

AN IMPROVED BELT SCRAPER MOUNTING

5 FIELD OF THE INVENTION

The present invention in general relates to belt scrapers for its application in bulk material handling belt conveyors and in particular, to an improved belt scraper mounting with increased cleaning efficiency, which is easy to install and possess auto adjustment mechanism, requires no maintenance for a long period and has reduced operational and cleaning cost.

BACKGROUND OF THE INVENTION

15 Belt Scrapers are used in bulk material handling belt conveyors to avoid material carry back, reduce spillage and keep belt clean. Clean belts help prevent material build up on snub pulley and return rollers and increase its life, thereby reducing cleaning cost, downtime cost and mis-tracking of the belt.

In first generation Counter weight belt scraper, single blade design is made from thick rubber strip (wider than belt width) under the return belt and the counter weight provided at the side of the belt scraper with a pivot point to provide contact with the belt. The initial load exerted to the belt is approximately 80 – 90 Kgs. With time when the cleaning effectiveness reduces, the weight is increased and it can go up to 150 Kgs.

Cleaning efficiency is approx 60-68 % and always, it is needed to increase counter weight load on a regular basis against blade wear. It is very less effective and high maintenance is involved.

Second generation fixed mount belt scraper's segmented blades module are made of hard alloy steel with rubber cushion at the bottom of blade mounted on a steel tube with both end fixed mount. It does not have automatic adjustments against blade wear. It provides
5 inconsistent contact pressure to the belt which is approximately 100 – 125 Kgs.

Cleaning efficiency is approx 70-85 % and always, there is need to lift-up of the fixed mount on a regular basis against blade wear. It is less effective and high maintenance involved.

10 Pneumatically operated third generation belt scraper having segmented blades module are made of hard alloy steel with or without polymer cushion at the bottom mounted of blade on a steel tube with ratchet and pinion mount and adjustment done through compressed air at 7-10 bars pneumatically. They provide inconsistent load to the
15 belt of approximately 90 – 110 Kgs.

Cleaning efficiency is approx 75-85 %. There is a need to pump air periodically to maintain the blade to belt contact due to drop in air pressure / leakage / chocking of air. Maintenance requirement is high.

In fourth generation belt scrapers with shock absorber which acts as
20 semi automatic adjustments to some extent but, there is a need for periodic manual adjustments against blade wear in every 3 - 4 weeks interval. This type of belt scrapers have segmented type metallic blades module with pivot point below the scraping edge mounted on a steel tube with both ends rubber shock absorber. It provides
25 comparatively less load to the belt, which is approximately 24 - 80 Kgs.

Cleaning efficiency is approx 92-95 %. It provides less consistency against heavy duty, high speed, vibration and bi-directional belt operation.

Accordingly there was a long felt need to design belt scraper mountings which are maintenance free and long lasting and facilitates automatic adjustment in the field of bulk material handling conveyor systems to meet the increasing belt capacity (tonnages), higher belt speed and heavy duty of belt with wider belt conveying system.

The present invention meets the aforesaid long felt need.

- 10 All through out the specification including the claims, the words "conveyor belt", "scraper blade" "scraper holding arm", "spring", "washer", "stud", and "nut" are to be interpreted in the broadest sense of the respective terms and includes all similar items in the field known by other terms, as may be clear to persons skilled in the art.
- 15 Restriction / Limitation if any, referred to the specification, is solely by way of example and understanding the present invention.

OBJECTS OF THE INVENTION

- 20 It is the principal object of the present invention to provide an improved belt scraper mounting which is maintenance free and provide long lasting cleaning efficiency & facilitates automatic adjustment in the field of bulk material handling conveyor systems to meet the increasing belt capacity (tonnages), higher belt speed and duty of belt
- 25 with wider belt conveying system.

It is another object of the present invention to provide an improved belt scraper mounting system possessing higher efficiency of belt cleaning compared to the contemporary belt scrapers.

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It is yet another object of the present invention to provide an improved belt scraper mounting system which provides easy and flexible installation.

- 5 It is a further object of the present invention to provide an improved belt scraper mounting which provides auto adjustment mechanism and compensate the need of varying loads to maintain contact with the belt.
- 10 It is a further object of the present invention an improved belt scraper mounting system which requires absolutely no maintenance for a very long period.

- It is another object of the present invention to provide an improved
- 15 belt scraper mounting system possessing reduced operational and cleaning cost.

- It is another object of the present invention to provide an improved belt scraper mounting system which possesses & confirmed precision
- 20 belt cleaning.

- It is yet another object of the present invention to provide an improved belt scraper mounting system which completely eliminates sagging of scraper assembly permanently and confirmed precision belt cleaning
- 25 continuously.

- It is another object of the present invention to provide an improved belt scraper for its application in bulk material handling conveyor systems, which is equipped with automatic scraper adjustment against
- 30 blade wear and does away with the need for manual lifting of scraper fixing mount in an upward direction towards the belt to compensate blade wear.

How the foregoing objects are achieved and the other aspects of the present invention will be clear from the following description which is purely by way of understanding and not by way of any sort of limitation.

SUMMARY OF THE INVENTION

Accordingly, the present invention provides an improved belt scraper mounting for belt conveyors having conveyor frame / stringer, comprising : a scraper blade module assembly and a means for holding said blade module assembly with said conveyor frame / stringer on both sides of said belt scraper, said means being adapted to function in an auto adjusting mode.

In accordance with preferred embodiments of the belt scraper mounting of the present invention:

-said means comprises of an upper dynamic spring adjuster and a lower dynamic spring adjuster;

-said belt scraper works in the range from 300 mm and 3200 mm of belt width and said upper dynamic spring adjuster and said lower dynamic spring adjuster together constitute a dynamic auto adjusting scraper fixing mount;

-said upper and lower dynamic spring adjuster are operatively adapted to be connected with a scraper holding arm through a long stud, said blade module assembly being mounted on said scraper holding arm and said scraper holding arm being kept in position by means of a step washer;

-said auto adjusting mount comprises of a pair of helical springs in which said lower spring has higher suspension stability than said upper spring;

- 5 -said dynamic auto adjusting scraper fixing mount is adapted to hold a circular tube scraper blade module assembly;

- said dynamic auto adjusting scraper fixing mount is adapted to hold a square / rectangular / triangular or any other cross-section tube
10 scraper blade module assembly;

-one helical spring is placed above said scraper holding arm and another helical spring is placed below said scraper holding arm and are kept in position by means of washer and nut arrangement.

- 15 -said nut arrangement comprises shoulder nuts adapted to be compressed by 30 mm in either direction, so as to ensure stability against belt velocity / precision cleaning.

- 20 The present invention also provides a method for applying a belt scraper for bulk material handling belt conveyors having conveyor frame / stringer, in the manner such as herein described, a scraper blade module assembly and a means for holding said blade module assembly with said conveyor frame / stringer on both sides of said belt
25 scraper, said means being adapted to function in an auto adjusting mode.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

- 30 The nature and scope of the present invention will be better understood from the accompanying drawings, which are by way of

illustration of some preferred embodiments and not by way of any sort of limitation. In the accompanying drawings,

Figure 1 illustrates a perspective view of the improved belt scraper mounting in accordance with a preferred embodiment of the present invention.

Figure 2 illustrates a detailed sectional view of the improved belt scraper mounting according to a preferred embodiment of the present invention.

Figure 3 illustrates a sectional view of the circular tube scraper blade module assembly holding.

Figure 4 illustrates a sectional view of the square tube scraper blade module assembly holding.

Figure 5 illustrates the method of precision belt cleaning with the improved belt scraper mounting of the present invention.

Figure 6 illustrates sagging of belt scraper assembly known in the art.

Figure 7 illustrates the efficiency curve achieved by the improved belt scraper mounting of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The following describes some preferred embodiments of the present invention, which are purely for the sake of understanding the performance of the invention, and not by way of any sort of limitation.

As stated before the present invention primarily aims at providing improved belt scrapers mounting system which is maintenance free and long lasting and facilitates automatic adjustment in the field of bulk material handling conveyor systems to meet the increasing belt capacity (tonnages), higher belt speed and heavy duty of belt with wider belt conveying system.

Belt Scrapers generally consist of two different major parts namely,

- a) Scraper Blade module Assembly and
- b) Scraper Fixing Mount.

Scraper Blade module Assembly: It is mounted on a steel tube by means of nuts and bolts and placed under the belt to touch and clean the belt surface.

Scraper Fixing Mount: It holds the scraper blade module assembly against the belt both sides of the tube to the conveyor stringer frame by means of nuts and bolts. Thus, there is no automatic scraper adjustment against the blade wear hence, always need manual lifting of scraper fixing mount upward direction towards the belt to compensate the blade wear.

In the present invention the existing scraper fixing mount is replaced by dynamic auto adjusting mount. This feature is indispensable for the invention.

Figure 1 illustrates a perspective view of the improved belt scraper in accordance with a preferred embodiment of the present invention. The entire belt scraper assembly wherein the scraper blade module is in contact with the conveyor belt is provided in the said figure. As shown in the figure the scraper holding arm (4) on which the scraper blade

module (3) is mounted and kept in position by a heavy duty upper dynamic spring adjuster (1) located above it and another heavy duty lower dynamic spring adjuster (2) located below it.

- 5 To meet the growing market demand of maintenance free and long lasting automatic adjustment of Belt Scraper in the field of bulk materials handling conveyor systems and to meet the increasing belt capacity (tonnages), higher belt speed and duty of belt with wider belt conveying system, the present invention thus provides an automatic
10 and long lasting vibration and maintenance free belt scraper suspension for the belt width 300 – 3200 mm.

The improved belt scraper automatic adjusting mount in the present invention, primarily consists of:

- 15
- 1) Heavy Duty Upper Dynamic Spring Adjuster (1)
 - 2) Heavy Duty Lower Dynamic Spring Adjuster (2)
 - 3) Step Washer (5), Stud (6) and so on as described hereinafter.
- 20 The accompanying figure 2 illustrates a more detailed sectional view of the improved belt scraper mounting showing its different components as according to a preferred embodiment of the present invention. As shown in the figure the springs (1,2) are kept in position by a couple of flat washers (5,5') on either side of the spring and tightened by means
25 of a lock nut (7,7') arrangement. The scraper holding arm is kept in position by means of a step washer (8). The springs (1, 2) are affixed on the conveyor frame by means of a stud (6).

The figure 3 shows a circular tube scraper blade assembly, while in
30 figure 4, the same is square. It is to be understood that the dynamic auto adjusting scraper fixing mount of the belt scraper mounting according to the present invention, is adapted to hold a square /

rectangular / triangular or any other cross-section tube scraper blade module assembly.

In the present invention the improved belt scraper holds the existing
 5 blade module assembly with the conveyor frame / stringer. The dynamic spring assembly (1,2) with scraper holding arm(4) inserted through a long stud, boost the existing scraper blade module assembly to a new high degree of cleaning efficiency continuously while in touch with the belt surface in suspension / floating condition, even after the
 10 scraper blades modules gets worn-out. Thus, it delivers vibration free precision belt cleaning for a long period without any manual adjustment / servicing.

Design Calculations involved in said improved belt scraper as according
 15 to the present invention with a few hypothetical parameters is illustrated as follows:

Load Calculation for 1000 mm Belt Width Scraper
 (Material Specification: EN 45).

20 Force (F) = Load due to scraper assembly weight + Load due to belt velocity + Load due to pressure given by the blade + Load of upper spring,

25 $F = (F1 + F2 + F3 + F4)$
 $F1 = (45 - 2 \times 6.1) \times 9.81 = 322 \text{ N.}$

$F2 = (\text{Power transmitted by the motor} / \text{Belt velocity}) \cos 60^\circ \times \cos 30^\circ.$

30 $F3 = 8 \times 5 \times 9.81 = 393 \text{ N.}$

$F4 = \text{Max. } 1800 \text{ N (Consider as per design).}$

35 So, $F = (322 + F2 + 393 + 1800) = (2515 + F2) \text{ N.}$

Lower Spring Calculation:

40 Let consider, W = Design the spring at max. load of 5000 N [for Safety Purpose].

Free Length of Spring = 130 mm.

Length at Full Load = 100 mm.

Inner Dia. of Spring = 45 mm.

$$5 \quad \text{Shear Stress} = 8 \times F \times D / 3.14 d^3 \quad [\text{Allowable Shear Stress} = 450 \text{ N/mm}^2]$$

$$d = 10.74 \text{ mm.}$$

$$\text{Spring Index (C)} = 5.18$$

10

$$\text{Wahl's Correction Factor (K)} = (4C-1) / (4C-4) + 0.615 / C = 1.29$$

Therefore, Modified Wire Dia,

$$\text{Shear Stress} = K \times 8 \times W \times D / 3.14 d^3$$

$$15 \quad d = 12 \text{ mm.}$$

$$\begin{aligned} \text{Total Deflection} &= 8 \times W \times C^3 \times N / G \times d \quad [G = \text{Modulus of Ridity} = 84 \text{ GPa, } N = 7] \\ &= 30 \text{ mm.} \end{aligned}$$

20

$$\text{Spring Constant} = 5000 / 30 = 167 \text{ N / mm.}$$

Upper Spring Calculation:

25 Lets consider, W = Design the spring at max. load of 2700 N [for Safety Purpose].

Free Length of Spring = 80 mm

Length at Full Load = 50 mm.

Inner Dia. of Spring = 45 mm.

$$30 \quad \text{Shear Stress} = 8 \times F \times D / 3.14 d^3 \quad [\text{Allowable Shear Stress} = 450 \text{ N/mm}^2]$$

$$d = 8.75 \text{ mm.}$$

$$\text{Spring Index (C)} = 6.14$$

35

$$\text{Wahl's Correction Factor (K)} = (4C-1) / (4C-4) + 0.615 / C = 1.246$$

Therefore, Modified Wire Dia,

$$\text{Shear Stress} = K \times 8 \times W \times D / 3.14 d^3$$

$$40 \quad d = 10 \text{ mm.}$$

$$\begin{aligned} \text{Total Deflection} &= 8 \times W \times C^3 \times N / G \times d \quad [G = \text{Modulus of Ridity} = 84 \text{ GPa, } N = 5] \\ &= 30 \text{ mm.} \end{aligned}$$

45

$$\text{Spring Constant} = 2700 / 30 = 90 \text{ N / mm.}$$

Suspension Stability of Spring for 1000 mm Belt Width Scraper:

Downward Force Given by Upper Spring (M) = $90 \times 22 = 1980$ N.
[Upper Spring Compression is 22 mm].

Downward Force by Belt Conveyor due to Belt Velocity = $(10 \times 10^3 / 3) \cos 60^\circ \cos 30^\circ$ [Motor = 10 Kw, Belt Speed = 3 m/sec]
= 1445 N

Considering, Force Balance on One Side Spring. The above Force to be half of the Total Force.

So, Downward Force by Belt Conveyor due to Belt Velocity (N) = $1445 / 2 = 722$ N. [Load of half Scraper Wt = $50 / 2 = 25$ Kgs. of 1000 mm B/W]

Total Downward Force of Upper Spring (P) = (M + N + O) = $(1980 + 722 + 250) = 2952$ N.

Upward Force given by Lower Spring (Q) = $167 \times 14 = 2338$ N + Load of Rubber Suspension of Scraper [Wt = 125 Kgs. of 1000 mm B/W and Lower Spring Compression is 14 mm] = $2338 + 1250 = 3588$ N.

Total Upward Force of Lower Spring (Q) = 3588 N.

Suspension Stability of Lower Spring = R = $(Q - P) = (3588 - 2952) = 636$ N.

Therefore, Percentage of Suspension Stability of Lower Spring against Upper Spring = $(Q - P) / P \times 100 \% = 21.54 \%$.

The non-limiting advantages achieved by the improved belt scraper are as follows:

1. Easy / Flexible Installation.
2. Auto Adjustment / No Maintenance for a long period (12-16 Weeks min).
3. Confirm Precision Belt Cleaning (Clean up-to 0.05-0.1 mm thin layer of carry back).
4. High Cleaning Efficiency for a long period (12-16 Weeks min).
5. Reduced Operational and Cleaning Cost.

6. Presence of automatic adjustment against blade wear does away with the need for normal lifting of scraper fixing mount in upward direction, towards the belt to compensate the blade module wear.

The improved belt scraper mounting is very handy and suitable for all type of belt scrapers replacing the existing fixed mount assembly, unscrewing the nut / bolt. Also, it has an option for circular, square, rectangular or any other cross-section tube scraper blade module assembly holding facilities as shown in the accompanying figures 3 and 4 respectively.

Automatic Adjustment:

As stated before, the improved belt scraper has two dynamic helical spring assemblies (1,2) , one each is placed above and below the scraper holding arm with adjustable shoulder nuts (7,7') can be compressed by 30 mm max. in either directions and make them stable against belt velocity / precision belt cleaning (Shown in figures 1 and 2).

Since the lower spring having approx 20 % higher suspension stability than upper spring it always keep the scraper blade module (3) in touch with the belt surface (10) automatically, even after the blade module wear. Therefore, no maintenance is required for a longer period.

Precision / High Efficiency Belt Cleaning:

The improved belt scraper cleans the belt surface further to a new high degree of precision cleaning, to remove even inherent micro fines materials and moisture from the belt surface.

Also, it prevents sagging of existing scraper assembly due to its dynamic spring assembly design. Thus, cleaning efficiency increases up to a level of 99.5 % as shown in figure 7.

- 5 Figure 5 illustrates precision belt cleaning as performed by the improved belt scraper mounting of the present invention. It shows a belt scraper blade module assembly fitted with highly wear resistant tip brazed with its supporting base approximately 1mm above for the very minimal frictional contact with the belt surface at an angle against the
- 10 direction of belt. This ensures sharp and precision cleaning of inherent carry back materials and moisture from the micro contours of the belt surface efficiently. With the help of the improved belt scraper mounting according to the present invention the blade module tip is kept in position for a longer period ensuring unhindered performance
- 15 for a substantially long period of time.

Figure 6 illustrates sagging of existing belt scraper assembly. The

firmed line specifies the minor sagging of existing belt scraper assembly by approximately 3 ° two to three weeks after initial

20 installation. This sagging also to be prevented and firmed contact with the belt surface always to be maintained by using dynamic spring mounting assembly. The reference numeral (9) indicates the scraping edge initially after installation. The reference numeral (10) indicates the belt direction.

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The dynamic auto adjusting scraper fixing mount of the belt scraper mounting according to the present invention, is adapted to hold a square / rectangular / triangular or any other cross-section tube scraper blade module assembly;

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Reduced Operational and Cleaning Cost:

In the improved belt scraper the cleaning efficiency is enhanced by 14.5 % also preventing existing scraper assembly sagging, thereby
5 improving productivity and reducing manpower / maintenance cost. Figure 7 illustrates the efficiency curve achieved by the improved belt scraper of the present invention on trial run. It can be seen that even after eighteen weeks of usage, the efficiency is 98%. Comparatively, on running with 2nd / 3rd generation scrapers, after two weeks, the
10 efficiency has been found to be 75% only as compared to the initial efficiency of 85%. With 4th generation scrapers, after 4 weeks the efficiency has been found to 92% from 95% initially.

All blade module assemblies can be directly mounted with the improved version of the belt scraper according to the present
15 invention, to achieve automatic scraper adjustments with high belt cleaning efficiency, precision belt cleaning of 98-99.5 % for a longer period without any maintenance thereby, highly reduced carry back, manpower, downtime and increased productivity / reduced cost.

20 The present invention has been described with reference to some drawings and preferred embodiments, purely for the sake of understanding and not by way of any limitation and the present invention includes all legitimate developments within the scope of what has been described hereinbefore and claimed in the appended claims.

CLAIMS

- 5 **1.** An improved belt scraper mounting for belt conveyors having conveyor frame / stringer, comprising : a scraper blade module assembly and a means for holding said blade module assembly with said conveyor frame / stringer on both sides of said belt scraper, said means being adapted to function in an auto adjusting mode.
- 10 **2.** The improved belt scraper mounting as claimed in claim 1 wherein said means comprises of an upper dynamic spring adjuster and a lower dynamic spring adjuster.
- 15 **3.** The improved belt scraper mounting as claimed in claims 1 and 2 wherein said belt scraper works in the range from 300 mm and 3200 mm of belt width and said upper dynamic spring adjuster and said lower dynamic spring adjuster together constitute a dynamic auto adjusting scraper fixing mount.
- 20 **4.** The improved belt scraper mounting as claimed in claims 1 to 3 wherein said upper and lower dynamic spring adjuster are operatively adapted to be connected with a scraper holding arm through a long stud, said blade module assembly being mounted on said scraper
- 25 holding arm and said scraper holding arm being kept in position by means of a step washer.
- 30 **5.** The improved belt scraper mounting as claimed in claims 3 and 4 wherein said auto adjusting mount comprises of a pair of helical springs in which said lower spring has higher suspension stability than said upper spring.

6. The improved belt scraper mounting as claimed in claims 1 and 3 wherein said dynamic auto adjusting scraper fixing mount is adapted to hold a circular tube scraper blade module assembly.
- 5 7. The improved belt scraper mounting as claimed in claims 1 and 3 wherein said dynamic auto adjusting scraper fixing mount is adapted to hold a square / rectangular / triangular or any other cross-section tube scraper blade module assembly.
- 10 8. The improved belt scraper mounting as claimed in claims 3, 4 and 5 wherein one helical spring is placed above said scraper holding arm and another helical spring is placed below said scraper holding arm and are kept in position by means of washer and nut arrangement.
- 15 9. The improved belt scraper mounting as claimed in claim 8 wherein said nut arrangement comprises shoulder nuts adapted to be compressed by 30 mm in either direction, so as to ensure stability against belt velocity / precision cleaning.
- 20 10. A method for applying a belt scraper mounting for bulk material handling belt conveyors having conveyor frame / stringer, in the manner such as herein described, said belt scraper mounting comprising: a scraper blade module assembly and a means for holding said blade module assembly with said conveyor frame / stringer on
25 both sides of said belt scraper, said means being adapted to function in an auto adjusting mode.