This invention relates to the extraction of fats and oils and oleaginous materials, and particularly to the use of solvents for that purpose.

Oils are usually recovered from seeds and similar vegetable products by crushing them in a press and expressing the oil. The amount of oil so recovered is subject to variation at different seasons. The season is naturally limited. A large proportion of the oil is left in the press cake, for example, in the case of cotton seed, about 6.50% of the weight of the cake or about 20% of the oil recovered by pressing. There is, therefore, a very substantial loss of oil.

Numerous attempts have been made to avoid losses by extracting oils from crushed vegetable materials with the aid of solvents. The solvents employed heretofore in commercial operations are liquids such as gasoline or naphtha and include constituents with boiling points well above ordinary atmospheric temperature at the usual pressure, and often above the maximum temperature which can be applied safely to the oil. Such solvents are not adapted for the successful recovery of oils for various reasons. The solvent or portions thereof cannot be removed completely from the oil and from the residue. The presence of even traces of these solvents in the products makes them unsuitable for many purposes. The oil, for example, is not edible, and the residue cannot be employed as cattle food and is suitable for use only as fertilizer. Moreover, the retention of the solvent in the oil and residue involves a direct loss and results in additional expense for fresh solvent. The degradation of the products and the loss of solvent make the operation unprofitable. Consequently, the object of solvent extraction is defeated.

It is the object of the present invention to provide an efficient and economical method of recovering oils and fats and oleaginous materials from vegetable products and the like.

I have discovered that the difficulties hereinbefore mentioned can be overcome readily by utilizing solvents which are gaseous at ordinary atmospheric temperature and pressure but are liquefied by a slight reduction in temperature or increase in pressure or by a combination of the lowered temperature and increased pressure. By “ordinary” atmospheric temperature and pressure I mean the temperature and pressure of the atmosphere as in commercial plants during all seasons of the year. The temperature in particular is subject to variation at different seasons. The pressure is subject to the usual barometric changes. I prefer to operate under pressures somewhat above atmospheric at or about ordinary atmospheric temperature. The solvent may be maintained thus in the liquid phase without substantial cooling, and it can be vaporized and separated readily from the oil and residue by the application of heat.

Among the solvents which are especially adapted for the process as hereinafter described are butane and iso-butane or mixtures thereof. Butane and iso-butane are gases at ordinary atmospheric temperature and pressure. These gases can be obtained from various sources, among which are natural gases. The treatment of “casing head” gasoline derived from natural gases yields a proportion of butane and iso-butane which may be utilized for my purpose. Butane is liquefied at ordinary atmospheric temperature by the application of a pressure of 20 pounds gauge. It is readily vaporized by application of heat. The pressures and heat supplied in the system can be adjusted readily to vaporize the solvent when desired and to condense it as liquid.

Other solvents including several hydrocarbon compounds may be used in the method. Thus butylene or iso-butylene, propane, propylene, methy1 chloride and ethyl chloride have boiling points at ordinary atmospheric pressure and other characteristics which may permit substitution thereof for butane or iso-butane. Solvents employed in the process should be free from high boiling-point ends.

In carrying out the invention I prefer to employ a closed system to avoid loss of the solvent. Thus the apparatus may include an extractor in which oleaginous material is subjected to the solvent in the liquid phase. The solution is delivered to a boiler which may be heated in any suitable way, for example, by a coil carrying steam or heated water. The
vapor which separates is passed through a suitable condenser wherein heat is withdrawn by a circulating fluid such as water or air. The solvent passes into the liquid phase and is returned to the extractor for further use. The system is maintained under a suitable pressure which may vary from 0 to 100 pounds per square inch gauge or higher, depending upon the nature of the solvent. In case butane is the solvent, the pressure may vary within a relatively wide range, for example, with a temperature of 80° F, in the condenser the pressure of the system would be approximately 30 pounds per square inch gauge, and with a temperature of 60° F, in the condenser the pressure would be approximately 15 pounds per square inch gauge.

The invention will be better understood by reference to the following description and accompanying drawing, which is a diagrammatic representation of an apparatus adapted for use in practising the invention.

Referring to the drawing, 1 represents a still which is partially filled with the solvent, 2 is a condenser adapted to liquefy the solvent vapors, and 3 is an extractor in which the oleaginous material is treated with the solvent. The solvent is vaporized by heat applied through a coil 4 which is supplied with steam or heated water. The vapor is delivered by a pipe 13 to the condenser 2 wherein it is cooled by a cooling medium such as water or air circulating through a coil 5. The condensed solvent passes through a pipe controlled by a valve 8 into the extractor 3 in which the material to be extracted rests on a diaphragm 6. A siphon 7 extending beneath the diaphragm delivers the solvent and the dissolved fat or oil, under control of a valve 9 to the still 1 wherein the solvent is vaporized. The vapor is delivered to the condenser. Fresh solvent may be introduced as required through pipes controlled by valves 10 or 11. The system is maintained under a suitable pressure as indicated by the pressure gauges 14, and the circulation of the solvent results in an accumulation of dissolved fat or oil in the still. When the extraction is completed the residue in the extractor may be discharged into a suitable heater wherein the residue is heated to drive out any remaining solvent which can be recovered in a suitable condenser and returned to the system. The solution can be distilled in the still 1 or it may be withdrawn through a pipe controlled by a valve 12 and subjected in a separate still to distillation. In the latter case a condenser may be provided to recover the solvent, or the vapors may be delivered to the condenser 2.

The following procedure may be used as an illustration of my method:

Valves 8, 9 and 10 are closed and the solvent (butane) in the liquid state is introduced into the still 1 through the valve 12 until the still 1 is partially filled. Valve 13 is then closed. The material from which oil is to be extracted is then introduced into extractor 3 through an opening provided for that purpose (not shown). This material rests on a permeable membrane 6 through which only liquids can pass.

The apparatus is now ready for operation. Valves 8 and 9 are opened and valve 10 is closed. Heat is supplied to the solvent in still 1 by means of steam or hot water circulating in the coil 4. This heat evaporates part of the solvent which condenses in the condenser 2, by means of cold water or air circulated in the coil 5. The condensed solvent flows down into the extractor 3 and through the material from which oil is to be extracted. When the solvent containing the oil has collected so that its surface reaches to the top of the siphon 7, the siphon operates and discharges the liquid back to the still 1. Thus we have a continuous operation in a closed system under pressure as indicated by the gauges 14. With butane, at a temperature of 60° F, in the condenser, the pressure would be about 15 lbs. per square in. gauge.

The process is allowed to continue until all of the oil has been removed from the material in extractor 3 and has collected in still 1. When the extraction has been completed, the valves 8 and 9 are closed as soon as possible after the last discharge of the siphon 7, thus isolating the extractor 3 and preventing any more solvent from entering.

The spent material is then removed and the valve 8 opened. The solvent is then distilled from the solution of solvent and extracted material in still 1, is condensed in condenser 2 and is collected in the empty extractor 3, leaving the oil or extracted material in still 1. When all of the solvent has been distilled off, valve 8 is opened, valve 10 opened, and the extracted material is drawn off through valve 12, the heating medium in the coil 4 having been shut off. Valve 12 is then closed.

The spent meal is removed from the extractor and placed in a separate still, where it is heated to remove last traces of solvent, the vapors entering the condenser 2 through the valve 10 and condensing, the condensate collecting in the condenser and flowing back into the still 1. After all of the solvent has been removed from the spent meal, valve 10 is closed and valve 9 opened to allow the solvent to be run back into the still 1. Valve 9 is then closed, and the apparatus is again ready for another extraction.

The method as described permits the extraction of the material treated with maximum efficiency. The solvent being readily vaporizable at relatively low temperatures can be separated easily and completely from the recovered fat or oils and likewise from the residue. The products are free, therefore, from noxious residue of the solvent used, and are of high quality comparable with...
those recovered by pressing. They are suitable for human consumption or for use as cattle food.

I have described a preferred procedure and a suitable apparatus for the practice thereof, but various changes can be made depending upon the particular solvent employed in the method and apparatus without departing from the invention or sacrificing any of the advantages thereof. In the accompanying claims "butane" includes iso-butane.

I claim:

1. The method of extracting oleaginous material which comprises subjecting the material to butane as a solvent, maintaining the solvent in the liquid phase while in contact with the material to be extracted, withdrawing the solution, and vaporizing the solvent to separate it from the extract.

2. The method of extracting oleaginous material which comprises subjecting the material to butane as a solvent under temperature and pressure conditions which maintain the solvent in the liquid phase while in contact with the material to be extracted, withdrawing the solution and vaporizing the solvent to separate it from the extract.

3. The method of extracting oleaginous material which comprises subjecting the material to butane as a solvent, maintaining the solvent in the liquid phase while in contact with the material to be extracted, withdrawing the solution, vaporizing the solvent therefrom condensing the solvent, and returning it to the material to be extracted.

4. The method of extracting oleaginous material which comprises subjecting the material to a hydrocarbon solvent, gaseous at ordinary temperature and pressure, maintaining the solvent in a liquid phase while in contact with the material to be extracted, withdrawing the solution, separately withdrawing the residue and heating the same to effect complete removal of the solvent.

5. The method of extracting oleaginous materials which comprises subjecting the material to a saturated hydrocarbon solvent, gaseous at ordinary temperature and pressure, maintaining the solvent in a liquid phase while in contact with the material to be extracted, withdrawing the solution, separately withdrawing the residue and heating the same to effect complete removal of the solvent.

6. The method of extracting oleaginous materials which comprises subjecting the material to butane as a solvent, maintaining the solvent in a liquid phase while in contact with the material to be extracted, withdrawing the solution, separately withdrawing the residue and heating the same to effect complete removal of the solvent.

7. The method of extracting oleaginous materials which comprises subjecting the material to a hydrocarbon solvent, gaseous at ordinary temperature and pressure, maintaining the solvent in the liquid phase while in contact with the material to be extracted, withdrawing the solution, and vaporizing the solvent to separate it from the extract.

8. The method of extracting oleaginous materials which comprises subjecting the material to a saturated hydrocarbon solvent, gaseous at ordinary temperature and pressure, maintaining the solvent in the liquid phase while in contact with the material to be extracted, withdrawing the solution, and vaporizing the solvent to separate it from the extract.

In testimony whereof I affix my signature.

EBENEZER EMMETT REID.