116. Studies on Non-freezing Lubricants.

(II) Production of Non-freezing Mineral Lubricants by Adding Saturated Fatty Acids.

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In the preceding report the present authors proved that a non-freezing lubricating oil was produced by adding hardened fatty oils to a freezing mineral lubricating oil. The present report refers to the effects of saturated fatty acids on the melting points of mineral lubricating oils. One of the results show that the saturated monobasic fatty acids exert the same effect on lowering the melting points of mineral lubricating oils, as shown in the following tables.

TABLE 1. Melting Points of Asphalt-base Spindle Oil
blended with Saturated Monobasic Fatty Acids.

Original lubricating oil—an asphalt-base spindle oil (m.p., $-42^{\circ}\text{C}.$;
sp. gr., d_4^{30} , 0.8958).

Weight % of saturated monobasic fatty acid added, $\longrightarrow$	Melting points of the blends, $^{\circ}\text{C}.$					
	0	0.2	0.4	0.6	0.8	1.0
Acetic acid (m.p. 16.7°C)	-42	-42	-42	-43	-43	-39
Butyric acid („ 1°C)	-42	-42	-43	-43	-43	-39
Caproic acid („ -9.5°C)	-42	-42	-43	-43	-43	-39
Caprylic acid („ 16.8°C)	-42	-44	-46	-47	-45	-42
Capric acid („ 31.5°C)	-42	-44	-46	-47	-45	-42
Myristic acid („ 53.8°C)	-42	-60	-60	-60	-60	-60
Palmitic acid („ 62.5°C)	-42	-60	-60	-60	-60	-44
Stearic acid („ 70.5°C)	-42	-60	-60	-60	-60	-60
Behenic acid („ 82°C)	-42	-60	-60	-60	-60	-60

TABLE 2. Melting Points of Mixed-base Spindle Oil
blended with Saturated Monobasic Fatty Acids.

Original lubricating oil—a mixed-base spindle oil (m.p., $-30^{\circ}\text{C}.$;
sp. gr., d_4^{30} , 0.9022).

Weight % of satu- rated monobasic fatty acid added, $\longrightarrow$	Melting points of the blends, $^{\circ}\text{C}.$					
	0	0.2	0.4	0.6	0.8	1.0
Acetic acid	-30	-29	-29	-28	-28	-27
Myristic acid	-30	-29	-33	-44	-33	-25
Palmitic acid	-30	-25	-36	-50	-30	-25
Stearic acid	-30	-50	-48	-39	-39	-39

TABLE 3. Melting Points of Paraffin-base Spindle Oil
added with Saturated Monobasic Fatty Acids.

Original lubricating oil—a paraffin-base spindle oil (m.p., $-22^{\circ}\text{C}.$;
sp. gr., d_4^{30} , 0.9024).

Weight % of saturated monobasic fatty acid added, $\rightarrow$	Melting points of the blends, $^{\circ}\text{C}.$					
	0	0.2	0.4	0.6	0.8	1.0
Myristic acid	-22	-24	-24	-36	-34	-28
Palmitic acid	-22	-24	-26	-40	-32	-28
Stearic acid	-22	-27	-34	-48	-40	-38

It may be seen from the above tables that small quantities of the saturated fatty acids added to a mineral lubricating oil render the latter's melting point exceedingly low, and that the higher the molecular weight of the fatty acids added or the lower their crystallisation properties, the lower the melting points of the blends. The present authors therefore assume that the lowering of the melting points of the mineral lubricating oils by adding the saturated monobasic fatty acids due to the prohibiting influence of the acids on the growth to well-defined (or macro-) crystals of paraffin wax from minute (or micro-) crystals in the medium of hydrocarbon oil, and to the production of a mobile suspensoid at extreme low temperatures. Such an influence presumably increases as lowering of the crystallisation properties (low crystalloid) of the fatty acids.

From the results shown in Table 1~3 it may also be seen that the lower the paraffin concentrations of the original spindle oils, the lower the melting points of the blends, since the melting points of the blends depend on not only the crystallisation properties of the acids added, but also the concentrations of the minute paraffin crystals crystallised from the hydrocarbon oil at low temperatures.

The same relations hold for the blends produced by adding the saturated dibasic fatty acids to the mineral lubricating oils, as illustrated by the following tables.

TABLE 4. Melting Points of Mixed-base Spindle Oil
added with Saturated Dibasic Fatty Acids.

Original lubricating oil—a mixed-base spindle oil (m.p., $-30^{\circ}\text{C}.$;
sp. gr., d_4^{30} , 0.9022).

Weight % of saturated dibasic fatty acid added, $\rightarrow$	Melting points of the blends, $^{\circ}\text{C}.$					
	0	0.2	0.4	0.6	0.8	1.0
Oxalic acid (m.p. 189°C)	-30	-28	-28	-28	-28	-28
Adipic acid (m.p. 151°C)	-30	-28	-28	-28	-28	-28
Sebacic acid (m.p. 133°C)	-30	-28	-28	-28	-28	-28

TABLE 5. Melting Points of Asphalt-base Spindle Oil
added with Saturated Dibasic Fatty Acids.

Original lubricating oil—an asphalt-base spindle oil (m.p., $-42^{\circ}\text{C}.$;
sp. gr., d_4^{30} , 0.8958).

Weight % of saturated dibasic fatty acid added, $\longrightarrow$	Melting points of the blends, $^{\circ}\text{C}.$					
	0	0.2	0.4	0.6	0.8	1.0
Oxalic acid	-42	-42	-42	-42	-42	-42
Adipic acid	-42	-44	-44	-44	-44	-44
Sebatic acid	-42	-60	-60	-60	-60	-60

In the case of the above blends produced by adding the dibasic fatty acids to mineral lubricating oils, their melting points generally fall as decrease of the paraffin concentration in the original lubricating oils and as lowering of the crystallisation properties of the acids added. The blends produced here are rather characteristic, for their melting points scarcely depend on the concentrations of the acids added, and moreover they are relatively high. These characteristics may be clearly explained by the facts that the saturated dibasic fatty acids are very difficultly soluble in mineral lubricating oil, and only a minute quantity of the acids added to the oil exert the favourable effect on lowering the melting point of the latter.