

Anaerobic Sealant Coating Equipment for Use on Screw Threads, Joints, and Connections

Introduction

Adhesives and sealing agents are widely used in industrial applications and contribute significantly to the reduction in the size and cost of various industrial products.

Although selection of appropriate materials and their applications in manufacturing lines are important points, these peripheral technologies tend to be overlooked, and not to be emphasized.

Followings are the reasons of this:

- 1) If handled improperly, chemical products may have adverse effects on people and the environment, and require technologies for environmental hygiene and hazardous substances handling.
- 2) It is required to meet seemingly contradictory requirements, these are to supply sealing agents and adhesives with uncured state and to be cured when

applied, although generally they function in cured state.

- 3) It is difficult to control viscous chemical liquid materials since they easily change their states and characteristics.

For mechanical engineers, these areas of technologies are usually unfamiliar and difficult to pursuit deeply.

Therefore, it is more efficient and effective for those who have sufficient knowledge of chemicals and are familiar with the handling of those products to develop and supply adhesives, sealing agents, and application technologies.

Our company has been focusing on adhesive and sealing agent application technologies for more than 20 years. In this issue of Three Bond Technical News, we place special focus on anaerobic sealant coating equipment.

Table of contents

Introduction	1	3-4. Types of valves and their features	5
1. Function of anaerobic sealant coating equipment and proper selection of equipment type.....	2	3-5. Valve structures and operating mechanisms.....	6
2. Types of sealants and their features	2	4. Application examples	7
2-1. Types of sealants and their features ...	2	4-1. Application of sealant to threads and shafts	7
2-2. Types of anaerobic sealants and their features...	3	4-2. Application of sealant to inner circumference of fittings and female threads.....	9
3. Anaerobic sealant coating equipment	3	4-3. Application of sealant to joints.....	9
3-1. Coating equipment structures and classification	3	4-4. Other sealant application examples ...	10
3-2. Types of coating equipment.....	4		
3-3. Dispenser components and examples of structures	4		

1. Necessity of anaerobic sealant coating equipment and its selection

Sealants that have both functions as adhesives and sealing agents are widely utilized in the area of assembling machines. In particular, anaerobic sealants are commonly used on screws, joints, and connections, thus contributing greatly to the reduction in the size of machine structures.

As for curing conditions, it must not be exposed to oxygen in air (i.e., it must be anaerobic) and it must be in contact with a metal. Therefore, sealants are used to fill small gaps in many applications. Furthermore, excessive sealant that extends from the applied location does not harden easily. Excessive sealant is wasteful, and may cause adverse effects adhering on other unnecessary portions, as well.

Therefore, application of sealant in assembly lines requires coating equipment that can supply a very small quantity of sealant accurately. In designing and assembling such coating equipment, considerations for the properties of anaerobic sealants are essentially required.

1. Any materials that contact with sealants must not be metal kinds.
2. These materials must be air-permeable.
3. There must be no fitting joints or small gaps in

the flow paths. Perfect sealing is required especially for thread part of screws in order to avoid penetration of sealant.

4. Structures that generate heat (i.e., frictional heat) in the flow path should be avoided.
5. Sealant will not cure if it is exposed in air (such as at nozzle tip and storage tank), but will cure if contacted any metals. Therefore, it must be protected from metal contact and mixture of metal powder.
6. Drilling or tapping tools previously used to process metals must not be used to process the flow path (for drilling or tapping), in order to avoid that metal debris adhere to the flow path.

According to the considerations described above, followings are minimum requirements of anaerobic sealants coating equipment.

1. Able to supply minute fixed quantity
2. Sealant should not be solidified in flow path.

In selecting equipment, the following properties of assembly line must be considered.

1. Ambient environments of the assembly site
2. Shapes and positions of the part to be coated
3. Carry in/out and positioning methods of the parts to be coated
4. Spendable time for coating (tact time)

2. Types of sealants and individual features

2-1. Types of sealants and individual features

Types	Solvent-type sealant	Anaerobic sealant	Precoat-type sealant
Features	Hardens due to the volatile of organic solvent. Slow curing speed, low adhesive strength, relatively low viscosity, easy to apply, low cost, and high preservation stability.	Hardens due to the reaction occurred mainly by interception of oxygen in air. Selectable adhesive strength. Selectable curing speed. High chemical resistance.	Hardens due to the reaction of base and curing agents occurred by breaking microcapsules. High initial sealing performance. Excellent workability in assembly. Hardens with lower class of screws which have wider dimensional allowances.
Applications	Used for screws, fittings, and joints. Used for wider ranges of threads, from small to large diameters. Also used for threads on small screws fixing low power electric components.	Used for screws, fittings, and joints. Used on bolts that require relatively high adhesive strength.	Used exclusively on threads. Used for wide ranges of applications, from small screws for eyeglasses to large-diameter bolts for such as constructions and machinery.
Name	TB 1100 series TB 1200 series TB 1400 series TB 4200 series	TB 1300 series TB 3000 series TB 1110B	TB 2300 series TB 2400 series

Each sealant type requires special coating equipment. However, in this article, only coating equipment for anaerobic sealants is described.

2-2. Types of anaerobic sealants and individual features

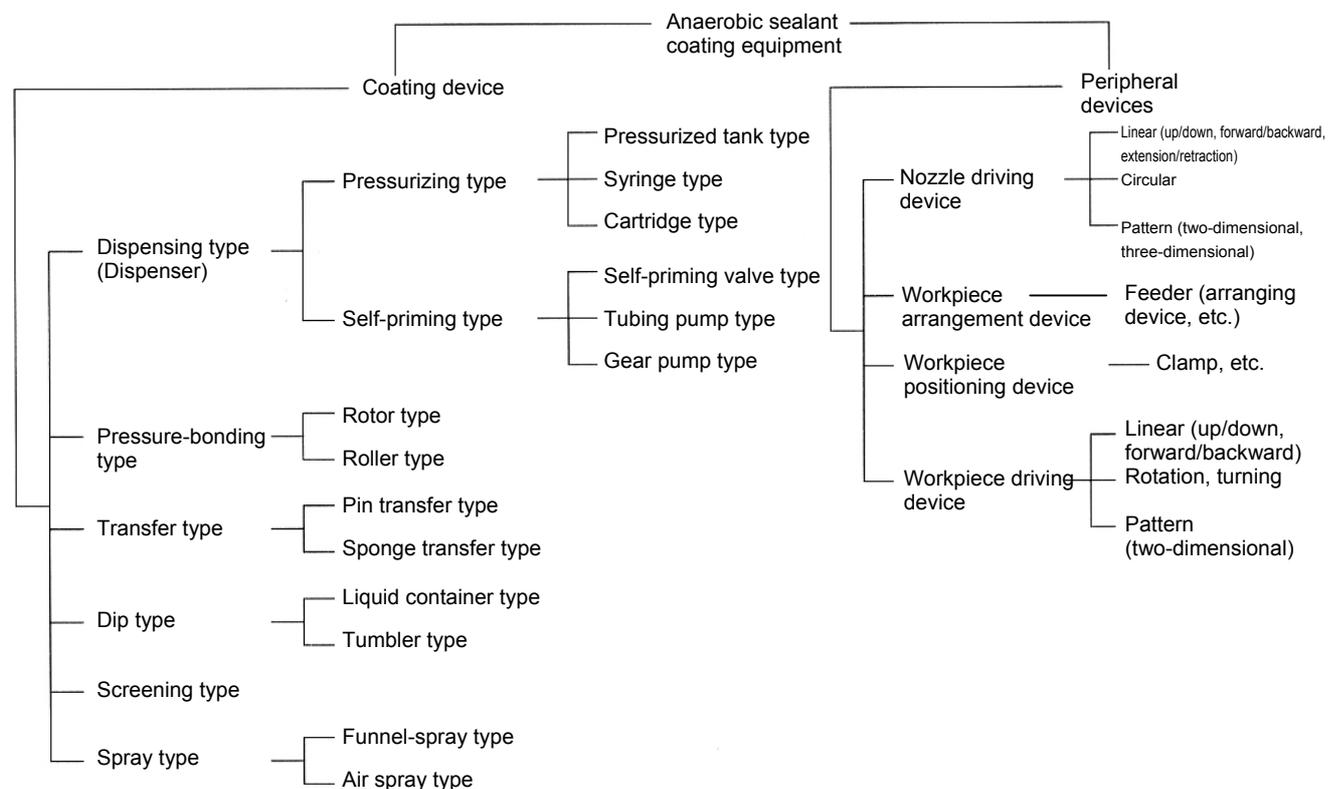
Variety of classifications for sealants such as by strength, by property exists. However, here sealants are classified by application, relating to coating equipment.

	For screws	For fittings	For joint surfaces and special applications
Features	High popularity. , Corresponding to applications, various grades products with low to high viscosity and low to high strength are available. Since there many quick hardening types exist, designing and manufacturing of coating equipment must be carefully performed.	Used for many press-fitting bearings. Various grades products with low to ultra high viscosity are available. Since there many quick hardening and high strength types exist, careful attention is required. Since sealants for welch plugs have slow hardening property, however, they are thixotropic, it is difficult to dispense fixed quantity.	Many of sealants for welded area of tire wheels and for post assembly impregnation have low viscosity, because they are aimed for porosity sealing. Sealants used for joints and piping are pastiness. Each of them requires dedicated coating equipment.
TB grade	High strength TB 1303, 1305 Medium strength TB 1322, 1324, 1327 Low strength TB 1342, 1344 Heat resistance TB 1360, 1374 For axial force stability (lubricating type) TB 1374	High strength for small parts TB 1373 B High strength with general-purpose heat resistance TB 1375 B High strength for large parts TB 1377 B, 1379 B For welch plugs TB 1386 series	For joint surfaces TB 1131 For welch plugs TB 1130, TB 1386 series For piping TB 1110 B For sealing welded area of tire wheels TB 1370 B, C For post assembly impregnation TB 1361 B

3. Anaerobic sealant coating equipment

3-1. Coating equipment structures and classification

Coating can be performed by single coating device only, but generally coating equipment includes combinations of peripheral devices and categorized as follow.



3-2. Types of coating equipment

Type		Product name	Feature	Applicable anaerobic sealants	
Dispensing type (Dispenser)	Pressurizing type	Pressurized tank type Pressurized tank type Syringe type Cartridge type	3B Coater S 3B Coater P Mini-coater C 3B Coater C	Small-quantity application, compact, inexpensive Small-quantity application, dedicated type Extra-small-quantity application, wide viscosity range, compact For high-viscosity sealants, inexpensive	All types with viscosity of 2,000 cps or lower All types with viscosity of 2,000 cps or lower All types TB 1110B
	Self-priming type	Self-priming valve type Tubing pump type	3B Coater CVA Fan-flow ADF	Precise fixed-quantity application Intermittent dispensing of extremely small quantity, air supply not required Continuous and variable dispensing of small quantity, air supply not required	Exclusively for TB 1386D All types with viscosity of 1,000 cps or lower
		Gear pump type	Fan-flow SMF Fan-flow MVF02	Precise fixed-quantity application	All types with viscosity of 1,000 cps or lower TB 1110B
Pressure - bonding type	Rotor type	3B Coater R	Small, lightweight, air supply not required	Low-reaction types with viscosity of 5,000 cps or lower	
	Roller type	Designed for each order	For automatic application only	Low-reaction types with viscosity of 5,000 cps or lower	
Transfer type	Pin transfer type	Designed for each order	Application of extremely small quantities possible	All types	
	Sponge transfer type	Designed for each order	Surface application possible	All types	
Dip type	Liquid container type	Designed for each order	High-speed coating, inexpensive	5,000 cps or lower	
	Tumbler type	Ty-Nee510, 1600	High-speed coating	TB 1130	
Screening type		3B Coater SC-100	Dedicated unit for flat surface coating, high-speed coating	TB 1131	
Spray type	Funnel-spray type	3B Coater RTM	For inner circumference coating	TB 1386 series	
	Funnel-spray type	3B Coater RTAH	Handheld unit for inner circumference coating	TB 1386 series	
	Air spray type	Designed for each order	Curved surface coating possible	TB 1370 series	

3-3. Dispenser components and examples of structures

The following describes the components of dispenser widely used for application of anaerobic sealants.

	Pressurizing type (see Fig. 1)	Self-priming type (see Fig. 2)
Features	Controls dispensing ON and OFF with open and close of the valve by pressurizing liquid material. Since dispensing quantity is determined by the applied pressure, and open and close time of valve, it is difficult to dispense fixed-quantity reacting to viscosity change of the liquid.	Repeats sucking and dispensing of liquid material using fixed-quantity supply valve. Because mechanism of the valve is complex, applicable liquid materials are restricted, however, accuracy of dispensed quantity is very high.
Standard components	<ol style="list-style-type: none"> Pressure-feeder components <ul style="list-style-type: none"> Pressurized tank Syringe Cartridge Piping <ul style="list-style-type: none"> Material feeding tube Distributor Head section <ul style="list-style-type: none"> Dispensing control valve (Syringe type does not use a valve.) Nozzle block Nozzle guide Nozzle Control section <ul style="list-style-type: none"> Electric control panel Pneumatic control panel 	<ol style="list-style-type: none"> Liquid storage section <ul style="list-style-type: none"> Liquid storage tank Material container Piping <ul style="list-style-type: none"> Material tube Distributor Self-priming section <ul style="list-style-type: none"> Self-priming valve Tubing pump Gear pump Head section <ul style="list-style-type: none"> Nozzle block Nozzle guide Nozzle Control section <ul style="list-style-type: none"> Electric control panel Pneumatic control panel
Non-standard components (components marked with * are for the pressurized type only)	<ol style="list-style-type: none"> Remaining quantity detecting device *2. Tank pressure compensation device *3. Material feed hopper Material warming unit Pen holder Felt nozzle 	<p>Electrostatic capacitance sensors are normally used.</p> <p>Varies the feeding pressure according to outside temperature.</p> <p>Supplies material without opening the lid to the pressurized tank.</p> <p>Used to maintain the fluidity of sealant when the ambient temperature is low in winter.</p> <p>Used for hand coating. Hand-operated switch type and foot switch type are available.</p> <p>Used for uniform coating on a flat surface.</p>

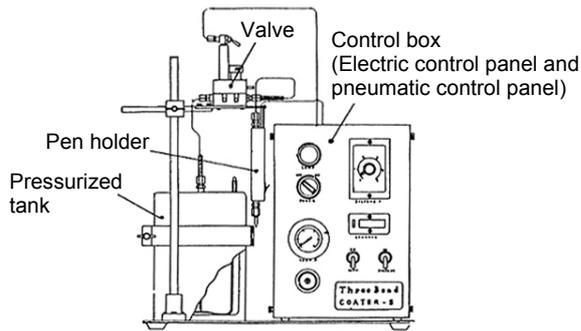


Fig. 1 Example of pressurized type dispenser

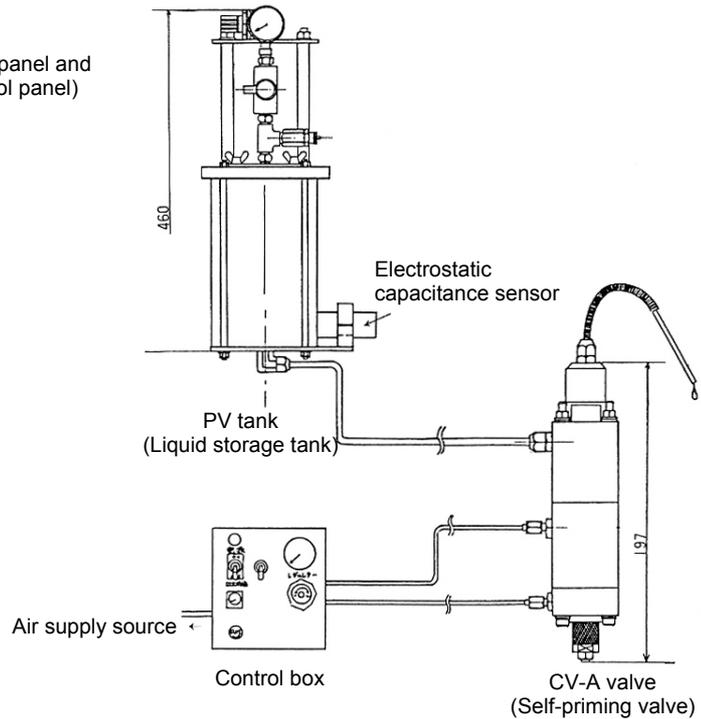


Fig. 2 Example of self-priming type dispenser

3-4. Types of valves and individual features

Valve is a especially very important component in dispenser components, and methods to prevent anaerobic sealant from curing must be devised..

	Pressurized type		Self-priming type
	Pinch valve	Diaphragm valve	Self-priming valve
Features	Closed by pinching visualized tube with air cylinder. Controls open and close of dispensing by operating the air cylinder. Piping is simple and easy to clean. Possible to make dispenser compact.	Controls open and close of dispensing with open and close of seating surface using bellow diaphragm of Teflon operated by air cylinder. The system offers excellent durability. By changing the orifice diameter, dispensing quantity can be adjusted, from small volume to large volume.	Repeats to such and dispense using reciprocating motion of plunger operated by air cylinder. Because the material will cure in the valve, usable materials are limited, however, this is able to dispense fixed quantity without being affected by change of viscosity.
Model	Type V: Compact, simple, inexpensive Type VV: Adjustable flow rate Type LV: If air supply stops, the valve is closed to prevent reverse flow of material. Type NV: Combines the features of Type V and Type VV to prevent liquid stagnation at the nozzle tip.	Type DVA: Equipped with a Teflon bellows diaphragm for high durability. Type AV-201: Open and close is driven by electromagnetic drive and it enables precise quantity control.	Type CVA: This is exclusively designed for the TB 1386 anaerobic sealant for welch plugs, and has excellent properties for fixed quantity dispensing and durability.
General specifications	Durability 100,000 operations (TT-23 tube)	300,000 operations (non-abrasive liquid)	300,000 operations
	Pressure resistance 6 kg/cm ²	7 kg/cm ² (2 kg/cm ² in the case of AV-201)	7 kg/cm ²
	Minimum discharge quantity 0.01 cc	0.02 cc (0.01 cc in the case of AV201)	0.03 cc
	Material viscosity 2,000 cps max.	100 to 15,000 cps	2,500 cps max.
Applicable material	All materials with viscosity of 2,000 cps or lower	All material with viscosity of 100 to 15,000 cps	TB 1386D

3-5. Valve structures and operating mechanisms

(1) Pinch valves

The pinch valve opens and closes the flow path by directly pressing the tube.

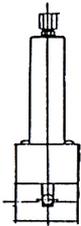


Fig. 3 Type V

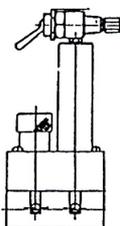


Fig. 4 Type VV

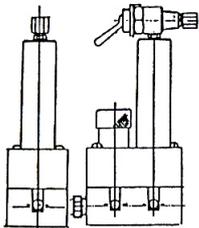


Fig. 5 Type NV

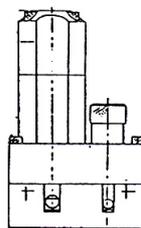


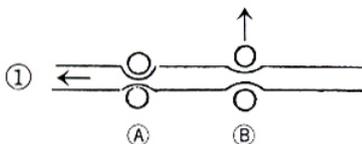
Fig. 6 Type LV

Operating mechanism of Type V and Type VV pinch valves

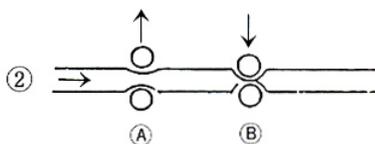
The tube is always pinched and closed by air pressure in idle state. Liquid material is dispensed when the air supply is stopped and the tube is opened by return force of the spring.

Operating mechanism of Type NV pinch valves

(Non-drip valve)



(1) The pinch at (B) is released to dispense material.



(2) (B) is pinched and closed and the pinch (A) is released and opened, thus dripping is prevented by sucking up the liquid material at the nozzle.

Operating mechanism of Type LV pinch valves

The tube is always pinched and closed by spring force in idle state. Liquid material is dispensed when the air pressure pushes up the spring and opens the tube.

(2) Diaphragm valves

The diaphragm valve utilizes elasticity of diaphragm to open and close the seating section.

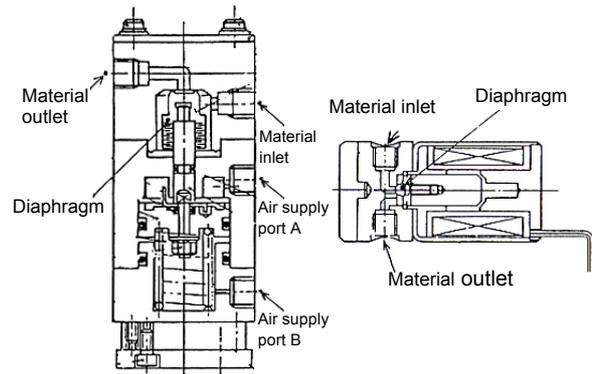


Fig. 7 Type DVA

Fig. 8 Type AV-201

Operating mechanism of Type DVA diaphragm valves

When compressed air is supplied to air supply port A, the plunger is pushed downward, contracting the bellows of the diaphragm to open the seating section, thus the material is dispensed.

Operating mechanism of Type AV-201 diaphragm valves

When an electric current is supplied to the solenoid, the solenoid pulls the rod towards the right to contract the diaphragm and open the seating section, thus the material is dispensed.

(3) Self-priming valves

Performs a kind of pumping operation as the valve itself sucks material and pushes out the sucked quantity.

Operating mechanism of Type CVA self-priming valves

* When compressed air is supplied to air supply port A, the pneumatic plunger is pushed downward and sucks material into the cylinder through the material inlet.

* When compressed air is supplied to air supply port B, the pneumatic plunger is pushed upward, thus the material in the cylinder is dispensed from the material outlet.

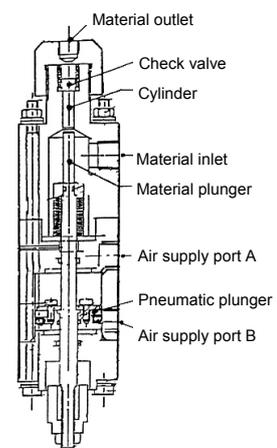


Fig. 9 Type CVA

4. Application examples

4-1. Coating methods for threads and shafts (1) Manual coating to the bolt threads

When the limit switch is operated by the bolt that is pushed on the jig manually, the anaerobic sealant drips from the nozzle tip onto the bolt threads.

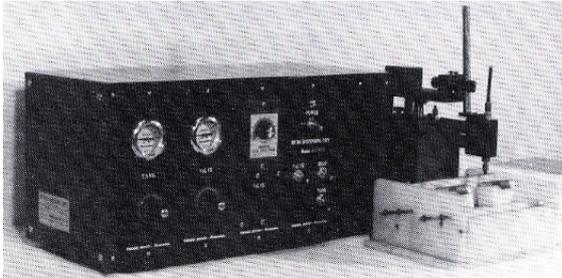


Photo 1

Dispenser 3B Coater P or S
Peripheral device Workpiece positioning jig

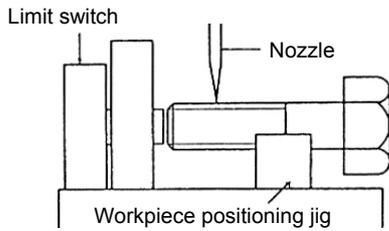


Fig. 10

(2) Automated coating methods for bolt threads

Aligned bolts in the parts feeder are dropped to the chute individually by the shutter. When a bolt stops at the stopper, the clamp holds the bolt. The nozzle moves forward and sealant drips from the nozzle. The clamp and stopper then release the bolt, which then drops onto the station. The bolts collected on the station are moved and tightened to a position to be used by a robotic arm or manually.

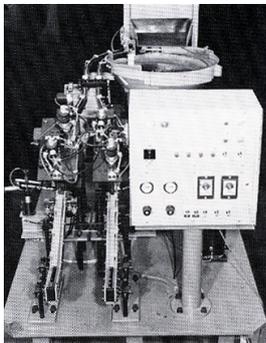


Photo 2

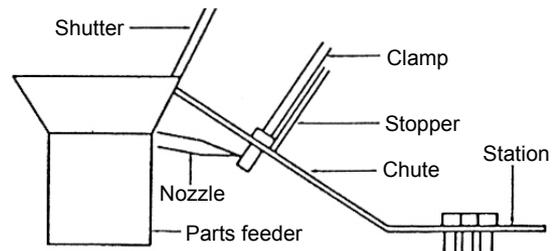


Fig. 11

Dispenser 3B Coater P
Peripheral device Parts feeder, chute, shutter, clamp, stopper, station
Application examples Differential ring gear bolts, flywheel fixing bolts

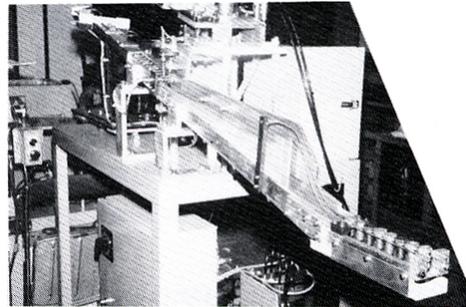


Photo 3 Example of automated coating method for bolt threads

The dispenser applies sealant to bolts lying on their side and sends them through the chute. The drawback of this system is that centrifugal force causes the coated sealant to splash.

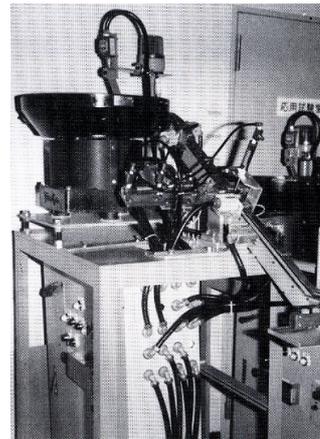


Photo 4 Example of automated coating method for bolt threads

If bolts are large in diameter, the dispenser can use two nozzles to apply sealant from both sides of each bolt, to coat nearly the entire periphery.

(3) Dipping method for bolt threads

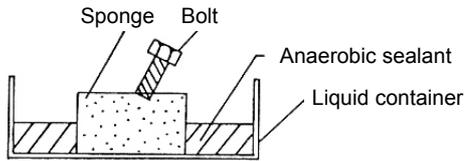


Fig. 12

Application example Bolts for motorcycle assembly lines

Caution Contacting fingertips to the sponge may cause skin irritation.

(4) Pressure-bonding method for bolt threads

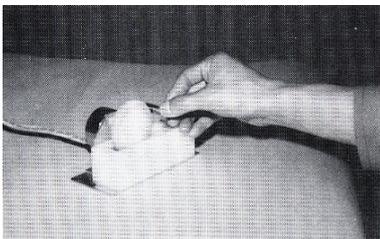


Photo 5 Three Bond Coater R

This system is designed to facilitate coating of male threads with anaerobic sealant. Sealant can be applied easily by holding a bolt and pressing it against the outer edge of the rotating disc.

This reduces work time, minimizes sealant loss, and allows clean sealant application with minimal adhesion of sealant to the worker's hands or clothes.

(5) Coating method for threads of taper plugs



Photo 6
Tumbler coating equipment

The tumbler containing taper plugs and the TB 1130 sealant is placed on the motor shaft; the shaft then rotates to coat the taper plugs with the sealant.

The coated taper plugs are taken out from the tumbler and assembled.

(6) Automated coating method for motor shafts

Shaft is inserted halfway into the rotor and set on the jig on the index table.

After anaerobic sealant is dripped onto the shaft, the shaft is inserted to the specified position. Then, the assembly is removed from the index table.

Dispenser 3B Coater P
Peripheral devices Index table, positioning jig, shaft insertion device

Application example Fitting adhesive of core and shaft of micro motors

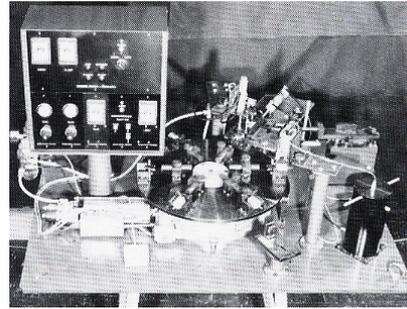


Photo 7

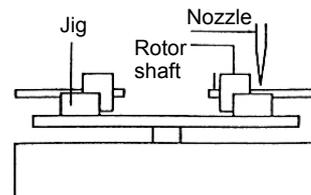


Fig. 13

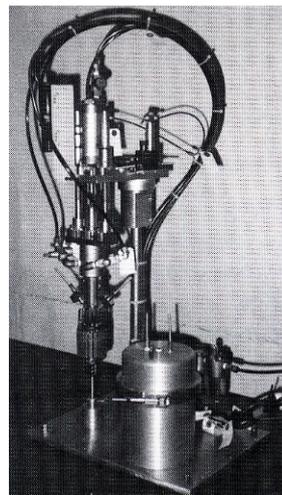


Photo 8
Example of application of sealant to motor shaft (vertical application method)

In relation to the assembly process, two nozzles are rotated 180° to coat the entire circumference of vertically standing shaft.

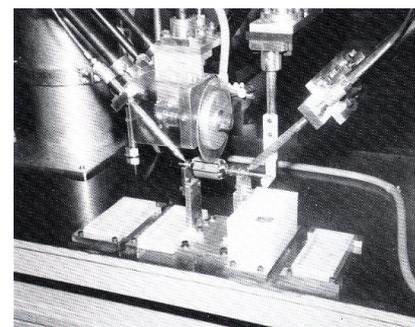


Photo 9
Example of application of sealant to motor shaft (horizontal application method)

With the shaft positioned horizontally, the urethane roller transmits rotating force to the motor rotor and turns the shaft, so sealant is applied to the entire circumference.

4-2. Coating method for inner circumference of fittings and female threads

The rotor is inserted into the inner circumference and anaerobic sealant is dripped inside the rotor. When the motor rotates the rotor at high speed, sealant is sprayed through the small holes on the periphery by the centrifugal force, coating the inner circumference of the fitting surface.

An electric motor is used for automated method. However, for manual operation, an air motor is used in order to reduce the weight.

Valves such as DVA or CVA are used.

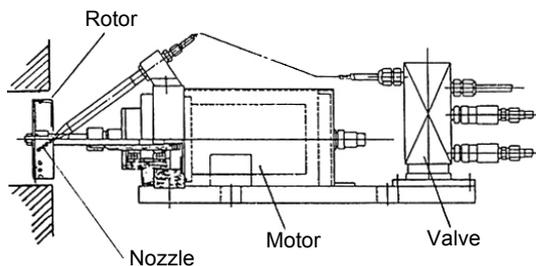


Fig. 14 Type RTM head

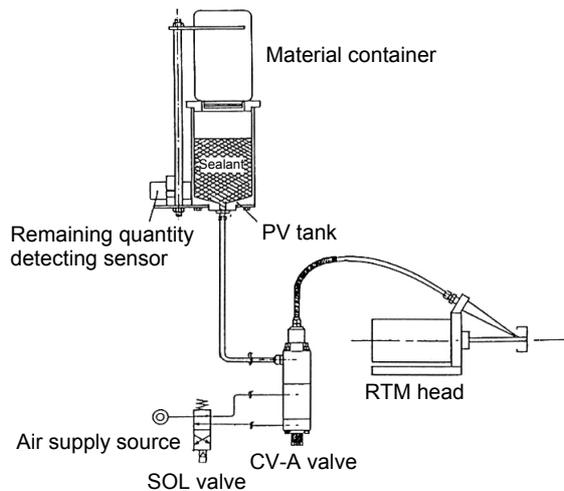


Fig. 15 Coating system using self-priming fixed-quantity valve

Features

- * Accuracy of fixed-quantity is excellent since this is not affected by viscosity changes of anaerobic sealant.
- * Workability for supplying material is good and sealant is not wasted, because no pressure is applied.
- * Remaining quantity of sealant can be visually checked and it eases workers.

Caution

- * Sealants other than the TB 1386 cannot be used.
- * Hanging position of the tank must be placed higher than CVA valve.

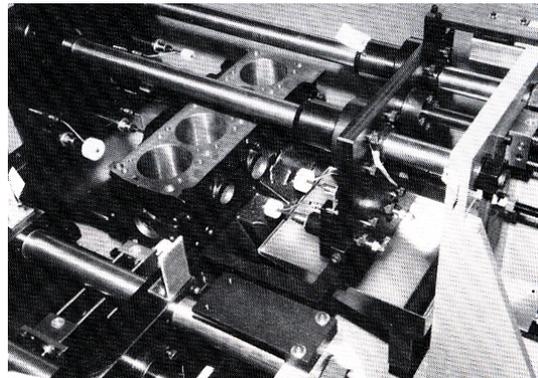


Photo 10 Example of application of sealant to inner circumference of sand draining holes of cylinder blocks (3B Coater RTM)



Photo 11 Example of application of sealant to inner circumference of sand draining holes of diesel engine cylinder heads (3B Coater RTM)

4-3. Application of sealant to joints

The following methods are used to coat anaerobic sealant to seal flange surfaces.

- (1) A pen-holder-type dispenser is used for manual coating.

With low-viscosity (2,000 cps or lower) materials

Use the 3B Coater S or Fan-flow SMF.

With high-viscosity (2,000 to 50,000 cps) materials

Use the 3B Coater C or Fan-flow MVF02.

- (2) A combination of a dispenser and a nozzle drive device is used for automated coating.

Dispenser

Use the 3B Coater P or 3B Coater C.

Nozzle drive device

Model TRT (tracing system, template type)

Model TRC (tracing system, computer type)

- * For details on the above devices, refer to the sections on the tracing system in Technical News No. 7 and No. 14.

(3) A screening-type coating device is used for automated coating.

* For details, refer to the sections on the screening system in Technical News No. 7 and No. 14.

4-4. Other sealant application examples

(1) Coating for sealing welded sections on tire wheels

Sealing of welded sections on tire wheels is an important manufacturing process to prevent air leak from tire.

Although epoxy adhesives are most commonly used, anaerobic sealants may be used in some cases, since they have impregnation property for small cracks.

In this coating process, wheels are transported hanging on hooks, but sealant must be coated manually because of difficulty of detecting welded sections. Because sealant needs to be coated as 200 to 300 mm length band, an air spray gun is used.

Commercially available air spray guns for paint applications are made of metal, and this could cause the sealant to harden inside the spray guns. Therefore, specially designed guns made of plastics are used.

The spray guns should be able to apply sealant in uniform thickness without splashing on the surrounding areas.

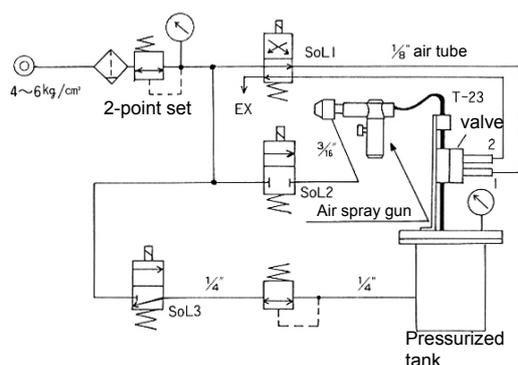


Fig. 16 Sealant coating system for tire wheels

(2) Coating for outer circumference of coolant liners of diesel engines

In large diesel engines, pipe-shaped liners are press-inserted into the hole of cylinder head that coolant flows.

There are two methods to coat the outer circumference of these liners.

(a) Pressure coating type with rollers (Photo 12)

(b) Sealant applied by a dispenser is rolled by rollers as like a belt (Photo 13)

In the case of method (a), high-reaction anaerobic sealant can harden too quickly.

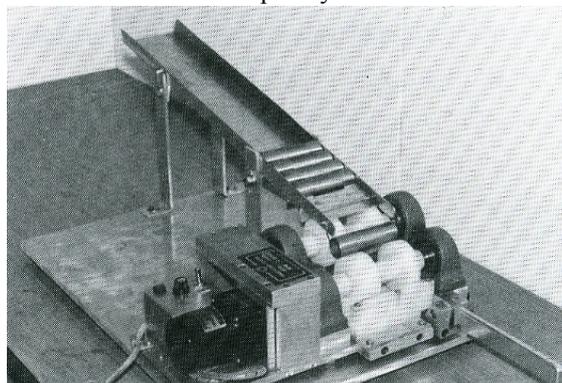


Photo 12 Example of application of sealant to outer circumference of liners for coolant passages (Pressure coating method using rollers)

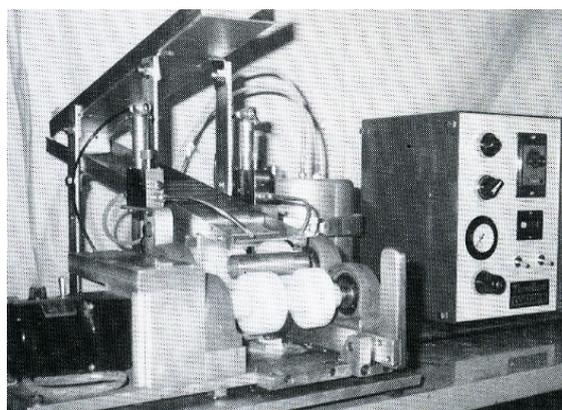


Photo 13 Example of application of sealant to outer circumferences of liners for coolant passages (System combining dispenser and film-forming rollers)

Yasuharu Nakane

General Manager, Three Bond Automation Equipment Co., Ltd.

