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Lienert

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[54] **CONVEYOR SYSTEM FOR A SHOT PEENING MACHINE**

[75] Inventor: **Gerold Lienert**, Georgetown, Canada

[73] Assignee: **Rockwell International Corporation**, Pittsburgh, Pa.

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Related U.S. Application Data

[63] Continuation of Ser. No. 690,011, Jan. 9, 1985, abandoned, which is a continuation of Ser. No. 445,395, Nov. 30, 1982, abandoned.

[51] **Int. Cl.**[4] **B23P 9/04**

[52] **U.S. Cl.** .... **72/53**; 51/420; 29/90 A

[58] **Field of Search** .... 72/53; 51/417, 410, 51/420; 29/90 A; 198/728, 733

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,249,677	7/1941	Wallace	72/53
2,341,674	2/1944	Wallace	51/420
3,383,803	5/1968	Schulte et al.	51/420
3,401,789	9/1968	Schuster	198/728
3,604,158	9/1969	Daffron	51/420
3,675,665	7/1972	Sadwith	198/728
3,903,652	9/1975	Baughman et al.	51/420
4,019,624	4/1977	Torres	198/728

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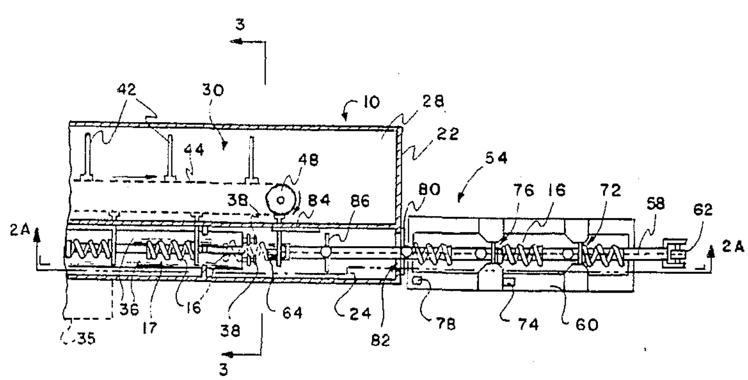
Primary Examiner—Francis S. Husar

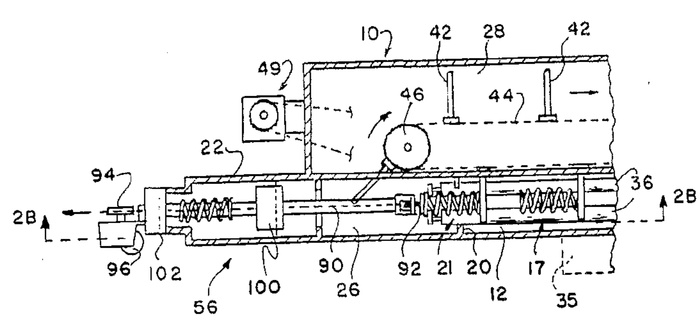
Assistant Examiner—David B. Jones

[57] **ABSTRACT**

A conveyor system is for a shot peening machine of the type which includes blast wheels which are capable of propelling shot generally downwardly into a critical blast region for shot peening a plurality of springs passing therethrough. The springs are supported on horizontally extending spinner rolls within the critical blast region to be capable of being conveyed along a horizontal peening path therethrough. The conveyor system includes a plurality of finger elements extending horizontally into the critical blast region above the spinner rolls and transversely of the peening path. Each finger element includes a first end for making contact with one of the springs and a second end which is secured to and supported by a continuous chain located remotely of the critical blast region. The finger elements are mounted on the chain a predetermined distance apart to be capable of receiving a single spring therebetween. The continuous chain is mounted in a horizontal loop between an idler sprocket and a driving sprocket to advance each finger element and cause it to be extended into the peening path to convey one of the springs therewith through the critical blast region. Each finger element will extend through and be advanced along a horizontally extending slot in a wall separating the critical blast region from the continuous chain.

3 Claims, 5 Drawing Figures





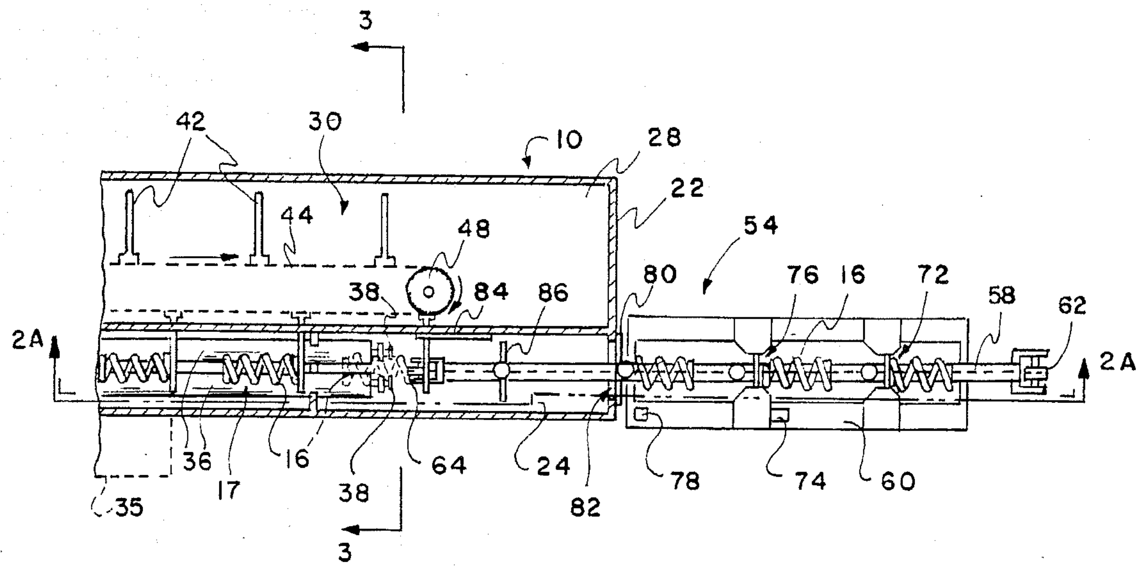

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FIG. 1A

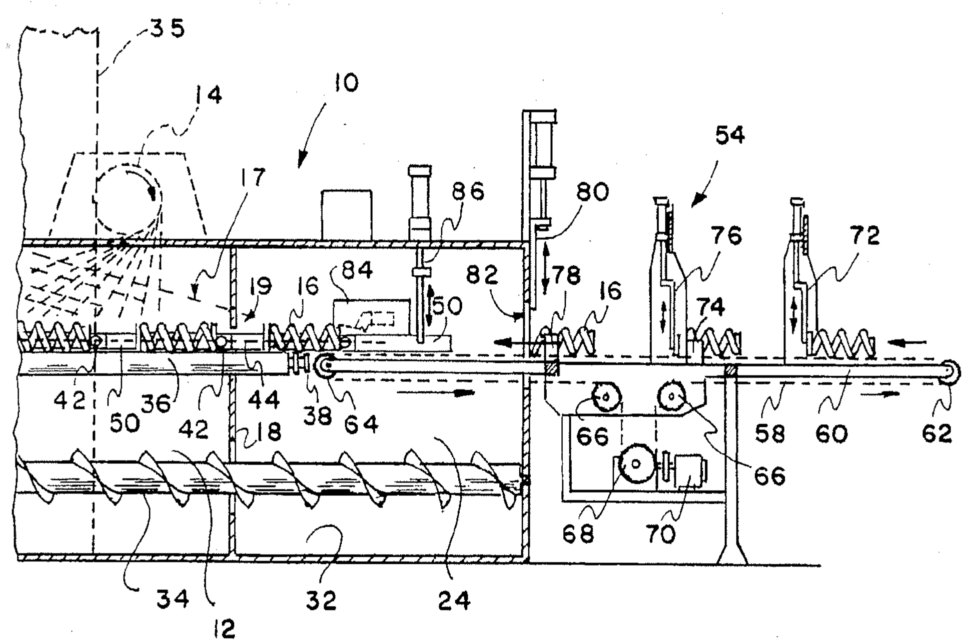
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FIG.2A

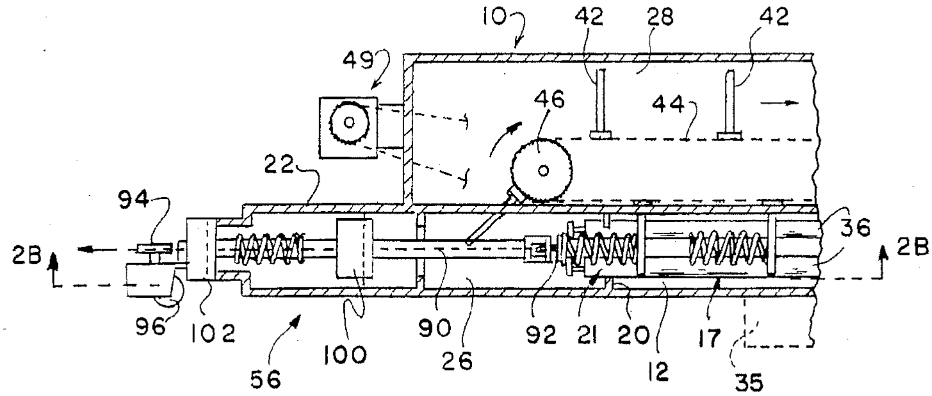

FIG. 1B

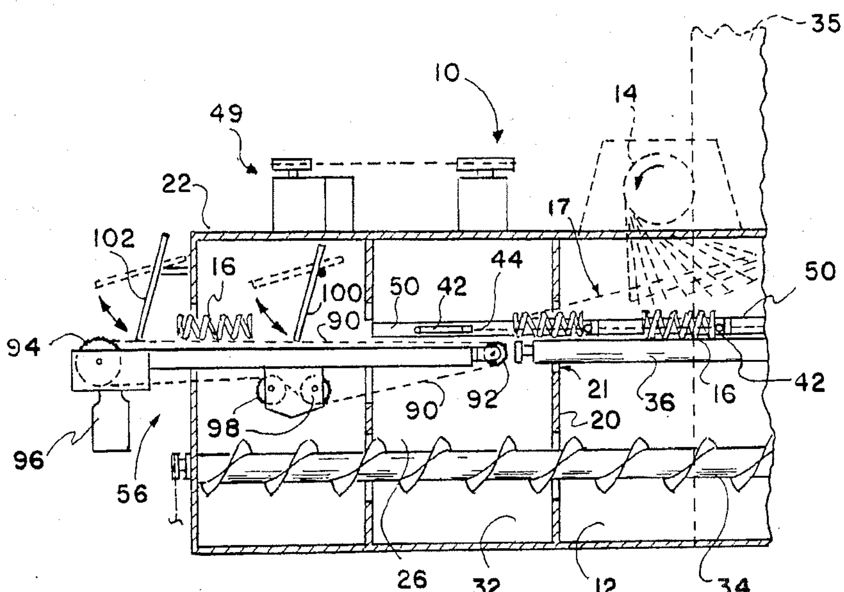

FIG. 2B

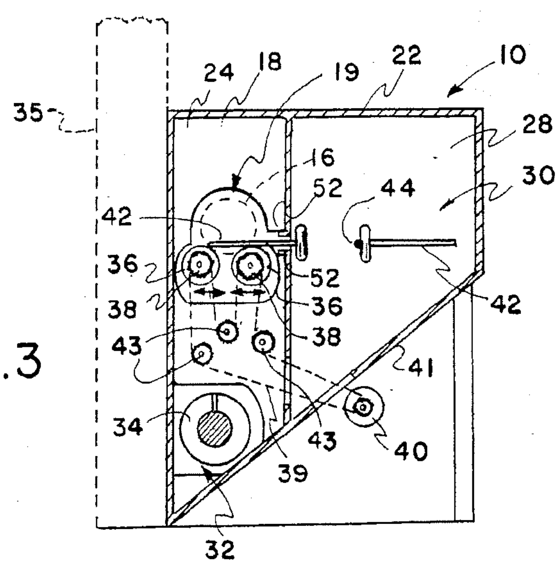

FIG. 3

CONVEYOR SYSTEM FOR A SHOT PEENING MACHINE

This application is a continuation of application Ser. No. 690,011, filed on Jan. 9, 1985, now abandoned, which is a continuation of application Ser. No. 445,395 filed on Nov. 30, 1982, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a conveyer system for a shot peening machine and more particularly to a conveyor system having major components which are located remotely from the critical blast region of the machine.

2. Description of the Prior Art

It is well known that the fatigue life of springs or similar types of workpieces that are subjected to repeated flexing stresses may be increased by cold working of the fibers at and near the surface of the metal by shot peening or blasting. For larger coil springs such as those used in automobile suspensions, it is not uncommon to provide a shot peening machine for conveying the springs through a fan-shaped shot stream with the springs being rotated about their axis for substantially uniform cold working of the entire surface.

A number of such shot peening machines have been heretofore successfully employed and include blast wheels and shot recirculation, fines separation and dust collecting systems which are well known to those skilled in the art. Although shown in a simplified form, U.S. Pat. No. 2,249,677 includes such a machine and, in one embodiment thereof, discloses a pair of spaced parallel spinner rolls which are mounted for rotation to support and rotate each spring being conveyed through the machine. Specifically, the springs are conveyed by a belt and finger arrangement which is located between the spinner rolls with each finger being capable of advancing an individual spring therethrough. A similar machine is shown in a simplified form in U.S. Pat. No. 2,341,674.

Still another prior art shot peening machine is shown in U.S. Pat. No. 3,383,803, which includes some discussion and explanation of the blast wheels and the shot recirculation system for returning shot to the blast wheels. The blast wheels provide the shot to an enclosed blast cabinet which is intended to contain all of the shot being used during the process. The prior art machine disclosed therein, however, utilizes a different means than discussed hereinabove for conveying and rotating a spring therethrough. This method is limited to coil springs which are formed with non-flattened ends. An elongated rotatable support roll extends continuously lengthwise through the machine and includes a plurality of annular ribs extending radially outwardly from the periphery of the roll. The ribs are axially spaced one from the other by a distance corresponding to the coil pitch of each coil spring to be supported thereon. Additionally, a pair of guide rollers are mounted for rotational movement about an axis parallel with the support roll but are spaced laterally one from the other and above the support roll. The space defined by the rolls is intended to loosely receive each coil spring therein. The guide rolls also extend continuously lengthwise through the machine and corresponding rotation of the guide rolls and the support roll cause rotation of the coil spring which results in it being conveyed through the machine as each coil spring is progressively advanced along the annular ribs of the support roll.

Still another prior art shot peening machine is disclosed in U.S. Pat. No. 3,604,158. This machine is also intended to rotate and convey cylindrical work pieces such as coil springs but utilizes a different conveying method than those described hereinabove. In order to provide for the transportation of each spring through the blast cabinet, a feed roll having a screw flight is mounted for rotation to progressively convey the springs through the machine. To maintain the springs in a spaced-apart relationship to insure that the shot can be directed to the ends thereof, the pitch of the screw is greater than the overall length of a spring. The spring is maintained in place on the feed roll by a pair of guide rolls which are mounted in a common horizontal plane slightly above the feed roll at a distance which is less than the spring diameter. Throughout the peening process, the guide rolls and feed roll are caused to rotate to impart a rotating motion to the springs to insure that the entire surface of each will be properly cold worked. In another embodiment disclosed in U.S. Pat. No. 3,604,158, a pair of fixed or rotating support rolls support a coil spring therebetween but axial movement of each spring is produced in a manner similar to those disclosed in the prior art devices mentioned hereinabove. Specifically, there is provided a plurality of fingers on a moving conveyor chain which is mounted between and below the support rolls. This embodiment still employs rotating guide rolls above and at opposite sides of the springs to produce rotation thereof as each spring is axially moved through the blast cabinet.

While each of the above described prior art shot peening machines appears to satisfactorily transport and rotate springs through a blast cabinet to insure proper shot peening of the entire surface of such springs, each of these machines includes features which cause them to be expensive to provide and costly to maintain. It has been found that any element located inside the blast cabinet in a critical blast region (a region in which shot which is provided by the blast wheels will still be traveling near to its maximum impact speed) is subjected to extensive wear. To increase the life of these elements, they are often manufactured of relatively expensive wear-resistent material, such as manganese steel alloy. Even though extensive manganese steel alloy protection plates and deflectors made of stock material may be provided to reduce and minimize this life-shortening damage to the various, more expensive, machined and manufactured components within the blast cabinet, they must nevertheless be periodically replaced and are just as expensive to replace as they were when initially provided.

Additionally, although the prior art shot peening machines discussed hereinabove appear to be primarily concerned with conveying and rotating coil springs through the critical blast regions of their respective shot peening machines, the particular components used for these purposes are also used to simultaneously feed the springs into the critical blast region and discharge the spring from the critical blast region. Accordingly, the various components required for the primary functions in the critical blast region must by necessity be sufficiently long to perform these additional functions. Any design requirement that would add to their overall length would tend to increase their initial cost and any future costs periodically required for their replacement.

SUMMARY OF THE INVENTION

It is therefor an object of this invention to provide a conveyor system for a shot peening machine which includes major components which are inexpensive to provide and would not be subjected to extensive wear or damage requiring their periodic replacement.

These and other objects of the invention are provided in a preferred embodiment thereof including a conveyor system for a shot peening machine of the type which includes blast wheel means or the like which is capable of propelling a plurality of shot generally downwardly into a critical blast region of the machine for shot peening a plurality of workpieces passing therethrough. The workpieces are supported on a horizontally extending support means within the critical blast region of the machine as the workpieces are conveyed along a horizontal peening path into one side of, through and out another side of the critical blast region of the machine. The conveyer system includes a plurality of finger elements extending horizontally into the critical blast region above the support means and transversely of the peening path. Each of the finger elements includes a first end which is adapted to make contact with one of the workpieces on the support means and in the peening path. A finger element support and advancing means is located remotely of the critical blast region. The finger element support and advancing means supports each of the finger elements at a second end thereof in an horizontally spaced relationship from adjacent finger elements along the peening path. The finger element support and advancing means advances each of the finger elements along the peening path from the one side of the critical blast region to the other side thereof to cause the first end of each of the finger elements to convey one of the workpieces therewith.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A and 1B are a top view of the preferred shot peening machine with portions of the housing thereof removed and/or shown in phantom for a better view of various features of the invention.

FIGS. 2A and 2B are a sectional elevation view of the preferred shot peening machine as seen generally along line 2—2 of FIGS. 1A and 1B.

FIG. 3 is a sectional view of the preferred shot peening machine as seen along line 3—3 of FIG. 1A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in FIGS. 1A, 1B, 2A, 2B and 3, the preferred shot peening machine **10** includes a blast cabinet **12**, the top of which supports a pair of blast wheels **14**. The blast wheels **14** are capable of directing a plurality of shot generally downwardly under sufficient force for cold working work pieces such as springs **16**. More specifically, the blast wheels **14** rotate in opposite directions to direct the shot to opposite ends of a spring **16** passing through the blast cabinet **12**.

The top, bottom, sidewalls, and end walls **18**, **20** of the blast cabinet **12** generally define the critical blast region **17** and are made of the wear-resistant metal as described hereinabove. They only generally define the critical blast region **17** because of access and egress holes **19**, **21** respectively through walls **18**, **20** which are needed to allow passage of the springs **16** into and through the blast cabinet **12**. Some shot at working speed could travel a short distance through the holes **19**, **21**.

Since shot cannot be limited to the blast cabinet **12** below the blast wheels **14**, the overall shot peening housing **22** is extended to include three other primary chambers thereof. An entrance chamber **24** is basically enclosed to prevent ricocheting and bouncing shot from escaping from the housing as the springs are being fed to the critical blast region **17**. Similarly, an exit chamber **26** provides a region for retention of ricocheting and bouncing shot as the springs are being discharged from the primary blasting region. A back chamber **28** extends almost the entire length of the housing **22** and will be seen to enclose a conveying means **30** therein. It will be seen that the overall shot peening housing **22** is intended to retain all of the shot within the interior thereof. Even though the critical blast region **17** is the specific area designated for the desired cold working of the springs **16**, there is no way of insuring that the shot will not escape the blast cabinet **12** and be propelled at a lower speed into the entrance chamber **24**, exit chamber **26** or the back chamber **28**.

In the base of the shot peening housing **22** is a trough **32** which extends the entire length thereof for the receipt and collection of spent shot and other solids removed from the surface of the coil springs **16**. An auger **34** is provided therein and is mounted for rotation to deliver the spent shot and other solids to an elevator (not shown) within a housing **35**. Such elevators are well known in prior art shot peening machines to be capable of delivering the material from the lower region of the shot peening housing **22** to a separator (not shown) above the blast wheels **14** for removal of undesired solids and the resupply of shot to the blast wheels **14**.

It is essential in the transmission of the coil springs **16** through the blast cabinet **12** and the critical blast region **17** thereof, that the springs **16** be properly supported and caused to rotate to insure that the shot will be directed to all surfaces thereof. In the preferred shot peening machine **10**, a pair of spinner rolls **36** are provided for this purpose. Specifically, the spinner rolls **36** are horizontally mounted with their axes parallel and slightly separating one from the other. As will be discussed hereinbelow, the space therebetween will depend upon the specific diameter of the coil springs **16** which are being peened. They clearly must be significantly closer than the overall diameter of the spring **16** to insure it will be properly supported between the spinner rolls **36**. Depending on the size and shape of the springs to be peened, it may be desirable to include side rails or guides (not shown) which are horizontally above the spinner rolls **36** and extend the length of the critical blast region **17**. The rails would not normally make contact with the springs **16** when properly positioned between the spinner rolls **36** but would insure that the springs **16** will not be dislocated by the shot or the rotation of the rolls **36**.

The spinner rolls **36** are mounted for rotation at their exit end just inside the exit chamber **26** and are caused to be rotated by a common chain drive system at a pair of sprockets **38** at the entrance end thereof. Although not shown in FIGS. 1A, 1B, 2A or 2B to simplify the drawings, a chain **39** can be seen in FIG. 3 to be driven by a variable speed motor **40** which is mounted beneath shot peening housing **22** below the inclined wall **41** at the base of the back chamber **28**. Idler sprockets **43** are provided within the entrace chamber **24** to direct the chain **39** to one sprocket **38**, down to one of the another idler sprocket **43** and back up to the other sprocket **38** to prevent the chain 39 from interfering with each spring 16 as it is being fed to the spinner rolls 36. Although the sprockets 38, 43 and chain 39 are located in the entrance chamber 24 at the edge of the cirtical blast region 17, shielding (not shown) is provided to minimize the wear thereto that would be caused by stray shot in the entrance chamber 24.

As thus described, it can be seen that the spinner rolls 36 are provided an overall length which enables them to properly perform their primary function. The spinner rolls 36 can be seen to terminate at the edges of the initial blast region 17 and will only support the spring 16 and impart a rotating motion thereto when the springs 16 are in the critical blast region 17. As a result, the spinner rolls 36, which are cast of manganese steel alloy and are relatively expensive to provide, are designed to have a minimal overall expense. The spinner rolls 36 are not required in the preferred shot peening machine 10 to perform the additional functions of feeding the springs 16 to the initial blast region and discharging the springs therefrom.

Although the spinner rolls 36 will properly support and rotate the springs 16 in the critical blast region 17, a conveying means 30 must be provided to longitudinally convey each spring 16 therethrough. The preferred conveying means 30 includes a plurality of horizontally extending fingers 42 on a conveyor chain 44. The conveyor chain 44 is mounted to form a loop which extends horizontally in the back chamber 28 between a driven sprocket 46 and an idler sprocket 48. The sprockets 46, 48 are mounted with their axes extending vertically. The idler sprocket 48 is located prior to the entrance end of the spinner rolls 36 while the driven sprocket 46 is located rearwardly of the exit end of the spinner rolls 36. The driven sprocket 46 is caused to rotate by a variable speed motor and pulley configuration 49 mounted on the shot peening housing 22 so that it will not be in contact with or effected by any of the shot supplied to the critical blast region 17.

Specifically, as the chain 44 is caused to pass over the sprockets 46, 48, the plurality of fingers 42 which are spaced a predetermined distance apart will be extended into the entrance chamber 24 and passed horizontally through the blast cabinet 12 and into the exit chamber 26. A longitudinally extending slot 50 on the back wall of the entrance chamber 24, blast cabinet 12 and exit chamber 26 allows each finger 42 to extend laterally of the peening path from the back chamber 28 into the critical blast region 17 while being capable of passing above the spinner rolls 36 to convey each spring 16 longitudinally and horizontally therealong. Since the longitudinally extending slot 50 provides the only access for the fingers 42 to the critical blast region 17, any shot which could impinge on the chain 44 must pass through the slot 50 in order to enter the interior of the back chamber 28. To further minimize access to the slot 50, the preferred shot peening machine 10 is provided a pair of narrow, horizontally extending shelves 52 (FIG. 3) above and below the slot 50 to deflect the shot and prevent any direct impingement on the chain 44.

It can be seen that the preferred shot peening machine 10 includes a conveying system which is basically capable of conveying the springs 16 along the spinner rolls 36 in a manner which is different from methods disclosed in the prior art machines described hereinabove. By providing a different orientation for the fingers 42 and having them driven by a chain 44 which is capable of being located remotely from the critical blast region 17, no appreciable damage or wear should be experienced in the chain 44. Obviously, the fingers 42 would be subjected to direct impingement by the shot and would have to be made of wear-resistant metal. However, periodic replacement of the fingers 42 which are relatively simple to design and form would be significantly cheaper than the required replacement of the entire chain configuration which was, in some of the prior art machines, designed to pass through the critical blast region 17. The same comparison of cost could be made for the fingers 42 when compared to prior art configurations which used additional rolls in the critical blast region 17.

There is an additional advantage gained by the use of horizontally extending fingers 42. As seen in the prior art shot peening machines which incorporate chain driven fingers which extend vertically between spinner or support rolls, space must be provided for the fingers therebetween. With practical limits on the degree to which the space between the rolls could be reduced, any spring being peened therein must have a diameter which is sufficiently large to insure that it could be adequately supported by the rolls. However, in the preferred shot peening machine 10, there has been provided means for adjusting the spinner rolls 36 to decrease the space therebetween to accommodate coil springs with smaller diameters. In the machine 10, this adjustment (as indicated by the double-ended arrows in FIG. 3) is no longer limited by the size or width of any vertically extending fingers which were heretofore needed to convey the springs through the critical blast region.

Since the preferred shot peening machine 10 includes a configuration which requires a minimum number of components to be included in the critical blast region 17, it is necessary to provide a separating and feeding system 54 to supply the springs 16 to the interior of the machine 10 and a discharge system 56 to discharge the springs 16 after the peening operation is completed. While these two systems may initially appear to add to the overall cost and complexibility of the preferred shot peening machine 10, it should be kept in mind that the prior art machines described hereinabove by necessity utilized relatively expensive components to provide the same functions. Additionally, these components had to be periodically, entirely replaced because of the wear and damage which existed in the critical blast region 17. Therefore, even though there is some additional initial costs, the costs are relatively small and the components used in the separating and feeding system 54 and the discharge system 56 would not need to be made of the more expensive and durable material since they would not be subjected to shot in the critical blast region 17.

In order to provide automatic feeding for the preferred shot peening machine 10, the separating and feeding system 54 is aligned with the spinner rolls 36 to extend horizontally from the exterior of the shot peening housing 22 to terminate within the interior of the entrance chamber 24. Specifically, springs 16 are placed on the upper surface of a transmission roller chain or similar type of chain 58 with an upward portion thereof moving horizontally toward the spinner rolls 36. The chain 58 is mounted on a frame 60 and forms a loop in a vertical plane as it passes around a leading sprocket 62 and a trailing sprocket 64. The chain 58 is caused on its lower, return pass to be redirected over idler sprockets 66 to a driving sprocket 68 and motor drive 70 mounted below the frame 60. The surface of the chain 58 has sufficient frictional qualities to longitudinally move a spring **16** which is placed thereon. Side rails or guides (not shown) insure that the springs **16** are maintained in a longitudinal orientation and prevent them from rolling off of the upper surface of the chain **58**. The speed of the motor drive **70** can be varied and, as will be discussed in detail hereinbelow, the feeding speed for the chain **58** can be selected according to the speed of the fingers **42**. It is sufficient at this time to simply understand that the chain **58** will move horizontally faster than will the fingers **42**.

Clearly, simply providing a horizontally, longitudinally moving chain **58** to supply springs **16** to the critical blasting region **17** would be inadequate since a means must be provided to insure that there is only one spring **16** in position as each finger **42** is extended into the entrance chamber **24** for conveying it through the critical blasting region **17**. As a result, the separating and feeding system **54** is provided a plurality of gates to separate the springs **16** and to regulate the timing of their entrance to the interior of the machine **10**. The gates will be seen to operate independently of the speed of the motor drive **70** and chain **58** even though the particular timing will be effected by the physical movement of the respective springs **16** along the upper surface of the chain **58**.

To initially produce separation of a plurality of springs **16**, a first gate **72** is normally open until a spring **16** which has passed therethrough is positioned at a first spring sensing device **74** which is located just prior to a second gate **76**. The second gate **76** would also initially be in an open position so that a spring **16** passing through the first gate **72** might be sensed at the first spring sensing device **74** and continue on through the second gate **76**. However, as the spring **16** passes through the first spring sensing device **74** a signal will be transmitted to close the first gate **72**. The first gate **72** includes a vertically depending retarding finger which will prevent the next spring **16** from passing therethough. The retarding finger is elongated and has relatively small cross-sectional dimensions so that it is possible that the retarding finger of the first gate **72** might extend through the coils of a spring **16** positioned half way through the gate **72**. Nevertheless, this still would retard the spring **16** in a manner which would be sufficient for its eventual supply to the subsequent gates. When the first gate **72** or the second gate **76** is closed, it should be understood that the springs **16** will simply be prevented from moving longitudinally with the upper surface of the chain **58** as the chain **58** continues to slide thereunder.

When a spring **16** has passed through the second gate **76**, it will proceed to a second spring sensing device **78** located exterior of the housing **22**. The second spring sensing device **78** will send a signal to close the second gate **76** and simultaneously open the first gate **72**. Normally, a spring **16** initially arriving at the second spring sensing device **78** would be on the chain **58** traveling into the shot peening housing **22** but would be prevented from entering by a spring stop and shot sealing gate **80**. The spring stop and shot sealing gate **80** includes sufficient cross-sectional dimensions to completely cover an access opening **82** to the housing **22** and the entrance chamber **24**. As a result, the spring stop and shot sealing gate **80** will prevent undesirable escape of shot from the interior of the preferred shot peening machine **10** and would only be open sufficiently long to allow the passage of a spring **16** therethrough.

In order to determine when a spring **16** should be provided through the spring stop and shot sealing gate **80**, a finger position sensing device **84** is provided in the interior of the entrance chamber **24** to determine when each finger **42** is passing thereby. Specifically, the preferred finger position sensing device **84** includes a camming element and a proximity switch (not shown) which will send a signal as each finger **42** is brought to a lateral position for conveying a spring **16** along the peening path through the critical blast region **17**. When the finger position sensing device **84** is activated by a finger **42**, the spring stop and shot sealing gate **80** receives a signal to open. Simultaneously, a secondary shot sealing gate **86** mounted within the entrance chamber **24** would be given a signal to close. The secondary shot sealing gate **86** is simply intended to insure deflection of shot from the access opening **82** during the short time that the spring stop and shot sealing gate **80** is in an open position. After a predetermined amount of time, which is preset in the control system and is predetermined according to the length of the springs **16** and the speed of the shot peening operation, the spring stop and shot sealing gate **80** will close, the secondary sealing gate **86** will open and the second gate **76** will open. Basically, this simultaneous operation is intended to allow a spring **16** being held at the spring stop and shot sealing gate **80** to pass completely through the opening **82** and then allow the gate **80** to close therebehind. The timing should be such that the secondary shot sealing gate **86** will be retracted prior to the spring **16** being longitudinally transmitted thereto. In other words, the secondary shot sealing gate **86** is not intended to and should not retard any of the springs **16** but simply serve as a barrier for the shot while the gate **80** is in an open position. As indicated, simultaneously, the second gate **76** will open to provide another spring **16** to the now closed spring stop and shot sealing gate **80** but will again be caused to close as soon as that spring **16** is positioned at the second spring sensing device **78**. Once the spring **16** is at the second spring sensing device **78**, as indicated hereinabove, the first gate **72** is then returned to its normal opened position and the spring **16** which had heretofore been retarded thereby would be released to be transported to the closed second gate **76**. Again, the second gate **76** being in the closed position prevents further longitudinal movement of any spring **16** therethrough to establish the basic separation of the springs **16** as is needed to allow for the timed closure of the spring stop and shot sealing gate **80**.

Clearly, as a finger **42** is brought to the finger position sensing device **84**, the spring **16** being stopped and retarded along the peening path by the gate **80** will be in no position to be transmitted by that particular finger **42**. However, as a particular finger **42** is at the finger position sensing device **84**, it serves as a positive indication that the spring **16** previously supplied to the region at the entrance end of the spinner rolls **36** is being conveyed thereon for passage through the critical blasting region **17**. Accordingly, the movement of each finger **42** by the sensing device **84** indicates that there is no longer a spring **16** at the trailing end of the chain **58** of the separating and feeding system **54** and a new spring **16** must then be supplied for the next proceeding finger **42**. As indicated hereinabove, the horizontal speed of the chain **58** of the separating and feeding system **54** is by design to be greater than the speed of the fingers **42**. Once the spring stop and shot sealing gate **80** is opened, the next spring **16** is rapidly transmitted to the end of the chain **58** at the sprocket **64** to be in a position for the next finger **42**. Each spring **16** will extend at least partially onto the spinner rolls **36** under the frictional force of the chain **58**. However, a spring **16** will not be fully positioned on the spinner rolls **36** or removed from the chain **58** sliding therebeneath until the next, appropriate finger **42** is properly, laterally positioned for conveying it into the critical blast regions **17**.

It should now be clear that as long as there is provided a continuous supply of springs **16** to the first gate **72**, the separating and feeding sytem **54** will automatically space and feed springs **16** to a position within the interior of the shot peening housing **22** as each finger **42** is in a position for its further conveyance through the critical blast region **17**. The first gate **72** tends to initially retard each spring to insure that only one spring is positioned at the second gate **76**. The second gate **76** tends to prevent any spring **16** from being provided to the spring stop and shot sealing gate **80** until a spring initially positioned there has been fully transported into the entrance chamber **24**. Gate **80** will prevent a spring held thereby from entering the entrance chamber **24** until the finger position sensing device **84** indicates that the previously supplied spring **16** is now being moved horizontally onto the rolls **36**. The spring stop and shot sealing gate **80** will then automatically close after the spring has passed completely therethrough and prior to the next spring being provided thereto. The secondary sealing gate **86** will only close to provide a secondary shot sealing means during the time that gate **80** is opened and will then be vertically retracted after a predetermined time which is sufficiently short to insure that no contact is made with a spring **16** passing therethrough. As a result, the spring **16** is capable of being positioned at the end of the chain **58** to be further transmitted by the next finger **42**.

In the preferred separating and feeding system **54**, each of the gates **72, 76, 80** and **86** are controlled by air operated cylinders. A control system (not shown) of a type which is well known in the machine control art is capable of actuation and deactuation of the cylinders according to various preplanned signals. Preferably, the spring sensing devices **74** and **78** are photocells but any number of other types of sensing devices might alternatively be utilized.

The discharge system **56** is provided to insure positive discharge of the springs **16** after they have passed through the critical blasting region **17**. The discharge system **56** also includes a horizontally extending chain **90** which is aligned with the exit end of the spinner rolls **36**. The chain **90** extends between a leading end sprocket **92** and a driven sprocket **94** which is driven by a fixed-speed motor **96**.

The upper surface of the chain **90** moves in a direction for continued passage of each spring **16** from the exit chamber **26** to the exterior of the housing **22**. On the return passage of the chain **9U**, it is caused to pass through a pair of adjustable idler sprockets **98** to provide proper tension for the chain **90**. The speed of the chain **90** is preset to move much faster than the fingers **42**. As a finger **42** has conveyed a spring **16** through the critical blast region **17**, it continues to convey the spring off of the end of the spinner rolls **36** and onto the upper surface of the chain **90**. Since the chain **90** is traveling at a higher rate, the spring **16** is propelled away from its finger **42** to provide sufficient space therebetween for the finger **42** to then be retracted from the exit chamber **26**. In other words, each finger **42** will no longer be in contact with its spring **16** when that portion of the chain **44** on which it is supported is passing around the driven sprocket **46** and the finger **42** is being returned to the interior of the back chamber **28**.

Again, to prevent inadvertent loss of shot which tends to ricochet within the interior of the housing **22**, the discharge system **56** is provided a pair of gates **100** and **102**. The gates **100** and **102** are both hinged, gravity return shot sealing gates which are opened by the spring as it passes therethrough. After each spring **16** passes through the open gate **100, 102**, the gate will automatically close to retard any shot which may have found its way into the exit chamber **26**.

Having thus explained the overall operation of the preferred shot peening machine **10**, it is appropriate to explain some of the versitility of the preferred shot peening machine and how it is basically operated to perform the shot peening operation on various springs. Initially, the operator must analyze the particular spring to be peened. If the spring has a small diameter, it is possible that the spinner rolls **36** must initially be adjusted to reduce the space therebetween to insure they will properly support and rotate the spring thereon. Further, the operator must determine how long the particular spring should be retained with the critical blast region **17**. The length of time the spring should be retained within the critical blast region **17** will dictate the speed at which the conveyor chain **44** of the preferred conveying means **30** will be operated. Depending on the length of the spring, the fingers **42** may or may not be properly horizontally spaced. It should be kept in mind, that additional fingers **42** can be added to the chain **44** as long as the spacing between each finger **42** and its adjacent fingers **42** is identical. Generally, a spring must not be too close to the immediately preceding spring to insure that the ends of each spring are properly peened. In any case, the operator will realize that for a fixed rate through the critical blasting region **17**, the overall number of springs to be peened can be increased if the distance between adjacent fingers **42** is kept to a minimum. While determining how long the spring will be retained in the critical blast region **17**, a determination of its rotational speed will also be made to establish the speed setting for the motor **40** and the spinner rolls **36**.

Once the speed of the chain **44** and the distance between the fingers **42** thereon is properly determined, the speed of the separating and feeding system **54** can be selected. As indicated hereinabove, the speed of the chain **58** thereof will definitely be faster than will be the speed of the conveyor chain **44**. Regulation of the motor drive **70** of the separating and feeding system **54** will not directly effect the operation of the gates **72, 78, 80** and **86**, since they will automatically be controlled by the various spring and finger sensing devices. However, the time delay after initiation of the finger position sensing device **84** will be separately regulated to insure free movement of the spring after it enters the entrance chamber **24**. As mentioned hereinabove, the discharge system **56** is operated at a predetermined speed which is sufficiently great to insure removal of each spring throughout the range of speeds at which the conveying system **30** can be set.

Although the particular components to be found in the machine may vary by design according to the range of springs to be peened therein, there are certain features of the preferred shot peening machine **10** which should be described in order to provide a better understanding of its overall operations. For example, the springs which might be peened in the preferred shot peening machine **10** could have an outside diameter ranging from 2⅝ inches to 11½ inches. Springs of various shapes such as cylindrical, conical or barrel springs could all be satisfactorily peened in the machine **10**. To insure proper cold working of this wide range of spring sizes and shapes, the preferred blast wheels are 2½ inches wide with a 19½ inch diameter and are driven by a 40 horse power motor mounted on top of the blast cabinet **12**.

The critical blast region **17** would be approximately nine feet long. To properly control the springs within the critical blast region **17**, as mentioned hereinabove, the spinner rolls **36** can be adjusted to vary the space therebetween to accommodate springs having any outside diameter within the range mentioned hereinabove while the speed of rotation can be adjusted to insure proper cold working of the particular spring being supported thereby. The variable speed drive for the conveying system **30** can be set to convey the fingers **42** at a speed of 9 to 27 feet per minute. The fingers **42** are approximately 15 inches long and made of ¾ inch diameter manganese steel alloy and are aligned to pass through the slot **50** which is approximately 1 inch wide. The chain **58** of the separating and feeding system **54** can be regulated to operate at a speed of 30 to 90 feet per minute. The fixed speed for the discharge system **56** is set at 130 feet per minute and, as indicated hereinabove is adequate for all settings for the conveying system **30**.

As a general rule, the components described hereinabove are capable of accommodating springs at a production rate of between 240 and 720 springs per hour. Assuming a production rate of 600 springs per hour, each spring would be fed into, conveyed through, and discharged from the preferred shot peening machine **10** at a rate of 1 every 6 seconds.

It should be kept in mind that any number of alterations may be made to the preferred conveyor means **30** without departing from the invention as claimed. Specifically, although each of the fingers **42** is shown to be an elongated element which extends horizontally, it would be possible for the fingers to be provided a different overall shape or different extended end for making contact with a spring as long as the finger includes some expanse which extends horizontally into the critical blast region from the region in which it is supported. Additionally, there may be other means for supporting and advancing each of the fingers other than the continuous, horizontal chain loop as long as the support and advancing means for the fingers is physically located remotely of the critical blast region.

I claim:

1. A conveyor system for a shot peening machine of the type which includes blast wheel means or the like which is capable of propelling a plurality of shot generally downwardly into a critical blast region in a blast cabinet for shot peening a plurality of work pieces passing therethrough, comprising:

first and second openings through longitudinally spaced end walls of said blast cabinet,

workpiece support means extending longitudinally through said first and second openings and said blast cabinet,

a vertical wall extending between said longitudinally spaced end walls of said blast cabinet,

continuous conveying means located exterior of said blast cabinet on one side of said vertical wall,

narrow access means substantially in the form of a horizontal slot extending the length of said vertical wall from said first opening to said second opening; and

a plurality of finger elements supportd by said continuous conveying means, each said finger element being spaced from adjacent finger elements and extending horiontally from said continuous conveying means in line with said narrow access means and above said support means whereby said finger elements are each adapted to extend through said narrow access means to contact and convey one of said work pieces along said support means through said first opening, said blast cabinet and said second opening and to return to said first opening with said continuous conveying means along a looped path of travel outside of said blast cabinet.

2. The conveyor system as set forth in claim **1**, wherein said vertical wall includes a first horizontal flange above said narrow access means and a second horizontal flange below said narrow access means and said first and said second flanges extend the length of said narrow access means along said critical blast region to restrict shot from leaving said critical blast and damaging said continuous conveying means.

3. The conveyor system as set forth in claim **1**, wherein said continuous conveying means iclude a continuous chain mounted on spaced first and second sprockets in a generally horizontally disposed loop on said one side of said vertical wall, said first sprocket is located adjacent said first opening, said second sprocket is located adjacent said second opening and means for rotating one of said first and second sprockets.

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