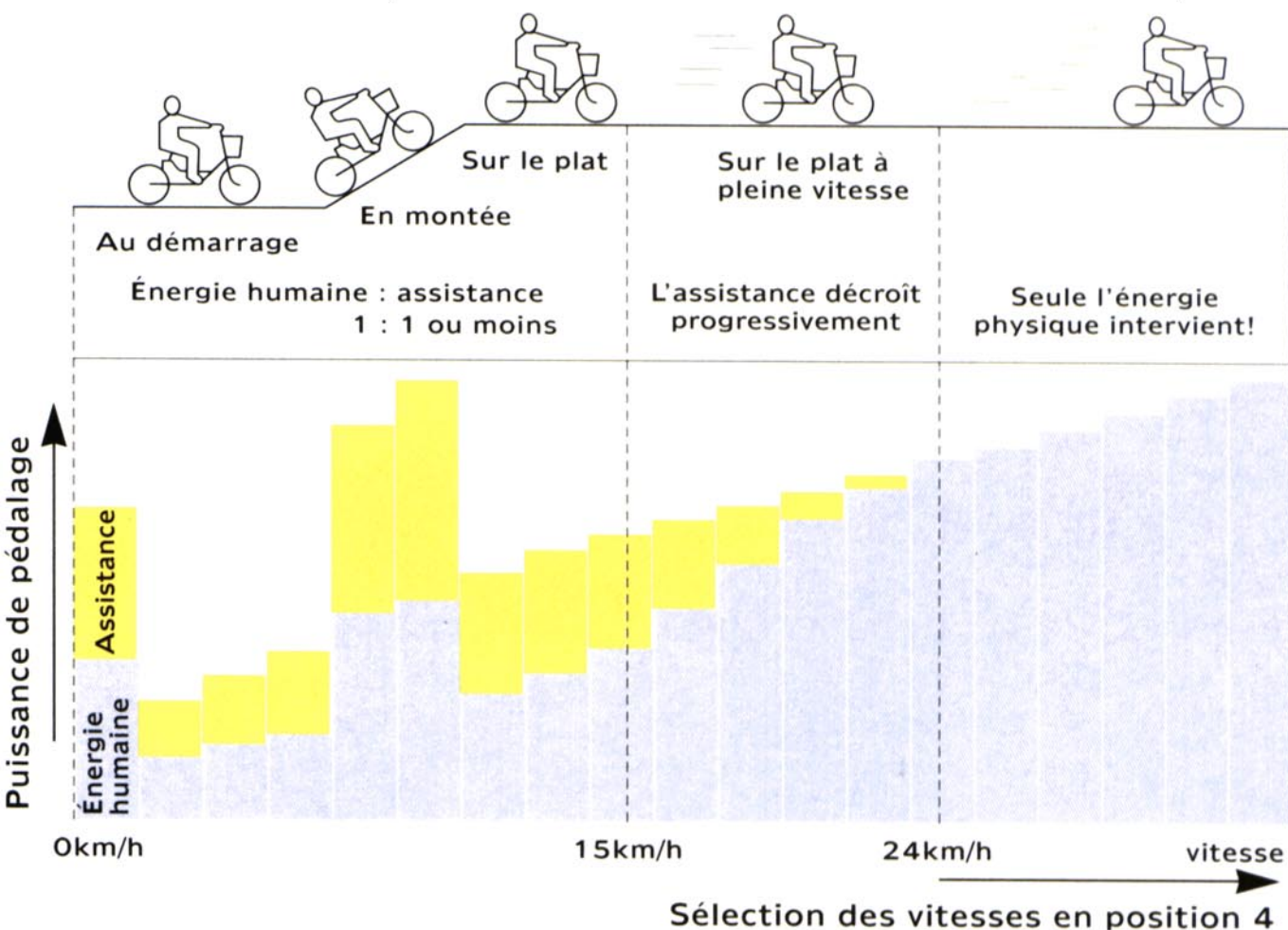


• Relations entre puissance musculaire et assistance électrique.



Sélection des vitesses en position 4

• Distance moyenne parcourue lorsque la batterie a été complètement chargée.

Les conditions de conduite		Distance				Les conditions d'utilisation
Schéma type de mesure		10km	20km	30km	40km	
		[Bar chart showing distance covered]				Schéma type de mesure, en assistance sur terrain vallonné.
Sur le plat 		[Bar chart showing distance covered]				En assistance continue sur terrain plat. (vitesse de 15 km/h, et poignée de dérailleur sur le repère 4)
Succession de montées et de descentes 		[Bar chart showing distance covered]				En montées et descentes constantes sur une côte de 2 degrés. (à la vitesse de 10 km/h, et poignée de dérailleur sur le repère 3)
En montée constante 		[Bar chart showing distance covered]				En montée constante sur une côte de 2 degrés. (à la vitesse de 10 km/h, et poignée de dérailleur sur le repère 3)
En montée par étape 		[Bar chart showing distance covered]				En montée constante sur une côte de 4 degrés. (à la vitesse de 10 km/h, et poignée de dérailleur sur le repère 2)

Ces cas de figure ne valent que si la batterie est neuve, la température de 20°C, et la charge totale de 70 kg, y compris le poids de l'utilisateur et celui de la charge transportée.

Structure & characteristics of planet roller reduction

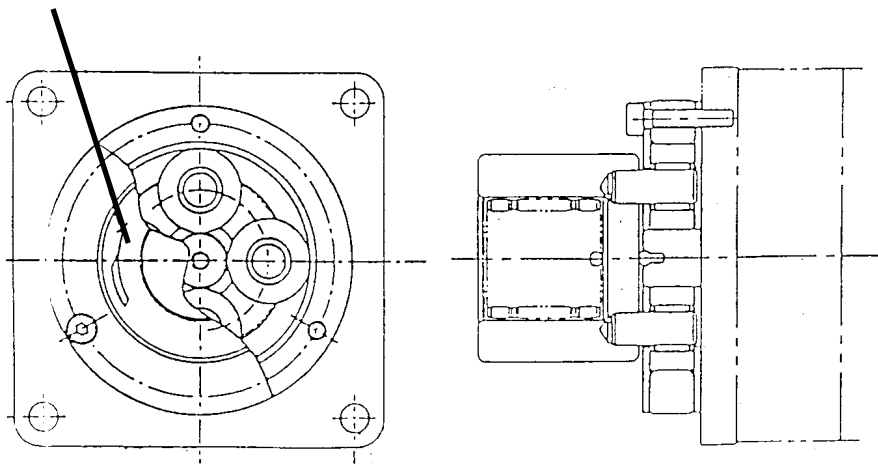
YAMAHA

Characteristics



The traction drive system has no engaging noise of gear tooth flanks : it has made the silent much closer to that of the bicycle

Revolving direction

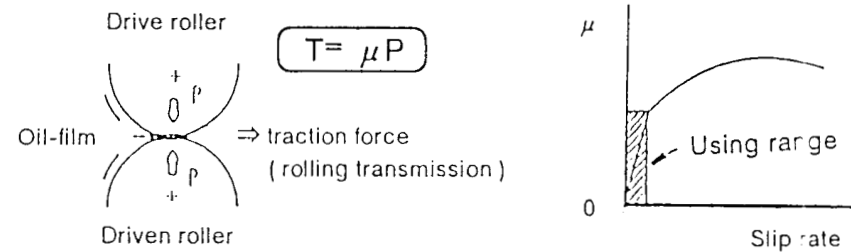


Principle, structure

Principle

Traction /Drive (T/D) is a device that transmit power through the oil-film lying between two rollers.

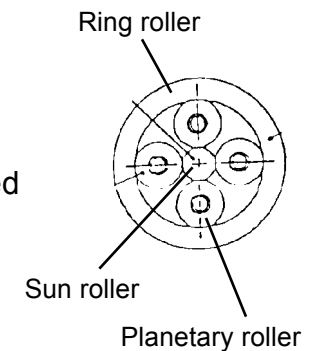
(These two rollers are having rolling contact)



Structure

The planet structure consists ring roller, planetary roller, sun roller and carrier

The roller's elastic deformation is used for the pressure between the rollers.

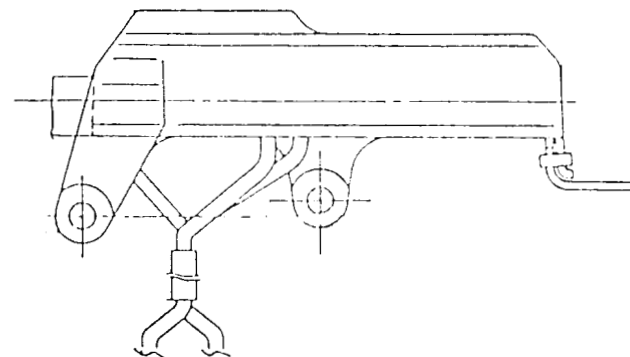


Characteristics of controller

YAMAHA

HA A S S

- Light weight and compact in size
- Sufficient assisting performance assist ratio less than 1.0
- Stable range for travel distance : YMC pattern 30 Km
- Battery- life protection
- Trouble detection



Stabilisation of travel distance

◆ Application of motor current feedback control

1. It controls motor current stably against the fluctuation of speed and battery voltage.
Can always get the stable assist power regardless of travel conditions.
2. High-accurate motor current control.
Electric current can be controlled as the motor current control has been improved.

◆ Stabilisation of battery warning and operation discontinuance

Control system that draws out battery performance to the full, regardless of travelling road conditions. (going uphill, flat, etc.)

Battery protection function

1. Auto power off.
2. Operation discontinuance with higher accuracy by the improved battery voltage detection system.
3. At stop for a traffic signal, electricity will not be supplied (for power saving) even if the rider keeps stepping on the pedal.

Trouble detection system

1. Trouble detection system is added.
Characteristics of Ni-Cd battery are considered.
2. Trouble condition of controller is reconsidered.
3. Visibility of lamp flashing is improved.
Lamp location is changed.
Flashing interval is changed.
4. Reduction of the shock given when the operation is discontinued due to a drop in battery voltage.

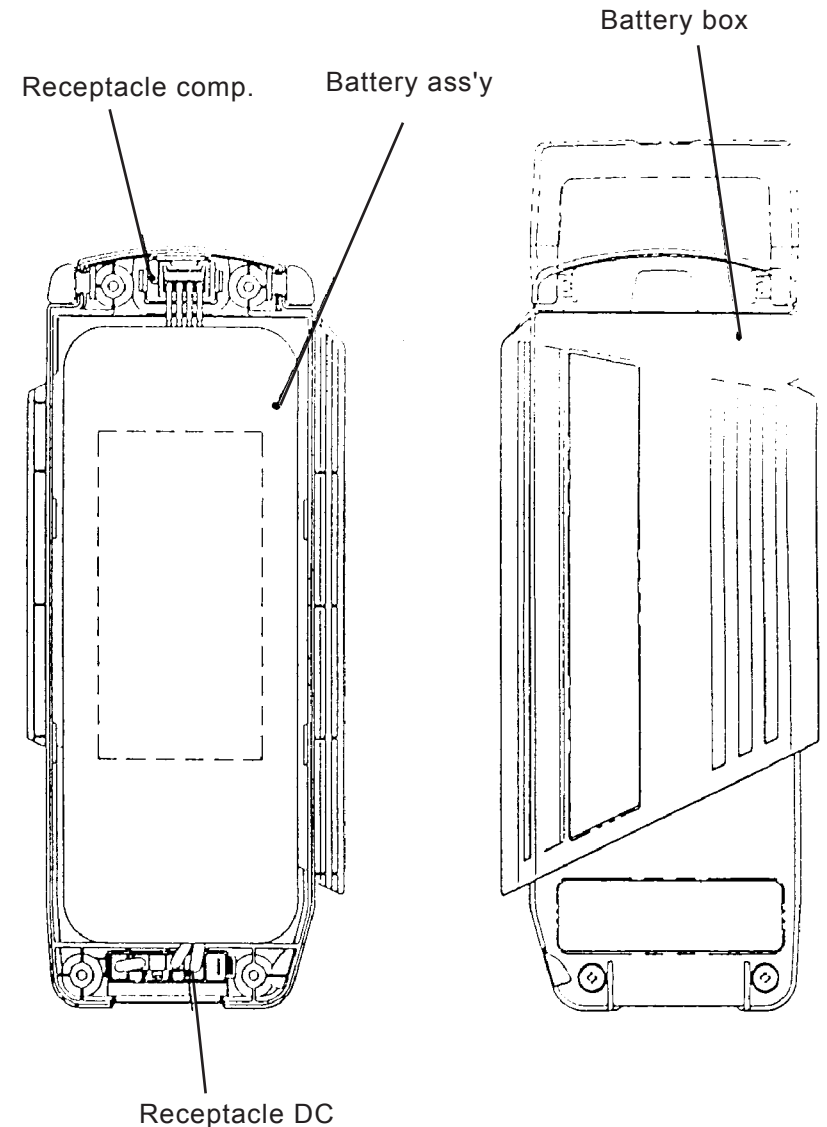
Structure & characteristics of battery box ass'y

YAMAHA

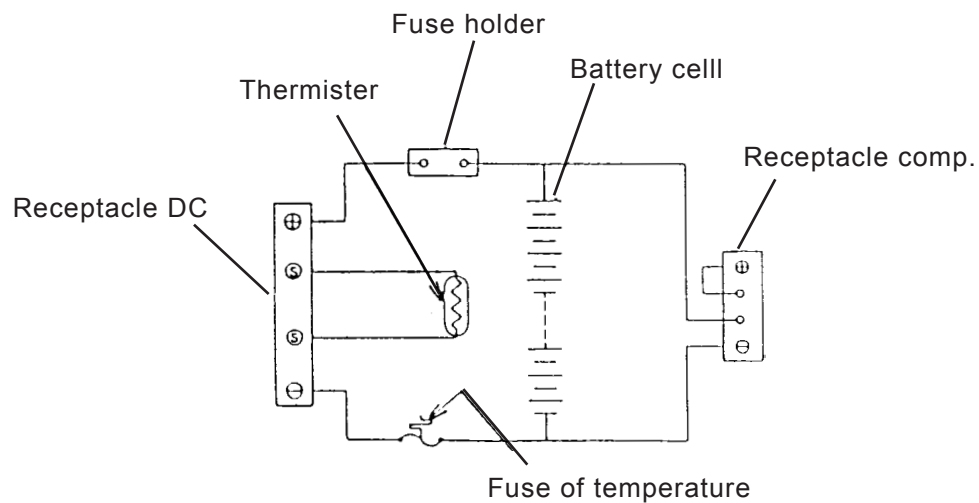
Characteristics

- It is a compact structure
It is easy to install the battery assembly for car in
- Sufficient discharge capacity
A
- Long cycle life
The battery assembly can provide more than
1000 discharge cycles or more YMC pattern
- Low cost
It is a low cost and easy to install on frame

Structure



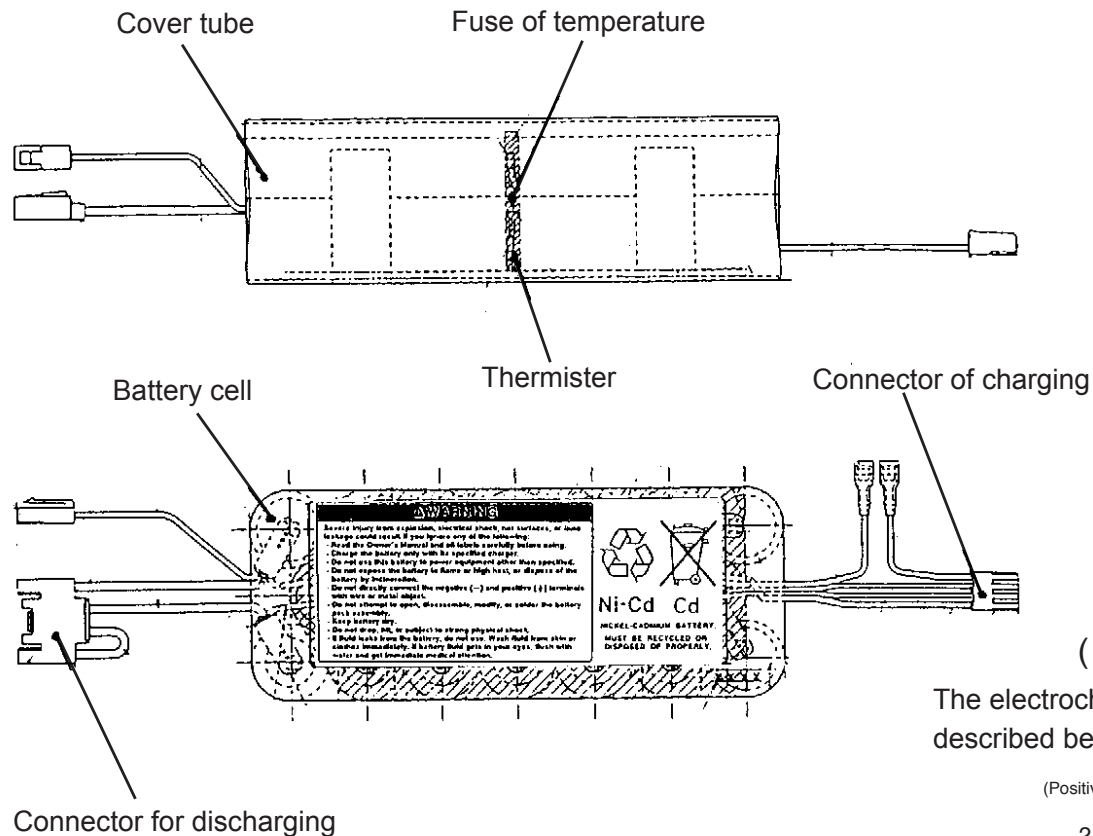
(Wiring diagram of the battery box ass'y)



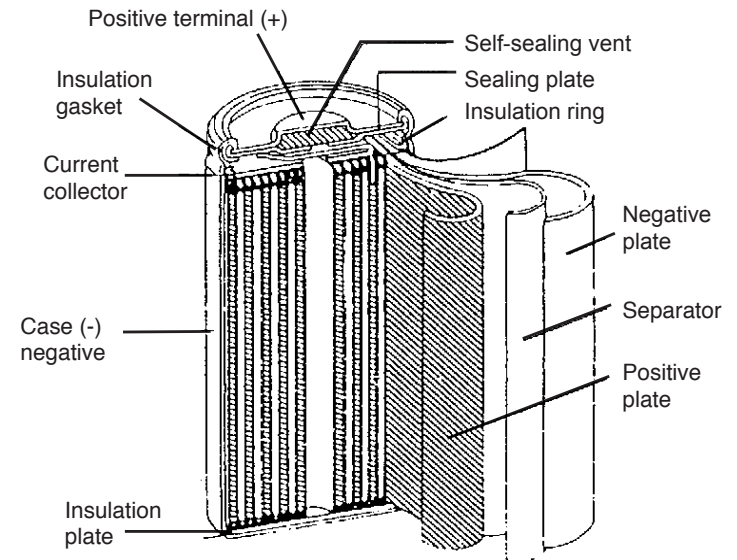
Structure of battery ass'y

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Structure of battery

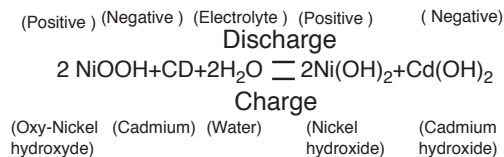


Structure of battery cell



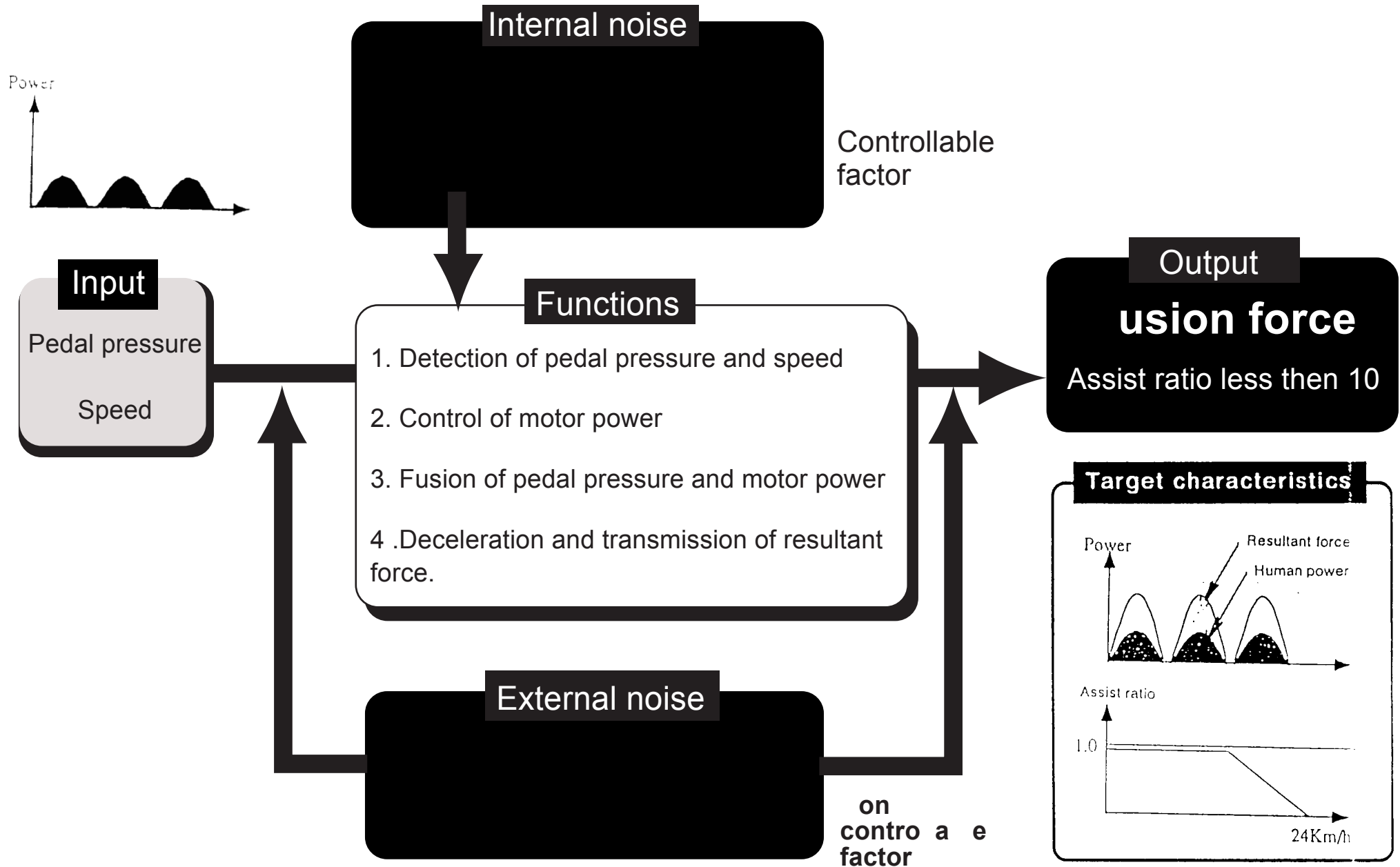
(Electrochemical processes)

The electrochemical processes of nickel-cadmium alkaline storage cell are described below



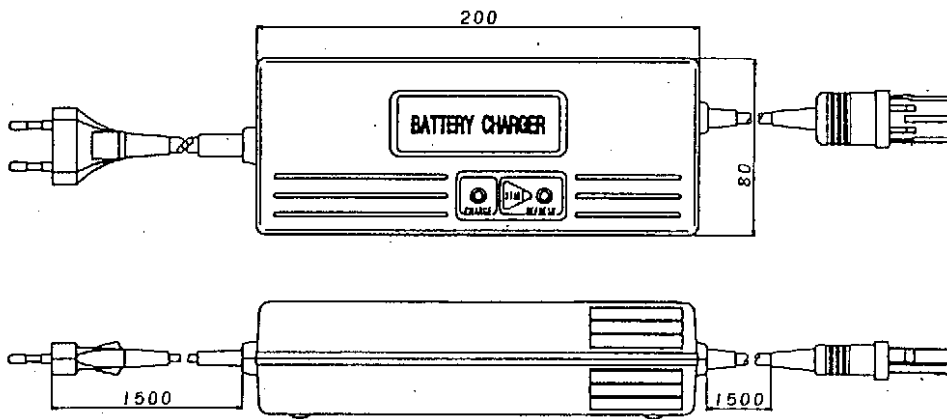
In this process, charging and discharging are reversed with high efficiency, with the electrical energy used during discharge being regained during recharge.

Overview of power Assist System -4



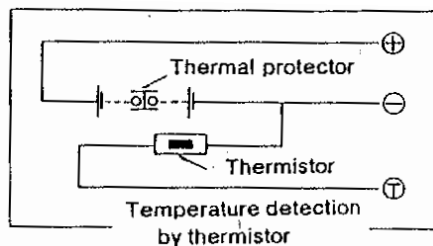
Characteristics of battery charger

Characteristics



(Temperature control during a charge/discharge)

Charge temperature range
Discharge temperature maximum

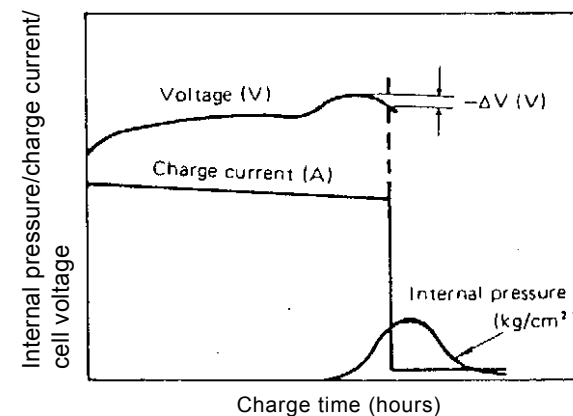


Temperature control circuit

Charging method

(- ΔV Cut off charging system)

This system cut off the high-rate charge current by detecting the drop in voltage in the cell after voltage has reached its peak during charge

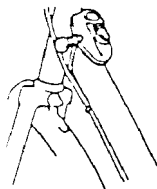


Charging characteristics
- ΔV cut off charging system

The amount of this voltage drop (- ΔV) is detected and the charging current is dropped to C/20 or less.
The value of - Δ is usually 5mV/cell at 20°C.

Self diagnosis system

YAMAHA



Main switch on

3 pilot lamps come on 3 sec., and off.

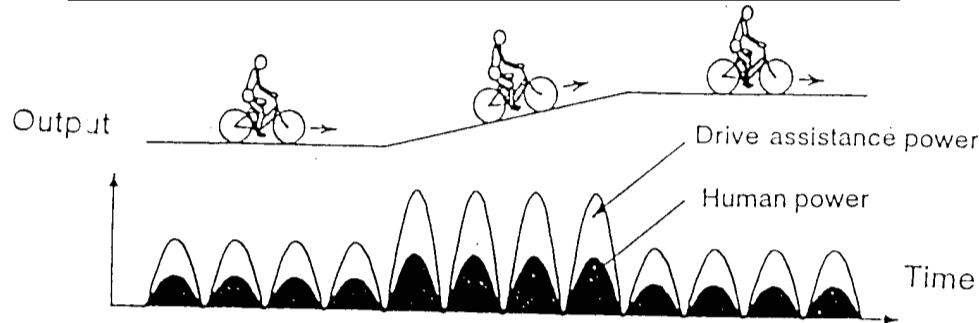
Identify the the flashing code of pilot lamp.
Once the code is identified, take recommended action.

Code No.	Flashing pattern	Countermesure
1	0,5 sec. 0,5 sec. ON OFF The 1 lamp is on for 0,5 sec. and off for 0,5 sec .. And this flashing pattern is repeated .	Same ride assistance power is still available, but the battery is running low Conduct charging.
2	0,2 sec ON OFF The 1 lamp is on for 0,2 sec. and off for the 0,2 sec.. And this flashing pattern is repeated .	There is no ride assistance power and the battery is low. Conduct charging immediately.
3	0,2 sec ON OFF The 3 lamps are on for 0,2 sec. and off for 0,2 sec.. And this flashing pattern is repeated .	There is no required current at the motor. - Check the wiring around the motor. - Refer to "Controler system check".
4	0,5 sec. 0,5 sec. off for 3 sec. Flashes two times and stop, and this pattern is repeated (two quick flashes every 4,5 sec.)	You have a defective torque sensor. Refer to " Torque sensor system check" and conduct repair or replacement of, respective parts.
5	0,5 sec. off for 3 sec. Come on for 0,5 sec. every 3,5 sec. and stay off For 3 sec , and this flashing pattern is repeated. ON OFF	You have a defective speed sensor. Refer to " Speed sensor system check and conduct repair or replacement of the speed sensor.

Effect of Power Assist System

YAMAHA

Reduce the pedaling load on a run

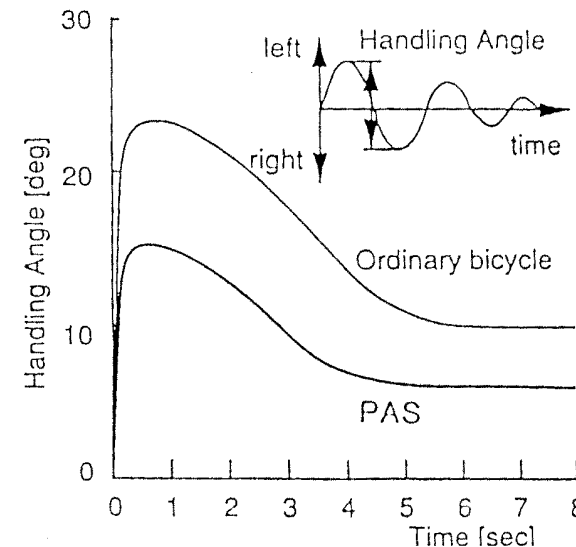


The pedaling force on a pedal is detected by the torque sensor, and the speed sensor pick Up the traveling speed. The data of these torque and the speed are transmitted to the controller, the required drive assistance force is added, then the pedaling load for the driver is reduced. As not allow the slightest time lag. Therefore, in order to perform smooth control which does not spoil the pedaling feel, the system allowing a rapid control is adopted. ("The Power Assist System" we have implemanted this time provides the time response of aprox. 10 msec.)

Accordingly the following 2 features are implemanted.

- (a) Realizes the constant drive assistance ratio against the load.
- (b) The pedaling by the drive assistance force offers the same feel as the human-power, free of time lag and disorder.

Reduce the deflection



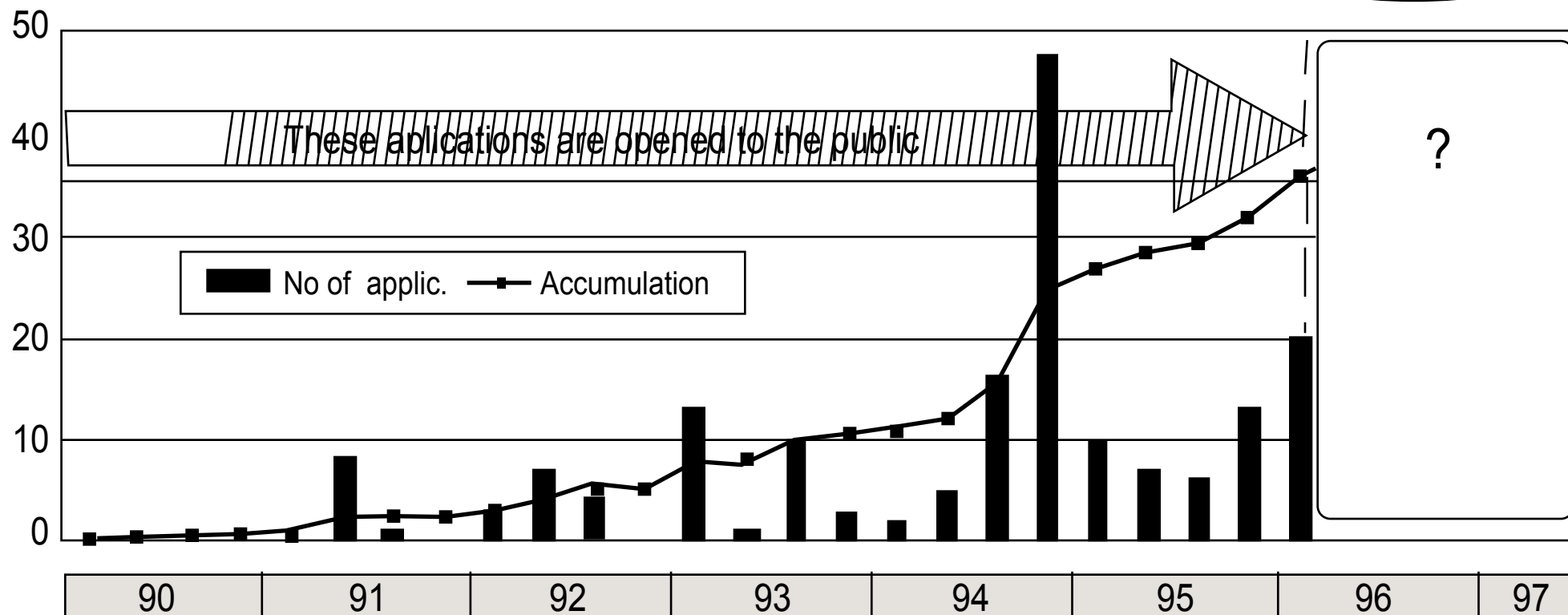
For the ordinary bicycle at start, an extremely high drive force is required. For the PAS, the loed is as small as about the half of the ordinary bicycle .The figure shows stability off he handle bar at start, and the PAS, as shown in the below reduces the deflection of the handle bar as well as reducing the load.

Situation of PAT application for PAS

YAMAHA

(Japan market)

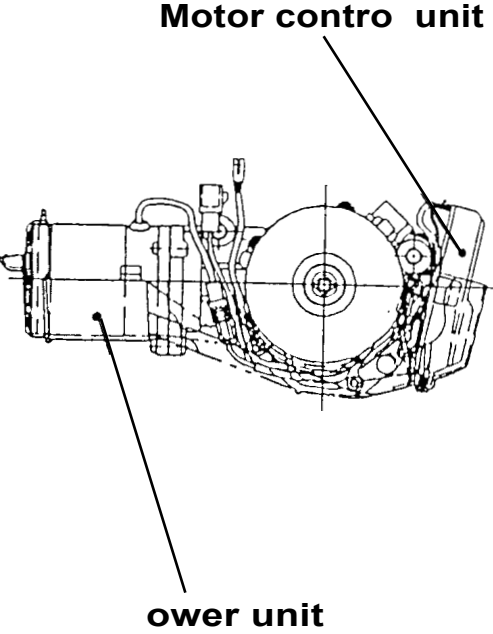
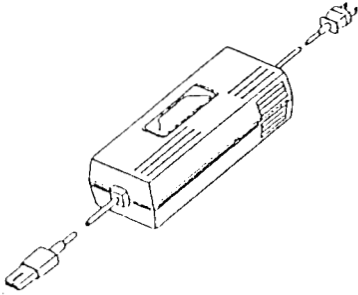
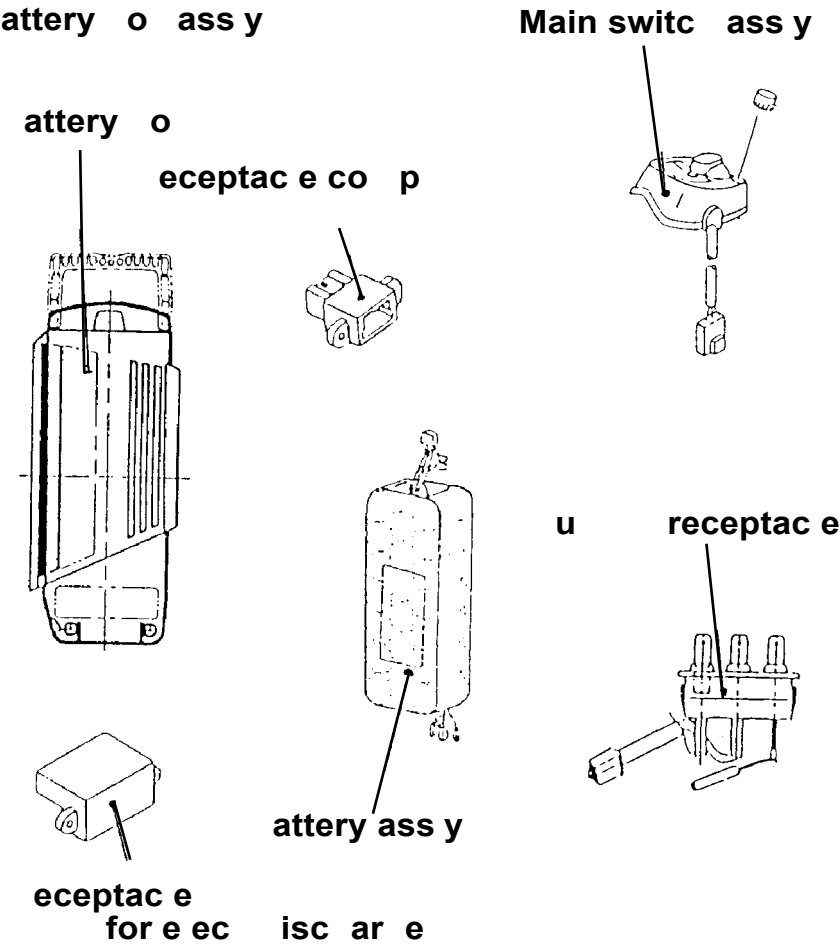
YAMAHA has the
advantage !!



We applied the essential PAT (more than 30 cases) to Europe
and United States Of America.

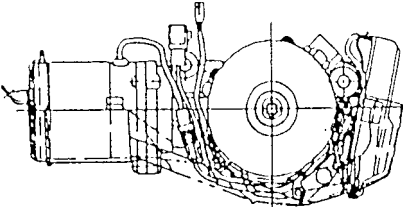
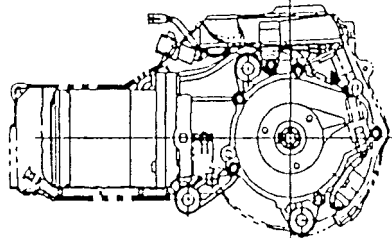
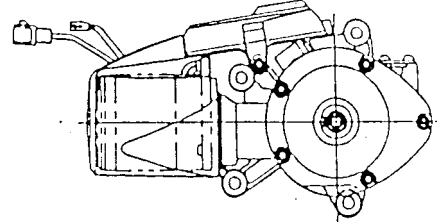
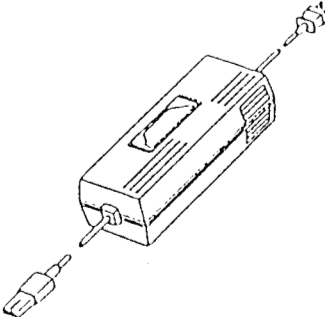
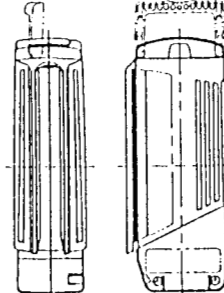
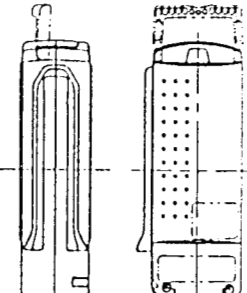
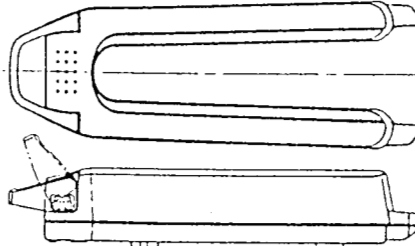
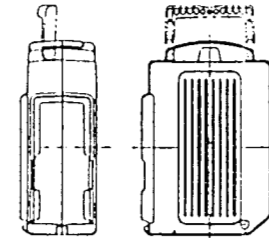
Basic Component of Power Assist Unit

YAMAHA

parts name	power unit assembly	battery charger	battery assembly & Main switch assembly receptacle
component	 Motor control unit power unit		 battery assembly receptacle for connection Main switch assembly receptacle

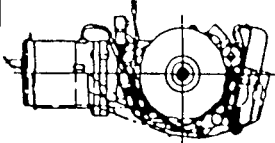
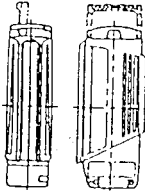
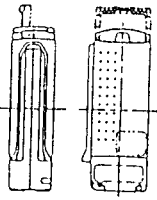
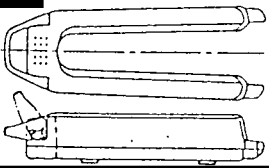
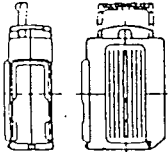
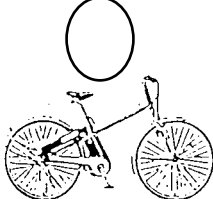
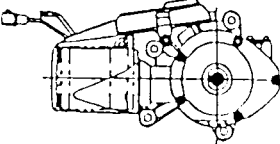
Optional Component of Power assist Unit

YAMAHA

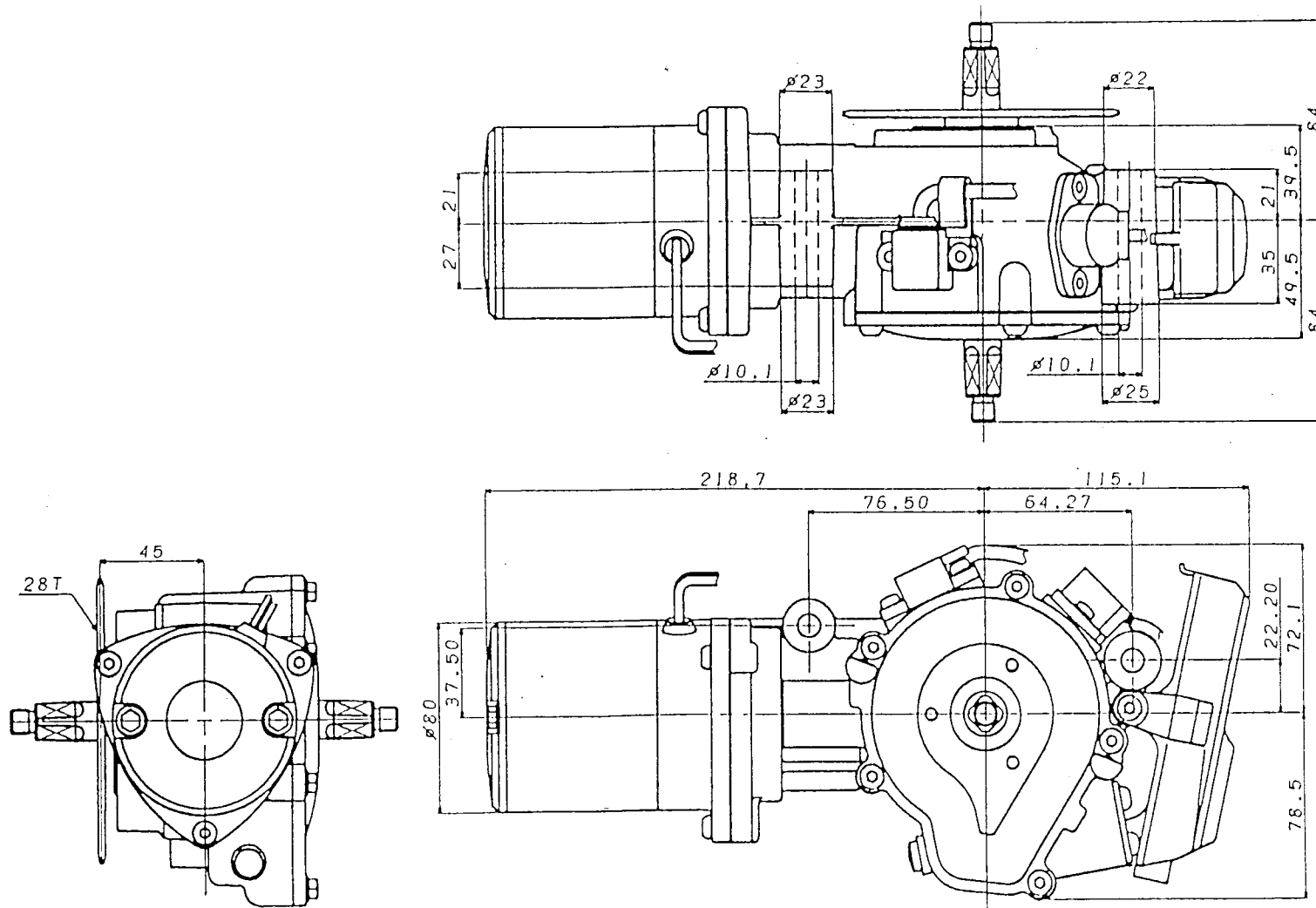
Parts name	Power unit ass'y	Battery charger	Battery box ass'y.S
Shape	A  B  C 		B1  B2  B3  B4 
Essential selection	■ Frame type ■ Design taste ■ Bicycle size (20 ~ 27 inches)	■ CE Reg. adjust	■ Frame type ■ Design taste ■ Cruising range / charge

Combination of Power Assist Unit

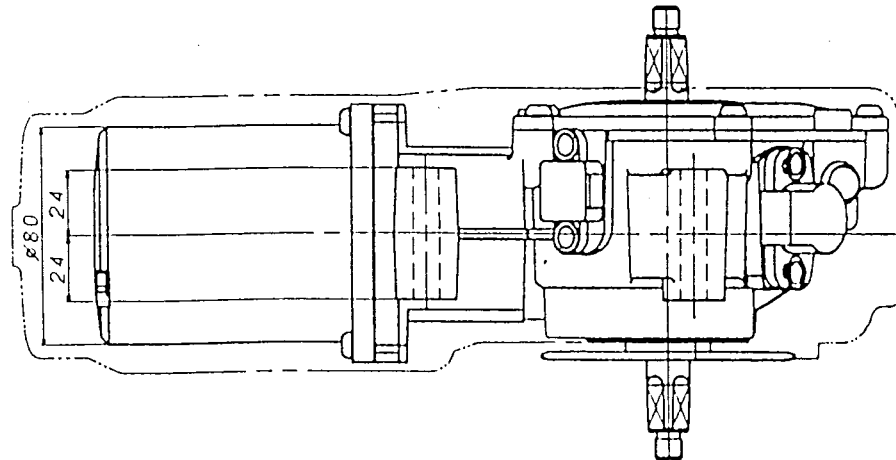
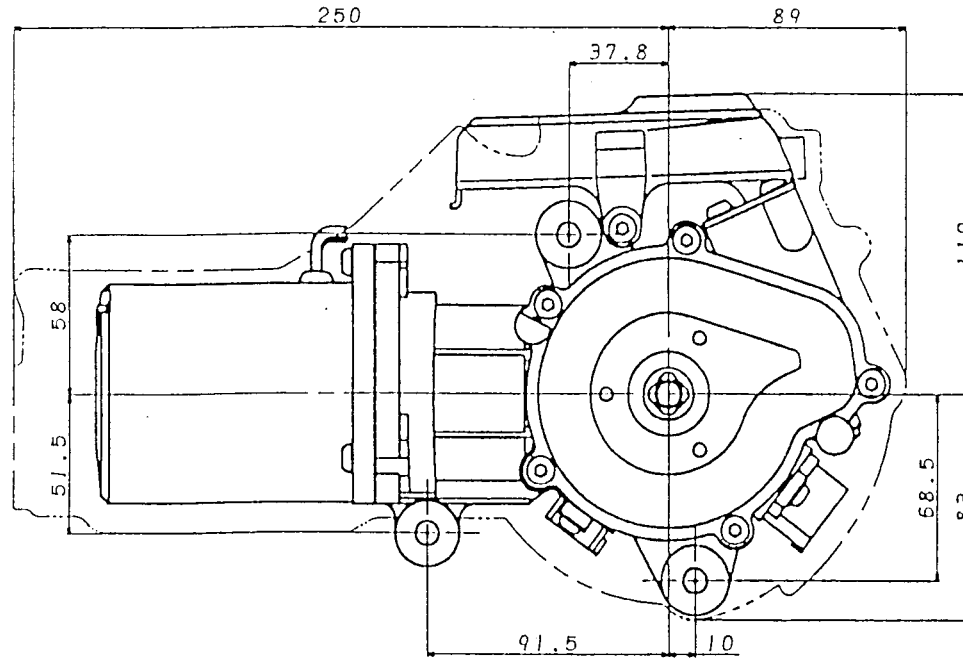
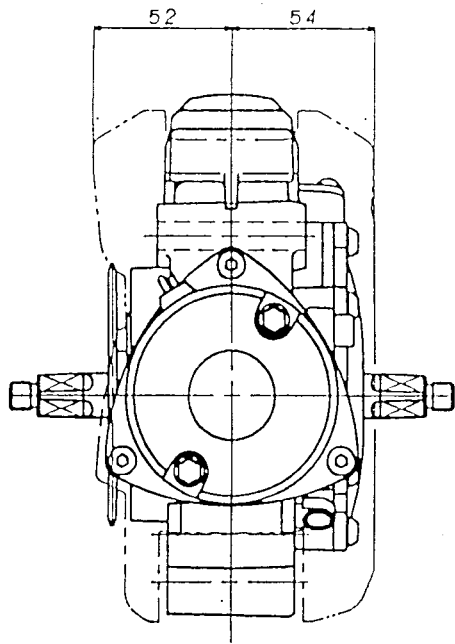
YAMAHA

Battery box ass'y		B1	B2	B3	B4
Power unit ass'y	Mount				
A 	Horizontal	 • Side cover : new design	 • Side cover : new design	 • Side cover : new design	 • Side cover : new design
	Vertical	 • Seat height : too high	 • Seat height : too high	 • Seat height : min.845mm	 • Seat height : min.845mm
C 	Horizontal Inclination	 • Batt. under case : new design	 • Batt. under case : new design	 • Batt. under case : new design	 • Batt. under case : new design
	Vertical	 • Seat height : too high	 • Seat height : too high	 • Seat height : too high	 • Seat height : too high

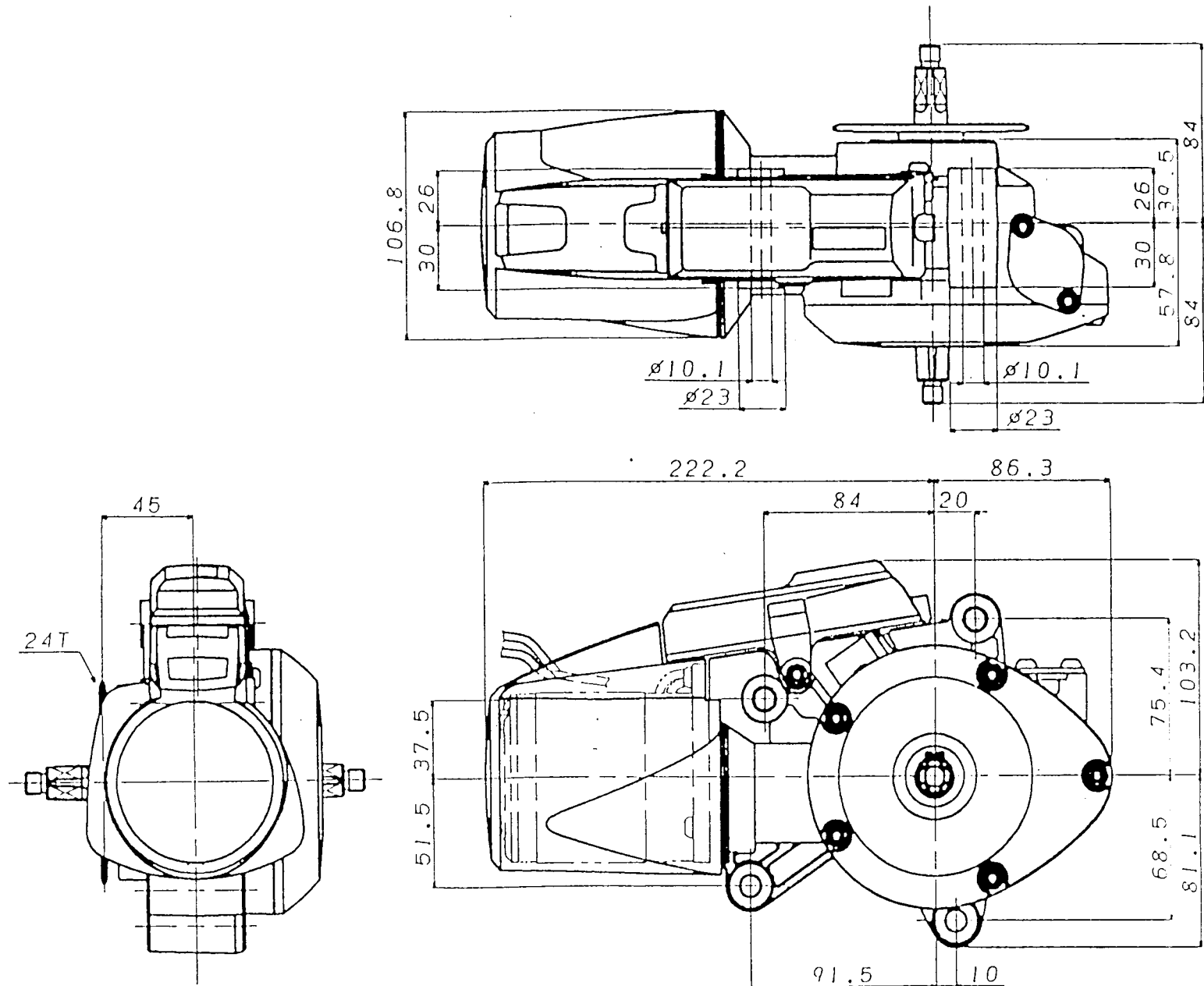
Structure& specifications of power unit A type YAMAHA



Structure& specifications of power unit B type YAMAHA



Structure& specifications of power unit C type YAMAHA



Comparison list of YAMAHA power assist unit

YAMAHA

		A type	B type	C type	
ASY M					
ountin et o		horizontal	vertical	horizontal, inclination	vertical
o t specification		M10*2	M10*3	M10*2	M10*3
necessity of co er		yes	no need	no need	no need
esi n i entity		◎	○	○	○
H SHA					
wei t		5.4 kg	5.6 kg	5.6 kg	
easeure ent		358*147*112	339*193*112	308*184*111	
pro ection area		351 cm ^2 (79 %)	445 cm^2 (100 %)	378 cm^2 (85 %)	
S Y					
pro uction cost		cheapest one	about 4 % more expensive	about 4 % more expensive	
in est ent		no need	yes	yes	
pro ucti ity cuttin		standard spec.	standard spec.	possible to use B equipment	
pro ucti ity ass y		standard spec.	ass'y base equipment : same as A type	possible to use B equipment	
pro ucti ity inspection		standard spec.	inspec. base equipment : same as A type	possible to use B equipment	
M Y					
co er esi n		3-D shape model	no need	no need	
co er e e op ent		3-D measurement, smoothing,CAD data	no need	no need	
co er s ape a ust		knowledge : construction,precision etc.	no need	no need	
Y M					
ifficu ty fra e esi n		P/U mount bracket : draw mold	P/U mount bracket : draw mold	P/U mount bracket : draw mold	
in est ent fra e					

3. Technical description of the apparatus

3.1 Bicycle specification

Refer to attached technical sheet n°7.

3.2 Electric parts list of electro-hybrid bicycle.

Refer to attached technical sheet n°8.

3.3 Bicycle structure

Refer to attached technical sheet n°9.

3.4 Electric parts layout.

Refer to attached technical sheet n°10.

3.5 Wiring diagram of electric system

Refer to attached technical sheet n°11.

3.6 Circuit diagram of control unit

Refer to attached technical sheet n°12.

3.1 Bicycle specification

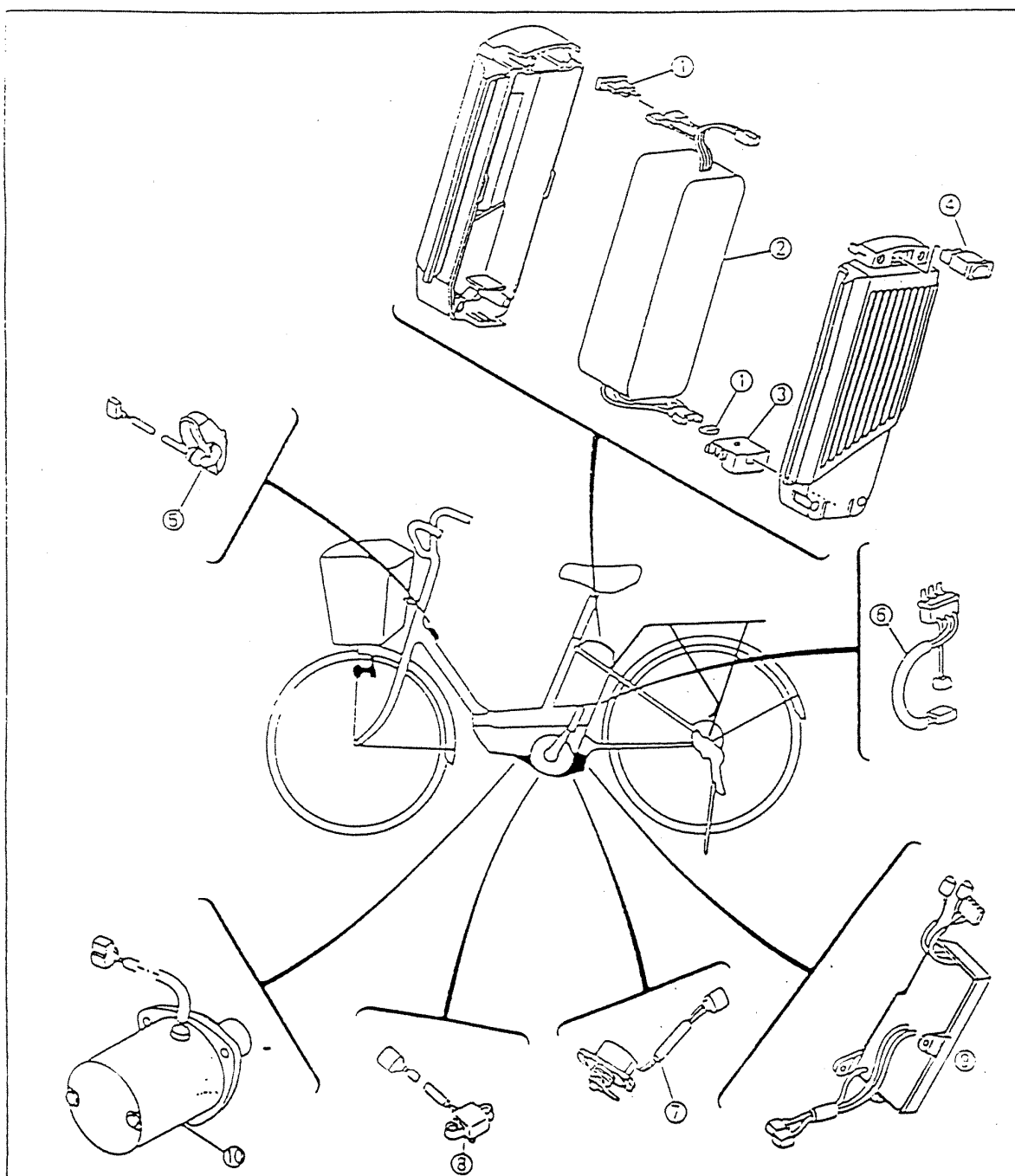
Product Name : electro-hybrid bicycle

5 AT

	Length (mm)	1880	
	width (mm)	600	
	1880Height (mm)	1100	
Number of wheells & wheel driver			2 wheels / rear wheel
Diameterof wheel s			Front wheel =26 inches Rear wheel = 26 inches
Weight (Kg)			28.4 Kg
Motor	Motor type	DC motor with brush	
	Motor wattage	235 w	
Detection of pedal torque			Rottary potentiometer
Detection of bicycle speed			Magnetic sensor
Operation speed range of electric assistance	Normal assistance	0 Km/h ~ 15 Km/h	
	Assistance reduction	15 Km/h ~ 24 Km/h	
Voltage of battery			1.2 V x 20
Brake system	Front wheel	Calliper brake	
	Rear wheel	Roller brake	

3.4 Electric parts layout

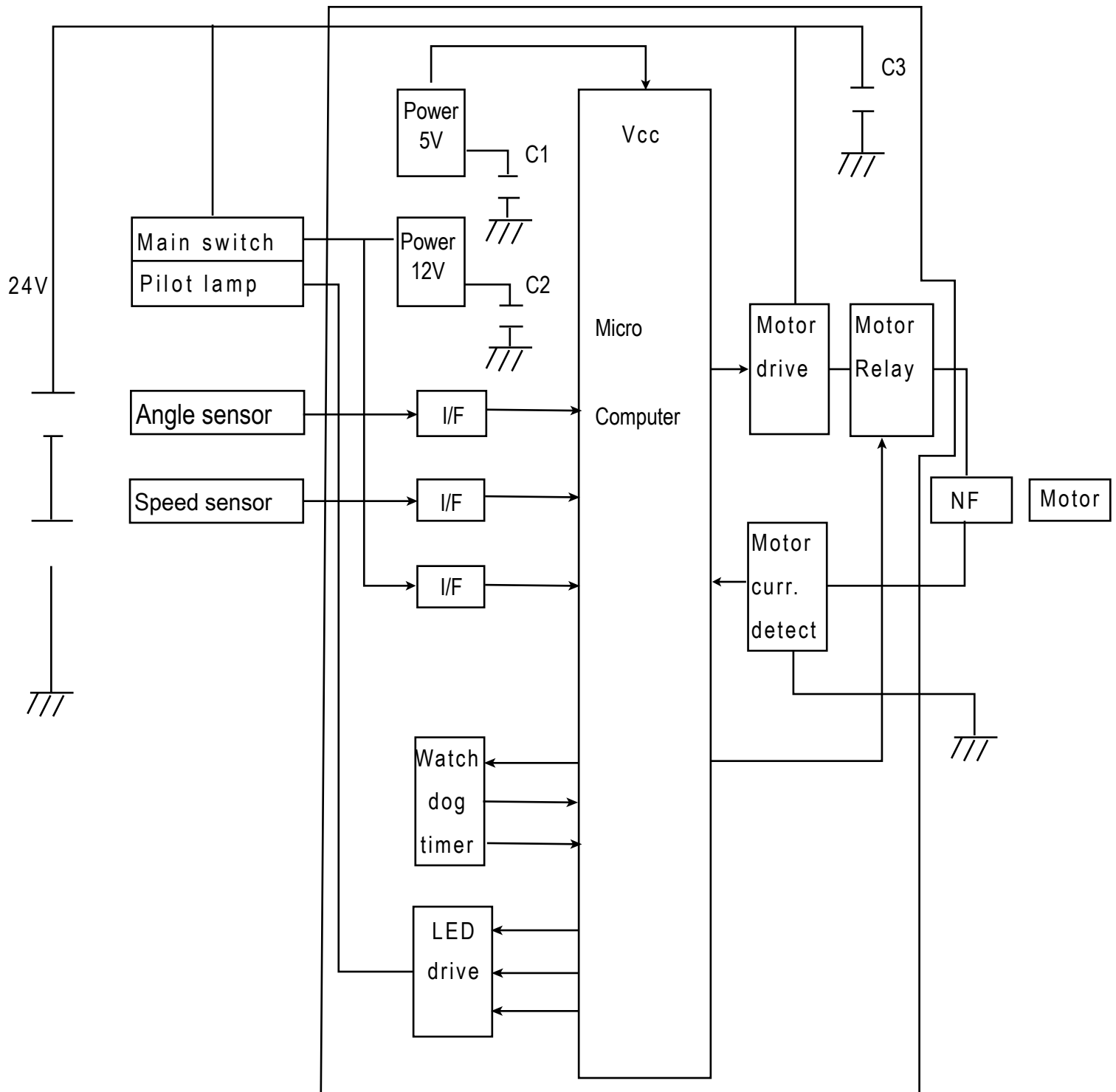
- | | |
|-------------------------------|------------------------------|
| 1. Fuse | 6 . Receptacle of frame side |
| 2. Battery | 7. Torque sensor |
| 3. Receptacle of battery side | 8. speed sensor |
| 4. Connector for charge | 9. Control unit |
| 5. Main switch & pilot lamp | 10 DC motor |



3.2 Electrics parts of electro-hybrid bicycle

N°	PARTS NAME	PART N°	SPECIFICATION
1	CONTROL UNIT	5 AT	Freq. of oscillator : 16 MHz Operation voltage : 13.6 V -32 V Current consumption : 60 + 10 mA Except Motor eur Motor drive freq. : 15.6 KHz
2	DC MOTOR	5 AT	Motor type : Permanent magnet with brush Motor wattage : 235W
3	SPEED SENSOR	5 AT	Type of sensor : magnetic sensor Operation voltage : 12V
4	ANGLE SENSOR	5 AT	Type of sensor : slide brush & resistor Operation voltage : 5 V
5	BATTERY	5 AT	Type of battery : Ni-Cd battery Battery voltage : 1,2V x 20 (cells) =24V
6	MAIN & PILOT LAMP	5 AT	Type of switch : mechanical contact switch Type of lamp : Led x 3 Operation voltage : 24
7	RECEPTACLE ON BATTERY	5 AT	Type of contact : mechanical contact Operation condition : 20 A at 26,4 V
8	PLUG ON FRAME	5 AT	Type of contact : mechanical contact Operation condition : 20 A at 26,4 V
9	CONNECTOR FOR CHARGER	5 AT	Type of contact : mechanical contact Operation condition : 3A at 50 V
10	BATTERY FUSE	5 AT	Fuse type : blade type Operation current : 30 A

Electrobicycle-hybrid bicycle control unit



3.5 WIRING DIAGRAM OF ELECTRIC SYSTEM

