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Center pivot and lateral move irrigation system

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ABSTRACT

Our country India is an agricultural country. About 70% of total population of India is directly and indirectly depend upon agriculture of or their livelihood and other similar needs. Tremendously increasing population of our country has put an extraordinary stress on the farming sector. The climatic conditions of South Asia is dependent upon Monsoon and our country is under full influence of it. Therefore, availability of water to crops at the time of requirement is an indispensible thing to get maximum production of crops to meet the food production target of the nation. At this stage it becomes unrealistic to depend solely upon natural source of water i.e rain. Hence at that time artificial irrigation comes to the scenario. Presently in India, Drip & Sprinkler irrigation are being practiced. This method represents one of such modern method of irrigation which has yet to fetch an attention of Indian farmers. The Centre Pivot method of irrigation is unique methodology to irrigate crops in circular pattern. This method may also referred as overhead sprinkler irrigation, waterwheel irrigation or circle irrigation.

Keywords— *Centre pivot, Water requirement of crop, Sprinkling system, Uniformity*

1. INTRODUCTION

Center-pivot irrigation was invented in 1940 by farmer Frank Zybach who lived in Strasburg, Colorado it was recognized as a method to improve water distribution to fields. Centre Pivot irrigation is a form of overhead sprinkler irrigation consisting of several segments of pipes joined together by trusses to support each other. The whole assembly is mounted on tires due to which it rotates in circular manner around a central point known as Pivot Point. The space between two tires is known as Span. The arm of the system is connected with number of pipes at fixed intervals of horizontal distance between them are known as sprinklers. The average quantity of water from sprinkler can be controlled by Control Unit. Various modifications in the system have done time to time to achieve optimum performance from the original concept of the system and to suit various topographical and climatic conditions of different locations of the world. The Centre Pivot irrigation comes under the category of Self Propelled irrigation system and in USA about 29% of the total irrigation is achieved by such self-propelled system of irrigation.

1.1 General concept

The machine moves in a circular pattern, and is fed with water from the pivot point at the center of the circle. The water is usually pumped from a source such as a well or a river. The pump is connected to the pivot at the pivot point. The outside set of wheels covers the greatest distance and thus sets the master pace for the rotation. The inner sets of wheels are mounted at hubs between two segments and use angle sensors to detect when the bend at the joint exceeds a certain threshold (the wheels should be rotated to keep the segments aligned). Most center pivots irrigate a circular area a quarter-mile (0.4 kilometer) in radius, although some can cover a larger area. Center pivots are typically less than one-third of a mile (0.5 kilometer) in length.

2. WORKING OF CENTER PIVOT IRRIGATION SYSTEM

Centre Pivot irrigation system connected with a fixed Pivot point (Fixed Tower) containing water supply point and power source around which other spans and towers rotates. The main components of the machine are self supporting frame spans (Truss structure) containing water delivery pipes. The pipe spans are supported at each end by a tower (lateral lines composed of sections) that incorporates gear boxes, drive wheals (Wheel-drive mechanism) by an electric motor. Sprinklers are attached directly to sockets on the main pipes suspended closer to the crop on flexible droppers. Flexible mechanical and hydraulic coupling ensures flexing, rotating and twisting of joints and spans can travel overland contours and obstacles. The machine works in such a way that the lateral line irrigates a circular area by rotating around a central, fixed pivot point. Water is supplied to the pivot point through an underground pipeline from a water source (tube well). This system is propelled by electric motors located on each

wheel-drive mechanism. Power for the pivot is supplied by an underground cable which conveys electric power from a commercial source to the center pivot.

Fig. 1: Center Pivot System

2.1 Linear move irrigation system

The linear move (sometimes called a lateral move) irrigation system is built the same way as a center pivot with moving towers and spans of pipe connecting the towers. The main difference is that all the towers move at the same speed and in the same direction. Water is pumped into either one of the ends or into the center. Water can be supplied to the linear system either through a canal, by dragging a supply hoses, which is connected to a main line, or by connecting and disconnecting from hydrants as the linear moves down the field. The lateral movement makes it difficult to power a linear move sufficient with electricity. Usually, a diesel motor with a generator is mounted on the main drive tower and supplies the power needed to operate the irrigation system. The primary advantage of the linear is that it can irrigate rectangular fields up to a 625 m along and 312.5 m wide. Due to the high capital investment cost, linear are used on high value crops.

Fig. 2: Linear move system

3. PARTS OF THE CENTER PIVOT SYSTEM

The typical center pivot system consists of a single long irrigating pipeline attached to a central tower that moves slowly over the field in a circular pattern and irrigates the plants with sprayers, or sprinklers placed on it at frequent spacing's. The central tower, which houses the pivot mechanism and main control panel (electric), is anchored to a small concrete base at a fixed the center of the field. The entire irrigating pipeline is supported above ground by "A"-frame towers that move on wheels, long spans, steel trusses and/or cables. The outside end of the pipe is sometimes overhung with a sprinkler end gun. The whole system is self-propelled and rotates slowly, at a typical speed (for the outermost span) of two to three meters per minute around the fixed pivot. It applies water to the field in the form of overhead spray irrigation and covers the irrigated area in a circular pattern.

3.1 Central tower and span

At the center of the circular field, an anchored tower holds up one end of system and provides flexible joints that allow 360 degrees of movement for both water pipes and electrical wires (see Figure. Water and power are supplied to the system at the pivot point. Buried pipe delivers water from a nearby pond, river, or other source. Electric utilities may deliver power by means of buried wires, or power may be generated on-site by a generator attached to a diesel-, propane-, or gas-fueled engine. For irrigation systems supplied by pumped water, that engine may also drive the well pump by a drive shaft, or the generator may supply electricity to an electric well pump.

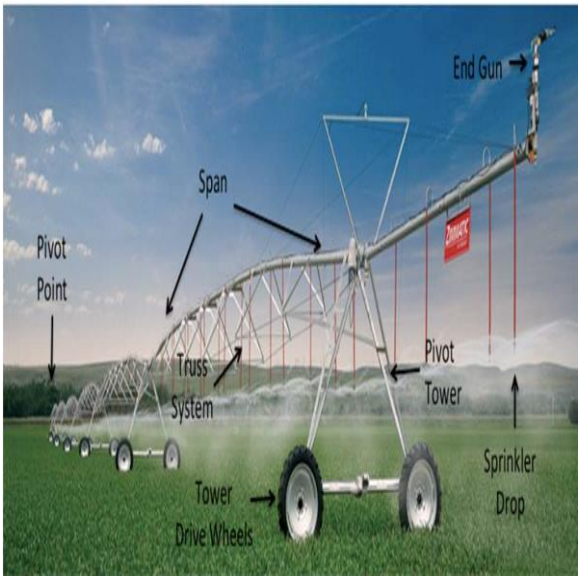

Fig. 3: Central Tower

3.2 Control panel

The control panel is the user interface for the center pivot irrigation system. Control panel technology ranges from very basic to very advanced. The primary functions of the control panel are to energize the system, select forward or reverse travel direction, and to select pivot travel speed by the percent timer setting. The entry-level basic control panels from center pivot manufacturers provide those functions and little else. Control panels at the advanced end of the spectrum incorporate more features into the package, including auto-reverse, auto-stop, digital displays, end gun controls, the ability to control pivot angles, auxiliary controls, corner catcher controls, auto-speed, programming capabilities, touch screen controls, and remote monitoring and control.

3.3 Sprinklers

Sprinklers are the devices that actually deliver the water to the plant and/or soil. The purpose of a sprinkler is to distribute the water uniformly over an area in droplet form. In order to cover a large area, a sprinkler must propel water a considerable distance. A properly-designed sprinkler "package" will take many factors into account, including water supply, soil, crop, topography, and atmospheric conditions. Center pivot systems use both high-pressure, impact-type sprinklers and low-pressure, spray-type sprinklers.

Fig. 4: Sprinkler

3.4 Pivot end guns

End guns are large impact sprinklers that are, as the name applies, located at the far end of the center pivot. The addition of that much distance to the existing radius of the pivot-irrigated circle substantially increases the field area that the pivot can water.

4. ADVANTAGES OF CENTER PIVOT SYSTEMS

- Soil needs not to be in level because water flowing over the ground is not due to gravity effect.
- Rubber tyres with moderate shock absorbing arrangement make the system suitable even for undulating field.
- Indian farmer often suffer from shortage of labour power so this system proves best because almost no labors are involved for operating.
- Herbicides, pesticides and soluble nutrient can be directly fed to each plant.
- Since water washes the leaves of the plant so reduces the chances of diseases
- Irrigation effectiveness by giving suitable quantity of water required to top of the soil wetness to the wanted level.

5. DISADVANTAGES OF CENTER PIVOT SYSTEMS

- Very large initial cost in involved.
- If proper service and maintenance is not taken then the system may lead to breakdown.
- Heavy constituent of salt may lead to blockages of sprinkle nozzles which may lead to frequent replacement of them.
- For clayey soil care has to be taken so as wheel does not stuck in the muddy wet soil.

6. APPLICATION

- All type of crops (eg: sunflower, soybean etc)
- Vegetables
- High height crop like sugarcane, cotton plant etc.
- Spraying the chemical fertilizer on the crops.

7. CONCLUSIONS

From this study the following conclusions:

- Centre Pivot Irrigation systems was assembled satisfactory by local experts if the necessary tools are made available.
- High values of coefficient of uniformity, distribution uniformity and water application efficiency are obtainable if the instructions in the operation manual are adhered to particularly the nuzzling chart (nuzzling adjustment).
- Reduce the farmer or operator effort for irrigation.
- The centre pivot has the ability to operate under different rotational speeds and this makes it flexible to apply water according to crop watering requirement (different growth stages or different crops).

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