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(54) **SEWING MACHINE VIBRATION DAMPENER**

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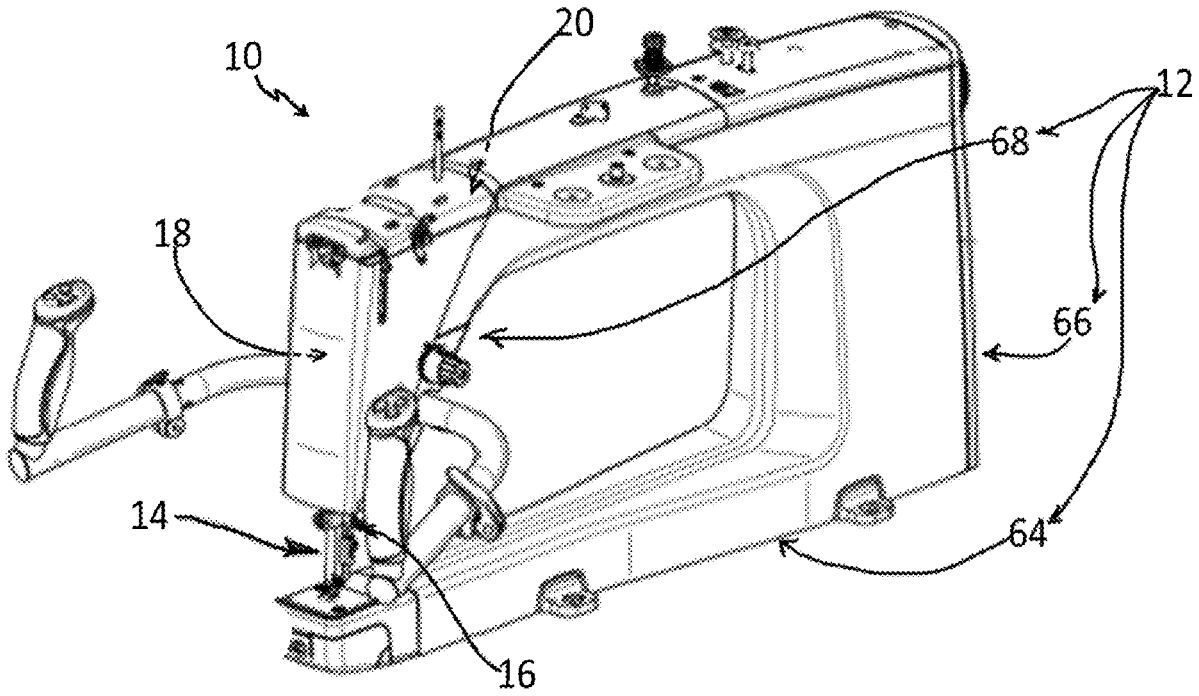
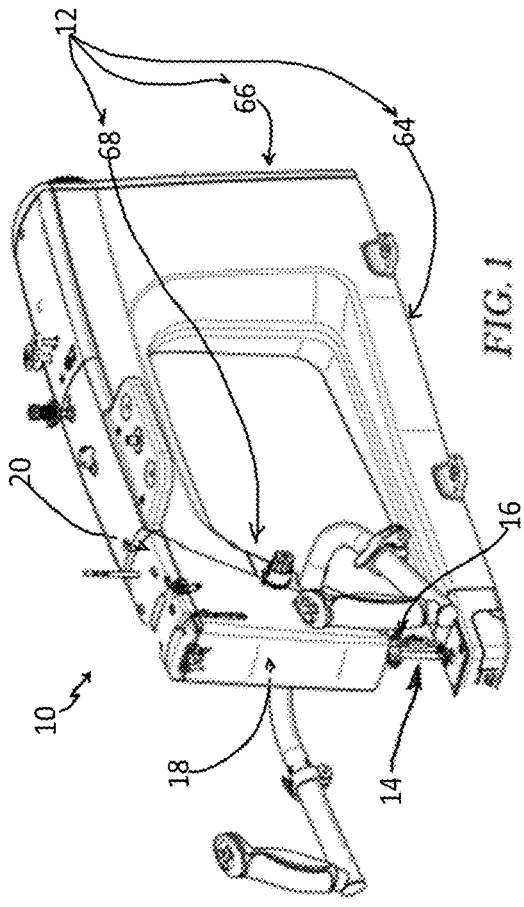
(57) **ABSTRACT**

A sewing machine assembly includes a sewing machine frame, a needle bar, a drive shaft, and a vibration dampener system. The needle bar configured to linearly reciprocate relative to the sewing machine frame along a needle bar axis. The drive shaft is coupled to the needle bar and configured to rotate about a drive axis to drive linear reciprocation of the needle bar along the needle bar axis. The vibration dampener system is coupled to the drive shaft to reduce vibration of the sewing machine assembly caused by linear reciprocation of the needle bar during use of the sewing machine assembly.

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16
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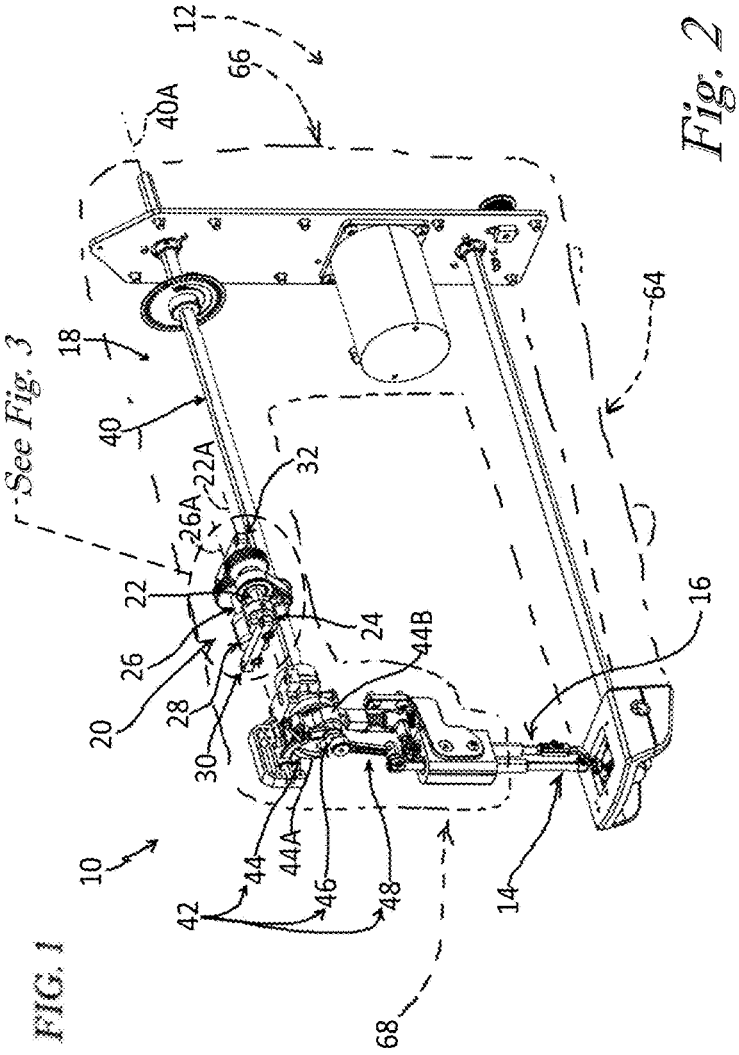
14

FIG. 1


12
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40A
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See Fig. 3
22A
26A
32
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44B
16
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28
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44A
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42
14
68

Fig. 2

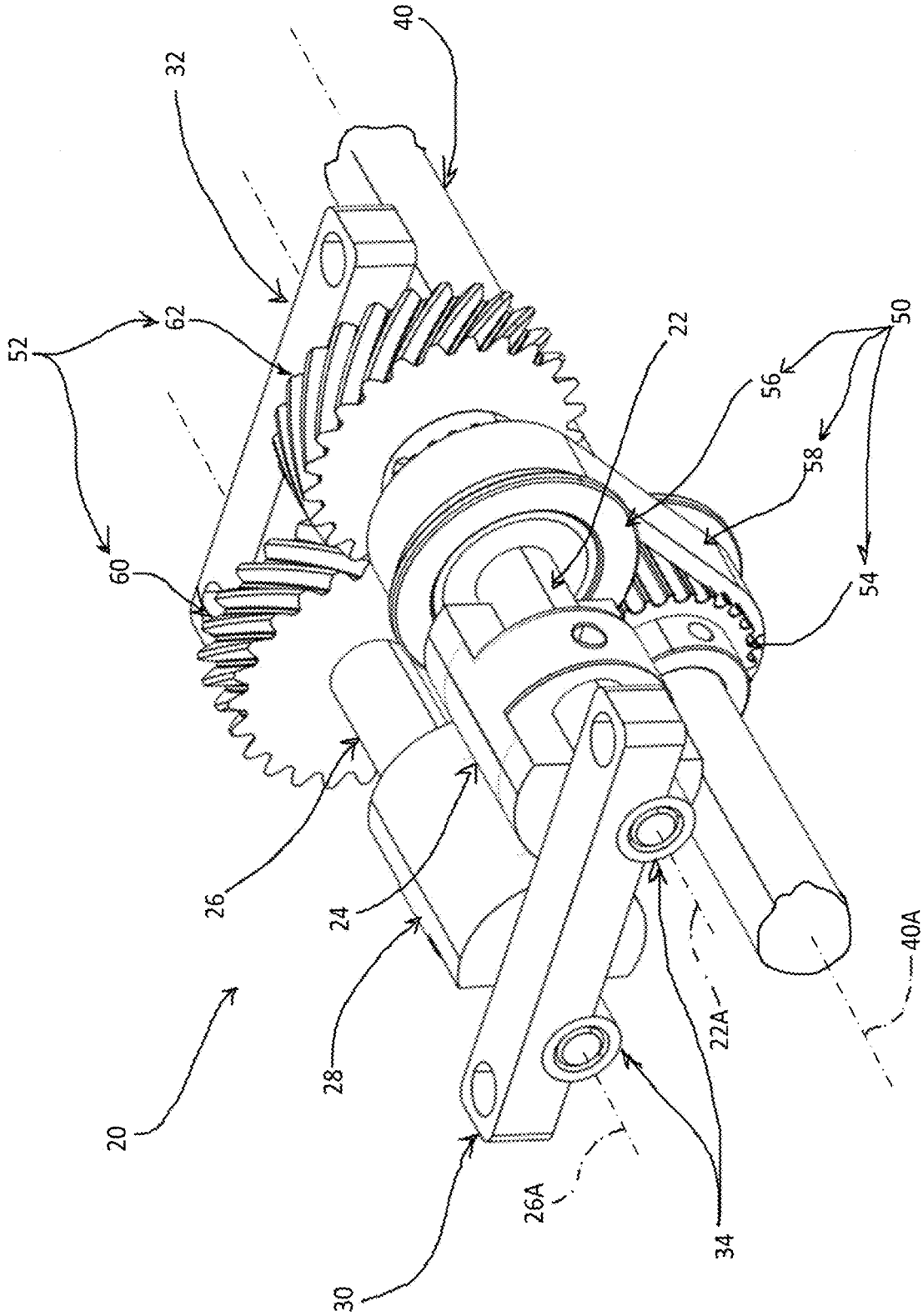
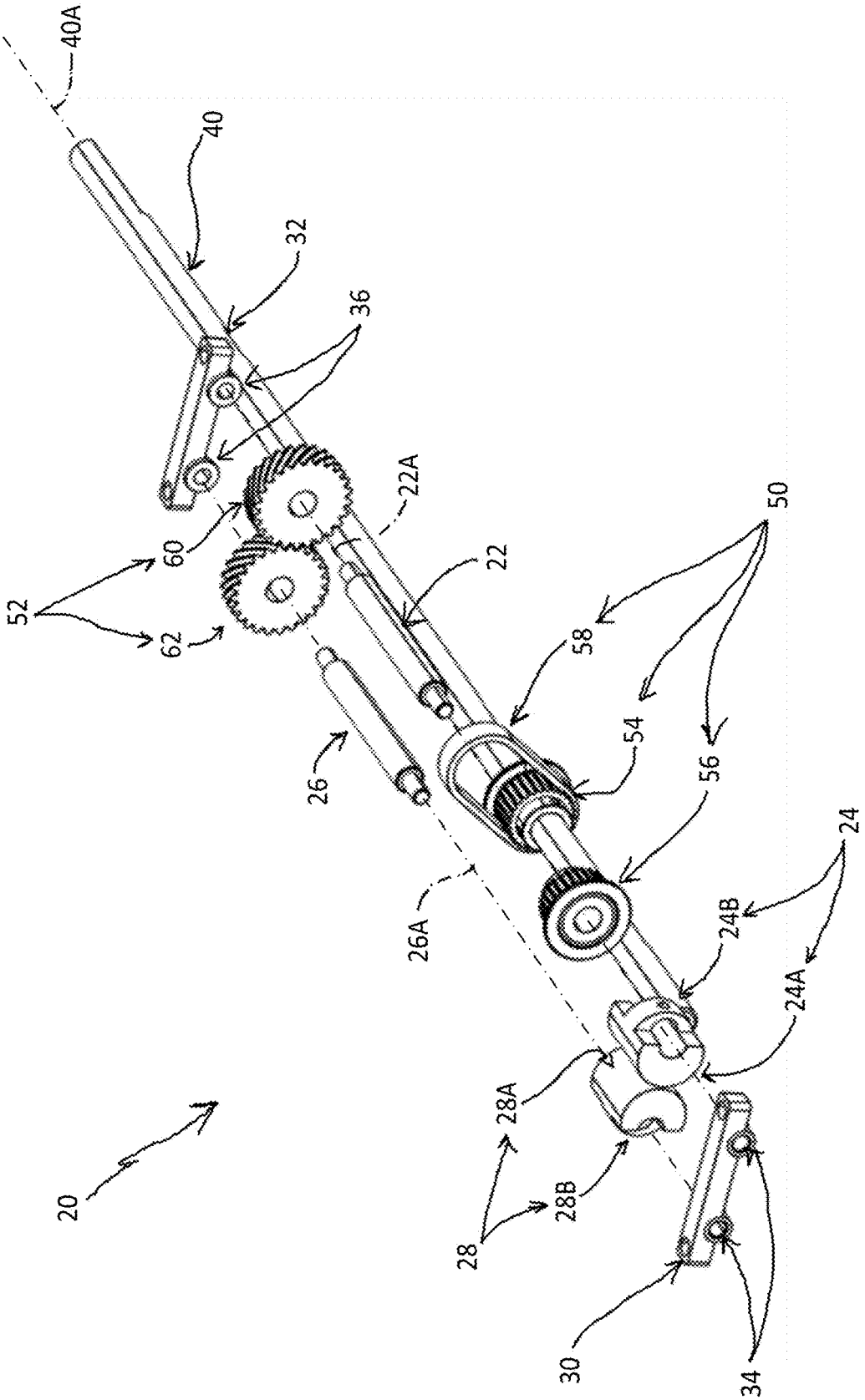


Fig. 3


40A
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22A
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26A
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28B
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Fig. 4

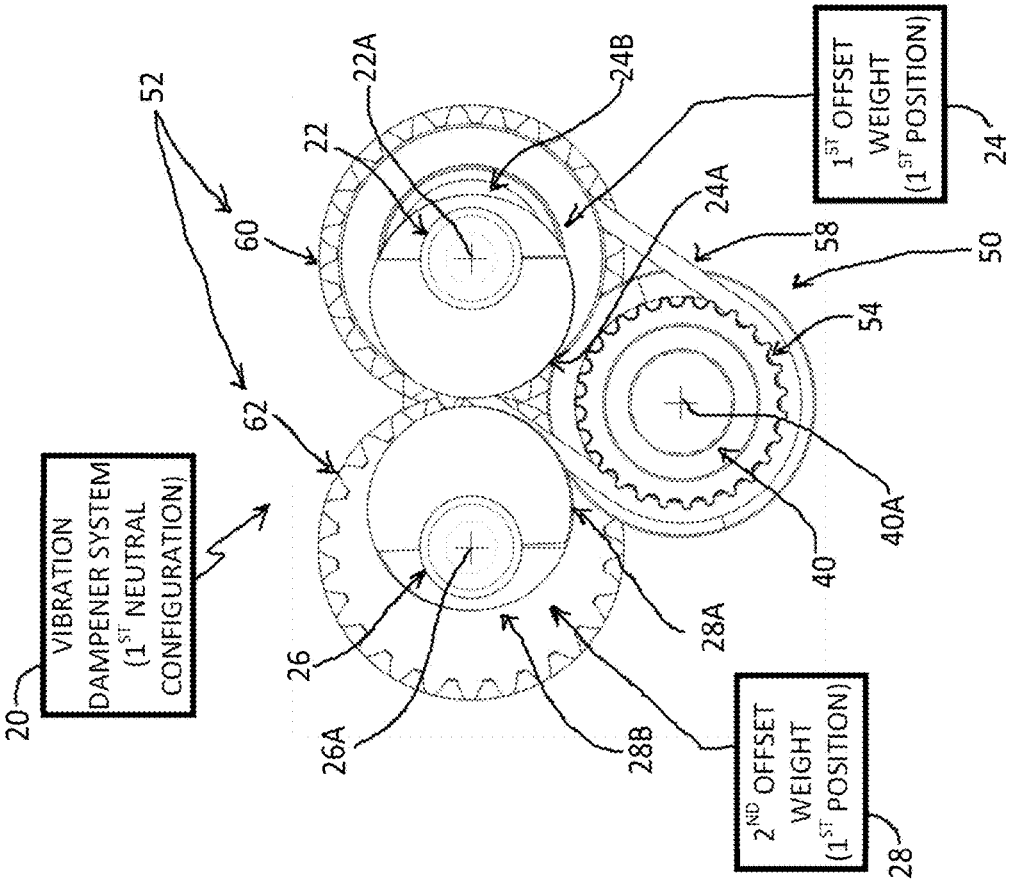
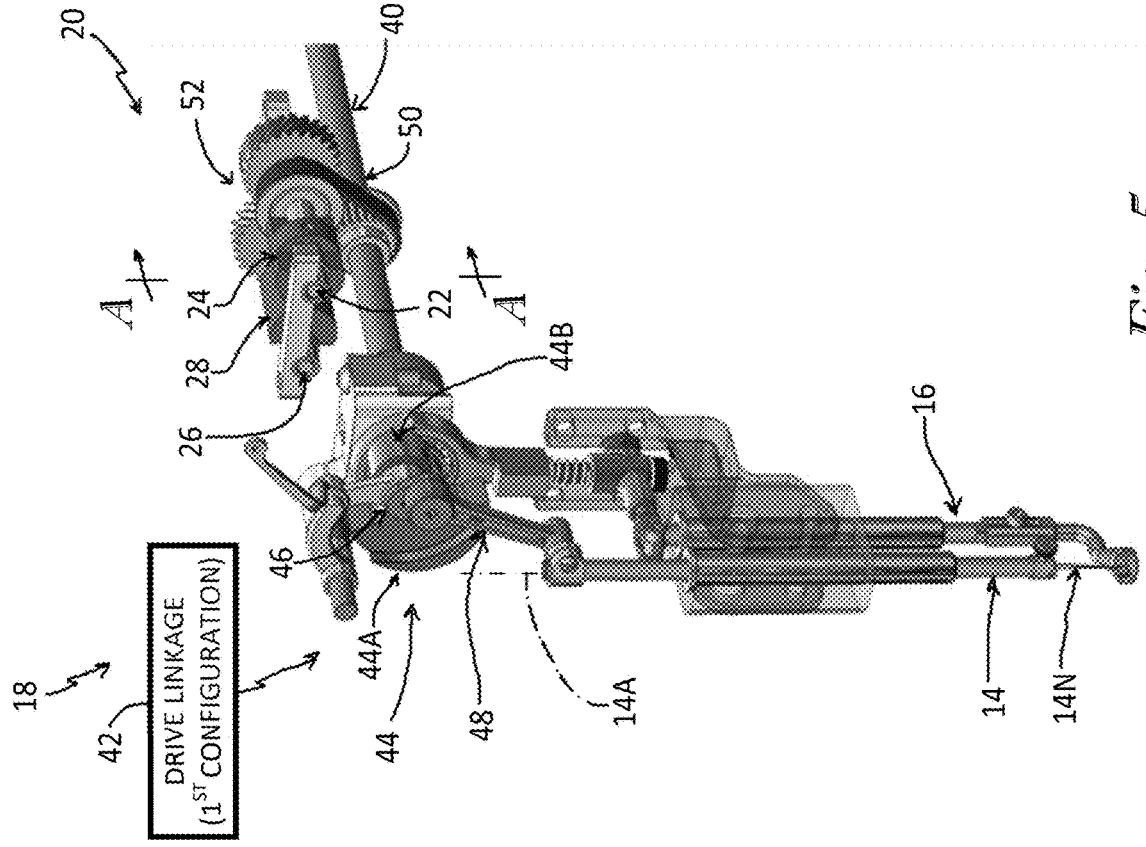

20
VIBRATION DAMPENER SYSTEM (1ST NEUTRAL CONFIGURATION)
52
60
62
22
22A
24B
1ST OFFSET WEIGHT (1ST POSITION)
24
24A
58
50
54
40
40A
26
26A
28A
28B
2ND OFFSET WEIGHT (1ST POSITION)
28

Fig. 5A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22
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44B
16
46
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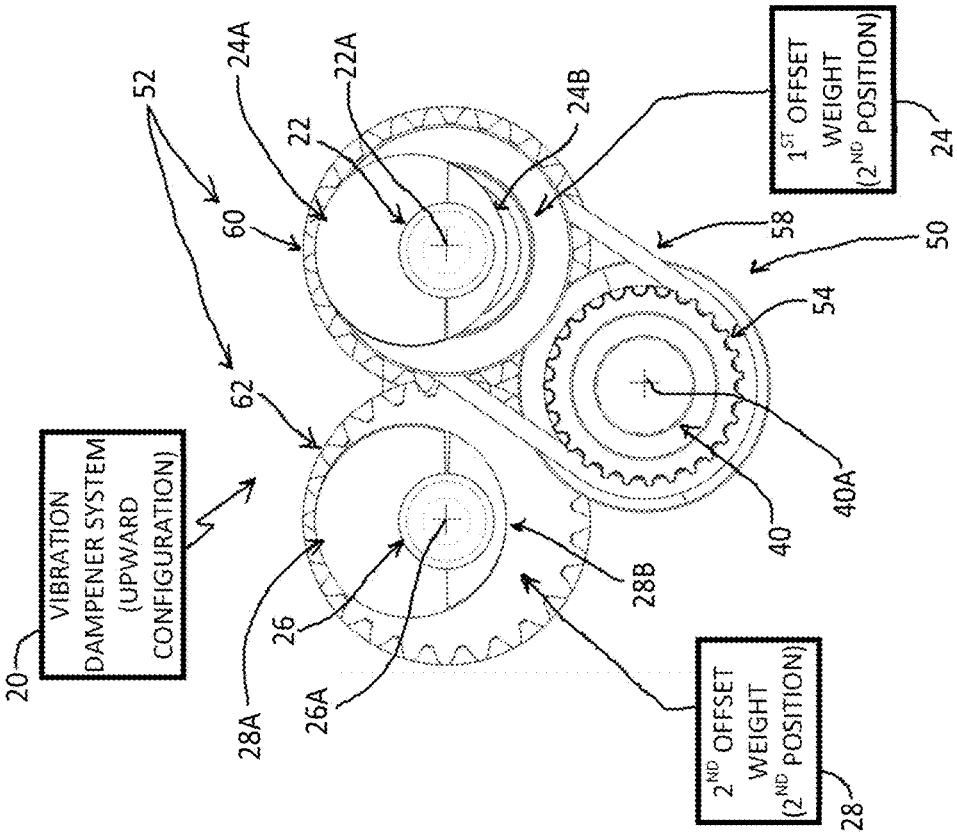
42
DRIVE LINKAGE (1ST CONFIGURATION)
44A
44
48
14A
14
14N

Fig. 5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VIBRATION DAMPENER SYSTEM (UPWARD CONFIGURATION)
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24A
22A
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24B
1ST OFFSET WEIGHT (2ND POSITION)
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40A
28B
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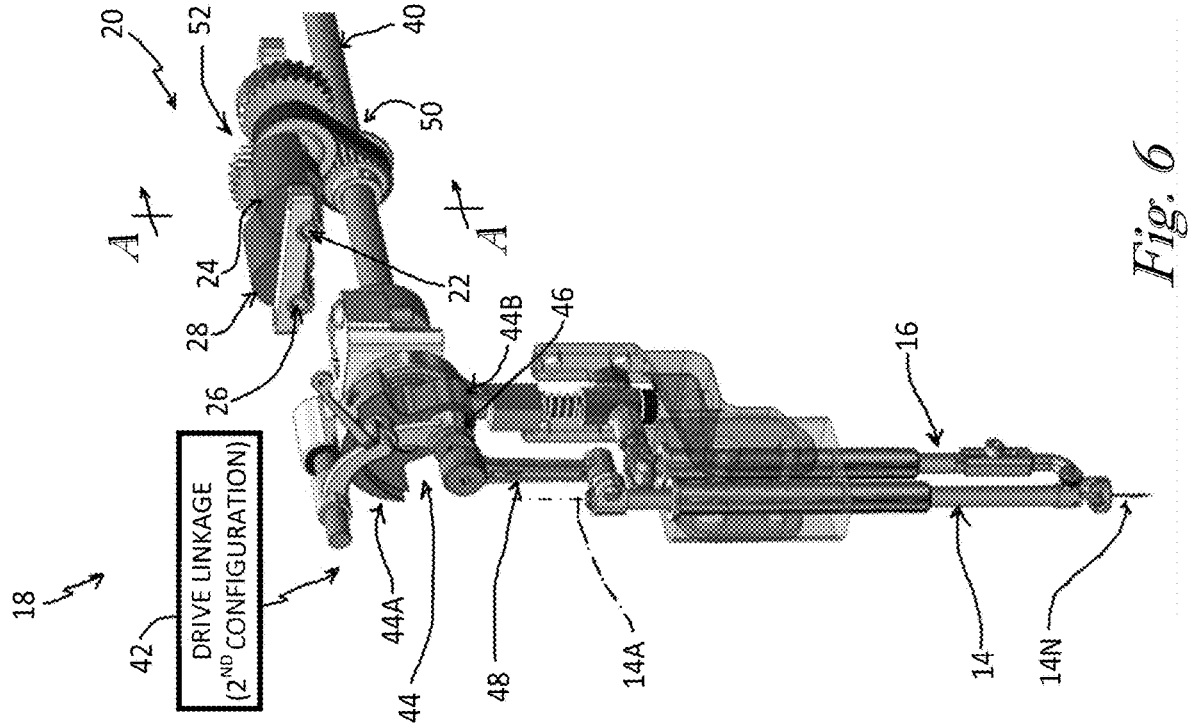
26A
28A
2ND OFFSET WEIGHT (2ND POSITION)
28

Fig. 6A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A
A
24
22
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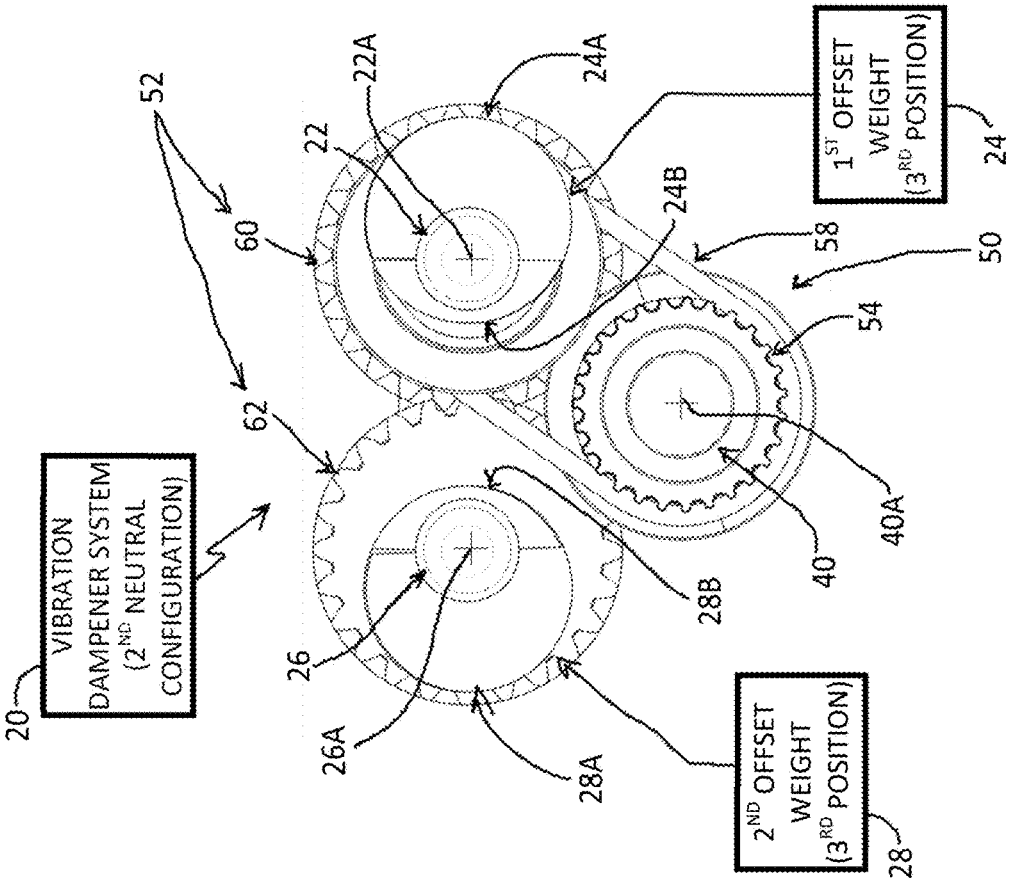
44B
46
16
DRIVE LINKAGE (2ND CONFIGURATION)
42
44A
44
48
14A
14
14N

Fig. 6


VIBRATION DAMPENER SYSTEM (2ND NEUTRAL CONFIGURATION)
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1ST OFFSET WEIGHT (3RD POSITION)
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2ND OFFSET WEIGHT (3RD POSITION)
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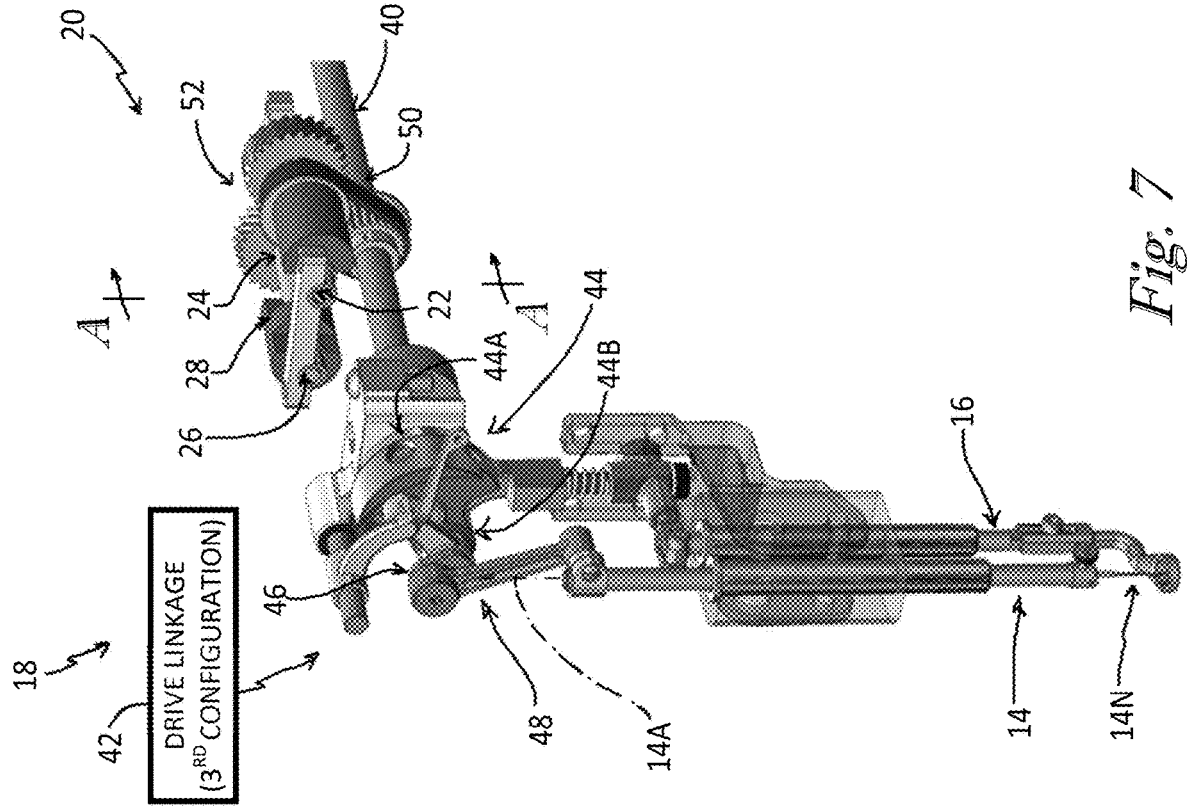
Fig. 7A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44B
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DRIVE LINKAGE (3RD CONFIGURATION)
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14A
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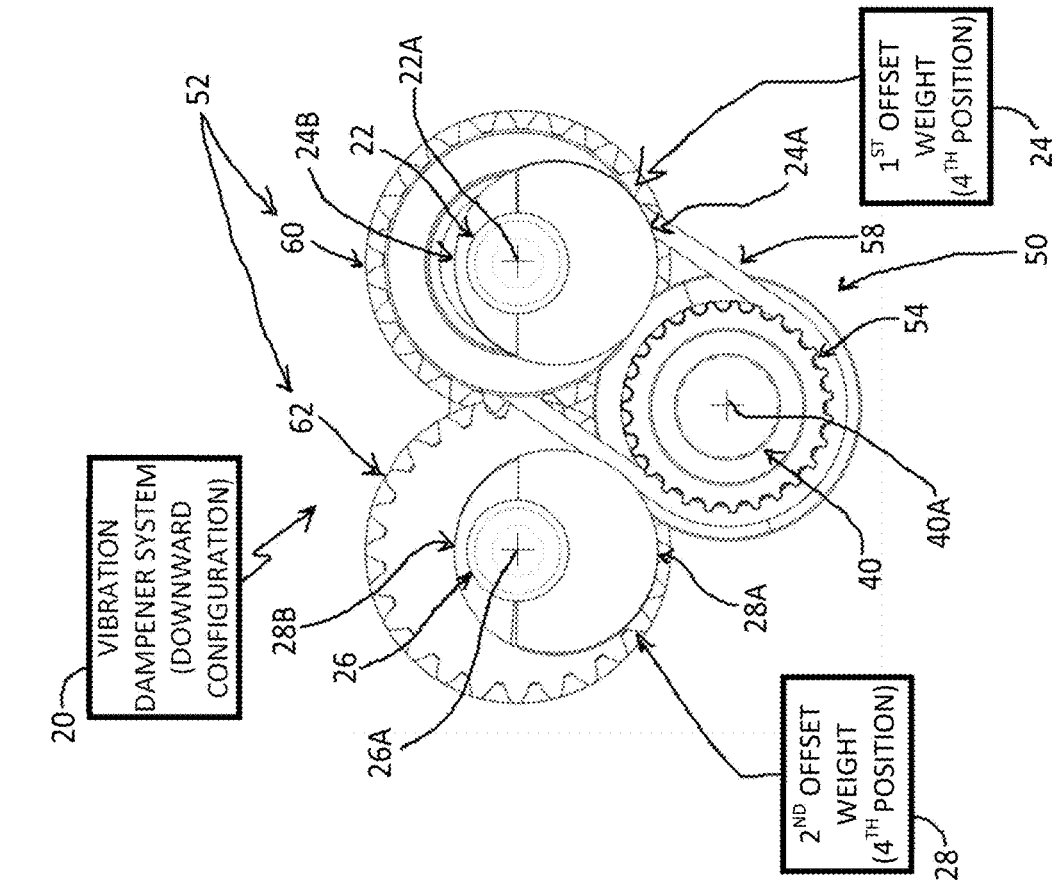
14N

Fig. 7


VIBRATION DAMPENER SYSTEM (DOWNWARD CONFIGURATION)
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24B
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22A
24A
1ST OFFSET WEIGHT (4TH POSITION)
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28B
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2ND OFFSET WEIGHT (4TH POSITION)
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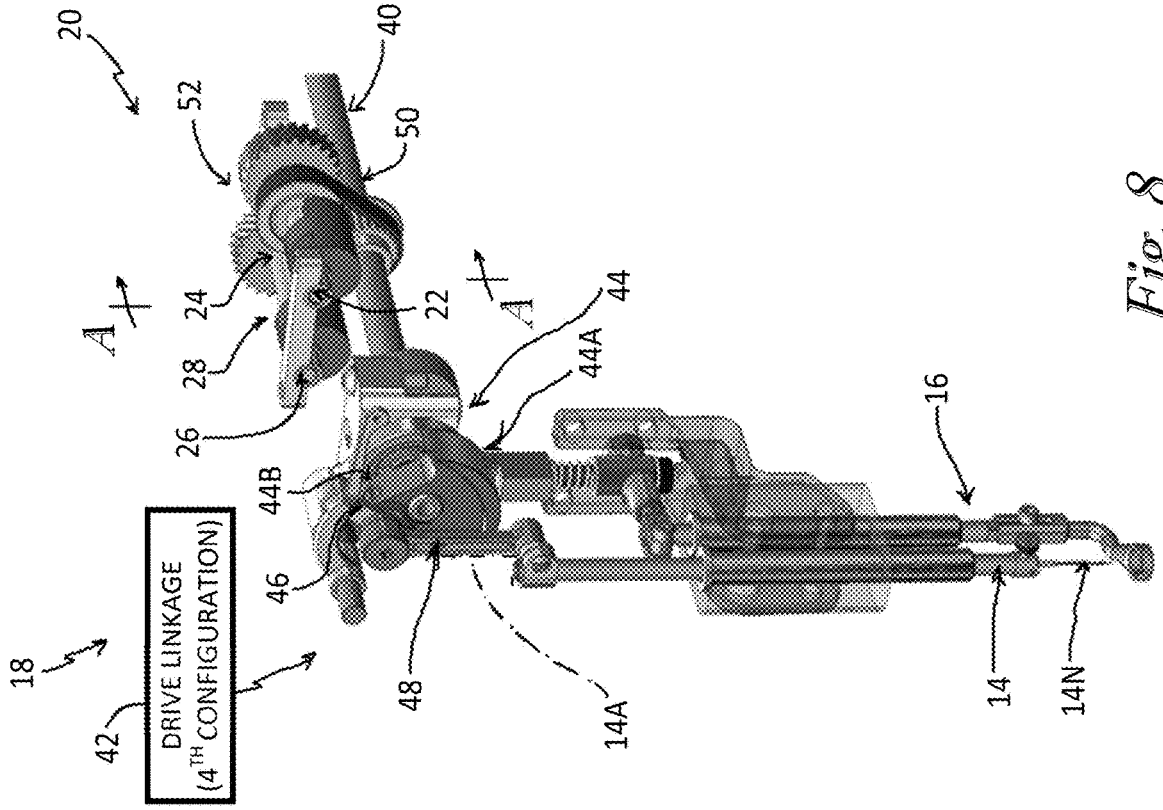
Fig. 8A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DRIVE LINKAGE (4TH CONFIGURATION)

Fig. 8

SEWING MACHINE VIBRATION DAMPENER

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of U.S. Provisional Patent Application No. 63/607,216, filed 7 Dec. 2023, the disclosure of which is now expressly incorporated herein by reference.

FIELD OF DISCLOSURE

[0002] The present disclosure relates generally to sewing or quilting machines, and more specifically to attachments for sewing or quilting machines.

BACKGROUND

[0003] Sewing machines are used for stitching one or more pieces of fabric with thread. Some sewing machines are stationary such that fabric is fed under a needle of the sewing machine, while other sewing machines, like quilting machines, are maneuverable such that the needle may be moved across the fabric.

[0004] Maneuverable sewing machines allow a user to create intricate patterns with the stitching. Such sewing or quilting machines, however, may also make it difficult to accurately follow a path on the fabric, such as a seam, a ditch line, or another desired pattern. They are also subject to vibrational feedback making it more difficult for the user to precise control movement of the machine.

SUMMARY

[0005] The present disclosure may comprise one or more of the following features and combinations thereof.

[0006] A sewing machine assembly may comprise a sewing machine frame, a needle bar, a drive shaft coupled to the needle bar axis, and a vibration dampener system. The sewing machine frame may include a frame base, a frame body that extends from the frame base, a frame head coupled to the frame body that extends from the frame body toward the frame base to define a throat of the sewing machine frame. The needle bar may be configured to linearly reciprocate relative to the sewing machine frame along a needle bar axis. The drive shaft may be configured to rotate about a drive axis in a first direction to drive linear reciprocation of the needle bar along the needle bar axis. The vibration dampener system may be coupled to the drive shaft to reduce vibration of the sewing machine assembly caused by linear reciprocation of the needle bar during use of the sewing machine assembly.

[0007] In some embodiments, the vibration dampener system may comprise a first counterbalance shaft configured to rotate about a first axis in the first direction, a first offset weight coupled to the first counterbalance shaft for rotation therewith, a second counterbalance shaft configured to rotate about a second axis in a second direction, and a second offset weight coupled to the second counterbalance shaft for rotation therewith. The second direction rotation of the second counter balance shaft may be opposite the first direction of the first counterbalance shaft. The second offset weight may oppose the first offset weight at neutral positions as the needle bar linearly reciprocates relative to the sewing machine frame. In some embodiments, the first offset weight is equal to the second offset weight.

[0008] In some embodiments, the first counterbalance shaft may be coupled to the drive shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction. The second counterbalance shaft may be coupled to the first counterbalance shaft so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

[0009] In some embodiments, the vibration dampener system may further comprise a first gear coupled to the first counterbalance shaft for rotation therewith and a second gear coupled to the second counterbalance shaft for rotation therewith. The second gear may mate with the first gear so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

[0010] In some embodiments, the vibration dampener system may further comprise a drive belt. The drive belt may extend between the drive shaft and the first counterbalance shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction.

[0011] In some embodiments, the first counterbalance shaft may be coupled to the drive shaft so that rotation of the drive shaft drives rotation of the first counterbalance shaft. The second counterbalance shaft may be coupled to the drive shaft so that rotation of the drive shaft in the first direction drives rotation of the second counterbalance shaft in the second direction. In some embodiments, the first counterbalance shaft and the second counterbalance shaft may be independently driven.

[0012] In some embodiments, the sewing machine assembly may further comprise a drive linkage. The drive linkage may extend between and interconnect the drive shaft and the needle bar to transfer the rotation of the drive shaft to linear movement of the needle bar.

[0013] In some embodiments, the drive linkage may comprise a counterbalance weight coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight, a link arm coupled to the lower mass end of the counterbalance weight for rotation therewith, and a needle bar crank that extends between a first end coupled to the link arm and a second end coupled to the needle bar.

[0014] In some embodiments, the sewing machine assembly may further comprise a counterbalance weight. The counterbalance weight may be coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight.

[0015] According to another aspect of the present disclosure, a vibration dampener system may be adapted for use with a sewing machine to reduce vibration of the sewing machine caused by reciprocal linear movement of a needle bar during use of the sewing machine. The vibration dampener system may comprise a first counterbalance shaft, a first offset weight, a second counterbalance shaft, and a second offset weight.

[0016] In some embodiments, the first counterbalance shaft may be coupled to a drive shaft of the sewing machine

and configured to rotate about a first axis in a first direction. The drive shaft may be coupled to the needle bar. The drive shaft may be configured to rotate about a drive axis in the first direction to drive linear reciprocation of the needle bar.

[0017] In some embodiments, the first offset weight may be coupled to the first counterbalance shaft for rotation therewith. The second counterbalance shaft may be coupled to the first counterbalance shaft and may be configured to rotate about a second axis in a second direction opposite the first direction of the first counterbalance shaft. The second offset weight may be coupled to the second counterbalance shaft for rotation therewith so that the second offset weight opposes the first offset weight at neutral positions as the needle bar linearly reciprocates. In some embodiments, the first offset weight is equal to the second offset weight.

[0018] In some embodiments, the vibration dampener system may further comprise a first gear coupled to the first counterbalance shaft for rotation therewith and a second gear coupled to the second counterbalance shaft for rotation therewith. The second gear may mate with the first gear so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

[0019] In some embodiments, the vibration dampener system may further comprise a drive belt. The drive belt may extend between the drive shaft and the first counterbalance shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction.

[0020] These and other features of the present disclosure will become more apparent from the following description of the illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. **1** is a perspective view of an illustrative sewing machine assembly showing the sewing machine assembly includes a sewing machine frame having a frame base, a frame body that extends from the frame base, a frame head coupled to the frame body that extends from the frame body toward the frame base to define a throat of the sewing machine frame;

[0022] FIG. **2** is a view similar to FIG. **1** with the sewing machine frame hidden to show the sewing machine assembly further includes a needle bar configured to linearly reciprocate relative to the sewing machine frame along a needle bar axis, a drive shaft coupled to the needle bar and configured to rotate about a drive axis in a first direction to drive linear reciprocation of the needle bar along the needle bar axis, and a vibration dampener system coupled to the drive shaft to reduce vibration of the sewing machine assembly caused by linear reciprocation of the needle bar during use of the sewing machine assembly;

[0023] FIG. **3** is a perspective view of the vibration dampener system included in the sewing machine assembly of FIG. **2** showing the vibration dampener system includes a first counterbalance shaft with a first offset weight configured to rotate about a first axis in a first direction, a second counterbalance shaft with a second offset weight configured to rotate about a second axis in a second direction, a drive belt mechanism that couples the first counterbalance shaft to the drive shaft so that rotation of the drive shaft rotates the first counterbalance shaft about the first axis, and a gear train that mates the first counterbalance shaft and the second counterbalance shaft so that rotation of the first counterbalance shaft drives rotation of the second counterbalance shaft about the second axis;

[0024] FIG. **4** is an exploded view of the vibration dampener system of FIG. **3** showing the vibration dampener system includes the first counterbalance shaft with the first offset weight, the second counterbalance shaft with the second offset weight, the drive belt mechanism comprising a driver pulley wheel configured to be coupled to the drive shaft, a driven pulley wheel configured to be coupled to the first counterbalance shaft, and a drive belt configured to extend between to transfer rotation from the drive shaft to the first counterbalance shaft, the gear train comprising a first gear configured to be coupled to the first counterbalance shaft and a second gear configured to be coupled to the second counterbalance shaft;

[0025] FIG. **5** is a perspective view of the drive system and the vibration dampener system included in the sewing machine assembly of FIG. **2** showing the drive linkage is in a first configuration so that the vibration dampener system is in a first neutral configuration in which the offset weights are in a first position as shown in FIG. **5**A;

[0026] FIG. **5**A is a cross-section view of FIG. **5** taken along line A-A showing the offset weights are in the first position, or one of the neutral positions, such that a higher mass ends of each offset weight faces towards each other;

[0027] FIG. **6** is a perspective view similar to FIG. **5** showing the drive linkage has moved to a second configuration to cause the needle bar to move downwards into the fabric, and further showing the vibration dampener system has moved to an upward configuration in which the offset weights have rotated in opposite directions to a second position as shown in FIG. **6**A;

[0028] FIG. **6**A is a cross-section view of FIG. **6** taken along line A-A showing the offset weights are in the second position such that the higher mass ends of each offset weight are above the respective counterbalance shaft and face away from the drive shaft;

[0029] FIG. **7** is a perspective view similar to FIG. **6** showing the drive linkage has moved to a third configuration to cause the needle bar to move back upwards out of the fabric, and further showing the vibration dampener system has moved to a second neutral configuration in which the offset weights have rotated in opposite directions to a third position as shown in FIG. **7**A;

[0030] FIG. **7**A is a cross-section view of FIG. **7** taken along line A-A showing the offset weights are in the third position, or the other neutral position, such that the higher mass ends of each offset weight face in opposite directions away from each other;

[0031] FIG. **8** is a perspective view similar to FIG. **7** showing the drive linkage has moved to a fourth configuration to cause the needle bar to move further upwards away from the fabric, and further showing the vibration dampener system has moved to a downward configuration in which the offset weights have rotated in opposite directions to a fourth position as shown in FIG. **8**A; and

[0032] FIG. **8**A is a cross-section view of FIG. **8** taken along line A-A showing the offset weights are in the fourth position such that the higher mass ends of each offset weight are below the respective counterbalance shaft and face toward the drive shaft.

DETAILED DESCRIPTION OF THE DRAWINGS

[0033] For the purposes of promoting an understanding of the principles of the disclosure, reference will now be made to a number of illustrative embodiments illustrated in the drawings and specific language will be used to describe the same.

[0034] An illustrative embodiment of a sewing machine assembly **10** is shown in FIG. **1**. The sewing machine assembly **10** includes a sewing machine frame **12**, a needle bar **14**, a presser bar **16**, a drive system **18**, and a vibration dampener system **20** as shown in FIGS. **1-3**. The needle bar **14** is configured to linearly reciprocate relative to the sewing machine frame **12** along a needle bar axis **14**A. The presser bar **16** is mounted to the sewing machine frame **12** and supports a presser or hopping foot. The drive system **18** is configured to drive linear reciprocation of the needle bar **14** along the needle bar axis **14**A. The vibration dampener system **20** configured to reduce vibration of the sewing machine assembly **10** caused by linear reciprocation of the needle bar **14** during use of the sewing machine assembly **10**.

[0035] During use of a sewing machine, the drive system causes the needle bar to linearly reciprocate relative to the sewing machine frame. The oscillations of the needle bar may cause the sewing machine to vibrate. At certain speeds, the movement of the needle bar may causes the sewing machine frame to vibrate at its resonance frequency.

[0036] For freely maneuverable sewing machines, i.e. machines able to move in lateral and longitudinal directions relative to the fabric, vibration of the sewing machine frame may make it difficult for the user to accurately move the sewing machine assembly along the desired pattern or stitch line. Moreover, if the sewing machine frame begins to vibrate at its resonance frequency, the user may have a difficult time controlling the movement of the sewing machine assembly.

[0037] The sewing machine assembly **10**, therefore, includes the vibration dampener system **20** to reduce vibration of the sewing machine assembly **10**. The vibration dampener system **20** is coupled to the drive system **18** of the sewing machine assembly **10** to reduce vibration of the sewing machine assembly **10** in the illustrative embodiment.

[0038] The vibration dampener system **20** includes a first counterbalance shaft **22** with a first offset weight **24** and a second counterbalance shaft **26** with a second offset weight **28** as shown in FIGS. **2-4**. The first counterbalance shaft **22** is configured to rotate about a first axis **22**A in a first direction. The first offset weight **24** is coupled to the first counterbalance shaft **22** for rotation therewith. The second counterbalance shaft **26** is configured to rotate about a second axis **26**A in a second direction opposite the first direction of the first counterbalance shaft **22**. The second offset weight **28** is coupled to the second counterbalance shaft **26** for rotation therewith so that the second offset weight **28** opposes the first offset weight **24** at neutral positions as the needle bar **14** linearly reciprocates relative to the sewing machine frame **12**.

[0039] Each offset weight **24**, **28** has a higher mass end **24**A, **28**A and a lower mass end **24**B, **28**B as shown in FIGS. **5-8**A. The first counterbalance shaft **22** is coupled to the first offset weight **24** closer to the lower mass end **24**B of the first offset weight **24** and the second counterbalance shaft **26** is coupled to the second offset weight **28** closer to the lower mass end **28**B of the second offset weight **28** as shown in FIGS. **5-8**A.

[0040] The vibration dampener system **20** moves through a plurality of positions as the drive system **18** moves the needle bar **14** linearly along the needle bar axis **14**A as shown in FIGS. **5-8**A. When the needle bar **14** is just above the fabric, but before the needle bar **14** is driven downwardly through the fabric, the vibration dampener system **20** is in a first neutral configuration in which the offset weights **24**, **28** are in a first position as shown in FIGS. **5** and **5**A. In the first position, or one of the neutral positions, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** faces towards each other as shown in FIGS. **5** and **5**A. The first and second offset weights **24**, **28** oppose each other in the first position as the needle bar **14** is in between being fully upward as shown in FIG. **6** or fully downward as shown in FIG. **8**.

[0041] As the needle bar **14** is driven downwardly through the fabric, the vibration dampener system **20** moves to an upward configuration in which the offset weights **24**, **28** are in a second position as shown in FIGS. **6** and **6**A. In the second position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** are above the respective counterbalance shaft **22**, **26** and face away from the drive shaft **40** as shown in FIGS. **6** and **6**A. In the second position, the first and second offset weights **24**, **28** provide a balancing force in the upwards direction as the needle bar **14** moves downward.

[0042] As the needle bar **14** moves back out of the fabric, the vibration dampener system **20** moves to a second neutral configuration in which the offset weights **24**, **28** are in a third position as shown in FIGS. **7** and **7**A. In the third position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** face in opposite directions away from each other as shown in FIGS. **7** and **7**A. The first and second offset weights **24**, **28** oppose each other in the third position as the needle bar **14** is between being fully upward as shown in FIG. **6** or fully downward as shown in FIG. **8**.

[0043] As the needle bar **14** moves to the fully upward position, the vibration dampener system **20** moves to the downward configuration in which the offset weights **24**, **28** are in a fourth position as shown in FIGS. **8** and **8**A. In the fourth position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** are below the respective counterbalance shaft **22**, **26** and face toward the drive shaft **40** as shown in FIGS. **8** and **8**A. In the fourth position, the first and second offset weights **24**, **28** provide a balance force in the downwards direction as the needle bar **14** moves upward.

[0044] Each counterbalance shaft **22**, **26** is mounted to the sewing machine frame **12** using mount brackets **30**, **32**. The sewing machine assembly **10** includes a first mount bracket **30** that mounts one end of each counterbalance shaft **22**, **26** and a second mount bracket **32** spaced apart axially from the first mount bracket **30** that mounts the opposite end of each counterbalance shaft **22**, **26**. Each mount bracket **30**, **32** has bearings **34**, **36** that support each shaft **22**, **26** for rotation about the respective axes **22**A, **26**A. The mount bracket **30** has bearings **34**, while mount bracket **32** has bearings **36** as shown in FIG. **4**,

[0045] Turning again to the drive system **18** includes a drive shaft **40** and a drive linkage **42** as shown in FIGS. **2-4**. The drive shaft **40** is configured to rotate about a drive axis **40**A in the first direction to drive linear reciprocation of the needle bar **14** along the needle bar axis **14**. The drive linkage **42** extends between and interconnects the drive shaft **40** and

the needle bar **14** to transfer the rotation of the drive shaft **40** to linear movement of the needle bar **14**.

[0046] The drive linkage **42** includes a counterbalance weight **44**, a link arm **46**, and a needle bar crank **48** as shown in FIG. **3**. The counterbalance weight **44** is coupled to one end of the drive shaft **40** for rotation therewith. The end of the drive shaft **40** is positioned between a higher mass end **44**A of the counterbalance weight **44** and a lower mass end **44**B of the counterbalance weight **44**. The link arm **46** is coupled to the lower mass end **44**B of the counterbalance weight **44** for rotation therewith. The needle bar crank **48** extends between a first end **48**A coupled to the link arm **46** and a second end **48**B coupled to the needle bar **14**.

[0047] The drive linkage **42** is configure to move through a plurality of configurations to move the needle bar **14** linearly along the needle bar axis **14**A as shown in FIGS. **5-8**A. When the needle bar **14** is just above the fabric, but before the needle bar **14** is driven downwardly through the fabric, the drive linkage **42** is in a first configuration and the vibration dampener system **20** is in the first neutral configuration as shown in FIGS. **5** and **5**A. In the first configuration, the counterbalance weight **44** is on the left of the drive shaft **40** when view axially down the drive axis **40**A facing a frame head **68** of the sewing machine frame **12**.

[0048] In the first position, or one of the neutral positions, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** of the vibration dampener system **20** faces towards each other as shown in FIGS. **5** and **5**A. The first and second offset weights **24**, **28** oppose each other in the first position as the needle bar **14** is in between being fully upward as shown in FIG. **6** or fully downward as shown in FIG. **8**.

[0049] As the needle bar **14** is driven downwardly through the fabric, the drive linkage **42** moves to a second configuration and the vibration dampener system **20** is in the upward configuration as shown in FIGS. **6** and **6**A. In the second configuration, the higher mass end **44**A of the counterbalance weight **44** is substantially above the drive shaft **40** when view axially down the drive axis **40**A facing the frame head **68** of the sewing machine frame **12**.

[0050] In the second position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** of the vibration dampener system **20** are above the respective counterbalance shaft **22**, **26** and face away from the drive shaft **40** as shown in FIGS. **6** and **6**A. In the second position, the first and second offset weights **24**, **28** provide a balancing force in the upwards direction as the needle bar **14** moves downward.

[0051] As the needle bar **14** moves back out of the fabric, the drive linkage **42** moves to a third configuration and the vibration dampener system **20** is in the second neutral configuration as shown in FIGS. **7** and **7**A. In the third configuration, the counterbalance weight **44** is on the right of the drive shaft **40** when view axially down the drive axis **40**A facing a frame head **68** of the sewing machine frame **12**.

[0052] In the third position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** of the vibration dampener system **20** face in opposite directions away from each other as shown in FIGS. **7** and **7**A. The first and second offset weights **24**, **28** oppose each other in the third position as the needle bar **14** is between being fully upward as shown in FIG. **6** or fully downward as shown in FIG. **8**.

[0053] As the needle bar **14** moves to the fully upward position, the drive linkage **42** moves to a fourth configuration and the vibration dampener system **20** is in the downward configuration as shown in FIGS. **8** and **8**A. In the fourth configuration, the higher mass end **44**A of the counterbalance weight **44** is substantially below the drive shaft **40** when view axially down the drive axis **40**A facing the frame head **68** of the sewing machine frame **12**.

[0054] In the fourth position, the higher mass ends **24**A, **28**A of each offset weight **24**, **28** of the vibration dampener system **20** are below the respective counterbalance shaft **22**, **26** and face toward the drive shaft **40** as shown in FIGS. **8** and **8**A. In the fourth position, the first and second offset weights **24**, **28** provide a balance force in the downwards direction as the needle bar **14** moves upward.

[0055] In the illustrative embodiment, the vibration dampener system **20** is coupled to the drive shaft **40** in between the two ends of the drive shaft **40** as shown in FIG. **3**. The vibration dampener system **20** includes the first counterbalance shaft **22** with the first offset weight **24** and the second counterbalance shaft **26** with the second offset weight **28** as shown in FIGS. **2-4**.

[0056] In the illustrative embodiment, the first counterbalance shaft **22** is coupled to the drive shaft **40** of the drive system **18** and the second counterbalance shaft **24** is coupled to the first counterbalance shaft **22**. The first counterbalance shaft **22** is coupled to the drive shaft **40** so that rotation of the drive shaft **40** in the first direction rotates the first counterbalance shaft **22** about the first axis **22**A. The second counterbalance shaft **24** is coupled to the first counterbalance shaft **22** so that rotation of the first counterbalance shaft **22** in the first direction drives rotation of the second counterbalance shaft **26** in the second direction about the second axis **26**A.

[0057] In the illustrative embodiment, the vibration dampener system **20** includes a drive belt mechanism **50** and a gear train **52** as shown in FIG. **3**. The drive belt mechanism **50** couples the first counterbalance shaft **22** to the drive shaft **40** so that rotation of the drive shaft **40** rotates the first counterbalance shaft **22**. The gear train **52** mates the first counterbalance shaft **22** and the second counterbalance shaft **26** so that rotation of the first counterbalance shaft **22** drives rotation of the second counterbalance shaft **26**.

[0058] The drive belt mechanism **50** includes a driver pulley wheel **54**, a driven pulley wheel **56**, and a drive belt **58** as shown in FIGS. **3** and **4**. The driver pulley wheel **54** is coupled to the drive shaft **40**, while the driven pulley wheel **56** is coupled to the first counterbalance shaft **22**. Both pulley wheels **54**, **56** have teeth that mate with teeth on the drive belt **58**. The drive belt **58** extends between the driver pulley wheel **54** on the drive shaft **40** and the driven pulley wheel **56** on the first counterbalance shaft **22**. The drive belt **58** transfers rotation of the drive shaft **40** about the drive axis **40**A to the first counterbalance shaft **22** so that the first counterbalance shaft **22** rotates about the first axis **22**A in the first direction. In the illustrative embodiment, the drive belt **58** is a timing or toothed belt **58** formed with teeth that mate with teeth on the driver pulley wheel **54** and the driven pulley wheel **56** as shown in FIGS. **3-7**A. In some embodiments, the drive belt **58** may be another suitable drive belt type.

[0059] The gear train **52** includes a first gear **60** and a second gear **62** as shown in FIGS. **3** and **4**. The first gear **60** is coupled to the first counterbalance shaft **22** for rotation therewith. The second gear **62** is coupled to the second counterbalance shaft **26** for rotation therewith. The second gear **62** has teeth that mate with teeth on the first gear **60** so that rotation of the first counterbalance shaft **22** about the

first axis **22**A in the first direction drives rotation of the second counterbalance shaft **26** about the second axis **26**A in the second direction opposite the first direction. The first and second gears **60**, **62** may be any suitable gear type, including, but not limited to, helical gears, spur gears, etc. In the illustrative embodiment, the first and second gears **60**, **62** are helical gears.

[0060] In some embodiments, the second counterbalance shaft **24** may be coupled to the drive shaft **40** of the drive system **18** and the first counterbalance shaft **22** may be coupled to the first counterbalance shaft **22**. The drive belt mechanism **50** may be coupled to the second counterbalance shaft **24** so that rotation of the drive shaft **40** drives rotation of the second counterbalance shaft **24**. The gear train **52** transfers rotation of the second counterbalance shaft **24** to the first counterbalance shaft **22** so that the first counterbalance shaft **22** rotates in the opposite direction.

[0061] In some embodiments, multiple gear trains are used to link the respective shafts together to transfer rotation therebetween. In some embodiments, another linking method may be used to link the rotation of the respective shafts together. In some embodiments, each counterbalance shaft **22**, **26** may be independently driven by a separate actuator.

[0062] In the illustrative embodiment, the sewing machine frame **12** has a frame base **64**, a frame body **66**, and a frame head **68** as shown in FIG. **1**. The frame body **66** extends from the frame base **64**. The frame head **68** is coupled to the frame body **66**. The frame head **68** extends from the frame body **66** toward the frame base **64** to define a throat of the sewing machine frame **12**.

[0063] The drive linkage **42** is located in the frame head **68** of the sewing machine frame **12** as suggested in FIG. **2**. The drive shaft **40** is located in the frame body **66** and frame base **64** as suggested in FIG. **2**. The vibration dampener system **20** is located in the frame body **66** adjacent to the frame head **68**.

[0064] While the disclosure has been illustrated and described in detail in the foregoing drawings and description, the same is to be considered as exemplary and not restrictive in character, it being understood that only illustrative embodiments thereof have been shown and described and that all changes and modifications that come within the spirit of the disclosure are desired to be protected.

What is claimed is:

1. A sewing machine assembly comprising:

a sewing machine frame including a frame base, a frame body that extends from the frame base, a frame head coupled to the frame body that extends from the frame body toward the frame base to define a throat of the sewing machine frame;

a needle bar configured to linearly reciprocate relative to the sewing machine frame along a needle bar axis; and

a drive shaft coupled to the needle bar and configured to rotate about a drive axis in a first direction to drive linear reciprocation of the needle bar along the needle bar axis; and

a vibration dampener system coupled to the drive shaft to reduce vibration of the sewing machine assembly caused by linear reciprocation of the needle bar during use of the sewing machine assembly,

wherein the vibration dampener system comprises:

a first counterbalance shaft configured to rotate about a first axis in the first direction;

a first offset weight coupled to the first counterbalance shaft for rotation therewith;

a second counterbalance shaft configured to rotate about a second axis in a second direction opposite the first direction of the first counterbalance shaft; and

a second offset weight coupled to the second counterbalance shaft for rotation therewith so that the second offset weight opposes the first offset weight at neutral positions as the needle bar linearly reciprocates relative to the sewing machine frame.

2. The sewing machine assembly of claim **1**, wherein the first offset weight is equal to the second offset weight.

3. The sewing machine assembly of claim **2**, wherein the first counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction and the second counterbalance shaft is coupled to the first counterbalance shaft so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

4. The sewing machine assembly of claim **3**, wherein the vibration dampener system further comprises:

a first gear coupled to the first counterbalance shaft for rotation therewith; and

a second gear coupled to the second counterbalance shaft for rotation therewith;

wherein the second gear mates with the first gear so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

5. The sewing machine assembly of claim **3**, wherein the vibration dampener system further comprises:

a drive belt that extends between the drive shaft and the first counterbalance shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction.

6. The sewing machine assembly of claim **2**, wherein the first counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft drives rotation of the first counterbalance shaft and the second counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft in the first direction drives rotation of the second counterbalance shaft in the second direction.

7. The sewing machine assembly of claim **2**, wherein the first counterbalance shaft and the second counterbalance shaft are independently driven.

8. The sewing machine assembly of claim **2**, further comprising:

a drive linkage that extends between and interconnects the drive shaft and the needle bar to transfer the rotation of the drive shaft to linear movement of the needle bar, the drive linkage comprising

a counterbalance weight coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight;

a link arm coupled to the lower mass end of the counterbalance weight for rotation therewith; and

a needle bar crank that extends between a first end coupled to the link arm and a second end coupled to the needle bar.

9. The sewing machine assembly of claim **2**, further comprising:

a counterbalance weight coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight.

10. The sewing machine assembly of claim **1**, wherein the first counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction and the second counterbalance shaft is coupled to the first counterbalance shaft so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

11. The sewing machine assembly of claim **1**, wherein the first counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft drives rotation of the first counterbalance shaft and the second counterbalance shaft is coupled to the drive shaft so that rotation of the drive shaft in the first direction drives rotation of the second counterbalance shaft in the second direction.

12. The sewing machine assembly of claim **1**, wherein the first counterbalance shaft and the second counterbalance shaft are independently driven.

13. The sewing machine assembly of claim **1**, further comprising:

a drive linkage that extends between and interconnects the drive shaft and the needle bar to transfer the rotation of the drive shaft to linear movement of the needle bar, the drive linkage comprising

a counterbalance weight coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight;

a link arm coupled to the lower mass end of the counterbalance weight for rotation therewith; and

a needle bar crank that extends between a first end coupled to the link arm and a second end coupled to the needle bar.

14. The sewing machine assembly of claim **1**, further comprising:

a counterbalance weight coupled to one end of the drive shaft for rotation therewith with the drive shaft positioned between a higher mass end of the counterbalance weight and a lower mass end of the counterbalance weight.

15. A vibration dampener system adapted for use with a sewing machine to reduce vibration of the sewing machine caused by reciprocal linear movement of a needle bar during use of the sewing machine, the vibration dampener system comprising:

a first counterbalance shaft coupled to a drive shaft of the sewing machine and configured to rotate about a first axis in a first direction, wherein the drive shaft is coupled to the needle bar and is configured to rotate about a drive axis in the first direction to drive linear reciprocation of the needle bar,

a first offset weight coupled to the first counterbalance shaft for rotation therewith; and

a second counterbalance shaft coupled to the first counterbalance shaft and configured to rotate about a second axis in a second direction opposite the first direction of the first counterbalance shaft; and

a second offset weight coupled to the second counterbalance shaft for rotation therewith so that the second offset weight opposes the first offset weight at neutral positions as the needle bar linearly reciprocates.

16. The vibration dampener system of claim **15**, wherein the first offset weight is equal to the second offset weight.

17. The vibration dampener system of claim **16**, wherein the vibration dampener system further comprises:

a first gear coupled to the first counterbalance shaft for rotation therewith; and

a second gear coupled to the second counterbalance shaft for rotation therewith;

wherein the second gear mates with the first gear so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

18. The vibration dampener system of any one of claim **17**, wherein the vibration dampener system further comprises:

a drive belt that extends between the drive shaft and the first counterbalance shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction.

19. The vibration dampener system of claim **15**, wherein the vibration dampener system further comprises:

a first gear coupled to the first counterbalance shaft for rotation therewith; and

a second gear coupled to the second counterbalance shaft for rotation therewith;

wherein the second gear mates with the first gear so that rotation of the first counterbalance shaft about the first axis in the first direction drives rotation of the second counterbalance shaft about the second axis in the second direction opposite the first direction.

20. The vibration dampener system of claim **15**, wherein the vibration dampener system further comprises:

a drive belt that extends between the drive shaft and the first counterbalance shaft so that rotation of the drive shaft about the drive axis in the first direction drives rotation of the first counterbalance shaft about the first axis in the first direction.

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