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MICHIGAN
STATE HIGHWAY DEPARTMENT
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MICHIGAN'S EXPERIMENT
IN
SNOW AND ICE REMOVAL ON HIGHWAYS
BY RADIANT HEAT

Winter Season 1952-1953
Performance and Cost

Cooperative Research Project between
the Michigan State Highway Department
and Detroit Public Lighting Commission

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MICHIGAN'S EXPERIMENT IN SNOW AND ICE REMOVAL BY RADIANT HEAT

Performance and Cost Data for Season 1952 - 1953

This is the sixth progress report on the Michigan experiment in snow and ice removal from highways by radiant heat. Previous reports may be referred to by Highway Research numbers 120, 130, 152, 165 and 190. It is the purpose of this report to present performance and cost information for the winter season 1952 - 1953. The winter of 1952 - 1953 was the second mildest since the beginning of the experiment; the only winter which was less severe was that of 1948 - 1949, the first winter of the experiment. The mildness of the winter is reflected in an energy consumption which was lower than that of any other season except 1948 - 1949.

General Performance

The system went into operation on December 25, 1952 and the last operation period ended March 8, 1953. The total operating hours were 415.17 as compared to 719.77 for 1951 - 1952; 916.35 for 1950 - 1951; 548.70 for 1949 - 1950; and 506.59 for 1948 - 1949. The average air temperature during operation periods for 1952 - 1953 was 29°F. as compared to 28°F., 25°F., 28°F., and 31°F., respectively for the previous seasons. The total snowfall for the 1952 - 1953 season was 14.78 inches, less than for any other winter except that of 1948 - 1949. The operating cost of the system per hour was \$1.97 for 1952 - 1953 as compared to \$1.84, \$2.02, \$1.89, and \$1.31 respectively for the other seasons.

Complete operative cost data for the 1952 - 1953 winter season furnished by the Detroit Public Lighting Commission will be found in Table I; Table II contains comparative operative data, by months, for the last five winter seasons; while Table III summarizes additional operative information for these seasons.

This year 6 breaks occurred in the heating elements, 1 in the concrete section and 5 in the bituminous section. Two of these breaks, No. 18 in the concrete section and No. 17 in the bituminous section, were in the same locations where breaks occurred in previous years. The other four were at new locations. Figure 1 shows the location of all breaks occurring to date. Figures 2 and 3 show views of locations in concrete and bituminous pavement where breaks in the heating grids have occurred. The views show condition of surface after repairs have been made. Figure 4 shows tools and equipment used in making repairs. These pictures were supplied by the Detroit Public Lighting Commission.

Concluding Remarks

For the second straight year, the energy consumption for the bituminous section was less than that for the concrete section. The difference between the two amounts was 9.4 percent as compared to 12.1 percent for the season 1951 - 1952. As yet, no explanation can be offered for this reversal of power consumption.

Because of limited snowfall throughout the winter, no attempt was made to present a pictorial performance record as in past years.

A summary of operating data and costs has been prepared in Table IV.

TABLE I

SUMMARY OF OPERATING DATA AND COSTS FOR SEASON 1952-53

DATA FURNISHED BY DETROIT PUBLIC LIGHTING COMMISSION

SYSTEM IN OPERATION		Time "ON" Hr. Min.	CONCRETE SECTION		BITUMINOUS SECTION		PRECIPITATION		Average Mean at Site-°F	Average Temperature of Favement at Control Point	
From	To		Energy Consumed KWH	Cost P.L.C. Rate	Energy Consumed KWH	Cost P.L.C. Rate	Snowfall Sleet Inches	Water Equivalent Inches		Concrete °F	Bituminous °F
NOVEMBER											
1:23 p.m. 11-25-52	8:45 a.m. 11-26-52	19 : 22	220		0		0	0	45	48	42
9:00 a.m. 11-28-52	2:45 p.m. 11-28-52	<u>5 : 45</u>	<u>240</u>		<u>0</u>		<u>T</u>	<u>T</u>	<u>25</u>	<u>48</u>	<u>36</u>
November Totals		25 : 07	460	\$12.42	0	00.00	T	T	35	48	39
DECEMBER											
11:40 p.m. 12- 1-52	8:00 a.m. 12- 3-52	32 : 20	1,720		1,440		2.80	0.25	28	41	37
5:40 p.m. 12- 5-52	9:25 p.m. 12- 5-52	3 : 45	360		280		0.32	0.10	37	40	48
3:13 a.m. 12-12-52	11:00 a.m. 12-12-52	7 : 47	340		400		0.70	0.07	33	40	48
10:30 p.m. 12-14-52	7:45 a.m. 12-15-52	9 : 15	460		560		T	T	28	40	48
9:53 a.m. 12-26-52	4:20 p.m. 12-26-52	6 : 27	460		120		0.10	0.01	27	38	48
9:50 a.m. 12-27-52	12:30 p.m. 12-28-52	<u>26 : 40</u>	<u>1,160</u>		<u>1,480</u>		<u>0.10</u>	<u>0.01</u>	<u>24</u>	<u>40</u>	<u>48</u>
December Totals		86 : 14	4,500	\$103.50	4,280	\$98.55	4.02	0.44	30	40	46
JANUARY											
7:40 p.m. 1- 2-53	8:15 p.m. 1- 4-53	48 : 35	2,280		2,120		0.70	0.06	28	40	48
6:30 a.m. 1- 5-53	8:15 p.m. 1- 5-53	13 : 45	700		780		0.60	0.06	23	38	48
7:25 p.m. 1- 6-53	8:45 a.m. 1- 7-53	13 : 20	1,160		1,080		0.40	0.02	17	39	48
9:55 a.m. 1- 8-53	6:00 p.m. 1- 8-53	8 : 05	460		520		0.60	0.41	27	37	48
10:55 a.m. 1- 9-53	8:05 p.m. 1-11-53	57 : 10	2,180		2,280		3.20	0.20	30	40	48
11:50 a.m. 1-17-53	6:45 p.m. 1-18-53	18 : 55	1,060		1,080		0.26	T	33	40	48
11:37 a.m. 1-19-53	4:43 p.m. 1-19-53	5 : 06	100		120		T	0.01	33	40	48
9:30 a.m. 1-24-53	11:30 a.m. 1-25-53	26 : 00	1,160		800		0.70	0.20	29	40	48
2:44 a.m. 1-29-53	4:30 p.m. 1-29-53	13 : 46	580		360		0.50	0.03	25	39	48
2:29 a.m. 1-30-53	4:25 p.m. 1-30-53	<u>14 : 54</u>	<u>680</u>		<u>680</u>		<u>2.60</u>	<u>0.18</u>	<u>31</u>	<u>37</u>	<u>48</u>
January Totals		219 : 36	10,360	\$205.49	9,820	\$196.34	9.56	1.17	28	39	48
FEBRUARY											
7:00 a.m. 2-11-53	1:20 p.m. 2-11-53	6 : 20	240		360		T	0.05	36	38	48
5:45 a.m. 2-13-53	10:05 a.m. 2-13-53	4 : 50	680		520		0.10	0.01	32	40	48
3:00 p.m. 2-16-53	7:40 a.m. 2-17-53	16 : 40	1,040		960		0.20	0.02	20	39	48
10:20 a.m. 2-17-53	12:30 p.m. 2-17-53	2 : 10	0		0		T	T	23	--	--
4:33 p.m. 2-28-53	12:00 p.m. 3- 1-53	<u>19 : 27</u>	<u>820</u>		<u>680</u>		<u>0.30</u>	<u>0.03</u>	<u>28</u>	<u>41</u>	<u>48</u>
February Totals		49 : 27	2,780	\$64.80	2,520	\$58.95	0.60	0.11	28	39	48
MARCH											
11:00 p.m. 3- 4-53	8:20 a.m. 3- 5-53	9 : 20	680		520		0.60	0.12	32	36	48
6:34 p.m. 3- 7-53	8:00 a.m. 3- 8-53	<u>25 : 26</u>	<u>1,160</u>		<u>920</u>		<u>T</u>	<u>0.03</u>	<u>21</u>	<u>40</u>	<u>48</u>
March Totals		<u>34 : 46</u>	<u>1,840</u>	<u>\$43.20</u>	<u>1,440</u>	<u>\$34.65</u>	<u>0.60</u>	<u>0.15</u>	<u>26</u>	38	48
Season Totals		415 : 10	19,940	\$429.41	18,060	\$388.49	14.78	1.87	29*	41*	46*

* Average

TABLE II
SUMMARY OF OPERATING TIME, ENERGY CONSUMPTION, AND WEATHER CONDITIONS
Winter Seasons 1948-49, 1949-50, 1950-51, 1951-52, 1952-53

Month	Time "ON" - Hours					KWH Consumption									
						1948-49		1949-50		1950-51		1951-52		1952-53	
	1948-49	1949-50	1950-51	1951-52	1952-53	Concrete	Asphalt	Concrete	Asphalt	Concrete	Asphalt	Concrete	Asphalt	Concrete	Asphalt
November	0.00	66.70	101.50	0.00	25.12	0	0	1980	2280	5660	7120	0	0	460	0
December	79.65	83.55	254.50	241.71	86.24	2590	2180	2080	2780	12840	15150	15940	14680	4500	4280
January	190.93	116.50	177.23	185.67	219.60	5010	5600	4400	5200	7740	9130	8120	6600	10360	9820
February	142.01	140.01	337.92	174.70	49.45	3540	3770	8560	7960	17220	16360	6360	5480	2780	2520
March	94.00	122.69	55.20	129.10	34.76	2670	3470	4840	4860	1570	1860	4160	3640	1840	1440
April	0.00	19.25	0.00	0.00	0.00	0	0	920	680	0	0	0	0	0	0
Total	506.59	548.70	926.35	731.18	415.17	13810	15020	22780	23860	45030	49620	34580	30400	19940	18060

WEATHER CONDITIONS DURING OPERATIONS

Month	1948-1949			1949-1950			1950-1951			1951-1952			1952-1953		
	Snow-fall, in.	Water Equivalent	Mean Air Temp. °F	Snow-fall, in.	Water Equivalent	Mean Air Temp. °F	Snow-fall, in.	Water Equivalent	Mean Air Temp. °F	Snow-fall, in.	Water Equivalent	Mean Air Temp. °F	Snow-fall, in.	Water Equivalent	Mean Air Temp. °F
November	---	---	---	4.5	0.76	32	8.4	1.25	18	---	---	---	---	---	35
December	0.50	0.49	38	4.7	0.48	33	6.5	1.91	24	18.0	2.25	23	4.02	0.44	30
January	4.60	0.26	35	9.2	0.71	30	12.4	0.79	34	10.7	1.83	27	9.56	1.17	28
February	3.10	0.39	25	12.6	2.29	25	7.4	1.38	20	7.3	0.77	27	0.60	0.11	28
March	2.1	0.11	25	9.6	0.81	24	5.7	1.41	30	6.7	1.00	31	0.60	0.15	26
April	---	---	---	0.4	0.4	26	---	---	---	---	---	---	---	---	---
Total	10.3	1.25		41.0	5.45		40.4	6.74		42.7	5.85		14.78	1.87	
	Average temperature 31			Average temperature 28			Average temperature 25			Average temperature 28			Average temperature 29		

TABLE III

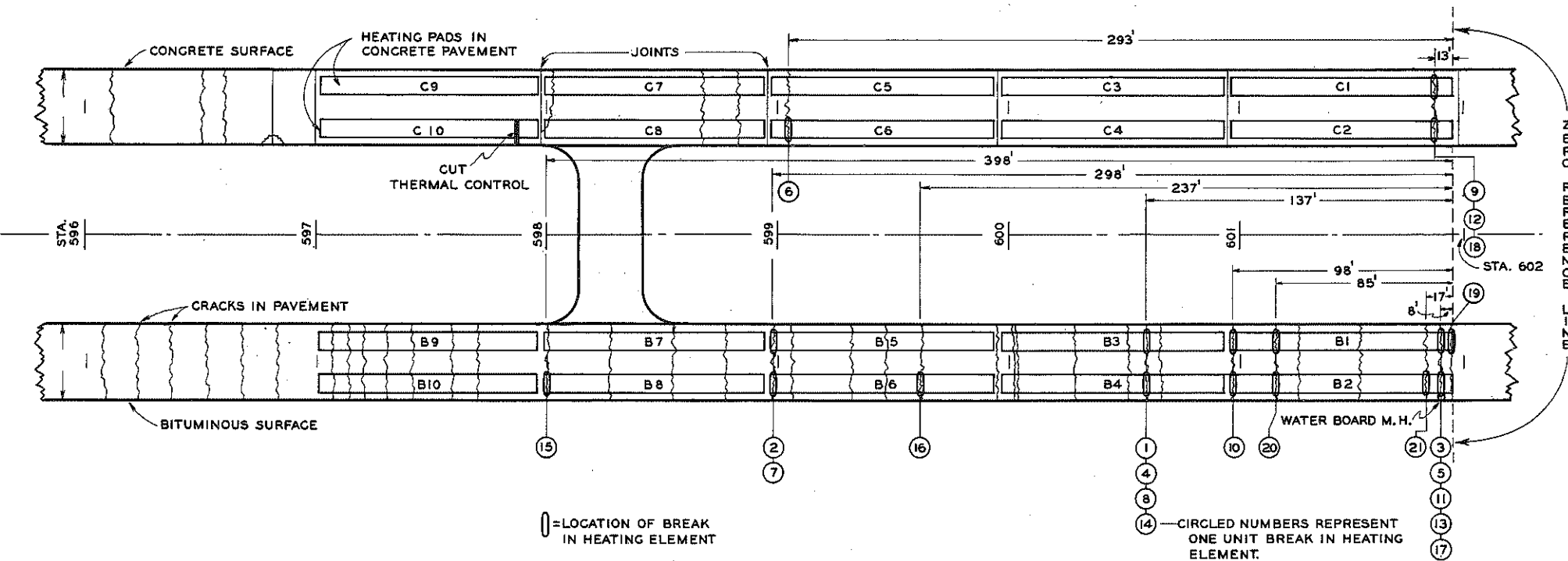
SUMMARY OF COMPARATIVE OPERATING DATA FOR FIVE SEASONS

	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953
Total Time "ON"	506.59 hrs.	548.70 hrs.	926.35 hrs.	719.77 hrs.	415.17 hrs.
<u>Total Energy Consumption - KWH</u>					
Concrete Section	13,810	22,780	45,030	34,580	19,940
Asphalt Section	<u>15,020</u>	<u>23,860</u>	<u>49,620</u>	<u>30,400</u>	<u>18,060</u>
Total KWH Consumption	28,830	46,640	94,650	64,980	38,000
<u>Energy Consumption per 500-ft. Section per Hour of Operation - KWH</u>					
Concrete Section	27.3	41.5	48.6	48.06	48.02
Asphalt Section	29.7	43.5	53.6	42.24	43.50
Percent Difference (Asphalt to Concrete)	+ 8.8%	+ 4.8%	+ 10.3%	- 12.1%	- 9.4%
<u>Energy Consumed per 500-ft. Section per Hr. per Sq. Ft. of Heating Surface in watts</u>					
Concrete Section	18.4	27.9	32.7	32.0	31.9
Asphalt Section	20.0	29.3	36.1	28.0	28.8
<u>Total Cost - (Detroit Public Lighting Commission Rate)</u>					
Concrete Section	\$319.66	\$507.24	\$893.93	\$701.15	\$429.41
Asphalt Section	<u>343.76</u>	<u>533.78</u>	<u>973.10</u>	<u>627.49</u>	<u>388.49</u>
Total Cost	\$663.42	\$1,041.02	\$1,867.03	\$1,328.64	\$817.90
<u>Cost per 500-ft. Section per Hour of Operation</u>					
Concrete Section	\$ 0.63	\$ 0.92	\$ 0.97	\$ 0.97	\$ 1.03
Asphalt Section	<u>0.68</u>	<u>0.97</u>	<u>1.05</u>	<u>1.05</u>	<u>0.94</u>
Total Cost	\$ 1.31	\$ 1.89	\$ 2.02	\$ 2.02	\$ 1.97
<hr/>					
Total Snowfall, inches	10.3	41.0	40.4	42.1	14.78

TABLE IV

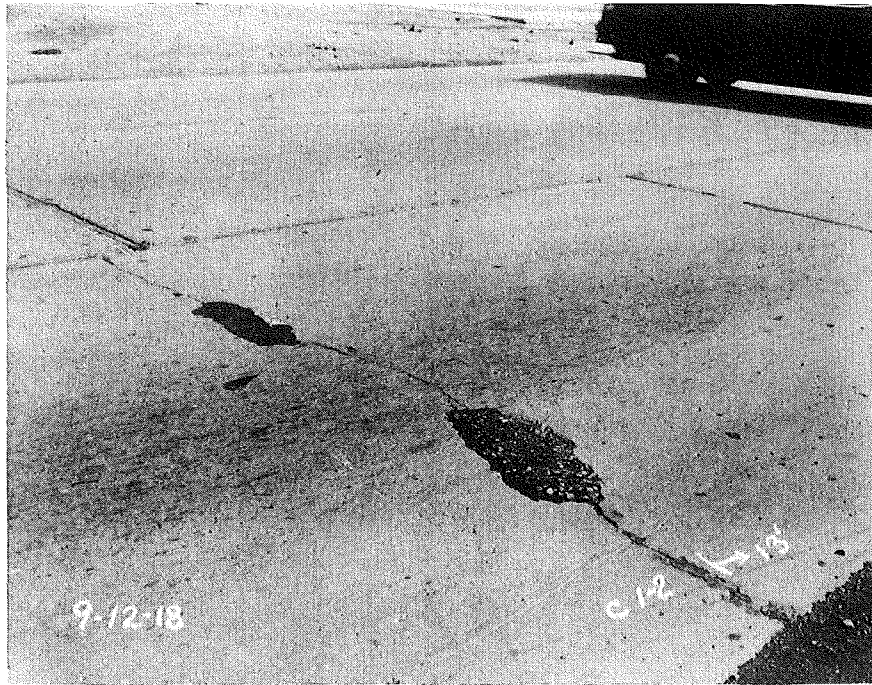
SUMMARY OF OPERATING DATA AND COSTS
for years 1948 to 1953

Winter	Water Equiv.	Snowfall in.	Avg. Temp.	Hrs. "ON"	KWH	Cost
48 - 49	1.25	10.3	31	506.59	28,830	\$ 663.42
49 - 50	5.45	41.0	28	548.70	46,000	1,041.02
50 - 51	6.74	40.4	25	926.35	94,000	1,867.03
51 - 52	5.81	42.1	28	719.77	64,980	1,328.62
52 - 53	1.87	14.78	29	415.17	38,000	817.90



BREAK NO.	'50-'51					'51-'52										'52-'53					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
DATE	11-24	12-26	1-14	1-21	1-27	12-3	12-4	12-4	12-5	12-10	12-13	12-18	1-16	1-16	1-30	11-6	11-6	11-10	11-10	1-30	1-30

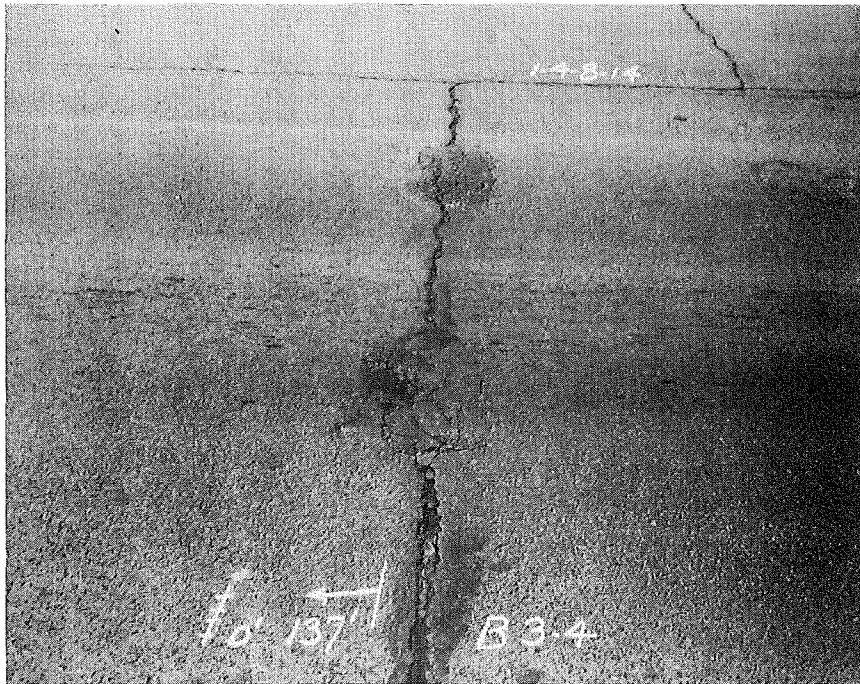
FIGURE 1
LOCATION OF CRACKS AND BREAKS IN HEATING ELEMENTS
 EIGHT MILE ROAD EXPERIMENTAL PAVEMENT HEATING FOR SNOW AND ICE REMOVAL



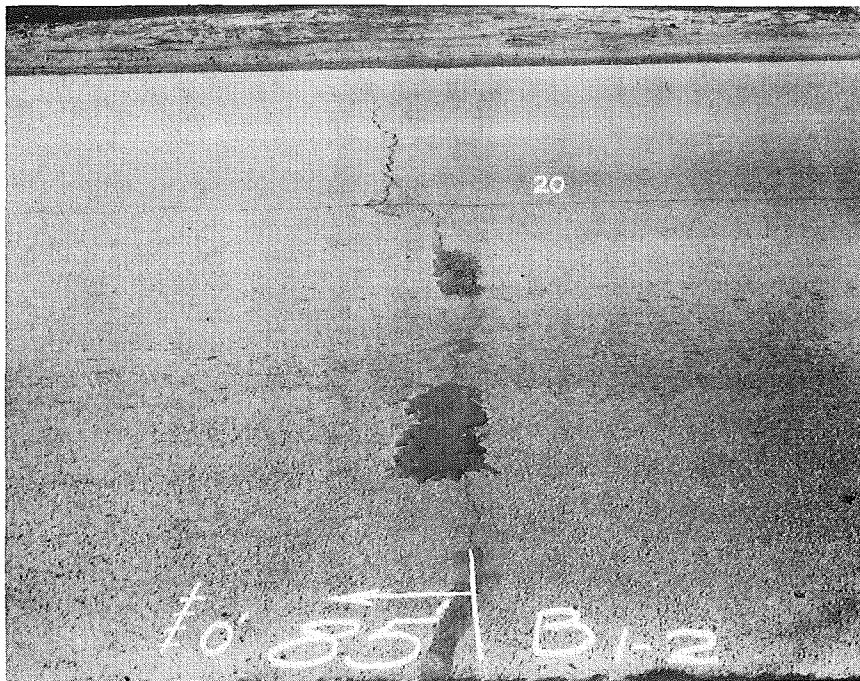
▲ FIGURE 2 A. LOCATION OF GRID BREAKS 9-12 AND 18 IN CONCRETE PAVEMENT.



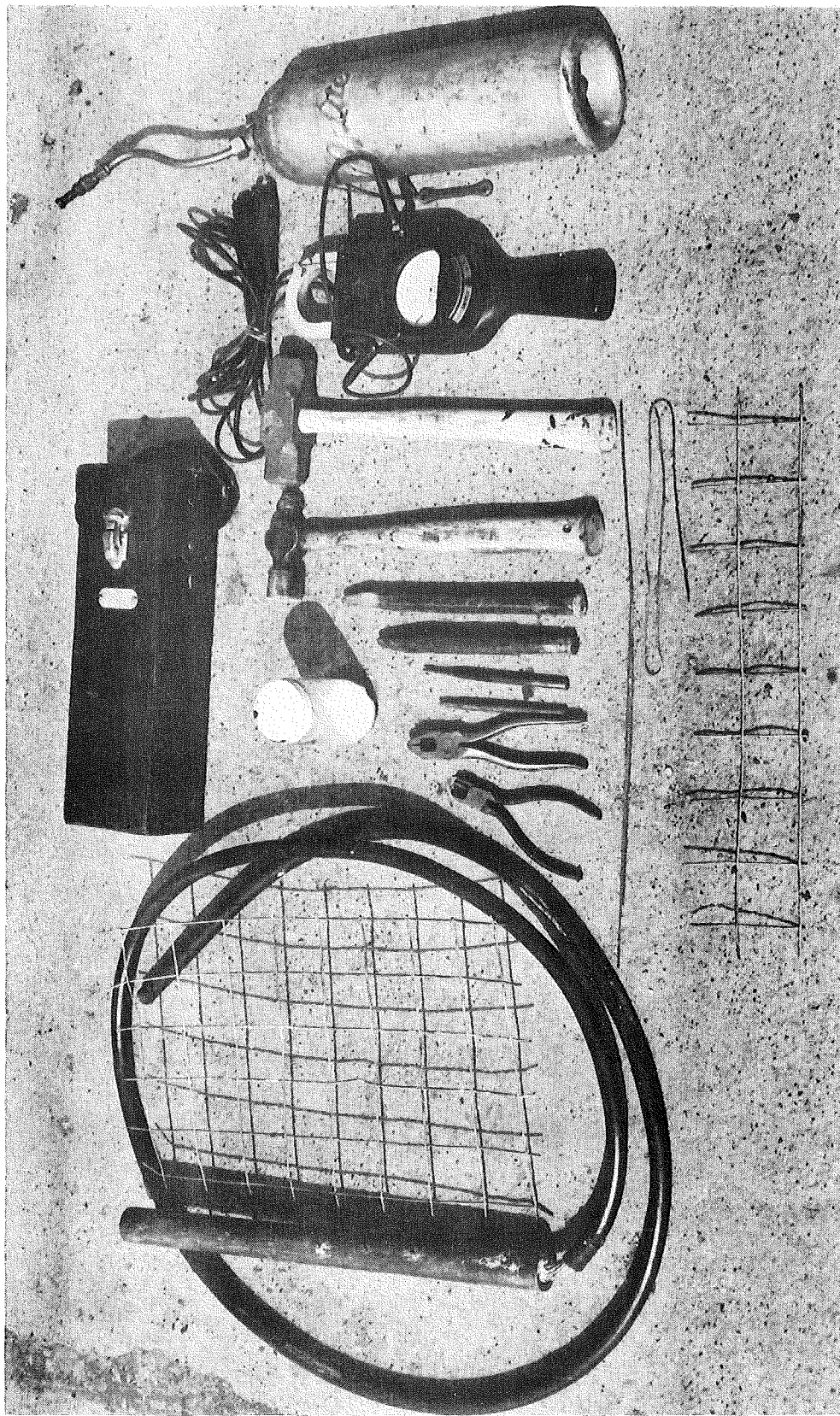
▲ FIGURE 2 B. LOCATION OF GRID BREAK 6. IN CONCRETE PAVEMENT.



▲ FIGURE 3A. LOCATION OF GRID BREAKS 1-4-8 AND 14 IN BITUMINOUS SECTION. NOTE WIDE CRACK.



▲ FIGURE 3B. LOCATION OF NEW GRID BREAK NO. 20 AT NARROW CRACK IN BITUMINOUS SECTION.



▲ FIGURE 4. LAYOUT OF TOOLS AND EQUIPMENT FOR MAKING GRID REPAIR