REPORT ON MANUFACTURING PROCESS OF BALER FOR COLLECTION OF STRAW

Square Hay Baler

Round Hay Baler

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ABSTRACT

The term "hay baler" refers to a specific agricultural tool utilized in the process of harvesting hay. Hay, consists of various grasses and legumes such as Timothy Grass, alfalfa, and clover, is a common crop used as animal feed. When the green hay reaches a height of approximately 18 inches (46 cm), it is cut using a mowing machine which not only cuts the forage but also crimps it, breaking the stems and making the hay more appetizing for cattle. The cut hay is then discharged into a windrow, which is a 4-feet (1.2 m) wide row. To ensure proper drying, a hayrack is employed to turn the hay over and the dry hay is then gathered by the baler, compressing it into either square or round-shaped bales which are easy for transportation and storage.

A Garud Hay Baler at work in an agricultural field

INTRODUCTION

HAY BALER

Hay balers are vital and essential agricultural machines used to collect and bundle hay in the field. They are designed to be pulled behind and powered by tractors. To ensure smooth operation, hay balers are equipped with flotation tires that help distribute their weight over a larger area allowing reduced damage caused to the hay stubble during the baling process.

When operating the baler, the tractor pulls the baler pickup, which consists of a horizontal spool of moving steel teeth. This pickup is aligned with the windrow, which is the line of hay that has been cut and left to dry in the field. As the tractor moves forward, the pickup collects the hay and feeds it into the baling mechanism. Simultaneously, the PTO drive engages, providing the necessary power to form the hay into tightly compressed bales.

Bales are widely used in the following industries:-

- Paper Industry
- Sugarcane Industry
- Cattle fodder Boiler
- Power Plant
- Bio Fuels

MANUFACTURING PROCESS OF A SQUARE HAY BALER MACHINE:-

The manufacturing process of a square hay baler involves several steps to ensure the production of a high-quality and efficient machine.

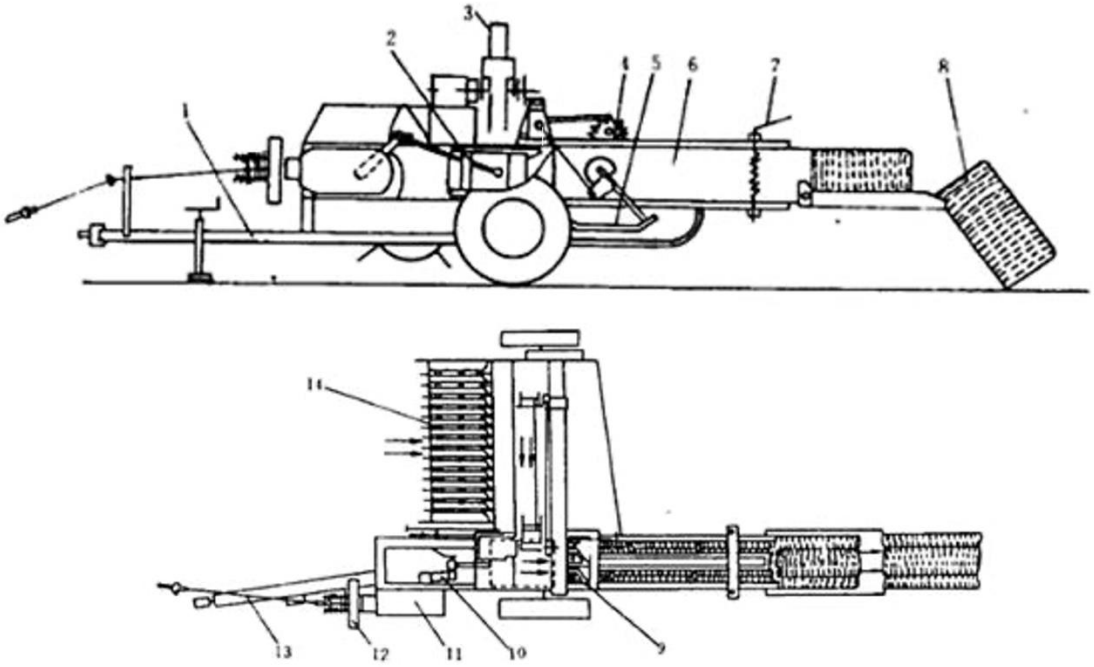
- **Design and Planning:** Engineers and designers work together to create a blueprint of the square hay baler, taking into consideration factors such as size, capacity, and functionality.
- **Material Selection:** Selection of appropriate materials for construction. High-quality steel is used for the frame and structural components, while durable materials like rubber and nylon are chosen for belts and moving parts.
- **Cutting and Shaping:** Materials are cut and shaped according to the specifications outlined in the design by using cutting machines, welding equipment, and other tools to ensure precision and accuracy.
- **Assembly:** The main structure of the square hay baler is assembled by attaching the frame, installing the hydraulic system, and mounting the various mechanical components such as the pick-up mechanism and baling chamber.
- **Testing and Quality Control**: The square hay baler undergoes rigorous testing to ensure proper functioning. This includes checking the hydraulic system, testing the pick-up mechanism, and verifying the baling chamber's performance. Any defects or issues are identified and rectified during this stage.
- **Painting and Finishing:** The square hay baler is prepared for painting and finishing and this involves cleaning, sanding, and applying a protective coating to enhance durability and appearance.
- **Packaging and Shipping:** The machine is carefully packaged to ensure safe transportation to the customers and this involves disassembling certain components, securing them in crates, and labelling them for easy identification.

Overall, the manufacturing process of a square hay baler requires careful planning, precise execution, and stringent quality control measures to produce a reliable and efficient machine that can effectively bale hay for agricultural purposes

COMPONENTS OF A SQUARE HAY BALER:-

A rectangular baler consists of several essential functional components. These units work together to efficiently create rectangular bales. Let's explore each of these components individually:

- **PTO (Power Take-Off):** A mechanical device that transfers power from the tractor's engine to the baler and provides necessary rotational force to operate the baler's various components.
- **Pickup and Elevating Unit:** Gathers the crop material from the ground, elevating it into the baler, consists of rotating pickup tines or belts that collect the crop and transfer it to the next stage.
- **Feed Conveyor:** Receives the crop material from the pickup unit, transporting it towards the compression chamber while ensuring a continuous flow of crop material into the baler and preventing any interruptions during the baling process.
- **Feeder:** Receives the crop material from the feed conveyor, evenly distributes it into the compression chamber while ensuring consistent bale density.
- **Compression Chamber:** The central component of the baler where the actual baling process takes place. Plunger or piston mechanisms exert pressure to compact the crop material tightly to form rectangular bales.
- **Tying Mechanism:** Responsible for binding the bale with twine or wire, this efficiently secures the bale to maintain its shape.
- **Knotter System:** Responsible for tying the bales with twine or wire this ensures that the bales remain intact to allow easily handling.
- **Bale Ejector:** This component pushes the bales out of the baling chamber and onto the ground, where they can be collected and stored.
- **Control System:** This allows the operator to monitor and adjust settings thus controlling the feeding speed, bale density, and knotter operation while ensuring efficiency and production of high-quality bales.

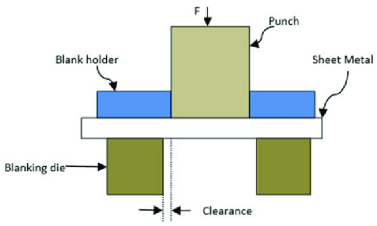


Rectangular pick up baler

1. Tow beam
2. Piston
3. Conveying and feeding equipment
4. Bale length controller
5. Needles
6. Compression chamber
7. Bale density adjuster
8. Bale
9. Needle and tying system
10. Crank
11. Main gear box
12. Flywheel
13. Universal joint gearing axis
14. Pick-up reel

STEPWISE MANUFACTURING PROCESS OF A SQUARE HAY BALER:-

1. CUTTING THE SHEET METAL



Punching Process of metal sheet

Laser Cutting of metal sheet

Cutting of Bar Stock steel

The process of manufacturing the outer skin, covers, and shields of the baler involves using either a large punch press or a laser cutter to punch or cut out these components from sheet steel. Punch presses are operated by applying immense force, up to 200 tons, to force a hardened steel punch through the material and into a hardened die. This action shears the metal to the desired size, and the rapid stroke of the punch press enables the production of numerous parts per hour.

For more intricate shapes and low-volume parts, an industrial laser is used to burn through the metal in a pre-programmed pattern. Although the laser cutter is slower compared to the punch press, it significantly reduces material waste by optimizing the arrangement of part shapes to effectively utilize the sheet size.

Bar stock steel, commonly employed for constructing frames, shafts, arms, and various structural components, undergoes cutting using a band saw. This type of saw is equipped with toothed cutting blades that are driven by two sizable wheels. The wheels continuously rotate and propel the blade, enabling it to effortlessly slice through the bar. Once the steel is cut to the desired length, additional processes such as drilling, punching, or milling are employed to create holes and slots in the parts as necessary.

2. WELDING

Welding by a human operator

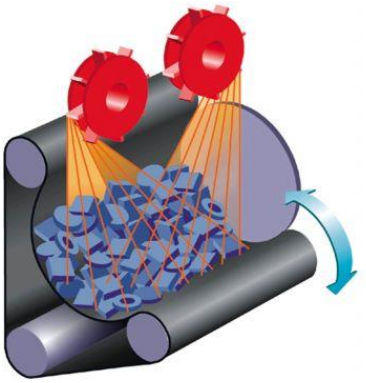
Robotic Welding Process

To begin the welding process, the various components to be welded are securely clamped into a large welding fixture by a human operator. The robot then extends a short piece of welding wire from the welding gun. Prior to initiating the welding current, the wire gently makes contact with a computer sensor, which accurately determines the exact position of the wire tip. This initial contact serves as a reference point for the subsequent welding process.

The robot proceeds to touch the tip of the wire to multiple points on each of the components being welded. These touches are not only physical but also serve as a means of transmitting data to the computer. By gathering information about the exact location of the components in relation to the desired weld location, the computer program can make slight compensations for any deviations from the ideal position.

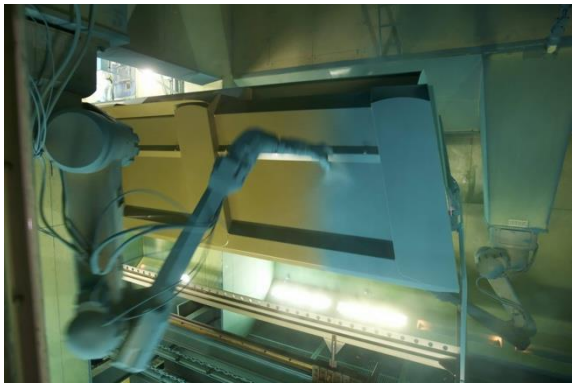
Once this data gathering process is complete, the welding current is activated, and the wire is fed into the arc. Simultaneously, the robot moves the welding gun along the joint, ensuring that the welds are precisely placed and achieve maximum strength. This meticulous control over the welding process helps to avoid welding any misplaced or incorrect parts, minimizing scrap and potential machine failures.

3. CLEANING AND PAINTING



Shot Blasting

A person painting the machine parts



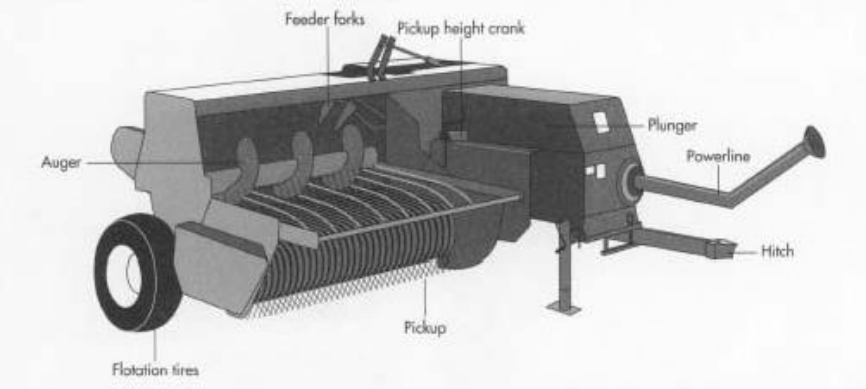
Industrial Painting of large components

Shot-blasting and painting a tractor-drawn hay square baler involves a process that aims to enhance the durability, appearance, and performance of the equipment. Shot-blasting is a technique used to clean and prepare the surface of the baler by propelling small abrasive particles at high speeds. This process removes rust, old paint, and other contaminants, ensuring a clean and smooth surface for painting.

After shot-blasting, the baler is ready for painting. The painting process involves applying a protective coating to the surface that provides a barrier against corrosion and damage from external elements. The paint is typically a high-quality, weather-resistant paint that withstands harsh conditions that the baler may encounter during operation.

The painting process may involve multiple layers of paint, including a primer, base coat, and topcoat, ensuring proper adhesion and coverage. The baler may also undergo additional treatments, such as sanding or filling, to address any imperfections before painting.

4. ASSEMBLY



The frame of the baler is now carefully placed onto a wheeled cart. This cart allows for easy movement and assembly of the baler at different work stations. At each station, specific components are added and quality checks are performed to ensure smooth production.

To secure the various parts in place, the hydraulics, pickup tines, bale tensioners, knotters, and subassemblies are bolted together. The design of the baler incorporates special hole patterns, tabs, pins, notches, and other features that prevent incorrect assembly or positioning of the parts.

Once the assembly is complete, the hydraulic systems are filled with oil, and the belt and chain tensions are adjusted to ensure optimal performance. Additionally, the bearings are greased to reduce friction and promote smooth operation. The tire and wheel assemblies are then mounted, and identifying decals and stickers are attached to the baler.

Due to the potentially hazardous nature of the machine, numerous warning labels are affixed to caution operators to keep their hands away from the moving parts. These labels serve as a reminder of the importance of safety when operating the baler.

5. INSPECTION AND ADJUSTMENTS

Inspection and adjustments are crucial for the efficient operation of a tractor-drawn hay square baler. Regular maintenance helps ensure that the baler functions optimally, resulting in high-quality hay bales. Here are some key areas to focus on during the inspection and adjustment process:

- **Knotter Mechanism:** The knotter mechanism is responsible for tying the bales. Inspect the knotter components for any signs of wear or damage. Check the twine tension and adjust it if necessary. Lubricate the knotter parts to prevent friction and ensure smooth operation.

- **Bale Chamber:** Examine the bale chamber for any obstructions or debris that may hinder the formation of square bales. Clear out any accumulated hay or foreign objects to maintain proper bale compression and shape.
- **Plunger and Feeder System:** Inspect the plunger and feeder system for any signs of wear or misalignment. Ensure that the plunger moves smoothly and evenly, without any jerking or sticking. Adjust the feeder system to ensure consistent hay flow into the bale chamber.
- **Bale Length and Density:** Measure the length and density of the produced bales. Adjust the bale length according to your desired specifications. If the bales are too loose or too tight, make appropriate adjustments to the density control mechanism.
- **Belts and Chains:** Check the condition of the belts and chains that drive the baler's components. Look for signs of wear, damage, or loose connections. Replace any worn-out or damaged parts to maintain proper power transmission and prevent breakdowns.
- **PTO and Hydraulic Systems:** Inspect the power take-off (PTO) and hydraulic systems for leaks, loose connections, or damaged components. Ensure that the PTO shaft is properly lubricated and securely attached to the tractor. Check the hydraulic fluid level and top it up if necessary.
- **Safety Features:** Verify the functionality of all safety features, such as emergency stop buttons, safety shields, and warning decals. Replace any missing or damaged safety components to ensure safe operation.

6. QUALITY CONTROL

Quality control is an essential aspect of the manufacturing process for tractor-drawn hay square balers. These machines are used in the agricultural industry to efficiently bale hay, ensuring its preservation and ease of transportation.

To ensure the highest level of quality, several measures are taken throughout the manufacturing process. The first step involves the selection of high-quality materials. Only durable and reliable components are used to construct the balers, ensuring their longevity and performance. This includes selecting robust metal frames, high-quality bearings, and sturdy hydraulic systems.

Once the materials are sourced, the manufacturing process begins with rigorous inspections at each stage. Skilled technicians closely monitor the assembly of the balers, checking for any defects or inconsistencies. This includes inspecting welds for strength and integrity, ensuring proper alignment of components, and verifying the accuracy of measurements.

During the assembly process, various tests are conducted to assess the functionality and performance of the balers. These tests include checking the hydraulic system for leaks, evaluating the effectiveness of the baling mechanism, and testing the overall stability and manoeuvrability of the machine.

In addition to these tests, the finished balers undergo comprehensive quality control inspections. These inspections involve a detailed examination of each component, ensuring that they meet the required specifications and standards. This includes checking the tightness of bolts and fasteners, verifying the smooth operation of moving parts, and assessing the overall structural integrity of the baler.

PRODUCT DETAILS:-

Brand	GARUD	**No. of Rollers**	10
Usage/Application	Agriculture & Farming	**Roller Diameter(cm)**	15
Material	Mild Steel	**No. of Protrusion**	6
Features	Paper Industry, Sugarcane Industry, Cattle fodder, Boiler Power Plant, Bio Fuels	**Roller Drive**	Chain Drive
Country of Origin	Made in India	**Bale Density Control**	Level adjustable
Inside Width(cm)	105	**Bale Density Indication**	Mechanical lever & buzzer indication
Flare Width(cm)	108	**Bale Ejection**	Hydraulic Cylinder
Bale Diameter(cm)	50	**Baling Twine Material**	Jute
Width(cm)	105	**Height of pickup tines from ground**	Max. 50mm
Bale Length(cm)	180	**Area Coverage (bales/hour)**	Max. 80
Bale Width(cm)	125	**Drive Protection**	Shearbolt
Bale Height(cm)	116	**PTO Speed (rpm)**	540
Bale Weight(kg)	Max. 22	**Weight(kg)**	553
Making of Bales	Paddy straw/sugarcane/maize/hay	**Tractor (hp) cat i & ii**	Max. 45
No. of Hynes Bar	4	**Tractor Clutch**	Dual Clutch
Bale Forming Chamber Type	Fixed	**Tractor Speed**	5km/hr