Aug. 23, 1955 M. E. CAMERON ET AL 2,715,912

MOVING AIR SUPPLY SYSTEM

Filed Dec. 8, 1952 3 Sheets-Sheet 1

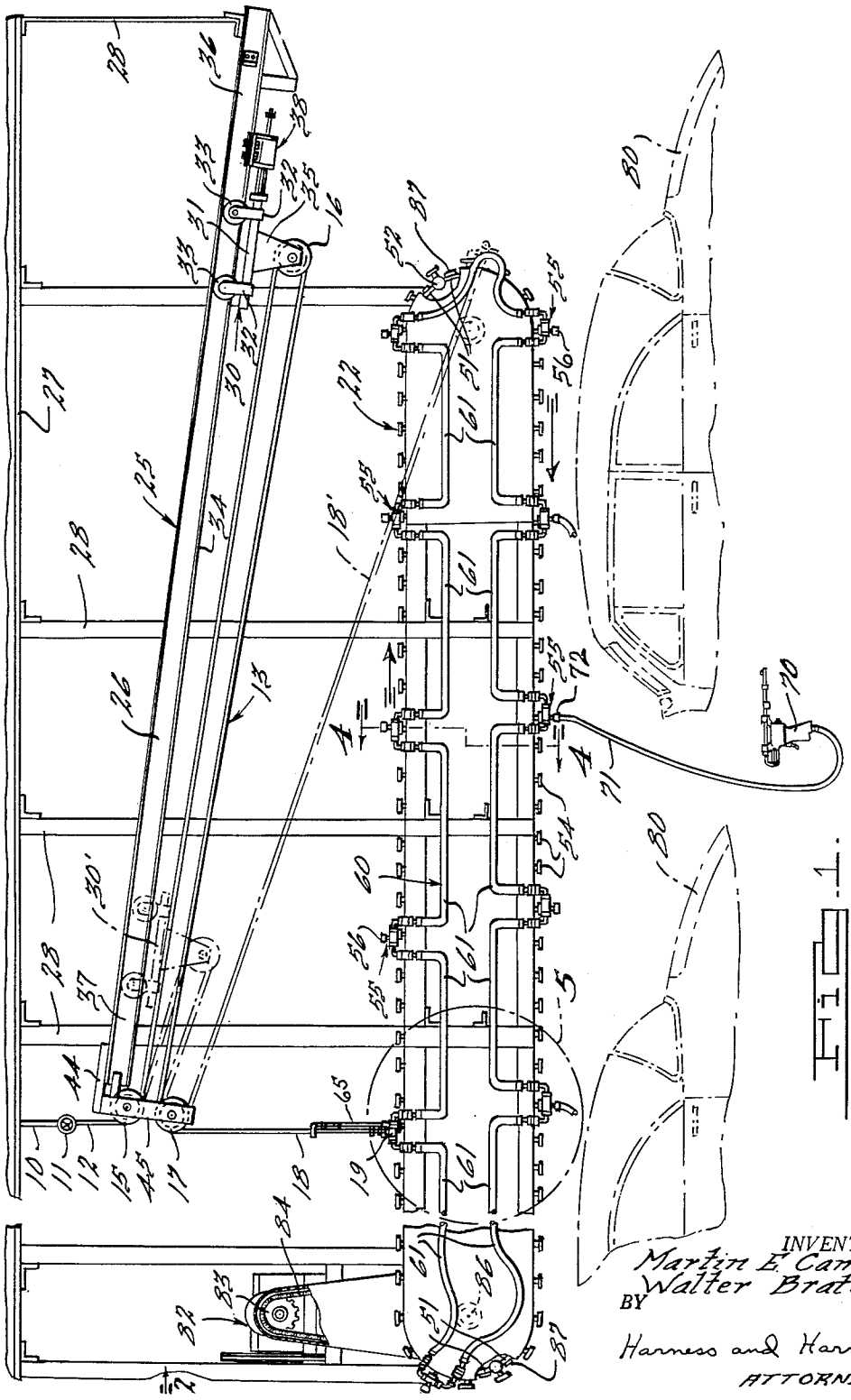


Fig. 1.

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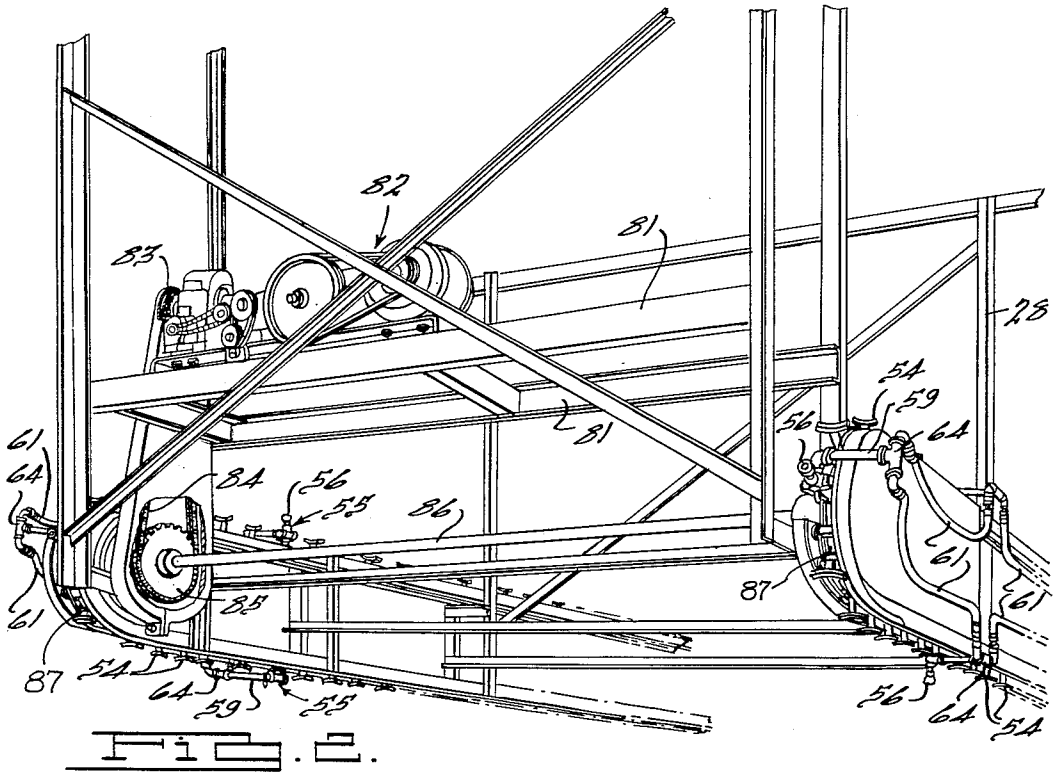


Fig. 2.

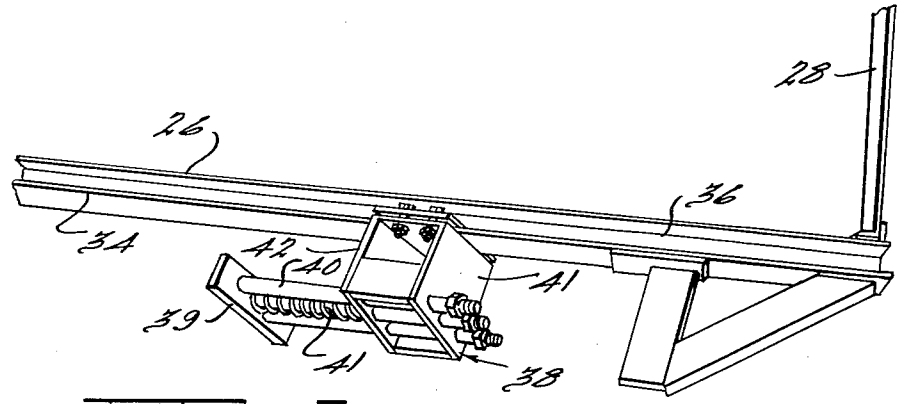


Fig. 3.

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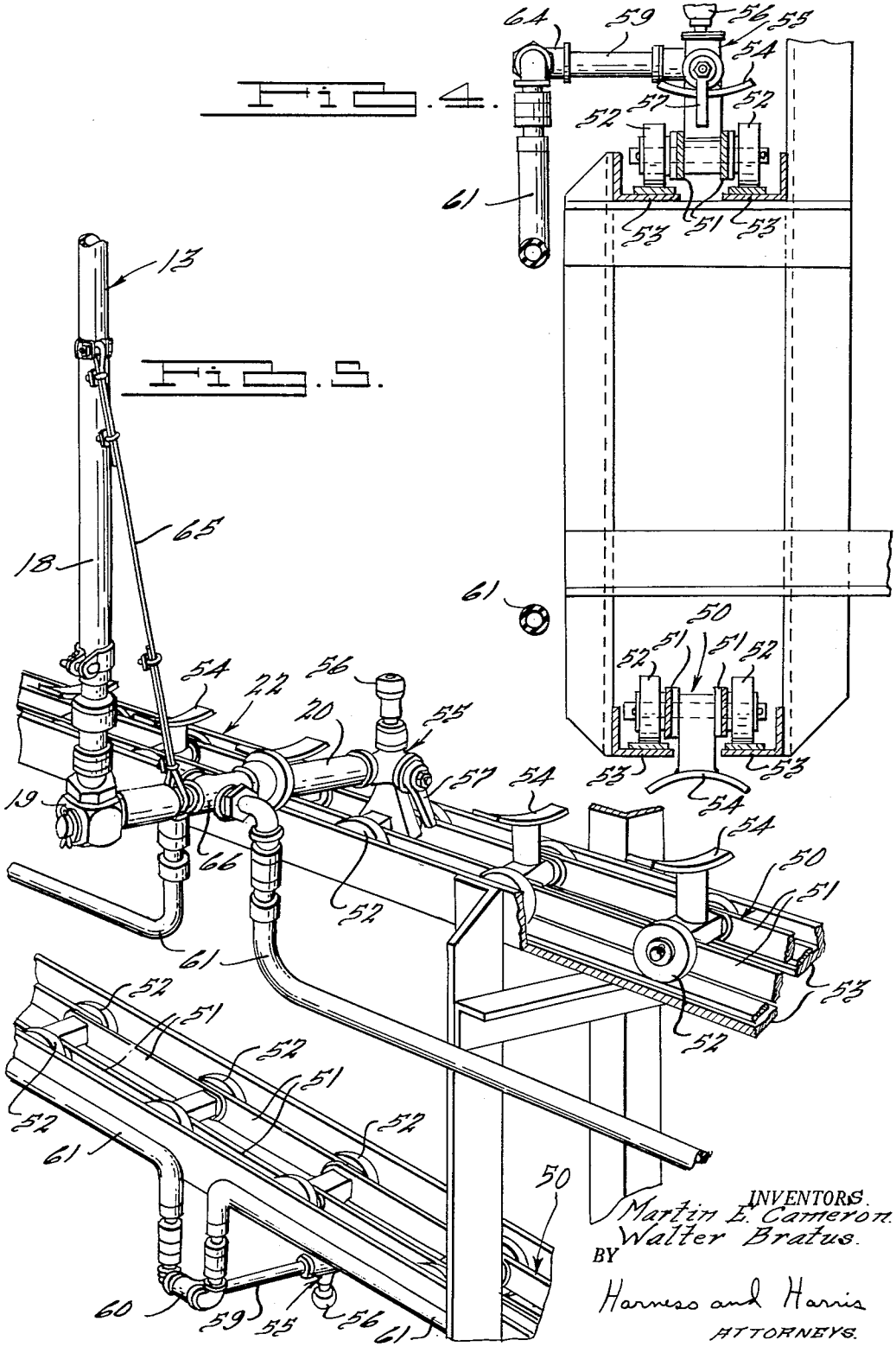
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MOVING AIR SUPPLY SYSTEM

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Fig. 4.

Fig. 5.



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2,715,912

MOVING AIR SUPPLY SYSTEM

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12 Claims. (Cl. 137—599)

This invention relates to pressure fluid supply systems and particularly to air supply systems adapted for use in conjunction with conveyor systems on assembly lines or the like.

With the advent of assembly line methods of fabricating articles such as automobiles and the like, it immediately became obvious that some method must be provided to continuously supply power to the assembly line workers power tools as the worker and the work article moved along the assembly line. Various schemes for utilizing overhead electric power supply trolleys have been utilized in the past so that electrically operated tools could be used at a plurality of locations along the assembly line. In a number of instances, however, it is more advantageous to utilize pneumatically operated tools rather than electrically operated tools and furthermore the dangers involved in the use of pneumatically operated tools are much less than with corresponding electrically operated tools.

In all of the power supply systems utilized to date along assembly lines, air or electric, there has always been a problem of keeping the several tool lead-in lines and power supply lines free so that they would not become tangled or broken as the work article and the worker were moved to different locations along the assembly line. In addition to preventing entanglement of the tool lines and the power supply lines, it was necessary that there be a quick, easy, safe method of connecting and disconnecting the various power operated tool lines to the power supply lines. In electrically operated systems sparks are often caused during the engagement or disengagement of an electrically operated tool with its power supply trolley or the like. These sparks present a fire hazard particularly if fumes of an explosive nature happened to be present in the area of the supply line. In addition to the fire and explosion hazard, frequently the tool lead-in lines cables on electrically operated tools would become frayed or broken and the assembly line worker would be subjected to shock as he attempted to connect his tool to or disconnect it from its power supply source. From the aforementioned brief discussion it is thought to be obvious that pneumatically operated power tools have certain very definite advantages over electrically operated power tools for assembly line work. Accordingly there has been a pressing desire for a simplified, continuous air supply system that would provide a plurality of moving air outlet connections along all portions of the assembly line.

The air supply system herein disclosed is adapted to provide a plurality of air supply outlets that continuously move along the assembly line, usually at the speed of the work article that is being moved along the assembly line. This air supply system provides means whereby a plurality of pneumatically operated power tools may be easily, safely and quickly either connected to or disconnected from the circulating air outlets. In addition, this air supply system includes novel means whereby the flexible air supply conduit, that connects the air supply

header to the circulating air outlets, may have its effective length varied to compensate for continuous movement of the associated air outlets along the assembly line. With the air supply system herein disclosed there is little, if any, possibility of the air supply conduit, the circulating air outlet conduit or the air tool conduits becoming tangled or broken or obstructed in any way. This air supply system is relatively simple in design and consequently inexpensive to manufacture and install. The various elements used in this air supply system are substantially standard items that have been assembled in a novel manner to provide an air supply system that solves the heretofore major problem in the use of pneumatically operated power tools along a moving assembly line.

It is a primary object of this invention to provide an air supply system having one or more air tool outlets that continuously move along the assembly line usually at the same speed as the work article passing along the assembly line.

It is another object of this invention to provide an air supply system having a novel means for controlling variation in the effective length of the flexible air supply conduit that is connected between the air system supply header and the movable carrier conduit for the air supply outlet connections.

It is still another object of this invention to provide an air supply system having a novel form of circulating air outlet carrier conduit.

It is a further object of this invention to provide an air supply system having novel means for coordinating the movement of one or more air supply outlets along the assembly line with the movement of the work article along the assembly line.

Other objects and advantages of this invention will become readily apparent from a reading of the following specifications and a consideration of the related drawings wherein:

Fig. 1 is a side elevational view of an air supply system embodying this invention installed along an assembly line, the view having certain parts of the air supply system broken away to permit the use of a larger drawing scale for the sake of clarity;

Fig. 2 is an enlarged, fragmentary, perspective view of the left end of the air supply system shown in Fig. 1, this view being taken generally in the direction of the arrow 2 applied to Fig. 1;

Fig. 3 is an enlarged, fragmentary, perspective view of the bumper mechanism associated with the slack take-up means for varying the effective length of the flexible air supply conduit of this air supply system;

Fig. 4 is an enlarged, sectional elevational view taken along the line 4—4 of Fig. 1 showing a portion of the circulating air outlet carrier means of this air supply system; and

Fig. 5 is an enlarged, fragmentary, perspective view of another portion of the air outlet carrier means, this view being taken at the area denoted by the circle 5 in Fig. 1.

Considering first Fig. 1 of the drawings, it will be noted that the reference numeral 10 is applied to a header pipe of an overhead air supply system. Header pipe 10 is connected through a valve 11 to one end 12 of a flexible air supply conduit that is generally represented by the numeral 13. The flexible air supply conduit 13 extends from its aforementioned one end 12 around a first fixedly mounted, pulley wheel 15 and then around a longitudinally spaced apart, movable, second pulley wheel 16 from whence it is bent back upon itself and directed around a third, fixedly mounted pulley wheel 17 after which its other end 18 is connected to a universal pipe joint coupling 19 (see Fig. 5 particularly). Pipe coupling 19 is a part of the hereafter described air outlet carrier mechanism 22. Coupling 19 has a pipe section 20 connecting it

to the conduit portion of the air outlet carrier mechanism that is generally represented by the numeral **22**.

The several pulley wheels **15**, **16** and **17** are each parts of a slack take-up mechanism, generally represented by the numeral **25**. This slack take-up mechanism **25** is adapted to automatically vary the effective length of the flexible air supply conduit **13** as its connection **19** to the moving air outlet conduit **60** of the carrier **22** moves to various positions along the assembly line. The slack take-up mechanism **25** comprises an I-beam type of rail **26** that is suspended from the overhead structure **27** by suitable strut means **28**. This rail **26** is arranged at an angle to the horizontal and provides a sloping track along which the trolley device **30** is adapted to reciprocate. Trolley **30** is of more or less standard construction and comprises a pair of bar weights **31** that are suspended by hangers **32** from the trolley wheels **33** that are adapted to roll along the lower flange **34** of the I-beam track **26**. Trolley **30** has a yoke type support **35** depending from its underside that rotatably supports the movable pulley wheel **16**.

The lower end **36** of the sloping I-beam track **26** has a bumper mechanism **38** (see Fig. 3 particularly) mounted thereon so as to provide a cushioning stop for the trolley unit **30** when it reaches its lowest point along the track **26**. The bumper mechanism **38** comprises a bumper block **39** having rod-like legs **40** reciprocably mounted in the box-like hanger **41**. Compression springs **42** are threadably mounted on the rod-like legs **40**. The springs **41** extend between the bumper block **39** and a spaced wall **42** that is part of the box-like hanger **41** so as to provide resilient means to cushion the engagement of the trolley **30** with the bumper mechanism **38**. Obviously other forms of trolley movement limiting and cushioning means could be utilized in place of this specific bumper mechanism **38** that is herein disclosed. As no claim is made for the specific type of bumper mechanism herein disclosed, it is thought to be unnecessary to go into greater detail as regards this particular mechanism.

The upper or elevated end **37** (see Fig. 1) of the sloping I-beam type of track **26** mounts an L-shaped support bracket **44**. Support bracket **44** has a depending leg **45** that rotatably supports in stacked arrangement the pair of fixedly mounted pulley wheels **15** and **17** respectively. The fixedly mounted pulley wheels **15** and **17**, as well as the movable pulley wheel **16** and the trolley wheels **32**, are each provided with suitable wheel bearings so that friction at the wheel axles will be kept to a minimum.

From the above description of the slack take-up mechanism **25**, it is thought to be fairly obvious how this mechanism operates to vary the effective length of air supply conduit **13** as its connection **19** to the air supply outlet conduit **60** moves along the assembly line. With the connection **19** in the position shown in full lines in Fig. 1, the trolley **30** may be in engagement with the bumper mechanism **38** at this time and the effective length of the flexible air supply conduit **13** is a minimum. It should be pointed out that the location of the pulley means **15**, **17** is substantially at the center of the assembly line section along which the air outlet carrier conduit **60** extends. As the work article, which in this instance happens to be automobile bodies **80** that are shown in broken lines in Fig. 1, moves towards the left the air supply conduit connection **19** between the supply conduit **13** and the air outlet carrier conduit **60** will move towards the right. This movement of the air connection **19** towards the right will require the effective length of the supply conduit **13** to be increased and this is accomplished by the rightward movement of air supply conduit end **18** causing, through the pulleys **15**, **16**, **17**, movement of the trolley **30** along the trackway **26** in a leftward and upward direction. When the air connection **19** has reached the end of its movement towards the right the effective length of the air supply conduit **13** will be at a maximum and will correspond to the conduit line shown in broken lines in Fig. 1 and denoted by the reference numeral **18'**. At the time that the air connection **19** is at the right end of the air outlet carrier means **22**, the trolley mechanism **30** will be positioned at the upper left end **37** of the sloping trackway **26**. The position of the trolley **30** at the upper left end of the trackway **26** is shown in Fig. 1 in broken lines and is denoted by the reference numeral **30'**. Thereafter, the air connection **19** passes around the right end of the carrier means **22** and starts to move towards the left along the track **26**. When the air connection **19** has reached a point along the lower side of carrier means **22** that is in vertical alignment with the overhead, fixedly mounted pulleys **15**, **17**, then the trolley mechanism **30** will again be substantially at the lower end of the track **26** and almost in engagement with the bumper plate **39** of the bumper mechanism **38**. Thereafter, as the air connection **19** continues to move towards the left along the lower side of the air outlet carrier means **22**, the effective length of the flexible air supply conduit **13** will then begin to lengthen and the trolley mechanism **30** will once again ride up the inclined trackway **26** until the time the air connection **19** reaches the left end of the carrier mechanism **22**. Once the air connection **19** reaches the left end of the air outlet carrier means **22** then the effective length of the air supply conduit **13** will begin to shorten and the trolley mechanism **30** will then ride down the sloping track **26** towards its right end **36**. From the foregoing description it is thought to be obvious that the trolley mechanism **30** will ride up and down the sloping track **26** twice during each circulating movement of the connection **19** around the air supply carrier means **22**.

The air outlet carrier mechanism **22** comprises an endless link or chain type conveyor belt **50** having pivotally connected links **51** (see Figs. 4 and 5) that mount a plurality of supporting wheels **52**. Wheels **52** are adapted to ride along supporting angle iron type tracks **53**. Spaced along the link type conveyor belt **50** are a plurality of substantially inverted T-shaped article support arms **54**. These support arms **54** are arranged so as to limit the upward movement of the wheels **52** away from the associated track elements **53**. Spaced along the endless conveyor belt **50**, at substantially four foot intervals in this instance, are a plurality of T-type valve air control connections **55**. Each of these T-type connections **55** mounts a self closing air outlet connection **56**. The air outlet connections **56** are of the female type and are adapted to have a male type coupling connection on the free end of an air operated power tool hose connected therewith to provide for ready engagement and disengagement of the tool with any of the connections **56**. Each T-type valve connection includes a gate valve means having a lever type operating handle **57** so that the air supply to the outlet connection **56** may be discontinued if such a condition should be desired. Extending outwardly in a horizontal direction (see Fig. 4) from each T-type valve connection **55** (except the connection **55** mounting the joint **19**) is a pipe section **59** that has a T-coupling **64** connected to the outer end thereof. Each of the T-type couplings **64** are interconnected with adjacent T-couplings **64** by means of short lengths of flexible tubing **61**. Due to the fact that the adjacent T-type couplings **64** are interconnected by pieces of flexible tubing **61**, it is thought to be obvious that a construction has been provided whereby a continuous, flexible, closed air supply conduit **60** is carried by the endless conveyor belt **50**. Furthermore, this endless air supply conduit **60** mounts a plurality of air outlet connections **56** at spaced points along its length such that a plurality of air operated tools may be simultaneously operated while being moved along the assembly line at any desired speed. As aforementioned, it is usually preferable to move the air supply outlets **56** along the assembly line at the same rate as

the work passes along the assembly line so that the workers using the air tools may ride upon the work article and use the tools while so doing.

From an inspection of Fig. 5 it will be noted that the end **18** of the flexible air supply conduit **13** is connected to the air outlet carrier mechanism **22** through the universal pipe coupling **19**. Coupling **19** is connected through a cross connection **66** to a pair of conduit hoses **61** and to the conveyor mounted pipe section **20**. A cable strut means **65** is connected between the conduit **13** and the cross connection **66** to reduce the tension placed on the universal coupling **19** during movement of the coupling **19** around the mechanism **22**. This strain reducing strut means **65** may assume any number of forms wherein the cable **65** is integral with the conduit **13** or portions thereof. No claim is made for this feature per se. Suitable valve controls (not shown) may also be provided to automatically shut off the air supply in the event of failure of certain portions of the conduit system.

In actual operation, a worker having an air operated tool, such as the staple gun indicated in Fig. 1 by the reference numeral **70**, will connect the male connection **72** on the free end of the tool hose **71** to the air supply connection **56** that is then passing around the right end of the carrier mechanism **22**. As the work piece **80** moves towards the left down the assembly line the air supply connection **56** to which the tool **70** is attached is likewise moving towards the left along the assembly line at the speed of the work article **80** and accordingly the worker may use his air tool during the entire period the work article **80** is passing along the assembly line. During periods of non-use of the tool it may be hung on one of the moving supports **54**. When the work article **80** has reached the left end of the carrier mechanism **22**, the worker merely pulls on the tool air hose connection **72** and thereby disconnects it from the associated air supply connection **56** after which the worker may return to the right end of the line with the tool and again plug in the tool hose connection **72** to an air supply outlet connection **56** that then happens to be passing the right end of the carrier mechanism **22**. With the arrangement herein shown it will be seen that the tool air hoses **71** need only be of minimum length and as they are continuously moving down the assembly line at the speed of the work article **80** they are never in danger of being entangled with other tool air supply conduits or the like and, furthermore, as they are always operably connected to the air supply line **60**, they may be continuously operated during passage along the assembly line.

Figs. 1 and 2 show a preferred form of drive for the carrier mechanism **22**. The carrier mechanism **22** is supported by overhead structure including a pair of beams **81** that support electric motor means generally denoted by the reference numeral **82**. Motor means **82** drives a sprocket **83** that is engaged with an endless chain **84**. Chain **84** is also engaged with a drive sprocket **85** that is fixedly connected to a drive shaft **86**. Drive shaft **86** also has drivingly connected thereto, at the opposite ends thereof, a pair of conveyor belt driving sprockets **87**. The drive sprockets **87** each are engaged with the endless link or chain type conveyor belts **50** that form portions of each of the carrier mechanisms **22** located at opposite sides of the assembly line. As the carrier mechanisms **22** on opposite sides of the assembly line are identical, only one carrier mechanism has been described. While a single motor means **82** has been shown for driving the pair of carrier mechanisms **22**, it is thought to be obvious that a similar type of drive mechanism could be utilized at either each side or each end of the carrier mechanism **22** if circumstances should require such a drive. Suitable control means, not shown, are associated with the motor means **82** so that the speed and period of operation of the carrier conveyor **22** will be coordinated with the speed and period of operation of the conveyor mechanism moving the work articles **80** along the assembly line.

From the aforementioned description it is thought to be obvious that there is provided a pressure fluid supply system that will readily permit the continuous use of air operated or fluid pressure operated tools or the like as the assembly line work article passes along the assembly line. Furthermore, this pressure fluid supply system includes means for varying the effective length of the flexible pressure fluid supply conduit such that there is no danger of the pressure fluid supply conduit becoming broken or entangled with the various tool supply conduits or any other portions of the associated conveyor system as the tools are moved lengthwise of the assembly line.

We claim:

1. An air supply system comprising an air supply header, a flexible air supply conduit connected to said header, an endless carrier having drive means for causing carrier movement along a closed circuit where air is to be supplied, an endless air outlet conduit having a connection to said air supply conduit and mounted on said carrier for movement around said predetermined circuit, and means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit.

2. An air supply system comprising an air supply header, a flexible air supply conduit connected to said header, an endless carrier having drive means for causing carrier movement along a closed circuit where air is to be supplied, an endless air outlet conduit having a connection to said air supply conduit and mounted on said carrier for continuous movement around said predetermined circuit, and means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit, said last mentioned means comprising a slack take-up device including a gravity actuated device connected to an intermediate portion of said flexible air supply and arranged to be reciprocated by movement of the air outlet conduit around its predetermined circuit.

3. A pressure fluid supply system comprising a supply header, a flexible pressure fluid supply conduit connected to said header, an endless carrier having driving means to cause carrier movement along a circuit where pressure fluid is to be applied, an endless pressure fluid outlet conduit having a connection to said flexible pressure fluid supply conduit and mounted on said carrier for movement around said predetermined circuit, and means associated with said flexible pressure fluid supply conduit adapted to automatically vary the effective length of the flexible pressure fluid supply conduit as its connection to the pressure fluid outlet conduit moves around the predetermined circuit.

4. An air supply system comprising an air supply header, a flexible air supply conduit having one end connected to said header, an endless carrier having drive means for causing carrier movement along a closed circuit where air is to be supplied, an endless air outlet conduit including one or more discharge connections, said endless air outlet conduit having a connection to the other end of said flexible air supply conduit and being mounted on said carrier for movement around said predetermined circuit, and means associated with said flexbile air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit, said last mentioned means comprising a trackway sloping to the horizontal, a first pulley wheel located adjacent the elevated end of said trackway guidingly receiving portions of said one end of said flexible air supply conduit, a weighted trolley device mounted on said trackway for movement longi-

tudinally thereof, said trolley device carrying a second pulley wheel that has an intermediate portion of said flexible air supply conduit guidingly looped thereabout, and a third pulley wheel fixedly mounted adjacent said first pulley wheel guidingly receiving portions of said other end of said flexible air supply conduit.

5. An air supply system comprising an air supply header, a flexible air supply conduit having one end connected to said header, an endless carrier having drive means for causing carrier movement along a closed circuit where air is to be supplied, an endless air outlet conduit including one or more discharge connections, said endless air outlet conduit having a connection to the other end of said flexible air supply conduit and being mounted on said carrier for movement around said predetermined circuit, means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit, said last mentioned means comprising a trackway, a weighted member movably mounted on said trackway and means connecting said weighted member to said flexible air supply conduit whereby said air supply conduit will remain taut during travel of said other end of said flexible air supply conduit around said predetermined circuit, and motion resisting cushioning means mounted so as to engage said weighted member and limit its movement along said trackway.

6. An air supply system comprising an air supply header, a flexible air supply conduit having one end connected to said header, an endless carrier having drive means for causing carrier movement along a closed circuit where air is to be supplied, an endless air outlet conduit including one or more discharge connections, said endless air outlet conduit having a connection to the other end of said flexible air supply conduit and being mounted on said carrier for movement around said predetermined circuit, means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit, said last mentioned means comprising a trackway, a weighted member movably mounted on said trackway and means connecting said weighted member to said flexible air supply conduit whereby said air supply conduit will remain taut during travel of said other end of said flexible air supply conduit around said predetermined circuit, and strut means connecting said flexible air supply conduit to the endless air outlet conduit to resist forces tending to separate the connection between the flexible air supply conduit and the endless air outlet conduit.

7. A pressure fluid supply system comprising a pressure fluid supply header, a flexible pressure fluid supply conduit having one end connected to said header, an endless pressure fluid outlet conduit having one or more discharge openings, said outlet conduit having a connection to the other end of said flexible pressure fluid supply conduit and being mounted on an endless carrier for movement around a predetermined closed circuit, said endless pressure fluid outlet conduit carrier comprising an endless conveyor belt mounted on means that drivingly support same, said one or more pressure fluid discharge openings being mounted on said belt for movement thereby, flexible pressure fluid conduit means connecting said one or more discharge openings, motor means connected to said conveyor belt supporting means to effect movement thereof, and means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit, said last mentioned means comprising a trackway, a weighted member movably mounted on said trackway, and means connecting said weighted member to said flexible air supply conduit whereby said air supply conduit will remain taut during travel of said other end of said flexible air supply conduit around said predetermined circuit.

8. An air supply system comprising an air supply header, a flexible air supply conduit connected to said header, an endless air outlet conduit having a connection to said air supply conduit and mounted on an endless carrier for continuous movement around a predetermined circuit, said endless air outlet conduit carrier comprising an endless conveyor belt, driving means supporting said conveyor belt, a plurality of air discharge connections drivingly supported by said conveyor belt, and a plurality of sections of flexible air conduit connecting said discharge connections to said flexible air supply conduit and to each other, and means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit.

9. An air supply system comprising an air supply header, a flexible air supply conduit having one end connected to said header, an endless air outlet conduit having a connection to the other end of said flexible air supply conduit and being mounted on an endless carrier for movement around a predetermined closed circuit, said endless air outlet conduit carrier comprising an endless conveyor belt, driving means supporting said conveyor belt, a plurality of valve controlled air discharge connections carried by said conveyor belt, a plurality of flexible sections of air conduit connecting said discharge connections to each other and to said other end of the flexible air supply conduit, and means associated with said flexible air supply conduit adapted to automatically vary the effective length of the flexible air supply conduit as its connection to the air outlet conduit moves around the predetermined circuit.

10. An endless air outlet carrier mechanism comprising an endless conveyor belt, driving means supporting said conveyor belt, a plurality of self sealing air discharge connections carried by said conveyor belt, a plurality of sections of flexible air conduit interconnecting said air discharge connections and providing a continuous air outlet conduit, and a connection on one of said flexible sections of air conduit providing for its connection to an air supply.

11. An air supply system adapted to be connected to an air supply header comprising a flexible air supply conduit, an endless conveyor belt adapted to circulate about a predetermined path, a plurality of air discharge connections carried by said circulating conveyor belt, air conduit means connecting at least two of said discharge connections together to provide an air discharge conduit and also providing a connection to said flexible air supply conduit, and means associated with said flexible air supply conduit to vary its effective length as its connection to the circulating air discharge conduit travels about the path of the conveyor belt.

12. An air supply system adapted to be connected to an air supply header comprising a flexible air supply conduit, an endless conveyor belt adapted to circulate about a predetermined path, an air discharge connection carried by said circulating conveyor belt, an endless air conduit means carried by said conveyor belt and connected to said discharge connection and to said flexible air supply conduit and means associated with said flexible air supply conduit to vary its effective length as its connection to the circlulating air discharge connection travels about the path of the conveyor belt.

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