UNITED STATES PATENT OFFICE.

NIELS HJELTE CLAUSSEN, OF COPENHAGEN, DENMARK.

MANUFACTURE OF ENGLISH BEERS OR MALT LIQUORS.

No. 813,199. Specification of Letters Patent. Patented Feb. 20, 1906.

Application filed May 17, 1904. Serial No. 208,464.

To all whom it may concern:

Be it known that I, NIELS HJELTE CLAUSSEN, a subject of the King of Denmark, residing at Copenhagen, Denmark, (having a post-office address at 40 Rahbeks Alle, Copenhagen, aforesaid,) have invented new and useful Improvements in the Manufacture of English Beers or Malt Liquors, of which the following is a specification.

It is well known that Hansen's researches have given rise to a far-reaching reform in the practice of brewing, both on the continent of Europe and in America, and that in accordance with this reform a single and systematically-selected species of saccharomyces is now almost exclusively used as pitching-yeast instead of accidental mixtures, as was formerly the case; but a like reform has not been introduced into English breweries and in breweries working on the English system in spite of numerous trials which have been made. The fermentation has been commenced either by means of a single pure cultivated species of saccharomyces or with a mixture of several species, according to the method formulated by Van Lehr, (*Transactions of the Institute of Brewing*, VII;) but neither in the one nor in the other case has it been possible to carry on a continuous manufacture, and the attempts have ultimately always had to be abandoned in consequence of the unsatisfactory results, the cause of which has not been ascertained. An explanation of this fact was sought by many authors in the supposition that a special secondary yeast was necessary for assuring the secondary fermentation of English beers; but the supposition was never positively proved, and it has always met with decided opponents, (Jörgensen and Riley, *Allgemeine Brauer und Hopfenzeitung* No. 257, page 2,817.) The authors who wrote more precisely stated what was supposed to be the nature of the hypothetic secondary yeast always called it a "saccharomyces." (Sykes, *The Principles and Practice of Brewing*, second edition, London, 1902, page 483.) From the same point of view Van Laer made the only attempt which has hitherto been made to isolate the secondary yeast and use it in the practice of brewing. He isolated ten different species of saccharomyces, (*Sacch. pastorianus and Saach. ellipsoideus*,) and he supposed he found the secondary yeast among these. (*Transactions of the Inst. of Brewing*, VII, page 55.)

My present invention is based on the discovery that the fine flavor and condition characterizing and peculiar to English beer is not essentially due to the yeast (saccharomyces) nor to the raw materials employed, but is due to a particular group of micro-organisms, which have hitherto not been isolated or described. The group in question belongs to the fungi, but is distinctly different from the saccharomycetes. According to what has been hitherto ascertained this group should be placed in the species "*Torula*," but until the position of the group in the botanic system has been determined by exact scientific investigation I propose to call it "brettanomyces" ($\beta\rho\varepsilon\tau\tau\alpha\nu\sigma\varsigma$=*Briton*, and $\mu\acute{\upsilon}\kappa\eta\varsigma$=*fungus*.) I have, for example, isolated brettanomyces from English beers old in bottle in the following manner—that is to say, I have distributed an adequate quantity of the deposit of a bottle of English ale or stout—as, for instance, Bass's India pale ale, Guiness's Dublin stout, &c.—in melted wort-gelatin and allowed the same to stiffen, and after the lapse of about three days there were formed visible specks of vegetation by the saccharomyces cells contained in the wort-gelatin whether or not they belonged to the cultivated or to the wild species of yeasts. These specks may often attain a considerable size. Only after several days does a fresh set of specks appear. These grow slowly and on the whole remain comparatively small. These specks (apart from any colonies of bacteria) consist of brettanomyces and can afterward be produced in absolutely pure cultures in the usual way, a single microscopically-controlled cell being taken as progenitor.

The characteristics which distinguish brettanomyces from the other fermentation-producing budding fungi are the following:

First. The cells of brettanomyces are smaller in size than the cells of saccharomyces cerevisiæ, and they are quite varying in shape, assuming a round oval elongated thread or irregular form.

Second. When permitted to stand for months, the culture of brettanomyces in wort or sugar solutions produce a flocculent growth of thread-formed mycelium floating above the deposit first formed.

Third. No endospores are formed.

Fourth. Glucose, fructose, and maltose are fermented, but saccharose is not attacked, as brettanomyces contain no invertase.

Fifth. During the fermentation the acidity of the fluids is considerably increased, and

etheral substances are formed, and these impart to the fluid the taste and flavor peculiar to English ales and stouts old in bottles.

Sixth. Distributed in wort-gelatin the cells at 75° Fahrenheit do not produce visible specks of vegetation until after the fifth or sixth day.

Seventh. Wort-gelatin is slowly liquefied by brettanomyces.

Eighth. The best temperature for the growth of brettanomyces is about 80° Fahrenheit. At 32° to 40° Fahrenheit no fermentation takes place.

The foregoing characteristics being common to the entire group of brettanomyces, the cultures originating from different sources may exhibit somewhat different properties, as stated in the following table:

No.	Isolated from—	Shape of cells.	Appearance of cultures in wort.	Flavor produced in beer.	Sediment produced in beer.	Special remarks.
1	Burton pale ale.	Irregular, many elongated.	Slowly settling, remains hazy.	Fine.	Small and compact.	
2	Burton pale ale.	Regular, oval cells predominating.	Quickly settling, clear.	Fine.	Small and compact.	Forms a film on surface of wort and beer.
3	Burton strong ale.	Oval and elongated.	Quickly settling, clear.	Very fine.	Small and compact.	
4	London dinner ale.	Regular, oval cells.	Fluid somewhat discolored, slight hazy.	Less pronounced.	Loose.	
5	London stout.	Many club-formed cells.	Slowly settling.	Fine.	Small and compact.	
6	Irish stout.	Regular, oval cells.	Quickly settling, clear.	Very fine and pronounced.	Small and compact.	
7	Irish stout.	Irregular.	Quickly settling, clear.	Fine.		Forms a film on surface of wort and beer.

In order to attain the best possible result, I have therefore found it necessary to select such species of brettanomyces exhibiting the properties desired in practice. The species preferably employed by me are No. 3 and No. 6 in the above table. Under certain circumstances it would, however, be also possible to obtain a practicable result when employing cultures which do not descend from a single cell of brettanomyces, but which have been freed from other micro-organisms capable of acting prejudicially. I produce such cultures from impure mixtures, taking advantage of the composition among the organisms by a proper choice of temperatures, nutritive substrata, &c., I may add, for instance, an ordinary brewer's yeast containing, besides saccharomyces, slight quantities of brettanomyces and bacteria to pasteurized strongly-hopped beer and leave it to stand at 95° Fahrenheit for two to four weeks, and whereas under these circumstances most of the micro-organisms in question will be much weakened brettanomyces will develop easily, and consequently will predominate in the deposit. By repeatedly transferring such deposit into fresh beer I may at last obtain a practically pure culture of brettanomyces.

According to my invention, I add to the beer at any stage of fermentation or while in cask the brettanomyces isolated in the way mentioned or in any other suitable way and propagated in suitable liquids (preferably wort) and allow it to influence the beer which is maintained at medium temperatures, such as 50° to 80° Fahrenheit. The larger the quantity of added brettanomyces and the higher the temperature the quicker the beer will get the desired flavor and condition. A larger quantity of brettanomyces will also at a lower temperature work essentially as speedily as an inferior quantity of brettanomyces at a higher temperature. Generally speaking, the addition of about one hundred and twenty-five cubic centimeters of a culture of brettanomyces in wort (previously well shaken in order to stir up the deposit) to a barrel of beer or wort may be recommended; but considerable deviations from this proportion in one or the other direction may be made according to the temperature of the storing-room and to the time during which the beer is to be kept in store. I may add the brettanomyces to the pitching-yeast; but in most cases I prefer not to add the same till the primary fermentation has finished. After having added it I may store the beer in cold cellars until it has become sufficiently clear for bottling and then expose the bottles for about fourteen days to a temperature of 59° to 86° Fahrenheit in order that the brettanomyces, still suspended in sufficient quantity in the beer, may produce the desired aroma and condition. I may also, after the addition of the brettanomyces, store the beer in casks at medium temperatures. Then the

effect of brettanomyces will take place in the cask and the right content of carbonic-acid will be obtained during storage when pressure-casks are used. The carbonic acid might also be allowed to escape from the casks during the storage, as a sufficient quantity of this gas will be produced later on by the action of brettanomyces when the beer has been filled in bottles. Of course the brettanomyces may also be added just before the racking off into the trade-casks, or it may be added to the contents of the casks or bottles.

As regards the primary fermentation of the beer, this may be effected by yeast of any suitable kind, while any of the usual modes of working may be employed for fermentation, skimming, or cleansing and storing without affecting the method of carrying out my invention. The best plan will, however, as a rule, be to effect the primary fermentation by a single suitable cultivated species of yeast and to add later on, at any stage after finishing the primary fermentation, a single systematically-selected pure culture of brettanomyces or a mixture of such pure cultures. If the brewer does this, he will have fulfilled a main condition for insuring the uniform production of a fine and stable beer instead of being liable, if no pure cultures are employed, to disastrous results, even if in every other respect the manufacture is carried on in the best possible way.

In carrying out my invention the beer may be pasteurized at the conclusion of the primary fermentation or later on, but before the brettanomyces is added.

If necessary, the beer may be filtered before being pasteurized. While pasteurizing the beer I may allow the carbonic-acid gas to escape, as the brettanomyces added later on will produce a sufficient quantity of the gas. By so pasteurizing the beer it will be prevented from containing any other living organisms than brettanomyces, and consequently the beer will remain in a stable condition for almost any space of time.

Having now described my invention, what I claim is—

1. As a step in the production of English beers, such as ale, stout and porter, the addition thereto of cultures of the brettanomyces, in order to produce the flavor and condition of English beers, substantially as set forth.

2. In the production of English beers, such as ale, stout and porter, the process which consists in adding thereto a mixture of yeast and cultures of brettanomyces, substantially as set forth.

3. In the production of English beers, such as ale, stout and porter, the addition thereto of cultures of brettanomyces to beer which has been primarily fermented in any suitable way, substantially as set forth.

4. In the production of English beers, such as ale, stout and porter, pasteurizing the beer and then adding cultures of brettanomyces to the pasteurized beer, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

NIELS HJELTE CLAUSSEN.

Witnesses:
K. E. WIBERG,
A. CHRISTENSEN.