

623173

FORM 1

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

Fisher & Paykel Limited, of 39 Mt. Wellington Highway, Mt. Wellington, Auckland, NEW ZEALAND, hereby apply for the grant of a standard patent for an invention entitled:

"Improvements in or relating to elements for electric motors and/or electric motors and/or laundry machines containing the same".

which is described in the accompanying complete specification.

Details of basic application(s):-

<u>Basic Applic. No:</u>	<u>Country:</u>	<u>Application Date:</u>
226374	NZ	28 September 1988

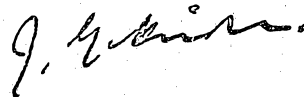
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DATED this FIFTEENTH day of SEPTEMBER 1989

Fisher & Paykel Limited

By:



Registered Patent Attorney



THE COMMISSIONER OF PATENTS
OUR REF: 107516
S&F CODE: 59769

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5845/2

DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a
patent for an invention entitled:

Title of Invention Improvements in or Relating to Electric Motors and/or
Machine Drives and/or Laundry Machines Containing
the Same

Full name(s) and address(es) of Declarant(s) Care of I/We ~~is/are~~
WILLIAM LINDSAY GILLANDERS
Fisher & Paykel Limited
39 Mt Wellington Highway, Auckland
in New Zealand, Company Secretary

do solemnly and sincerely declare as follows:--

Full name(s) of Applicant(s) 1. I ~~am/We are~~ the applicant(s) for the patent ~~XXXX~~
(or, in the case of an application by a body corporate)
1. I am/We are authorised by FISHER & PAYKEL LIMITED

the applicant(s) for the patent to make this declaration on
its/~~their~~ behalf.

2. The basic application(s) as defined by Section 141 of the
Act was/~~were~~ made

Basic Country(ies) in NEW ZEALAND
Priority Date(s) on 28 September 1988
Basic Applicant(s) by FISHER & PAYKEL LIMITED

Full name(s) and address(es) of inventor(s) 3. I ~~am/We are~~ the actual inventor(s) of the invention referred
~~to in the basic application(s)~~
(or where a person other than the inventor is the applicant)

3. JOHN JULIAN AUBREY WILLIAMS, FRANK WHITNEY SHACKLOCK,
KEITH DESMOND FERGUSON & ROGER ALAN CHALK
Fisher & Paykel Limited
all care of 39 Mt Wellington Highway, Mt Wellington,
Auckland, New Zealand

(respectively)

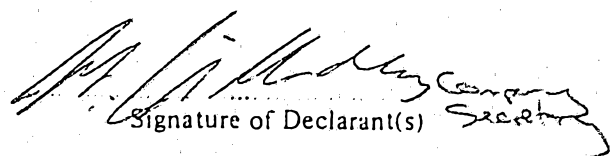
is/~~are~~ the actual inventor(s) of the invention and the facts upon
which the applicant(s) is/~~are~~ entitled to make the application are
as follows.

Set out how Applicant(s)
derive title from actual
inventor(s) e.g. The
Applicant(s) is/~~are~~ the
assignee(s) of the
invention from the
inventor(s)

The Applicants ^{is} are the Assignees of the invention
from the inventors.

4. The basic application(s) referred to in paragraph 2 of this
Declaration was/~~were~~ the first application(s) made in a Convention
country in respect of the invention (s) the subject of the application.

Declared at Auckland, this 11th day of October 1989
New Zealand


Signature of Declarant(s)

(11) AU-B-41477/89
(10) 623173

-2-

shaft mounting means; and to form a shaped web between said ferromagnetic circuit and said shaft mounting means, said die holding desired parts of said ferromagnetic circuit in a fixed radial disposition relative to said selected shaft mounting means and the shaping of said web enabling substantial concentricity to be maintained between said desired parts of said ferromagnetic circuit and said shaft mounting means during and after cooling of said plastics material without machining said plastics material, the shaping of said web being such that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of the desired parts of said ferromagnetic circuit.

15. A motor element of an electric motor said motor element being selected from a rotor having a ferromagnetic circuit spaced radially from a shaft mounting means thereof and a stator having a ferromagnetic circuit including a set of poles adapted to receive electrical windings thereon said poles being spaced radially from a shaft mounting means thereof said motor element comprising a plastics injection moulding having embedded therein parts of a selected one of said ferromagnetic circuits and having a web connecting said selected ferromagnetic circuit to said selected shaft mounting means with parts of said selected ferromagnetic circuit held in a fixed radial disposition relative to said shaft mounting means to maintain substantial concentricity between said desired parts of said ferromagnetic circuit and said shaft mounting means without machining, said web being shaped so that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of said desired parts.

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S & F Ref: 107516

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:

Accepted:

Published:

Priority:

Related Art:

Name and Address
of Applicant:

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Complete Specification for the invention entitled:

"Improvements in or
relating to elements for electric motors and/or electric motors and/or
laundry machines containing the same".

The following statement is a full description of this invention, including the
best method of performing it known to me/us

This invention relates to elements for electric motors and/or electric motors and/or methods of making same and has been devised particularly though not solely for use as a source of power for a laundry machine.

5 It is an object of the present invention to provide an electric motor and/or a machine drive utilizing such a motor and/or a method of making the same which will at least provide the public with a useful choice.

According to one aspect the invention consists in a method of
10 manufacturing a motor element of an electric motor said motor element being selected from a rotor having a ferromagnetic circuit spaced radially from a shaft mounting means thereof and a stator having a ferromagnetic circuit including a set of poles adapted to receive electrical windings thereon said poles being spaced radially from a shaft
15 mounting means thereof said method comprising the steps of fixing the selected ferromagnetic circuit in a selected plastics injection moulding die, said die having walls defining a cavity to receive injection moulded plastics material, said walls including wall portions to define a part of the cavity into which plastics material is injected to from the
20 appropriate selected shaft mounting means, and injecting a plastics material into said die to provide a plastics moulding to have embedded therein the selected ferromagnetic circuit; to form the selected shaft mounting means; and to form a shaped web between said ferromagnetic circuit and said shaft ~~carrier~~ mounting means, said die holding desired
25 parts of said ferromagnetic circuit in a fixed radial disposition relative to said selected ^{shaping of} shaft mounting means and the shaft of said web enabling substantial concentricity to be maintained between said desired parts of said ferromagnetic circuit and said shaft mounting means during and after cooling of said plastics material without machining said



plastics material, the shaping of said web being such that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of the desired parts of said ferromagnetic circuit.

5 In a further aspect the invention consists in a method of manufacturing an electric motor comprising the steps of taking a motor element comprising a stator made by a method according to the preceding paragraph, placing electrical windings on the poles thereof and taking a further motor element comprising a rotor made according to the preceding
10 paragraph magnetizing part of said ferromagnetic circuit to a permanent magnetic state, attaching said stator to a bearing housing containing a distal bearing separated from a proximal bearing the outer surface of said proximal bearing being mounted partly in said shaft mounting means, mounting a shaft in said bearings and mounting said rotor on said shaft
15 so that on the windings on said stator being energized through an electronic commutation circuit occurs to cause said rotor to rotate.

In a further aspect the invention consists in a motor element of an electric motor said motor element being selected from a rotor having a ferromagnetic circuit spaced radially from a shaft mounting means thereof
20 and a stator having a ferromagnetic circuit including a set of poles adapted to receive electrical windings thereon said poles being spaced radially from a shaft mounting means thereof said motor element comprising a plastics injection moulding having embedded therein parts of a selected one of said ferromagnetic circuits and having a web connecting
25 said selected ferromagnetic circuit to said selected shaft mounting means with parts of said selected ferromagnetic circuit held in a fixed radial disposition relative to said shaft mounting means to maintain substantial concentricity between said desired parts of said ferromagnetic circuit and said shaft mounting means without machining, said web being shaped so
30 that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of said desired parts.



In a still further aspect the invention consists in an electric motor comprising a motor element comprising a stator according to the preceding paragraph, said stator having electrical windings on the poles thereof and further motor element comprising a rotor made according to the preceding paragraph said motor having some of said ferromagnetic circuit magnetized to a permanent magnet state, a bearing housing attached to said stator, said housing containing a distal bearing separated from a proximal bearing, the outer surface of said proximal bearing being mounted partly in said bearing housing and partly in said shaft mounting means, a shaft rotatable in said bearings and said rotor being mounted on said shaft so that on windings on the poles of

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said stator being energized through an electronic commutating circuit magnetic coupling occurs to cause said rotor to rotate.

5 In a still further aspect the invention consists in a laundry machine having an outer casing, a water container within said casing, a spin tub rotatable within said container, an agitator mounted for agitation within said spin tub, said agitator being operable to enable said agitator alone to be agitated backwards and forwards or
10 said spin tub and said agitator to be rotated in a single direction and spinning speed, said agitator being driven by an electric motor according to the preceding paragraph, said shaft driving said agitator and said bearing housing being fixed to a lower part of said container.

15 To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely
20 illustrative and are not intended to be in any sense limiting.

25 The invention consists in the foregoing and also envisages constructions of which the following gives examples only.

One preferred form of the invention will now be described with reference to the accompanying drawings in which;

5 Figure 1 is a diagrammatic cross section of a laundry machine constructed according to the invention,

Figure 2 is an enlarged diagram of the drive mechanism forming part of the laundry machine of Figure 1,

Figure 3 is a plan view of a stator forming part of an electric motor also shown in figures 1 and 2,

10 Figure 4 is a cross section of an assembled die containing cavities in which a stator according to the invention is moulded,

Figure 5 is a plan view of a part of the die shown in Figure 4 and

15 Figure 6 is a cross section of an assembled die containing cavities in which a rotor according to the invention is moulded.

Referring to the drawings a laundry machine 1 is provided having an outer casing 2 and a container 3 which in use contains water in which clothes are to be laundered. The container 3 is preferably an injection moulding of a plastics material having reinforcing ribs 4 and 5. The ribs 4a and 5 support a bearing tube 6 preferably having a metal e.g. an aluminium alloy extrusion liner 8 moulded in the tube 6 when the container 3 is being injection moulded. The liner 8 is preferably shaped in plan to provide four

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wings into which motor mounting screws 65 extend. Mounted within the container 3 is a spin tub 4 having balancing rings 9 and mounted within the spin tub is an agitator 7. The agitator is mounted on and driven by a shaft 10 the driving being effected by splines 11 engaging corresponding parts 12 of the agitator. The described laundry machine also includes a clutch arrangement operated by a float 15 which is shown in a lower engaging position on the left hand side of the drawing and an upper disengaged position as shown in the right hand side. The operation of this float in connecting and disconnecting the spin tub 4 from the agitator 7 is fully described in European Patent Specification No. ^{87301863.3} ~~7301868.3~~ (corresponding to US No. 4,741,183) which specification is incorporated herein by reference.

The shaft 13 is mounted in an upper distal bearing 20 (Figure 2) and a lower proximal bearing 21. The upper bearing 20 is mounted within the bearing tube 6 and the two bearings are separated by spacers 19 and 22. A seal 23 of known form is provided to seal the shaft 13 from the bearing tube 6.

The drive mechanism of the laundry machine above described includes an electric motor generally referenced 30 which in the preferred form is an inside out salient pole electronically ^{commutated} ~~commutated~~ motor (herein referred to as an ECM). The ECM 30 is constructed according to the invention as follows:



A ferromagnetic magnetisable member 31 (Figure 3) is provided having salient poles 32, the poles 32 extending outwardly from a yoke 29 and the poles 32 having pole faces 33 lying on an outer circumference. The stator member 31 is manufactured by punching the poles 32 and yoke 29 out of a strip of electrical steel having a lightly insulated surface and then curving the strip of steel on edge into a continuous helix arranged with adjacent coils of steel having the light insulation thereon touching. The continuous helix is wound so that the resulting ferromagnetic magnetisable member has an outside diameter which is slightly larger than the preferred outside diameter of the stator member 31 in its completed form. The adjacent coils of steel are riveted together to maintain the desired shape. The plan shape is shown in Figure 3.

To provide a frame for the stator the stator member 31 is fitted in a space 24 of die 25 (Figure 4) with the pole faces 33 a close fit against a face 28 of a part of the die. The outside diameter of stator member 31 is shaped precisely by three sliding cones 71, spaced 120° apart, which move radially toward the centre of bearing mounting 27 (Figure 5). A plastics material preferably a Dupont Rynite FR543 plastics material is injected to encase the stator member 31 with the exception of the pole faces 33 in the plastics material. The position of the pole faces 33 is accurately determined by angled pins (not shown) and the



poles 32 are mounted over shaped portions 26 of the die as may be seen in Figure 5. The die also includes provision to provide a shaft ~~carrier~~ mounting comprising a bearing mounting 27 in which the bearing 21 is later fitted to carry the shaft 11. The die 25 has shaped cavities 37, 38, 39 and otherwise to provide the shape of the stator frame as may be seen in Figure 2.

Referring now to that figure, the web 41 of the stator frame connects the plastics moulded section 36 to the bearing mounting 27. The web 41 has an annular shape containing a V shape 42 between a frustum of a cone portion 47 directed in one direction to a further frustum of a cone portion 48 directed away from the annular V shape 42 between the two portions 47 and 48. This shape has been found satisfactory in that after the plastics material has been injected any changes in volume thereof due to contraction of the plastics material while cooling result in changes of shape, for example, of the V shape 42 or change of angle between the portions 47 and 48 rather than varying the relative position of the bearing mounting 27 and the encasement 36 which encases the stator member 31 which in particular is fixed in position by the engagement of the pole faces 33 with the die face 28. The injection moulding also covers the pole pieces except the faces thereof with the plastics material giving electrical insulation 45 to such pole pieces. At a later stage, a protective coating is applied to the pole faces eg. by spraying.



The moulding produced also provides terminal sockets 46. When the poles are wound the winding machinery places tails of winding wires automatically in the terminal sockets 46 and external wiring connections of spade type are then inserted in the sockets 46 giving a scraping action on the winding wires placed in the sockets 46, the insertion baring the tails of those wires and making electrical connection as desired.

To provide a rotor for the motor having a plastics rotor web and hub ^{51, the hub providing a shaft mounting means} a die is provided, and that die includes removeable members 66 and 67 (Figure 6) which fits in a further die part 68 and associated with the die parts 66 and 67 is a further male die part 69.

In use a series of pieces of magnetisable material (herein referred to as magnets) are placed in an unmagnetised condition in position in prepared slots (not shown) in the removable piece 67 and one such magnet is shown at 53 in Figure 6. The magnets are later magnetized in a separate process to be permanently magnetized in the known way. The material is preferably of the Neodymium type. The magnets are held in place by friction, being a reasonably tight fit in the slots or otherwise held temporarily in position and a strip of lightly insulated ferromagnetic material (steel) is then wound into a spiral coil in a clock spring manner over the magnets and in contact therewith until a suitable thickness is built up. The steel is shown at 54 in Figures 2 and 6. In order to



resist forces acting during cooling of plastics web and hub the rotor after moulding, adjacent turns of the steel are fixed to each other preferably by the use of a suitable adhesive such as Loctite 290. The magnets are then held in a fixed position on the face of the removable die member 67 and the steel 54 is locked into a substantially solid form by the adhesive with the inner surfaces of the magnets each maintained in a circumferential position. The die parts are then assembled with the part 67 carrying the steel 54 and magnets 53 in position as shown in Figure 6. A plastics material preferably Rynite 545 made by Dupont is injected into the closed die parts.

In the preferred form for injection moulding both the stator and the rotor, the plastics material is injected at 290°-300°C into the die parts which are maintained at 110°C. After injection, the die remains closed for about 15 seconds and the male and female die parts then separated. Ejection pins then eject the moulded part almost immediately. The plastics material encases the steel and all of the surfaces of the magnets except the face in contact with the die surface.

In the finished rotor, the web injected into space 58 of the die interconnects the encased steel 54 and magnets 53 to hub 51. The web 52 is formed to a shape such and the fixing of the steel and the magnets in the die is such that distortion of the position of the hub relative to the magnets and particularly concentricity are controlled

during cooling of the plastics material to die temperature, we have found that an extended frustum of a cone shape of the portion 52 passing through an annular change of direction of the base of an annular 55 V from the cylindrical portion 57 to the plastics material 43 encasing the magnets and steel has been found satisfactory in this respect. Thus the web 52 is formed to a shape which resists distortion of the portion of the hub relative to the permanent magnets and we have found that a cone shape changing through a V shape to a cylinder is satisfactory in this respect.

Referring again to Figure 2 the hub 51 is held in place on the shaft 11 by a screwed cap 56. A useful adjunct to the invention is the provision of a downwardly directed short cylinder 60 on the stator member 52 and this co-acts with an upstanding cylindrical member 61 on the rotor so that should the seal 23 leak water will pass downwardly to be expelled through apertures 62 in the rotor.

The number of poles in the stator and the rotor may be varied but for example for a 42 pole stator 56 permanent magnets are spaced equi-distantly on the rotor.

The lower end of the shaft 11 has a splined portion 50 and the hub 51 of the rotor is mounted on this splined portion.

During assembly the bearing 21 is placed with its outer race partly in the bearing mounting 27 and partly in the extruded liner 8.

The above construction has the advantage that an electric motor may be made by a plastics injection process

in which in particular the bearing 21 maintains its concentricity relative to the pole faces 33 and thus enables a motor to be produced very quickly and very easily. Also the mounting of the tube 6 in the injection moulding of the outer container 3 enables the shaft 11 to be mounted quickly and readily. The whole arrangement has the advantage that the motor may be dismantled quickly and easily by undoing the cap 56, removing the rotor and then undoing screws 65 so that the motor may be dropped from the tube 6. The shaft may then be withdrawn and the bearings replaced if necessary.

Although the preferred form of the invention has been described in relation to a laundry machine in which the shaft 11 drives an agitator it will be apparent that the invention particularly though not solely the method of manufacturing the motor frame will be applicable to other drives where a pair of bearings rotatably support not only the motor rotor but also a rotatable part of a machine of which the motor and drive form parts.

The claims defining the invention are as follows:

1. A method of manufacturing a motor element of an electric motor said motor element being selected from a rotor having a ferromagnetic circuit spaced radially from a shaft mounting means thereof and a stator having a ferromagnetic circuit including a set of poles adapted to receive electrical windings thereon said poles being spaced radially from a shaft mounting means thereof said method comprising the steps of fixing the selected ferromagnetic circuit in a selected plastics injection moulding die, said die having walls defining a cavity to receive injection moulded plastics material, said walls including wall portions to define a part of the cavity into which plastics material is injected to form the appropriate selected shaft mounting means, and injecting a plastics material into said die to provide a plastics moulding to have embedded therein the selected ferromagnetic circuit; to form the selected shaft mounting means; and to form a shaped web between said ferromagnetic circuit and said shaft mounting means, said die holding desired parts of said ferromagnetic circuit in a fixed radial disposition relative to said selected shaft mounting means and the shaping of said web enabling substantial concentricity to be maintained between said desired parts of said ferromagnetic circuit and said shaft mounting means during and after cooling of said plastics material without machining said plastics material, the shaping of said web being such that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of the desired parts of said ferromagnetic circuit.



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2. A method as claimed in claim 1 which includes the step of selecting said stator as said motor element.

3. A method as claimed in claim 2 which includes the step
5 of providing said selected shaft mounting means as a housing adapted in use to receive a bearing.

4. A method as claimed in either of claim 2 or claim 3 which includes the step of forming said web in a shape
10 which includes members which form an annular V formation positioned so that contraction of said plastics material during cooling after injection causes a change in shape of said V formation.

5. A method as claimed in any one of claims 2 to 4 which
15 includes the step of forming terminal sockets in said plastics moulding.

6. A method as claimed in any one of claims 2 to 5 which
20 includes the step of forming said ferromagnetic circuit as a yoke having associated therewith a plurality of outwardly extending poles with the pole faces of the poles lying on a circumference.

7. A method as claimed in claim 6 which includes the step
25 of forming said poles and said yoke integrally from a strip of ferromagnetic material and curving the strip edgewise to form said yoke with said outwardly extending poles.



8. A method as claimed in claim 1 which includes the step of selecting said rotor as said motor element.

9. A method as claimed in claim 8 which includes the steps of providing said shaft mounting means as a hub in which a shaft is mounted in use.

10. A method as claimed in claim 8 or claim 9 which includes the step of forming said web in a shape which includes members which form an annular V formation positioned so that contraction of said plastics material during cooling after injection causes a change in shape of said V formation.

11. A method as claimed in any one of claims 8 to 10 which includes the step of forming said rotor with pieces of inwardly facing magnetisable material magnetisable to form permanent magnet poles.

12. A method as claimed in claim 11 which includes the step of mounting said pieces of magnetisable material so as to be retained in slots in a removeable piece of said die, wrapping a strip of ferromagnetic material about said pieces of magnetisable material on said removeable die piece to provide a desired thickness, rigidifying the assembly and placing the removeable die pieces with the ferromagnetic assembly thereon in association with the die parts before injecting said plastics material.



13. A method as claimed in claim 12 which includes the step of rigidifying said ferromagnetic assembly by applying a gap penetrating adhesive thereto.

5 14. A method of manufacturing an electric motor comprising the steps of taking a motor element comprising a stator made by a method according to any one of claims 2 to 7, placing electrical windings on the poles thereof and taking
10 a motor element comprising a rotor made according to any one of claims 8 to 13, magnetizing part of said ferromagnetic circuit to a permanent magnet state, attaching said stator to a bearing housing containing a distal bearing separated from a proximal bearing the outer surface of said proximal bearing being mounted partly in
15 said shaft mounting means, mounting a shaft in said bearings and mounting said rotor on said shaft so that on the windings on said stator being energized through an electronic commutation circuit magnetic coupling occurs to cause said rotor to rotate.

20 15. A motor element of an electric motor said motor element being selected from a rotor having a ferromagnetic circuit spaced radially from a shaft mounting means thereof and a stator having a ferromagnetic circuit including a set of
25 poles adapted to receive electrical windings thereon said poles being spaced radially from a shaft mounting means thereof said motor element comprising a plastics injection



moulding having embedded therein parts of a selected one of said ferromagnetic circuits and having a web connecting said selected ferromagnetic circuit to said selected shaft mounting means with parts of said selected ferromagnetic circuit held in a fixed radial disposition
5 relative to said shaft mounting means to maintain substantial concentricity between said desired parts of said ferromagnetic circuit and said shaft mounting means without machining, said web being shaped so that distortion of said web causes a change in the shape of said web without materially affecting the concentricity of said desired parts.

10 16. A motor element as claimed in claim 15 which comprises said stator as said motor element.

17. A motor element as claimed in claim 16 wherein said shaft mounting means is provided as a housing adapted in use to receive a part of a bearing.

15 18. A motor element as claimed in claim 16 or claim 17 wherein said web is formed in a shape which includes members which form an annular V formation positioned so that during manufacture of said motor element contraction of said plastics material during cooling after injection causes a change in shape of said V formation.

20 19. A motor element as claimed in any one of claims 16 to 18 wherein said ferromagnetic circuit is formed as a yoke having associated therewith a plurality of outwardly directed poles with the outer faces of the poles lying on a circumference.

20. A motor element as claimed in any one of claims 16 to 19 wherein said poles and said yoke are formed integrally from a strip of ferromagnetic material and the strip is curved edgewise to form said yoke with outwardly extending poles.

21. A motor element as claimed in claim 15 wherein said rotor is selected a said motor element.

22. A motor element as claimed in claim 21 wherein said shaft mounting means is provided as a hub in which a shaft is mounted in use.

23. A motor element as claimed in claim 21 or claim 22 wherein said rotor web is formed in a shape which includes members which provide an annular V formation positioned so that *during manufacture of said motor element* contraction of said plastics material during cooling after injection causes a change in shape of said V formation.

24. A motor element as claimed in any one of claims 21 to 23 wherein said rotor is formed with pieces of inwardly facing magnetic material magnetisable to form permanent magnet poles.

25. A motor element as claimed in claim 24 wherein said pieces of inwardly facing magnetic material are wrapped in



a strip of ferromagnetic material to a desired thickness and the assembly is rigidified.

5 26. A motor element as claimed in claim 25 wherein said assembly is rigidified by a gap penetrating adhesive between parts thereof.

10 27. An electric motor comprising a motor element comprising a stator according to any one of claims 15 to 20, said stator having electrical windings on the poles thereof and a further motor element comprising a rotor made according to any one of claims 21 to 26 having some of said ferromagnetic circuit magnetized to a permanent magnet state, a bearing housing attached to said stator, said
15 housing containing a distal bearing separated from a proximal bearing, the outer surface of said proximal bearing being mounted partly in said bearing housing and partly in said shaft mounting means, shaft rotatable in said bearings and said rotor being mounted on said shaft so
20 that on windings on said stator being energized through an electronic commutating circuit, magnetic coupling occurs to cause said rotor to rotate.

25 28. A laundry machine having an outer casing, a water container within said casing, a spin tub rotatable within said container, an agitator mounted for agitation within said spin tub interconnecting means between said spin tub,



and said agitator being operable to enable said agitator alone to be agitated backwards and forwards or said spin tub and said agitator to be rotated in a single direction and spinning speed, said agitator being driven by an electric motor according to claim 27, and shaft driving said agitator and said bearing housing being fixed to a lower part of said container.

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29. A method of manufacturing a motor element of an electric motor when effected substantially as herein described with reference to and as illustrated by the accompanying drawings.

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30. A method of manufacturing an electric motor when effected substantially as herein described with reference to and as illustrated by the accompanying drawings.

15

31. An electric motor element when constructed arranged and operable substantially as herein described with reference to and as illustrated by the accompanying drawings.

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32. A laundry machine when constructed arranged and operable substantially as herein described with reference to and as illustrated by the accompanying drawings.

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DATED this FIRST day of AUGUST 1991

Fisher & Paykel Limited

Patent Attorneys for the Applicant

SPRUSON & FERGUSON



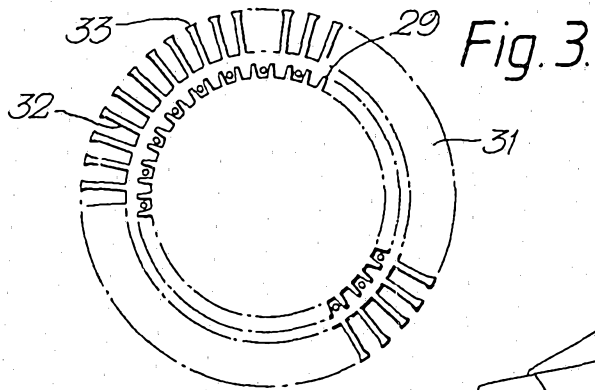


Fig. 1.

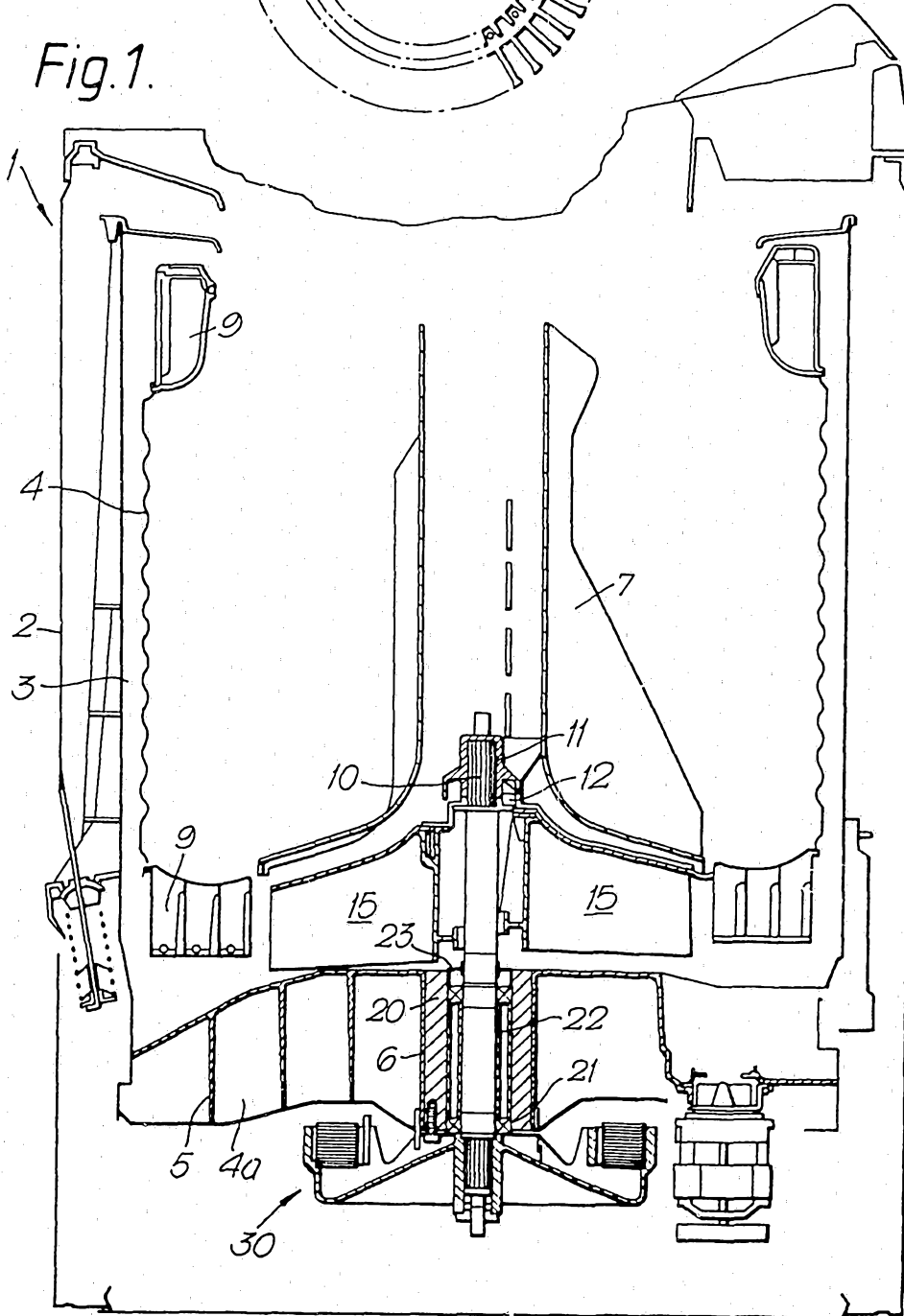


Fig. 4.

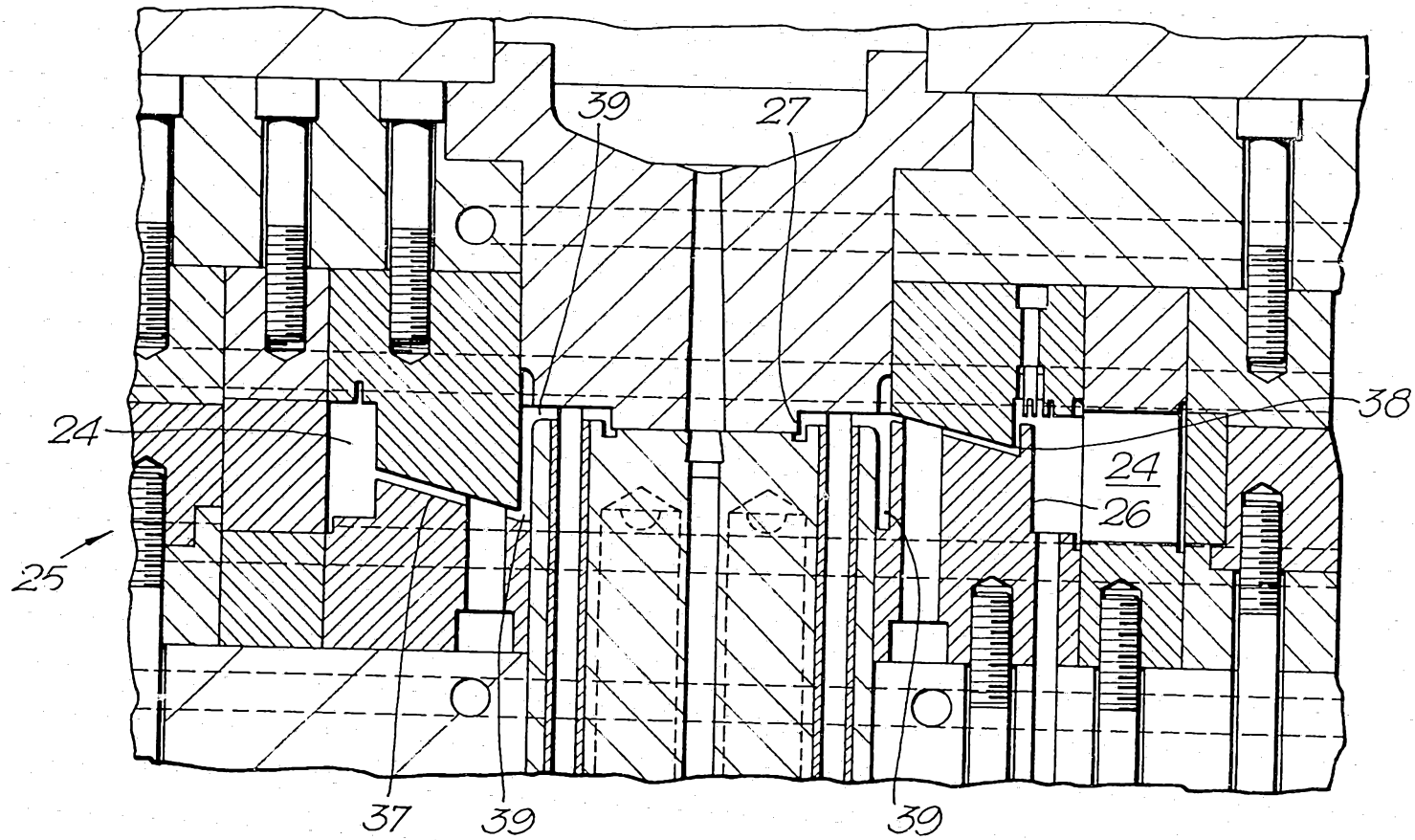


Fig. 5.

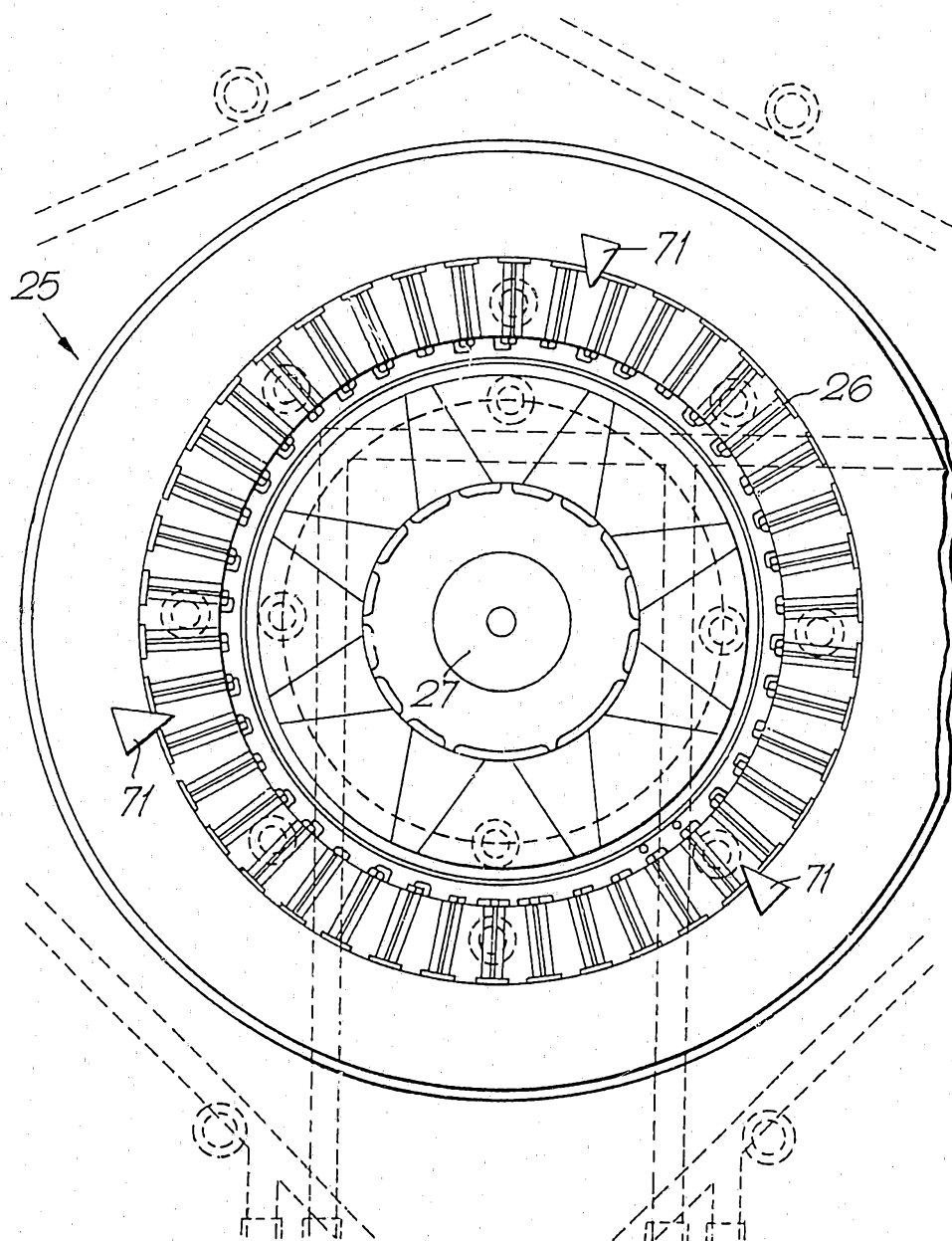


Fig. 6.

