### Title:
**AUTOMATED CRUSTACEAN CLEANING AND CUTTING APPARATUS AND METHOD OF USING SAME**

**Abstract:**
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ABSTRACT

An automated crustacean processing apparatus is featured. The apparatus provides automated scrubbing of the leg portions of the crustacean at high speed and volume and additionally maximizes the amount of leg processable. A cutting arrangement is provided to sever the legs from the body portions with minimum wastage of the vendible leg material. The process and apparatus have marked advantages over the conventional manual processes currently employed in the art.
AUTOMATED CRUSTACEAN CLEANING AND CUTTING APPARATUS
AND METHOD OF USING SAME

FIELD OF THE INVENTION

The present invention relates to an automated system and method for removing crustacean legs from body portions thereof and more particularly, the present invention relates to an apparatus and method of maximizing the efficiency in removing crab legs from a body portion of a crab in an expedited manner.

BACKGROUND OF THE INVENTION

Crustacean processing, and more particularly, crab processing, typically involves a washing procedure to remove foreign objects and debris from the outer shell of crab sections. The debris includes slubb, a build-up of slime which is picked up from the sea floor and appears to only occur in catch location with low water levels and leech eggs which are minuscule sized objects which become attached to the underside of the crab legs in densely packed configurations.

Currently, there are a variety of methods for removing the debris and processing the legs for the consumer market. One of the methods involves manually cleaning the crab sections by making use of a hand-held brush. Manual brushing is generally satisfactory and meets quality specifications. The problem is that this method is expensive and labour-intensive. It is estimated that approximately 40 workers are required to scrub 30,000 pounds of crab sections within a typical nine hour workshift.

A further method currently employed involves semi-automated high pressure spray wash systems. The procedure involves passing the crab sections along a perforated conveyor belt. The high pressure water (approximately 1,000 psi) is blasted through the conveyor belt from a nozzle system beneath the conveyor. This procedure is rife with limitations, including:
(1) a loss of product yield due to the high pressure stream impinging on exposed meat in a butchered cavity;
(2) worker intervention to flip the crab sections over to facilitate access and cleaning both sides of the crab;

(3) excessive water consumption;
(4) power consumption; and
(5) significant maintenance costs for the equipment employed.

A further method for processing the crab sections includes manually sawing the crab legs. This method is, as well, affected by limitations such as significant product yield loss and significant labour intervention for positioning the crab for the sawing operation.

In view of the limitations currently being experienced in this art, there exists a need for an automated arrangement for processing the crab or other crustacean sections which can be more efficient and less expensive in terms of financial commitment and labour requirements. The present invention alleviates the limitations in the prior art and accordingly, one object of the present invention is to provide a highly efficient processing apparatus and a method of employing the apparatus.

One aspect of one embodiment of the present invention, there is provided an automated apparatus for cleaning and separating the legs from a body portion of a crustacean, comprising:

- conveyor means for conveying a body portion of a crustacean having legs;
- cleaning means for cleaning the crustacean legs, the cleaning means cooperative with the conveyor means and including at least a pair of counter-rotatable brushes adapted to receive said legs therebetween for debris removal;
- cutting means for cutting cleaned legs from the body portion; and
- means for removing the body portion remaining on the conveyor means
subsequent to cutting.

The conveyor apparatus conveniently includes an endless loop of spaced apart hooks. The hooks are particularly useful to be positioned between the legs of the crab section at the underside of the body portion to which the legs are connected. This facilitates easy loading of the conveyor hooks by the operator. The hooks are preferably vertically disposed so that the legs are pendulant. It has also been found that by providing a conveyor such as that employed herein, cleaning of the conveyor is a much less difficult procedure than that which would be attributed to the spray bar conveyor system discussed herein previously.

The cleaning station provides the rotatable brushes and the conveyor is preferably inclined relative to the rotating brushes. It has been found that as the conveyor advances the crab sections which move through the counter-rotatable brushes of the cleaning station, a more effective cleaning is achieved. This occurs since the crab sections are advanced through a positive inclination from about 5° to about 40° along the brushes and therefore the legs are progressively scrubbed from directly adjacent the body portion to the tip of the legs prior to severing the legs from the body portion. As will be appreciated, this facilitates site specific scrubbing and ensures that substantially all of the debris is removed from the legs prior to severance from the body. The result is a much more desirable product which is inherently more vendible.

The counter rotatable brushes may be independently driven or may have an indirect linkage to the conveyor. This will depend upon the size of the apparatus and other user requirements.

Turning to the brushes, the same preferably extend a substantial distance along the length of one side of the conveyor and between the hooks of the conveyor. The spacing between the brushes will be such that the legs are
somewhat tensioned as they are scrubbed to achieve effective scrubbing and further, to maximize the amount of leg length prior to the cutting operation. In this manner, a maximum amount of leg length results to increase the product yield and the economy of the method.

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In accordance with a further aspect of the present invention, there is provided an automated apparatus for separating the legs from a body portion of a crustacean, comprising:

an endless loop conveyor of the individual hooks in spaced relation for receiving the legs and a body portion;

drive means for driving the loop;

a cleaning station for receiving and cleaning the legs, the cleaning station including at least a pair of counter-rotatable brushes for scrubbing the legs and simultaneously applying tension to the legs during rotation of the brushes;

a cutting member for cutting the legs from the body portion; and

at least one rotatable member for removing body portions remaining subsequent to a cutting operation.

In a further aspect of the present invention, there is provided an automated apparatus for cleaning debris from the legs of a crustacean, the crustacean having a body portion comprising:

conveyor means for conveying the body portion having the legs;

drive means for driving the conveyor means;

a cleaning station for receiving and cleaning the legs, the cleaning station including at least a pair of counter-rotatable brushes for scrubbing debris from the legs; and

a dislodging member for dislodging cleaned legs from the conveyor means.

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In order to manage the wastage from the process, the apparatus includes
a member for removing body portions that remain subsequent to a cutting
operation. Advantageously, the individual hook portions of the conveyor facilitate
simple removal of the body portion into a collecting bin or container. One
embodiment of an apparatus for removing the body portions from the hooks of the
conveyor comprises a rotatable brush for dislodging the body portion from the
hooks. This form of the apparatus not only serves to dislodge the body portion,
but also cleanses the hooks of the conveyor for reloading.

The method of practising the present invention has been found to
significantly reduce labour involvement and financial requirements and
accordingly, in a further aspect of one embodiment of the present invention, there
is provided a continuous method for separating crustacean legs from a portion
body of the crustacean, comprising the steps of:

conveying, with a conveyor, the crustaceans legs into contact with cleaning
means, the cleaning means comprising at least a pair of counter-rotatable
brushes adapted to receive the legs therebetween;

removing surface debris from the legs with the cleaning means;
applying tension to the legs simultaneously during cleaning; and
cutting the legs under tension to separate the legs from the body portion.

In another aspect of the present invention there is provided a continuous
method for cleaning and separating crustacean legs from a body of the
crustacean, comprising the steps of:

conveying the crustacean legs into contact with at least a pair of counter-
rotatable cleaning brushes adapted to receive the legs therebetween;
cleaning the legs with the brushes;
applying tension to the legs during the cleaning step; and
cutting the legs while under tension.
It is preferable the brushes rotate along an axis having a generally common plane and the tensioning step elongates the legs away from the body.

Desirably, the legs are rinsed during said cleaning step, the legs are progressively scrubbed as the legs pass between the brushes during the cleaning step.

It is also preferable the above method includes the further step of collecting the cut legs subsequent to the cutting step and the further step of discharging the body of the crustacean subsequent to the cutting step where the crustacean legs are pendulant during the conveying step.

In another aspect of the present invention, there is provided an automated apparatus for cleaning and cutting legs on a body of a crustacean, comprising:

- conveyor means for conveying the body;
- cleaning means having a pair of counter-rotatable brushes adapted to receive the legs therebetween and cooperative with the conveyor means for cleaning the legs of the body and for applying tension to the legs; and
- cutting means for cutting the legs from the body while the legs are under tension.

It is desirable, the brushes are rotatable on an axis having a generally common plane and the brushes elongate the leg away from the body during rotation simultaneously effecting a tension.

Preferably, the conveyor means comprises an endless loop of individual hooks in spaced relation, the hooks are vertically disposed, and are interdigitated
with said legs for the legs to pendulantly distend between the hooks.

Further, it is desirable the conveyor means is angularly inclined relative to the cleaning means

Moreover, it is further desirable the conveyor means is angularly inclined at an angle from about 5° to about 40° relative to the cleaning means.

It is preferable the cleaning means further includes rinsing means for rinsing loosened debris from the legs and the apparatus further includes discharge means for collecting said cleaned legs after cutting.

Having thus described the invention, reference will now be made to the accompanying drawings illustrating preferred embodiments, and in which:

Figure 1 is a top plan view of the apparatus according to one embodiment;
Figure 2 is a side view of Figure 1;
Figure 3 is a sectional view along line 3-3 of Figure 2;
Figure 4 is an enlarged view of the cutting operation of the present invention; and

Figure 5 is a similar view to Figure 2 illustrating a further embodiment. Similar numerals denote similar elements.

Referring now to the drawings, Figure 1 illustrates a top plan overall view of the apparatus globally denoted by numeral 10. The apparatus 10 comprises an elongate conveyor generally denoted by numeral 12 which is operated by a single operator, denoted by numeral 14.

Figure 2 illustrates a side elevational view of the apparatus 10 in greater detail. The conveyor 12 comprises an endless loop of hooks 16 to which are
mounted to a typical chain drive (not shown). The hooks 16 are particularly useful to be positioned between the legs 38 of the crab section at the underside of the body portion 40 to which the legs 38 are connected. This facilitates easy loading of the conveyor hooks 16 by the operator. The hooks 16 are preferably vertically disposed so that the hooks are interdigitated between the legs 38 which legs 38 are pendulant. It has also been found that by providing a conveyor 12 such as that employed herein, cleaning of the conveyor 12 is a much less difficult procedure. The chain drive (not shown) is driven by a drive motor 18 at one end of the apparatus 10 by a drive sprocket (not shown). The conveyor 12 provides an idler pulley motor 20 having a pulley (not shown) for receiving the chain drive referred to herein previously. The conveyor 12 is mounted in cooperative relation to a cleaning station 22, the cleaning station 22 including a supporting frame 24. The cleaning station 22 provides a pair of counter rotating brushes 26 which brushes 26 are rotatably driven by motor 28. Motor 28 imparts rotation to sprockets 30 and 32 (shown more clearly in Figure 1) by a chain or belt 34 communicating between motor 28 and sprockets 30 and 32. The brushes 26 are positioned in relatively close relation and are positioned between the hooks 16 of conveyor 12.

The relationship referred to herein above with respect to the brushes 26 is more clearly illustrated in Figure 3. The brushes 26 are particularly adapted for removing debris and unwanted material from crab portions 36 having legs 38 and body portions 40 positioned on the hooks 16 of conveyor 12. The brushes 26 are spaced to effectively scrub the legs 38 of the crab portions 36. The brushes 26 of cleaning station 22 are substantially horizontal relative to the disposition of the conveyor 12. It has been found that if the conveyor 12 is disposed at an angle relative to the brushes 26 from about 5° to about 40° relative to the brushes, the legs 38 of the crab portions 36 are progressively cleaned from the body portions 40 through to the tips of the legs 38. In order to assist further with the removal of debris (not shown), the cleaning station 22 may include a water dispenser 42 for
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rinsing the crab portions 36 as they pass through the brushes 26.

As the crab portions 36 pass longitudinally along the counter rotating brushes 26 by way of the action of the conveyor 12, the brushes 26 impart a tension to the legs 38 such that the same are slightly elongated while in position on hooks 16. This procedure is not only useful to ensure positive scrubbing of the legs 38, but also prepares the portions 36 for cutting while maximizing the effective length of leg to be cut thus avoiding unnecessary wastage and enhancing the product yield for the amount of leg 38 removed.

Figure 4 illustrates the final stages of the operation prior to cutting the legs 38 from the body portions 40. Once the legs 38 have been tensioned, a cutting mechanism 44 (shown schematically in Figure 4 and more clearly in Figure 2) severs the legs 38 from the body portion 40. The free legs 38 are then collected in a suitable container 46. The cutting mechanism 44 may comprise a circular saw, band saw or other suitable cutting mechanism, conveniently positioned between and under brushes 26.

Regarding the body portions 40, the same remain on hooks 16 of conveyor 12 until such time that they are moved into location for contact with a dislodging member 48. The dislodging member 48, in the example, comprises a rotatable brush selectively movable between adjacent hooks 16. The brush rotates and effectively lift to dislodge the body portions 40. The dislodged body portions are then collected in a suitable container (not shown).

The arrangement discussed herein is subject to substantial variation. It will be readily appreciated by those skilled in the art that the longitudinal brushes 26 may be separate, longitudinally disposed brushes or be segmented into several different brushes. Additionally, there may be a plurality of pairs of brushes depending upon the size of the apparatus 10 and intended volume of
product to be processed.

Further possible variations on the apparatus, shown in Figure 2, would include a reversal of the angular relationship between the brushes 26 and the conveyor 12. In this manner, the brushes 26 may be angularly disposed relative to a substantially horizontal conveyor system without any detriment to the efficiency of the apparatus or method of employment.

As a variation from Figure 2, Figure 5 illustrates an embodiment of the apparatus 10 where a discharge chute 50 is positioned in place of cutting mechanism 44. This embodiment would be useful where the user does not intend to sever the legs from the body portions, but rather simply requires the legs to be cleansed by brushes 26 and the crab portion 36 eventually removed by dislodging member 48. The discharge chute 50 would then be useful to collect dislodged portions 36.

Although embodiments of the invention have been described above, it is not limited thereto and it will be apparent to those skilled in the art that numerous modifications form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.
THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. An automated apparatus for cleaning and separating the legs from a body portion of a crustacean, comprising:
   conveyor means for conveying a body portion of a crustacean having legs;
   cleaning means for cleaning said crustacean legs, said cleaning means cooperative with said conveyor means and including at least a pair of counter-rotatable brushes adapted to receive said legs therebetween for debris removal;
   cutting means for cutting cleaned legs from said body portion; and means for removing said body portion remaining on said conveyor means subsequent to cutting.

2. The apparatus as set forth in claim 1, wherein said conveyor means comprises an endless loop of individual hooks in spaced relation.

3. The apparatus as set forth in claim 2, wherein said hooks are vertically disposed.

4. The apparatus as set forth in any one of claims 1 to 3, wherein said cleaning means further includes rinsing means for rinsing loosened debris from said legs.

5. The apparatus as set forth in any one of claims 1 to 4, wherein said brushes, during rotation, simultaneously effect a tension on said legs to elongate said legs.

6. The apparatus as set forth in claim 2 or claim 3, wherein said means
for removing said body portions comprises a rotatable dislodging member for dislodging residual body portions from said hooks.

7. The apparatus as set forth in claim 6, wherein said dislodging member comprises a rotatable brush.

8. The apparatus as set forth in any one of claims 1 to 7, further including means for collecting cut legs.

9. The apparatus as set forth in any one of claims 1 to 8, wherein said conveyor forms an angle of about 5° to about 40° with said brushes.

10. An automated apparatus for separating the legs from a body portion of a crustacean, comprising:
    an endless loop conveyor of individual hooks in spaced relation for receiving said legs and a body portion;
    drive means for driving said loop;
    a cleaning station for receiving and cleaning said legs, said cleaning station including at least a pair of counter-rotatable brushes for scrubbing said legs and simultaneously applying tension to said legs during rotation of said brushes;
    a cutting member for cutting said legs from said body portion; and
    at least one rotatable member for removing body portions remaining subsequent to a cutting operation.

11. The apparatus as set forth in claim 10, wherein said endless loop conveyor is inclined relative to said cleaning station such that said conveyor diverges upwardly away from said brushes of said cleaning station.

12. The apparatus as set forth in claims 10 or 11, wherein said brushes
comprise discrete elongate brushes extending from about 10 percent to about 60 percent on the length of a side of said conveyor.

13. The apparatus as set forth in any one of claims 10 to 12, wherein said conveyor forms an angle of from about 5° to about 40° with said brushes of said cleaning station.

14. An automated apparatus for cleaning debris from the legs of a crustacean, said crustacean having a body portion, comprising:
   conveyor means for conveying said body portion having said legs;
   drive means for driving said conveyor means;
   a cleaning station for receiving and cleaning said legs, said cleaning station including at least a pair of counter-rotatable brushes for scrubbing debris from said legs; and
   a dislodging member for dislodging cleaned legs from said conveyor means.

15. The apparatus as set forth in claim 14, wherein said conveyor means comprises an endless loop of vertically disposed individual hooks in spaced relation.

16. The apparatus as set forth in claim 14 or 15, wherein said conveyor means is angularly inclined relative to said brushes of said cleaning station.

17. The apparatus as set forth in any one of claims 14 to 16, wherein said brushes effect a tension on said legs of said crustacean during rotation elongating extension of said legs.

18. The apparatus as set forth in any one of claims 14 to 17, wherein said cleaning station further includes rinsing means for rinsing loosened debris
from said legs.

19. The apparatus as set forth in any one of claims 14 to 18, wherein said cleaning station further includes a cutting member for cutting said legs from said body portion.

20. The apparatus as set forth in claim 19, wherein said cutting member is adapted to cut said legs from said body portion when said legs are elongated.

21. The apparatus as set forth in any one of claims 14 to 20, further including a discharge chute for receiving cleaned legs.

22. A continuous method for separating crustacean legs from a portion body of said crustacean, comprising the steps of:
   conveying, with a conveyor, said crustacean legs into contact with cleaning means, said cleaning means comprising at least a pair of counter-rotatable brushes adapted to receive said legs therebetween;
   removing surface debris from said legs with said cleaning means;
   applying tension to said legs simultaneously during cleaning; and
   cutting said legs under tension to separate said legs from said body portion.

23. The method as set forth in claim 22, wherein said step of conveying includes suspending said body portion from a hook conveying means to allow said legs to be pendulant.

24. The method as set forth in claim 23, wherein said hook conveying means comprises hooks interdigitated with said legs.
25. The method as set forth in any one of claims 22 to 24, wherein said step of removing the surface debris includes moving said legs into contact with counter rotating brushes to scrub said debris from said legs.

26. The method as set forth in any one of claims 22 to 25, wherein said brushes, during rotation, effect downward tension on said legs to maximize the length of leg available for cutting.

27. The method as set forth in any one of claims 22 to 26, wherein said cutting comprises simultaneously cutting all legs from said body portion.

28. The method as set forth in any one of claims 22 to 27, further including the step of removing residual body portions remaining in said conveyor subsequent to cutting said legs.

29. The method as set forth in claim 28, wherein said conveying means includes a series of hooks for suspending said body portions and said step of removing residual body portions includes urging a rotatable member between said hooks of said conveyor.

30. The method as set forth in any one of claims 22 to 29, further including the step of progressively scrubbing the length of said legs with said counter-rotatable brushes as said legs are advanced by said conveyor along said brushes.

31. The method as set forth in any one of claims 17 to 30, further including the step of rinsing said legs while brushing.

32. The method as set forth in any one of claims 22 to 31, further including the step of collecting said body portions.
33. The method as set forth in any one of claims 22 to 32, further including the step of collecting said cut legs.

34. A continuous method for cleaning and separating crustacean legs from a body of said crustacean, comprising the steps of:

conveying said crustacean legs into contact with at least a pair of counter-rotatable cleaning brushes adapted to receive said legs therebetween; cleaning said legs with said brushes; applying tension to said legs during said cleaning step; and cutting said legs while under tension.

35. The method as set forth in claim 34, wherein said brushes rotate along an axis having a generally common plane.

36. The method as set forth in any one of claims 34 to 35, wherein said tensioning step elongates said legs away from said body.

37. The method as set forth in any one of claims 34 to 36, wherein said legs are rinsed during said cleaning step.

38. The method as set forth in any one of claims 34 to 37, wherein said legs are progressively scrubbed as said legs pass between said brushes during said cleaning step.

39. The method as set forth in any one of claims 34 to 38, further including the step of collecting said cut legs subsequent to said cutting step.

40. The method as set forth in any one of claims 34 to 39, further including the step of discharging said body of said crustacean subsequent to said cutting
41. The method as set forth in any one of claims 34 to 40, wherein said crustacean legs are pendulant during said conveying step.

42. An automated apparatus for cleaning and cutting legs on a body of a crustacean, comprising:

   conveyor means for conveying said body;
   cleaning means having a pair of counter-rotatable brushes adapted to receive the legs therebetween and cooperative with said conveyor means for cleaning said legs of said body and for applying tension to said legs; and
   cutting means for cutting said legs from said body while said legs are under tension.

43. The apparatus as set forth in claim 42, wherein said brushes are rotatable on an axis having a generally common plane.

44. The apparatus as set forth in claim 42 or claim 43, wherein said brushes elongate said leg away from said body during rotation simultaneously effecting a tension.

45. The apparatus as set forth in any one of claims 42 to 44, wherein said conveyor means comprises an endless loop of individual hooks in spaced relation.

46. The apparatus as set forth in claim 45, wherein said hooks are vertically disposed.
47. The apparatus as set forth in claim 45 or 46, wherein said hooks are interdigitated with said legs for said legs to pendulantly distend between said hooks.

48. The apparatus as set forth in any one of claims 42 to 47, wherein said conveyor means is angularly inclined relative to said cleaning means.

49. The apparatus as set forth in any one of claims 42 to 48, wherein said conveyor means is angularly inclined at an angle from about 5° to about 40° relative to said cleaning means.

50. The apparatus as set forth in any one of claims 42 to 49, wherein said cleaning means further includes rinsing means for rinsing loosened debris from said legs.

51. The apparatus as set forth in any one of claims 42 to 50, wherein said apparatus further includes discharge means for collecting said cleaned legs after cutting.