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SECONDARY RECOVERY IN ILLINOIS

By

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## CHAPTER 42

## SECONDARY RECOVERY IN ILLINOIS ||

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## ABSTRACT

Secondary-recovery methods which have been used in the older Illinois oil fields include vacuum, gas, and air repressuring, as well as water flooding. Only gas repressuring and water flooding have been used to any appreciable extent in the newer fields discovered since 1936. It is estimated that, of the 371,000 oil productive acres in Illinois,‡ only 25,400 acres, or 7 per cent, have been repressured or flooded to date, which leaves considerable acreage yet to be developed. Recent activity in scattered areas in Illinois indicates greatly expanded interest in these methods of increasing a dwindling supply of crude oil.

Gas and air repressuring were the most widespread secondary-recovery methods used in the old fields; but

interest in water flooding has increased in the past five years, and will probably continue to increase in relative importance. Recent figures show that 5,690,000 bbl of new oil have been recovered in slightly more than 3 years from approximately 7,200 flooded acres, whereas it has taken an average of 9 years to recover 4,700,000 bbl of new oil from 12,500 repressured acres. This indicates that almost twice as many barrels per acre are recovered by flooding as by repressuring; and, furthermore, the oil is recovered in one-third of the time.§

The paper consists primarily of a statistical report of the results obtained by repressuring and water flooding in Illinois to January 1, 1947.

## INTRODUCTION

Vacuum, air, and gas repressuring, as well as water flooding, have been used in Illinois since shortly after oil was discovered in the southeastern Illinois field in 1905. Vacuum was first applied in Clark County in 1910, repressuring with gas and air in Clark County in 1921, and water flooding in Crawford County in 1924. The use of vacuum was, in most cases, commercially unsuccessful except as a gasoline-recovery method; but repressuring and water flooding have been, and continue to be, profitable. Repressuring and water flooding to date have been applied to only a relatively small amount of the productive acreage in Illinois. Of the 371,000 productive acres in Illinois, a recent survey shows that 25,400 acres, or 7 per cent, have been repressured or flooded—leaving considerable acreage yet undeveloped, much of which is sufficiently rich in residual oil to warrant serious consideration. This acreage does not include 17,700 acres of pressure maintenance in the Salem, Loudon, and New Harmony-Griffin Consolidated Pools. Rapid strides in research in secondary recovery, especially during the recent war years, coupled with diminishing oil reserves, gives impetus to the extension of secondary recovery over much of this acreage. Fig. 1 is an index map for counties, townships, and ranges; and Fig. 2 shows oil-productive

areas in Illinois and also those areas where repressuring and water-flooding operations are now being conducted. Fig. 3 is a geologic column for the Illinois Basin, and includes the total productive acreage of each of the important oil-producing zones.

## Regional Structure

The oil fields discussed in this article are located in the Eastern Interior Basin, a major area of downwarping which occupies four-fifths of Illinois and includes adjoining parts of southwestern Indiana and western Kentucky. The new fields discovered in this area in the past 10 years are located on structural highs, stratigraphic traps, or on the upthrown sides of faults within the Illinois Basin, which is defined as the central deepest part of the Eastern Interior Basin.

## Air and Gas Repressuring

Since the first successful repressuring operation was attempted in Illinois in 1921, the practice has been considerably extended; so that, by the end of 1946, some 18,000 acres had been developed. As may be seen in Tables 1-A, 1-B, and 1-C, repressuring with gas and air has been confined essentially to the old Southeastern Field. Inasmuch as there already were many gasoline plants which employed gas compressors in their operation, a good deal of the work involved in changing over to gas or air repressuring was a matter of converting producing wells to input wells and the addition of pressure lines; therefore, the cost of material and labor was very little. On the other hand, increases in oil production were not high, the average being approximately 400 bbl per acre. Fig. 4 is a map showing typical repressuring operation in the old fields.

\* Illinois State Geological Survey, Urbana, Ill.

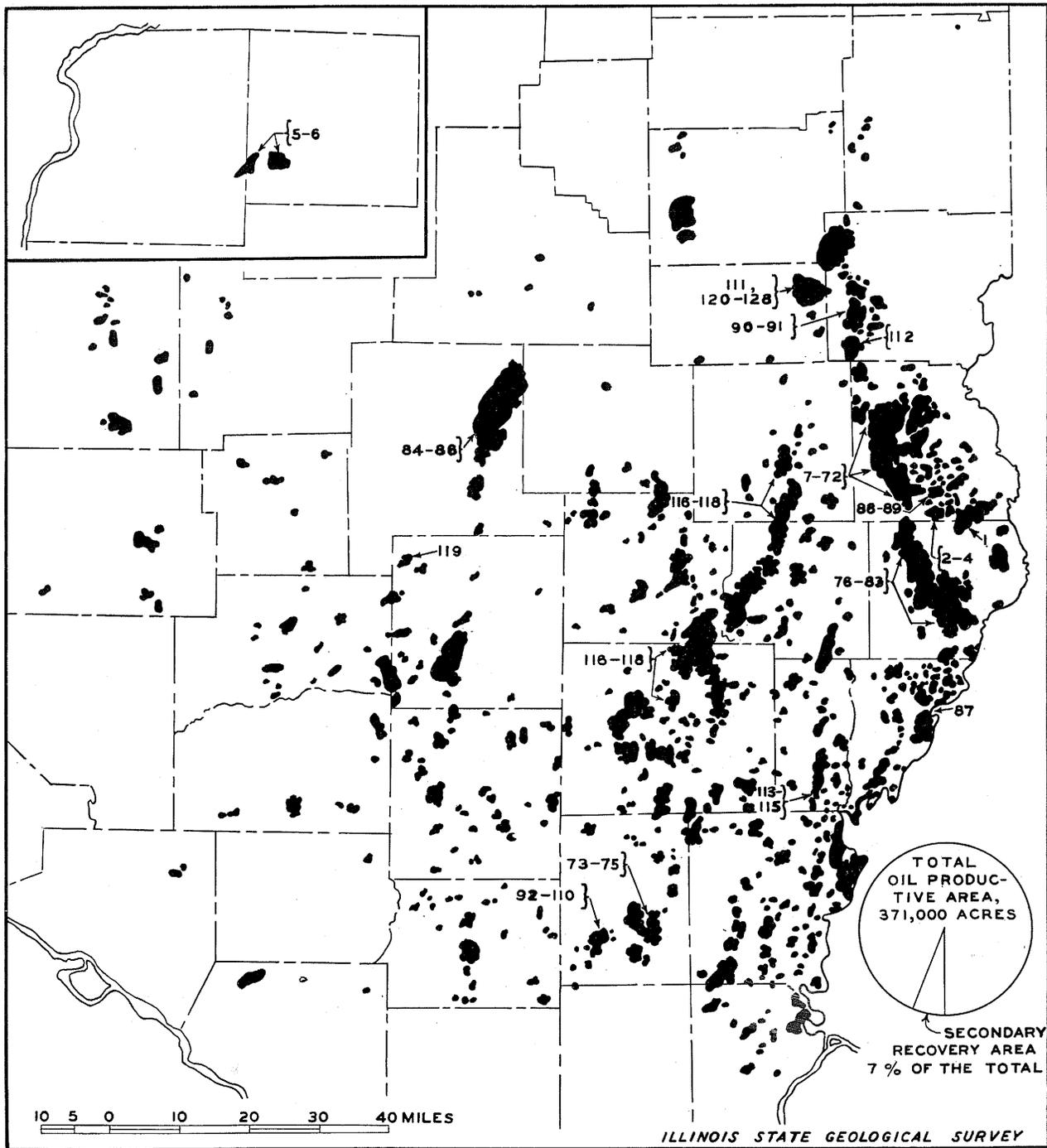
† Illinois State Geological Survey, Urbana, Ill. Removed to Sohio Petroleum Co., Centralia, Ill.

‡ Includes productive acreage of each sand in multiple-zone pools.

§ Figures obtained from totals of columns 32 and 45, Table 1-C. Conclusions arrived at by dividing totals of column 45 by totals of column 32, with due consideration being given to the fact that some oil-recovery figures are missing from column 45; hence the acreage involved is not counted.

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Map of Illinois Oil Pools and Locations of Secondary-Recovery Operations. (Numbers Refer to Line Numbers in Tables 1-A, 1-B, and 1-C.)

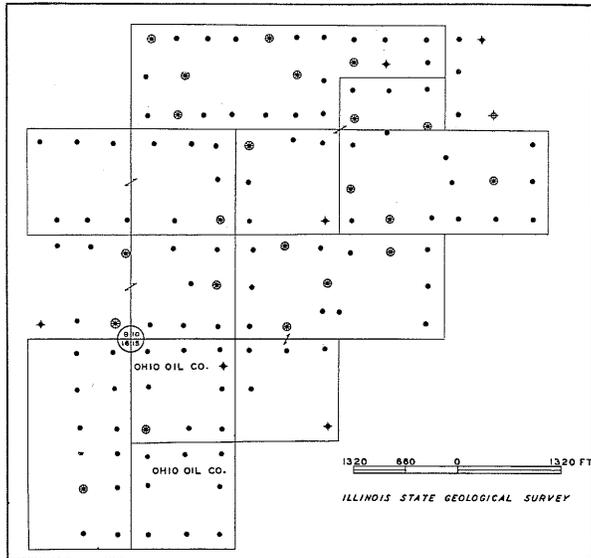
FIG. 2

SYSTEM OR SERIES	GROUP OR FORMATION, AND LITHOLOGY	PRODUCTIVE ACREAGE
PLEISTOCENE	GLACIAL DRIFT & LOESS	
PLIOCENE	CHERT & GRAVEL	
EOCENE	SAND & CLAY	
PALEOCENE	SAND & CLAY	
CRETACEOUS	SAND & CLAY	
PENNSYLVANIAN	<u>MC LEANSBORO</u> GROUP - SH., SS., LS., COAL	} 9,000 58,000
	<u>CARBONDALE</u> GROUP - SH., LS., SS., COAL	
	<u>TRADEWATER</u> GROUP - SS., SH., COAL	
	<u>CASEYVILLE</u> GROUP - SS., SH., COAL	
CHESTER (UPPER MISSISSIPPIAN) SERIES	KINKAID - LS., SH.	900
	DEGONIA - SS.	
	CLORE - LS., SH., SS.	
	<u>PALESTINE</u> - SS.	3,500
	MENARD - LS., SH.	
	<u>WALTERSBURG</u> - SS.	5,900
	VIENNA - LS., SH.	
	<u>TAR SPRINGS</u> - SS.	1,300
	GLEN DEAN - LS., SH.	
	<u>HARDINSBURG</u> - SS.	57,800
	GOLCONDA - LS., SH.	11,500
	<u>CYPRESS</u> - SS.	37,000
	<u>PAINT CREEK</u> - LS., SH., SS.	16,200
<u>BETHEL</u> - SS.		
RENAULT - LS., SH., SS.		
<u>AUX VASES</u> - SS.		
IOWA (LOWER MISSISSIPPIAN) SERIES	STE. GENEVIEVE	3,100
	<u>LEVIAS</u> - LS.	3,900
	<u>ROSICLARE</u> - SS.	
	FREDONIA	
	( <u>MC CLOSKY</u> ) - LS.	76,700
	ST. LOUIS - LS.	
	SALEM - LS.	
	WARSAW - LS.	
KEOKUK - LS.	} OSAGE GROUP	
BURLINGTON - LS.		
FERN GLEN - LS.		
KINDERHOOK - SH., LS., SS.		
MISSISSIPPIAN AND DEVONIAN	CHATTANOOGA - NEW ALBANY - SH.	
DEVONIAN	<u>LIMESTONE</u>	14,000
SILURIAN	<u>DOLOMITE</u>	2,700
ORDOVICIAN	MAQUOKETA - SH.	
	KIMMSWICK ( <u>TRENTON</u> ) - LS.	2,500
	PLATTIN - LS.	
	JOACHIM - LS.	
ST. PETER - SS.		
PRE-ST. PETER	UNIDENTIFIED	TOTAL 371,000*

\* Includes 67,000 acres in pools containing multiple-zone completion wells.

Geologic Column and Productive Acreage Chart. (Important Oil-Producing Zones Underlined.)

FIG. 3



**Repressuring Project: Tide Water Associated Oil Company—Henry Group—Sect. 9, 10, 15, and 16, T.7N., R.13W., Crawford County, Illinois.**

**FIG. 4**

Production records from the old fields are not complete, and those that are available, except in a few cases, do not distinguish between primary and secondary-recovery oil; therefore, it is difficult to estimate the total amount of additional oil that was produced by repressuring. It is interesting to note, however, that production from the Colmar-Plymouth Pool in Hancock and McDonough Counties, discovered in 1914, totaled 3,314,000 bbl, of which 1,589,000 bbl of new oil, or approximately 870 bbl per acre, have been recovered in the 11 years that the fields have been repressured. This operation was exceptionally successful, and similar recoveries from the Southeastern Field are unusual.

Most injection wells in the old fields, formerly repressured with gas, have been gradually converted to air as the gas supply decreased. In a few of the new pools there is still sufficient gas produced which, after being stripped of its heavier components, is re-injected into the oil-producing sands. Unfortunately, in most areas this procedure was not practiced until almost too late to be of much benefit, and large volumes of valuable gas were vented to the air or burned in flares. Except for such pools as Dale-Hoodville and Rural Hill in Hamilton County, and Loudon in Fayette County, most of the other repressuring projects in Illinois are injecting only air, or mixtures of air and gas. Recent figures show that only 689,000 cu ft of gas are injected per day into 41 wells in the old oil fields in Illinois; whereas 2,600,000 cu ft of air are injected per day into 216 wells, and 1,970,000 cu ft of combined gas and air are injected per day into 175 wells in the same fields. In contrast to these figures, approximately 17,500,000 cu ft of gas are being injected per day into more than

50 wells in the new fields, with no air being used as yet.

Repressuring of limestone pays (as distinguished from pressure maintenance) has not been attempted to any appreciable extent in Illinois except in the Rural Hill Pool, Hamilton County. Results obtained here are uncertain because of the fact that the wells are dual completions in the Aux Vases sand and the McClosky limestone, and separate production records are not kept.

#### Water Flooding

The old Southeastern Field, where flooding was first attempted in 1924, has abundant supplies of surface water; and, in many areas, fresh water may be obtained from shallow wells in glacial drift. Early haphazard attempts at circle flooding made use of this water by injecting it into the producing sands, with indifferent results. Recent operations are increasing the use of produced salt water, or salt water from upper water-bearing sands, for injection purposes. In areas where the production of salt water is large, this procedure also aids in solving the problem of salt-water disposal.

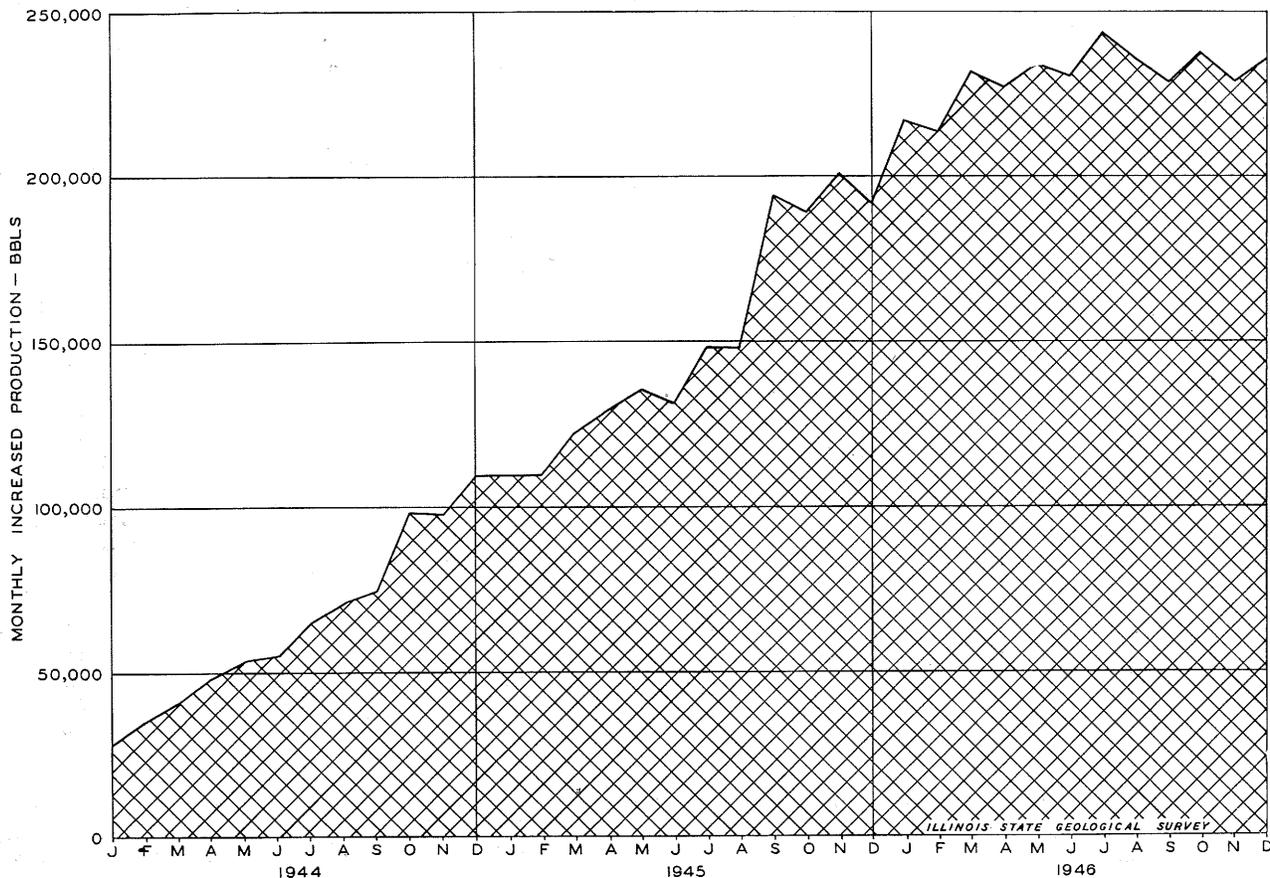
The three major flooding projects now in operation employ three different methods in flooding the pay zones. In the first two floods in the Siggins area, flooding is done entirely with fresh water obtained from drift wells located  $5\frac{1}{2}$  miles from the flooded area. A closed system is employed, and the water is injected without chemical treatment. In December 1946 water was turned into an additional 200 acres adjoining the original floods. The water injected into this flood is a mixture of fresh and produced salt water in the approximate proportion of 1,500 bbl of fresh to 1,000 bbl of salt water per day. This water is aerated, treated with chemicals, and filtered before injection. Cement-lined pipe is used in all water-supply lines and injection wells.

At Patoka, Tar Springs salt water is pumped to the surface, aerated, treated with chemicals, and filtered before injection into the stratigraphically lower Bethel sand. The basin McClosky limestone is flooded by perforating the casing opposite the upper water-bearing Cypress sand and allowing the water to flow by gravity to the McClosky pay zones. Unfortunately, complete data, especially on amounts of water injected and sand characteristics, are not available on the McClosky floods. Statistical data on flooding operations in Illinois are listed in Tables 1-A, 1-B, and 1-C, lines No. 113 to No. 128.

Although different methods were used, all of the three major water floods in Illinois are highly successful. The total for the three may be seen in Fig. 5, which is a composite graph showing the gross increase in oil production due to the floods for the years 1944 through 1946. It is interesting to note that the increase in production during 1946 was more than double the estimated amount that was produced during the first two years that the floods were in operation.<sup>14</sup>

Fig. 6 is a map showing the flooded area in the

<sup>14</sup> Figure refers to REFERENCE on p. 511.



Cumulative Increased Oil Due to Siggins, Patoka, and Basin—McClosky Floods: 5,690,000 Bbl.

FIG. 5

Siggins Pool, Cumberland County, one of the three floods mentioned previously.

#### Relative Costs of Development

The costs involved in converting from primary recovery to secondary recovery in Illinois vary greatly with the local conditions and the methods used. As mentioned earlier, the cost of converting in the old Southeastern Field was confined largely to that of changing a producing well to an input well, plus the addition of gas compressors (where there were no gasoline plants) and gas lines to the system. A survey of 50 of these projects in the old fields showed that the additional expense for material and labor did not amount to more than a few hundred dollars in most cases, and the increase in operating costs did not average more than 10 per cent. In general, the results obtained were considered to have more than repaid the additional expense involved.

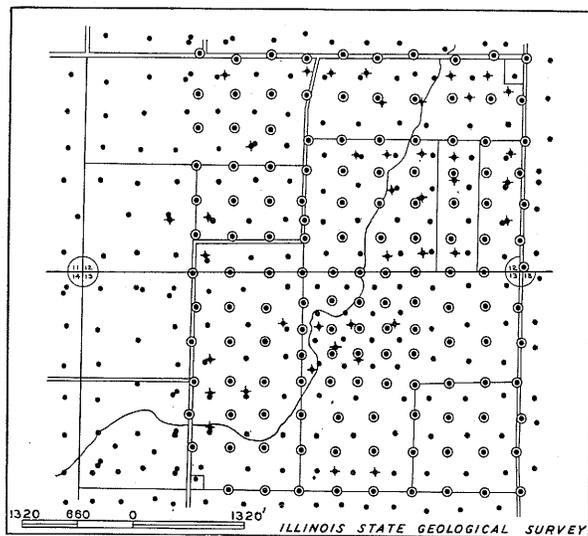
Although actual figures are not available for costs involved in the three major floods, an approximate idea

may be gained from a comparison of the different methods used. Of the 254 wells in the flooded area of the Siggins Pool, 179 were newly drilled; and gathering lines and water lines had to be installed in addition to the pumping plant. However, the cost of drilling the wells was not excessive, because the average depth to the producing sand is only 400 ft.

In the Patoka Pool, many of the old producing wells were used as such in the flood pattern, but almost all of the water-input wells were newly drilled. This amounted to 92 new wells at an average depth of 1,400 ft each. Added to this cost are a water-treatment plant and a water pump, plus water lines.

In direct contrast to the foregoing two flooding operations are the basin McClosky floods. Except for an initial trial at flooding the McClosky with filtered river water, 37 producing wells were converted to input wells by pulling the tubing and pumps, perforating with an average of 10 shots opposite the water-bearing Cypress sand, and allowing the water to flow by gravity into the McClosky.

The additional oil produced by water flooding, as



Siggins Flood: Forest Oil Corporation—Sect. 12 and 13, T.10N., R.10E., Cumberland County, Illinois.

FIG. 6

shown graphically in Fig. 5, undoubtedly had a dollar value greatly in excess of the costs involved. An illustration of the success of flooding in Illinois may be obtained from an examination of Table 1-C, lines 120 to 128, which show that 619,000 bbl of new oil have already been produced from 280 acres in the Siggins project, a recovery to date of 2,200 bbl per acre. This production was obtained from an old field that was on the verge of being abandoned.

#### Pressure Maintenance

Pressure-maintenance operations are conducted in three large areas in the state, viz., in the Salem Pool in Marion County, Illinois; in the New Harmony-Griffin Consolidated Pool in White County, Illinois, and Posey County, Indiana; and in the northern part of the Loudon Pool, but in the New Harmony-Griffin Consolidated Pool, 10 different pay zones are being repressured with gas through 43 input wells in an area comprising 8,600 acres. Inasmuch as the first injection wells were put on the line in July 1942, approximately 9 billion cubic feet of gas have been injected into the sands in this area. This program has greatly arrested the rate of decline of bottom-hole pressures, and will ultimately result in the lengthening of the life of the producing wells—and should, thereby, increase the volume of produced oil.

Pressure maintenance has been applied to three sands in the northern part of the Loudon Pool since shortly after it was discovered in 1937. Approximately 110 input wells are being used to inject gas under line pressures of 700 psi. The area subjected to these operations comprises 9,100 acres out of the 20,650 acres in the pool. The pattern used is the "sunflower," where 1 injection well is placed in the center of 8 producing

wells for an average density of 1 injection well per 160 acres. Increased oil production is difficult to estimate, because the program was initiated early in the life of the field; but the practice has undoubtedly contributed a fair share of the total production of 130,193,000 bbl of oil that the pool has produced in 10 years. The success of this operation is shown by the fact that there were still 83 flowing wells in the field in October 1946, as compared with a maximum of 435 in the field in 1940.

#### CONCLUSION

In spite of the numerous individual secondary-recovery operations that are carried on, the acreage involved, as compared with the total productive acreage, is as yet very small. From all indications, operations are to be greatly expanded in 1947, with greater emphasis being placed on water flooding than on repressuring. The present high price of oil, the increasing tendency toward using old wells for injection wells, and the phenomenal success of the three floods already in operation combine to offer an attractive prospect for increased supplies of oil by flooding, and they should result in the testing of producing zones now considered uneconomic to repressure or flood.

#### ACKNOWLEDGMENT

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<sup>1</sup> Frederick Squires, "Flood Tide in Illinois," *Producers Monthly* 10 [9] 10-19 (1946). [Reprinted as *Ill. State Geol. Survey Circ.* 125 (1946).]

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<sup>1</sup> Anon., "Illinois Limestone Successfully Water-flooded," *Oil Weekly* 117 [8] 68-70 (1945); *J. Inst. Petroleum* (abstract) 31 [261] 312A (1945).

<sup>2</sup> K. B. Barnes, "Studies Indicate Water Drives in Illinois Pools Increase Ultimate Recovery," *Oil Gas J.* 43 [23] 89-90, 92-4, 109 (1944); *J. Inst. Petroleum* (abstract) 31 [255] 98A (1945).

<sup>3</sup> A. W. Baucum and W. D. Steinle, "Efficiency of Illinois Water-Drive Sand Reservoirs" (API Mid Continent District, Oklahoma City, June 6-7, 1946) *Oil Gas J.* 45 [12] 199, 201-2, 204 (1946); *API Quarterly* (abstract) 16 [3] (1946); *Oil Gas J.* (abstract) 45 [6] 122 (1946); *J. Inst. Petroleum* (abstract) 32 [274] 333A (1946); *Oil Weekly* (abstract) 122 [3] 30 (1946).

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<sup>8</sup> Earl Lamm, "Joint Repressuring Project Slows Production Dip in Illinois Field," *Natl. Petroleum News* 36 [16] 18-20, 22, 24 (1944).

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<sup>10</sup> Paul Reed, "Applied Water-Flooding Experiments in Illinois," *Oil Gas J.* 42 [38] 262-3 (1944).

<sup>11</sup> Paul Reed, "Repressuring Program for Plymouth Pool Maintains Improved Production Rate," *Oil Gas J.* 43 [5] 58 (1944).

<sup>12</sup> C. H. Riggs, "Water Flooding of the McClosky in Clay City Oil Field, Clay County, Illinois," (*Federal Bur. Mines Rept. Invest.* 3792, 20 p., Jan. (1945); *Producers Monthly* 9 [7] 12-8 (1945).

<sup>13</sup> C. H. Riggs, "Gas Injection into the McClosky Limestone

in the Griffin and New Harmony Oil Fields, Indiana and Illinois," (*Federal Bur. Mines Rept. Invest.* 3818, 28 p., July (1945).

<sup>14</sup> Frederick Squires and A. H. Bell, "Water Flooding of Oil Sands in Illinois," *Ill. State Geol. Survey Rept. Invest. No.* 89, 101 p. (1943).

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<sup>17</sup> Frederick Squires, "Flood Tide in Illinois," *Producers Monthly* 10 [9] 10-19 (1946); *Ill. State Geol. Survey Circ. No.* 125, 10 p. (1946).

<sup>18</sup> D. B. Taliadro, C. M. Keithly, and T. Jennings, "Water Flooding of Oil Sands in Illinois," (*Federal Bur. Mines Rept. Invest.* 3778, 23 p. (1944).

**TABLE I-A**  
**Secondary-Recovery Operations in Illinois**  
**GENERAL DATA**  
**As of January 1, 1947**

Line No.	Pool Name	Date Discovered	County	Township	Range	Maximum Area (Acres)	Maximum Number of Wells	Producing Sand	Geological Age	Average Depth (Feet)	Average Thickness (Feet)	Porosity (Per Cent)	Permeability (Millidarcys)	Estimated Connate Water (Per Cent)	Estimated Original Oil (Per Cent)	Type of Reservoir Mechanism	Estimated Total Recoverable Oil (Barrels Per Acre)
1	Birds	×	Crawford and Lawrence	5N	11W	4,485	685	Robinson	Pennsylvanian	875	25	21.7	155	39.4	35.0	Gas expansion	×
2	Chapman	1914	Crawford	5N	12W	1,560	193	Robinson	Pennsylvanian	900	25	×	×	×	×	Gas expansion	×
3																	
4																	
5	Colmar-	1914	McDonough	4N	4W	2,470	490	Hoing	Devonian	465	12	18.8	1,000	×	×	×	1,970
6	Plymouth*	1914	McDonough and Hancock	4N	5W			Hoing	Devonian	430	11	×	×	×	×	×	×
7	Crawford Main	1906	Crawford	5N	12W	85,650	7,328	Robinson	Pennsylvanian	900	35	×	×	×	×	Gas expansion	×
8	Crawford Main	1906	Crawford	5N	13W			Robinson	Pennsylvanian	850	30	×	×	×	×	Gas expansion	×
9	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	860	15	×	×	×	×	Gas expansion	3,740
10	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	2,580
11	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	950	30	×	×	×	×	Gas expansion	3,190
12	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	6,650
13	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	925	35	×	×	×	×	Gas expansion	8,875
14	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	20	×	×	×	×	Gas expansion	4,635
15	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	870	35	×	×	×	×	Gas expansion	7,125
16	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	40	×	×	×	×	Gas expansion	×
17	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	×
18	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	850	30	×	×	×	×	Gas expansion	×
19	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	925	40	×	×	×	×	Gas expansion	×
20	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	40	×	×	×	×	Gas expansion	×
21	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	950	15	×	×	×	×	Gas expansion	×
22	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	875	20	×	×	×	×	Gas expansion	×
23	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	50	×	×	×	×	Gas expansion	×
24	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	35	×	×	×	×	Gas expansion	×
25	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	35	×	×	×	×	Gas expansion	×
26	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	20	×	×	×	×	Gas expansion	×
27	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	900	25	×	×	×	×	Gas expansion	×
28	Crawford Main	1906	Crawford	6N	13W			Robinson	Pennsylvanian	950	25	×	×	×	×	Gas expansion	3,130
29	Crawford Main	1906	Crawford	6N	12W			Robinson	Pennsylvanian	975	30	×	×	×	×	Gas expansion	5,060
30	Crawford Main	1906	Crawford	7N	12W			Robinson	Pennsylvanian	1,050	30	×	×	×	×	Gas expansion	×
31	Crawford Main	1906	Crawford	7N	12W			Robinson	Pennsylvanian	975	30	×	×	×	×	Gas expansion	×
32	Crawford Main	1906	Crawford	7N	12W			Robinson	Pennsylvanian	1,125	30	×	×	×	×	Gas expansion	×
33	Crawford Main	1906	Crawford	7N	12W			Robinson	Pennsylvanian	1,150	15	×	×	×	×	Gas expansion	×
34	Crawford Main	1906	Crawford	7N	12W			Robinson	Pennsylvanian	1,150	15	×	×	×	×	Gas expansion	×
35	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	3,760
36	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	860	20	×	×	×	×	Gas expansion	3,710
37	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	950	25	×	×	×	×	Gas expansion	4,400
38	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	950	25	×	×	×	×	Gas expansion	2,080
39	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	6,710
40	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	880	20	×	×	×	×	Gas expansion	2,970
41	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	925	30	17.7-23.1	130-680	×	×	Gas expansion	11,650
42	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	875	25	18.0	100	×	×	Gas expansion	2,100
43	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	925	30	×	×	×	×	Gas expansion	4,100
44	Crawford Main	1906	Crawford	7N	13W			Robinson	Pennsylvanian	925	40	×	×	×	×	Gas expansion	×

\* Commonly treated as a single pool.

TABLE I-A (Continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Line No.	Pool Name	Date Discovered	County	Township	Range	Maximum Area (Acres)	Maximum Number of Wells	Producing Sand	Geological Age	Average Depth (Feet)	Average Thickness (Feet)	Porosity (Per Cent)	Permeability (Millidarcys)	Estimated Connate Water (Per Cent)	Estimated Original Oil (Per Cent)	Type of Reservoir Mechanism	Estimated Total Recoverable Oil (Barrels Per Acre)
45	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	23	17.2	113.6	×	×	Gas expansion	×
46	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	15	×	×	×	×	Gas expansion	×
47	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	20	×	×	×	×	Gas expansion	×
48	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	20	19.9	165	38	45	Gas expansion	×
49	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	950	20	17.4	117	×	32	Gas expansion	×
51	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	950	20	23.9	138	13.8	66.4	Gas expansion	×
52	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	20	×	×	×	×	Gas expansion	×
53	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	950	25	×	×	×	×	Gas expansion	×
54	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	925	20	×	×	×	×	Gas expansion	×
55	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	925	35	×	×	×	×	Gas expansion	×
56	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	925	25	×	×	×	×	Gas expansion	×
57	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	25	×	×	×	×	Gas expansion	×
58	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	975	20	×	×	×	×	Gas expansion	×
59	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	875	25	×	×	×	×	Gas expansion	×
60	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	930	30	×	×	×	×	Gas expansion	×
61	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	930	30	×	×	×	×	Gas expansion	×
62	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	950	45	×	×	×	×	Gas expansion	×
63	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	875	40	×	×	×	×	Gas expansion	×
64	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	31	×	×	×	×	Gas expansion	×
65	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	30	×	×	×	×	Gas expansion	×
66	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	30	×	×	×	×	Gas expansion	×
67	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	25	×	×	×	×	Gas expansion	×
68	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	25	×	×	×	×	Gas expansion	×
69	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	25	×	×	×	×	Gas expansion	×
70	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	950	30	×	×	×	×	Gas expansion	×
71	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	35	×	×	×	×	Gas expansion	×
72	Crawford Main	1906	Crawford	7N	13W	.....	.....	Robinson	Pennsylvanian	900	30	×	×	×	×	Gas expansion	×
73	Dale-Hoodville	1940	Hamilton	5 and 6S	6 and 7E	5,000	427	Bethel and Aux Vases	Upper Mississippian	2,950	50	15.0	74.0	33	56	Gas expansion	6,500
74	Dale-Hoodville	1940	Hamilton	6S	6E	.....	.....	Aux Vases	Upper Mississippian	2,938	22	19.6	74.7	×	×	Gas expansion	×
75	Dale-Hoodville	1940	Hamilton	6S	7E	.....	.....	Aux Vases	Upper Mississippian	2,954	20	18.8	95.0	×	×	Gas expansion	×
76	Lawrence	1906	Lawrence	2N	12W	26,100	4,482	Bridgeport	Pennsylvanian	975	41	×	×	×	×	Gas expansion	12,260
77	Lawrence	1906	Lawrence	3N	12W	.....	.....	Bridgeport	Pennsylvanian	975	56	×	×	×	×	Gas expansion	11,764
78	Lawrence	1906	Lawrence	3N	12W	.....	.....	Bridgeport	Pennsylvanian	950	49	×	×	×	×	Gas expansion	14,763
79	Lawrence	1906	Lawrence	3N	12W	.....	.....	Bridgeport	Pennsylvanian	925	42	×	×	×	×	Gas expansion and water drive	19,147
80	Lawrence	1906	Lawrence	4N	12W	.....	.....	Bridgeport	Pennsylvanian	950	48	×	×	×	×	Gas expansion	14,750
81	Lawrence	1906	Lawrence	4N	12W	.....	.....	Bridgeport	Pennsylvanian	925	51	×	×	×	×	Gas expansion	15,260
82	Lawrence	1906	Lawrence	4N	12W	.....	.....	McClusky	Pennsylvanian	1,004	20	×	×	×	×	Gas expansion	×
83	Lawrence	1906	Lawrence	4N	12W	.....	.....	McClusky	Lower Mississippian	1,803	30	×	×	×	×	Gas expansion	×
84	Louden	1938	Fayette and Effingham	6N	2E	22,000	1,940	limestone	Upper Mississippian	1,485	20	19.5	Estimated 80	65	65	Gas expansion	×
85				7N	2E and 3E	.....	.....	Cypress	Upper Mississippian	1,500	14	18.5	Estimated 80	70	70	Gas expansion	×
				8N and 9N	3E and 4E	.....	.....	Paint Creek	Upper Mississippian	1,585	13	19.5	Estimated 80	65	65	Gas expansion	×
86					.....	.....	.....	Paint Creek	Upper Mississippian	1,560	19	19.5	Estimated 80	65	65	Gas expansion	×
					.....	.....	.....	Bethel	Upper Mississippian	1,500	14	18.5	Estimated 80	70	70	Gas expansion	×
87	Mt. Carmel	1943	Wabash	1S	12W	3,740	881	Biehl	Pennsylvanian	1,500	14	18.5	400	25.0	75.0	Gas expansion	600
88	New Hebron	1909	Crawford	6N	12W	1,560	297	Robinson	Pennsylvanian	×	×	×	×	×	×	Gas expansion	5,450

TABLE I-A (Continued)

Line No.	Pool Name	Date Discovered	County	Township	Range	Maximum Area (Acres)	Maximum Number of Wells	Producing Sand	Geological Age	Average Depth (Feet)	Average Thickness (Feet)	Porosity (Per Cent)	Permeability (Millidarcys)	Estimated Connate Water (Per Cent)	Estimated Original Oil (Per Cent)	Type of Reservoir Mechanism	Estimated Total Recoverable Oil (Barrels Per Acre)				
AIR AND GAS REPRESSURING—Continued																					
89	New Hebron	1909	Crawford	6N	12W	.....	.....	Robinson	Pennsylvanian	970	25	×	×	×	×	×	×				
90	North Johnson	1907	Clark	9N	14W	1,440	487	Casey	Pennsylvanian	475	35	×	×	×	×	×	×				
91	North Johnson	1907	Clark	9N	14W	.....	.....	Casey	Pennsylvanian	450	50	21.1	413.7	×	×	×	×				
92	Rural Hill	1941	Hamilton	6S	5E	3,100	205	Aux Vases	Upper Mississippian	3,130	24	.....	.....	.....	.....	.....	6,000				
93	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Levias limestone	Lower Mississippian	3,200	×	.....	.....	.....	.....	.....	.....				
94	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Levias limestone	Lower Mississippian	3,300	12	.....	.....	.....	.....	.....	.....				
95	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Upper Mississippian	3,157	23	×	×	×	×	Gas expansion	×				
96	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,183	17	16.6	42.6	×	×	×	×				
97	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,106	36	20.8	70.7	×	×	×	×				
98	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,191	18	18.7	38.0	×	×	×	×				
99	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,260	12	16.5	29.4	×	×	×	×				
100	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Lower Mississippian	3,108	27	20.4	158.9	×	×	×	×				
101	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,190	33	13.9	31.8	×	×	×	×				
102	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Lower Mississippian	3,110	19	19.7	41.4	×	×	×	×				
103	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,192	15	11.8	84.0	×	×	×	×				
104	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Lower Mississippian	3,102	25	16.8	72.6	×	×	×	×				
105	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,238	13	16.5	33.1	×	×	×	×				
106	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Lower Mississippian	3,095	26	18.6	77.9	×	×	×	×				
107	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,165	26	11.1	2.1	×	×	×	×				
108	Rural Hill	1941	Hamilton	6S	5E	.....	.....	McClosky limestone	Lower Mississippian	3,170	10	16.0	75.0	×	×	Gas expansion	×				
109	Rural Hill	1941	Hamilton	6S	5E	.....	.....	Aux Vases	Upper Mississippian	3,217	17	14.0	100.0	×	×	Gas expansion	×				
110	Rural Hill	1941	Hamilton	6S	5E, 6E	.....	.....	Levias	Lower Mississippian	3,130	45	16.0	74.0	84.0	54.0	Gas expansion	6,200				
111	Siggins	1906	Cumberland	10N	10E	3,685	1,021	McClosky	Mississippian	400	25	×	×	×	×	×	×				
112	South Johnson	1907	Clark	9N	14W	1,800	544	Siggins	Pennsylvanian	480	25	×	×	×	×	×	×				
WATER FLOODING																					
113	Albion Consolidated	1940	Edwards	3S	10E	2,600	218	Bridgeport	Pennsylvanian	1,900	21	19.7	304	29.0	71.0	Gas expansion	498				
114	Albion Consolidated	1940	Edwards	3S	10E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....				
115	Albion Consolidated	1940	Edwards	3S	10E	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....				
116	Cine, Clay City, Consolidated	1987 to 1940	Wayne, Clay, Richland and Jasper	1N	7E, 8E	39,470	1,925	McClosky limestone	Lower Mississippian	2,980	9	×	×	×	×	×	×				
117	Noble, Dundas Consolidated, Boos North			3N	8E				Upper Mississippian	2,980	9	×	×	×	×	×	×	×	×	×	×
118	Patoka			4N	9E, 8E				Lower Mississippian	2,980	9	×	×	×	×	×	×	×	×	×	×
119	Siggins			5N, 6N	10E				Upper Mississippian	1,400	25	19.0	185.0	×	×	×	×	×	×	×	×
120	Siggins	1906	Cumberland	10N	10E	700	111	Bethel	Upper Mississippian	350	20	16.0	20.0	×	×	Gas expansion	×				
121	Siggins	1906	Cumberland	10N	10E	3,685	999	Siggins*	Pennsylvanian	320	40	19.0	50.0	×	×	Gas expansion	×				
122	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	300	50	20.0	70.0	×	×	Gas expansion	×				
123	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	320	35	19.0	50.0	×	×	Gas expansion	×				
124	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	330	35	19.0	40.0	×	×	Gas expansion	×				
125	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	320	31	16.6	11-132	×	×	Gas expansion	×				
126	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	335	30	16	2-500	×	×	Gas expansion	×				
127	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	345	33	17.4	6-505	×	×	Gas expansion	×				
128	Siggins	1906	Cumberland	10N	10E	.....	.....	Siggins*	Pennsylvanian	320	31	16.6	11-132	×	×	Gas expansion	×				

\* In small areas, an upper and a lower sand are being flooded in this pool.



TABLE 1-B (Continued)

Line No.	19 Initial Reservoir Pressure (PSI)	20 Initial Reservoir Temperature (Deg F)	21 Initial Gravity of Oil (Deg API)	22 Initial Gas-Oil Ratio	23-25 Total Production			26 Estimated Oil Recovery (Barrels Per Acre)
					Oil (Thousands of Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)	
70	x	x	x	x	x	x	x	x
71	x	x	x	x	x	x	x	x
72	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	24,638	x	x	..
73	1,000	90	40.0	280 to 1	x	x	x	..
74	x	x	x	x	x	x	x	x
75	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	x	x	x	..
76	x	x	x	x	3,570	x	x	7,596
77	x	x	x	x	3,430	x	x	9,024
78	x	x	x	x	4,670	x	x	11,138
79	x	x	x	x	1,970	x	x	14,027
80	x	x	x	x	4,275	x	x	10,680
81	x	x	x	x	4,290	x	x	11,140
82	x	x	x	x	x	x	x	x
83	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	22,205	x	x	..
84	639	79	38.9	x	x	x	x	..
85	639	79	38.9	x	33,023	x	x	9,600
86	639	79	38.9	187 to 1	x	x	x	..
Sub-totals	..	..	..	..	33,023	x	x	..
87	500	82	37	0	24.6	330	1,000	273
Sub-totals	..	..	..	..	24.6	330	1,000	..
88	x	x	x	x	283	x	x	4,725
89	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	283	x	x	..
90	x	x	x	x	x	x	x	8,159
91	x	x	x	x	x	x	x	3,744
Sub-totals	..	..	..	..	x	x	x	..
92	x	x	x	x	x	x	x	..
93	x	x	x	x	x	x	x	..
94	x	x	x	x	762	x	x	3,810
95	x	x	x	x	x	x	x	x
96	x	x	x	x	x	x	x	x
97	x	x	x	x	x	x	x	x
98	x	x	x	x	x	x	x	x
99	x	x	x	x	x	x	x	x
100	x	x	x	x	x	x	x	x
102	x	x	x	x	x	x	x	x
103	x	x	x	x	x	x	x	x
104	x	x	x	x	x	x	x	x
105	x	x	x	x	x	x	x	x
106	x	x	x	x	x	x	x	x
107	x	x	x	x	x	x	x	x
108	x	x	x	x	x	x	x	x
109	1,140	101	40.4	533 to 1	x	x	x	x
110	1,070	66	38.0	420 to 1	x	x	x	x
Sub-totals	..	..	..	..	762	x	x	..
111	x	x	32.4	x	x	x	x	x
Sub-totals	..	..	..	..	x	x	x	..
112	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	x	x	x	..
Total	..	..	..	..	82,948.6	330	1,000	..
113	..	..	..	..	..	..	..	..
114	750	Estimated 82	Estimated 37	45 to 1	199.3	1,605	87,000	220
115	..	..	..	..	..	..	..	..
Sub-totals	..	..	..	..	199.3	1,605	87,000	..
116	x	x	x	x	x	x	x	x
117	x	x	x	x	x	x	x	x
118	x	x	x	x	x	x	x	x
Sub-totals	..	..	..	..	x	x	x	..
119	550	80	39	20 to 1	3,545	215,000	781,000	5,064
Sub-totals	..	..	..	..	3,545	215,000	781,000	..
120	x	x	x	x	x	x	x	3,500
121	x	x	x	x	x	x	x	11,000
122	x	x	x	x	x	x	x	8,900
123	x	x	x	x	x	x	x	8,900
124	x	x	x	x	x	x	x	8,900
125	x	x	x	x	x	x	x	4,000
126	x	x	x	x	x	x	x	4,200
127	x	x	x	x	x	x	x	5,660
128	x	x	x	x	x	x	x	4,000
Sub-totals	..	..	..	..	x	x	x	..
Totals	..	..	..	..	3,744.3	216,605	868,000	..

**TABLE I-C**  
**Secondary-Recovery Operations in Illinois**  
**SECONDARY-RECOVERY DATA**  
**As of January 1, 1947**

Line No.	Date Started	Daily Production Rate Prior to Secondary Recovery			31	32	33	34	35	36	37	38	39	40	Present Daily Production Rate			44	45
		Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)											Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)		
1	September 1945	5	×	×	76	12	1	.....	×	Air	18	140	Pump	12	134	None	2.4		
2	Sub-totals	5	×	×	76	12	1	.....	.....	.....	18	.....	.....	12	134	.....	2.4		
3	1937	6.5	×	×	15	1	0	.....	.....	.....	Estimated	40	Pump	4	×	×	×		
4	1937	6.5	×	×	40	2	1	.....	Variable	Air	25	40	Pump	4	×	×	×		
					146	8	2	.....	.....	Air	Estimated	40	Pump	4	×	×	×		
5	Sub-totals	6.5	×	×	201	6	3	.....	.....	.....	25	.....	.....	4	×	.....	×		
6	July 1935	149	×	×	1,415	177	49	.....	Variable	Air	650	57	Pump	235	0	Average	1,589		
7	March 1934	75	×	×	414	42	22	.....	Variable	Air	236	47	Pump	61	0	Average	1,589		
8	Sub-totals	224	×	×	1,829	219	71	.....	.....	.....	886	.....	.....	296	0	.....	1,589		
9	March 1936	22	×	×	120	16	3	.....	Variable	Air and gas	60	45	Pump	47	×	62	136		
10	February 1932	5	×	×	40	8	1	.....	Variable	Air and gas	20	49	Pump	4	×	×	4.2		
11	October 1945	13	25	47	180	49	10	.....	Variable	Air	80	235	Pump	35	50	Slight	21		
12	July 1938	27	24	98	320	47	7	.....	Variable	Air and gas	93.9	210	Pump	32	49	Average	87		
13	January 1943	43	87	77	320	73	12	.....	Variable	Air and gas	130	162	Pump	81	74	Slight	95		
14	May 1941	51	24	29	280	47	7	.....	Variable	Air	80	154	Pump	84	49	Slight	131		
15	January 1943	30	27	65	200	53	12	.....	Variable	Air and gas	108	165	Pump	55	60	Slight	66		
16	June 1945	64	31	56	240	62	11	.....	Variable	Air	130	145	Pump	81	62	Average	38		
17	March 1944	84	43	97	300	86	15	.....	Variable	Air	160	45	Pump	126	87	Slight	111		
18	May 1936	8	×	×	65	10	1	.....	×	Air and gas	30	25	Pump	15	×	×	23		
19	July 1936	10	×	×	65	12	1	.....	×	Air and gas	20	20	Pump	11	×	×	5		
20	April 1936	3	×	×	55	9	1	.....	×	Air	10	110	Pump	3 <sup>3</sup>	×	×	0		
21	July 1945	8	×	×	50	8	1	.....	×	Air	10	45	Pump	11	×	×	2.6		
22	March 1932	25	×	×	80	11	3	.....	Variable	Air and gas	60	35	Pump	29	×	×	31		
23	June 1929	19	×	×	85	10	1	.....	×	Air and gas	28	40	Pump	16	×	×	×		
24	April 1941	5	×	×	40	6	2	.....	Variable	Air and gas	10	100	Pump	10	×	×	×		
25	January 1941	5	×	×	60	11	1	.....	×	Air and gas	19	100	Pump	6	×	×	×		
26	July 1937	19	×	×	80	19	2	.....	Variable	Air and gas	22	55	Pump	14	×	×	×		
27	1937	9	×	×	80	14	1	.....	×	Air	23	30	Pump	17	×	×	×		
28	1937	15	×	×	100	18	1	.....	×	Air	23	30	Pump	11	×	×	×		
29	1937	20	×	×	120	22	1	.....	×	Air	23	30	Pump	15	×	×	×		
30	August 1932	32	13	25	130	20	5	.....	Variable	Air	32	209	Pump	84	27	Slight	165		
31	July 1929	17	10	58	130	20	5	.....	Variable	Air and gas	38.9	181	Pump	15	25	Slight	113		
32	October 1926	15	×	×	255	20	4	.....	Variable	Air	45	135	Pump	12	×	×	×		
33	August 1941	7	×	×	85	13	1	.....	×	Air	20	20	Pump	10.5	×	×	5.1		
34	May 1936	7	×	×	40	7	2	.....	×	Gas	25	60	Pump	5	×	×	5.5		
35	September 1946	4	×	×	5	3	1	.....	×	Air and gas	2.5	8	Pump	4	×	×	.....		
36	October 1946	3	×	×	5	5	2	.....	×	Air and gas	3	12	Pump	6	×	×	.....		
37	January 1942	59	27	×	150	53	9	.....	Variable	Air and gas	65.3	204	Pump	61	54	Slight	123		
38	January 1943	25	30	55	250	59	10	.....	Variable	Air	73.9	127	Pump	64	61	Slight	76		

TABLE I-C (Continued)

Line No.	Date Started	Daily Production Rate Prior to Secondary Recovery			31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
		Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)															
37	March 1937	35	11	60	172	21	9	None	Variable	Air and gas	93	58	Pump	51	28	66	Slight	179	
38	June 1937	9	12	23	40	20	2	None	X	Air and gas	9	85	Pump	10	22	27	Average	89	
39	June 1941	29	25	100	860	52	9	None	Variable	Air and gas	116	77	Pump	80	55	115	Slight	186	
40	July 1944	26	29	39	310	57	11	None	Variable	Air and gas	100	200	Pump	41	60	44	Slight	31	
41	January 1943	89	31	95	280	62	10	None	Variable	Air and gas	123	187	Pump	150	65	109	Slight	211	
42	July 1936	39	32	97	240	64	13	None	Variable	Air	110	187	Pump	32	60	107	Average	136	
43	February 1942	90	55	297	700	110	23	None	Variable	Air and gas	227	185	Pump	168	110	323	Slight	248	
44	May 1932	8	X	X	140	17	8	None	Variable	Gas	5	45	Pump	7	X	35	X	14	
45	November 1935	5	X	X	120	12	8	None	Variable	Air and gas	45	36	Pump	5	X	29	X	5.8	
46	March 1935	2	X	X	80	11	1	.....	X	Gas	25	23	Pump	5.5	X	83	X	16	
47	May 1932	7	X	X	50	8	3	None	Variable	Air and gas	50	20	Pump	13	X	42	X	34.8	
48	May 1934	12	X	X	100	16	7	None	Variable	Air and gas	105	18	Pump	24	X	56	X	85.9	
49	June 1934	14	X	X	80	11	8	None	Variable	Air and gas	60	25	Pump	23	X	72	X	68.5	
50	June 1934	7	X	X	110	15	4	None	Variable	Air and gas	68	25	Pump	20	X	58	X	50.7	
51	December 1937	8	X	X	25	3	1	.....	X	Air and gas	16	25	Pump	6	X	62	X	7.5	
52	September 1935	13	X	X	90	8	2	None	X	Air and gas	15	45	Pump	12	X	97	X	11	
53	March 1936	4	X	X	100	12	1	.....	X	Air	10	45	Pump	5	X	79	X	20.6	
54	March 1932	25	X	X	72	10	2	None	X	Air and gas	35	30	Pump	29	X	41	X	69.7	
55	December 1929	12	X	X	140	8	1	.....	X	Air and gas	30	55	Pump	6	X	43	X	50	
56	December 1935	2	X	X	48	5	1	.....	X	Air	12	30	Pump	3.5	X	17	X	9	
57	June 1946	4.5	X	X	80	7	1	.....	X	Air	15	65	Pump	7	X	29	X	...	
58	X 1936	16	X	X	145	14	4	None	Variable	Air and gas	18	72	Pump	47	X	X	X	X	
59	February 1930	7	X	X	160	17	1	.....	X	Air and gas	9	50	Pump	9	X	X	X	X	
60	July 1930	11	X	X	80	9	2	None	X	Air and gas	6	50	Pump	8	X	X	X	X	
61	November 1940	5	X	X	40	9	1	None	X	Air and gas	14	45	Pump	7	X	X	X	X	
62	X 1936	19	X	X	97.5	13	2	None	X	Gas	33	10	Pump	16	X	74	X	X	
63	X 1937	9	X	X	138	14	1	.....	X	Gas	21	30	Pump	11	X	25	X	X	
64	X 1929	4	X	X	126	7	2	None	Variable	Air and gas	25	85	Pump	5.7	X	13	X	X	
65	X 1937	10	X	X	80	11	1	.....	X	Air	23	30	Pump	7.5	X	X	X	X	
66	X 1937	5	X	X	40	6	1	.....	X	Air	23	30	Pump	5.6	X	X	X	X	
67	X 1937	5	X	X	40	6	1	.....	X	Air	23	30	Pump	7	X	X	X	X	
68	X 1924	1	X	X	40	3	2	None	Variable	Air	Estimated	100	Pump	0.5	X	X	X	X	
69	X 1922	1	X	X	40	4	2	None	Variable	Air	Estimated	100	Pump	3	X	X	X	X	
70	X 1922	1	X	X	40	4	2	None	Variable	Air	Estimated	100	Pump	2	X	X	X	X	
71	X 1923	1	X	X	40	3	1	.....	X	Air	Estimated	100	Pump	1.5	X	X	X	X	
72	X 1924	0	X	X	10	1	1	.....	X	Air	Estimated	100	Pump	1.5	X	X	X	X	
73	Sub-totals	1,184.5	486	1,956	8,333.5	1,446	267	.....	.....	.....	Estimated	.....	.....	1,745.3	998	3,082	.....	4,253.7	
74	April 1943	2,500	X	X	240	24	4	X	X	Gas	157	200	Pump	1,063	1,250	X	Slight	164.0	
75	March 1944	142	X	X	170	12	1	.....	X	Gas	54	120	Pump	8.4	X	X	X	X	
76	May 1946	187	47	567	480	45	6	.....	.....	.....	265	.....	.....	1,211.4	1,250	X	X	164.0	
77	July 1945	101	25	740	380	69	9	None	Variable	Air	145	167	Pump	335	163	625	Slight	.....	
					300	55	11	None	Variable	Air	168.3	165	Pump	205	115	811	Slight	.....	

TABLE I-C (Continued)

Line No.	Date Started	Daily Production Rate Prior to Secondary Recovery			Lease or Project Name	Area (Number of Acres)	Number of Producing Wells	Number of Injection Wells	Pattern Used	Distance of Producing Well to Injection Well (Feet)	Injection Fluid	Injection Rate Per Day (Barrels or Thousands of Cubic Feet)	Injection Pressure (PSI)	How Produced (Flowing, Pumping, Gas Lift, Etc.)	Present Daily Production Rate			Extent of Bypassing	Estimated Oil Recovered to Date (Thousands of Barrels)
		Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)											Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)		
78	April 1944	160	89	300	W. E. Robbins a/c 1	310	66	11	None	Variable	Gas	225	Pump	270	235	353	Slight	×	
79	March 1946	74	18	760	P. Finley	140	33	4	None	Variable	Air	70	Pump	110	32	760	Slight	×	
80	August 1946	136	32	350	I. Boyd	100	62	9	None	Variable	Air	167	Pump	157	39	383	Slight	×	
81	April 1948	150	38	150	J. E. Johnson	325	63	11	None	Variable	Gas	245	Pump	280	275	160	Slight	×	
82	December 1945	25	×	×	Stallings	36	21	2	None	Variable	Air and gas	4	Pump	...	×	×	×	×	
83	June 1946	883	249	2,867	Stallings	1,591	369	57	None	Variable	Air and gas	41	Pump	...	×	×	×	×	
84	1942	3,823	1,988	×	Louden	3,400	375	37	"Sunflower"	660 ft	Gas	850	Pump	3,225	2,050	×	Slight	103	
85	1942	3,823	1,988	×	Louden	3,400	375	37	"Sunflower"	467 ft	Gas	850	Pump	3,225	2,050	×	Slight	103	
86	1942	3,823	1,988	×	Louden	3,400	375	37	"Sunflower"	467 ft	Gas	850	Pump	3,225	2,050	×	Slight	103	
87	February 1944	110	2	12	E. and C. Crow and Viehman	90	9	1	None	500	Gas	32	Pump	32	0	5	×	×	
88	Sub-totals	110	2	12		90	9	1	None	500	Gas	32	Pump	32	0	5	×	×	
89	April 1944	10	7	20	W. Montgomery	50	13	2	None	Variable	Air	26	Pump	12	13	22	Extreme	×	
90	June 1946	×	×	×	Mohler-Bussard	200	15	1	None	×	Air	10	Pump	9.3	×	×	×	×	
91	Sub-totals	10	7	20		250	28	3	None	×	Air	36	Pump	21.3	13	22	×	×	
92	August 1942	7	×	×	Brimmer	71	5	1	None	×	Air	15	Pump	5.5	×	6	×	×	
93	June 1941	12	×	×	Howe	120	15	1	None	×	Air	10	Pump	12	×	20	×	×	
94	Sub-totals	19	×	×		191	20	2	None	×	Air	25	Pump	17.5	×	26	×	×	
95	January and February 1945	221	414	25	Rural Hill	200	17	3	×	660	Gas	78	Pump	159	339	22	×	×	
96	December 1944	8	×	0	B. Johnson	40	2	1	None	660	Gas	41.8	Pump	10.5	×	0	×	×	
97	November 1944	90	×	×	C. Ventress	80	5	1	None	×	Gas	33	Pump	43	×	×	×	×	
98	November 1944	58	×	×	C. Smith	100	4	1	None	×	Gas	66	Pump	28	×	×	×	×	
99	November 1944	15	×	×	L. Lockwood "A"	40	4	1	None	660	Gas	63	Pump	17	×	×	×	×	
100	November 1944	29	×	×	L. Lockwood "B"	40	3	1	None	660	Gas	69	Pump	28	×	×	×	×	
101	November 1944	16	×	×	J. Nohava	40	2	1	None	×	Gas	63	Pump	×	×	×	×	×	
102	November 1944	61	×	×	Crabtree "B"	129.5	6	2	×	×	Gas	75	Pump	32	×	×	×	×	
103	November 1944	29	×	×	Crabtree "B"	129.5	6	1	None	×	Gas	67	Pump	32	×	×	×	×	
104	November 1944	29	×	×	L. Lockwood "C"	39	1	1	None	×	Gas	69	Pump	×	×	×	×	×	
105	November 1944	16	×	18	Morlan	40	2	0	None	×	Gas	25	Pump	13	×	5	None	×	
106	July 1945	800	×	×	Rural Hill	680	45	9	×	660	Gas	320.0	Pump	330	530	×	Slight	210	
107	September 1944	1,372	414	43		1,428.5	93	14	None	×	Gas	969.8	Pump	660	869	27	×	210	
108	Sub-totals	8	×	×	Queen	80	34	5	None	Variable	Gas	Estimated 2	Pump	8	0	0	×	×	
109	Sub-totals	8	×	×		80	34	5	None	Variable	Gas	Estimated 2	Pump	8	0	0	×	×	
110	December 1937	13	×	×	Larrison	40	10	2	None	Variable	Air and gas	24	Pump	14	×	×	×	×	
111	Sub-totals	13	×	×		40	10	2	None	Variable	Air and gas	24	Pump	14	×	×	×	×	
112	Total	10,387	3,146	4,298		17,990	2,666	478				Estimated 7,302.6		8,634.0	6,039	6,929		4,730.3	

TABLE I-C (Continued)

Line No.	Date Started	Daily Production Rate Prior to Secondary Recovery			Lease or Project Name	Average (Number of Acres)	Number of Producing Wells	Number of Injection Wells	Pattern Used	Distance of Producing Well to Injection Well (Feet)	Injection Fluid	Injection Rate Per Day (Barrels or Thousands of Cubic Feet)	Injection Pressure (PSI)	How Produced (Flowing, Pumping, Gas Lift, Etc.)	Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)	Extent of Bypassing	Estimated Oil Recovered to Date (Thousands of Barrels)
		Oil (Barrels)	Gas (Thousands of Cubic Feet)	Water (Barrels)															
113	August 1946	91	×	46	Mussett	378	1	0	600	Treated brine	50	Vacuum	Pump	62	14.5	40	None	×	
114	August 1946	18	×	2	Blood	378	1	0	660	Treated brine	100	Vacuum	Pump	15	0.7	2	None	×	
115	August 1946	39	×	16	Schmittler	378	5	1	660	Treated brine	150	Vacuum	Pump	59	0	45	None	×	
116	Sub-totals	148	×	64	Basin, McClosky Basin, McClosky Basin, McClosky	Estimated 6,000 Estimated 6,000	12	2	None	660	Untreated brine	×	Vacuum	Pump	×	×	87	....	×
117		×	×	×			None	and	37	37	1,320	....	×	×	×	×	×	×	1,849.9
118		×	×	×			None	467	37	59	5-Spot	467	Treated brine	7,500	100	Pump	4,200	×	2,800
119	September 1943	650	40	200	Patoka	540	77	59	5-Spot	467	7,500	100	Pump	4,200	×	2,800	....	3,175.5	
120	Sub-totals	650	40	200	Stults	100	21	23	5-Spot	311	7,500	280	Pump	75	×	×	×	3,175.5	
121	February 1945	7	×	×	Hayworth Heirs	40	9	12	5-Spot	311	690	200	Pump	350	×	×	×	11.0	
122	January 1945	12	×	×	I. Hayworth	60	17	16	5-Spot	311	1,020	200	Pump	350	×	×	×	180.0	
123	July 1945	3	×	×	W. Black	20	4	4	5-Spot	311	320	200	Pump	800	×	×	×	375.5	
124	September 1945	3	×	×	W. Wood	20	4	10	5-Spot	311	700	200	Pump	800	×	×	×	375.5	
125	June 1942	5	×	×	E. E. Chrysler	40	16	25	5-Spot	283	425	280	Flow	29	×	×	Extreme	52.8	
126	December 1946	4	×	×	S. Pierson	40	9	7	5-Spot	311	190	190	Pump	....	....	....	....	....	
127	December 1946	8	×	×	F. Walker	80	18	22	5-Spot	311	190	190	Pump	....	....	....	....	....	
128	December 1946	10	×	×	E. E. Chrysler	80	18	19	5-Spot	311	190	190	Pump	....	....	....	....	....	
	Sub-totals	64	×	×	Estimated	480	116	188	....	....	6,295	....	....	1,344	....	....	....	619.3	
	Totals	862	40	264	7,398	205	236	....	....	....	13,931	....	....	5,680	15.2	2,387	....	5,689.7	