THE RATIONALISATION OF IDLER MANUFACTURING, BASED UPON THE USE OF PREFABRICATED IDLER BEARING HOUSING ASSEMBLIES - CARTRIDGE TYPE

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With modern advances in manufacturing techniques, particularly in the field of deep drawn presswork, it is no longer necessary for an idler manufacturer to restrict his range of products to those with which he is familiar or to those demanded by one particular sector of the market. On the contrary, it is the intention of this Paper, to show that it is now possible to design an idler manufacturing layout, in such a manner, that virtually any idler specification can be manufactured swiftly and accurately upon one production line. At the same time great flexibility can now be incorporated into the manufacturing process which will allow the idler manufacturer to switch production between either small batch production and high volume throughput, or between different specifications of idlers, swiftly, economically, and without unduly interrupting the flow of the production process upon the shop floor.

To date, this degree of flexibility has been very difficult to achieve by manufacturers around the world, because of the rather conservative and restrictive nature of the manufacturing process. Indeed, some idler production lines have been laid down based upon methods and ideas which originated perhaps twenty years ago.

It is the intention of this Paper to show that the idler manufacturing process can be rationalised not only to render manufacturers more efficient but also to give them the ability to achieve consistently higher levels of quality, than those associated with traditional manufacturing methods.

These new developments have been brought about, specifically because of advances made within the field of deep drawn presswork, and subsequently relating these new presswork techniques, to the field of component manufacture for conveyor idlers.

THE IDLER BEARING HOUSING

To summarise briefly, there have traditionally been three main methods of manufacturing steel bearing housings, for use on welded steel conveyor idlers. These are:-

1. A steel casting is produced to a rough profile, approximating to the final shape of the required bearing housing assembly. A series of subsequent machining operations is carried out upon the casting - primarily within the bore, upon the back face of the flange and to the edge of the flange itself.

2. A rough metal pressing is produced - again approximating to the final required profile, although obviously a little more closely than the aforementioned steel casting. Here again, a subsequent series of machining operations are necessary upon this component, to enable the manufacturer to arrive at the final specified dimensions.

3. The modern version of the housing is a precision pressed steel housing, produced as a finished pressed component, without the need for any subsequent machining operations.

   Such components can be manufactured very quickly and to extremely close dimensional tolerances. They can be manufactured in steel up to 6.00 mm thick, eliminating the need for heavy duty machined components.

With regard to comparing the merits of these three alternatives, it is self evident that both the machined casting and the machined pressing necessitate manufacturing cycle times which are unnecessarily extended and laborious, and at the same time relatively expensive. By contrast, the cycle time required to produce each housing via the presswork manufacturing process, is only a fraction of that required for the two alternative components.

Nevertheless both the machined castings and the machined rough pressings still have their adherents - not all idler manufacturers worldwide use pressed steel housings for their entire range of idlers. Sometimes this is because of a natural conservatism within the organisation itself, but often it is simply because there is a lack of sufficient deep drawn presswork skill, within the manufacturing base of that country. It is the experience of the writer that the capacity to manufacture such precision pressed steel bearing housings is very limited, even within fairly sophisticated industrialised nations such as continental European nations, and the United States of America for example.

TYPICAL CONSTRUCTION OF AN IDLER BEARING HOUSING ASSEMBLY

There are very many variations of a theme to be had here, but the basic design and construction of a typical bearing housing assembly, for a welded steel idler, is fairly standard.

A typical assembly would contain the following series of components:-

a) A steel bearing housing - either a machined casting, a machined rough pressing, or a precision pressing.

b) A ball bearing or a taper roller bearing.

c) An outboard sealing arrangement in front of the bearing.

d) Occasionally an inboard sealing arrangement behind the bearing.

e) A seal retainer of some kind (i.e. another steel pressing or forging) which also offers protection to the seal against impact damage etc.

f) Occasionally an outboard wiper seal, as a barrier against liquid contaminants.

Ball bearing style assemblies are typically held in-situ upon the idler shaft, by means of circlips or snap rings, whereas taper roller bearing style of assemblies are usually held in position, via an outboard threaded nut, located upon a matching thread, upon the idler shaft.

Some idler manufacturers prefer to use a machined shoulder, upon the idler shaft to act as an inboard bearing location. In addition some idler manufacturers - particularly in the USA - do not use a threaded nut to retain the taper roller bearing in-situ, they use a machined sleeve for the same purpose. Occasionally the profile of the sleeve also enables it to be used as a locating device for mounting the idler upon the transome brackets.

Traditionally, such assemblies are produced by firstly welding the steel bearing housings, onto the idler tubes, and thereafter assembling all of the necessary individual components - i.e. bearings, seals, shaft etc., into the bores of the bearing housings, via a subsequent series of additional assembly operations.

Frequently this can be a very labour intensive process, although some manufacturers have managed to automate this to a large degree.

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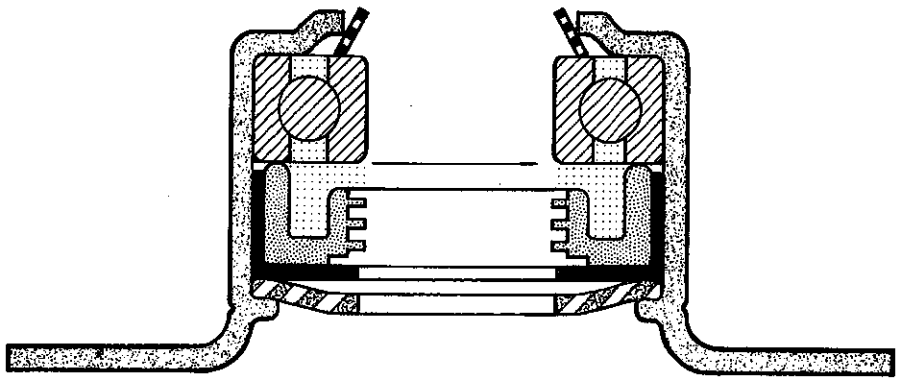
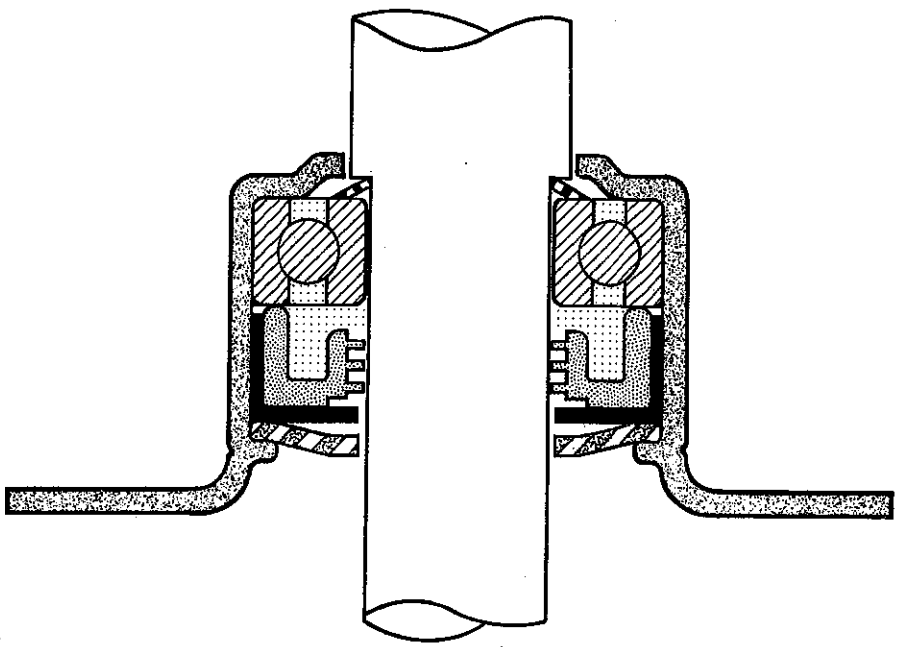
A PREFABRICATED IDLER BEARING HOUSING ASSEMBLY
SELF COMPENSATING BALL BEARING DESIGN — GREASED FOR LIFE



- **Pressed steel bearing housing**
- **Ball bearing to specification**
- **Pressed steel seal retainer**
- **Pressed steel retaining washer**
- **Polyurethane 3 lip shaft seal**
- **Biasing spring washer**
- **Grease**



Not to scale

ILLUSTRATION OF SHAFT LOCATION

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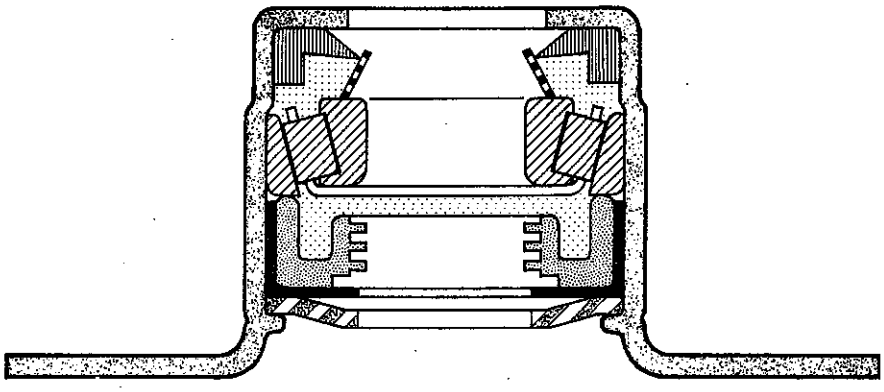
A PREFABRICATED IDLER BEARING HOUSING ASSEMBLY
SELF COMPENSATING TAPER ROLLER BEARING DESIGN — GREASED FOR LIFE



- **Pressed steel bearing housing**
- **Taper bearing to specification**
- **Pressed steel seal retainer**
- **Pressed steel retaining washer**
- **Polyurethane 3 lip shaft seal**
- **Grease**
- **V ring seal**
- **Biasing spring washer**

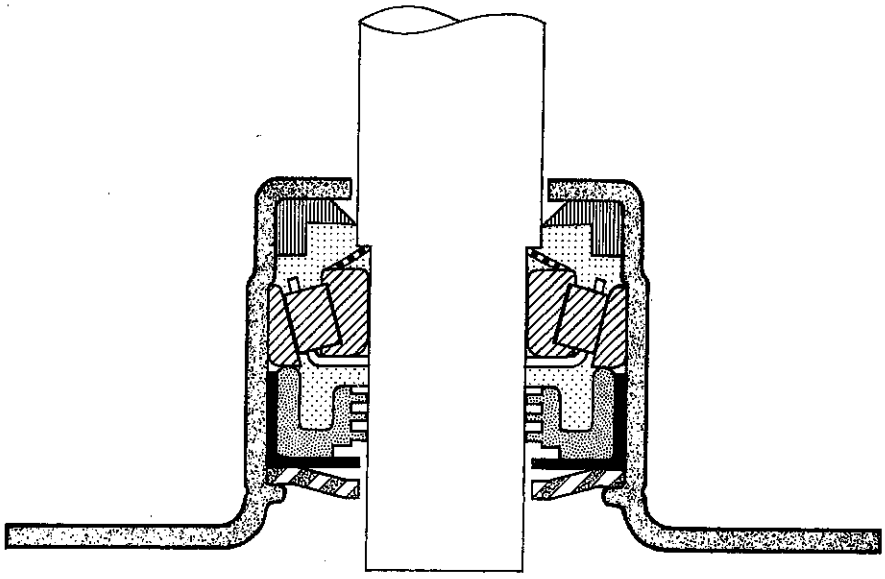


ILLUSTRATION OF SHAFT LOCATION

Not to scale

PRESSWORK MANUFACTURING ROUTE FOR BEARING HOUSING ASSEMBLIES

As already mentioned, most bearing housings used today, on welded steel idlers, are precision deep drawn steel pressings.

What is not immediately obvious, is the fact that the design and construction of the majority of idler bearing housing assemblies lend themselves naturally to the manufacturing methods used in such deep drawn precision presswork. It can be said therefore, that assembling a series of components into the bores of such pressings, in order to produce completed idler bearing housing assemblies, can simply be regarded as a continuation of the presswork manufacturing process.

It is this latest development, which has enabled a new manufacturing technique to be developed for the high speed/high volume production of idler bearing housing assemblies, which is at the same time highly flexible.

PREFABRICATED IDLER BEARING HOUSING ASSEMBLIES - A NEW DEVELOPMENT

Using this new technique, idler bearing housing assemblies can be manufactured as a series of pregreased sub-assemblies - i.e. completely self-contained cartridges. These can be produced as precisely engineered components, complete with bearings and sealing arrangements of whatever specification, all of which are locked in-situ within the bores of the pressed steel housings, by adapting precision presswork techniques to the manufacturing process.

No further operations are necessary upon these components, they are simply mounted upon the idler shafts and welded straight onto the idler tubes - eliminating the need for a dedicated bearing housing assembly production line, upon the idler manufacturers' shop floor.

They can be manufactured to suit all common idler and shaft diameters - either to imperial dimensions or to metric dimensions, as required. It is also a relatively simple process to switch quickly between different flange diameters. In certain circumstances it is possible to produce two different flange diameters for example, at the same time, based upon a common specification with regard to the internal construction of the assemblies. Also, bearing housing assembly cartridges can be produced at extremely fast rates of between 200 and 1000 per hour, as completely finished components, depending upon the size and the design of the components in question.

BEARING HOUSING ASSEMBLIES AND RELATED LEVELS OF IDLER PERFORMANCE

It can be fairly assumed that the quality of the idler bearing housing assembly is a major feature governing the performance of the idler itself. Obviously, the more robust the assembly and the more accurately it is put together, then the more likely it is that the idler will perform satisfactorily in the field, for an extended working life.

It is well known, that some idler manufacturers have experienced difficulty at some point or other, in controlling accurately not only the dimensions of all the relevant components within the idler, but also the accuracy of the assembly process itself.

In turn, this has led to inaccuracies in construction, which is the major cause of idler failures in the field. The adoption of bearing housing assembly cartridges, for idler production, which have been manufactured via the precision presswork route, ensures a higher degree of repeatability with regard to the adherence to dimensional tolerances within the idler, than do traditional manufacturing methods.

Consequently, this means that idler manufacturers now have the opportunity of significantly achieving tighter control over their finished product, while at the same time significantly increasing production output.

Obviously this has implications with regard to cost effectiveness, but more particularly with regard to higher levels of quality being consistently achieved for the idler, giving as a result, better performance and a longer working life in the field.

MANUFACTURING CONSTRAINTS

One important point - where traditional methods of manufacturing the bearing housing assembly are used, the end result can often be a bottleneck in the idler production line. The writer has in fact seen this in various manufacturing sites, both in the UK and in North America. Indeed, very often the overall level of output of the idler production line is geared to the total capacity of the bearing housing assembly production line - not the other way about.

This obviously can lead to constraints in the overall manufacturing output, limiting potential capacity and also perhaps resulting in higher fixed overhead costs per unit produced.

Again the use of prefabricated assemblies resolves this problem.

SOME COMMON QUALITY PROBLEMS WITH WELDED STEEL IDLERS

Shaft Misalignment and Bearing Preload

This is a common problem, with which most idler manufacturers are familiar. The end to end misalignment of the shaft within the idler, gives rise to a preload condition of the bearings at both ends of the idler. This pre-stressing of the bearings, can bring about premature failure of the bearings, resulting in the failure of the idler in the field.

Shaft End Float

Again this is a problem familiar to most manufacturers. Excessive shaft end float - i.e. the amount of uncontrolled lateral movement permitted between the shaft and the idler tube itself - can give rise to a "Hammering" action upon the inner races of the bearings within the idler, which can cause damage to the bearing. This may result in premature failure of the bearing, with the knock-on effect that the working life of the idler is also prematurely curtailed.

Also excessive shaft lateral movement can wear a groove in the shaft itself, at the point at which the bearing inner race locates. Within a short time, the bearing then becomes incorrectly seated upon the shaft, and here too further damage to the bearing can ensue.

Compromised Sealing Arrangements

Depending upon the type of seal used within the bearing housing assembly, both shaft misalignment and excessive shaft end float can compromise the efficiency of some sealing arrangements. Therefore, if this element of the manufacturing process is not controlled accurately, there is a risk of an ingress of contaminants into the bearing, with the added risk of damage to the bearing as a result.

Precise Control of Taper Roller Bearing Clearances

The ideal taper roller bearing clearance is NIL - with a bias towards a slight preload.

However during the writer's researches in the field, primarily in North America and Mexico, it was apparent that virtually all idler manufacturers who used taper roller bearings within their assemblies, operated to a positive clearance. Such clearances were quoted at between 0.004" and 0.007", for the complete system - i.e. total clearance across both bearings.

Attempts have been made in various ways to control these clearances more precisely, but generally speaking, most idler manufacturers find it extremely difficult to guarantee exact clearances. Obviously where bearing clearances are allowed to go beyond the recommended norms, there is a risk of damage within the race. This can result in rapid deterioration, and a very much foreshortened working life for the bearing.

There are obviously other quality problems which do arise during the idler manufacturing process, but those mentioned here have been specifically highlighted, since they can be fairly simply resolved by the use of prefabricated idler bearing housing assembly cartridges.

THE ADOPTION OF BEARING HOUSING ASSEMBLY CARTRIDGES AND THE SUBSEQUENT RATIONALISATION OF THE IDLER MANUFACTURING PROCESS

1. Bearing housing assembly cartridges can be manufactured to incorporate whatever bearing and whatever sealing arrangement is required.

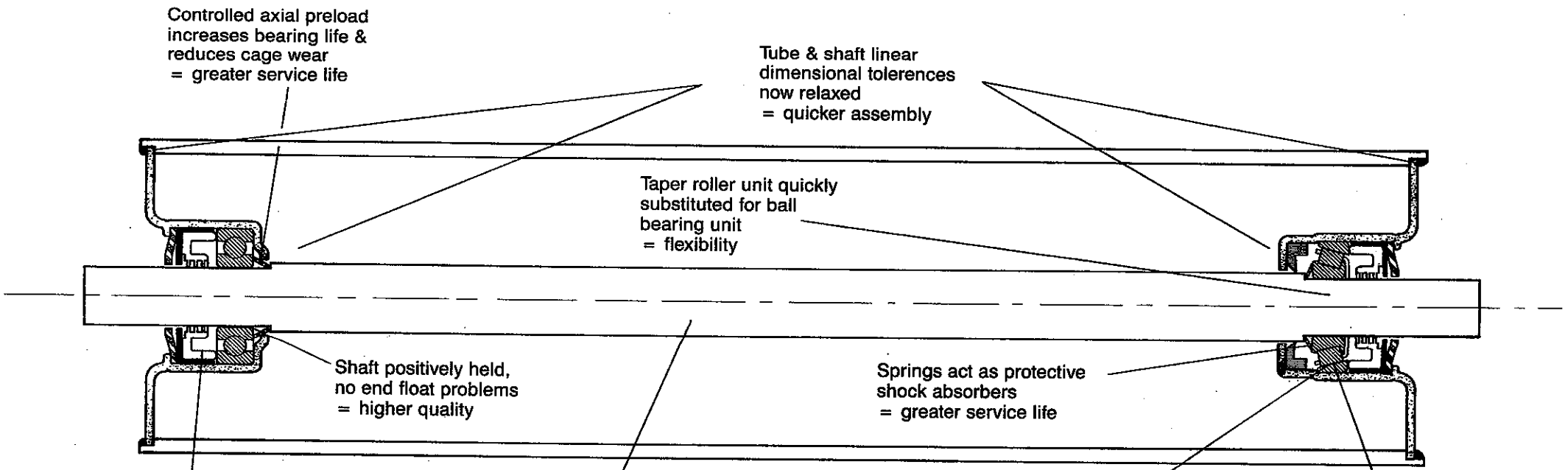
   They can also be manufactured to suit virtually all common idler tube and shaft diameters.

2. The idler is now reduced to three components only, namely: prefabricated bearing housing assembly cartridge, idler shaft and idler tube.

3. As a result, idler manufacturing cycle times can be significantly reduced.

4. There is greater flexibility with regard to switching production between idlers of different specifications, and between small batch and high volume production.

5. All of the "grey" areas are removed from the manufacturing process - it is now self regulating, and virtually "foolproof".



Assembly process now self regulating =higher quality	Only 3 components now necessary = quicker assembly

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AN ILLUSTRATION OF A CONVEYOR IDLER—INCORPORATING SPRING LOADED PREFABRICATED BEARING HOUSING ASSEMBLIES—-SELF COMPENSATING DESIGNS

6. It is now easier to maintain consistently high quality standards.
7. There is now the possibility of significant savings on both the direct and indirect costs, associated with the idler manufacturing process.
8. It is now much easier to take on board new production designs, with minimum lead times, without necessarily compromising existing production output.
9. There is now an increased ability to extend the idler manufacturer's product range. Simply use existing machinery to prepare the shafts and the idler tube and obtain new bearing housing assembly cartridges, to the required specification.
10. The prospects are now much easier for fully automating the idler manufacturing process.

FINAL CONCLUSIONS

With the introduction of this new technique within the industry, many obstacles have been removed from the idler manufacturer's path. His horizons have now been broadened to encompass the entire available market, and because of the self regulating nature of the revised manufacturing process, the necessity of having skilled labour is no longer paramount.

Furthermore, the manufacturing process becomes more efficient, resulting in quicker throughput and reduced lead times, for the customer. The possiblity now exists that direct and indirect cost savings can be generated, resulting in higher overall profit margins.

Major benefits also accrue to the end user of the idler. He will obtain his products more quickly, which are also manufactured to consistently higher levels of quality. This will have the knock-on effect of giving a better working performance for the idler in the field and a longer working life. In turn, this will generate further cost savings in the field with regard to maintenance and replacement costs.

Finally, because this revised method of idler manufacturing removes nearly all of the potential problem areas from the production process, the end result is a much more reliable and consistent product, which can only enhance safety standards.

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