RTL

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Beef Aitchbone & Knuckle Puller Production Prototype

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Abstract

RTL has been developing a manual assistance device to aid in the pulling of beef aitchbones and knuckles. This is showing great promise, with the basic test rig greatly reducing worker strain and the finished product being of an extremely high standard offering the potential benefit of yield improvement. Feedback from Australian and New Zealand Meat Processors has identified improvements to be made in developing a commercial version of the Puller.

The purpose of this project is to complete the development of the Aitchbone & Knuckle Puller. The items required to complete the development are:

- Replace the gripper with a boning-hook style device
- Replace the existing controls with proportional controls more simply operated by the boner
- Re-configure the frame structure to a frame which moves alongside a boning chain
- Install the Puller into a beef boning room and trial its operation

Executive Summary

RTL has developed a manual-assistance device for the pulling of aitchbones and knuckles on beef butts. The device is able to be integrated with existing boning chains, and has the further benefit of providing precise control of speed and force with minimal effort from the Boner.

The prototype has been installed in the boning chain at PPCS Belfast, and has been largely in full production since early September.

The prototype has significantly reduced the amount of strain on the Boner, and has also provided PPCS with yield benefits. It also potentially reduces the skill level necessary to do the task.

PPCS, NCMC and Teys are all interested in purchasing machines.

Contents

1 Purpose and description

RTL has been developing a manual assistance device to aid in the pulling of beef aitchbones and knuckles. This is showing great promise, with the basic test rig greatly reducing worker strain and the finished product being of an extremely high standard offering the potential benefit of yield improvement. Feedback from Australian and New Zealand Meat Processors has identified improvements to be made in developing a commercial version of the Puller.

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The Australian Processors involved felt that the main aim of automation in the short term should be to reduce the heavy labour nature of the boning tasks with the aims of reducing the worker injuries, and opening up the industry to a greater spectrum of the workforce (i.e. the tasks will not require such muscular people). By concentrating on a manual assistance device, rather than full automation, the industry is able to gain confidence in the pathway forward, and Scott/RTL is able to get a good understanding of the industry, and the nature of the tasks. The hindquarter was chosen because there is commonality here between both quarter-boning and side-boning plants, and because this is the highest value portion of the carcass (hence there is a greater return from any yield gain achieved). Aitchbone and Knuckle pulling were identified as two of the most physically demanding tasks.

Currently, nearly every process in the beef industry utilises manual labour. Mechanical assistance is provided in the form of small hand-held saws or bandsaws for example. The boning of the buttock in particular is performed in most plants solely by skilled Boners, using nothing more than a knife and a hook. Most of the tasks in this region (particularly the removal of the aitchbone and the knuckle) are performed using a small amount of strategically positioned knife cuts and a large amount of manual pulling by the boners. This approach has 4 main disadvantages:
1. It is physically very difficult. (This has the added problem of reducing the potential labour pool, at a time when it is becoming increasingly difficult to maintain the required workforce level in the meat processing industry).
2. The quality varies between Boners, and at different times of the day or week.
3 It gives rise to a large amount of Health and Safety issues, in particular OOS.
4. The skill level required of the task is high

The adoption of a mechanical puller will reduce the physical problems of the boning task, and will increase the consistency of the quality. Another possible advantage will be an increase in yield, as the machine is able to produce a greater pulling force than a Boner can, thereby reducing the amount of cuts necessary to free the bone/muscle. Furthermore, it is expected that a lower level of training will be required to bone using the puller.
After the demonstration of the project outcomes to the Australian processing sector, it is

anticipated that the device will be offered for commercial sale to the Australian Beef Boning Industry.

2 Background

In February 2006, a group of Australian Beef processors (Gary Burridge, Gary Thomas, Michael Nolan, John Hughes and Greg O'Hare) came to visit RTL (a joint venture between Scott Technology Ltd and PPCS Ltd), along with MLA and AMPC. The aim of the visit was to explore possibilities for introducing automation into beef processing in a similar way to the automation RTL is developing for lamb processing. The outcome was a desire from the industry delegates to start down the automation track, but tempered with a degree of caution.

To that end it was decided to investigate a device for assisting Boners in physically demanding tasks, with the particular tasks chosen being aitchbone & knuckle pulling.

MLA and AMPC initially funded RTL to develop a prototype to demonstrate the basic pulling functions. This was successful in proving the concept of a reduced load on the Boner, as well

as indicating that a yield benefit may also be possible. Australian processors who viewed this

prototype indicated some reservations about its ability to be integrated with a boning chain – not part of the initial prototype development. The project was cancelled before completion by the AMPC technical committee.

Following the initial project, MLA entered into the current funding agreement with RTL to complete the development of a production-suitable prototype. Gary Burridge of NCMC has been involved in the project, giving an Australian industry perspective during the production prototype development.

3 Project Outcomes

General Outcomes

• The hook system was trialled and proven in isolation. This system has the hook and handle mounted to a push-pull cable, and from there to a 5-port pneumatic valve. The

hook is connected to the inner cable, which is connected to the valve spool, and from there connected to the Puller arm. The handle is connected to the cable outer sleeve, which is connected to the valve body. Moving the handle up and down actuates the valve, which actuates a cylinder on the Puller arm – handle up for upwards movement, and handle down for downwards movement. The pulling force is then transmitted through the inner cable to the hook. The valve was further modified to give graduated flow as it is moved, rather than the standard on-off control, thereby giving the Boner full control of the pulling speed. A further benefit of the cable is that it gives a high degree of flexibility to the Boner, although this can also be a slight disadvantage with the hook then “flopping over” when not in use, forcing the Boner to reach for it. However, more rigid outers are also available.

• A carriage system was developed, in which the carriage is designed to be run alongside existing overhead chain conveyors. By latching onto the chain pusher, the carriage can be driven by the chain and hence tracks the carcass motion. It is then unlatched at the end of its stroke by means of a cam track, and the carriage is driven back to the next chain pusher by a pneumatic cylinder.

• A vertical spindle attached to the carriage gives the vertical motion, with a pneumatic cylinder being used to drive this up and down. The Puller arm is then mounted from the bottom of this, along with the hook system.

• The prototype as described above was installed at the end of the main boning chain at the PPCS Belfast plant, where it could be used for all product in a full production sense, but was out of the way when not in use – especially useful for a prototype. However, the prototype showed high promise at this point, and was therefore shifted into the standard on-line position further up the chain.

• PPCS have used the prototype largely in full production since early September. While there have been the inevitable teething problems, PPCS have embraced the technology, and have gained significant benefits from it. In particular, the Puller has significantly reduced the amount of strain on the Boner – to the extent that they have been able to use

a Boner who was on light-duties while awaiting an elbow operation. Furthermore, yield benefits have been realized (refer 4.2).

• Gary Burridge (NCMC) and John Hughes (Teys) have both since visited Belfast to view the Puller. John brought with him the Teys Boner who has operated the Proman derived Puller that John developed, in order for the Boner to try out the Puller and get a direct comparison. Both John & Gary have shown their support for the concept, and while both of them want to see some variations to it, these are largely enhancements rather than concept changes. Refer 5.1.

4.2. Yield Benefits

PPCS's experience with the Puller is a definite improvement to yield. It has been said that Australian beef boning operations achieve a higher yield than their New Zealand counterparts. However, even for operations where the manual yield is very high, the Puller can offer improvement both from the long-term consistency of operation, and the ability to easily employ less skilled staff.

PPCS's aitchboning yield data is shown below. Full knuckle pulling trials are not expected until PPCS purchases a further Puller (refer 5.1), but early indications were of a significant improvement to the yield of the higher value cuts adjoining the knuckle (topside, outside etc).

To put the results above in perspective, a plant processes ~ 85,000 animals per year (single Boning Chain). Using the results in the top row:

85,000 carcasses x 2 sides x 0.142kg x $4.53/kg = $109,354 benefit per year.

4.3. Issues Encountered

Issues encountered were only of a minor technical nature. A selection of these is shown below:

• Push-pull cable design: the cable has to be designed carefully to avoid binding of the control motion when offset loads are applied.

• The assumption that the loading of the Puller would be similar to manual boning proved to be incorrect. It was found in trials that the operator was using up to 120kg

force to pull heavy bull aitchbones – far in excess of what is possible manually. (Note, these are pasture-grazed animals – grain-fed are expected to be even harder to pull). What this indicates is that the Boner is able to treat the tougher animals in a similar way to the easier ones, giving the advantage of less cutting, and hence a cleaner finish. Unfortunately, it also resulted in the Puller being subjected to loads in excess of what it was designed for. The main casualty of this was the hook cable, which was only rated for 70kg force. This can easily be upgraded in future models.

• The valve spool also proved to be a weak link. Occasionally, the Boner would struggle to free a heavy aitchbone from the hook after the bone was released from the butt. The weight of the bone would subsequently pull the cable over and snap the spool. Again, this can easily be upgraded.

• Plastic-tyred wheels were used on both the horizontal carriage and the vertical spindle as a means of transmitting the linear motion. While these were very effective, the vertical spindle in particular looks prone to getting meat and other debris flicked inside it where it is difficult to clean. To that end, it is likely that future models will use plastic bushes instead, which would seal up the spindle opening.

4.4. Learnings

The main learning from this project is that if processors are to be involved in the development at all, then they need to be involved right throughout the development process. This has the twin effects of ensuring that as wide a perspective as possible is gained, and generating the buy-in of the processors involved.

4.5. IP Protection

RTL has two patent applications in place as a result of the Puller development: NZ552206 and NZ560540. The latter reflects some variation in the design which came out of later development. It is anticipated that the two applications will be amalgamated into one when the complete specification is filed.