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New Concept in Coal Feeders

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Eine neue Kohle-Austragsvorrichtung
Une nouvelle installation de décharge du charbon
Un nuevo descargador de carbón

給炭機における新しい概念

煤炭进料器的新概念

مفهوم جديد في أنظمة تلقيم الفحم

Summary

The development of a new machine for feeding coal from storage to pulverising mills is presented. The paper covers the historical background giving rise to the need for such a device, the factors taken into account in its design, how the machine meets the current market need and the implications for the future.

1. Introduction

Coal handling has recently become a highly topical subject due mainly to the resurgence of interest in coal as a fuel and chemical feedstock. This upsurge has occurred as a result of dramatically increased world oil prices during recent years. Over the last 15 to 20 years developments in coal handling have essentially been confined to the mining and raw material preparation areas of the minerals processing industry which have different needs to those of the coal burning and processing sectors. As industry is currently considering the benefits of using coal instead of oil or gas, handling requirements fall basically into two separate categories, generally based on the quantites of coal consumed:

— Industrial and institutional coal burning installations in the main feed coal to boilers in its original as bought form. The systems utilised have their own handling requirements which will become more complex as economic factors demand the use of lower and varying grades of coal.

— The high volume users, such as the power generating industry, pulverise their coal before firing. The distinction between the two methods of coal firing is not new and the various types of equipment required to handle the coal have developed separately. The particular requirements of the pulverised fuel firing system are the subject of this case study.

For pulverised fuel firing a buffer stock of coal is held in bunkers. From there it is fed into pulverising mills and thence to the burners either directly or indirectly via further storage. This case study deals with the design of the particular piece of equipment used to convey the coal from the bunkers and feed it at the required rate to the pulverising mills.

Redler Conveyors Ltd. have supplied coal feeders for this application for many decades. Throughout the 1950s and 1960s there was a continual demand for such machines from the Central Electricity Generating Board (CEGB) and similar organisations both in the UK and throughout Europe. This demand diminished somewhat in later years in line with the decline in the fortunes of coal, but now it is reappearing as coal stages its comeback.

The original Redler coal feeder was the result of a joint design exercise between Redler Conveyors Ltd. and Foster Wheeler Ltd., England, for the CEGB's new generation of high capacity power stations. The design was based on the Redler *en masse* chain conveying system. One characteristic of this system is that it provides a very accurate volumetric measurement of the material it is conveying, the volume measured being directly proportional to the speed of the chain and the cross-sectional area of the material being conveyed. By keeping this cross-sectional area constant and linking the drive speed to the loading in the pulverising mill, the correct quantity of coal is consequently fed to the mill.

2. Feeder Design

As a result of the above renewed interest in the coal feeder, Redler decided that a detailed reappraisal of the design was necessary. It soon became apparent that today's design requirements differed in several respects from those 15 years ago. For example, health and safety legislation and the increased cost of maintenance place different demands on the machinery. The capital cost has to be minimised and the costs of labour and materials have changed dramatically.

Because of the nature of the product being handled, the present day major design requirement is for all equipment between the coal storage bunkers and the burners to be capable of being able to withstand an explosion of an intensity that varies depending upon the location of the equipment. In the case of the coal feeder, an explosion pressure of 3.5 kg/cm² is the requisite desired design specification.

Routine maintenance must of course be kept to a minimum and emergency repairs must be capable of being undertaken rapidly.

The above requirements naturally made a complete re-think of the design of the coal feeder a necessity.

The original Redler coal feeder was in essence a conventional *en masse* chain conveyor with a rectangular casing incorporating strengthening ribs to provide the necessary resistance; the

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casing was also used to contain the coal. Not only was such a construction expensive to produce but its pressure resistance capability gradually reduces with time due to the wearing effect of the moving coal. The conveying chain was carried on four sets of wheels set at the four corners of the casing (Fig. 1).

This arrangement, whilst allowing for a greater depth of casing, caused to double the necessary number of articulations of the chain, thus increasing the wear rate, which in turn required a chain tensioning operation to be undertaken more frequently.

The basic problem, therefore, was how to deliver a constantly variable, but controlled quantity of coal to the pulverising mills, with a machine which was able to withstand the pressures required and that was also both easy to maintain and simple in construction.

Additionally the machine had to be able to handle coal of varying quality and moisture content.

A major design problem, therefore, was how to achieve the necessary structural strength cheaply and at the same time prevent wear from reducing this strength.

Previously the strength requirement had been met by a massive stiffening of the conveyor casing, but this obviously did not in any way overcome the wear problem.

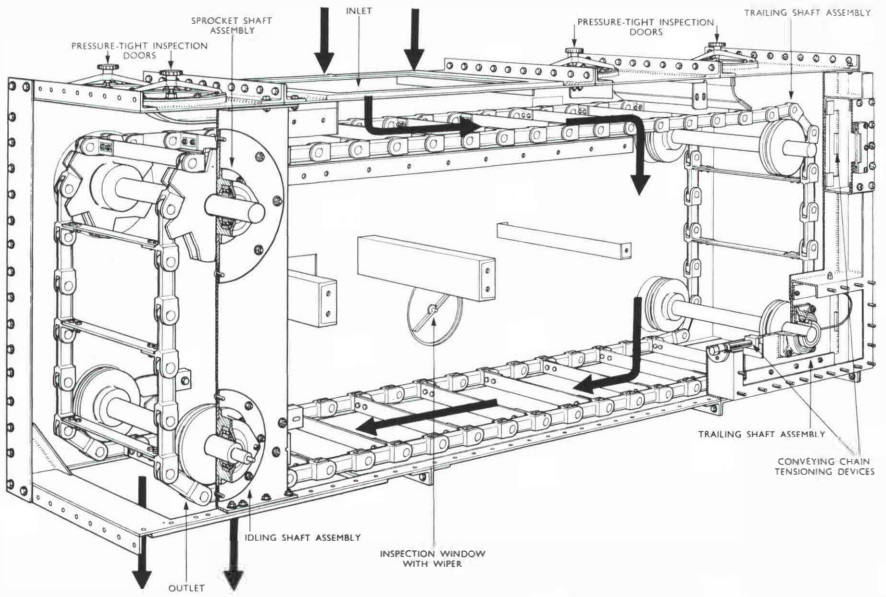

Fig. 1: General arrangement of the original coal feeder showing direction of coal flow

3. New Design Concept

Towards the end of 1979 a new coal feeder design evolved which had at its heart the utilisation of a cylindrical casing to provide the capability of containing the requisite pressures, as the *hoop strength* of a cylinder against internal pressure such as would occur in a dust explosion, made this an attractive proposition.

The quantity of material utilised in its construction and the necessary manufacturing time showed considerable potential savings. The new machine was more compact with the ends of the tube sealed by stiffened flat plates carrying inspection hatches.

Once this concept had been accepted, it was then necessary to design the inside of the feeder so that the coal when handled would be kept out of contact with the outside casing, thus overcoming any problems associated with wear. This latter design requirement was met by conveying the coal in a series of trays which were designed in such a manner as to minimise the abrasive effect of the coal moving over them, and the corrosive effect on them of wet coal which could conceivably remain in the feeder for a period of weeks during a shutdown. To facilitate maintenance, the trays were mounted on slides for easy removal.

The conveying chain itself uses improved materials in its construction and is carried on only two wheels so that wear is minimised. With the same object in mind the chain was designed to be driven by a sprocket located immediately after the feeder inlet. Hence, the shortest possible length of chain is subjected to the maximum load required to shear the static coal in the feeder inlet. Previous feeders worked in the opposite direction (Fig. 1).

Inevitable chain tensioning requirements are handled by using an automatic constant tension mechanism. This works on a hydraulic accumulator charged with grease, which itself exerts a constant tension on the chain through a lever system to a yoke on the chain wheel (Fig. 2).

The only maintenance requirement is the occasional charge of grease through the normal grease gun when the accumulator pressure drops. The tensioning system has the added merit of ensuring that the shaft assembly is always at exactly the correct angle relative to the conveying chain.

The driving shaft bearings are mounted on flanges external to the tubular casing and the complete shaft, bearing

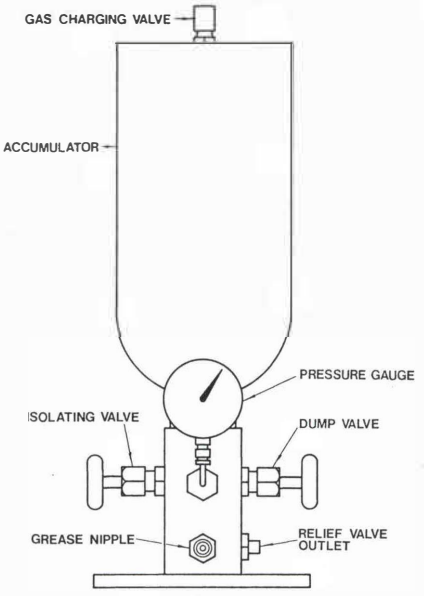

Fig. 2: Schematic view of the hydraulic tension accumulator

and sprocket assembly can be withdrawn from either side of the casing through one of the flanges for easy maintenance.

The overall dimensions of the feeder and the range of handling capacities and capabilites of the machine had to be designed to facilitate easy incorporation into existing and new installations.

To achieve this objective, the inlet of the feeder can be designed to suit hoppers from 0.6 to 2.5 m long with a maximum capacity range of 10—60 t/h and a drive unit speed range of 28:1.
The whole feeder unit can be mounted either on the floor or suspended from

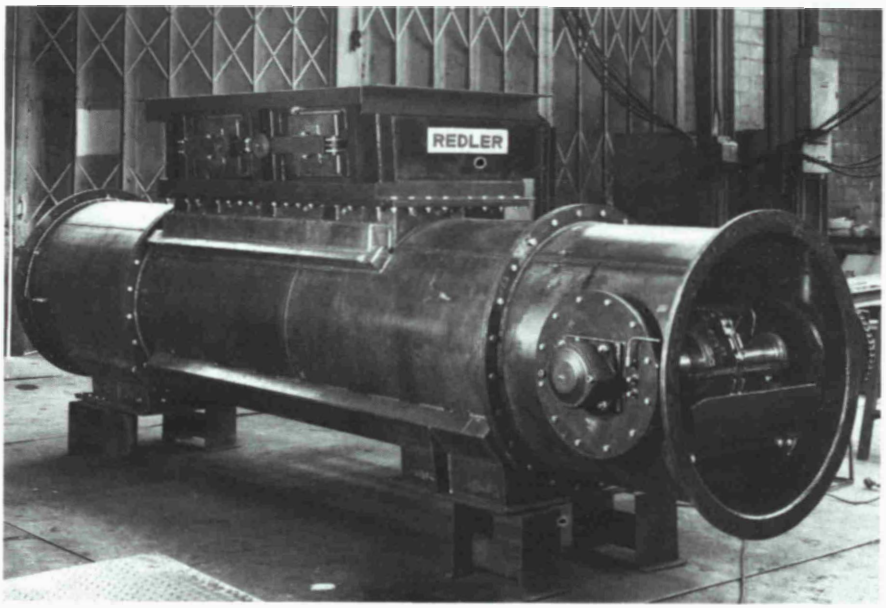

Fig. 3: Redler cylindrical coal feeder

the coal bunker itself and machine length can be varied to suit any installation requirement.

4. Performance Trials

Performance and operational trials have recently been completed in the form of an initial unit installed at Alcan UK in Lynemouth, England. Design through to commissioning was achieved in less than ten months from original conception. As a result of the tests undertaken at Alcan UK the final design has now evolved and Redler Conveyors are now well advanced with the manufacture of 24 such coal feeders which will be supplied to the Indian processing industry.

5. Final Comment

The original problems have all been overcome and the new design (Fig. 3) meets the very stringent health and safety legislation requirements, optimises expensive maintenance requirements, is versatile in its application and is considerably cheaper than its predecessor.