Grant	17	Gravel	55,484.00	27,742.00	
	10	Nov. 16, 1917	do		Borden Hill-Honda Road.	Lincoln	25	do	116,479.00	58,239.50	
	11	Nov. 17, 1917	do		Roswell-Carrizozo Road	do	5	do	25,371.50	12,685.75	
12	Nov. 26, 1917	Dec. 12, 1917		Roswell-Tatum Road	Chaves	15.5	Gravel or macadam.	112,178.00	56,089.00		
N. Y....	1	Sept. 13, 1917	Sept. 25, 1917		Brockton-Fredonia Road.	Chautauqua	4.64	Concrete	92,800.00	46,400.00	
	2	do	do		Perry Center-Moscow Road.	Wyoming	2.59	Bituminous macadam.	51,195.10	25,597.55	
	3	do	do		Greene-Oxford Road	Chenango	11.44	do	227,693.00	113,846.50	
	4	do	do		Fredonia-Silver Creek Road.	Chautauqua	4.2	Concrete	83,999.00	41,999.50	
	5	Oct. 29, 1917			Copake-Mount Riga Road.	Columbia	7.33	Concrete or macadam.	135,875.00	67,937.50	
	6	Sept. 13, 1917			New York State Line-Nyack Road.	Rockland	5.57	Macadam or concrete.	110,000.00	55,000.00	
	7	Jan. 18, 1918			Nicholville-St. Regis Falls Road.	St. Lawrence	3.5	Bituminous macadam.	55,000.00	27,500.00	
	8	Feb. 18, 1918			Alton-Wolcott Road	Wayne	3.21	Bituminous macadam or concrete.	63,900.00	31,950.00	

1 Superseded by project No. 9.

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designations of road.	County.	Length, in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
N. C.	1	Dec. 20, 1916	Apr. 21, 1917	June 23, 1917	Bridge across Catawba River.	Mecklenburg and Gaston.	(1)	Bridge.....	\$51,956.52	\$10,000.00	\$10,000.00
	2	Mar. 23, 1917	Apr. 26, 1917	Aug. 16, 1917	Hickery Nut Gap Road.	Henderson.	7.75	Graded earth...	26,392.83	10,000.00	13,196.41
	3	do.	June 29, 1917	Nov. 23, 1917	Swannonoa Gap Road.	McDowell.	2.85	do.	26,490.50	10,000.00	10,000.00
	4	Oct. 3, 1917	Oct. 20, 1917		Beaufort Road.	Craven.	9.5	Topsoil and sand-clay.	20,000.00	10,000.00	
	5	June 11, 1917	Aug. 7, 1917	Jan. 17, 1918	Central Highway.	Burke.	8.03	Topsoil.	20,985.27	5,000.00	5,000.00
	7	do.	(2)		Wilmington - Fayetteville Highway.	Sampson.	47.5	Sand-clay and gravel.	66,929.28	10,000.00	
	8	do.	Oct. 17, 1917		do.	Cumberland.	13.8	Sand-clay gravel.	28,956.87	5,000.00	
	10	Oct. 4, 1917	Oct. 20, 1917		Denton-Troy Road.	Davidson.	7.5	Topsoil or concrete.	19,595.13	8,000.00	
	11	Oct. 22, 1917	Nov. 5, 1917		Central Highway.	Lenoir.	1.75	Concrete.	32,967.00	10,000.00	
	12	June 11, 1917	Aug. 31, 1917	Feb. 9, 1918	do.	Wayne.	8.23	Sand-clay gravel.	17,769.40	5,000.00	5,000.00
	14	June 28, 1917	Sept. 13, 1917		New Hope Road.	Halifax.	8	Clay-gravel.	13,809.19	5,000.00	
	15	Aug. 13, 1917	Aug. 3, 1917	Feb. 9, 1918	National Highway to Danville, Va.	Guilford.	14.55	Topsoil and bituminous macadam.	26,834.41	7,500.00	7,500.00
	16	Aug. 24, 1917	Sept. 18, 1917		Asheville - Atlanta - Knoxville Highway.	Haywood.	14.27	Gravel and sand-clay.	27,132.16	8,000.00	
	17	Jan. 7, 1918	Jan. 21, 1918		North Wilkesboro-Deep Gap-Boone Highway.	Wilkes.	25	Graded earth...	53,790.00	25,000.00	
	18	Oct. 25, 1917	Dec. 7, 1917		Taylorsville - Wilkesboro Road.	Alexander.	11	Topsoil.	27,332.36	10,000.00	
	19	Jan. 23, 1918			National Highway.	Rockingham.	8.22	do.	24,218.96	10,000.00	
	20	Jan. 28, 1918			Yadkinville - Wilkesboro Road.	Yadkin.	7	do.	16,543.44	5,000.00	
	21	Feb. 6, 1918			Roxboro-Virginia Road	Person.	7.55	Sand-clay or topsoil.	17,934.29	5,000.00	
N. Dak.	1	July 12, 1917	Aug. 30, 1917		Meridian Road.	Cass.	17	Graded earth...	15,444.00	7,722.00	
	2	do.	do.		5 miles on Primary Road and 10 miles on Secondary Road.	Foster.	15	1½ miles gravel, balance earth.	11,781.00	5,890.50	
	3	Jan. 5, 1918			Wonderland Trail.	Williams.	30.5	Earth.	39,658.04	19,829.02	
	4	Aug. 10, 1917			Meridian Road.	Richland.	20	do.	13,407.43	6,703.71	
	6	Jan. 21, 1918			Black Trail.	Eddy.	5.5	Gravel and earth.	6,653.53	3,326.76	
	7	Feb. 4, 1918			New Home Road.	Stutsman.	9.2	Earth.	12,972.96	6,486.48	
	8	Jan. 21, 1918			Fessenden-New Rockford-Carrington Road.	Eddy.	9.5	Gravel.	23,949.24	11,974.62	
	9	Feb. 5, 1918			Meridian Road.	Grand Forks.	3.6	do.	11,456.50	5,728.25	
	10	Feb. 6, 1918			Balta Road.	Pierce.	5	1 mile gravel, 4 miles sand-clay.	7,999.64	3,999.82	
	11	Feb. 11, 1918			Rock Lake - Langdon Road.	Cavalier.	7.8	Graded earth...	7,190.92	3,595.46	
	12	Feb. 7, 1918			Black Trail and Red Trail.	Barnes.	29.6	Earth and gravel.	47,775.09	23,887.54	
	13	Feb. 9, 1918			Pingree - Woodworth Road.	Stutsman.	7.9	Earth.	15,080.19	7,540.09	
	14	Feb. 11, 1918			Black Hills Auto Trail.	Stark.	18.9	do.	18,944.26	9,472.13	
	16	Feb. 8, 1918			Wonderful Trail.	Grand Forks.	6.9	Gravel.	17,295.12	8,647.56	
	17	Feb. 11, 1918			Red and Yellow Trail.	Griggs.	17.5	Earth.	21,707.40	10,853.70	
	18	Feb. 13, 1918			Wonderful Trail.	Ramsey.	5.3	do.	3,729.17	1,864.58	
Ohio	1	May 4, 1917	Oct. 17, 1917	Dec. 1, 1917	Old National Road.	Muskingum.	13.63	Brick or concrete.	488,501.00	136,300.00	136,300.00
	2	May 17, 1917	Sept. 6, 1917	Oct. 17, 1917	River Road.	Lucas.	4.48	Macadam and concrete.	76,900.00	37,000.00	37,000.00
	3	May 18, 1917	do.	Oct. 16, 1917	do.	do.	3.73	Concrete.	90,300.00	37,300.00	37,293.00
	4	Aug. 20, 1917	Sept. 28, 1917	Dec. 1, 1917	Cleveland - Buffalo Highway.	Lake.	7.715	Reinforced concrete or semi-monoolithic brick.	270,209.28	77,150.00	77,150.00
	5	do.	do.	Dec. 3, 1917	do.	do.	5.433	Reinforced concrete or monoolithic brick.	189,170.00	54,330.00	54,330.00
	6	Aug. 31, 1917	Nov. 2, 1917	Dec. 1, 1917	Ashland-Wooster Road.	Ashland.	2.47	Monoolithic brick.	68,000.00	24,600.00	24,600.00
	7	do.	Sept. 20, 1917	Dec. 3, 1917	Columbus-Wooster Road.	do.	1.542	do.	46,500.00	15,400.00	15,400.00
	8	Jan. 18, 1918			do.	Knox.	4	Brick or concrete.	163,893.40	40,000.00	
	9	do.			do.	do.	2	do.	65,289.13	10,000.00	
	10	Jan. 21, 1918			Cleveland-Wooster Road.	Wayne.	5	Bituminous macadam or brick.	140,662.50	50,000.00	
	11	Feb. 19, 1918			Cleveland - Buffalo Road.	Ashtabula.	11.92	Brick or concrete.	431,790.00	119,000.00	
	12	Feb. 15, 1918			Ashland-Wooster Road.	Wayne.	6.71	Brick.	170,541.95	50,000.00	
Okla.	2	Oct. 10, 1917	Nov. 16, 1917		Broken Bow-Smithville Road.	McCurtain.	25	Gravel.	100,058.75	50,029.37	
Oregon.	1	Aug. 15, 1917	(3)		Pacific Highway.	Josephine.	4.9	Graded earth...	83,606.50	41,800.00	
	2	Sept. 11, 1917	(4)		do.	Douglas.	10.8	Macadam.	233,653.75	108,000.00	
	3	do.	(5)		do.	do.	4.8	Graded and drained earth.	38,065.50	19,032.75	
	4	Oct. 20, 1917	Dec. 4, 1917		John Day Highway.	Wheeler.	9.47	Earth.	36,733.40	18,366.70	
	5	Dec. 10, 1917	Feb. 25, 1918		Elgin-Minam Road.	Union.	9.3	do.	36,094.30	18,047.15	
	6	Dec. 20, 1917			John Day Highway.	Grant and Wheeler.	48.45	do.	400,433.79	157,216.89	
	7	Dec. 28, 1917			Pacific Highway.	Marion.	21	Bituminous macadam.	359,546.00	179,773.00	
Pa.	1	Oct. 5, 1916	Feb. 17, 1917	May 11, 1917	Waterford and Susquehanna Turnpike.	Clarion.	2.675	Vitrified brick on concrete foundation.	70,857.65	26,750.00	26,750.00
	2	do.	Mar. 21, 1917	do.	Washington Pike.	Washington.	6.48	Reinforced concrete.	160,433.53	64,800.00	64,800.00
	3	do.	Feb. 13, 1917	do.	Johnstown and Munds Corner Road.	Cambria.	6.234	Brick on concrete base.	138,466.49	62,340.00	62,340.00

1 1,760 feet.

2 Not included in 1918 schedules.

3 Disapproved Sept. 29, 1917.

4 Disapproved Oct. 17, 1917.

5 Canceled after being approved for 2.4 miles used for mails.

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length, in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.	
Pa. (con.)	4	Oct. 3, 1917	Oct. 20, 1917	Nov. 23, 1917	Kane-Mount Jewett Road.	McKean...	4.186	Vitrified brick.	\$158,674.78	\$41,860.00	\$41,860.00	
	5	Nov. 1, 1917	Dec. 1, 1917		Johnstown Road.....	Somerset...	7.45	Reinforced concrete or bituminous concrete and vitrified brick.	308,290.62	74,500.00		
	6	do	do		Altoona-Tyrone Road..	Blair.....	3.01	Bituminous concrete.	91,319.08	30,100.00		
	7	Nov. 22, 1917	Dec. 3, 1917		Wampum-New Castle Road.	Lawrence..	4.98	Reinforced concrete.	180,746.50	49,800.00		
	8	Jan. 7, 1918	Jan. 29, 1918		Buffalo Ridge Road....	Erie.....	28.3	Cement concrete or bituminous concrete on concrete base.	809,380.00	283,000.00		
	9	Feb. 2, 1918	Feb. 28, 1918		State Highway Route No. 13.	Butler....	3.69	Reinforced concrete.	129,888.00	36,900.00		
	10	do	do		State Highway Route No. 77.	Lawrence..	2.33	do	84,579.00	23,300.00		
	11	do	do		State Highway Route No. 18.	Lycoming..	6.97	do	230,010.00	69,700.00		
	13	do	do		State Highway Route No. 71.	Armstrong.	4.1	do	157,850.00	41,000.00		
	16	do	do		State Highway Route No. 73.	Butler....	3.3	do	127,050.00	33,000.00		
	R. I.	1	Apr. 24, 1917	May 29, 1917	Sept. 13, 1917	Post Road.....	Washington	3.64	Bituminous concrete.	85,444.16	34,997.13	34,997.13
	S. C.	1	Aug. 28, 1917	Sept. 15, 1917		Garners Ferry Road....	Richland..	2.12	Concrete.....	49,846.94	23,248.20	
		2	do	do		National Highway.....	Spartanburg	14.9	Concrete or brick and topsoil.	132,706.68	48,577.87	
		3	Aug. 29, 1917	do		do	Greenville..	4.9	Concrete.....	76,899.90	38,449.95	
		4	Oct. 11, 1917	Nov. 8, 1917	Dec. 22, 1917	Cherry Road.....	York.....	3	Cement concrete.	36,757.69	18,378.84	18,378.84
		5	do	do		Washington-Atlanta Highway.	Chesterfield	2.14	Gravel.....	11,911.02	5,955.51	
Tenn.	1	Nov. 12, 1917	Jan. 17, 1918		Chattanooga-Birmingham Pike.	Hamilton..	1.87	Macadam.....	42,598.66	21,299.33		
	2	do	Feb. 27, 1918		Chattanooga-Whitwell Pike.	do	3.6	do	36,855.81	18,427.90		
Tex.	1	Oct. 13, 1917	Dec. 5, 1917		Dougherty Highway...	Culberson..	50.4	Grading and gravel where required.	45,265.55	22,632.77		
	2	do	Dec. 4, 1917		Edinburg Road.....	Brooks....	20	Sand-clay or gravel.	42,077.75	21,038.87		
	3	do	Dec. 1, 1917		Section of Meridian Road.	Wichita....	8.9	Bituminous gravel.	87,737.10	43,868.55		
	4	do	do		Austin-Pflugerville Road.	Travis....	6	do	25,389.10	12,500.00		
	5	do	Dec. 3, 1917		Monahan-Grand Falls Road.	Ward.....	17.5	Gravel.....	26,141.50	13,070.75		
	6	Nov. 5, 1917	Dec. 7, 1917		Fort Worth-El Paso Highway.	Shackelford	9	do	30,221.68	15,110.84		
	7	Nov. 26, 1917	Dec. 19, 1917		do	Mitchell...	7.5	do	25,867.60	12,933.80		
	8	do	Dec. 20, 1917		Austin-San Antonio Post Road.	Hays.....	24.8	Gravel, bituminous top-ping.	43,131.00	21,565.50		
	10	Jan. 10, 1918			Meridian Highway....	Williamson	21.5	Gravel base, bituminous top.	106,375.50	50,000.00		
	11	Nov. 5, 1917			Seven Mile Road.....	McLennan.	1.25	Gravel with asphalt surface.	10,003.07	5,000.00		
	12	do			Waco-Marlin Road....	do	3.5	Bituminous gravel.	25,003.00	12,500.00		
	13	do			Waco-Valley Mills....	do	3	do	25,088.80	12,500.00		
	14	Jan. 1, 1918			Meridian Road.....	Wise.....	42.3	Gravel, possibly bituminous top.	170,000.00	80,000.00		
	15	Dec. 11, 1917	Jan. 8, 1918		Part of Central Route or State Highway No. 3.	Wharton... 3.3	Bituminous gravel.	23,526.70	11,763.35			
	16	do	Jan. 17, 1918		Puget Sound-Gulf Highway.	McColloch.. 37.4	Gravel and sand-clay.	75,774.60	35,000.00			
	17	Dec. 26, 1917			Puget Sound-Gulf Highway.	Mason..... 24	Sand-clay and gravel.	22,533.50	11,266.75			
	18	Jan. 23, 1918			Winfield-Saltville Highway.	Franklin... 12.15	Gravel.....	49,500.00	24,750.00			
	19	Dec. 26, 1917			Fort Worth-El Paso.	Eastland... 28.3	do	117,983.80	35,000.00			
	20	Nov. 28, 1917	Dec. 20, 1917		Meridian Highway....	Johnson... 33.89	do	89,365.10	44,682.55			
	21	Dec. 26, 1917			Jefferson Highway....	Gregg..... 14.6	Bituminous macadam.	57,995.72	19,000.00			
	22	Dec. 22, 1917			Maple Avenue between Dallas city limits and Love Aviation field.	Dallas..... 3	Macadam with asphalt surface.	20,401.48	10,200.00			
	23	do			Rowlett-Dallas-Rockwall Road.	do	3.00	Gravel.....	14,000.00	7,000.00		
	24	do			Dallas-Fort Worth Road.	do	1	Concrete.....	20,000.20	10,000.00		
	25	do			Millers Ferry Road....	do	3	Macadam with asphalt surface.	19,999.98	10,000.00		
	26	Jan. 10, 1918			El Paso-Texarkana Road.	Titus..... 8	Bituminous gravel.	56,039.69	28,019.84			
	27	Jan. 5, 1918			Jefferson Highway....	do	11.25	do	19,800.00	9,900.00		
	28	Feb. 2, 1918			Omaha-Cookville and Omaha-Naples.	Morris..... 10.88	Sand-clay.....	65,200.00	32,600.00			
	29	Jan. 5, 1918			Del Rio-Canadian.	Val Verde.. 3.64	Gravel.....	25,687.90	12,843.95			
	30	Jan. 14, 1918			East Texas Highway...	Jasper..... 13.6	do	71,696.90	30,000.00			
	32	Feb. 13, 1918			Washington Avenue and Webster Air Line.	Harris..... 3.183	Concrete with bituminous top.	113,221.22	34,602.19			
	34	Jan. 12, 1918			Fort Worth-Roswell Highway.	Dickens... 6.5	Gravel.....	32,439.00	15,345.00			
	35	Jan. 14, 1918			Seguin-Gonzales Road.	Guadalupe. 15.7	Gravel with bituminous top.	69,789.50	34,894.75			
	36	Jan. 24, 1918			Middle Buster Highway.	Caldwell... 15.8	Gravel.....	77,061.82	35,000.00			

RECORD OF FEDERAL AID, TO MARCH 1, 1918—Continued.

State.	Project No.	Date submitted.	Date approved.	Plans, specifications, and estimates approved.	Local designation of road.	County.	Length in miles.	Type of construction.	Total estimated cost.	Federal aid requested.	Federal aid allowed.
Tex. (con.)	37	Jan. 19, 1918			Central Route Highway.	Fayette....	11	Bituminous gravel.	\$73,546.00	\$36,773.00	
	41	Jan. 22, 1918			Saginaw Road.	Tarrant....	10	do.	68,740.65	34,370.32	
Utah...	42	do.			Weatherford Road.	do.	6.2	do.	28,619.25	14,309.63	
	1	July 3, 1917	Sept. 27, 1917		Castle Gate-Duchesne Road.	Carbon and Duchesne	45	Earth.	77,400.00	38,700.00	
	2	Aug. 14, 1917			Ogden-Hooper Road.	Weber....	9.6	Macadam.	32,818.75	16,409.37	
	4	Sept. 15, 1917			Price-Emerly Road.	Emery and Carbon.	63	Graded earth.	109,923.00	54,961.50	
	5	Nov. 23, 1917	Jan. 17, 1918		Thompsons-Moab Road	Grand....	35	do.	50,685.25	25,342.62	
	6	do.	do.		Moab-La Sal Junction Road.	Grand and San Juan.	24	do.	34,755.60	17,377.80	
	7	do.	do.		La Sal Junction-Monticello Road.	San Juan....	36	do.	52,133.40	26,066.70	
	8	do.	do.		Monticello-Blanding Road.	do.	25	do.	36,203.75	18,101.87	
Vt.	1	June 14, 1917	July 25, 1917		French Hill Road.	Chittenden.	.9	Gravel.	9,991.52	4,995.76	
	2	do.	do.	Dec. 11, 1917	Winooski River Road.	Washington	.793	Gravel with stone base.	10,192.46	3,225.47	\$5,096.23
	3	July 5, 1917	Aug. 31, 1917		St. Johnsbury - Wells River Road.	Caledonia..	.7	Gravel on stone base.	11,935.79	5,967.89	
	4	do.	Sept. 5, 1917		Old Stage Road.	Addison..	1.4	Gravel.	10,135.75	5,067.87	
	5	July 7, 1917	Aug. 31, 1917		Richford Road.	Franklin..	.75	do.	7,390.12	3,690.06	
	6	Aug. 14, 1917	do.		River Road.	Orange....	2.4	Gravel or macadam.	11,792.44	5,896.22	
	7	do.	do.		Brattleboro - Wilmington Road.	Windham..	1.65	Gravel.	13,308.34	6,654.12	
Virginia	8	Aug. 22, 1917	Sept. 4, 1917		Gulf Road.	Caledonia..	1.25	do.	7,928.80	3,964.40	
	9	do.	Sept. 19, 1917		Morrill Hill Road.	Orleans....	2.85	do.	25,961.58	12,980.79	
	1	May 11, 1917	June 4, 1917	Aug. 27, 1917	Moccasin Gap Road.	Russell....	4.38	Gravel and macadam.	28,441.22	14,236.75	14,220.61
	2	May 21, 1917	July 12, 1917	Sept. 18, 1917	Marumscoc-Neabasco Road.	Prince William.	3.51	Gravel.	37,814.72	10,000.00	12,857.06
	3	June 11, 1917	July 20, 1917		Kecoughton Road.	Elizabeth City.	3.45	Concrete.	50,000.00	22,500.00	
Wash.	4	July 7, 1917	Aug. 2, 1917	Sept. 20, 1917	Danville-Martinsville Highway.	Pittsylvania.	8.03	Topsoil.	16,797.44	10,650.00	8,398.72
	15	Dec. 4, 1917	Dec. 2, 1917		Harrisonburg-Warm Springs Turnpike.	Augusta...	5.682	Macadam.	45,250.17	22,625.08	
	6	Dec. 23, 1917	Jan. 8, 1918		Moccasin Gap Road.	Russell....	3.58	do.	33,103.30	16,551.65	
	1	Mar. 24, 1917	Apr. 23, 1917	July 19, 1917	Pacific Highway.	Thurston...	3.52	Concrete.	61,730.45	30,865.22	30,865.22
	2	May 24, 1917	July 16, 1917	Nov. 8, 1917	Navy Yard Highway.	Mason and Kitsap.	9.9	Gravel.	83,405.99	41,018.94	41,018.95
	3	June 12, 1917	July 26, 1917	Feb. 13, 1918	State Road No. 22.	Stevens....	5.92	do.	33,142.18	20,000.00	15,571.09
	4	May 29, 1917	do.	Jan. 28, 1918	Pacific Highway.	Clarke....	3.62	Gravel or macadam.	78,065.57	35,000.00	35,000.00
	5	June 23, 1917	Sept. 27, 1917	Dec. 28, 1917	do.	Cowlitz....	5.22	Graded and drained earth.	91,194.51	40,000.00	40,000.00
	6	May 25, 1917	Aug. 8, 1917	Dec. 7, 1917	Kamillehe section of Olympic Highway.	Mason....	3.41	Gravel.	47,724.19	20,000.00	20,000.00
	7	July 20, 1917	Nov. 17, 1917		Sunset Highway.	Lincoln....	8.3	Gravel or macadam.	60,714.50	28,768.56	
W. Va. ..	1	July 21, 1917	Aug. 16, 1917	Jan. 28, 1918	Ronceverte and Lewisburg Highway.	Greenbrier.	2.53	Asphaltic concrete.	32,857.08	9,246.48	9,246.48
	2	Feb. 14, 1918			Fetterman-Pruntytown Road.	Taylor....	2	Brick surface on concrete base.	57,420.00	8,000.00	
	3	Dec. 22, 1917	Jan. 17, 1918		Petersburg-Franklin Road.	Pendleton..	10	Graded and drained earth.	36,000.00	12,500.00	
	4	Feb. 14, 1918			Brandonville and Fishing Creek Turnpike.	Marion....	2.4	Brick road on concrete base.	43,461.00	13,000.00	
	5	Jan. 11, 1918			Westover-Randall Road.	Monongalia	2.6	Cement concrete.	60,247.00	18,000.00	
	7	Feb. 14, 1918			Round Bottom.	Wetzel....	1.3	Concrete.	30,319.30	8,645.00	
	8	Feb. 25, 1918			Wilson Creek-Elmwood Road.	Wayne....	2	do.	60,930.00	8,930.00	
Wis.	10	do.			Clarksburg Road.	Mason....	5.89	do.	133,000.00	16,530.00	
	12	do.			Seneca Pike.	Randolph..	1.89	Earth.	9,197.10	4,588.55	
	1	July 5, 1917	Dec. 20, 1917		Sheridan Road, also known as Lake Shore Highway.	Racine....	3.2	One-course cement-concrete.	53,900.00	17,966.66	
	2	do.			Lake Shore Road.	Manitowoc.	.61	Bridge, 21-foot span.	22,161.92	7,387.30	
	3	do.			Sheridan Road.	Kenosha...	1.5	Cement concrete.	28,429.50	9,476.50	
	4	Feb. 2, 1918			Shawano-Green Bay Road.	Shawano....	7.33	Gravel.	36,102.00	12,034.00	
	7	Feb. 19, 1918			Watertown Plank Road	Waukesha.	3.66	Water-bound macadam.	29,975.00	9,991.66	
	8	Feb. 1, 1918			Madison - Middleton Road.	Dane....	3.4	Concrete.	75,622.27	25,207.42	
	9	do.			Green-Bay-Kewaunee.	Kewaunee. (?)		Gravel macadam.	9,152.00	3,050.66	
	12	Sept. 25, 1917			Madison - Sauk City Road.	Dane....	2.73	Water-bound macadam.	29,645.00	9,881.66	
Wyo.	19	Feb. 2, 1918			Prntice-Phillips Road.	Price....	6.9	Earth.	20,790.00	6,930.00	
	1	June 12, 1917			Casper-Salt Creek Road	Natrona....	45	do.	59,670.00	29,835.00	
	2	June 16, 1917	Oct. 17, 1917		Medicine Bow-Marshall Road.	Albany....	23.4	Earth.	10,349.94	5,174.97	
	3	June 19, 1917			Cokeville-Star Valley Road.	Lincoln....	30	do.	15,862.00	7,931.00	
	4	June 25, 1917	Jan. 10, 1918		Hat Creek-Warren Road.	Niobrara...	6.76	Graded and drained earth.	9,999.95	4,999.97	
	5	July 3, 1917	Dec. 12, 1917		Eden Valley Road.	Sweetwater	14	Earth.	15,987.40	7,993.70	
	7	July 5, 1917	Jan. 10, 1918		Carter-Lyman Road.	Uinta....	1.5	Graded and drained earth.	2,242.02	1,121.01	
	8	July 17, 1917			Cody-Meeteetse Road.	Park....		4 bridges.	8,564.52	4,282.26	
	10	July 24, 1917	Nov. 16, 1917		Part of Wheatland-Laramie Road, including 2 bridges.	Platte....	1.2	Earth.	4,100.23	2,050.11	
	12	Aug. 8, 1917	do.		Part of Big Piney Road.	Lincoln....	4.12	Gravel.	8,125.15	4,062.57	
17	Nov. 16, 1917	Jan. 10, 1918		Fort Bridger-Urie Road	Uinta....	3.83	Graded and drained earth.	5,896.00	2,948.00		

1 Withdrawn.

2 7,900 feet.

FEDERAL AID PROJECTS IN IDAHO.

The projects upon which the Idaho State Highway Commission expects to use Federal aid funds in 1918 are:

(a) Portions of the north and south highway lying between New Meadows and Grangeville, in Idaho County;

(b) A portion of Lost River Highway, in Custer County; and

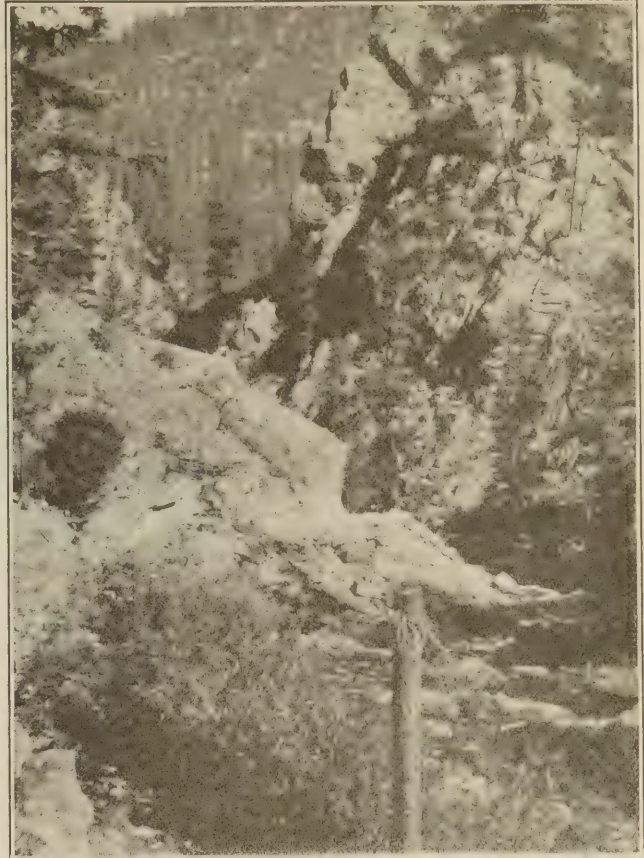
(c) A portion of Sawtooth Park Highway, in Lemhi County.

It can be argued that all of these are meritorious post-road projects and are urgently needed. The roads of which these are a part have a total mileage of about 208, and the building of approximately one-half is contemplated this year.

The people of the entire State, and particularly the adjoining communities, are much interested in the first-named road. Because of the topography of the country, the Salmon River Canyon, through which it will run, is the only possible route lying within the State which connects the north and south portions. At present only a dangerous stage trail traverses the canyon, which in reality is little short of an effective barrier separating the two sections of the State. It is expected to let contracts from Grangeville southward and build during the season to and south from Whitebird a few miles—about 23 miles in this vicinity. Also, beginning 10 miles below New Meadows, it is intended to build northward through about 5 miles of extremely rough canyon, making a total of approximately 28 miles of the 88 miles of post road on north and south highway to be built this year, at a total cooperative cost of approximately \$320,000.

(b) The Mackay-Challis section is 60 miles long and the estimated cost \$190,000, this being the easiest construction encountered. This link is urgently needed because of the isolated mining region and other infant industries it will serve and from which high-grade ores are now being brought out 60 to 100 miles on motor trucks and wagons to the rail terminus at Mackay. The present rate of trucking supplies in from Mackay to Challis, the county seat, is \$20 per ton. Rapid development undoubtedly will follow road construction.

(c) The section of highway from Salmon to Challis is quite rough, narrow, and has many dangerous turns in the present road; the project contemplated this year will build from Salmon southward some 30 miles. Cooperative State, county, and Federal funds will be used to the extent of about \$200,000, and it is believed that the greater portion of the dangerous places will be covered, thereby eliminating the danger of accidents to tourists and strangers who traverse this wonderfully scenic region, as well as make safer traffic conditions for residents. It is expected also to secure daily mail service between Salmon and Challis, instead of alternate daily service now maintained.



Along the Little Salmon.

IOWA'S FIRST PROJECT NEARLY COMPLETE.

IOWA'S first Federal aid project, 4.07 miles in length, is a link in the road connecting Mason City and the city of Clear Lake, in Cerro Gordo County. Mason City is an important manufacturing center, having very large Portland cement and clay products industries. Clear Lake is a popular summer resort. Many residents of Mason City have their summer homes at Clear Lake and during this season travel back and forth in automobiles. Two miles of the road between the two cities had been paved with concrete, 16 feet wide, previous to the promotion of this project, which will provide, when completed, a pavement from the west corporate limit of Mason City to the east corporate limit of Clear Lake.

The pavement is built of reinforced concrete to a width of 16 feet, and has a thickness of 7½ inches at the center and 6 inches at the sides, with no expansion joints. Before placing the concrete the roadbed was graded level from side to side, the additional 1½ inches in the depth of the concrete at the center providing the crown of the pavement. The concrete was proportioned: One part Portland cement, two parts sand, and three parts broken stone. The sand used in the work was obtained from local pits and washed and screened. The coarse aggregate was Wisconsin trap rock. Work was commenced by the contractor, the Bryant Asphalt Paving Co., of Waterloo, Iowa, October 1, 1917, and discontinued October 27 on account of cold

weather, at which time 7,360 linear feet of surfacing had been laid. The materials and workmanship were unusually good and the work appears to be in fine condition. The contract price for the pavement was \$1.62 per square yard, exclusive of the



Showing materials for concrete distributed on road bed and manner of handling same to mixer. Iowa Federal Aid Project.

cement, which was furnished by the county. The cement cost \$1.90 per barrel, or 61 cents per square yard of pavement, making the total cost of pavement, \$2.23 per square yard. This does not include the cost of grading and drainage structures.

RHODE ISLAND'S PROJECT.

The project statement for Rhode Island project No. 1 was mailed April 20, 1917. Notice that the project had been approved was received from Washington June 1. The plans, specifications contract, and bond were then prepared and sent to Federal District Engineer Miller. The site of the work was inspected by Mr. Miller in company with the State engineers June 26. The project agreement was executed September 13. Advertisements for the work involved appeared October 11 and proposals were opened October 26. The contract was awarded November 7 at a price approximately \$2,000 less than the estimated cost of the items contained in the proposal. The clearing and grubbing were very nearly completed, and a small amount of excavation was accomplished before the weather stopped further work upon the contract. The type of construction adopted was bituminous concrete of the Topeka type.

From hundreds of thousands of American farms, in answer to the call of their country and in obedience to the law of their country, American boys have gone and to-day are fighting side by side with hundreds of thousands of American boys from the cities and towns of the country, confronting danger and death.

The duty of us who remain at home in safety to afford the means to make these boys powerful and victorious is a most imperative one.

Buy Liberty Bonds and furnish them with the sinews of war.

OHIO HAS TWELVE PROJECTS.

By

T. D. BRUNING, Chief Highway Engineer.

Under act of the legislature passed March 21, 1917, by which the State assented to the provisions of the Federal aid road act and authorized the State highway department to enter into contracts with the United States touching the construction and maintenance of rural post roads, all funds apportioned to the State must be expended upon the highways comprising the system of main market and intercounty highways.

So far the State of Ohio has submitted for consideration of the Federal authorities 12 Federal aid projects, for the first seven of which project agreements have been drawn. For three projects, known as Nos. 2, 3, and 7, the contracts have been let, although upon the first two no actual work of construction has been done.

The type of pavement on project No. 2, which is an intercounty highway in Lucas County, is reinforced concrete and water-bound macadam. That on project No. 3, also in Lucas County, is of reinforced concrete. Work on No. 7, in Ashland County, was suspended on account of the severity of the weather after but little of the grading and culvert work had been done.



Completed concrete paving in Iowa. Shoulders not finished.

VERMONT FEDERAL AID.

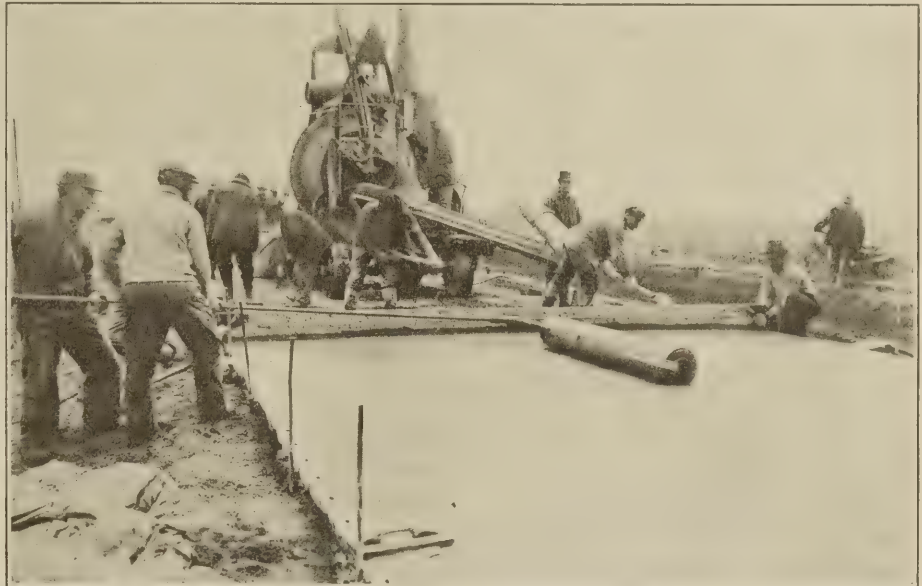
By

HERBERT M. McINTOSH, State Engineer.

The proposition of the Federal Government assisting the States in their effort to improve more important roads has met with general favor in Vermont. While the Federal work has not yet pro-

gressed beyond the paper stage in this State, we feel that we are getting organized, and will, under reasonable conditions, be able to show results the coming season.

Vermont's system of trunk lines or State roads consists of certain important highways which have



Showing manner of placing concrete on road bed and use of roller in removing water from surface of Iowa road.

been chosen by mutual agreements between the State and towns. So far the work on these selected roads has been done by joint action between the State and the several towns through which the roads pass. This cooperative work has resulted in developing a system of well-constructed earth and gravel roads, but with short stretches still in need of improvement. I make this brief statement, that the conditions under which we are working may be understood.

Careful consideration was given to the selection of our earlier Federal-aid projects. In making these selections, we did not alone consider the Government's requirements, but endeavored to offer such projects as would most improve our general road system, not forgetting local considerations. Our efforts resulted in submitting nine

projects to the Federal department with the gratifying result that all were accepted.

These projects are short, varying from 0.7 to 2.8 miles, and are fairly well distributed over the State, and as a rule fill in gaps between improved sections on our most important selected roads. All nine projects have been surveyed, and plans and speci-

fications completed for three of them, two of which have been submitted, and one accepted and agreement entered into. The plans and specifications for the remaining projects are in process of completion. These projects have a total length of 12.72 miles, and, as now contemplated, will be constructed of either gravel or macadam surface 18 to 21 feet in width with subdrain or stone base, where conditions require.

PROGRESS IN MICHIGAN.

By

J. H. BATEMAN, Office Engineer, Michigan State Highway Department.

Before the passage of the Federal-aid road act, roads in Michigan were constructed entirely by the various counties, townships, and road districts throughout the State. The State highway department's activity was confined largely to the distribution of State reward to the local communities building roads under specifications prepared or approved by the State highway commissioner. The State already had engaged in the construction of bridges on State trunk-line roads and was just beginning the construction of roads by special assessment under the provisions of a law passed by the 1915 legislature.

The Federal-aid law required that the State legislature, at its next regular session, assent to its provisions. The question had been raised as to the legality of the State building roads under the provisions of the State constitution, and to assure this, the 1917 legislature passed a joint resolution to refer a constitutional amendment to the people which would provide the necessary authority. The people voted favorably upon this amendment and the legislature then passed act No. 99, P. A. 1917, assenting to the provisions of the national law and outlining the procedure for building Federal-aid roads in Michigan. The essential features of the plan are as follows:

1. The State highway department, through the State highway commissioner, is authorized to take charge of all the management, engineering, building, and maintenance of Federal-aided roads and to enter into all contracts and agreements with the United States Government relative thereto.

2. Funds for building these roads are to be provided by the State and the local communities. The local communities are required to pay a certain percentage, depending upon their assessed valuation per trunk-line mile, according to the following table:

Assessed valuation per trunk-line mile.	Per cent of cost to be paid by local community.
Below \$100,000.....	25
\$100,000 to \$200,000.....	30
\$200,000 to \$300,000.....	35
\$300,000 to \$400,000.....	40
\$400,000 to \$500,000.....	45
Over \$500,000.....	50

In each case the State pays the remainder of the cost from the State funds appropriated for this purpose and from such funds as may be allotted to each project by the Federal Government. The valuation per trunk-line mile of any county is determined by dividing the latest State equalized valuation by its allotted trunk-line mileage, computed on the basis of the number of surveyed townships in each county.

3. Localities in which Federal-aided roads are built are required to raise annually a sum equal to 3 per cent of the amount they contribute toward the cost of construction up to \$100. The State pays the remainder of the cost of maintenance.

The Michigan plan, as described, presents several distinct advantages. The State trunk-line system was created by the 1913 legislature and since that time the improvement of a large mileage has been completed. But there are still a considerable number of gaps in the important roads of the State. These are largely in the poorer counties which cannot afford to build roads on a very extensive scale. They can, however, by paying, say, 25 to 40 per cent of the cost, go a long way toward completing the gaps in the trunk lines within their boundaries.

The various counties throughout the State appreciate the opportunity offered by the Federal-aid law and plans are being made quite generally which will take care of Michigan's apportionment for the five-year period.

About 32 projects are contemplated for the first three years' work. A summary of progress made to date is as follows:

Number of projects on which surveys have been made and plans started.....	24
Number of projects submitted.....	17
Number of projects accepted.....	10
Number of projects for which plans and specifications have been completed.....	6
Number of projects on which contracts have been let.....	2
Number of project agreements.....	1

All types of roads will be built under the five-year program, ranging from earth and gravel to concrete, brick, and asphaltic concrete. It is hoped that with the completion of this work most of the gaps in the trunk-line system of the State will be filled in.

SOUTH CAROLINA.

Federal-aid projects in South Carolina have been approved by the State highway commission and the Secretary of Agriculture for work in the following counties: Richland, Spartanburg, York, and Chesterfield. Greenville project will be approved by the Department of Agriculture as soon as detailed plans are completed.

It is planned to submit for approval projects for work in the following counties during the period of

January 1 to July 1: McCormick, Cherokee, Chester, Marion, Horry, and Union.

Projects for work in the following counties will be taken up when the 1919 Federal-aid apportionment becomes available: Clarendon, Bamberg, Chesterfield, Lancaster, Dorchester, Newberry, Lexington, Orangeburg, Darlington, Horry, and Pickens.

NEBRASKA.

History will repeat itself if the five-year program of State Engineer Johnson, of Nebraska, is carried out, as several stretches of roadway in his program received Government aid in Territorial days when Nebraska was considered but little better than Indian country. By an act of Congress of February 17, 1855, the construction of a "Territorial road

from a point on the Missouri River (opposite the city of Council Bluffs, Iowa) in the Territory of Nebraska to new Fort Kearney in said Territory" was authorized. This road was laid out from the now city of Omaha to Fort Kearney, and the original location, made in 1855, has been followed closely in the counties traversed. Substantial improvements no doubt will be made on this historical "Military Road." Another road was authorized by Congress on March 3, 1857, and \$30,000 appropriated for its construction. According to a map published in Morton's History of Nebraska, it paralleled the Missouri River from near the mouth of the Platte River to near the mouth of the Niobrara River, passing through Omaha, Fort Calhoun, and Tekamah—the present route of the George Washington Highway through this section.

Federal Aid Act Interpretations.

IN connection with the administration of the Federal aid road act questions arise constantly which involve interpretations of the act and decisions as to policy. Among these the following may be cited:

FUNDS IN STATES PROHIBITED FROM ENGAGING IN INTERNAL IMPROVEMENTS.

In such States as are forbidden by their constitutions from engaging in internal improvements, it was determined that the counties must raise the full amount necessary to be raised to entitle the State to its apportionment before cooperation can be undertaken.

WHAT CONSTITUTES EXPENDITURE:

The period for which the funds apportioned to a State shall be available for expenditure is fixed by section 3, which also provides for a reapportionment of any balance unexpended at the close of such period. The question arose as to what constitutes expenditure within the meaning of the act. Inasmuch as the negotiations between the State highway department and the Secretary of Agriculture for cooperation under the act consist of the submission by the highway department of a project statement; its consideration and approval by the Secretary of

Agriculture; the filing of plans, specifications, and estimates by the highway department and their approval by the Secretary of Agriculture; the execution of project agreement by the highway department and by the Secretary; and the execution by the secretary of a certificate approving the plans, specifications, and estimates, by which the Federal funds allotted to the project are set aside in the Treasury, thus definitely obligating the Government to pay the amount of funds so set aside, it was determined to be the view of the department that the money is expended within the meaning of the act at the time the secretary executes the project agreement. If at the end of the period during which the apportionment for a particular fiscal year is available the State should not have entered into project agreements with the Secretary of Agriculture in an amount sufficient to consume the entire apportionment for that particular year, the balance would be apportioned in accordance with the terms of section 3 of the act.

AVAILABILITY OF BALANCES THAT OCCUR ON PROJECTS:

It may occur frequently that after the construction work is completed and final payment is made on a project there will remain a balance of the funds set aside in the Treasury for that particular project. Therefore it was important to determine whether such balance would be available for application on other projects in the State and also whether it would be applicable on such other projects without the project agreement therefor being executed prior to the expiration of the period allowed for the expenditure of the apportionment from which the funds were originally

The sooner the irresistible might of this great Republic is organized and put into full action the sooner the war will end. Every dollar invested in Government securities works to shorten the war, to save the lives of American soldiers and sailors.

set aside in the Treasury. After careful consideration it was determined that such balances may be credited to the apportionments of the particular State available during the year when it is found that such balances have occurred and may be applied on other projects, but to become nonavailable at the end of the period when the then available apportionments become nonavailable. It was determined also that the liability incurred by the Government on account of an individual project can be set up against any funds apportioned to the State which are available for payment instead of against the apportionment for a specific fiscal year.

MILEAGE SHOULD NOT BE INDEFINITE:

Closely related to the foregoing questions there arose the alternative suggestion of specifying in the project statement and in the project agreement an approximate instead of an exact mileage. However, it was deemed inadvisable to have the project statement and the project agreement specify an indefinite mileage. In cases where it may be found desirable to alter the mileage stipulated in the project agreement, it can be done by a modification of the agreement.

USE OF FEDERAL FUNDS ON ROADS IN INDIAN RESERVATIONS:

The question as to whether or not the Federal aid road funds may be used in the construction of rural post roads on Indian reservations is of importance to those States in which such reservations are located. Consideration was given to this matter and it was determined that there is nothing in the act itself to indicate any intention on the part of Congress to exclude from the benefits thereof rural post roads within Indian or other reservations and that the question was one for determination from an administrative standpoint.

CONVICT LABOR OR FORCE ACCOUNT—PAYMENTS:

The practice in many of the States is to do a large portion of road work by convict labor or force account. In some few States the law even prohibits the letting of such work to contract. Therefore it was necessary to arrive at a basis on which payment of Federal funds would be made on projects in such instances, the basis of payment finally determined upon being as follows:

- (1) Where in road construction, a State calls for bids and bidders have the option of using free or convict labor and each bidder has equal opportunity to secure convicts and the lowest responsible bid is to be accepted, the department is willing to enter into a project agreement on the basis of such bid, without further reference to the terms on which the convict labor may be secured by the contractor.
- (2) Where the State has the option of doing the work itself with convict labor and is in a position to call for bids, the department is willing to proceed with a project on the following basis: It will assent to the State's proceeding with the work on the assumption that it will

not cost more than the lowest responsible bid and that the department will be expected to pay not exceeding fifty per cent of the actual cost, but the convict labor shall not be reckoned in the account at more than the current local rate of wages specified in the project agreement.

- (3) In rare cases where bids are not received, or where they are clearly unreasonable, if free labor is employed by the State it shall not be reckoned in the account at more than the current local rate of wages specified in the project agreement.
- (4) Where the State is prohibited by law from awarding a project to contract or where conditions are such as to make it impracticable or unduly expensive to do the work by contract, and the State highway department desires that it shall be done by day labor or convict labor, payment may be made by the Federal Government on the basis of the labor and materials which have been actually put into the road. The value of such labor and materials in such cases, and also in cases arising under paragraphs (2) and (3) if so provided in the project agreement, shall be determined on the basis of the unit prices set forth in the estimate as approved by the Secretary.

RESTRICTIONS ON USE OF CONVICT LABOR:

In further reference to the matter of convict labor, it was determined that the Executive order of May 18, 1905, prohibits, in the construction of roads under section 8 of the Federal aid road act, the use of convict labor (*a*) by a contractor where the road is to be constructed by contract; or (*b*) by a county where a road under section 8 is to be constructed by day labor and the local authorities agree to contribute labor as their part of the cooperation.

PROJECTS MAY BE APPROVED AND AGREEMENTS ENTERED INTO AFTER CERTIFICATE OF APPORTIONMENT FILED:

After considering the question as to whether or not after the certificate of apportionment for any fiscal year has been filed, and prior to the beginning of the next fiscal year, projects may be approved and project agreements entered into, it was determined that it could be done, provided no part of the road for which Federal aid is contemplated under such agreement should be constructed prior to the beginning of the fiscal year for which the appropriations involved were made, and provided further that no project statement should be approved or project agreement be entered into involving the appropriation for any fiscal year prior to the filing of the certificate of apportionment for that year.

AMENDMENTS TO REGULATIONS.

The Rules and Regulations of the Secretary of Agriculture for carrying out the Federal aid road act, as issued September 1, 1916, and revised April 28, 1917, have since that date been further amended as follows:

Amendment No. 3 to the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the Federal aid road act, issued September 1, 1916.

Under authority conferred upon the Secretary of Agriculture by the act of Congress approved July 11,

1916, entitled, "An act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes" (39 Stat., 355), known as the Federal aid road act, I, D. F. Houston, Secretary of Agriculture, do hereby amend Regulation 5, section 8, of the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of said act, promulgated September 1, 1916, as amended by Amendment No. 2 under date of January 24, 1917, to read as follows:

For all projects for which statements are submitted after September 30, 1917, standards governing the form and arrangement of plans, specifications, and estimates will be hereafter prescribed and promulgated by the Secretary.

Done at Washington this 23d day of April, 1917.

Witness my hand and the official seal of the United States Department of Agriculture.

(Signed) D. F. HOUSTON,
Secretary of Agriculture.

Amendment No. 4 to the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the Federal aid road act, issued September 1, 1916.

Under authority conferred upon the Secretary of Agriculture by the act of Congress approved July 11, 1916, entitled "An act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes" (39 Stat., 355), known as the Federal aid road act, Regulation 6, section 1, of the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the said act, promulgated September 1, 1916, and amended by Amendment No. 1, dated October 18, 1916, is hereby further amended to read as follows:

REGULATION 6. *Project agreements.*

SECTION 1. A project agreement between the State highway department and the Secretary shall be executed, in triplicate, on a form furnished by the Secretary, previous to commencement of the construction of the project, except that as to projects for which project statements were approved prior to August 15, 1917, payments may be made on account of work done prior to the execution of the project agreement, if such work can be adequately inspected as required by the act.

Done in the District of Columbia this _____ day of August, 1917.

Witness my hand and official seal of the United States Department of Agriculture.

(Signed) D. F. HOUSTON,
Secretary.

Amendment No. 5 to the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the Federal aid road act, issued September 1, 1916.

Under authority conferred upon the Secretary of Agriculture by the act of Congress approved July 11, 1916, entitled "An act to provide that the United States shall aid the States in the construction of

rural post roads, and for other purposes" (39 Stat., 355), known as the Federal aid road act, Regulation 6, section 1, of the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the said act, promulgated September 1, 1916, and amended by Amendment No. 1, dated October 18, 1916, and further amended by Amendment No. 4, dated August 31, 1917, is hereby further amended to read as follows:

REGULATION 6. *Project agreements.*

SECTION 1. A project agreement between the State highway department and the Secretary shall be executed, in triplicate, on a form furnished by the Secretary, previous to commencement of the construction of the project, except that as to projects for which project statements were approved prior to November 1, 1917, payments may be made on account of work done prior to the execution of the project agreement, if such work can be adequately inspected as required by the act.

Done in the District of Columbia this 8th day of November, 1917.

Witness my hand and official seal of the United States Department of Agriculture.

[SEAL.] (Signed) D. F. HOUSTON,
Secretary.

Amendment No. 6 to the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the federal aid road act, issued September 1, 1916.

Under authority conferred upon the Secretary of Agriculture by the act of Congress approved July 11, 1916, entitled "An act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes" (39 Stat., 355), known as the Federal aid road act, Regulation 5, section 7, of the Rules and Regulations of the Secretary of Agriculture for carrying out the provisions of the said act, promulgated September 1, 1916, is hereby amended to read as follows:

REGULATION 5. *Surveys, Plans, and Specifications and Estimates.*

SEC. 7. When plans, specifications, and estimates have been approved by the Secretary, no alteration thereof shall be made without his approval, except that minor alterations which will not involve an increase in the cost of the project to the Federal Government may be made with the approval of the Director of the Office of Public Roads and Rural Engineering.

Done in the District of Columbia this 15th day of November, 1917.

Witness my hand and official seal of the United States Department of Agriculture.

[SEAL.] (Signed) D. F. HOUSTON,
Secretary.

Amendment No. 1 to the Standards Governing the Form and Arrangement of Plans, Specifications, and Estimates for Federal Aid Projects, as prescribed by the Secretary of Agriculture and promulgated April 28, 1917.

In accordance with the requirements of Regulation 5, section 8, as amended, of the Rules and Regulations of the Secretary of Agriculture, issued September 1, 1916, for carrying out the provisions of the act of Congress approved July 11, 1916 (except section 8 thereof), entitled, "An act to provide that

The test is on—does German autocracy breed better men than American democracy?

the United States shall aid the States in the construction of rural post roads, and for other purposes" (39 Stat., 355), known as the Federal aid road act, the paragraph entitled "Scales," on page 6, and the paragraph entitled "Cross Sections," on page 7, of the Standards Governing the Form and Arrangement of Plans, Specifications, and Estimates for Federal Aid Projects, prescribed by the Secretary of Agriculture and promulgated April 28, 1917, are hereby amended to read, respectively, as follows:

Scales.

The plan shall be drafted to a scale of 1 inch=50 feet or 1 inch=100 feet, at the option of the State highway department, with the following exceptions: Where the proposed location passes through a plains country or where the contemplated improvement consists only of surfacing without changes in the existing grade or alignment, sections not less than 2 miles in length may be drafted to a scale of 1 inch=400 feet, provided there are relatively few topographic features, such as fences, pole lines, buildings, etc., to be shown.

The profile shall be drafted to the same horizontal scale as the plan. Where the horizontal scale is 1 inch=50 feet or 1 inch=100 feet the vertical scale shall be 1 inch=10 feet, and where the horizontal scale is 1 inch=400 feet the vertical scale shall be 1 inch=20 feet.

Cross Sections.

Cross sections shall be taken at intervals not exceeding 100 feet, with the following exceptions: Where the grading is relatively light and uniform in section or where only surfacing is contemplated, cross sections will be required only at such intervals as will be necessary to show the character and extent of the intended work.

The cross sections shall be plotted to a scale of 1 inch=5 feet vertically and horizontally. They should be plotted from the bottom of the sheet upward and so as not to interfere unduly with one another. Either the lower side or the right-hand end of the sheets may be used as the bottom in plotting. The cross sections should show the ground surface and the templet lines for the proposed construction, each being marked with its station location, "grade line" elevation, and cross-sectional area or the yardage between sections. Any desired additional information may be shown.

Done in the District of Columbia this 10th day of December, 1917.

Witness my hand and official seal of the United States Department of Agriculture.

[SEAL.] (Signed) D. F. HOUSTON,
Secretary of Agriculture.

FOR STRONG MAINTENANCE POLICY.

Pennsylvania has declared for a strong maintenance policy. The State commissioner determined that roads already built must be maintained adequately at all costs. The roads in certain sections of the State suffered from cloudbursts, freshets, slips, slides, and in this last winter from excessive snowfalls, all of which factors combine to increase the maintenance costs in the particular localities affected. The main trans-State roads are being subjected to greatly increased heavy motor truck traffic and this adds to the problem of maintenance.

Lets \$1,254,998 Contracts in a Season.

In the 1917 season Pennsylvania let highway construction contracts aggregating \$1,254,998.20 for road improvements in 15 counties. A large proportion of these contracts were let after the 1st of September.

HIGHWAY WORK IN WISCONSIN.

(Continued from page 18.)

6,000 miles of road on the system of prospective State highways. This includes the construction of approximately 10,000 concrete culverts and approximately 1,500 State aid bridges. In addition the commission has designed and supervised the construction of a still greater number of bridges built by the towns and counties, toward which the State made no contribution in money.

The State highway law will continue in operation with an average annual expenditure of two and one-half million dollars and will serve to increase the work done on the State trunk highway system and to improve other highways which, while important from the standpoint of local communities, are not so important from the State and national standpoints.

Little need be said about the work being done under the township system. The inefficiency and wastefulness of township road work are proverbial, but there are indications that the influence of systematic improvements made under the State aid system is beginning to cause the introduction of the same methods in the township work, and it is believed that when the Federal aid construction is fully under way that this will have yet greater influence. The maintenance provision to be instituted by the State under its trunk highway law has met with wide appreciation. Several of the counties already have arranged to institute the patrol system on county roads not included in the State trunk highway system, and it is altogether likely that the results will cause a revolution in the past methods, even in town road work.

Those who expect too much are sure to be disappointed, and no one expects the immediate road millenium in Wisconsin, but we believe that the system now in force in the State, well financed as it is, and sure to be better financed when normal times return, will effect the solution of the road problems of the State and that the improvements made will soon put this State in the front rank of good roads States in the Middle West.

The greater part of the world now looks to America as its chief hope of safety from tyranny and oppression. Our mission is worth the devotion, the sacrifice, the labor of every American.

BUY LIBERTY BONDS.

SAVING FUEL IN HIGHWAY WORK.

BY

GEORGE E. LADD, Economic Geologist, Office of Public Roads and Rural Engineering.

WHEREVER coal is burned for steam generation, fuel economy is important from a business standpoint. With the country suffering from coal shortage, and the need for coal for war purposes increasing steadily, it becomes a patriotic duty to avoid waste in every way possible in our consumption of coal. In connection with highway construction steam is used at quarry plants in driving road rollers, at municipal paving plants and in the manufacture and application of bituminous materials. Altogether the amount of coal used in these plants is large, and the amount of waste notable.

This is written in the hope that every man in charge of a coal consuming steam-power unit used for quarrying, stone crushing, and road construction will not only do his "bit," but his best to cut down the waste of coal. This can be done by eliminating steam leaks; by keeping the boiler and furnace in the best possible condition; and by proper attention to "firing" and draft regulation.

Knowledge of his plant and his duties are vitally important in a fireman. To handle a furnace and boiler properly requires expert knowledge and considerable experience. Make sure that your fireman possesses such knowledge and experience and puts into practice the following suggestions:

Keep track of the coal burned even in your smallest steam-producing units and see that none is wasted. Obviously, coal is wasted when steam is wasted. Stop the steam leaks. A recent trip to quarries in the Eastern States where crushed stone is being used showed an amazing amount of carelessness in this respect. Valves and the pipe lines to drills, engines, and asphalt heaters were leaking badly in the great majority of quarries.

Mud or scale is not only ruinous to boilers, as well as dangerous, but leads to coal waste. Keep the boilers clean. Get the best water possible for boiler use. Bad water may produce erosion, incrustation, priming, or the formation of a heavy precipitate. Corrosion is the eating away of the shell and tubes, and is caused by acid water, carbon dioxide and oxygen dissolved in water, grease (from condensed steam), organic matter, or chloride or sulphate of magnesium. Incrustation is the formation of scale on shell and tubes of boiler, and may be caused by mud, clay, or other sediment in water; salts in solution, as bichloride of lime, magnesium or iron, and sulphate of lime. Priming is the violent foaming of the water in the boiler, often carrying it over into the steam lines. It may be due to sewage in water or to a large quantity of carbonate of soda. Any-

one of these troubles leads directly or indirectly to waste of fuel.

If the water be troublesome, there is no use in trying to remedy it with "boiler compounds" unless they are made for the water in question, and the only way to find out what is needed is to have a chemical analysis made, and a compound prepared which is suitable for that particular water.

REMOVAL OF SCALE.—There are two kinds of scale: (1) A hard, adherent scale, due to sulphate of lime in the water; and, (2) a soft, powdery scale, due to carbonates of lime, magnesia, or iron.

The soft scale can be removed by blowing off and washing thoroughly with stream of water when cleaning.

Kerosene has been used with good results in loosening the hard scale. Scale can be removed to some extent by acids, such as hydrochloric, acetic, and tannic, but they also attack the iron, may cause damage, and are not to be recommended.

Heavy scale must be removed from the sheet by a hammer and chisel, but it is impossible to clean it from tubes in this way. A good flue rattler will remove thick, hard scale from tubes, and, if handled properly, will not injure them.

WATER HEATER.—A big saving of fuel can be made by heating the water before it enters the boiler with exhaust steam from the engines. For every 11° feed water is heated, there is a saving of one per cent of fuel. If bad water is being used an additional saving is effected by the elimination of much sediment and scale-forming minerals in the heater, by installing trays and a filter in it.

SELECTING BOILER.—If possible use only such a boiler as, with easy firing, moderate draft, and ordinary fuel, will develop one-third more "commercial horsepower" than is required by the work in hand.

Following is a list of duties of firemen, with notes and suggestions:

1. Know all the pipe connections, locations of valves, unions, and the easiest and best methods of reaching them on an emergency.
2. Know the principles of firing, and the method which gives best results.

The problem of the American Treasury is the problem of the American people. The Treasury is but the medium, the instrument, of the Nation to raise the means to carry on the Government and to bring this war to a victorious conclusion.

BUY LIBERTY BONDS.

The following are offered as suggestions and have been found to embody the best practice for hand-fired, stationary boilers:

- (a) Fire evenly and regularly, that is, put on approximately the same amount of coal each time and at regular intervals of time.
 - (b) Place the coal where needed and keep fires in such condition that a moderate amount of coal (two to four shovelfuls) is sufficient.
 - (c) Keep fires clean and bright all over.
 - (d) Break up large lumps if they are used.
 - (e) If coal contains much volatile matter, the coking method often is used instead of (c). The coal is banked at the door and kept bright behind the bank, thus causing the bright hot fuel to burn the volatile matter in the coal. This is pushed back as necessary before putting on fresh fuel.
 - (f) Keep fires free from holes. Attention is called especially to sides of the furnace and rear end.
 - (g) Regulate draft and air supply to suit working conditions.
 - (h) Watch the gauges.
 - (i) Do not level or stir fire if not necessary.
 - (j) Thickness of fire will depend on draft and amount of smoke. Regulate this to give the best conditions.
 - (k) Do not allow ashes or clinkers to accumulate on walls or in combustion chamber.
 - (l) Clean fires when necessary. If let run too long air spaces in grates clog up.
3. See that the water is at proper height and kept at that height all the time. Do not rely on water gauge, but try the gauge cock.
 4. Keep even and uniform steam pressure.
 5. Gauge cocks and water glasses should be kept clean. The water gauges should be blown out frequently and glass and passage to gauge kept clean.
 6. Safety valve should be tested at least once every day, preferably in the morning, to see that it acts freely.
 7. The pressure gauges should stand at zero when the pressure is off, and show correct reading when the boiler is popping off. The steam pressure gauges should be tested once every three months.
 8. See that the feed pumps or injector are in duplicate and both in good repair, and either capable of doing the required work. All machinery needs repairs occasionally
- It is bad to put cold water in boiler. If it is used an injector should be employed.
- If hot water is used see that feed pumps are below the supply, otherwise pumps will give trouble.
- A little hot-water packing, rubber valves, and piston and gland packing always should be kept with tools, and these should have a specific place, and always be kept there ready for use.
9. The check valve should be kept clean and be watched to see if it is working when water is being pumped into the boiler.
 10. Examine fuse plugs when cleaning boiler and scrape both ends to clear surface.
 11. Keep all holes in "setting" carefully stopped, and make all air enter through grates.
 12. See that blow-off does not leak, and blow off frequently if water is muddy.
 13. Do not empty boilers if brick work is very hot.
 14. Keep boiler clean both inside and outside. Conditions of water will regulate time of cleaning, which may be from every day to intervals of not more than two weeks.
 15. Keep dampness away from outside of boiler.
 16. See notes above about importance of keeping out scale, and how to remove it from flues. The saving in fuel makes it pay to have flues taken out occasionally, cleaned, rewelded and and put in again. Bad scale on shell causes burning and cracking of sheet.
 17. The bridge and furnace walls should be kept in good condition.
 18. The grates should be kept in good condition, and for poor coal extra large rather than small grate area is better. If too large, the sides can be covered with layers of brick. If shaking grates are used, be careful to see that the grates go back level after shaking.
 19. If a heater is used it may get dirty faster than boilers, and needs cleaning regularly.
 20. A small leak about the man head soon destroys the planed surface, and makes it difficult to keep tight with any gasket. If graphite is mixed with oil and put on the gasket, it will make it last longer and prevent sticking.
 21. If fire-brick lining to the boiler front is not kept in good condition, warped and cracked fronts and doors soon will be the result.
 22. Steam leaks should not be permitted, because steam under pressure travels with an enormous velocity, and small leaks discharge many pounds of steam in a day. Many leaks mean many horsepower lost.
 23. Ash pits should be water-tight and water should be kept in them at all times. They should be cleaned out thoroughly when fires are cleaned, and oftener if necessary.
 24. If the draft is poor an accumulation of soot or ashes will make it worse. Breaching and stack connections should be kept tight.
 25. The tools—shovel, coal pick, rake, two-pronged hook, leveler, and long-handled scraper—should be kept in good repair and in regular place.
 26. In order to know the results or value being obtained from the fuel, records should be

kept, and the following data is necessary and valuable:

- (a) The character of fuel being used.
 - (b) The amount of coal burned per day or shift. This can be weighed or measured.
 - (c) To know the area and condition of grate surface and calculate the pounds burned to square foot of grate surface per hour.
 - (d) The amount of ashes made per day or shift. This can be measured or weighed. It would be a help to note color and character of the ash, amount of clinkers formed, and amount of coal or coke that goes out with the ash.
 - (e) Weigh or measure the amount of feed water used per day or shift.
 - (f) Take reading occasionally of temperature of the feed water.
 - (g) Calculate at some time, and put down as a permanent record, the heating surface of each boiler.
 - (h) Divide the total heating surface into pounds of water used each hour, and find out the pounds evaporated to the square foot of heating surface.
 - (i) Note reading of steam gauge hourly unless a recording gauge is used.
 - (j) Determine the amount of draft there is, if a draft gauge is available.
 - (k) Determine the amount of air being used and compare the pounds of air used to the pounds of coal. This is not simply or easily done, because it requires special apparatus. It gives valuable information because it shows whether the coal is being completely burned or not; shows the presence of bad leaks and helps to show method necessary in order to correct trouble.
 - (l) The conditions of boilers and grates should be noted each shift, and made a matter of record because it may save a big expense in the future.
 - (m) Note the thickness of fire that seems to give the best results. See how the smoke from this thickness compares with amount of smoke made at other thicknesses.
27. If a boiler stand unused, it should be emptied and dried if possible. If not subjected to freezing weather it may be filled full of water to which a little common soda (washing soda) has been added.
28. Cleanliness about boilers is as necessary as it is in the boiler room.
29. *In case of emergencies:*
- (a) In case of low water cover fire with dirt or ashes, or, if these are not handy, cover thor-

oughly with fresh coal. Draw fire when it can be done without increasing the heat. *Do not turn feed water in, start or stop engine, or lift safety valve until fires are out and boiler cooled.*

(b) Should boiler show signs of buckle starting, it is an indication of scale and that sheet is too hot. A boiler may be pulled through the shift by watching it carefully, and firing light as possible, otherwise buckle will get larger. If boiler sheet is cleaned at end of shift, and mud pan put over the buckle, it can be used until arrangements are made for hammering it back.

(c) If a boiler has a patch a bad leak may come at any time, but if boiler is needed badly it can be used, although it is much harder to fire, and leak may put fire out in places. When it is being cleaned and is cool it may be examined. If leak is due to loose rivet the old one may have to be removed and new one driven, or it may be calked with proper calking tool, or it may have to be chipped and calked. Sometimes patent cements are put in the crack if calking does not hold. Chipping and calking tools should be kept in good condition, and used by a man who has had experience or helped to make a repair.

Our endeavor should be to lose as little heat from the combustion of fuel in the furnace as possible, to change the water into steam in the most efficient way, to convey the steam to our engine with the least loss of heat possible, and to convert the greatest amount of it possible into *mechanical energy*. These problems are accompanied by that of the proper care of all the apparatus used in the above processes.

BRIDGE BUILDING IN MINNESOTA.

In 1917 there were 124 large bridges built on Minnesota State roads and it is believed it will be necessary to build approximately twice that number in 1918. There were 1,112.67 miles of road graded to permanent grade line and 314.2 miles surfaced with gravel, in addition to 458.2 miles of grading not entirely completed and 98.7 miles of graveling still under contract and not quite completed.

WILL BUILD NEW TYPE OF BRIDGE.

Six new bridges will be built on the St. Paul to Duluth highway this year, according to J. T. Ellison, bridge engineer, Minnesota highway department. One of the bridges will be a type entirely new in highway and bridge construction in Minnesota. It will be built on Federal aid project No. 1 at Pine City and will have 20-foot spans supported upon concrete piles. The concrete piles will be driven with equipment much the same as used in driving timber piles. The bridge will be 400 feet long with an 18-foot roadway and will be one of the best constructed bridges in the Northwest.

Good business as well as patriotism urges support of the Government in its financial needs, and to no class of Americans more than to the farmers of the Nation whose own welfare is indissolubly bound up with that of the United States Government.

BUY LIBERTY BONDS.

STATE HIGHWAY DEPARTMENTS AND LABOR.

By

C. J. BENNETT, State Highway Commissioner, Connecticut.

AT a time when the country is disturbed by labor conditions it is of especial interest to the State highway official to consider his place in the general scheme of organization and determine for himself how to work out his salvation. The labor question presents itself to one of us in two different ways: First, labor employed by the contractor; and second, labor employed directly by the department.

The question of securing labor by the contractor will, in the opinion of the writer, make it unlikely that satisfactory bids for road construction on a unit basis, will be received during the present crisis, and some definite system of awarding contracts on cost plus a fixed profit or cost plus a percentage must be worked out. Of course, if either method is adopted, the first requisite will be the selection of a thoroughly reliable and competent contractor so that the fixed profit or percentage will be the only outlay by the department which does not go directly into the purchase of material or remuneration of labor. By adopting some such method as this, it will of course, be possible to take care of fluctuations in the labor market without injustice either to the state or to the contractor; and with a reliable contractor receiving a fair profit, of which he is sure, the general result should be that roads will cost a fair amount.

One difficulty that arises along these lines, however, is the fact that if the State highway official is paying a fixed profit or percentage, he has more opportunity to interfere with the organization and operation of the work than in the case where the contractors operate on the unit price basis, and while he may be fully as competent to organize the job as the contractor, the conflict of authority may tend to cause confusion in the proper completion of the work. Consequently, in contracts of this nature, the organization of the job should be worked out thoroughly before the work is started; that is, the equipment to be used should be determined and the maximum number of men and teams decided upon. The department should employ a competent timekeeper to check up the accounts on the job so that no mistakes will occur.

Given reasonable department officials, honest and competent contractors, this method of carrying on highway construction at this particular time should give good satisfaction.

With regard to the employment of labor directly by the department, the work done, of course, divides itself into the items of construction and maintenance. It may be possible and, in fact, satis-

factory, for State highway departments to carry on construction work with their own forces and equipment. There is some element of unfairness in this where a department has been accustomed to receive bids from contractors for work of this character, but in this crisis, it seems that we are justified in taking almost any steps to carry on the work necessary and, therefore, in order to avoid difficulties between contractors and the department, it will be necessary, in many cases, to organize construction forces for the carrying on of road building.

Securing labor for this purpose will not be an easy matter, especially where the work is to be done in the vicinity of centers of population. It will be difficult to maintain a steady working force, because of advantageous offers from outside sources. The rate of wages for maintenance work paid to the regular employees should be increased to such an amount as to make the work attractive to them.

At this particular time, every attempt should be made to utilize labor from sources which are not ordinarily available. This, of course, refers to the use of convicts or interned alien enemies. The use of convicts for road construction and maintenance has been discussed thoroughly from time to time and many objections have been raised, but it would seem from experience gained in this section that prisoners from the jails and penitentiaries could be used with success, particularly if they are paid a reasonable amount for their services. No attempt should be made to get something for nothing. The men should be treated not as convicts but as men. Of course, the use of labor of this class is restricted to sections where they do not come in touch with the ordinary population, since their freedom is restricted. They may be kept in camps or returned to the prison at night, although it is the opinion of the writer that every effort should be made to disconnect them from the institution to which they have been sentenced, during the time they are at work on the roads. The endeavor should be to make them forget their imprisonment and to realize they have become useful members of society.

With reference to the use of alien enemies, the number available is comparatively small, but may increase as the war goes on. The treatment of the alien enemies, of course, is a military matter, and the damage done by their escape would be greater than in the case of the ordinary convict. Nevertheless, at this particular time, we must endeavor to use every possible instrument to carry on our work. Ordinary methods cannot be used. Extraordinary efforts must be made to utilize not only

the usual supply of labor but to augment this supply by recourse to the prisons and reformatories, and even the enemy alien camps.

Convict Labor on Highways Success in Rhode Island.

By

I. W. PATTERSON, Chief Engineer.

WE IN Rhode Island suffered more or less during the past year from the unusual conditions surrounding the labor situation.

As a matter of fact, however, the conditions never were as serious as we anticipated early in spring. The rate of wages paid labor was higher than normal and the efficiency of labor was lower than usual in many cases, but at no time did the labor situation become serious enough to cause the stopping of road work which was in progress. We considered the work of repairing sections of our main through trunk lines, which were at certain seasons almost prohibitive to travel, of such great importance in view of the commercial value of these routes at this time, that the higher cost of repair occasioned by the labor situation was deemed insufficient to warrant the stopping of work.

An act allowing the use of convicts upon State road work was passed by the general assembly early in 1917. This act provided for our use of convicts by agreement with the State penal and charitable commission. Under this act the rate of allowance for the service of convicts was to be agreed upon between the highway department and the penal and charitable commission. The guarding, feeding, and clothing of the convicts was to be taken care of by the penal commission and the highway department was to supervise their work upon State roads.

Two camps were established and the convicts from these camps were employed in building bituminous macadam State roads during a large part of the past construction season. For a matter of two or three weeks the fact that many of the prisoners were unused to hard manual labor and had never had experience in road work affected the efficiency secured. Gradually, however, the efficiency increased.

At the beginning of the work by convicts \$1.50 per workingman day of nine hours was allowed for their services. Later the penal and charitable commission demanded an allowance of \$2.25 per day for the services of each convict employed upon the work, no time to be deducted for periods when, because of inclemency of weather or for other reasons except the incapacity of the prisoners, no work was done. Although this department felt that this demand was not wholly justified, the demand was granted in order that the work undertaken by the prisoners might be carried to completion so that this experiment might receive a fair trial.

The results secured varied. The convicts from one camp built a road which was first class in every detail, while the convicts from the other camp produced results which were disappointing as far as quality is concerned. The road which was excellently built, furthermore, cost much less as far as unit costs are concerned than did the inferior road. Differences in housing facilities, in the personalities of the guards over the convicts, in the capabilities and energy of the camp cooks, and in the character of the prisoners themselves, were reasons, to our minds, for such a difference in the results secured. Changes in the personnel of the gang whose work was not particularly satisfactory, by reason of the expiration of sentences and the return of prisoners to the jail for infractions of rules, also had a disorganizing effect, which resulted in a lessening of efficiency.

Our experience with convict labor has convinced us that excellent results are possible by the use of prisoners for road work. We are able to perceive faults, both with our law which makes possible our use of convict labor, and also with some of the details of carrying out of the work. We heartily approve of convict labor for road work, both on account of the physical and moral benefits derived by the prisoners, and on account of the aid to the labor situation which the use of convicts brings about.

VERMONT.

By

S. B. BATES, State Highway Commissioner.

The labor situation in Vermont as to highway work is somewhat different from that in most States. The highway improvement work is taken up with each town each year and certain sections determined on for improvement. This has resulted in the construction of limited projects which could be taken care of with local labor, so that the question of assembling a large force on one job has not yet come up—the number of men engaged in any one project seldom exceeding 20.

When practical, construction work has been taken up in many of the towns in that part of the season which interfered the least with agricultural work. Because of this it has been possible to utilize labor that during other parts of the year were employed locally.

At this time there is a great scarcity of labor for the farms—in fact, in many of the communities a large part of the labor force has gone into the service, or sought industrial employment. The possibility of obtaining sufficient labor for highway work is very uncertain.

Not much has been done in the way of employing prison labor, although the matter has been discussed. Some work was done last year with labor from the house of correction. This plan is receiving careful consideration at the present time.

COMING PUBLICATIONS.

THE COMMERCIAL SIZES OF BROKEN STONE AGGREGATES: By F. H. Jackson, jr., and C. W. Mitman.

This article will appear in the next issue of *Public Roads*. It gives the results of the study of about 90 commercial stone-crushing plants located in the New England and Middle Atlantic States made in the summer of 1917. Those features of crushing plant design and operation which bear directly upon the production of the actual sizes of the various grades of stone used in road construction are taken up separately and discussed in detail. Comparative studies are made also of the nomenclature used in designating stone sizes and of the actual sizes of stone produced under the requirements of the several State specifications.

Examples of the adverse conditions under which the crushed-stone operator is obliged to work on account of the fact that no uniform sizes of crushed stone exist and the reasons for these conditions are given. Means for alleviating and possibly eliminating them are proposed. On the basis of the information obtained, a series of standard crushed-stone sizes is offered tentatively for consideration, as is also a system of designating these sizes.

HIGHWAY COST KEEPING: By James J. Tobin and United States Engineer Economists; Reviewed by Halbert P. Gillette, Consulting Cost Engineer.

This department bulletin has a twofold object: to present in an elementary way, first, the principles of cost keeping; and, second, a practicable system of highway cost keeping.

A review of highway engineering literature will show that there is very little published relating to highway cost keeping as compared with that to be found in other fields of engineering endeavor. This is especially noticeable when highway cost keeping is compared with factory cost-keeping. An exhaustive study was made of the highway cost keeping systems at present in vogue. This study revealed the general absence of cost keeping on by far the greater portion of highway work. It was also discovered that a wide latitude existed in the interpretation of cost terms and comparable costs were almost nonexistent. In a number of instances cost-keeping systems well suited to specific cases were found, and from these systems valuable information was gathered, which has been incorporated in this bulletin.

The first part of the bulletin is devoted to the fundamentals of cost keeping. A short history of cost keeping is given, showing its development in the manufacturing industries. The elements of cost, labor, materials, plant and equipment, and general expense are discussed sufficiently to show their relation to highway costs. Particular attention is given to plant and equipment costs. The importance of considering cost of repairs, loss of time through idleness, and the fixed charges of depreciation, interest, taxes, and insurance is emphasized. A tabular analysis of cost, showing the cost elements as finally applied to highway operations is given. In order to obtain costs satisfactorily it is necessary to decide upon definite, determinable units of measure. A chapter on units of measure is included in the bulletin.

The second part of the bulletin deals with a system of highway cost keeping. The essentials of such a system are first discussed. Following this is given a classification of accounts based upon road parts and major operations. The object of this classification is to establish a definite connection between highway cost keeping and the ledgerized accounts of the highway organization. This classification of accounts is simple enough to be applicable to small highway organizations where only general costs are desired. It is capable of expansion so as to enable the recording of costs in great detail where desired. A cost-keeping code is given based on the classification of accounts and a classification of highway operations. The use of the code is illustrated by numerous examples. Forms suitable for recording costs in the field are included, as well as forms for compiling and reducing such costs to unit operation costs.

TYPICAL SPECIFICATIONS FOR BITUMINOUS ROAD MATERIALS: By Prevost Hubbard, Chemical Engineer, and Charles S. Reeve, Chemist.

This publication presents the latest recommendations of this office on typical specifications for bituminous materials, which are intended to supersede all prior specifications for bituminous materials issued by the Office. It contains a total of 29 specifications, covering, respectively, oils for cold and hot surface treatment, tars for the same purposes, as well as for cold patching, oil asphalts, fluxed native asphalts and tar pitches for use in construction. They are based on the experience of the Office as well as the ability of the manufacturers to meet their requirements. Each specification is accompanied by a brief paragraph describ-

ing the general character of the material, the purpose for which it is intended, the method of using it, the type of road and the general condition for which it is best suited and the results which may be expected from its use. The bulletin contains an appendix in which recommended methods for sampling are given and also descriptions of the methods for making all tests to which reference is made in the specifications.

SMALL-SCALE PRODUCTION OF CRUSHED STONE FOR PUBLIC ROADS: By Geo. E. Ladd, Economic Geologist.

This is the title of a department bulletin now in press. It is an elementary discussion of the principles governing the selection of quarry sites, drilling, blasting, and crushing and screening.

The rapid expansion of highway construction in the United States has led to a demand for crushed stone which can not be met by commercial plants operating at fixed points, and the supply for which must come through portable plants operating at temporary quarries. Towns, cities, counties, and contractors are obliged more and more to resort to this practice, and there is a rapidly growing demand for information about the equipment necessary and the methods involved for the economical production of crushed stone on a small scale.

This bulletin has been prepared for the use of those unfamiliar with the important details involved. It treats of the factors which should be taken into consideration in selecting a quarry site, with reference to both the opening and operating the quarry itself, and the location of the crushing plant. The equipment necessary is listed and discussed, and in a chapter on "Operation" data are given on the operation of drills, the handling of explosives, blasting, and the opening of a quarry. The accurate keeping of costs is urged, and the cost data of a number of small quarries are given in the final chapter.

RESULTS OF PHYSICAL TESTS OF ROAD BUILDING ROCK IN 1916 AND 1917, INCLUDING ALL COMPRESSION TESTS: By Prevost Hubbard and F. H. Jackson, jr.

In this department bulletin will be found the results of physical tests on some 655 samples of rock examined by the Office during the years 1916 and 1917. These tests were made for the purpose of determining the value of the materials for use in road construction. The bulletin is supplementary to United States Department of Agriculture Bulletin No. 370, which gives all the results of similar tests made in the laboratory of the Office since its inception in 1900 up to January 1, 1916. An interpretation of the results of these tests is also given in Bulletin No. 370. The results of the tests themselves are arranged by States, counties, and towns so as to make it possible for any one interested in the available road building rock of any particular locality to readily determine just what materials in the section have been examined by the Office. For the information of anyone interested in the utilization of stone as railroad ballast, the results of all compression tests have been included in the bulletin.

GRAVEL ROADS: By Charles H. Moorefield, Senior Highway Engineer; Revision by Benjamin F. Heidel, Senior Highway Engineer.

Gravel suitable for road surfacing purposes occurs widely distributed and can frequently be obtained ready for such use more easily than fractured stone in other forms. It varies widely in the composition and size of the pebbles as well as in the character of the fine material mixed with it. In order to secure the best results it is necessary to adopt road construction methods to these variations. This *Farmers' Bulletin* discusses the properties of gravels as road surfacing material, their treatment, and the methods used in the construction and maintenance of gravel roads. It also deals with the design and location of roads.

EARTH AND SAND-CLAY ROADS: By Charles H. Moorefield, Senior Highway Engineer; Revision by Benjamin F. Heidel, Senior Highway Engineer.

Regarding the earth road as the first step to the construction of the higher types of road surfaces this *Farmers' Bulletin* discusses the considerations entering into road location and design so that all essential effort and expenditure shall be devoted to the production of a roadway suited to the immediate needs of light traffic and at the same time capable of being used as the basis for hard surfacing in the years to come. It also treats of the use of selected earths or "top soils," peculiarly adapted to the needs of light traffic and describes in detail the methods of mixing sands and clays to render them more stable under traffic.

OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING ROAD PUBLICATIONS.

NOTE.—(Application for the free publications in this list should be made to the Chief of the Division of Publications, U. S. Department of Agriculture, Washington, D. C. Applicants are urgently requested to ask only for those publications in which they are particularly interested. The Department can not undertake to supply complete sets, nor to send free more than one copy of any publication to any one person. The editions of some of the publications are necessarily limited, and when the Department's free supply is exhausted and no funds are available for procuring additional copies, applicants are referred to the Superintendent of Documents, Government Printing Office, this city, who has them for sale at a nominal price, under the law of January 12, 1895. Those publications in this list, the Department supply of which is exhausted, can only be secured by purchase from the Superintendent of Documents, who is not authorized to furnish publications free).

REPORTS.

- *Report of the Director of the Office of Public Roads for 1914. 5c.
- *Report of the Director of the Office of Public Roads for 1915. 5c.
- Report of the Director of the Office of Public Roads for 1916.
- Report of the Director of the Office of Public Roads for 1917.

BULLETINS.

(In applying for these bulletins the name of the office as well as the number of the bulletin should be given, as "Office of Public Roads Bulletin No. 28").

- *Bul. 28. The Decomposition of the Feldspars (1907). 10c.
- *37. Examination and Classification of Rocks for Road Building, including Physical Properties of Rocks with Reference to Their Mineral Composition and Structure. (1911.) 15c.
- *43. Highway Bridges and Culverts. (1912.) 15c.
- *45. Data for Use in Designing Culverts and Short-span Bridges. (1913.) 15c.
- 48. Repair and Maintenance of Highways (1913).

DEPARTMENT BULLETINS.

(In applying for these bulletins the name should be given as follows: "Department Bulletin No. 53").

- *Dept. Bul. 53. Object-Lesson and Experimental Roads and Bridge Construction of the U. S. Office of Public Roads, 1912-13. 5c.
- 105. Progress Report of Experiments in Dust Prevention and Road Preservation, 1913.
- 136. Highway Bonds.
- 230. Oil Mixed Portland Cement Concrete.
- 249. Portland Cement Concrete Pavements for Country Roads.
- 257. Progress Report of Experiments in Dust Prevention and Road Preservation, 1914.
- *284. Construction and Maintenance of Roads and Bridges, from July 1, 1913, to December 31, 1914. 10c.
- 347. Methods for the Determination of the Physical Properties of Road-Building Rock.
- *348. Relation of Mineral Composition and Rock Structure to the Physical Properties of Road Materials. 10c.
- 373. Brick Roads.
- 386. Public Road Mileage and Revenues in the Middle Atlantic States.
- 387. Public Road Mileage and Revenues in the Southern States.
- 388. Public Road Mileage and Revenues in the New England States.
- 389. Public Road Mileage and Revenues in the Central, Mountain, and Pacific States, 1914.
- 390. Public Road Mileage in the United States. A summary.
- 393. Economic Surveys of County Highway Improvement.
- 407. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1915.
- 414. Convict Labor for Road Work.
- 463. Earth, Sand-Clay, and Gravel Roads.
- 532. The Expansion and Contraction of Concrete and Concrete Roads.
- 537. The Results of Physical Tests of Road-Building Rock in 1916, including all Compression Tests.
- *555. Standard Forms for Specifications, Tests, Reports, and Methods of Sampling for Road Materials. 10c.
- 583. Report on Experimental Convict Road Camp, Fulton County, Ga.
- 586. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1916.

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OFFICE OF PUBLIC ROADS CIRCULARS.

(In applying for these circulars the name of the office as well as the number of the circular should be given, as "Office of Public Roads Circular No. 89.")

- Cir. 89. Progress Report of Experiments with Dust Preventatives, 1907.
- *90. Progress Report of Experiments in Dust Prevention, Road Preservation, and Road Construction, 1908. 5c.
- *92. Progress Report of Experiments in Dust Prevention and Road Preservation, 1909. 5c.
- *94. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1910. 5c.
- *96. Naphthalenes in Road Tars. 1. The Effect of Naphthalene upon the Consistency of Refined Tars. (1911.) 5c.
- *97. Coke-Oven Tars of the United States. (1912.) 5c.
- 98. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1911.
- *99. Progress Reports of Experiments in Dust Prevention and Road Preservation, 1912. 5c.
- *100. Typical Specifications for Fabrication and Erection of Steel Highway Bridges. (1913.) 5c.

OFFICE OF THE SECRETARY CIRCULARS.

- Sec. Cir. *49. Motor Vehicle Registrations and Revenues, 1914. 5c.
- 52. State Highway Mileage and Expenditures to January 1, 1915.
- 59. Automobile Registrations, Licenses, and Revenues in the United States, 1915.
- 62. Factors of Apportionment to States under Federal Aid Road Act Appropriation for the Fiscal Year 1917.
- 63. State Highway Mileage and Expenditures to January 1, 1916.
- 65. Rules and Regulations of the Secretary of Agriculture for Carrying out the Federal Aid Road Act.
- *72. Width of Wagon Tires Recommended for Loads of Varying Magnitude on Earth and Gravel Roads. 5c.
- 73. Automobile Registrations, Licenses, and Revenues in the United States, 1916.
- 74. State Highway Mileage and Expenditures for the Calendar Year 1916.

FARMERS' BULLETINS.

(The Farmers' Bulletins are a series of popular treatises issued by the Department of Agriculture. The following list includes only numbers contributed by the Office of Public Roads, and should be applied for by numbers, as "Farmers' Bulletin No. 239").

- F. B. *239. The Corrosion of Fence Wire. 5c.
- 311. Sand-Clay and Burnt-Clay Roads.
- 338. Macadam Roads.
- *403. The Construction of Concrete Fence Posts. 5c.
- *461. The Use of Concrete on the Farm. 5c.
- 505. Benefits of Improved Roads.
- 597. The Road Drag.

SEPARATE REPRINTS FROM THE YEARBOOK.

(In applying for these separates the numbers should be given, as "Yearbook Separate No. 638.")

- Y. B. Sep. *638. State Management of Public Roads; Its Development and Trend. 5c.
- *712. Sewage Disposal on the Farm. 5c.
- 727. Design of Public Roads.
- 739. Federal Aid to Highways.

REPRINTS FROM THE JOURNAL OF AGRICULTURAL RESEARCH.

- Vol. 5, No. 17, D-2. Effect of Controllable Variables upon the Penetration Test for asphalts and asphalt Cements.
- Vol. 5, No. 19, D-3. Relation Between Properties of Hardness and Toughness of Road-Building Rock.
- Vol. 5, No. 20, D-4. Apparatus for Measuring the Wear of Concrete Roads.
- Vol. 5, No. 24, D-6. A New Penetration Needle.
- Vol. 6, No. 6, D-8. Tests of Three Large-sized Reinforced-Concrete Slabs under Concentrated Loading.
- *Vol. 10, No. 5, D-12. Influence of Grading on the Value of Fine Aggregate Used in Portland Cement Concrete Road Construction. 15c.
- Vol. 10, No. 7, D-13. Toughness of Bituminous Aggregates.
- Vol. 11, No. 10, D-15. Tests of a Large-sized Reinforced-Concrete Slab Subjected to Eccentric Concentrated Loads.

*Department supply exhausted.

THE CITY'S PART IN FARM LABOR PROBLEM.

The problem of farm labor is largely a local one. It is necessary to meet the needs of farmers in large part by drawing upon near-by sources of labor. Most of the help needed on farms is of a skilled sort requiring previous farm experience. In towns and villages throughout the country from 30 to 40 per cent of the persons engaged in various lines of industries were born and brought up on farms. These men, therefore, by reason of their previous farm experience and their sympathetic understanding of agricultural conditions are best able to meet the farm-labor emergency wherever it may exist in farming communities.

The largest demands for farm labor are for short periods at seeding and harvest time. It is quite possible, therefore, for city employees to assist in this work without seriously neglecting city industries. Moreover, there are many unessential industries in all towns and villages which can be shut down temporarily during an emergency like the present in favor of the urgent demands for farm production. The Department of Agriculture is conducting an active campaign to bring about a closer business cooperation between the town and country. In this campaign city employers are requested to release some of their employees at certain periods for work on farms where their services may be urgently required. A canvass is being conducted in towns and cities in all States to secure the pledges of persons with previous farm experience who are willing to go out on farms for work during the coming season. The results of this campaign are very gratifying, but a much more active campaign must be pushed in many States where the residents of towns and cities have not yet realized the need of their cooperation in farm production and where farmers have not fully realized the importance of this source of farm labor. In Kansas, for example, the results thus far obtained indicate that 50,000 city and town residents with previous farm experience are willing to give from two to fifteen days of their time during their summer season to necessary farm work, especially harvesting. As another example of what can be done by an organization of city business men, attention may be called to a recent canvass by a committee of business men in Aberdeen, S. Dak. Within two days a pledge of 5,500 days labor on farms was obtained.

Some of the best and most alert farm laborers have been going to the city for years to engage in other lines of occupation. These men, when properly appealed to, are willing to go back to the farm temporarily in order to relieve the labor situation. The best method of making an appeal has been found to consist in the joint effort of a committee composed of a few farmers from the neighboring community and a few business men from the town or village who unite in the selection of one or two active business men in town to take a canvass of the business population and secure pledges from men who can render farm service during an emergency. In at least one State this canvass was taken in a very satisfactory manner by the pupils of the public schools.

In all States where the work is in progress the confidence of the whole community in their ability to meet the farm-labor situation is increasing, and this feeling of optimism rests upon the solid foundation of actual pledges of men who have had farm experience and who have lived near the farms on which their services may be required.

It is believed that the widest possible extension of this campaign of appeal to the business men and farmers for a close cooperation is the most logical method of meeting the farm-labor problem in a satisfactory way.

CLARENCE OUSLEY,
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