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(72) Inventeur/Inventor:
GROZINGER, MICHAEL, DE

(73) Propriétaire/Owner:
ACCULUBE MANUFACTURING GMBH - SCHMIERMITTEL UND - GERATE, DE

(74) Agent: FINLAYSON & SINGLEHURST

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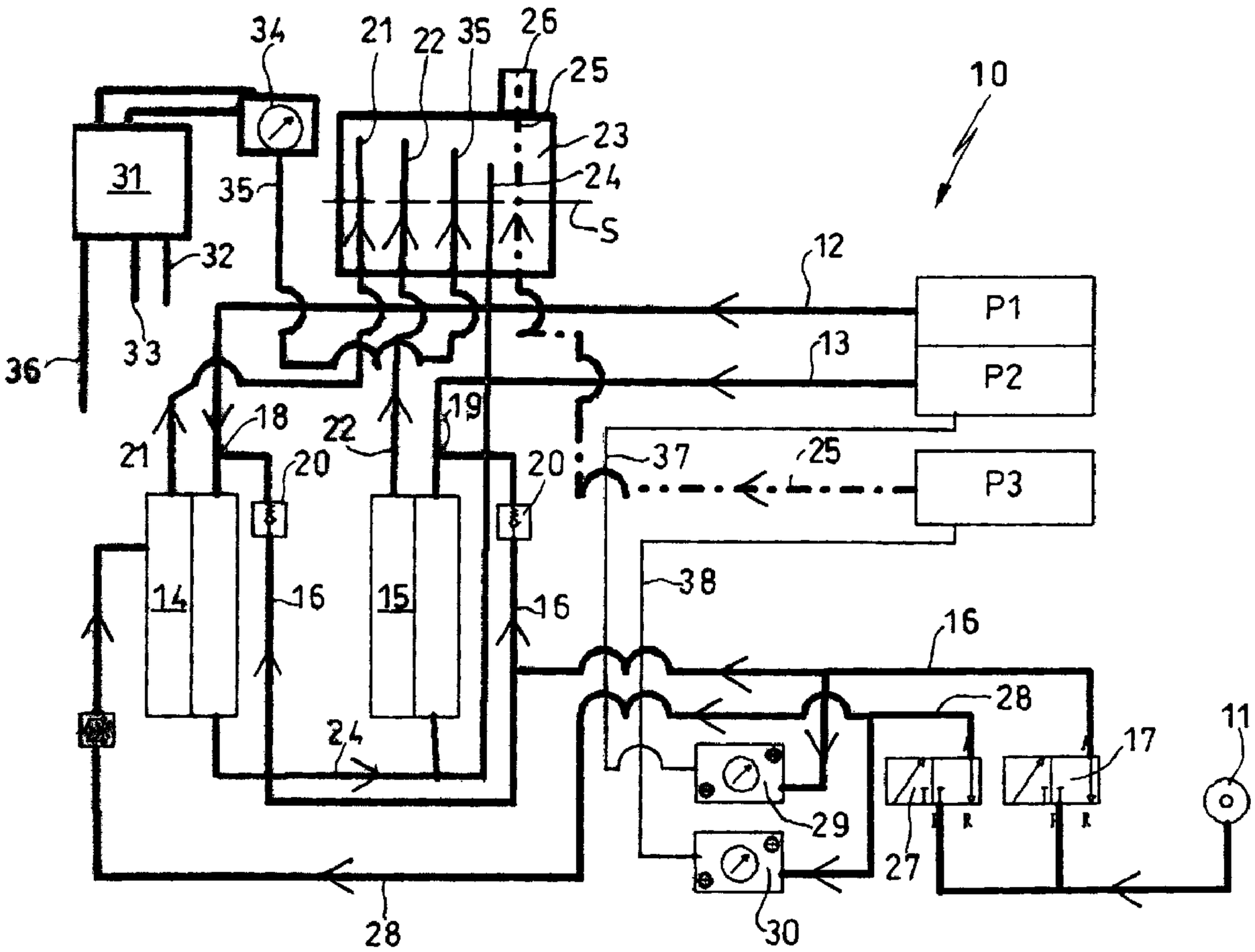

(57) Abrégé/Abstract:
The invention relates to apparatus and a method for preparing a fine oil mist, in particular to be fed into tool lubrication ducts of a CNC machine tool. The apparatus is turned ON/OFF solely using the standardized machine commands M08 ("Cooling lubricant

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(57) Abrégé(suite)/Abstract(continued):
ON") and M09 ("Cooling lubricant OFF"). The control/regulation of the tools' aerosol supplies then will be fully automatic. It involves -- contrary to known quantitative regulations -- a simple regulation by means of aerosol pressure values. When starting the apparatus or following a change of tools, all aerosol pumps are operating, including, where tools exhibit cross-sectionally large boreholes, an oil over-enriching pump. At least one aerosol pump operates when regulated within a range of supply pressures. When the upper pressure value of the supply pressure range is exceeded, the pump(s) shut(s) down until the aerosol supply has been exhausted and will turn ON again when the lower pressure value of the supply pressure range is crossed downward because of aerosol consumption.

ABSTRACT

The invention relates to apparatus and a method for preparing a fine oil mist, in particular to be fed into tool lubrication ducts of a CNC machine tool. The apparatus is turned ON/OFF solely using the standardized machine commands M08 ("Cooling lubricant ON") and M09 ("Cooling lubricant OFF"). The control/regulation of the tools' aerosol supplies then will be fully automatic. It involves -- contrary to known quantitative regulations -- a simple regulation by means of aerosol pressure values. When starting the apparatus or following a change of tools, all aerosol pumps are operating, including, where tools exhibit cross-sectionally large boreholes, an oil over-enriching pump. At least one aerosol pump operates when regulated within a range of supply pressures. When the upper pressure value of the supply pressure range is exceeded, the pump(s) shut(s) down until the aerosol supply has been exhausted and will turn ON again when the lower pressure value of the supply pressure range is crossed downward because of aerosol consumption.

APPARATUS AND METHOD FOR MAKING A FINE OIL MIST

The present invention relates in part to apparatus producing a fine oil mist in particular to feed such a mist into lubricating ducts of the tools of CNC machine tool, comprising oil conveying pumps and at least one compressed air conduit conveying air, also at least one oil-air mix generator combining oil and air into a fine mist of oil (aerosol) and feeding it to a supply vessel from which the oil mist is fed through a supply conduit to the tool.

From the print-unsupported state of the art, the above apparatus also is known as a minimum amount lubrication system. Such apparatus includes at least one oil-air mix generator producing the oil-air mix. This mixture is fed in pressurized form for purposes of lubrication to the tools of a CNC machine tool.

The nearest state of the art is a well known and previously used "minibooster system" made by applicant. Said system comprises three oil-air mix generators each with its associated pump, that may be applied individually depending on the tool used, i.e. depending on the cross-section of the internal lubricating ducts of the particular tool.

Large diameter tools typically also exhibit large lubricating duct cross-sections, and consequently all three pumps must be operated to produce the oil-air mix in order to assure both an adequate amount of lubrication and corresponding conveyance pressure. As regards tools of smaller diameters that are fitted with commensurately smaller lubricating duct cross-sections, only one, at most two pumps are needed to generate an adequate film of lubrication.

It is typical practice in the state of the art to manually program the lubrication output as function of the particular tools used, namely by employing so-called M functions. M functions are standardized machine or switching commands operating a CNC machine tool. Different M functions must be used in the CNC program for each different tool. Accordingly a large number of tools must be programmed to attend to a large plurality of tools.

Programming is critical to assure smooth-running production. If for instance the operation of too many pumps for a small-diameter tool and for a small cross-section of the lubrication ducts should entail excessive feed pressure, then, due to this small lubrication duct cross-section, a back pressure would build up that may become so large that in spite of sufficient lubricant in the supply receptacle, the tool nevertheless would be lubricated insufficiently. In the reverse case of large tools, a similar situation arises when an insufficient number of pumps is operating. In both instances insufficient lubricant at the tool entails increased tool wear and possibly tool failure.

Even though the previously used minibooster system has been successfully used in practice, it still leaves room for improvement because on occasion problems arise in erroneous operation, i.e. defective programming of the M-functions. In principle cutting may be fully automatic, the more so that the machines also are able to automatically change the particular tools. Therefore degradation of production on account of defective programming is considered a substantive impediment.

Accordingly the present invention seeks to create in the first place a new apparatus minimizing application of lubricants while retaining the conventional feed to tools having different and strongly diverse cross-sections of lubricant ducts, and to do so without involving elaborate, manual programming.

The invention in one aspect provides an apparatus to prepare a fine oil aerosol mist to feed said oil mist into lubricant ducts of tools of a CNC machine tool, comprising a plurality of pumps and at least one compressed air conduit to feed air and further comprising at least one oil-air mix generator for processing oil and air into the fine oil aerosol mist and feeding it to a tank from which the oil aerosol mist is supplied via a feed conduit to the tool. The apparatus is characterized in that the apparatus comprises a pressure sensor measuring the pressure of the oil aerosol mist in the tank and a control unit which, following turning ON of the apparatus, initiates air supply and at least one of two aerosol supply pumps (P1, P2) and an over-enriching pump (P3) of the plurality of pumps to generate oil-air mixes. Further, the control unit

- stops the over-enriching pump (P3) when a first predetermined supply pressure p2 has been exceeded,
- stops the at least one of the two aerosol supply pumps (P1, P2) when a predetermined, maximally permissable second supply pressure p4 has been exceeded,
- restarts the at least one of the two aerosol supply pumps (P1, P2) when a predetermined third supply pressure p3 has fallen below a set value, and
- restarts the over-enriching pump (P3) when a predetermined fourth supply pressure p1 is fallen below a set value,

wherein $p1 < p2 < p3 < p4$.

In another feature of the invention the apparatus is switched ON via a control line using the standardized machine command M08 ("Cooling lubricant ON") and is turned OFF using the standardized machine command M09 ("Cooling lubricant OFF").

As regards the pressure values, the invention provides with respect to compressed air and aerosol supply at about 6 bars into the supply tank that the tank pressures be approximately p1 = 1.6 bars, p2 = 1.8 bars, p3 = 3.8 bars and p4 = 4.1 bars. These values are approximate and even may slightly vary in either direction. Even special settings may be applicable in special applications.

In advantageous manner, the invention allows maintaining adequate supply of oil-air mix quantity within a predetermined pressure range by using merely the automated control depending on the supply pressure -- not by the quantitative control of compressed air and/or oil – of pumps and air feed. When the supply pressure drops by a decrease in oil-air mix through the conduit to the tool, the supply tank shall be refilled again with a fine mist of oil after the pressure value p3 has been crossed downward or fallen below by means of oil and compressed air feed from the aerosol generators.

In this manner not only an adequate quantity of the oil-air mix is available in the supply tank for the tools generally used, but also the relatively high shutoff pressure p4 defined in the control unit assures a maximum feed pressure.

Contrary to the situation in the state of the art, which raises the conveyance pressure in uncontrolled manner by merely turning pumps ON as a function of the particular

tools used, the present invention assures -- by a predetermined maximum feed pressure when using small tools – that the lubricant feed to the tool cannot be interrupted by an excessively high back-pressure.

Erroneous programming such as encountered in the state of the art is precluded in the present invention because the generation of the oil-air mix is automatically triggered by the control unit as a function of the tank pressure .

Special programming of given pressure values or ON or OFF states of numerical control are not required in the present invention because therein the apparatus is turned ON by means of the standard machine command M08 ("Cooling lubricant ON") and is turned OFF by means of the standardized machine command M09 ("Cooling lubricant OFF"). In the invention, the apparatus operates most effectively, reliably and in fully automated manner between the turn ON command M08 ("Cooling lubricant ON") and the turn OFF command M09 ("Cooling lubricant OFF") which it receives from the machine tool control unit.

Turning ON the oil over-enriching pump is especially significant for tools having cross-sectionally large cooling lubricant ducts. When tools fitted with cooling lubricant ducts of large cross-sectionally areas are used, the discharge of large amounts of oil-air mixes prevents building up adequate pressure in the supply tank. By automatically supplying supplemental air and by directly feeding oil into the conduit to the tool by means of the control unit, the invention advantageous assures that adequate amounts of lubricant and air are made available even when using tools having cross-sectionally large lubricant ducts.

In a preferred embodiment mode the invention, two oil-air mix generators operating in parallel are used, each one with its own oil conveying pump. In this manner the apparatus of the invention may be advantageously made of known and foremost of tested components of the state of the art. Besides economical manufacture, high reliability of the minimum-quantity lubricating system is also assured. Also only one instead of two aerosol pumps may be used.

A specially preferred embodiment mode of the invention is characterized in that the oil over-enriching pump is connected by a conduit directly to the tool and in that an additional compressed air conduit to feed supplemental air is connected to at least one oil-air mix generator, the supplemental air feed and the oil over-enriching pump being shut OFF by the control unit when the third tank pressure value p2 has been reached.

Another advantageous embodiment of the apparatus of the invention is characterized in that the aerosol pumps and the oil over-enriching pump are designed as pneumatic pumps connected to the particular compressed air conduits and are operated by applied air or supplemental air. In this manner the air required by the apparatus is used to operate the pumps. As a result additional power lines (such as electric cables) no longer are needed and moreover the pumps used are simple in design. In especially advantageous manner, the apparatus control complexity is reduced because no more is needed than starting/terminating the particular feed of air by the control unit in order to turn ON/OFF the said pumps.

Power-controlling frequency generators may precede the pumps and the oil over-enriching pump.

Furthermore the invention relates to a method for preparing a fine oil mist in particular to be fed into the lubricant ducts of the tools of a CNC machine tool, whereby compressed air and oil are fed by pumps to oil-air mix generators to generate a fine oil mist (aerosol), the pumps and the compressed air feed being configured as a function of the particular tools being used..

Further the invention pertains to a method for preparing a fine oil mist for feeding it into tool lubricant ducts of a CNC machine tool, wherein compressed air and oil are fed to oil-air mix generators to generate a fine oil aerosol mist, aerosol supply pumps (P1, P2, P3) and the feed of compressed air are adapted to be turned ON as a function of the particular tool used. The method is characterized in that following start up of the apparatus, aerosol supply pressure is measured and the oil-air mix generators are driven solely as a function of preset supply pressure values (p1, p2, p3, p4).

The standardized machine command M08 ("Cooling lubricant ON") turns the apparatus ON and the standardized machine command M09 ("Cooling lubricant OFF") turns the apparatus OFF.

In the regulating mode, the pumps implementing aerosol generation operate continuously within a tank pressure range between p0 = 0 and p4 < 6 bars. When a predetermined tank pressure p1 is crossed downward, the oil over-enriching pump is reconnected and supplemental air then shall be fed to at least one oil-air mix generator.

In said method of the present invention, when the compressed air or aerosol feed is at about 6 bars, the tank pressure values p1 are about 1.6 bar, p2 about 1.8 bar, p3 about 3.8 bar and p4 about 4.1 bar. These are approximate values which may be slightly varied in both directions or also may be frozen in special applications.

Aside from the general programming "Cooling lubricant ON", "Cooling lubricant OFF", the method of the present invention allows omitting separate and tool-specific ON/OFF commands to the particular pumps. Because the lubricant duct cross-sections, depending on the tool diameter, pass different quantities of cooling lubricant into the tool, whereby the tank pressure is decreased, driving the oil-air mix generators by means of a predetermined ON/OFF pressure assures the availability of an adequate quantity of fine oil mist independently of the sizes of the tools being used.

The description of the drawing below elucidates the present invention.

The drawing shows an apparatus, denoted overall by "10", feeding minimal quantities of lubricant to the tool head of a CNC machine tool. For the sake of clarity, the conduits shown in the drawing and of which the functions are discussed below, denote the directions of flow.

The apparatus 10 comprises a compressed air hookup 11 feeding it with the needed conveyance air preferably at a standard pressure of 6 bars. Three pumps P1, P2, P3 are used for moving the oil which serves as lubricant. For further clarity, the pumps P1 and P2

also are denoted as "aerosol pumps", the pump P3 as the "oil over-enriching" pump even though all serve to produce aerosol.

In this embodiment mode the pumps P1, P2 and P3 are pneumatic pumps. Pump P1 is connected by the conduit 12 to the oil-air mix generator 14 and pump P2 is connected through the conduit 13 to the oil-air mix generator 15. Both oil-air mix generators are fitted in the mouth zones of the conduits 12 respectively 13 with an atomizing nozzle (omitted here). The conveying air is applied upstream through the conduit 16 to said atomizing nozzle. The airflow issuing from the compressed air hookup 11 is controlled by a valve 17. To prevent oil pressurized by the pumps P1 and P2 from entering the air conduit 16, this conduit is fitted with check valves upstream of the air feed sites 18 and 19.

Starting at the oil-air mix generators 14 and 15, oil-air mix conveying conduits 21 and 22 as well as an oil recycling conduit 24 run to an oil/oil-mist tank 23. This tank contains oil at a liquid level S, the space above the liquid oil level S being filled during operation with oil mist.

In order to assure adequate oil supply even for large-diameter tools, the apparatus of the invention provides a so-called oil over-enriching pump P3 which is connected by a capillary conduit 25 – while bypassing the tank 23 – directly to a feed conduit 26 to the tool head of a CNC machine tool. To assure adequate oil supply of tools having large lubricant duct cross-sections, the apparatus 10 includes an supplemental air feed conduit 28 separately controlled by a valve 27 which in the present instance applies additional conveying air to the oil-air mix generator 14. However the conduit 28 may just as well issue into the oil-air mix generator 15 or also in the two oil-air mix generators 14 and 15.

The apparatus of the invention comprises two frequency generators 29 and 30 to regulate the feed output of the pumps P1 through P3. The pumps P1 and P2 in the present embodiment are operated in parallel and are regulated by the frequency generator through the air conduit 37 connected to them. The frequency generator 30 regulates the feed output of the pump P3 to which it is connected by the air conduit 38. In this embodiment mode

the frequency generators are connected to the air conduits 16 and 28 respectively, as a result of which the air required to operate the pumps shall be taken from the compressed air conduits 16 and 28 when the valves 17 and 27 respectively are opened .

The apparatus of the invention is controlled by a control unit 31 which in a manner not shown in the drawing and using two switching lines 32 and 33 can open as needed the valves 17 and 27 to feed the conveying air. In order to determine the need for supplemental conveying air and supplemental oil-air mix, the control unit 31 comprises a pressure sensor 34 which, connected by a conduit 35 to the tank 23, measures the applied pressure, namely the so-called supply pressure in the apparatus 10. The apparatus 10 is turned ON/OFF by the command "Cooling lubricant ON/OFF" transmitted through a control line 36.

The operation of the apparatus 10 is comprehensively discussed below.

The apparatus 10 is started by the machine command ("Cooling lubricant ON". The control unit 31 measures the supply pressure by means of the pressure sensor 34 and opens the valve 17 provided that the pressure in the apparatus 10 (the supply pressure) is less than a critical value set at the site of operation (for instance p3 = 3.8 bar). As conveying air flows for instance at about 6 bars, the pumps P1 and P2 are supplied from the air conduit 37 with the air flow required for operation, the pumps' output being regulated by the frequency generator 29. Air and the oil conveyed by the pumps P1 and P2 passes through the (omitted) atomizer nozzles into the oil-air mix generators 14 and 15, as a result of which the oil-air mix has been made available with oil particles in their most minute state (preferably in the microscopic range). Larger oil particles deposit on the inner wall surfaces of the oil-air mix generators 14, 15 and pass through the oil return conduit 24 back into the tank 23 from where they are recycled into the oil circuit. Applicant's German patent DE 298 11 504 U1 discloses an illustrative design of the oil-air mix generators 14 and 15.

The oil-air mix passes through the oil-air mix conduits 21 and 22 into the oil and oil mist tank 23 and from there into the feed conduit 26 to the omitted tool. This process con-

tinues until a shutdown pressure predetermined and set on site (for instance p4 = 4.1 bars) has been reached.

Below a shutdown pressure illustratively of p3 = 2.1 bars previously set on site, additional conveying air for the purpose of rapid pressure buildup passes through the valve 27 opened as needed by the control unit and through the conduit 28 into the oil-air mix generator 14 and from there through the oil-air mix conduit 21 also into the oil and oil mist tank 23. If supplemental conveying air is applied, the pump P3 also receives from the air conduit 38 the air flow required for operation, said airflow being regulated if needed by the frequency generator 30. The oil conveyed by the pump P3 passes through the capillary conduit 25 while bypassing the oil and oil mist tank 23 directly into the conduit 26 and then into the tool head. In this manner the supply of lubricant is already initially assured in the critical start stage to make immediately available an adequate quantity of oil, an adequate conveying pressure and an adequate quantity of air to ensure tool lubrication at the beginning of cutting.

During regulation, the pressure in the tank 23 is maintained by the control unit 31 within the range set at the site (in this instance p0 = 0 bar and p4 = 4.1 bars). The oil mist supply made available by the pumps P1 and P2 as well as by the air supply through the conduit 16 suffice as regards tools of small and middle diameters up to about 12 mm. The problem of inadequate lubricant supply of small tools (up to about 8 mm diameter) is circumvented by the automated pressure regulation in the tank 23. By operating the apparatus 10 in the pressure range between p3 = 3.3 bars and p4 = 4.1 bars, the back pressure arising from the small lubricant duct cross-section is precluded from exceeding a critical value. As a result even small tools are fed with sufficient lubricant without need for special programming as mandatory in the state of the art.

Again, the quantity of oil-air mix made available by the pumps P1 and P2 as well as the conveying air passing through the conduit 16 suffice to reliably ensure adequate lubrication. It follows that by means of the two oil-air mix generators 14 and 15 and the parallel

operating pumps P1 and P2, the apparatus 10 of the invention is a substantial improvement over the state of the art.

When more substantial tools are used for cutting (12 mm to 63 mm diameters), the larger lubricant duct cross-sections entail a significant pressure drop in the tank 23 because a larger quantity of oil-air mix is being conveyed. Nevertheless the oil-air mix production of the pumps P1 and P2 suffices down to a supply pressure of about p2 = 1.8 bars.

When the pressure drops below this threshold value, the control unit 31 opens the valve 27 and thereby increases the conveying flow. In addition the pump P3 is made operational and conveys oil directly through the capillary conduit 25 into conduit 26 leading directly into the tool spindle and in this manner oil over-enriching the oil-air mix flow also passing through the conveyance conduit 26 to the tool head. In this manner adequate lubrication also is assured fro tools having large lubricant duct cross-sections, without the need for separate manual actions or for programming an additional M function.

Actually and illustratively, a sufficient quantity of lubricant to operate large tools also can be made available using a third or even a fourth oil-air mix generator. The direct oil feed of the invention made possible at large lubricant duct cross-sections however reduces the bulk of the apparatus 10.

Accordingly the apparatus 10 is characterized by two substantive advantages. Aside from turning ON/OFF the apparatus 10, no control action is needed to assure adequate lubrication. By controlling an adequate supply pressure in the oil mist and oil receptacle 23 and by controlling the oil feed through the pair of pumps P1 and P2 respectively the pump P3, sufficient lubricant is automatically applied independently of tool diameter. Erroneous programming, as is encountered in the state of the art, therefore is precluded. Moreover the apparatus 10, unlike the state of the art, is operational with only two oil-air mix generators, and accordingly makes its manufacture more economical.

The second significant advantage is that the design and operation of the apparatus 10 are such that it uses tested standard components. The selected operational pressure

up to 4.1 bars allows employing as before the standard 6 bar compressed air hookups. In order to allow using tested and reliable components, the apparatus 10 comprises the two pumps P1 and P2 and also the two oil-air mix generators 14 and 15 which basically are operated in parallel. The pump P3 again is a model identical with the pumps P1 and P2. Such a design assures high operational reliability and the advantages of assured spare parts supplies. Where appropriate, of course, particular devices specially designed for given applications also may be used to replace the parallel operation of the pumps P1 and P2 and of the oil-air mix generators 14 and 15 .

Moreover the supply pressure up to p = 4.1 bars obviates any tool adaptation. Again further standard tools having conventional lubricant ducts may be used. The apparatus 10 of the invention therefore may be exchanged in problem-free manner against the state of the art already in place in extant work places.

In summary, the apparatus and the method of the invention for preparing a fine oil mist to be fed into lubricant ducts of the tools of a CNC machine tool is characterized essentially by the following particulars and advantages:

The apparatus of the invention is switched ON/OFF solely using he standardized machine commands M08 ("Cooling lubricant ON") and M09 ("Cooling lubricant OFF").

The control/regulation of the tools' aerosol supplies then takes place in fully automated manner. It involves simple regulation on the basis of the aerosols' pressure values as compared to the known quantitative regulation.

When said apparatus is started, or following a change of tools and as regards tools having large cross-sectional cooling lubricant boreholes inclusive an oil over-enriching pump, all aerosol pumps are operational. .

At least one aerosol pump operates in regulated manner within a range of supply pressures. When the upper pressure value of the supply pressure range is exceeded, the pump(s) shut(s) OFF until the aerosol supply has been used up and turn(s) ON again when

the lower pressure value of the range of supply pressures has been crossed downward on account of aerosol consumption.

In conclusion, the tabular survey represents an illustrative summary of the procedures followed when operating the apparatus of the invention respectively when implementing the method of the present invention.

Overview of operations and control switching

Designation of pressure p	p0	p1	p2	p3	p4
Pressure value designation in application		fourth	first	third	second
Pressure in bars	0	1.6	1.8	3.8	4.1
At apparatus start (machine command M08)	all pumps ON				
Apparatus regulation					
Operation with cross-sectionally large tools					
Action upon exceeding the applicable pressure value			pump P3 OFF		
Action upon dropping below the applicable pressure value		pump P3 ON again			
Operation with cross-sectionally small tools					
Action upon exceeding the applicable pressure value			pump P3 OFF		pumps P1,P2 OFF
Action when crossing downward applicable pressure value				pumps P1,P2 ON again	
When apparatus is stopped (machine command M09)	all pumps OFF				

Tool with cross-sectionally large cooling lubricant ducts
Apparatus starts: all pumps P1-P3 turn ON; tank pressure p0 = 0 bar
Supply pressure exceeds p2 = 1.8 bars => oil over-enriching pump P3 turns OFF
Supply pressure drops during processing below p1 = 1.6 bars => oil over-enriching pump P3 switches ON again
Supply pressure rises again above p2 = 1.8 bars => oil over-enriching pump P3 again shuts down.

Tool with cross-sectionally small cooling lubricant ducts
Apparatus starts: all pumps P1-P3 turn ON; tank pressure p0 = 0 bar
Supply pressure rises in tank => beyond p2 = 1.8 bars => oil over-enriching pump P3 shuts down
Supply pressure rises further above p4 = 4.1 bars; => pumps P1 + P2 shut down
Supply pressure drops during processing below p3 = 3.8 bars; => pumps P1 + P2 turn ON again.
Apparatus is shut down; the supply pressure drops to p0 = 0 bar.

WHAT IS CLAIMED IS:

1. An apparatus (10) to prepare a fine oil aerosol mist to feed said oil mist into lubricant ducts of tools of a CNC machine tool, comprising a plurality of pumps and at least one compressed air conduit (16, 28) to feed air, further at least one oil-air mix generator (14, 15) for processing oil and air into the fine oil aerosol mist and feeding it to a tank (23) from which the oil aerosol mist is supplied via a feed conduit (26) to the tool,

characterized

in that the apparatus (10) comprises a pressure sensor (34) measuring the pressure of the oil aerosol mist in the tank (23) and a control unit (31) which, following turning ON of the apparatus (10), initiates air supply and at least one of two aerosol supply pumps (P1, P2) and an over-enriching pump (P3) of the plurality of pumps to generate oil-air mixes, and wherein the control unit

- stops the over-enriching pump (P3) when a first predetermined supply pressure p2 has been exceeded,
- stops the at least one of the two aerosol supply pumps (P1, P2) when a predetermined, maximally permissable second supply pressure p4 has been exceeded,
- restarts the at least one of the two aerosol supply pumps (P1, P2) when a predetermined third supply pressure p3 has fallen below a set value, and
- restarts the over-enriching pump (P3) when a predetermined fourth supply pressure p1 is fallen below a set value,

wherein $p1 < p2 < p3 < p4$.

2. The apparatus (10) as claimed in claim 1, further characterized in that the apparatus is turned ON by a standardized machine cooling lubricant ON command M08 transmitted through a control line (36) and is turned OFF by a standardized machine cooling lubricant OFF command M09.

3. The apparatus as claimed in claim 1 or 2, further characterized in that when the applied compressed air or aerosol mist feed is at about 6 bars in the tank (23), the supply pressures are approximately p1 = 1.6 bars, p2 = 1.8 bars, p3 = 3.8 bars and p4 = 4.1 bars.

4. The apparatus as claimed in claim 1, further characterized in that there are two oil-air mix generators (14, 15) driven in parallel to produce the aerosol mist, each generator being fitted with its own supply pump (P1, P2).

5. The apparatus as claimed in claim 1, characterized in that the oil over-enriching pump (P3) is connected by conduit (25) directly through the feed conduit (26) to the tool and that an additional compressed air conduit (28) to feed supplemental air is connected to the at least one oil-air mix generator (14, 15), the control unit (31) adapting to shut off the feed of supplemental air and shut off the oil over-enriching pump (P3) when the first supply pressure value p2 is reached.

6. The apparatus as claimed in any one of claims 1 to 5, characterized in that the supply pumps (P1, P2) and the oil over-enriching pump (P3) are pneumatic pumps which, being connected to a respective compressed air conduit (16, 28), are operated by the feeding of air or supplemental air.

7. The apparatus as claimed in claim 6, characterized in that an output of each of said aerosol supply pumps is regulated by a frequency generator (29, 30).

8. A method for preparing a fine oil mist for feeding it into tool lubricant ducts of a CNC machine tool, wherein compressed air and oil are fed to oil-air mix generators (14, 15) to generate a fine oil aerosol mist, aerosol supply pumps (P1, P2, P3) and the feed of compressed air are adapted to be turned ON as a function of the particular tool used,

characterized

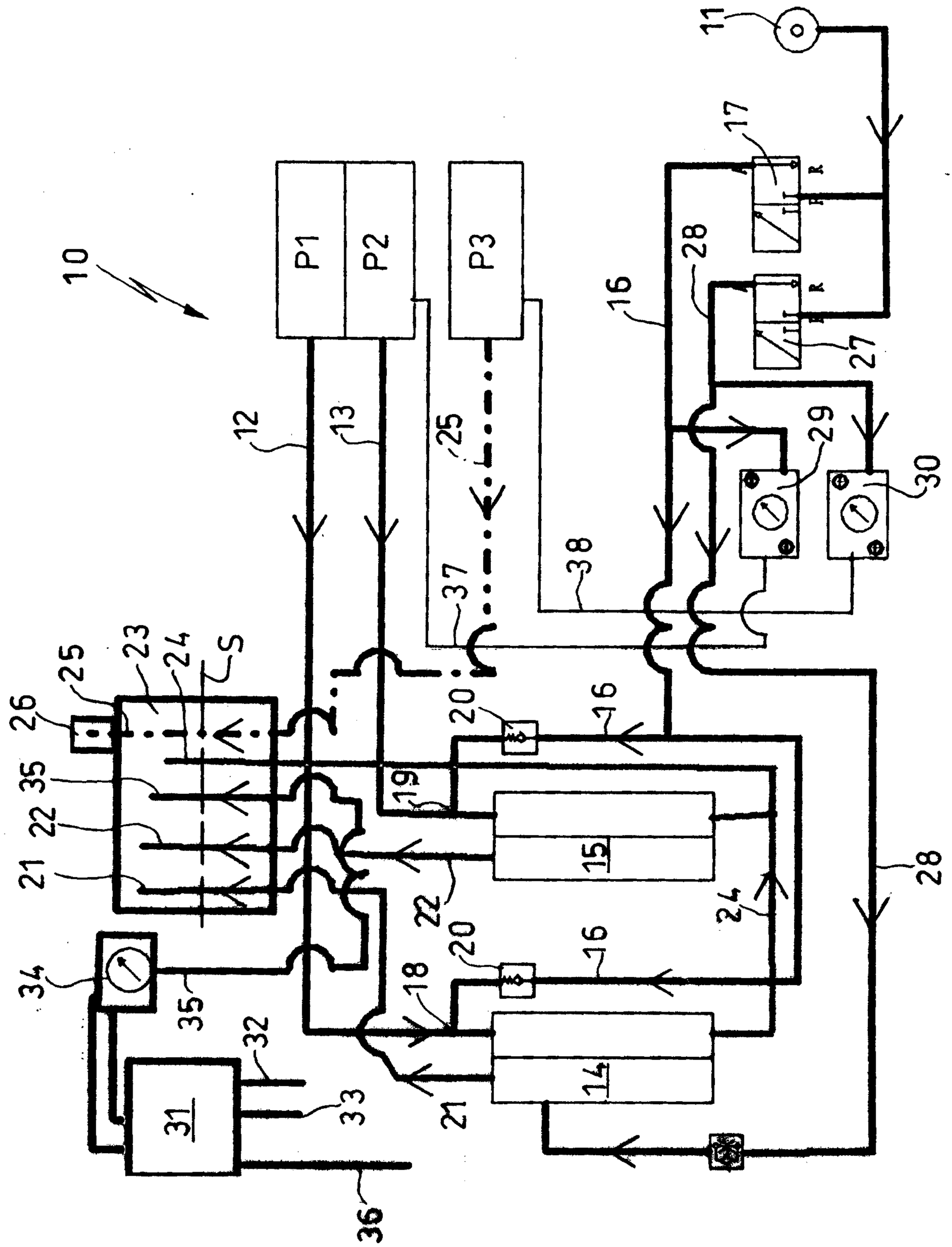
in that following start up of the apparatus (10) aerosol supply pressure is measured and the oil-air mix generators (14, 15) are driven solely as a function of preset supply pressure values (p1, p2, p3, p4).

9. The method as claimed in claim 8, further characterized in that a standardized machine cooling lubricant ON command M08 turns ON the apparatus (10), and a standardized machine cooling lubricant OFF command M09 turns the apparatus (10) OFF.

10. The method as claimed in claim 8, further characterized in that the supply pumps (P1, P2) used in aerosol generation, when regulated, operate continuously within a supply pressure range between $p0 = 0$ bar and $p4 < 6$ bars.

11. The method as claimed in claim 8, further characterized in that in operation of the apparatus, a control unit (31) turns ON an oil over-enriching pump (P3) when a supply pressure p1 has fallen below a set value and controls a feed of supplemental air into at least one of the oil-air mix generators (14, 15).

12. The method as claimed in any one of claims 8-11, further characterized in that when compressed air or aerosol mist are fed at about 6 bars into a tank (23), the supply pressures are approximately $p1 = 1.6$ bars, $p2 = 1.8$ bars, $p3 = 3.8$ bars and $p4 = 4.1$ bars.



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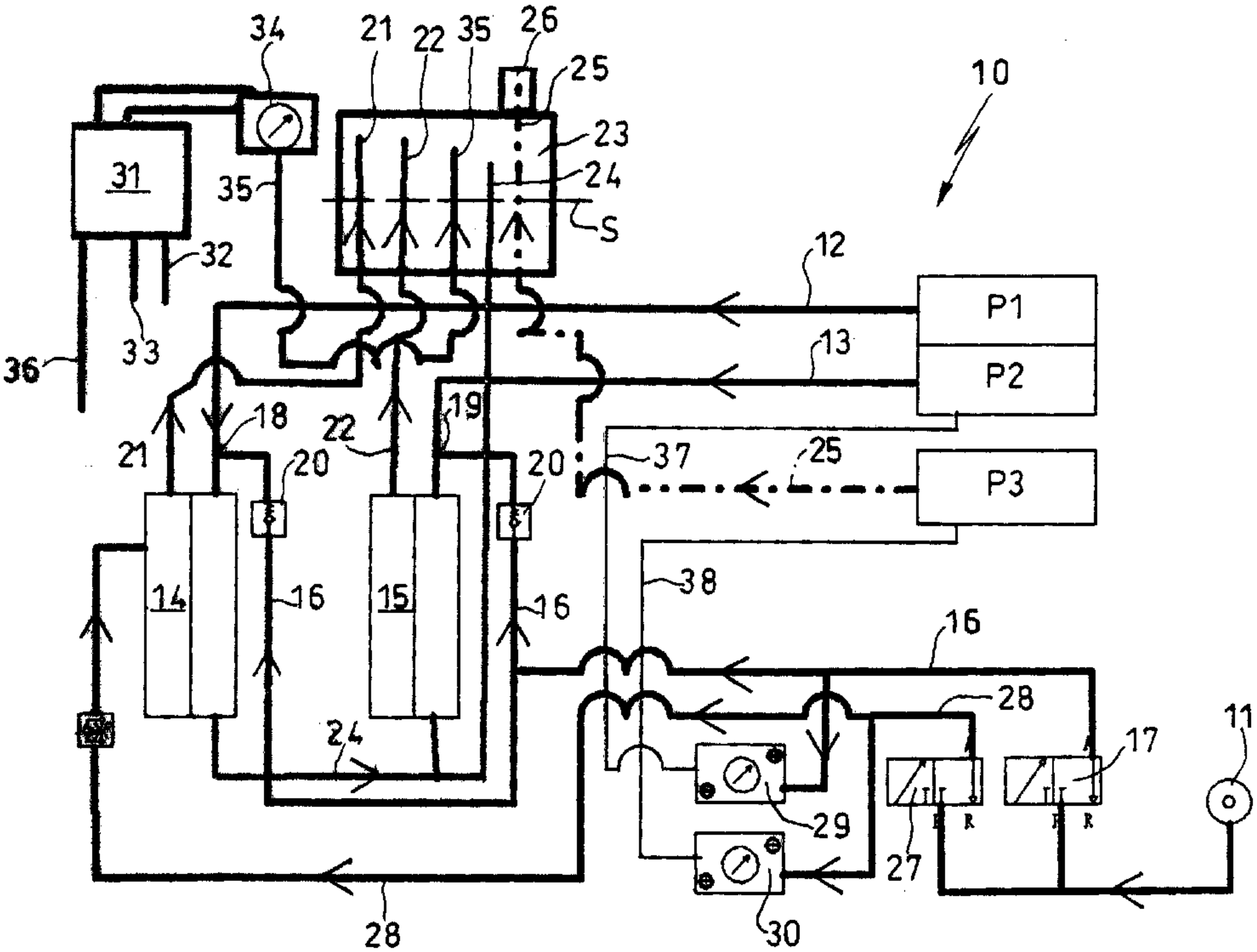
PATENT AGENTS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