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COIL COMPACTING METHOD AND APPARATUS

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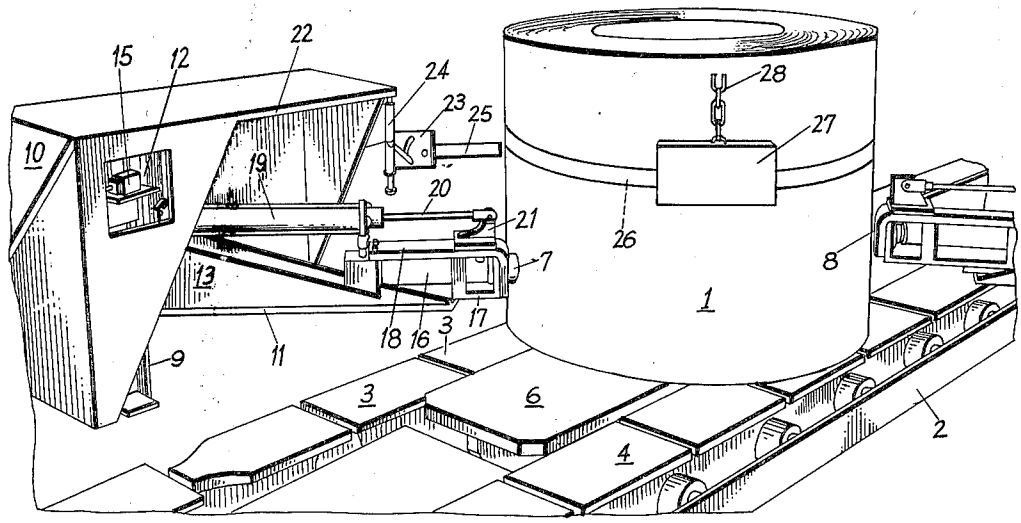

Fig. 2

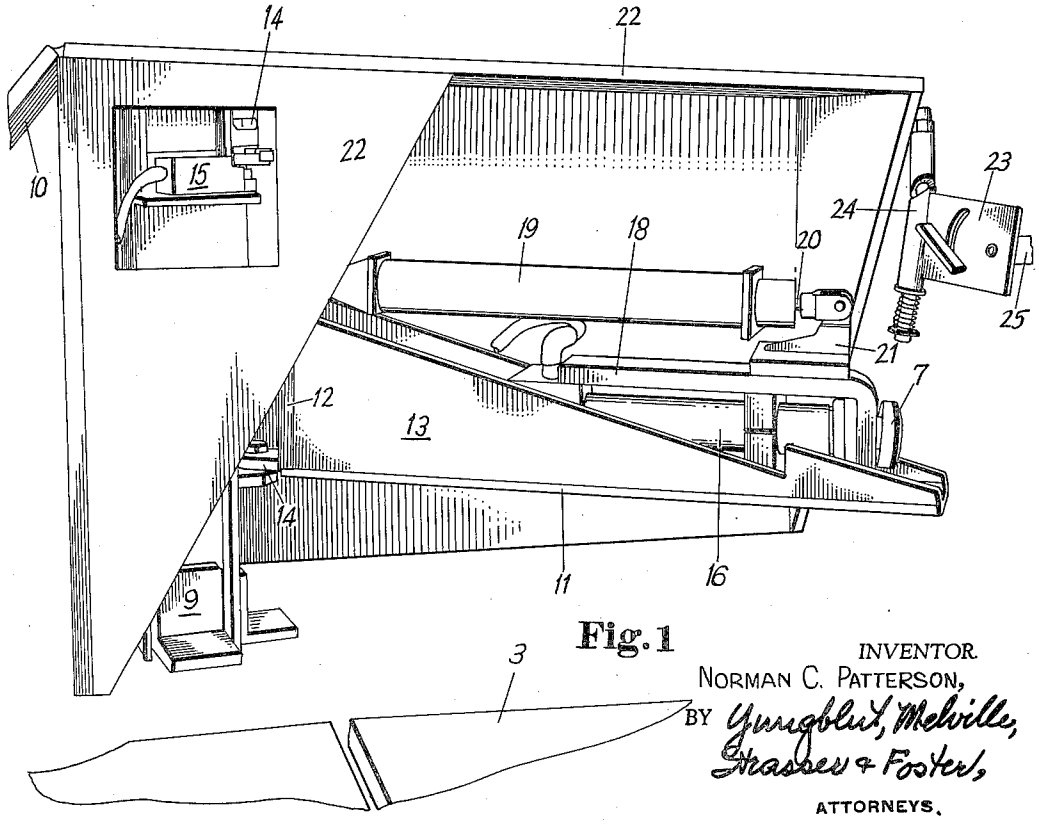

Fig. 1

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COIL COMPACTING METHOD AND APPARATUS

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This invention has to do with the compacting of coils of metal and, although it can be used in the compacting of coils of cold rolled steel or other metal from any source, it will be described in connection with a primary field of utility which is the compacting of hot coils of iron or steel which have been rolled from slabs or ingots on well-known continuous hot rolling mills and coiled on the conventional coiling apparatus at the end of the run-out table which forms a conventional part of the continuous hot mill installation.

As will be recognized by the skilled worker in the art, the hot coils when delivered from the conventional coiling devices are not generally in compacted form, at least as to the outer convolutions thereof, so that difficulties are encountered in transporting the hot coils from the coiler to the next operation. The loose outer convolutions make the hot coils difficult and sometimes dangerous to handle. Also the coils should be both tight and banded, a condition difficult to achieve with hot coils as delivered from conventional coiling apparatus.

There are known ways to tighten or compact a loose coil of material. For example, it may be possible to secure the free end of the material and then rotate the coil until the wraps are tight. Another expedient is to rotate the coil while forcing an object such as a roller inwardly against the coil to cause the loose laps to become tightened. In addition to methods involving a rotation of the coil during tightening, there have been various attempts to pull or push the outer laps into close relationship while the main body of the coil is stationary with its axis vertical.

A typical effort of the last mentioned type has involved the provision of a complicated machine which surrounds the coil with a relatively large number of radially disposed pushing devices, which devices are then actuated by a system of controls in such fashion as to push the outer convolutions against the inner and firmer part of the coil, leaving a space in which the outer convolution or convolutions can bow outwardly to accommodate their effective excess length, the control system being such that the pushing forces are both exerted and relieved in a circumferential sequence so as, in effect, to wind the outer convolutions of the coil against the inner and firmer portion by application of contricting forces rather than tensional forces. As has been indicated such machines are complicated and expensive and possess other disadvantages.

It is the primary object of this invention to provide a means and method of simplified and economical character for tightening coils rapidly and effectively while banding them.

This and other objects of the invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that process and apparatus of which an exemplary embodiment will now be described. Reference is made to the accompanying drawings wherein:

FIG. 1 is an elevational view of one of the elements of this invention for acting upon a coil.

FIG. 2 is a perspective view of a coil being acted upon by the mechanical elements of this invention in the practice of the process.

This invention is based upon the discovery that if a coil is acted upon in a radial direction by a hammering

of vibrational means, there will occur a gradual tightening of the loose convolutions of the coil. The hammering or vibrational forces exerted upon the coil may be exerted continuously at a single radial position; and it is not necessary during the tightening operation either to rotate the coil or to move, with respect to the coil, the locus of the application of the forces. The forces may be exerted in a truly radial direction, although the direction of force application may be directed by an angle of a few degrees toward the outer end of the coil. A more rapid tightening action is achieved by providing for the application of the forces at two diametrically opposed positions with respect to the surface of the coil, thereby increasing the vibrational forces two-fold. The provision of more than two force applying means while possible, has not been found to be advantageous or economical.

As has been indicated, a gradual tightening or compacting action will occur; but there is a tendency for the outer or loose convolutions of the coil to re-expand. The degree of re-expansion is less than the degree of contraction, so that the coil ultimately becomes tight and compacted. But such re-expansion as occurs somewhat delays the attainment of a tight coil by the means thus far described. It has been found that the degree of re-expansion can be lessened and the process made quite rapid in the attainment of a compact coil by placing a band around the coil and tightening the band as permitted by the contracting movements of the outer convolutions. The band by itself will not serve to compact the coil. It serves merely to minimize the re-expansion of the outer convolutions. The point or points of application of the hammering or vibrational forces need not be located at the center of the coil in the axial or vertical direction, but can be located at any part of the coil from substantially the top to substantially the bottom of it. In general practice the points of force application are located for convenience about three-quarters of the way down from the top of the coil. This makes it possible to locate a band around the coil in the central portion of it, and to take up the band progressively as the coil is compacted. The take-up means for the band is generally provided with a device for locking the band when the coil has become compacted. Thus the apparatus and method of this invention is adapted to deliver compacted and banded coils which are ready for future handling, storage or transportation; and the compacting of the coils does not add significantly to the banding time, nor does it constitute a separate operation.

The apparatus and method of this invention will now be described in detail with reference to the accompanying drawings.

The coils are brought to the compacting station in upright position, i.e. with their axes vertical. While this does not constitute a limitation on the invention they will generally be moving on a conventional conveyor. This is illustrated in FIG. 2 where the up-ended hot coil **1** has been brought to the position shown by a conventional conveyor **2** which in this instance is of the type in which flexible treads **3** and **4** support the coil. Other types of conveyors may be used, or the coils may be delivered to the compacting station by means of wheeled vehicles, an overhead crane, or in other suitable ways.

When the coil reaches the compacting position as shown in FIG. 2 the conveyor will be stopped. Or, if desired, an elevating means **6** such as a weighing platform may be employed to raise the coil from the treads **3** and **4** of the conveyor. When the elevating means **6** is a weighing platform, the coils are weighed at the same time that they are compacted and banded. While the coil **1** is a conventional coil of continuously hot rolled metal, it has been illustrated in FIG. 2 in the compacted condi-

tion. This is achieved through the action of hammering or vibrational means having heads **7** and **8** which heads, it will be noted, are located at diametrically opposite positions.

Various means for mounting and positioning the devices which exert the hammering or vibrational forces may be employed. However, in general, it will be necessary to provide means for projecting the devices toward and widthdrawing the devices from the positions in which they act upon the coil. In addition, and depending upon the conditions in the work space, it may be found advisable to provide a means whereby the entire hammering or vibrational mechanism may be swung out of the way so that passage alongside the conveyor **2** is made possible. Mechanism of this type is illustrated in FIG. 1.

An upright beam or standard **9** is affixed to the floor and is held in the vertical position by any suitable means which may include braces such as are shown at **10**. A cantilever arm **11**, which extends horizontally, is provided with a vertical back plate **12** and generally, for rigidity, with tapering side members **13**. The cantilever arm assembly is pivoted to the standard **9** by suitable hinging means at the top and bottom of the backing member **12**. These hinging means are shown in FIG. 1 at **14**. The hinging means permit the cantilever arm to be swung from a position in which it is substantially parallel to and spaced from the conveyor **2**, to a position such as is shown in FIG. 2 in which it extends at an angle from the standard **9** toward the center of the coil **1**. The cantilever arm **11** may be moved by hand if desired; but it is convenient to provide it with a means, such as an air cylinder **15**, whereby it may be moved from its first mentioned position to its operational position, and held against further movement in either selected position.

The vibrational or hammering device having the head **7** is shown in the figures as an air hammer **16**. This air hammer is mounted for longitudinal sliding movement on the cantilever arm **11** by means of a carriage which comprises a base **17** and an upper frame **18**. The base **17** may be mounted for sliding movement upon the cantilever arm **11** in any suitable fashion, such as by the employment of ways, tracks, rollers, or the like.

In the operation of the device, when the cantilever arm **11** is swung into the position illustrated in FIG. 2, the carriage will be moved outwardly along the cantilever arm **11** until the head **7** is brought against the coil. This movement is accomplished by means of an air cylinder **19**, the rear end of which is connected to the back plate **12** of the cantilever arm. The piston rod **20** of the cylinder is connected to a bracket **21** on the carriage **17, 18**. The cylinders **15, 16** and **19** are preferably actuated by air; but steam or other compressed fluid may be employed. They will have connections through suitable conduits with a source of the compressed fluid; and where the parts are movable with respect to the source, these connections will be by means of flexible conduits as well understood in the art. Some of these conduits have been shown in the drawings. The skilled worker in the art will understand that valving means are provided to effect the actuating of the cylinders in proper sequence. These valving means (not shown) may be located in any position of convenient access to an operator.

In the particular form of the invention illustrated, there is a housing **22** in connection with the standard **9**. At one end of this housing there is provided a means for initially supporting a band in connection with the coil **1**. This means may take various forms. In the form illustrated a plate **23** is hinged as at **24** to a portion of the housing, and may be spring controlled so as to be urged into a position in which it extends toward the coil. An arm **25** is pivoted to the plate **23** and, if desired, may be provided with means including a slot and key as illustrated for adjusting its angular position. The arm **25** extends toward the coil **1** and is so positioned that its outer end is in contact or substantially in contact with the outer convolution of the coil. The purpose of the

arm **25** is to support a band **26** shown in FIG. 2. This band may be the ordinary steel band or strap used in banding coils; and the ends of it are engaged in a tightening means **27** also shown diagrammatically in the figure. An air-operated ratchet type means, as conventional in the art, may be employed; and since the temperature of a hot coil as received from the coiler may be quite high, say up to 1000° F., it will generally be found preferable to use the conventional powered tightening and clamping means suspended from above as by means of a chain **28** or other suitable suspension so that it may be swung into position when needed. The arm **25** is useful in supporting one side of the band while it is being passed over the coil and until it is tightened somewhat by the device **27**. Unless the outer convolutions of the coil are too loose to permit this, it is preferable to apply the band and the tightening device at the start of the coil compacting operation.

When the cantilever arms **11** are swung into position, the air cylinders **19** will be actuated to bring the devices **16** into such position that the heads **7** and **8** contact the outer convolution of the coil. Since the carriage **17, 18** is moved by an air or like cylinder, the heads **7** and **8** will move inwardly with the outer convolution of the coil as the coil is being compacted. When the air or other fluid has moved the carriages **17, 18** to their extended positions, fluid under pressure will enter the cylinders **16** and initiate the hammering action of the heads **7** and **8** against the coil at the desired number of strokes per minute.

The compacting action takes place as hereinabove described, and in the course of the compacting action the band **26** is tightened so as to take up the slack. In a short time the coil will be found to be fully compacted, and the band **26** will have its ends fastened together as is conventional in the art of banding.

While the force-exerting members have been illustrated and described as air hammers (these being preferred) other means including purely vibrational means may be employed. The rapidity of the operation of the vibratory or hammering devices may be considerably varied, and satisfactory results have been obtained with rates varying from about 100 to 3,000 strokes per minute. Twelve hundred strokes per minute has given excellent results. The strokes of the force-exerting devices appear to be the chief factor in producing an actual compacting of the coil; and the force of the strokes of the hammering or vibrational devices bears a relationship to the material which is being treated. For example, with an apparatus as shown, it was found entirely practicable to compact rolls of hot rolled low carbon steel .080 in. in gauge and 25 in. in width with an air pressure in the cylinders **16** of about 50 pounds per square inch gauge (p.s.i.g.). However, in another operation in which 18–8 hot rolled stainless steel coils .160 in. in gauge and 28½ in. wide were being treated, a better and more rapid result was noted when the air pressure was increased to about 120 pounds p.s.i.g. as compared with the use of lower pressures.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in a particular exemplary embodiment, what is claimed as new and desired to be secured by Letters Patent is:

1. In a process for the compacting of metal coils the steps of supporting a coil in a stationary position with its axis vertical, and subjecting the exterior of the coil to a series of rapidly repetitive hammer blows at a frequency of substantially one hundred to substantially three thousand blows per minute from a powered apparatus acting upon the coil in a substantially radial direction and at a fixed point as respects the coil body.

2. A process of compacting coils including the steps of supporting the coils in a position with their axes vertical, and subjecting the coils to a series of rapidly repet-

itive hammer blows delivered by mechanical means acting upon the coil at not more than two diametrically opposed positions, the said means exerting forces upon the said coil in a substantially radial direction.

3. The process claimed in claim 2 wherein the coils are hot coils of metal characterized by a looseness or uncompacted condition of at least the outer convolution thereof, and the frequency of said repetitive blows is substantially 100 to substantially 3,000 blows per minute.

4. The process claimed in claim 2 wherein a band is placed about the periphery of the coil so as to be in place thereon during at least the latter portion of the compacting operation, the said band being taken up as permitted by the contracting of the outer convolutions of the coils so as to prevent re-expansion of the said convolutions.

5. In a structure for tightening the convolutions of metal coils, means for supporting a coil of metal with its axis in a substantially vertical position, means for applying to the outer curved surface of the coil a series of hammer blows of repetitive character and in a substantially radial direction at at least one but not more than two points on the surface of the coil, and means for actuating said blow exerting means at a frequency of substantially one hundred to substantially three thousand blows per minute.

6. The structure claimed in claim 5 wherein there are two means for applying the said blows, the said means being located at opposite ends of a diameter of the said coil.

7. The structure claimed in claim 6 wherein the blows are applied to the coil at positions below the center thereof, and including means for supporting a band encircling the coil during the initial exertion of the said forces.

8. The structure claimed in claim 7 including substantially horizontal arms, and wherein the means for exerting the said blows on the coil are movably located on said arms.

9. The structure claimed in claim 8 including means for moving the blow exerting means along a portion at least of the length of the said arms.

10. The structure claimed in claim 9 including a substantially vertical pivoting means, and in which said arms are swingable about said pivoting means.

11. The structure claimed in claim 5 wherein the means for applying the blows is an air hammer.

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