REPLACING THE PRIVATE MOTOR CAR WITH A MORE ATTRACTIVE PUBLIC TRANSPORT SYSTEM

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ABSTRACT A new and attractive public urban transport system is outlined which appears to be competitive with the private car. The guiding principle used is to integrate public transport with personal transport access using a cheap, small, lightweight (20 kg) personal-access folding scooter which is in the possession of the user at all times so that no parking facilities are needed at any time. When not in use, the folded scooter resembles a suitcase on wheels, similar to the suitcases usually used when traveling at airports. Folding and unfolding of the scooter is quick and easy even for elderly people who would use a tricycle version which would integrate fully with the system. The apparent advantages for this urban transport system include significantly reduced expenditure in household budgets, much reduced traffic congestion, less environmental pollution, reduced fuel consumption and a contribution towards controlling and investigating urban crime.

The system is suggested for worldwide application in all climates. For very cold climates such as winter in Toronto or Helsinki, a special oversuit could be worn which is attached with a flexible umbilical heater duct connected to the cooling air from the 1 kW engine. This supplements 100 W of natural body heat with up to 400 W of additional heat. Heating is under the direct control of the rider with a thermostatically-controlled valve. The heating air exits from the rider's suit at 4 points, the wrists and ankles.

Ticketing would be fully automated and seat bookings made using either the customer's personal computer or mobile telephone. Access to the system would be through a transport credit card. Billing would be computed automatically and usually rendered via email with direct debiting a likely preferred option of payment.

The system is intended to replace the private motor car for most people accommodating all their urban transport needs including shopping, commuting, visiting and access to airports etc.

The system could lend itself to an improved computer-organised and managed public transport service. It points towards replacing our present day casual-use systems using fixed timetables with a prior-booking system which avoids queuing and congestion. Such a system would allow transport availability to be matched with demand by computer control thus achieving greater efficiency in seat occupation rates.

The system requires separation of high speed trunk roads from low speed access or residential roads in suburban areas.

KEYWORDS Urban transport; Urban congestion; Urban planning; Urban Renewal; Road business strategy; personal transport; fuel conservation; vehicle emissions

1 INTRODUCTION

This paper is one of a series attempting to find a roadmap towards developing those emergent technologies which will enable us to find a truly sustainable society. The other papers in this series include:-

- Using algae(1) to speed up the naturally-occurring petroleum fuel generation process. This would also recycle municipal and industrial waste, while also sequestering CO2 into a more useful form than is possible with alternative competing technologies.
- Making merchant shipping more cost efficient(2) using parasails and adapting its diesel propulsion system to the use of directly-useable coal which is our most abundant source of fossil fuel.
- Developing a different supplementary civil aviation system(3) which is also more energy-efficient, cheaper to use and less polluting.

Both these latter two emergent technologies are also the subject of separate papers presented at this conference(2,3).

It is important to emphasize that all of these early suggestions towards developing an emergent technology must be tentative in nature. Nothing can be considered as 'carved in stone' at this stage. These days modern technology is like a dense jungle, perhaps aptly described as the realm of the specialist-scientist. The role of the emergent technologist is to put different pieces of technology together and plot a path through this jungle which enables us to avoid the many obstacles which can block our path to achieving a marketable development. While it is necessary to be 'quantity specific' in developing new technology, everything in a preliminary design is subject to adjustment. When the best path is found, then and only then, can we optimize the design with firm details.

The present paper seeks a very radical and different approach to providing personal urban transport. The final paper in this series(4) , which is still in preparation, is intended to find the best path towards a truly sustainable society which will minimize social disruption caused by necessary change. In some ways the preparation of this final paper seems to be the most difficult and demanding task of all.

2 THE PRESENT SITUATION

Perhaps the time has come for us to question the need for our private car in today's urban environment? Transport accounts for about 15% of CO2 emissions in Australia but this proportion is likely to be significantly higher in many other developed countries which may have nuclear powered electricity, less extractive mineral industry and more crop-based agriculture instead of animal husbandry.
In an era of impending fossil-fuel scarcity and increasing levels of CO2, how can we justify the present system of commuting to work, crawling along in traffic congestion using an oversized machine weighing 1000kg with a payload which is usually only 100kg? How can

we justify using its powerful engine so inefficiently? What price are we paying for tired and overstressed staff as they finally get to their place of work? Do we have an alternative?

Many people[5], including the present writer[6-8], have in the past advocated using ultralightweight vehicles. However, after reviewing[9] this 30 year old concept and adopting the best that modern technology can provide, it seems difficult to achieve a fuel consumption of 2.5 litres/100km in a vehicle which is marketable[5]. Moreover this achievable figure of fuel consumption is only about half the value we had 50 years ago with some very conventional small 4-seater cars. Perhaps the most important factor we have to consider is that today's automated production lines for cars are very specialised and inflexible facilities. They cannot be adapted economically or quickly to manufacture radically different vehicles.

It is argued in this paper that people should have a choice with regard to car ownership. If they tow a boat or a caravan every weekend, they will need to own a sizeable car. If they merely take a similar annual holiday, it makes more sense to hire a specialized towing vehicle for the occasion. It makes little sense to use an oversized personal vehicle for all occasions. Today's automobile industry is already experiencing much contraction and this can be expected to worsen. It is suggested that this is just a natural development in our society. On the other hand, related industries such a vehicle hire, specialized vehicle manufacture and more efficient personal transport systems are seen as significant areas of future commercial expansion.

Car ownership can absorb as much as 20% or more of a family's disposable income. Perhaps the best choice for most families in urban areas would be to enjoy a comparable rise in income simply by rejecting car ownership?

Many of today's scientists (and other responsible professionals) reason that the world economy must inevitably enter an era of economic contraction if our planet and its many species are to survive[10]. The present policy of world governments to stimulate economic growth to offset recession is considered by these many experts to be to be the wrong policy even if it may be politically expedient as a temporary fix for a sensitive political problem. These same experts reason that we need to learn how to spend less, not more. Consequently it can be reasoned in this paper that if we could eliminate the high cost of motoring from the household budget and substitute low cost public transport, then families would have more choice in managing their reduced disposable income. As our population increases on a planet with finite resources, a future decline in personal income seems likely for most of us[10]. We can also expect economic contraction to even cause civil unrest in our advanced relatively stable nations. Consequently we need to find new developments in technology and a roadmap which provide hope for a continuing reasonable quality of life.

It seems that we must inevitably come to this conclusion. If cities could have their public transport systems improved by public investment then surely this would be a far better use of taxation than just subsidising large failing industries?

2.1 The Public Transport Problem

All major cities have an existing public transport system which is usually insufficiently attractive to compete with the private motor car. One of the main disadvantages in using public transport is that bus-stops and railway stations are usually too far away from possible customers. To be really attractive it should be possible to use public transport to go from anywhere to anywhere, even in the largest city, without walking more than 100 metres. In this paper such a system is outlined. It may not be the best system that can be devised but it seems to be feasible both technically and economically. At the very least this paper might stimulate some more creative thinking in this area from other technologists. Moreover the bigger and more sprawling the city, the more practical and useful does the suggested concept seem. The guiding principle seems to be that we must integrate public transport with personal transport access. Personal access is unlikely to involve a distance exceeding 5 km and an additional journey time not exceeding 20 minutes seems reasonable. Present day "park and ride" systems try to achieve this . The problem with "park and ride" systems is that it is often difficult to find somewhere to park your car. Also 'park and ride' doesn't provide transport for the final leg of the journey.

2.2 A Suggested System

Fig (1) illustrates a man emerging from his home to go to work. He is dragging what appears to be an ordinary suitcase on wheels. This "suitcase" would not exceed 20 kg in weight . When he gets to the road outside his home, he unclips the suitcase to reveal a small folding scooter. Fig (2) illustrates the quick and easy assembly of the scooter. Sliding overtubes clip into place and the "suitcase" clips on to the scooter frame and becomes the seat, giving good stiffness and strength to the frame. The motor need only have a power rating of about 1 kW. Lithium-ion battery-driven motors are likely to be the most popular form of drive followed in popularity by lightweight air cooled miniature diesels. The latter single cylinder motors could even be push-started or use recoil starting according to customer preference. Transmission in these diesel versions would always be automatic using a simple form of continuously variable gearing, such as the dual pulley v-belt system, which is well-suited to this low power application.

Several Asian manufacturers already market small direct-injection diesels down to 3kW. Extension of this technology down to a lightweight 1kW unit is technically feasible using the experience we now have from the much larger high injection pressure common rail designs. Hitherto there has been no market for very small diesel engines. Inevitably the multiple pulse injector would need to be piezo-electrically operated and controlled by a small microprocessor. Certain design refinements are necessary. For example the injector would need to be protected from damage which could cause the ingress of moisture into the piezo-electric stack.

Traveling along designated roads where the speed limit is 20km/hr the man in fig(1) arrives at the bus stop or railway station where the scooter is folded up in its case and stowed in a specially designed and numbered compartment on the outside of the bus or train (see fig(4)By limiting the speed of these access roads to 20km/hr, an ordinary lightweight helmet, normally worn by pushbike riders, should be sufficient safety equipment. The only other equipment normally carried in the "suitcase" is a lightweight plastic cape for inclement weather. The speed limit of 20km/hr on these designated suburban roads would apply to all vehicles including the largest trucks. A particular advantage in using this low speed limit is that children of ten years or older could also be licensed to drive a scooter and thus take themselves to school. Younger children would probably be driven in a conventional car but it would still be possible to opt for scooter transport using a folding lightweight trailer designed for 3 small children. This would be very similar in design to the 'Tag-A-Long' pushbike trailer marketed by RepcoSport. Younger, exercise-conscious mothers often take their children to kindergarten in this way.Several other bicycle accessory manufacturers market similar designs of push-bike trailer. The trailer would be attachable to the suitcase scooter in a similar way. Apart from its use for transporting small children, this accessory is likely to be popular with larger families for shopping. Use of a trailer is the only situation which would need two stowage compartments on public transport vehicles. A tricycle version could also be available for the elderly. It must be emphasised that all these versions would need to fit into the same standardised stowage compartments in public transport vehicles.

Most people would make a prior booking of their seat on public transport using their home personal computer or mobile phone. This would avoid queues, insufficient seats and 'waiting for the next bus due to crowding'. It would also allow the public transport system's 'overall control and management computer' to adjust transport availability to suit demand. Inevitably some people would make ‘last minute’ bookings using their mobile phone or at a computer terminal actually at the railway station or bus stop.. This is where the the ‘central overall control and management computer’ becomes necessary.

A public transport access "credit card" would be used by everyone who uses public transport. Ticket payments could be made monthly after being computed and billed automatically. This methodology is subject to the criticism that computers seem to know more about us these days than we know about ourselves. Nevertheless the contribution made by this system to controlling and detecting urban crime would be significant and worthwhile.

A number of refinements are possible with this system. For example lithium-ion batteries can be charged and checked for condition by the public transport vehicle.. On-vehicle charging is a desirable feature because these particular batteries last longer if they are not fully charged. Also on-vehicle checking is a desirable safety feature with this type of battery. Sometimes lithium-ion batteries can suffer from internal short circuits. A small speaker near each passenger seat can automatically advise travellers when they have reached their destination. Each traveller's scooter stowage compartment could also be arranged to open automatically when the vehicle is stopped.

The suitcase scooter can also be used for short local trips for shopping etc. Larger families are likely to opt for the trailer accessory. These scooters could also be available for hire at airports and other transport termini for travellers with limited amounts of baggage so avoiding the higher cost of conventional taxis.

Although large vehicles would be allowed on 20km/hr limited roads, suitcase scooters would not be allowed on trunk roads which would have typical present day speed limits.

Small motorised scooters are not new and modern versions can be purchased today. The relatively heavy 32kg Welbike was used in the second World War by paratroopers. It was even sold after the war as the Corgi 50 Dinky Devil, the forerunner of the Monkeybike craze among the younger generation.

By keeping the speed limit low, the specification outlined here can be achieved to provide a very cheap and light mass-produced product which is also inexpensive to use.

In the event of malfunction of the scooter on the road, the most logical breakdown service would be to simply replace the scooter and take the malfunctioning scooter away for repair. This would be much more convenient than coping with breakdown of a conventional car.

2.3 Applying the System in Different Countries

The proposed system seems to be adaptable to the requirements of any transport authority throughout the world.

Whereas a lightweight plastic cape and a push-bike style helmet may be sufficient accessories in a warm climate such as in South-East Asia, additional equipment would be needed in much colder climates. For example, for early morning commuting in Helsinki or Toronto during winter, a special oversuit would be needed together with a swiveling Perspex visor on the helmet to shield the face. The proposed cold weather oversuit would be similar to the 'siren suits' used in the second World War during air raids. Using an umbilical flexible tube, the suit would be fed with cooling air from the lightweight 1 kW diesel engine. The heated air would enter the suit at navel level and exit at four points, namely the wrists and ankles. Up to 400W of additional heat is thus made available to supplement 100W of natural body heat. The umbilical heater hose would probably also incorporate electrical connections feeding LEDs (light emitting diodes). These would be sewn into the back of the suit and act as indicators/braking lights. A single left/right/upright arrow indicator pattern seems to be suitable. This system is already under consideration in Australia for ordinary push-bike riders. The electrical connection on the umbilical hose would also allow thermostatic control of the oversuit temperature by transmitting a signal to the inlet valve of the heater hose.

Local authorities in warm climates are also likely to require a similar light vest to be worn by riders traveling at night.

3. REFLECTING ON NEW TECHNOLOGY. ITS CONSEQUENCES AND ITS PROMISE

One of the most severe and obvious criticisms of the proposed concept would be its serious adverse effects on employment in the motor and allied industries. This issue will be addressed in detail, with other important matters, in a later technical discussion paper(4). However, in the meantime, the following points may merit a brief mention and consideration.

So much of our manufacturing industry is now automated using sophisticated machinery that we need to ask ourselves why we still need to work 5 days per week often with overtime. Surely our developed societies have at last reached a stage when the 3 day working week should be the norm with job sharing a typical and common situation? Why can't we enjoy more leisure time with our families? Also, are our homes now becoming excessively large and expensive? Are they becoming cluttered with unnecessary and complicated gadgetry which often has to be carted to the garbage dump when the 12 month warranty is over? Are we being exploited commercially and manipulated into becoming creatures whose main function in life is mere consumption? Can we avoid the consequent household debt burden resulting from excessive consumption? In particular do we need to curb our work ethic and find other more pleasurable outlets for our surplus energy?

4. MORE DETAILED MATTERS FOR FURTHER AND NECESSARY CONSIDERATION

Any application of this suggested approach to improving a public transport system requires considerable further study before embarking on reconfiguring a particular city's transport system.
Foremost is the need for a thorough cost-benefit analysis for a particular situation. The level of public acceptance and preference also needs to be assessed accurately. Alternative competing schemes also need to be considered.

Typical examples of issues which are likely to be encountered are as follows:-

* How can the urban road network be adapted, in particular the separation of high-speed and low-speed roads?
*Are there complications with the suburban railway network? For example, on some railway lines, passengers may enter and exit on different sides of the train. This may limit the usefulness of the proposed system. It is easy enough to program the ticketing computer to decline to accept a booking for incompatible stations but will an alternative booking fill customers' needs adequately?
*Is it preferable for the proposed accessing "suitcase scooter" to be privately owned as suggested in this paper, or should these machines be leased by the municipality who would then own and service these machines? If the latter policy is chosen what limitations would be imposed with regard to the lease? There are some very sound arguments both for and against public vs private ownership of "suitcase" scooters.

The above questions can be quite complicated and it is difficult to generalize. Largely this is because different cities have different situations to consider. Also different nations have different political, environmental and economic circumstances. To what extent should urban renewal be a national policy or should it be just a municipal matter?

Lastly, but by no means least, are the interests of manufacturing industry who would market these machines.. They are interested in mass markets and also prefer uniformity and stability in public policy.

The reality is that we live in a fast-changing world where environmental and economic considerations are in a state of flux. Perhaps many of the answers we need in urban renewal will just evolve naturally as we try to adapt to a changing future.

5. CONCLUDING COMMENT

Almost all urban area municipalities have an interest in the problems produced by the private motor car. For example the Author's home capital city Brisbane has changed in 25 years from a pleasant, if sprawling, garden city into a congested overpopulated industrial metropolis. Traffic congestion is now becoming intolerable. The main criticism(11) in adopting the system outlined here is that it would involve significant capital investment in retrofitting the existing public transport system and expanding it. Yet tinkering with the existing transport system is not solving the problem.

On the other hand, some other municipalities have a long history of success and enterprise. One such example is La Rochelle on the coast of France. La Rochelle has had a policy[12,13] of 'placing public transport in competition with private transport'. They also look towards 'an integrated transport system'. They have made free bicycles available to everyone and only levy a charge when they are used for more than 2 hours. Yet they have still managed to make a profit from their bicycles!

We do need the best that modern technology can provide and we do need a system which can be applied worldwide.

Finally, ending on a more traditional, conservative and consumption-orientated note, we should at least recognise that good public transport provides a more flexible and useful workforce.There is much to be said for not having to sell your house in order to buy a new one just because that better job is at the other end of town.

DIAGRAMS

These are collected on the following pages with explanatory captions.

<u>Fig (1).</u> The wheels of the 'suitcase scooter" protrude slightly from the case. They give little friction when freewheeling as the wheels are about 300mm in diameter

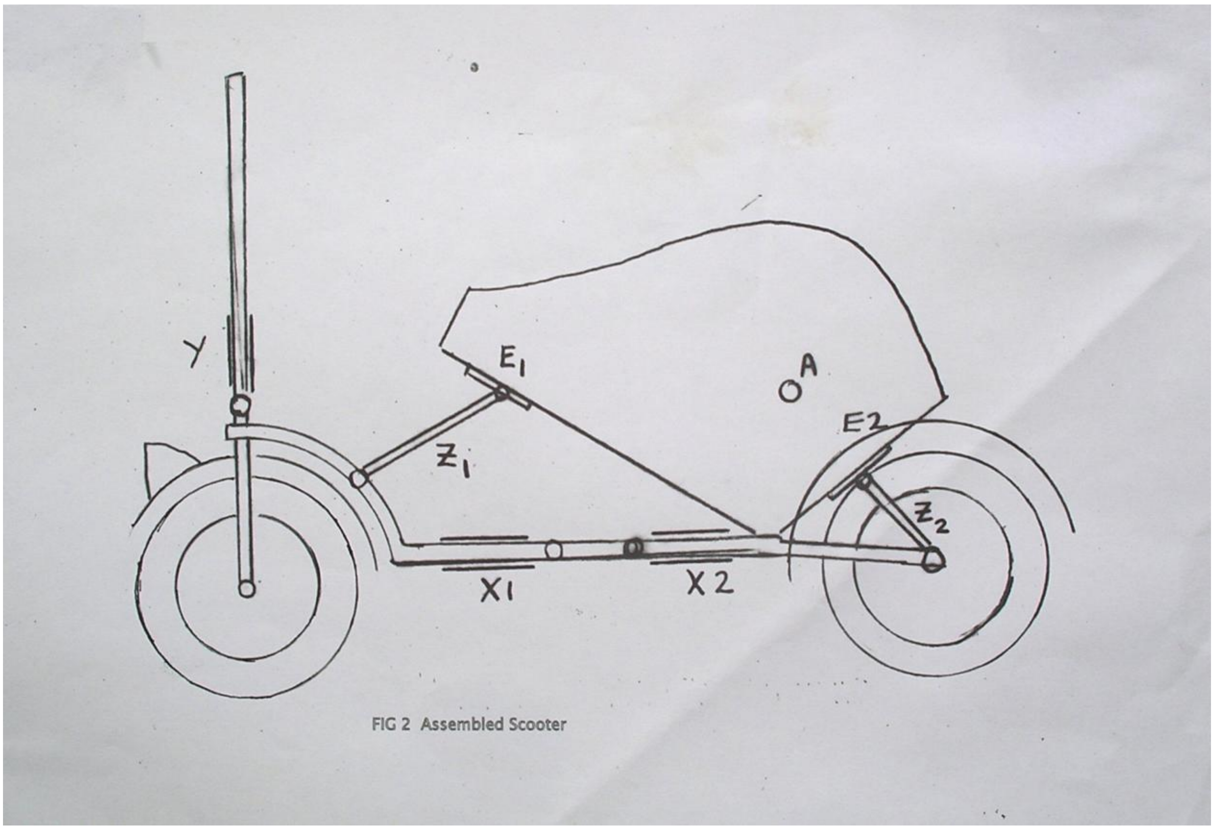


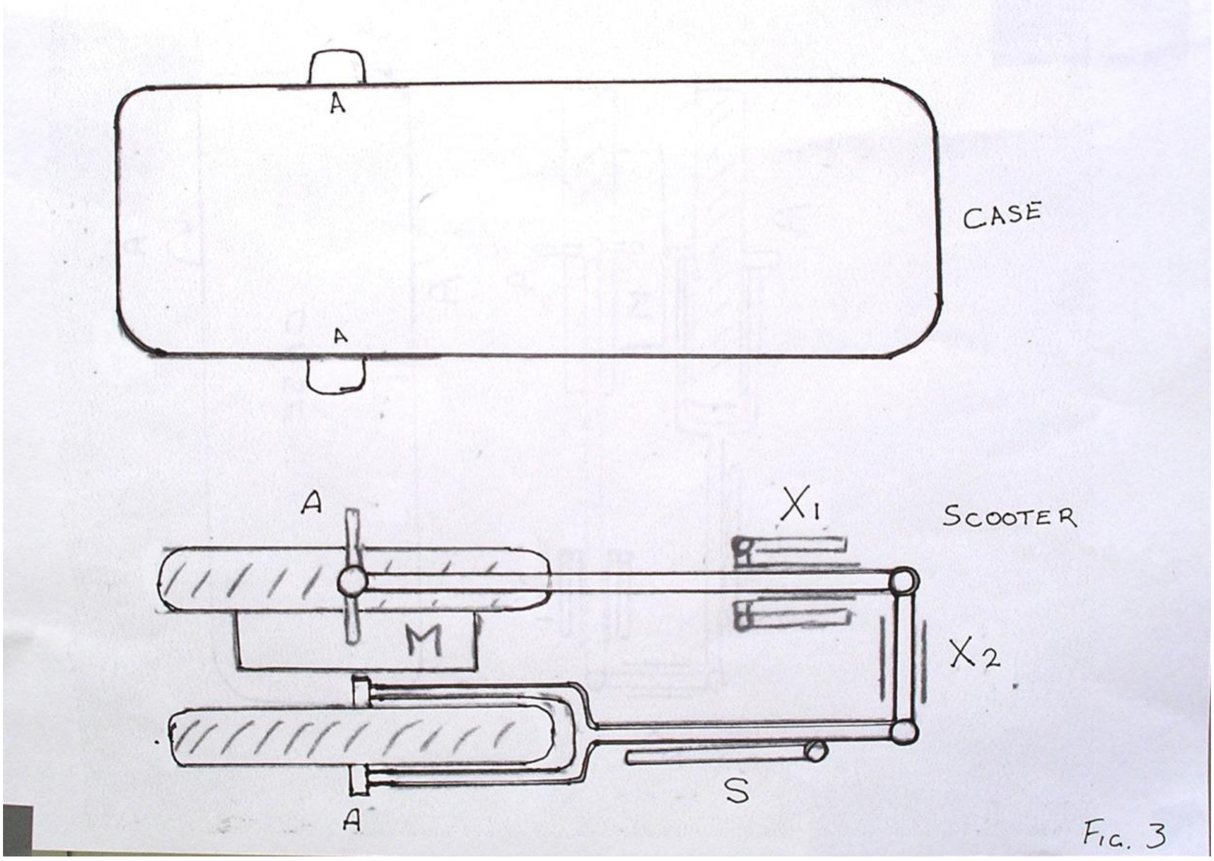
Fig (2) Side elevation of the scooter assembled for use. It has front-wheel drive. For safety it has two cable-operated disc brakes but both operate on the front wheel only. This is safer in emergency stopping than having brakes on both wheels.

Obviously there are several possible alternatives in the detailed design. Also not only are there several models to fit in the same standardised 'suitcase' but each model can have different versions. The particular design example shown in figs (2& 3) is considered to be easy to use but it has not yet been optimised. The dual-brake system is operated from each foot-rest and all electrical controls e.g. headlight, speed control, turning indicator lights etc. are fitted on the folding handlebars.

The machine illustrated has a height-adjustable seat. It may well be found preferable to sell a simpler and cheaper machine, factory-fitted and adjusted, to suit the purchaser's size and shape.

The "suitcase/seat" must of necessity be a standard design in all models and versions so that it can fit in all public transport vehicles. It will be seen in fig 2 that the ‘suitcase seat’ has two straight edges. The shorter edge is open so that the wheels can protrude allowing the owner to drag the encased scooter along on its wheels. The longer straight edge is where the ‘suitcase seat’ is hinged. The top curved edge has 3 clips to close the suitcase to form the seat.

The hubs of the folded wheels are located in a moulded recess in the suitcase shown at A. These recesses aid in easy and accurate stowing of the folded scooter in its suitcase



<u>Fig (3) Top view of scooter folded and ready to be encapsulated in its "suitcase" or when the scooter is ready to be unfolded for use.</u>

For clarity the folded steering column is not shown here. It lies over the top from M to X1. The components Z1 and Z2 are also not shown but they are smaller in size from the top view than the other items shown here.

To assemble the scooter for use, it is unfolded and the wheels are aligned roughly. The sliding foot-rest/brake 'overtube' X1 and overtube X2 are clipped into place. The same is done with the sliding overtube for the steering column Y which also extends telescopically. The handlebars lying alongside Y are rotated 90 degrees on their swivel joints to clip into place. The pre-adjusted seat supports Z1 and Z2 are rotated into position on their swivel-joints. The suitcase is closed as is also illustrated here and is then clipped on at E1 and E2 and the scooter is ready to go.

All this may sound complicated in words but, in reality, assembly should be easily completed within 10 seconds. Reversing the procedure stows the scooter in its suitcase and this should also take less than 10 seconds.

Because different motors can be used, this item M is only shown schematically. A stand S of conventional design keeps the scooter vertical

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Fig (4) Stowing/unstowing the scooter in a public transport vehicle

Insert your transport card into the slot provided on the outside of the bus or train. The locker door pops open and a ramp slides out from below the locker. Roll your encased scooter up the ramp so that its wheels fall into two slots in the ramp. This positions the scooter accurately. Press the stow button. This withdraws the ramp and scooter into the vehicle and closes the locker door. Enter the train or bus and take your seat.

On arrival at your destination insert your card again to open the locker. This will be necessary with prior booking if you decide to disembark earlier than planned. On removing your scooter the ramp withdraws and the locker door closes automatically. Continue on your journey.

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