ABSTRACT

This system utilizes autonomous rail cars that automatically couple and uncouple to and from a primary moving train. The primary train travels along a given route but never needs to stop at intermediate stations. Instead, autonomous rail cars gather passengers or goods at designated station locations and then automatically depart in order to meet up with the primary train. When the autonomous rail cars couple to the primary train, the contents of the autonomous rail car are transferred to the primary train. Likewise, contents that are already aboard the primary train which need to depart will be loaded onto this autonomous rail car. When the primary train approaches the next station, the autonomous rail car will detach and stop at the station while the primary train continues to travel on. This process repeats for each station on the route.
Figure 1
Figure 3
AUTONOMOUS RAIL COUPLING SHUTTLE SYSTEM (A.R.C.S SYSTEM)

BACKGROUND FIELD OF THE INVENTION

[0001] The present invention relates to railroad service and more specifically it relates to a procedure for improved operations at railroad stations. Rail transit systems are slow and inefficient ways for people to move around from location to location. Slow commuter trains and long distance trains can waste valuable time and energy during their operational use. While trains like these can carry numerous passengers and cargo long distances, the number of stops they need to make requires them to constantly slow down, stop, wait, and start up again at each station. Each one of these actions adds to the amount of travel time needed to go from location to location. Also, because each station requires a fully loaded train to use energy to stop and start, this is seen as a waste of fuel and adds wear and tear to the train. These issues all result in an increased operating cost to rail service providers.

SUMMARY OF THE INVENTION

[0002] The autonomous rail coupling shuttle system creates a new and innovative system that allows transit companies to deliver and receive passengers and/or cargo in a more economical, environmentally friendly, and efficient way. This system operates by eliminating the many interruptions of railroad station stops and allows for the continuous flow of travel. This system reduces travel time between stations, minimizes the amount of wear and tear on trains, lowers the amount of fuel consumption, increases the efficiency of rail transportation, and saves rail transit companies money by lowering the cost of operation.

DESCRIPTION OF DRAWING FIGURES

[0003] Drawing FIG. 1 depicts a setup of a primary train as well as the inclusion of the DROP shuttle car. The locomotive 1 is followed by the subsequent carriages 2. The number of carriages 2 can vary depending on the rail service provider. The locomotive 1 is located at the front of the train, followed by the subsequent carriages 2. The final carriage of the train 3 is shown and acts as a location for the DROP Shuttle Car 4 to couple up to. An arrow 5 located above the primary train shows the direction of travel. All the carriages 2 are connected to each other. The DROP Shuttle Car 4 is shown behind the locomotive 1 and carriages 2 and is shown in the process of coupling or uncoupling from the primary train. The arrow 6 shows the direction of travel for the DROP Shuttle Car 4.

[0004] Drawing FIG. 2 depicts an example of the type of a rail station that would accommodate this system. The arrow 14 shows the direction of travel in which the primary train would travel along the main line track 13. The arrival bay track 8 and departure bay track 9 for the DROP Shuttle Car 4 can be seen next to the train station platform 7. A power charging station 10 is located along the entire length of the arrival bay track 8 and departure bay track 9. Side tracks 11 separate the arrival bay track 8 and departure bay track 9 from the main line track 13. An empty space 12 not occupied by rail track can be seen between tracks in this design.

[0005] Drawing FIG. 3 depicts a conventional setup for a train station. The arrows 14 show the different direction of travel in which primary trains may travel. Platforms 7 are located adjacent to the main line tracks 13 for passengers boarding and departing from different trains. Each main line track 13 is typically used for one predetermined direction of travel as depicted by the arrows 14.

[0006] Drawing FIG. 4 depicts the same train station as in FIG. 3, but modified for Autonomous Rail Coupling Shuttle System operations as describes in FIG. 2. The direction of travel for each main line track 13 is shows with arrows 14. Each side of the station has its own platform 7, arrivals bay track 8, departs bay track 9, and charging station 10. Side tracks 11 separate the arrival bay track 8 and departure bay track 9 from the main line track 13 in each direction. An empty space 12 not occupied by rail track can be seen between tracks in this design.

DESCRIPTION OF THE SYSTEM IN OPERATION

[0007] A primary train, as described in FIG. 1, travels along a certain transit route predetermined by the rail agency it is operated by. At the same time, a DROP shuttle car, as described in FIG. 1, will be situated at the departures platform of a railroad station described in FIG. 2. This section can be located on a side track located parallel to the main line route which the primary train will be traveling on. Passengers/Cargo will be placed inside the DROP shuttle car and wait for the primary train to pass by the station. Once the primary train has passed by the station, the DROP shuttle car will depart the station, being propelled under its own power, and catch up to the primary train. The DROP shuttle car will then couple to the last carriage of the primary train and then allow passengers/cargo to exit from the DROP shuttle car into the primary trains other carriages. At this time, the DROP Shuttle will be propelled by the power of the Primary train that it is coupled to, rather than by its own power source. When the primary train approaches the next station, any passengers/cargo that will be getting off at this next stop will move to the DROP shuttle car located at the rear of the primary train. As the primary train approaches the next station, the DROP shuttle car will uncouple from the primary train. The primary train will continue to move on past this next station without stopping. The DROP shuttle car that detached will once again be propelled by its own power and arrive in the arrivals platform of this next railroad station. Passengers/Cargo will then exit the DROP shuttle car. At the same time, a second DROP shuttle car, already waiting at the departures platform of this next railroad station, will depart with its passengers/cargo and couple up to the primary train in the same manner that the previous DROP shuttle car did. When then departures platform of the station is empty of a DROP shuttle car, the recently arrived DROP shuttle car that was located at the arrivals platform will move to and stop in the departures platform to allow for new passengers/cargo to board and await the next passing primary train. This process will repeat all the way down the train route as the primary train passes by each station.

[0008] Because a DROP shuttle car will be loaded up with passengers/cargo at each station the primary train passes by, it is beneficial that every train station along a route have a designated siding at each station platform with an arrivals section, a departures section, and its own DROP shuttle car. This is shown in FIG. 2 and FIG. 4 by describing how such a layout would look like. Having a siding to accommodate the DROP shuttle cars for each station will prevent collisions
when the primary train passes by the station. Additionally, since the DROP shuttle car of a given station is able to leave that station to catch up to the primary train, the previous DROP shuttle car which would be arriving will take its place. This prevents a station from ever being without a DROP shuttle car when a new primary train passes by.

One instance of having a station accommodate this system would be a train station which has separate tracks for different directions. This type of train station would utilize multiple sidings for arrival sections, departure sections, and DROP shuttle cars. For example, a station with a track for north bound trains would use a DROP shuttle car for north bound travel only. Likewise, this same station would also use the same setup and a second DROP shuttle car for its south bound trains that would be located on another track. FIG. 3 and FIG. 4 gives details of a station with tracks for different directions and how they would implement this system.

Description of the Power Source

The primary train can be run on a number of different energy sources comprising of current methods such as electric power or fossil fuels. The DROP shuttle cars ideally should be propelled by electric power. Since the DROP shuttle car spends most of its time in the departures section of the train station, this rail vehicle will be connected to a charging system and recharge its power source that allow for its electric systems to function. An example of this charging system is similar to the use of a third rail. This third rail, running the length of a station platform, would allow for the DROP shuttle car to make contact with it once it arrives in the station and disconnect when departing the station. The DROP shuttle car would use contact shoes that touch the third rail and allow for electrical power to be transferred from this third rail into the power systems of the DROP shuttle car. The track that the wheels of the DROP shuttle car ride on would be grounded to complete the electrical circuit. FIG. 2 depicts how a charging station would be incorporated in the station design.

While the DROP shuttle car is connected to the primary train, all necessary power for the DROP shuttle car would come from the power source of the primary train rather than the DROP shuttle cars own onboard power systems. This will allow the DROP shuttle car to conserve its own power as well as give time for it to recharge in anticipation of the next time when it will be moving independently. This would remain so until the DROP shuttle car disconnects from the primary train, at which time it would resume its power from its onboard power systems.

Description of the Coupling System

The coupling mechanisms of the DROP shuttle cars are designed to incorporate current rail coupling devices to reduce costs and allow for easy use. Current systems can be retrofitted to existing couplers to allow for autonomous coupling, and uncoupling of the couplers on current trains as well as retrofitting devices that allow for connection of electric power to be transmitted between the primary train and the DROP shuttle cars. The manner of physically coupling and uncoupling of the DROP shuttle car to and from the primary train as well as connecting or disconnecting of any electrical systems between each other would be accomplished completely autonomously and without the need of a human operator. Additionally, this system allows for the ability to be accomplished while moving at any speed in addition to current stationary coupling. Because of this, it is desirable to include a buffering system and self-centering alignment system that would reduce the shock and impact forces when the DROP cars connect to a primary train while adjusting the positions of the coupling mechanism of the rail cars to allow for proper connections to take place and minimize failed connections or damage to equipment.

Description of the Drop Shuttle Car

The DROP shuttle car can be of any size, including but not limited to the same dimensions as a regular passenger car, however it is preferred that it contains less seating to accommodate for more passengers and cargo to fit inside. While current doorways of moving between passenger cars can be used for these DROP shuttle cars, alternative possible ways include dual doors on each end of the DROP shuttle car. One door would allow for passengers to move from the DROP shuttle car into the primary train. The second door would allow for passengers to move from the primary train into the DROP shuttle car. This system would prevent passengers from blocking one another from moving between train cars.

If a rail transit company determines that multiple DROP shuttle cars would be needed to handle the volume of passengers that may use a certain train station or travel along a certain route, then multiple DROP shuttle cars may be implemented rather than simply using one DROP shuttle at each station.

The DROP shuttle car should contain all systems necessary for independent movement. Additionally, the DROP shuttle car should have a cab location to accommodate a human driver with controls to drive the DROP shuttle car in case of a system malfunction. This human control system being able to override the autonomous control systems.

Description of System Integration/Connectivity

This autonomous control system would also have a communication system linking it to approaching primary trains, stations, and track side signals. For instance, wireless communication via a cellular and/or satellite network may be employed. By way of example, each DROP shuttle car, the primary train and each train station adapted to handle DROP shuttle cars would include one or more communication devices to send and receive information with other devices in the network. This system would be able to send signals to the DROP shuttle car notifying it when to depart the station to couple to the primary train, when it is an appropriate time to uncouple from the primary train and arrive in the next station, or of any signal settings it may pass or approach while operating under autonomous conditions before coupling or after departing from a primary train. This communication system would also be able to send information to the engineer controlling the primary train notifying of DROP shuttle car couplings and decouplings, as well as DROP shuttle car approaching distances and speeds, if a coupling or uncoupling was successful or unsuccessful, and of any issues or emergency situations that may have happened in or with the DROP shuttle car. It is also desirable for similar information about the primary train to be sent to the DROP shuttle car.
When using the autonomous rail coupling shuttle system, rail companies may choose the maximum operational speeds that the DROP shuttle cars can reach while traveling to catch up to the train. Additionally, notifications to passengers of a DROP shuttle car departing a station as well as coupling up to a primary train can be set up according to the transit company’s preferences.

Advantageous Effects of this Invention

There is no need to have a fully loaded primary train stop at each station location, but rather deliver only what is needed at each stop, the amount of energy required to do so is optimized to what is necessary and thus considerably less than it otherwise would be.

The amount of wear and tear on all the train cars and other railroad equipment is reduced. Items like breaks are not used as much for every train car since there is no need for the entire train to stop at each station. The stress on a heavy locomotive and its components is reduced since the number of times it needs to start a static load is minimized.

Fuel consumption of each train is reduced. The amount of energy to start, stop, and idle at each station is drastically reduced since the primary train can continue on at a decent cruising speed for a longer distance and time, rather than sit at a station and idle. The amount of energy and fuel needed to move the DROP shuttle car is only necessary when they are independently moving from the primary train.

The amount of travel time is reduced. Unlike conventional transit travel where people aboard need to wait at station stops that do not pertain to them, this inconvenience is eliminated since the only train car stopping at each station is the DROP Car that is delivering passengers or cargo pertaining to that stop. Passengers and cargo aboard the primary train can travel to their desired stops without any interruptions.

Cost of operation is lower; allowing for rail companies to save money and invest money elsewhere. Because a locomotive will not be consuming as much fuel, and wear and tear on rail vehicles is lowered, the maintenance costs and fuel costs are reduced since they are not in as high a demand with this system. This system allows for these components and resources to last over a longer time period and allows for savings to be reinvested in other aspects of railroad operations.

1. A detachable rail operating passenger ("DROP") shuttle car, comprising:
   a. compartment adapted to receive at least one of passengers and cargo;
   b. a series of wheels coupled to the compartment and adapted to ride along a railway of a rail transit system;
   c. a coupling system configured to couple the DROP shuttle car with a carriage of a primary train;
   d. a communication system configured to transmit and receive information with the primary train and with one or more train stations of the rail transit system; and
   e. a control system including one or more processing devices, the control system being operatively connected to the coupling system and the communication system, the control system being configured to provide autonomous operational control features to allow for rail travel of one or both of passengers and cargo by:
      causing the DROP shuttle car to decouple from the carriage of the primary train to enable the DROP shuttle car to head to a first train station while the primary train continues along the railway towards a second train station, and
      causing the DROP shuttle car to depart from the first train station and link up with another primary train while the other primary train is en route to another train station.

2. A primary train comprising:
   a. a locomotive power unit that provides propulsion for the primary train;
   b. one or more subsequent carriages operatively coupled to and pulled by the locomotive; and
   c. a detachable rail operating passenger ("DROP") shuttle car, releasably coupled to a given one of the one or more subsequent carriages, the DROP shuttle car comprising:
      a compartment adapted to receive at least one of passengers and cargo;
      a series of wheels coupled to the compartment and adapted to ride along a railway of a rail transit system;
      a coupling system configured to couple the DROP shuttle car with one of the subsequent carriages of the primary train;
      a communication system configured to transmit and receive information with the primary train and with one or more train stations of the rail transit system; and
      a control system including one or more processing devices, the control system being operatively connected to the coupling system and the communication system, the control system being configured to provide autonomous operational control features to allow for rail travel of one or both of passengers and cargo by:
      causing the DROP shuttle car to decouple from a given one of the one or more subsequent carriages of the primary train to enable the DROP shuttle car to head to a first train station while the primary train continues along the railway towards a second train station, and
      causing the DROP shuttle car to depart from the first train station and link up with another primary train while the other primary train is en route to another train station.

3. A railroad station comprising:
   a. a main line rail track to allow for the primary train of claim 2 to travel on;
   b. a rail road track for a DROP shuttle car of claim 2 to use that does not interfere with use of the main line track by the primary train of claim 2;
   c. a signaling system configured to perform railroad train flow operations a track switching system operatively coupled to the signaling system and configured to perform rail track and train flow operations;
   d. a platform location configured to enable passengers to board and cargo to be loaded into the DROP shuttle car of claim 2;
   e. a platform location configured to enable passengers to exit and cargo to be unloaded from the DROP shuttle car of claim 2;
   f. a communication system configured to transmit and receive information with multiple primary trains of claim 2 and multiple DROP shuttle cars of claim 2;
   g. an electrified charging station configured to regenerate power to the DROP shuttle cars in the station;
a communication system configured to inform passengers of current and upcoming transit operations at the station; and

a control system including one or more processing devices, the control system being operatively connected to the communication system, signaling system, and track switching system, the control system being configured to provide autonomous operation control features to allow for rail travel of passengers and cargo by:

preventing DROP shuttle car and primary train collisions;

arranging timing of departures and arrivals of DROP shuttle cars and primary trains; and

maintaining a flow of trains to allow for on time operation and improved efficiency.

4. An autonomous operational control system for use as part of the DROP shuttle car of claim 1, the primary train of claim 2, or the railroad station of claim 3, the autonomous operational control system further comprising one or more of:

radar speed control monitoring;

RFID tag recording and tracking of railroad equipment;

GPS system tracking of railroad equipment;

proximity sensing devices;

video surveillance and recording of railroad operations.

5. The primary train of claim 2, further comprising of either single or multiple DROP shuttle cars of claim 1.

6. A method in which the DROP shuttle car of claim 2 is arranged to connect with and disconnect from the primary train of claim 2, the method comprising:

coupling the DROP shuttle car to a given one of the subsequent carriages of the primary train;

uncoupling the DROP shuttle car to a given one of the subsequent carriages of the primary train;

aligning of railroad coupling mechanisms between DROP shuttle cars and subsequent carriages of the primary train;

transmitting data between the DROP shuttle car and the primary train; and

communicating information to at least one of passengers and cargo of current and future DROP shuttle car and primary train operations.

7. The DROP shuttle car of claim 1, where in:

the autonomous control features include one or more of acceleration, breaking, climate control, lighting, safety systems for fire crashes passenger injury or other malfunctions, video and audio surveillance, computer systems for autonomous control, systems to allow for autonomous coupling and uncoupling, sensor systems for interaction with the environment, radio or telephone communication to contact railroad personnel as well as communicate between the DROP shuttle and different primary trains or stations or track side signals, and alert systems including any of bells, chimes, voice recordings, and horns.

8. The DROP shuttle car of claim 1, further comprising:

a system of electrification for purposes of power regeneration;

a connection for regeneration of power from a supply located at the railroad station of claim 3; and

a connection for regeneration of power from a supply located at the primary train of claim 2.

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