

PATENT SPECIFICATION

DRAWINGS ATTACHED

943.811

Inventors: PERCY HENRY WATTS, MICHAEL EDWARD ASH
and GEORGE CORDERY PHILLPOTTS

Date of filing Complete Specification (under Section '3 (3) of the Patents
Act, 1949): April 4, 1962.

Application Date: April 14, 1961.

No. 13499/61.

Application Date: Oct. 20, 1961.

No. 37680/61.

Complete Specification Published: Dec. 4, 1963.

© Crown Copyright 1963.



Index at acceptance:—~~Class~~ C6, E(11B1, 11B2, 11D2).

International Classification:—C 12 c.

COMPLETE SPECIFICATION

An improved method and apparatus for preparing Brewers Wort

5 We, ARTHUR GUINNESS SON AND COMPANY (PARK ROYAL) LIMITED, of Park Royal Brewery, Park Royal, London, N.W.10, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a process and apparatus for the preparation of brewers wort and is concerned with mashing of ground malted grain (commonly called "grist" in the Brewing Industry) with hot water, conversion and subsequent filtration and extraction of wort.

15 The traditional infusion process normally termed a "mashing process" broadly involves mixing grist with hot water to produce a porridge-like mixture or mash which is passed into large vessels called mash tuns. These are operated intermittently, that is to say a batch of mash is fed to a mash tun and, after a suitable period of conversion during which the mash is maintained at one or more appropriate temperatures to convert the starches in the mash into sugars, the resultant sweet liquid or wort is drained off from the bottom of the mash tun. When draining commences, the grains are in suspension in the mash, but the action of draining through the perforate floor of the mash tun settles the grains on this floor so that they finally form a filter bed which may be as much as six feet in depth in the normal mash tun and through which the remaining liquid passes. As the initial runnings are inevitably cloudy, these may be re-circulated so that they pass again through the filter bed. A deep filter bed of this kind renders filtration on a slow process and moreover after the wort has been drawn off, it is necessary to sparge the bed of spent grains in the mash tun with water, in some cases for a period of several hours to secure high extractive efficiency. The cleaning of these

large mash tuns, which has to take place between every batch, is a difficult and laborious process which adds to the length of time between the processing of successive batches.

A continuous mashing process has also been proposed in which the mash is passed at a controlled rate through a tower, being allowed to remain in this tower for a suitable conversion period and being maintained at an appropriate temperature or range of temperatures during the process. Separation occurs as the spent grains emerge from the top or bottom of the tower. The rates of feed of water and malted grain and rates of take-off, may be controlled separately or together. It has been found that a continuous process of this kind tends to result in cloudy wort, because the grains are kept in suspension throughout the process and are inevitable subject to movement and agitation which results in fine particles passing out in suspension in the wort and making it cloudy. Thus a further filtration step is required, which tends to make the process more expensive.

A further mashing process has been suggested in United Kingdom Patent 852,561 in which the preparation of wort comprises feeding mash in separate quantities into separate compartments defined in a circular vessel by a plurality of angularly spaced members rotating about the axis of said vessel, successively holding the mash over an imperforate section during the period necessary for conditioning the mash (i.e. conversion) and for settlement of the spent grains to form a filter bed, carrying the mash over a perforate section of the vessel floor for a sufficient time to permit adequate separation of the wort from the grains, collecting the separated wort and carrying the spent grains over a discharge section of the vessel floor to remove the grains from the vessel. This process also may involve re-circulation of the wort when it is drawn off from the various compartments.

[Price 4s. 6d.]

The term "re-circulation of wort" is intended in this Specification to denote the sparging, over some part of the bed, of wort drawn from beneath the same part or from beneath some other part of the bed.

We have found that the gradual movement of the mash laterally over the floor of the vessel, tends to disturb the filter bed after it has settled, and thus to impair the clarity of the filtered wort. In addition, whilst it is possible to discharge a substantial part of the spent grains through an aperture in the floor of the vessel, relatively complex sealing arrangements are required to prevent loss of wort through this discharge opening.

It is an object of our invention to provide a mashing process and apparatus for the preparation of wort which can be operated continuously or intermittently. In particular, we aim to provide a process which includes a continuous filtration system which can incorporate the conversion step within itself, or can be used as a final step in the mashing process following a separate conversion step, such as for example as that carried out in the above-mentioned tower process or described in our co-pending Application No. 12066/62 (Serial No. 943,812).

For most efficient operation in a continuous mashing operation, it is desirable to provide, initially, means for continuously carrying out conversion of mash at a controlled rate and under variable temperature conditions so that conversion appropriate to the differing requirements of the Brewer of stout, porter or ale and of the Brewer of lager for example, may be carried out using the same equipment without substantial changes.

Our filtration step utilises one or more conveyor belts to move the mash during filtration, in a more or less horizontal plane—although a slight degree of inclination may be allowed. The main direction of linear movement is horizontal and, for convenience, the starting end of the process is herein called the "upstream" end and the finishing end the "downstream" end.

The principle of utilising endless perforated belts as filters for removing suspended solids from liquids is well known in many fields, for example in paper preparation; and in the production of kaolin. Moreover, in West German Patent Specification No. 1,058,958 this technique has been proposed for filtering brewers mash. This West German Specification discloses a process and apparatus in which mash is fed on to the upstream end of a perforate endless filter belt, which is supported at three widely spaced intervals along its upper run by two guide rolls. Between the upper and lower runs of the belt are collecting pans, and as the mash passes from the upstream to the downstream end of the upper run, wort in diminishing strengths is collected in the underlying pans. After the first runnings of strong wort have

been collected upstream, liquor is sparged over the moving bed of mash and this lixiviates the grains. The belt may also comprise moving filter screens, the use of vibration is suggested to accelerate the filtration process. This specification points out that the filtering and separation of the wort from the grains is effected principally by the filter belt, but to a lesser extent by the bed of grains on the belt. It is clear that the process described in West German Patent No. 1,058,958 must rely almost entirely on the perforated belt to act as a filter, since any applied vibration such as is suggested, would disturb the bed of grains on the belt and largely nullify its supplementary filtration effect. It is also clear that the escape of liquid through the filter bed is intended to be rapid, since a pressing device is described for squeezing the mash part way along the belt.

By contrast our invention, whilst utilizing the principle of an endless perforated belt as a filter bed carrier relies on this belt not as a filter but as a base to support the coarsest grains to that a filter bed of settled grains can build up on the belt, this moving settled bed operating as the filter medium in the same way as does the bed in the mash tun of the traditional batch process.

According to our invention in its broadest aspect, we provide a continuous mashing process for the preparation of wort which comprises feeding mash continuously and at a controlled rate through one or more conversion zones, maintained at one or more temperatures according to the required nature of the wort, and in a substantially horizontal linear direction through a filtration zone in which a perforate conveyor, moving in a trough, carries a settled and mechanically undisturbed filter bed of grains over a perforate platform, above a wort collecting zone; collecting wort from the underside of the filter bed and removing spent grains from the conveyor at the downstream end of the filter bed.

The wort collecting zone underneath the filtration zone may be divided into a series of compartments. These compartments, or groups of compartments, are used to collect differing qualities and strengths of wort, according to the particular region of the filtration zone beneath which they are located.

One or more compartments located beneath the bed at the upstream end of the filtration zone (herein called "the stabilising region") is used to collect the first runnings of the wort. These tend to be cloudy until draw-off has proceeded long enough for substantially all particles in suspension to have lodged on or in the interstices between the larger particles in the grain bed. The initial drawing off of wort while the particles are settling is herein called "stabilising the bed."

If extreme clarity of wort is desired, the first runnings of wort, which of necessity will contain some small solid particles of mash en-





trained in them, may be recirculated and sparged at least once over the filter bed, so as to filter out these small particles.

5 The region of the bed immediately downstream of the stabilising region is herein called "the production region." Wort passing through the bed to the underlying compartments at the upstream end of the production region will be strong and may either be re-circulated or collected for subsequent use. At the downstream end of the production region, it is preferred to sparge the bed with hot water so that weak wort is run off and collected in the compartments below this part of the bed. This weak wort may either be added to the strong wort being run off, or may be sparged over the bed in the intermediate or upstream part of the production region.

20 At the downstream end of the filtration zone beyond the production region there is a further region (herein called the "drainage region"). Preferably the mash is sparged with hot water in this region to extract the last amount of useful material from the grains, thus producing a weak wort. The weak wort from the drainage region is run off and directed through one or more underlying compartments, being there after normally sparged over the bed in the production region. In some cases, it may be found 30 preferably to feed some or all of the weak wort from the drainage region directly into the outflow of strong wort from the production region.

35 It will be obvious that there is no definite line of division between the three regions above-mentioned since the filter bed is continuous, and it is a matter of choice for the particular brewer where he will cease re-circulating the first runnings of wort, or where he will sparge with water at the downstream end, or 40 where he will sparge with weak wort in the production zone.

We have found that it is desirable to produce a gradual lowering of liquid level in the bed from the upstream to the downstream end of the filtration zone. Where the conveyor is level or is sloping downwardly from upstream to downstream, this may be effected by passing the outflow from successive collecting compartments over a series of weirs of progressively decreasing height until finally at the last compartments in the drainage zone, it is drawn off without the weir so as to drain the bed completely. Preferably, the conveyor may run slightly upwardly from the upstream to the 55 downstream end of the filtration zone.

We find that when sparging with a relatively small flow of sparge liquid per unit of area of the bed, an intermittent supply is to be preferred because it ensures that the sparged liquor is evenly distributed over the width of the bed when a sparger with a number of holes is used for distribution. A continuous flow of liquid tends to dribble preferentially from some particular hole in a perforated sparger. The 65

holes have to be of sufficiently large size to avoid blockage by solid particles when recycling and sparging the wort.

Where an intermittent sparge is used, a perforated tube may extend across the bed and sparged liquid may be supplied in short bursts by the well known system in which liquid is fed continuously into a tank, from which it siphons each time the tank level rises sufficiently high to start the siphon action.

70 Where a continuous sparge is used, we may use a distributor in the form of a rotary brush the axis of which may be parallel to the long axis of the bed, and the bristle tips of which dip into a trough of liquid and are "flipped" past a stationary blade, which serves to give regular and controllable sprinkling effect.

75 In some cases we may arrange our process so that conversion and filtration are both being carried out concurrently in time, but in sequence in space, on the perforated conveyor, while the mash is being moved along. If this is required, the length of the conveyor may be extended upstream of the filtration zone so that it passes first over an impermeate platform of suitable length, which is heated at the appropriate place or places to the required temperature or temperatures necessary to effect conversion. The dwell of the mash in the conversion zone so formed, will be dependent upon the speed of the conveyor and the length of the conversion zone. We prefer to pre-mix the water and grist before passing it to the conversion zone to enhance the regular consistency of the mash. 85 90 95 100

Alternatively we may employ the improved conversion method and apparatus described in our co-pending Application No. 12066/62 (Serial No. 943,812) in conjunction with our filtration operation, in cases where it is not desired to carry out conversion on the perforated conveyor. 105

The conversion step of co-pending Application No. 12066/62 (Serial No. 943,812) broadly comprises passing the mash in a controlled flow into and through at least one heated conversion zone defined by the interior walls of a hollow drum or cylinder of which the longest axis is substantially horizontal but may be inclined slightly, the inlet level to this zone being higher than the outlet level therefrom; continuously agitating the mash mechanically within the conversion zone whereby the components of the mash are prevented from separating and finally passing the mash, without extracting wort therefrom, away from the conversion zone and towards a filtration zone. 110 115 120

Our improved process has the following advantages over the traditional method of mashing. First, it is a continuous rather than a batch process and control over the rates of feed, temperatures and other variable factors can be exercised more closely. Any changes in the wort being produced can be corrected rapidly by controlling these variables severally or inde- 125 130

pendently; moreover, by the use of an automatic wort sampler and tester, such changes may to a large extent, be carried out automatically by linking the sampling and testing mechanism to the mechanisms which operate controls for the variables. Second, the use of a perforated conveyor to provide a moving filter bed, enables a relatively shallow bed to be maintained, which can be no more than a few inches in depth as compared with the traditional bed of several feet in a mash tun. This results in much more rapid filtration. Thirdly, the linear separation of the conversion step from the filtration step in our process, enables conversion conditions, such as times and temperatures, to be varied according to the type of wort required, without affecting the remainder of the process.

As compared with the known continuous tower process mentioned earlier in this Specification, our filtration process only takes place when the bed has formed and thus tends to produce a clearer wort, despite the fact that we may use a conversion operation such as that described in our co-pending Application No. 12066/62 (Serial No. 943,812) which involves continuous agitation of the mash and hence violent disturbance of the grist particles during conversion.

As compared with the rotary segmental masher of United Kingdom Patent 852,561, our process is truly continuous, whereas the rotary segmental masher involves the splitting up of the mash into continuously moving batches. Moreover, in our process we separate the conversion step from the filtration step, as already mentioned, even in the case where both steps take place on the perforated conveyor. Further, although Patent 852,561, involves a considerably shallower bed (and hence more rapid filtration) than that of a conventional mash tun (e.g. from one to six inches as against up to six feet) in the traditional process as mentioned earlier, the process of the present invention permits an even shallower bed than this to be employed economically, with correspondingly greater filtration speed.

Lastly, the movement of the mash across and relative to the stationary floor of the rotary masher, after the bed has settled, inevitably results in some degree of disturbance of the lowermost layer of particles in the bed, and thus a cloudy wort may still result, even though recirculation is carried out. By contrast, in our process the bed is formed on the moving perforated conveyor which is supported along its full length and is not vibrated. Once the bed has been formed it is not disturbed mechanically and is never caused to move relative to that conveyor until filtration has been completed and the time comes for spent grains finally to be removed from the conveyor. This enables the grain particles when settled to be

used as the filter medium, by contrast to the apparatus of West German Specification No. 1,058,958, in which the perforated conveyor belt, even if not vibrated, serves as the main filter medium.

One embodiment of our invention will now be described with reference to Figures 1 and 3—5 of the diagrammatic drawings accompanying Provisional Specification No. 13499/61 in which:—

Fig. 1 is a diagrammatic general arrangement of continuous mashing equipment comprising the conversion equipment of our co-pending Application No. 12066/62 (943,812) in conjunction with the filtration equipment of the present Application to show the relationship of the various components.

Fig. 3 is a part sectional side elevation of the mash filtration apparatus.

Fig. 4 is a cross-sectional view on the line A—A of Fig. 3 with some mash in place of the filter.

Fig. 5 is an enlarged sectional side view showing the mash as it begins to settle on the filter conveyor belt.

In this embodiment we describe the preferred form of conversion step which is carried out in a rotating drum and which forms the subject of our co-pending Application No. 12066/62 (943,812).

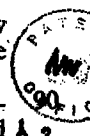
Referring to Fig. 1, grist is fed to a hopper 1. The grist is then fed by a conveyor 2 to a hopper 3 and thence to a grinding mill 6. The ground grist is extruded from the chamber 9 by a conveyor 10. The conveyor 10 is arranged so as to be able to operate faster than the conveyor 2. This avoids any clogging, prevents dust from building up and also avoids any tendency for moisture seeping back from the mixing pot 12.

The ground grist passes to a mash pot 12 where it is mixed with hot mashing liquor from a pipe 13; the mixture is mashed by a blade 14 and the rate of feed of water and ground grist is such that the mash gradually overflows down a tube 16 to a rotating drum 17. The drum is carried on rollers 18 and churns up the mash inside it. The mash eventually overflows from the drum through a tube 19 and is deposited on to a conveyor belt 20.

To carry out conversion, heat must be applied to the mash. This is done by any suitable conventional heating arrangement applied to the drum.

There is a slight fall between the inlet and outlet levels of the drum which ensures a steady flow by gravity through the converter.

The mash is spread on the belt by a spreader 26, the belt is guided by rollers 22 and driven by roller 23. As the belt travels along the mash gradually stabilises and forms a filter bed through which liquid will pass. Under the belt are troughs 25 for collecting wort which has



passed through the filter bed, and arrangements for re-circulating some of the collected wort. Wort is finally collected in tank 28.

5 The filtration of the wort will now be described in detail with reference to Figs. 3—5 of the drawings.

10 The mash eventually emerges from the drum through the outlet 19 on to a conveyor belt 20. The belt 20 which is made of 20 mesh nylon is carried on a perforated support formed by a series of slotted plates 21, although at the region on the belt where the mash is deposited the support is imperforate.

15 If desired, this imperforate region may be extended and may be heated so that conversion of the mash is partly carried out in this zone.

20 The belt travels around a series of rollers 22, and is driven by roller 23 which is connected to a suitable source of power, e.g. an electric motor 24. As the belt travels along, the mash gradually stabilises and forms a filter bed through which liquid will pass. Underneath the slotted plates 21 are arranged a series of tanks 25, which form juxtapositioned troughs, sealed from one another, for different regions along the length of the belt.

25 As soon as the mash has been deposited on the belt is spread by a movable arm or spreader 26, so that the solid particles in the mash are deposited evenly over the width of the belt. The mash then passes along the apparatus on the belt over three regions constituted by batches of collecting tanks. Above the first batch of collecting tanks, which is sub-divided into five sections, the mash completes its stabilising process in which a filter bed is formed. This is the stabilising region. When the mash is above the first section any liquid which passes through the belt is collected and re-circulated by the pump 27 to a point above the second section so that it again passes through the filter bed for subsequent re-circulation to the third or later sections. This re-circulation continues until the wort has been passed through the filter bed several times, after which point the wort is collected and passed to the main collecting tank 28. As the mash continues downstream it passes to the second region—the production region—and after that to a third region—the drainage region. While it is in the third region, hot water is spread on to it; this water extracts the last amount of useful material from the mash on the bed to form weak wort. This weak wort is then pumped over the production region and spread on to the mash in this region. The wort collected is then passed to the main collecting tank.

60 When the mash is conveyed past the third zone it is removed from the belt, e.g. by a scraper 29, and is ejected through the outlet 30. The belt then continues underneath the apparatus until it again collects fresh mash from the outlet 19.

65 To clean the nylon belt, a flow of water may

be employed passing through it in the reverse direction to the wort. This may be done while the belt is underneath the apparatus.

70 The belt and collecting tanks are confined within a heating container having a steam-heated jacket 31. The top of the container 32 is made from a sheet of polymethyl methacrylate, thus allowing the filter bed operation to be inspected.

75 Referring to Fig. 4, which shows the re-circulation circuit, liquid from the mash 36 passes through the mash bed, and the belt 20 is pumped by the re-circulating pump 37 to a position above the mash bed whereby it is again spread over the mash, over the succeeding collecting tank. The conveyor belt 20 rests on the slotted plate 21. Steam passes through the apparatus in the jacket 31.

80 In Fig. 5 the mash is shown as it begins to settle on the conveyor belt. The solid particles 38 of the mash gradually settle until the filter bed 35 is stabilised. The resultant bed of solid particles forms an effective labyrinth filter and the fact that the bed does not move in relation to the moving belt on which it is carried, results in the minimum of disturbance to the particles once they have settled in place. This minimises the tendency to produce cloudy wort.

85 In the case where it is desired to carry out conversion of the mash and its subsequent filtration concurrently in time, but in sequence in space, on this perforated conveyor as the mash is being moved along by it, this may be done by extending the length of that portion of the conveyor upstream of the filtration zone between the points X and Y (Fig. 3), so that it first passed over an imperforate platform of suitable length, heated at the appropriate places to the required temperature or temperatures, necessary to effect conversion. Any conventional heating means may be employed.

90 As a result of further experiments, we have developed yet another alternative method and apparatus for conversion, embodying the principle of the moving conveyor band, but so arranged as to permit easier control of the variations in temperature and "dwell" in the or each conversion zone, and hence to permit wider variation of the process according to whether it is meeting the requirements of the beer or ale Brewer, or the widely different requirements of the lager Brewer.

95 We provide, in one form, a method of converting the mash which consists in moving it along at a controlled linear rate on a conveyor band (Exemplified by a flat imperforate moving belt or belts), maintaining an appropriate conversion temperature for an appropriate time by heating one or more zones along the length of this conveyor, the dwell of the mash in the or each zone being determined by the rate of travel of the or each belt in relation to the linear length of the or each zone of the belt.

100 Alternatively, a series of belts may be em-

70

75

80

85

90

95

100

105

110

115

120

125

130



played sequentially each belt having one or more conversion zones heated to the required temperature and having a controlled dwell period as determined as before by relating the linear length of conversion zone to the speed of the conveyor.

For simplicity, it is preferable to arrange that the mash is delivered by gravity from the end of one conveyor on to the beginning of the next, in cases where a plurality of conveyors is required.

Where it is important, as in most instances, that the temperature of the mash should not be allowed to fall during its transfer from one conversion zone to the next, and where a plurality of conveyors are being employed, means may be provided for heating the mash or maintaining its temperature, during its passage from one conveyor to the next.

By separating the conversion step from the filtration step (when both are carried out on moving conveyor belts) we are able to arrange the process so as to provide extreme flexibility of operation and ease of control whereas if a single perforated belt is employed as a conveyor and both conversion and filtration are carried out thereon, the belt is liable to be ~~unnecessarily~~ long, which in some cases may prove inconvenient if space is limited.

WHAT WE CLAIM IS:—

1. In a continuous mashing process for the production of brewers wort which comprises the sequential steps of conversion and filtration, and wherein these steps are separated in space from each other, and wherein mash, after the conversion step, is being continuously passed forward for separation of the wort from the spent grains; a separation and filtration step which comprises conveying the mash continuously and at a controlled rate in a substantially horizontal linear direction through a filtration zone by means of a perforate conveyor, moving in a trough; causing the mash to settle on the moving conveyor to form a settled and mechanically undisturbed filter bed of grains; moving this filter bed smoothly over a perforate platform above a wort collecting zone; draining wort through the filter bed, perforate conveyor and perforate platform and collecting wort from the underside of the platform, and removing spent grains from the conveyor at the downstream end of the filtration zone.

2. In a continuous mashing process, a filtration step as claimed in Claim 1, wherein the filtration zone is divided into three regions, a stabilizing region at the upstream end of the filtration zone where first runnings of wort are drawn off and where the grains settle to form the filter bed; a production region immediately downstream of the stabilizing region where strong wort is drawn off for subsequent use, and a drainage region immediately downstream of the production region where the

last of the wort is drawn off and from which spent grains are removed.

3. In a continuous mashing process, a filtration step as claimed in Claim 2, wherein a series of the wort collecting compartments is provided below the filter bed throughout the filtration zone.

4. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein the cloudy first runnings or wort collected from one or more compartments underlying the stabilising region are re-circulated and sparged at least one over the filter bed, to remove small particles from the wort.

5. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein the or most of the strong wort is collected from one or more compartments underlying the production region and is continuously drawn off for subsequent use.

6. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein water is sparged over the filter bed at the downstream end of the filtration zone and weak wort is collected from one or more compartments underlying the drainage region.

7. In a continuous mashing process, a filtration step as claimed in Claim 4, wherein the cloudy first runnings of the wort are drawn successively from one part of the filter bed, and are re-circulated and sparged over another part of the filter bed further downstream to produce increasing clarification of the wort.

8. In a continuous mashing process, a filtration step as claimed in Claim 6, wherein the weak wort is sparged over the filter bed in the production region.

9. In a continuous mashing process, a filtration step as claimed in Claims 5 and 6, wherein weak wort is added directly to the outflow of strong wort from the production region.

10. In a continuous mashing process, a filtration step as claimed in Claims 5 and 6, wherein a fraction of the weak wort is sparged over the filter bed in the production region, and the remaining fraction is added directly to the outflow of strong wort from the production region.

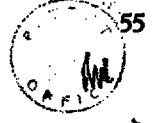
11. In a continuous mashing process, a filtration step as claimed in Claim 4 or Claim 7, wherein the sparging is intermittent.

12. In a continuous mashing process, a filtration step as claimed in Claim 11, wherein the sparging is continuous.

13. In a continuous mashing process, a filtration step as claimed in Claim 6 or Claim 8, wherein the sparging is intermittent.

14. In a continuous mashing process, a filtration step as claimed in Claim 6 or Claim 8, wherein the sparging is continuous.

15. In a continuous mashing process, a filtration step as claimed in any one of the preceding Claims, in which the drawing off of wort from various places along the filter bed produces a gradual lowering of liquid level



stabilising

employed sequentially each belt having one or more conversion zones heated to the required temperature and having a controlled dwell period as determined as before by relating the linear length of conversion zone to the speed of the conveyor.

For simplicity, it is preferable to arrange that the mash is delivered by gravity from the end of one conveyor on to the beginning of the next, in cases where a plurality of conveyors is required.

Where it is important, as in most instances, that the temperature of the mash should not be allowed to fall during its transfer from one conversion zone to the next, and where a plurality of conveyors are being employed, means may be provided for heating the mash or maintaining its temperature, during its passage from one conveyor to the next.

By separating the conversion step from the filtration step (when both are carried out on moving conveyor belts) we are able to arrange the process so as to provide extreme flexibility of operation and ease of control whereas if a single perforated belt is employed as a conveyor and both conversion and filtration are carried out thereon, the belt is liable to be ~~necessarily~~ long, which in some cases may prove inconvenient if space is limited.

WHAT WE CLAIM IS:—

1. In a continuous mashing process for the production of brewers wort which comprises the sequential steps of conversion and filtration, and wherein these steps are separated in space from each other, and wherein mash, after the conversion step, is being continuously passed forward for separation of the wort from the spent grains; a separation and filtration step which comprises conveying the mash continuously and at a controlled rate in a substantially horizontal linear direction through a filtration zone by means of a perforate conveyor, moving in a trough; causing the mash to settle on the moving conveyor to form a settled and mechanically undisturbed filter bed of grains, moving this filter bed smoothly over a perforate platform above a wort collecting zone; draining wort through the filter bed, perforate conveyor and perforate platform and collecting wort from the underside of the platform, and removing spent grains from the conveyor at the downstream end of the filtration zone.

2. In a continuous mashing process, a filtration step as claimed in Claim 1, wherein the filtration zone is divided into three regions, a stabilizing region at the upstream end of the filtration zone where first runnings of wort are drawn off and where the grains settle to form the filter bed; a production region immediately downstream of the stabilizing region where strong wort is drawn off for subsequent use, and a drainage region immediately downstream of the production region where the

last of the wort is drawn off and from which spent grains are removed.

3. In a continuous mashing process, a filtration step as claimed in Claim 2, wherein a series of the wort collecting compartments is provided below the filter bed throughout the filtration zone.

4. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein the cloudy first runnings or wort collected from one or more compartments underlying the stabilising region are re-circulated and sparged at least one over the filter bed, to remove small particles from the wort.

5. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein the or most of the strong wort is collected from one or more compartments underlying the production region and is continuously drawn off for subsequent use.

6. In a continuous mashing process, a filtration step as claimed in Claim 3, wherein water is sparged over the filter bed at the downstream end of the filtration zone and weak wort is collected from one or more compartments underlying the drainage region.

7. In a continuous mashing process, a filtration step as claimed in Claim 4, wherein the cloudy first runnings of the wort are drawn successively from one part of the filter bed, and are re-circulated and sparged over another part of the filter bed further downstream to produce increasing clarification of the wort.

8. In a continuous mashing process, a filtration step as claimed in Claim 6, wherein the weak wort is sparged over the filter bed in the production region.

9. In a continuous mashing process, a filtration step as claimed in Claims 5 and 6, wherein weak wort is added directly to the outflow of strong wort from the production region.

10. In a continuous mashing process, a filtration step as claimed in Claims 5 and 6, wherein a fraction of the weak wort is sparged over the filter bed in the production region, and the remaining fraction is added directly to the outflow of strong wort from the production region.

11. In a continuous mashing process, a filtration step as claimed in Claim 4 or Claim 7, wherein the sparging is intermittent.

12. In a continuous mashing process, a filtration step as claimed in Claim 11, wherein the sparging is continuous.

13. In a continuous mashing process, a filtration step as claimed in Claim 6 or Claim 8, wherein the sparging is intermittent.

14. In a continuous mashing process, a filtration step as claimed in Claim 6 or Claim 8, wherein the sparging is continuous.

15. In a continuous mashing process, a filtration step as claimed in any one of the preceding Claims, in which the drawing off of wort from various places along the filter bed produces a gradual lowering of liquid level



in the bed from the upstream to the downstream end of the filtration zone.

16. In a continuous mashing process, a filtration step as claimed in Claim 15, in which the filter bed is on a level base and the outflow from successive collecting compartments is passed over a series of weirs of progressively decreasing height and finally drawn off from one or more of the last compartments without a weir to drain the bed completely.

17. In a continuous mashing process, a filtration step as claimed in Claim 15, in which the filter bed is on a base which slopes slightly upwardly from the upstream to the downstream end of the filtration zone.

18. In a continuous mashing process, a filtration step as claimed in any of the preceding claims, in which the mash and the wort being collected are kept hot during filtration.

19. A continuously mashing process which includes the step of continuously converting the mash and subsequently extracting the wort by a filtration step as claimed in any one of the preceding claims.

20. A continuous mashing process as claimed in Claim 19, in which the continuous conversion step is that described in our co-pending Application No. 12066/62 (Serial No. 943,812).

21. A continuous mashing process as claimed in Claim 19, in which the continuous conversion step is carried out in at least one conversion zone constituted by a perforate moving conveyor belt operating in an appropriately heated imperforate trough.

22. A continuous mashing process as claimed in Claim 21, in which the steps of continuous conversion and continuous filtration are carried out on the same perforated conveyor, the continuous conversion step being carried out on a perforate conveyor in a conversion zone forming an extension upstream of the filtration zone and mash to be converted is carried by the perforate conveyor over an appropriately heated imperforate platform, the mash after conversion, being carried by the perforate conveyor to the filtration zone.

23. A continuous process as claimed in Claim 19, in which the continuous conversion step takes place on a separate conveyor from the conveyor utilised for the continuous filtration step.

24. A continuous mashing process as claimed in Claim 23, in which the continuous conversion step takes place on a series of separate conveyors, each heated to an appropriate temperature.

25. In a continuous mashing process, a conversion step utilising a moving conveyor band substantially as herein described.

26. In a continuous mashing process, a filtration step substantially as herein described.

27. In a continuous mashing process, the filtration step substantially as herein described

with reference to the drawings accompanying the Provisional Specification.

28. A continuous mashing process substantially as herein described.

29. The continuous mashing process herein described with reference to the drawings accompanying the Provisional Specification.

30. An apparatus for carrying out the filtration step in a continuous mashing process wherein the steps of conversion and filtration are separated in space from each other, and wherein mash, after the conversion step, is being continuously produced for separation of the wort from the spent grains, said apparatus comprising a perforate conveyor constituted by an endless band having a substantially horizontal upper run and a lower run; a trough supporting the conveyor and itself having a perforate base constituting a platform for the upper run; means for moving the conveyor smoothly over the platform through a filtration zone constituted by the upper run of the conveyor; means for feeding converted mash to the upstream end of the conveyor; means for collecting wort from underneath the platform and means for removing the spent grains from the conveyor at the downstream end of the filtration zone.

31. Apparatus as claimed in Claim 30, wherein the means for collecting wort comprises a series of compartments underlying the filtration zone each having its own outlet.

32. Apparatus as claimed in Claim 31, including means for collecting cloudy wort from one or more compartments at the upstream end of the filtration zone and for re-cycling this cloudy wort by sparging it over the mash further downstream.

33. Apparatus as claimed in Claim 31, including means for continuously removing a main outflow of strong wort from one or more compartments intermediate the upstream and downstream ends of the filtration zone.

34. Apparatus as claimed in Claim 31, including means for sparging water over the mash in a region at the downstream end of the filtration zone and means for collecting weak wort from the compartments underlying this region.

35. Apparatus as claimed in Claim 34, including means for re-circulating weak wort over the mash in that part of the filtration zone from which the main flow of strong wort is drawn off.

36. Apparatus as claimed in Claim 33 and 34, including means for mingling the outflow of weak wort with the main outflow of strong wort.

37. Apparatus as claimed in Claim 33 and 34, including means for re-circulating a fraction of the weak wort over the mash in that part of the filtration zone from which the main flow of strong wort is drawn off and means for passing the remaining fraction of weak



wort directly to the main outflow of strong wort.

38. Apparatus as claimed in any of the Claims 32, 34, 35 or 37, including means for intermittently sparging the wort or water.

39. Apparatus as claimed in any of the Claims 32, 34, 35 or 37, including means for continuously sparging the wort or water.

40. Apparatus as claimed in Claim 38, wherein the intermittent sparging means comprises a perforated tube extending across the conveyor above the mash and supplied with liquid from a tank by siphon action, the liquid being fed to the tank from the appropriate compartment.

41. Apparatus as claimed in Claim 39, wherein the continuously sparging means comprises a trough of liquid and a rotary brush located above said trough parallel to the long axis of the filtration zone, the bristles of the brush dipping into the liquid in the trough, and a stationary blade at the end of the trough serving to trip the ends of the bristles of the brush and cause them to scatter the liquid continuously.

42. Apparatus as claimed in any one of the preceding Claims in which the upper run of the conveyor carrying the mash is level and the outflow from successive wort collecting compartments in a downstream direction, is passed over a series of weirs of progressively decreasing height in order to produce a gradual lowering of the level of liquid in the mash on the conveyor.

43. Apparatus as claimed in any one of the preceding Claims in which the upper run of the conveyor slopes gradually from the upstream to the downstream end of the filtration zone in order to produce a gradual lowering of the liquid in the mash on the conveyor.

44. Apparatus as claimed in any one of the preceding Claims, including means for heating the mash and the wort during filtration.

45. Apparatus for continuous mashing comprising continuous conversion apparatus and continuous filtration apparatus in sequence, the continuous conversion apparatus including a first moving conveyor constituted by an endless band operating substantially horizontally

in an appropriately heated imperforate trough, means for feeding mash to said conveyor band and for passing the mash to filtration apparatus as claimed in any one of the preceding Claims 30 to 44.

46. Apparatus for continuous mashing, comprising a perforate conveyor constituted by an endless band having an upper run and a lower run, a trough supporting and constituting a platform for the upper run, the platform having a first imperforate section constituting a conversion zone at the upstream end of the upper run, and a second perforate section at the downstream end of the upper run constituting a filtration zone; means for moving the upper run smoothly over the platform through both zones; means for feeding mash to the upstream end of the upper run means for heating the mash passing through the conversion zone to an appropriate conversion temperature or temperatures; means for collecting wort from underneath the filtration zone, and means for removing the spent grains from the conveyor at the downstream end of the filtration zone.

47. Apparatus for carrying out the conversion step on a moving conveyor band in a continuous mashing process, substantially as hereinbefore described.

48. Apparatus for carrying out the filtration step on a moving conveyor band in a continuous mashing process, substantially as hereinbefore described.

49. In a continuous mashing process, filtration apparatus substantially as herein described with reference to the drawings accompanying the Provisional Specification.

50. Apparatus for continuous mashing substantially as hereinbefore described.

51. Continuous mashing apparatus, substantially as herein described with reference to the drawings accompanying the Provisional Specification.

URQUHART-DYKES & LORD,
Maxwell House, 11, Arundel Street,
Strand, London, W.C.2. and
12, South Parade, Leeds 1, Yorks.
Chartered Patent Agents.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1963. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.



* C L M S *